GEOLOGIC REVIEW AND SOILS ENGINEERING REPORT
GEAR ESTATES
1156 18 ROAD
FRUITA, COLORADO

Prepared For:
TreyTyn Homes

Prepared By

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GEOTECHNICAL AND MINING ENGINEERING
TESTING AND INSPECTION SERVICES

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August 31, 2023
Job No. 4812

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JOB # 4812

Attention: TreyTyn Homes
2460 Patterson Road
Grand Junction, CO 81505

Subject: Geologic Review and Soils Engineering Report
Gear Estates
1156 18 Road
Fruita, CO 81521

As per your request, Capstone Enterprises West, LLC performed a geotechnical investigation of the aforementioned parcel. The purpose of this work was to determine if the soils at the site were suitable for nine residence housing development and the associated roadway.

This report contains results of the geologic hazard review, subsurface investigations, foundation recommendations and a pavement section design for the local roadway.

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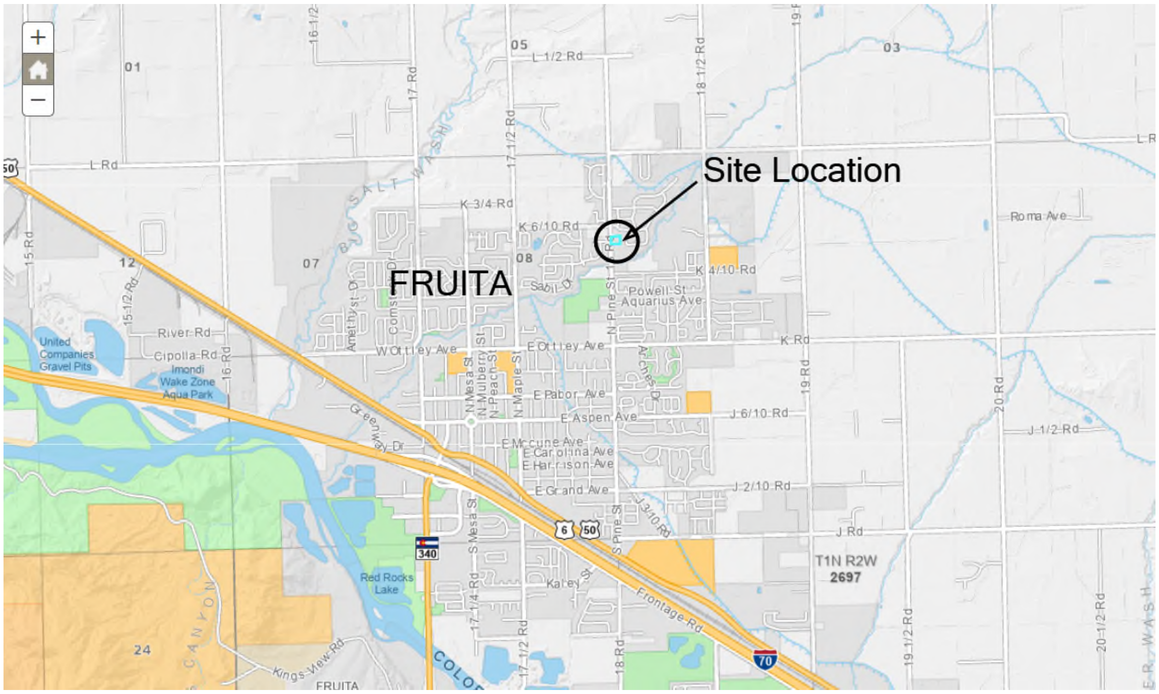
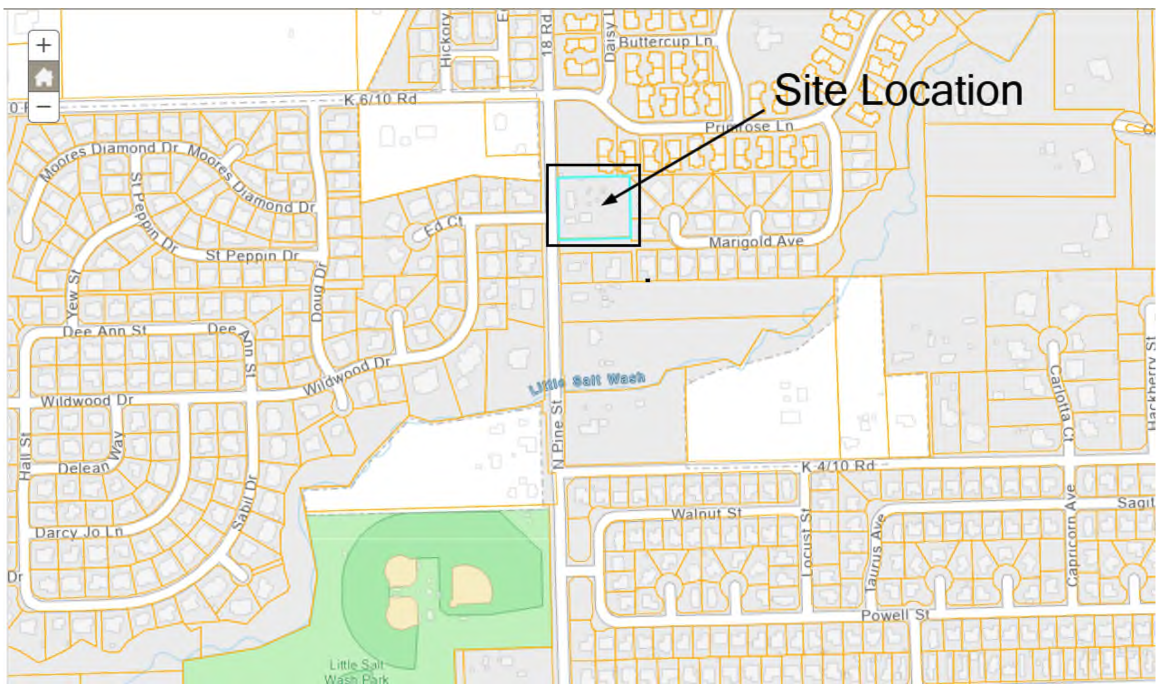
SITE LOCATION

The site is in the northwest of Section 9 Township 1 North Range 2 West of the Ute Meridian. The following maps show the general location.





SITE DESCRIPTION

The parcel totals 1.23 acres and has been farmland / pastureland for over 80 years. The foundation of a single-family residence and several shop buildings remain on site as of August 5, 2023.

The geologic setting of the site is an ancient floodplain/alluvial fan. Storm events washed sediments from the Bookcliffs covering the Mancos Shale bedrock (Km). The site has been mapped by the USGS as (Qac) alluvium and colluvium deposited during the Holocene and late Pleistocene eras. A portion of the USGS geologic map of the Fruita Quadrangle is presented below.

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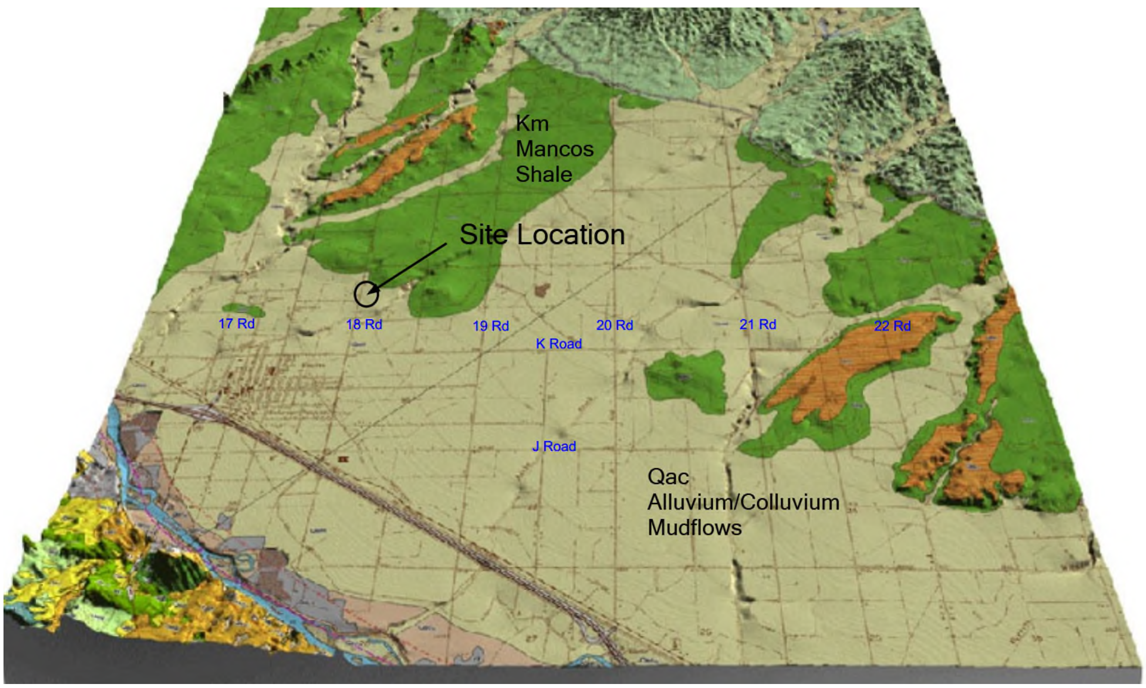


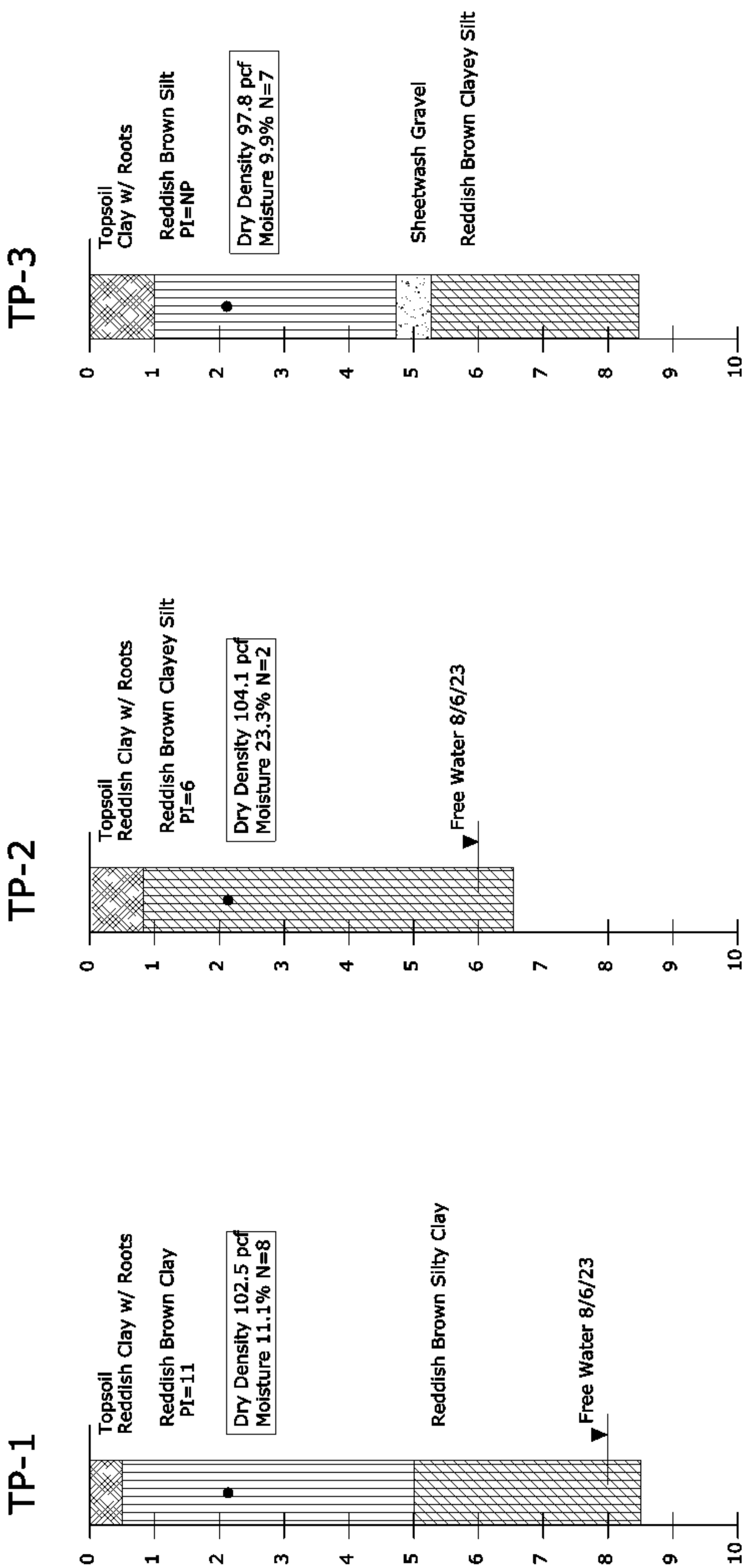
SUBSURFACE INVESTIGATIONS

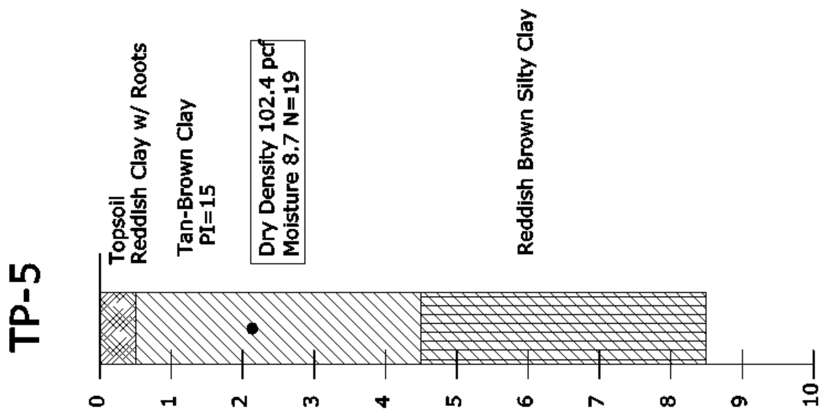
Five test pits were excavated on the site as shown on the following map.

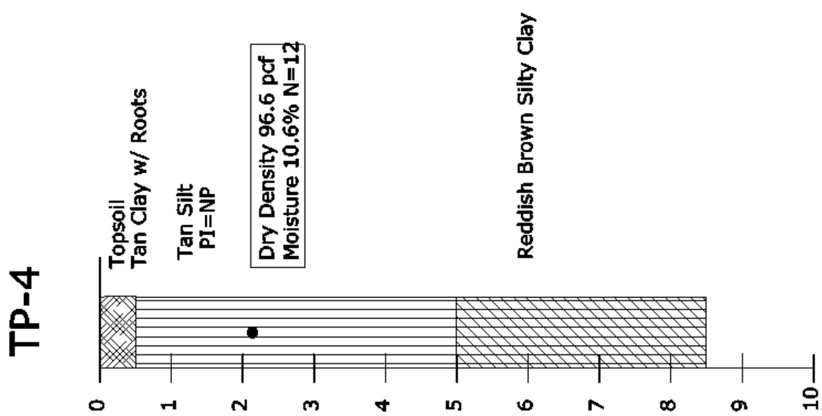
Generally, all of the test pits encountered the same type of material consistent with the USGS and NRCS mapping, alluvium and colluvium sediment derived from sandstone and shale. The geologic logs of the test pits are presented on the following pages.

GROUNDWATER

On August 8th, 2023, groundwater was encountered two of the test pits (TP-1 and TP-2), The water levels 8.0 and 6.0 feet below the surface respectively. The water appeared to be associated with an unlined irrigation ditch on the north side of the lot. Water migrates downward until it hits sandier layers of soil that allow it to migrate laterally above more clayey layers. This is typical of these types of geologic deposits formed by sporadic mudflows.

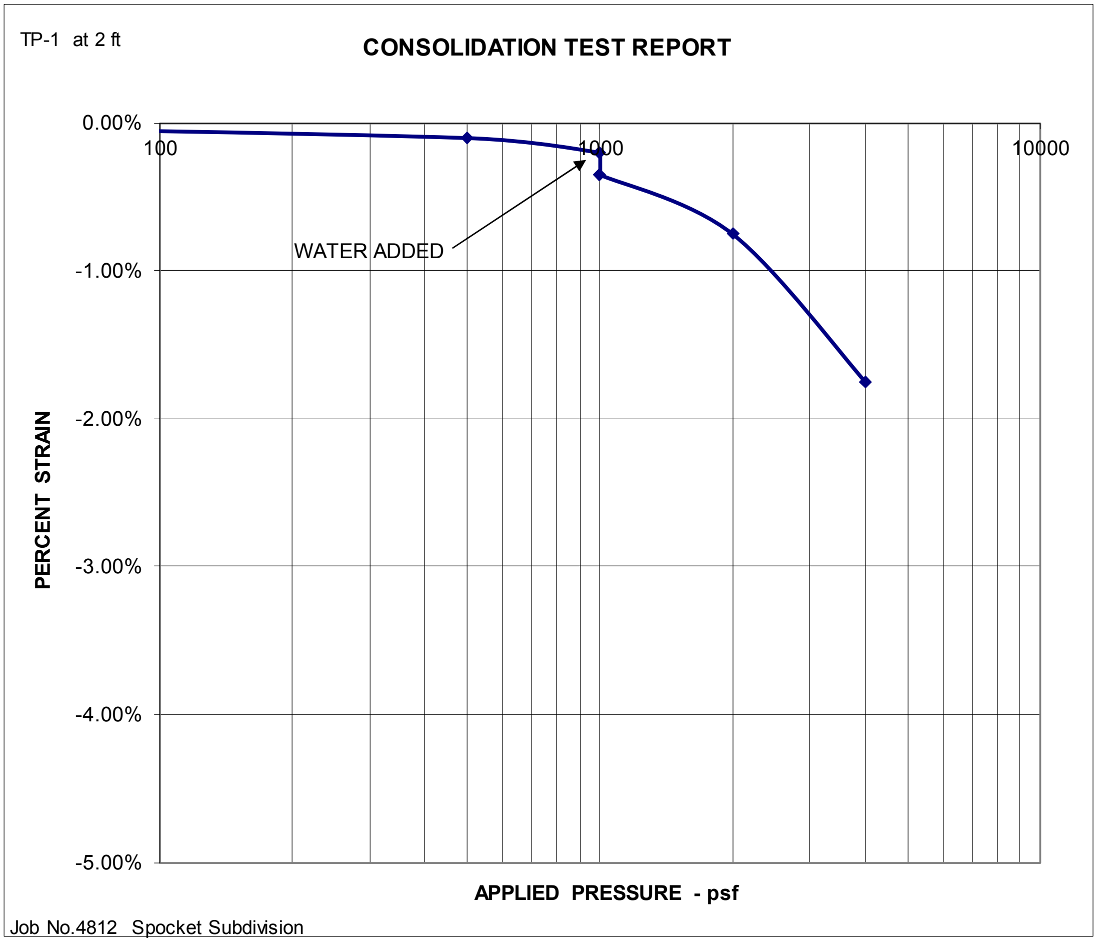

TP-1
Topsoil
Reddish Clay w/ Roots
Reddish Brown Clay
PI=11
Dry Density 102.5 pcf
Moisture 11.1% N=8
Reddish Brown Silty Clay
Free Water 8/6/23
0 1 2 3 4 5 6 7 8 9 10
TP-2
Topsoil
Reddish Clay w/ Roots
Reddish Brown Clayey Silt
PI=6
Dry Density 104.1 pcf
Moisture 23.3% N=2
Free Water 8/6/23
0 1 2 3 4 5 6 7 8 9 10
TP-3
Topsoil
Clay w/ Roots
Reddish Brown Silt
PI=NP
Dry Density 97.8 pcf
Moisture 9.9% N=7
Sheetwash Gravel
Reddish Brown Clayey Silt
0 1 2 3 4 5 6 7 8 9 10



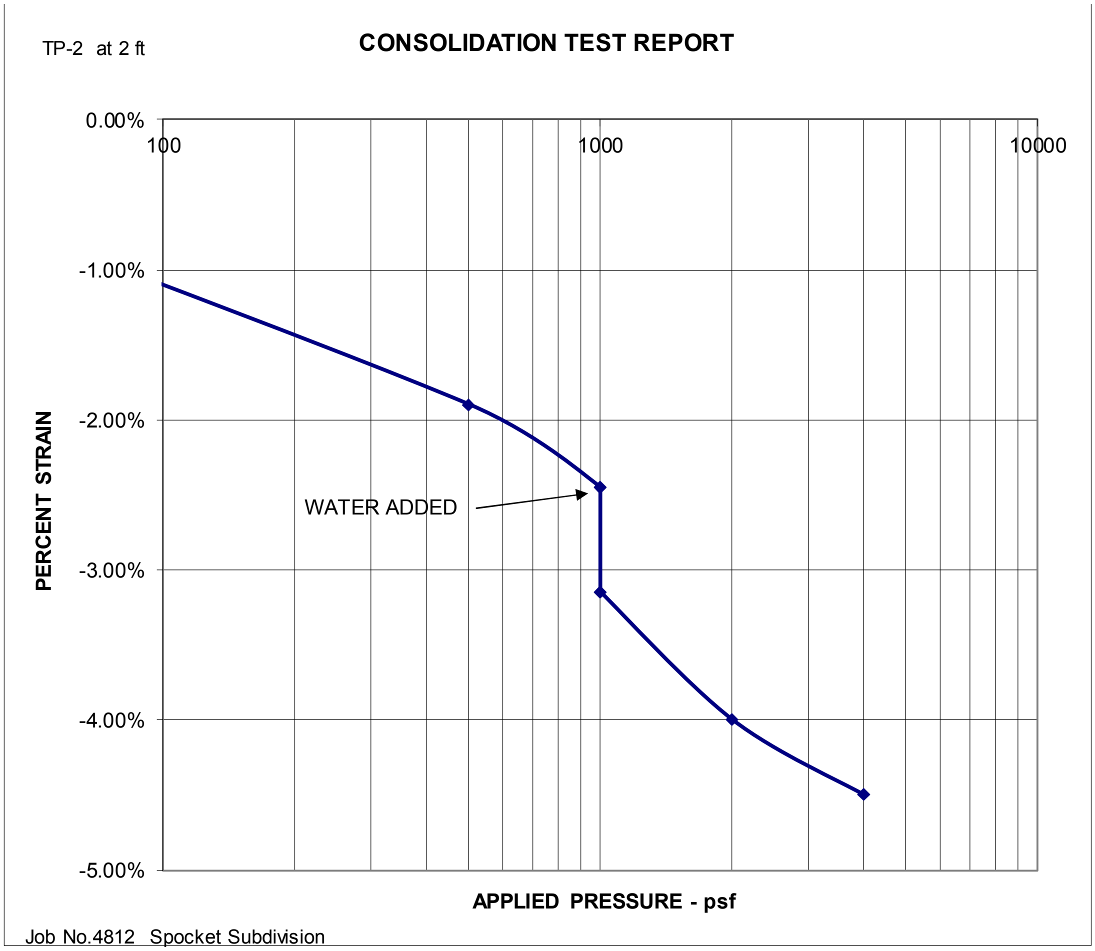


LABORATORY RESULTS

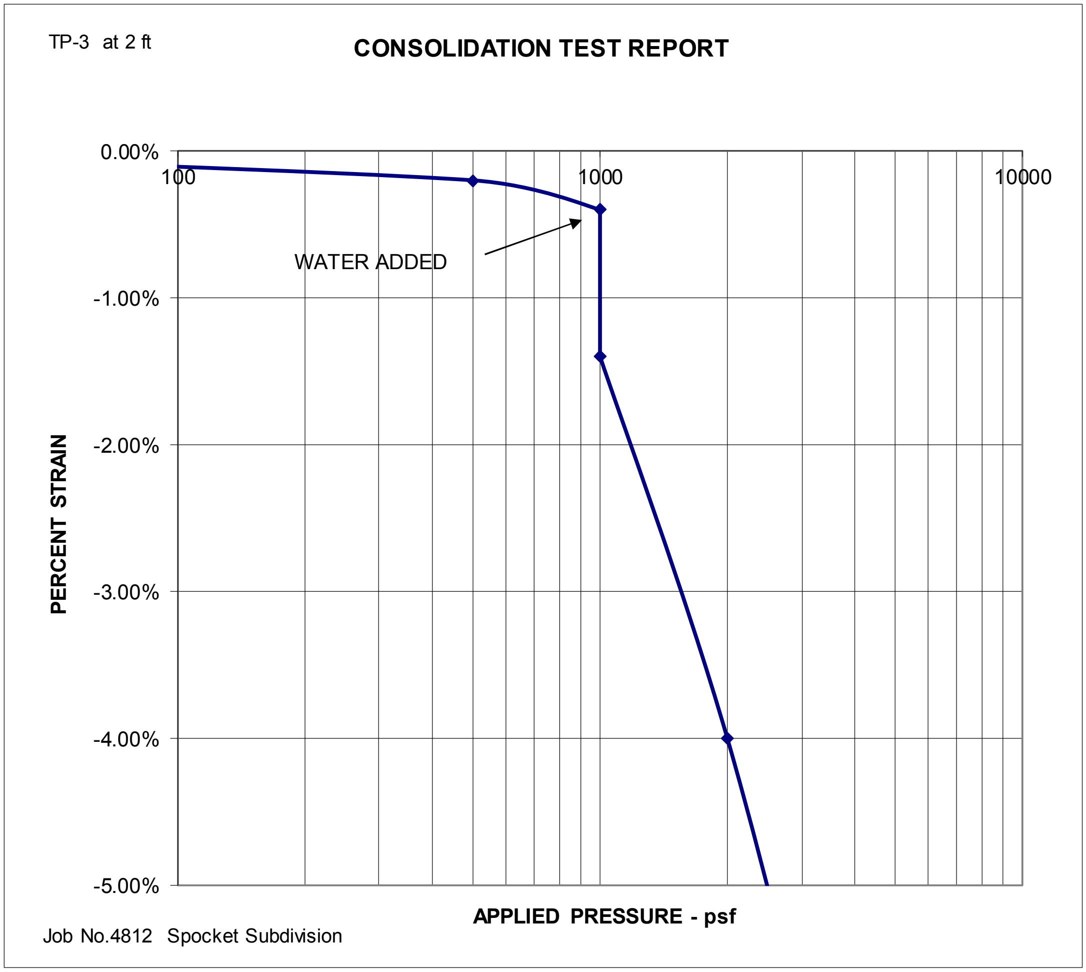
The suitability for foundation material is generally determined by two tests: the Swell/Consolidation test and the Atterberg Limits test. The Swell/Consolidation test consists of placing an undisturbed sample of material in a device that applies a load to the soil. The specimen compacts or "consolidates". After the initial load stabilizes, the specimen is saturated, and the specimen will either swell or consolidate further. The results are shown on the following pages.



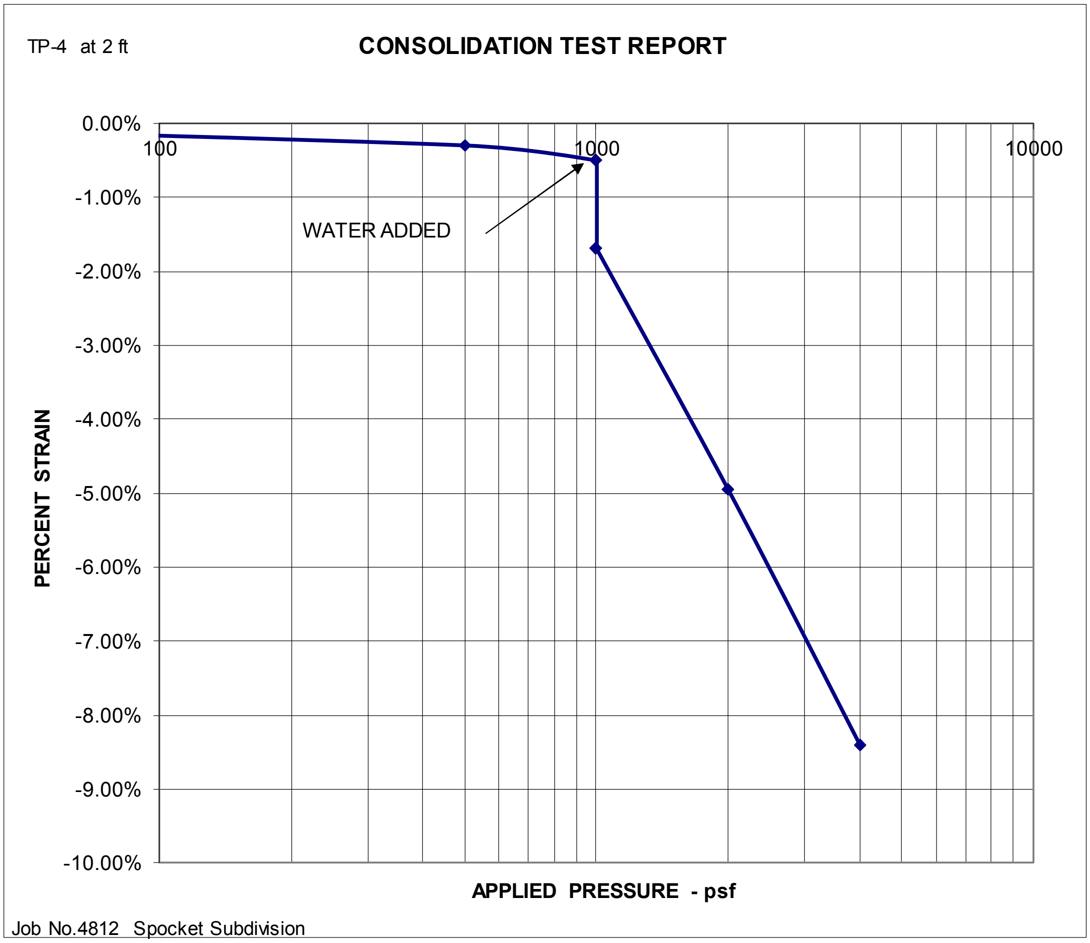
Job Number	Job No.4812 Spocket Subdivision	
Sample Source	TP-1 at 2 ft	
Sample Description	CL	
Natural Dry Density	102.5 pcf	90% Relative Compaction
Natural Moisture Content	11.1%	-3.7% From Optimum
Saturated Moisture Content	20.6%	



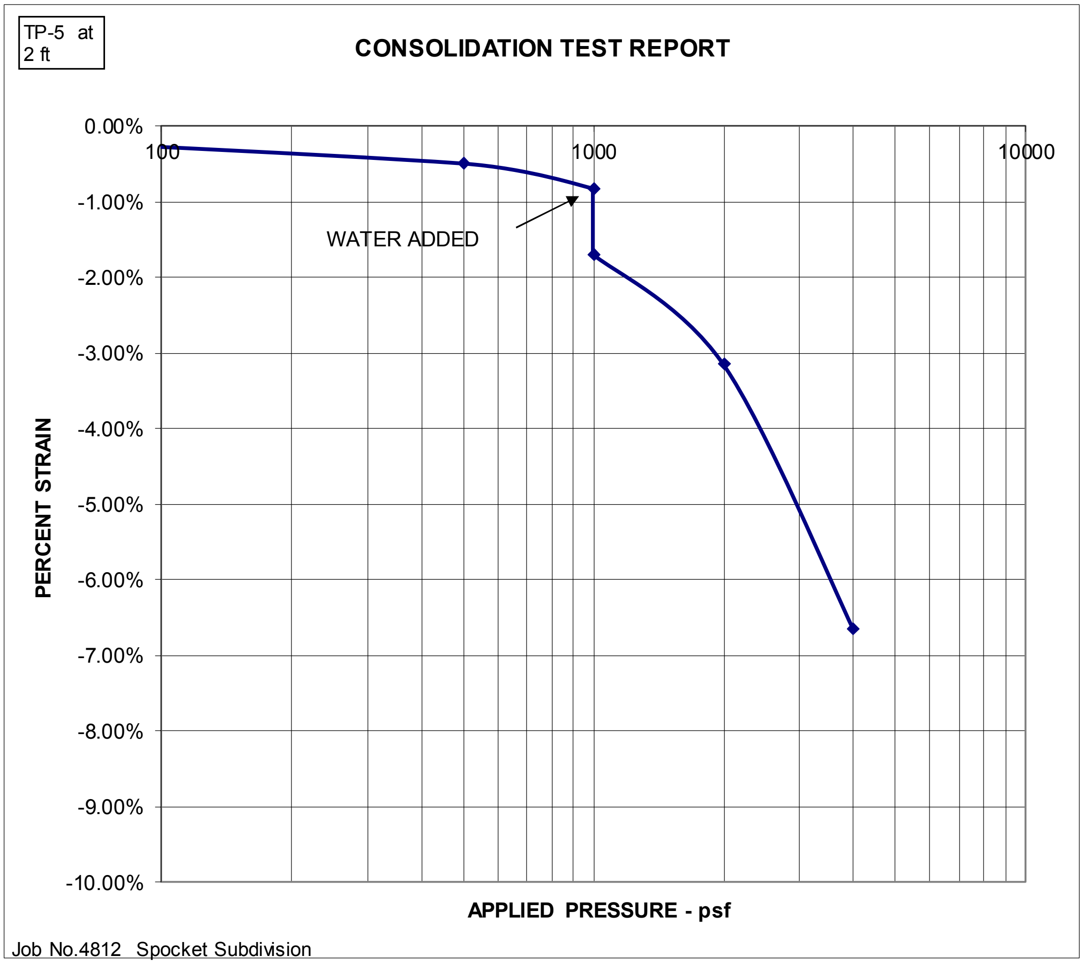
Job Number	Job No.4812 Spocket Subdivision	
Sample Source	TP-2 at 2 ft	
Sample Description	CL-ML	
Natural Dry Density	104.1 pcf	88% Relative Compaction
Natural Moisture Content	23.3%	9.3% From Optimum
Saturated Moisture Content	21.6%	



Job Number	Job No.4812 Spocket Subdivision	
Sample Source	TP-3 at 2 ft	
Sample Description	ML	
Natural Dry Density	97.8 pcf	82% Relative Compaction
Natural Moisture Content	9.9%	-4.1% From Optimum
Saturated Moisture Content	21.6%	



Job Number	Job No.4812 Spocket Subdivision	
Sample Source	TP-4 at 2 ft	
Sample Description	TP-1	
Natural Dry Density	96.6 pcf	81% Relative Compaction
Natural Moisture Content	10.6%	-3.4% From Optimum
Saturated Moisture Content	18.7%	



Job Number	Job No.4812 Spocket Subdivision	
Sample Source	TP-5 at 2 ft	
Sample Description	CL	
Natural Dry Density	102.4 pcf	86% Relative Compaction
Natural Moisture Content	8.7%	-5.3% From Optimum
Saturated Moisture Content	18.3%	

While the soil types are very similar, their mechanical properties are quite different due to their natural moisture content. When the native soils are properly moisture conditioned and compacted, they form a suitable foundation material.

The Atterberg Limits Test gives an indication of the mechanical properties of fine grained materials. The first part of the test is to determine the Plastic Limit of the material. Then the Liquid Limit is determined. The difference between the Liquid Limit and the Plastic

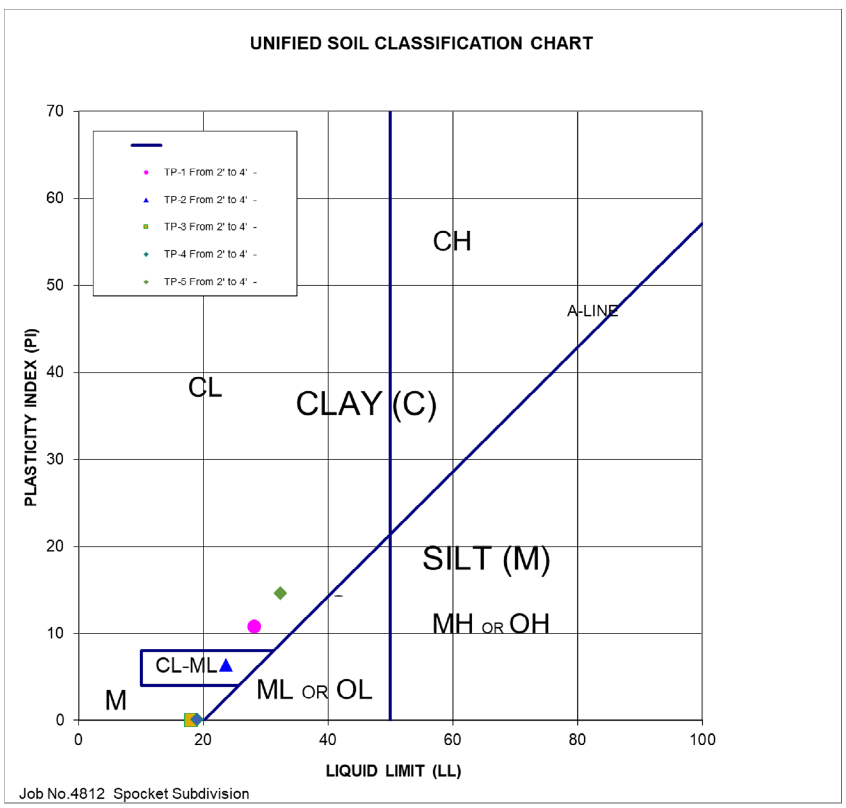
Limit is defined as the Plasticity Index. Swell potential based on the plasticity limit (PI) are shown below.

Plasticity Index (PI)	Inherent Swelling Capacity
0-15	Low
10-35	Medium
20-55	High
35+	Very High

(After Seed et al. 1962)

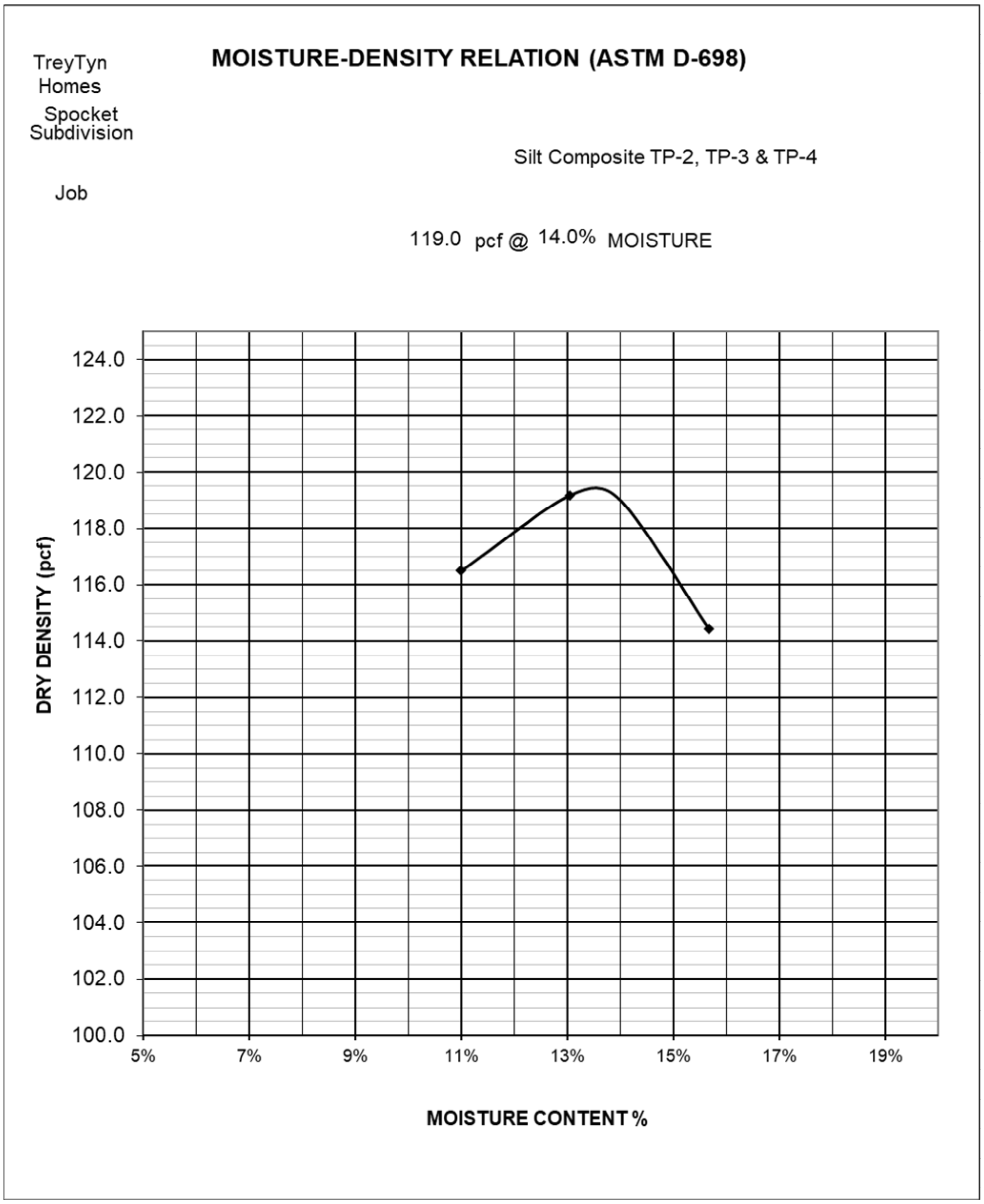
The results of the tests performed on samples of subgrade at each test pit are presented below. The classifications may vary slightly from the field logs due to more information obtained from laboratory testing.

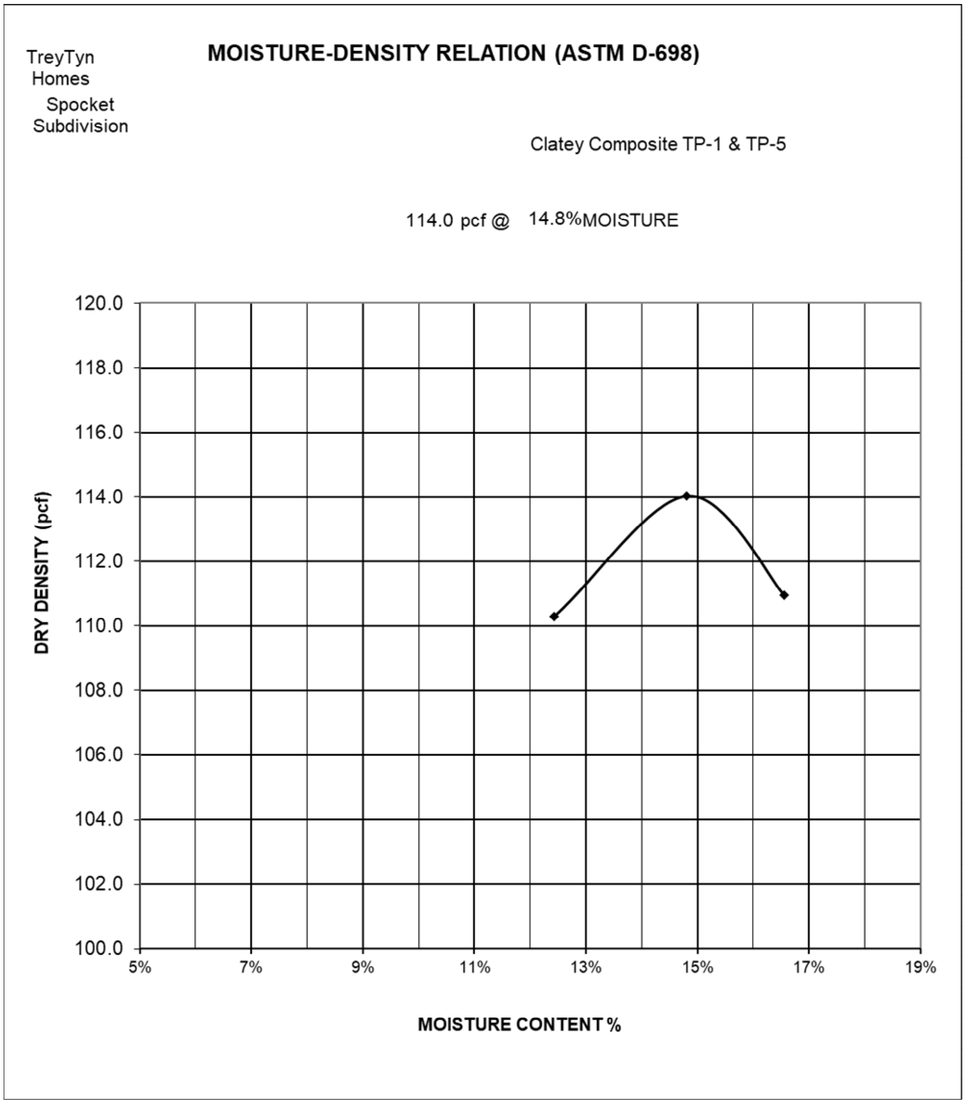
Test Pit	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Description
TP-1	2-4'	28	17	11	Lean Clay
TP-2	2-4'	25	17	6	Clayey Silt
TP-3	2-4'		NP	NP	Silt
TP-4	2-4'		NP	NP	Silt
TP-5	2-4'	33	18	15	Lean Clay



These results indicate low to moderate swelling potential.

The strength of soils and aggregates is a function of their density. The denser a given material is, the stronger it is. The maximum dry density of a material is determined by running an ASTM D-698, Moisture-Density Relation Test. This is commonly called the Standard Proctor Test. Samples with different moisture contents are compacted with equal forces and a curve of the moisture density relationship is established. The result of the Standard Proctor for a composite sample of the silty material from TP-2 TP-3 and TP-4 and the clayey material from TP-1 and TP-5 clay is presented below and on the following page.





SUMMARY OF GEOLOGIC FINDINGS

The site is a floodplain alluvium deposit. A relatively thick layer of sediments is blanketing the formational Mancos Shale bedrock. The sediments are suitable for foundation material, as they exhibit low to moderate swelling potential from the PIs; However, only collapsing from the Swell/Consolidation tests. The very moist soils will slowly consolidate when loaded. The dry poorly compacted soils will collapse when in contact with water and loading.

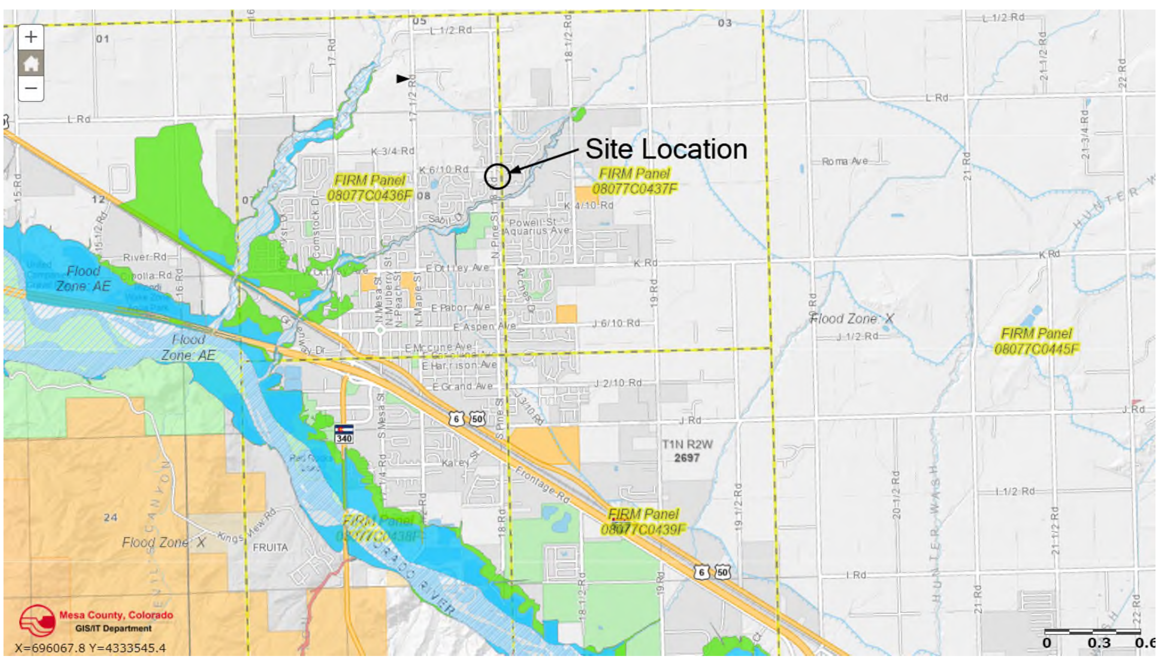
The subgrade materials vary widely in their natural moisture content. The very moist to wet material is very soft, and geotextile stabilization may be required in these areas.

GEOLOGIC HAZARD REVIEW

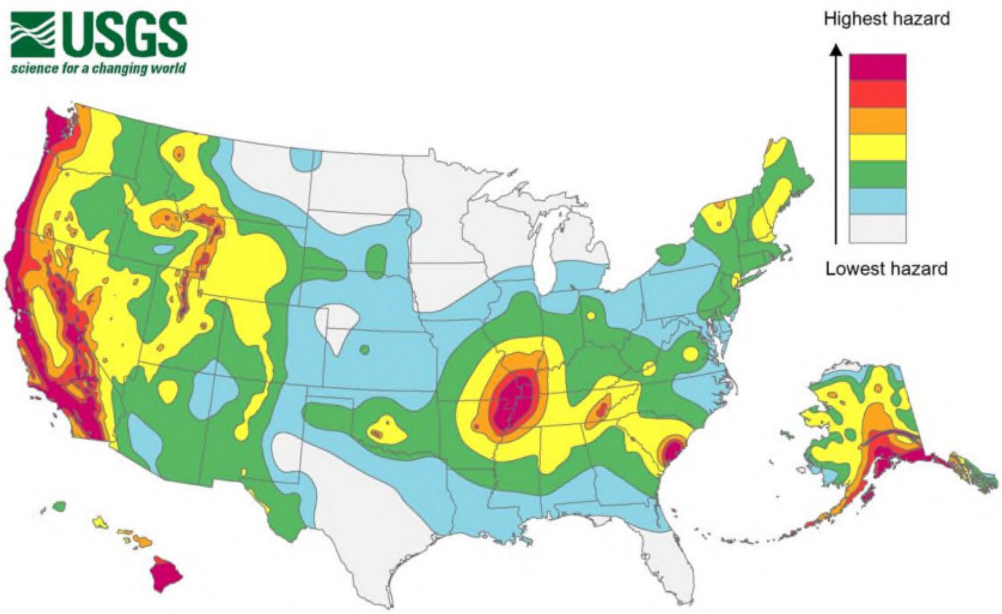
The following are typical geologic hazards that would prevent development of a subdivision:

- Flooding
- Earthquakes
- Volcanos
- Rockslides
- Mudslides
- Avalanches
- Swelling soils
- Collapsing soils
- Radiation

The site is virtually flat and well away from any floodplain. The following map shows the site and the floodplains in the area.



Seismic risk is rated low. Between 1867 and 1996 only four seismic events have been recorded within a twenty mile radius of the site. The largest of which was between 4.0 and 4.9 on the Richter Scale, 8 miles north of the site. No faults (mapped in Mesa County, Colorado) are suspected of movement in the last 750,000 years.



This Earthquack risk map shows the relative level of risk across the United States.

There are no active volcanoes in Colorado.

The nearest rockslide/mudslide risk would be at the Colorado National Monument over two miles away.

The nearest avalanche risk would be on Grand Mesa over 30 miles away.

The soils have some swelling potential as well as collapsing potential. Both conditions can be mitigated with proper soil conditioning or replacement for the foundation pad construction. Appropriate grading and landscaping are also required to minimize risk of future movement.

A gamma radiation survey was performed using a hand-held Giger Counter. The radiation levels ranged from 0.008 to 0.022 mR/hr, with an average of 0.0177 mR/hr. This level is considered to be typical background radiation and presents no additional risk.

There are no adverse geologic features that would prevent development of this subdivision. While not a geologic hazard, there was evidence of trash disposal on the site. Care must be taken to remove any trash from the lots prior to construction.

GRADING AND EXCAVATION CONSIDERATIONS

Grading plans were not available at the time of this investigation. ***Prior to fill placement, all organic and deleterious materials should be removed.*** The surface should be scarified 12 inches deep; moisture conditioned to within 2% of optimum for the material and compacted to above 95% of the Standard Proctor Maximum Dry Density for the material; or 90% of the value of a Modified Proctor (ASTM D-1557). Soft spots encountered during this phase of construction should be reworked or removed to provide the required compaction. Moisture conditioning may require drying.

Utility construction should comply with OSHA standards for sloping and or shoring. The depth of utility trench should not be below the water table.

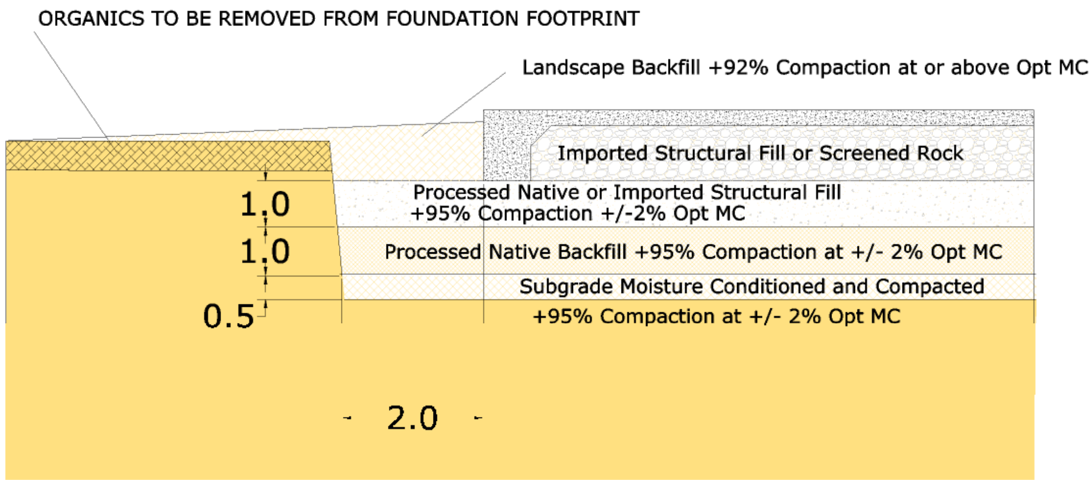
SEASONAL LIMITATIONS

The high moisture content of the soils will require significant moisture conditioning to produce an acceptable subgrade; therefore, this type of work should be done when the temperatures are below freezing. No backfilling shall be performed while backfill materials are subjected to freezing conditions.

FOUNDATIONS

The alluvial sediments are suitable foundation material when properly moisture conditioned and compacted. A shallow foundation system such as slab on grade is recommended to maximize the separation between the bottom of the foundation and the soft very moist soils at depth. The depth of required moisture conditioning and recompaction is dependent on the state of natural moisture, the required depth of moisture conditioning and recompaction will generally be 1 to 2 feet below the foundation, very moist soils may require reinforcement with a layer of geo-textile. Foundation bearing capacities will range from 800 psf to 1,250 psf. Foundations may be designed for a bearing capacity of 1,000 psf. However, a geotechnical engineer should observe the excavation and make recommendations as to how to achieve the 1,000 psf value. Open hole inspections should be conducted (on individual lots or a small cluster of lots) to determine the exact bearing capacity and required remediation. County Minimum Standards may be used for foundation design, provided that an engineer specifies the allowable bearing capacity for the lot. Gable truss construction may require an engineered foundation depending on the truss loads. All earthwork should be tested by a qualified geotechnical engineering firm.

The following sketch gives the general layout.



EXCAVATION

The topsoil should be removed and stockpiled for landscaping. The footprint of the foundation should be excavated to the appropriate depth below the bottom of the planned foundation elevation. The excavation should extend laterally a minimum of 2 feet from the footprint of the foundation, to insure compaction under the thickened edges. Compaction should extend beyond any foundation pads not attached to the main foundation.

SUBGRADE PREPARATION

Once the over-excavation has been completed, the subgrade should be compacted. The subgrade should be scarified to a depth of 8 to 10 inches, thoroughly moisture conditioned and compacted. Any soft spots noticed during compaction should be removed or reconditioned. Very moist soils may require reinforcement with a layer of geo-textile or adding cobble to the soft spot, the engineer should be consulted.

BACKFILL

All structural fill should consist of non-expansive, granular material with a PI of less than 10. The silt sand native soils meet these requirements; however, their moisture content may make them unsuitable. The material should be moisture conditioned and placed in lifts compatible with the size of equipment used (4" lifts for jumping-jack, 8" for front end loader) no lift shall exceed 12". The structured fill should be compacted to at least 95 percent of the maximum standard Proctor density at a moisture content (±)2% of optimum; or 90% of the value of a Modified Proctor (ASTM D-1557). We recommend that moisture and density testing be performed during placement and at final grade. Since the native materials will become loose with construction traffic, Capstone recommends that the compaction fill mat be capped with a minimum of 4" of course aggregates such as minus ¼" crusher fines if the area is going to be exposed to the elements for more than 3 days.

SLAB CONSTRUCTION

The materials that would support slab on grade construction exhibited low to moderate swell potential. Slab-on-grade construction may be used. The following precautions should be taken to reduce the effects of movement should the subgrade become wet.

- The slab should rest on a moisture conditioned and compacted mat. The depth of conditioning is to be determined by an open hole inspection. The top 6 to 8 inches of subgrade soils should be moisture conditioned to +/- 2% of optimum and recompacted to minimum 95% of ASTM D-698, or 90% of the value of a Modified Proctor (ASTM D-1557). The moisture content should be maintained until the structural fill is placed.
- All structural fill placed below the slabs should consist of non-expansive, non-free draining, granular material with a PI less than 10. The majority of the native materials will meet these requirements. The structured fill should be compacted to at least 95 percent of the maximum Standard Proctor density at moisture content +/-2% of optimum.
- Water lines and gas lines connected to water heaters and/or furnaces resting on the slab need to be constructed with flexibility to allow for slab movement. Heater ducts must be provided with expandable connections between the furnace and ducts.
- Slabs should be provided with control joints to reduce damage due to shrinkage cracking.

WATER SOLUBLE SULFATES

The Soil Conservation Service's soil types reported up to 5% gypsum, and gypsum crystals were observed in the sediments when dried. This indicates a sulfate content of in excess of 2000 ppm. This concentration of water-soluble sulfates represents a severe degree of sulfate attack on concrete exposed to these materials. Based on this observation, sulfate resistant cement (Type II modified) should be used in all concrete exposed to the on-site soils.

DRAINAGE AND IRRIGATION

The success of shallow foundation and slab-on-grade floor systems is contingent upon keeping the sub grade soils at more or less constant moisture content, and by not allowing surface drainage a path to the subsurface. Positive surface drainage away from the structures must be maintained at all times. Landscaped areas should be designed and built such that irrigation and other surface water will be collected and carried away from foundation elements. The final grade of the foundation's backfill and any overlying concrete slabs or sidewalks should have a positive slope away from the foundation walls on all sides. We recommend a minimum slope of 8" in the first ten feet; however, the slope can be decreased to 3" in ten feet if the ground surface adjacent to the foundation is covered with concrete slabs sidewalks or pavement.

- As much as practical, we recommend landscaping vegetation that is common to semi-arid climates, with low moisture requirements. A "drip" system of watering could be utilized to keep water usage low. Dry-type landscaping is encouraged.
- Areas close to foundation elements, where snow will drift and accumulate, should be protected from standing water during periods of snowmelt.
- Landscaped areas should be placed away from the foundation elements and be designed to drain surface runoff away from the foundation elements.
- The structure should have a rain gutter system that directs water away from the foundation elements. Ideally, the subdivision drainage plan would incorporate drain that collect the water and transport it to the retention or detention feature.
- The potable water supply and the sanitary sewer service trenches should be backfilled in a manner to prevent water entering the trenches and migrating to the foundation.
-

PAVEMENT DESIGN

The design of a roadway requires the following information:

- Knowledge of the subgrade strength.
- The volume of traffic, now and in the future.
- The function of the road (highway or collector)
- The drainage characteristics of the roadbed.

SUBGRADE

The first factor to be determined is the strength of the material that the roadbed is going to rest on. The California Bearing Ratio (CBR) Value is used by Colorado Asphalt Paving Association (CAPA) to calculate the Resilient Modulus, an indicator of the subgrade strength. The CBR was estimated from the California Spoon blow count and field shear strength measurements. The estimated CBR of 5 was used for the design of the roadway. Using CAPA formulas, the Resilient Modulus was calculated to be 4,500 psi for the subgrade.

TRAFFIC VOLUME

For the 9 residences in the subdivision the traffic load would be relatively low and have a traffic classification of Class III (Medium traffic up to 700 autos per day). sing the Asphalt Institutes recommendations, the Equivalent Single Axle Loads (ESAL's) would be between 0.5 and 1.0 million.; therefore, the ESAL rating of 0.5 million will be used.

ROAD USAGE

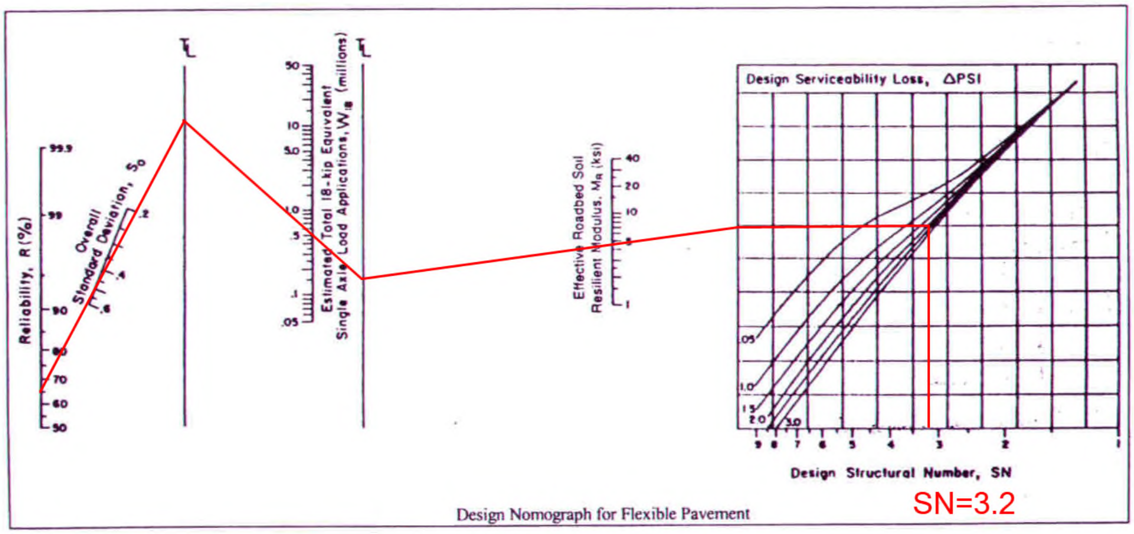
The local road would be classified as a rural local access. The recommended Reliability Factor for collectors is to be between 50 and 75. For this section study, a factor of 65 is used.

DRAINAGE CHARACTERISTICS

The subgrade material is generally silty. These types of deposits are generally good draining. The drainage will be enhanced by grading; therefore, the drainage for this roadway is rated good.

PAVEMENT DESIGN

The CDOT- AASHTO nomograph design method was used to calculate the required Structural Number for each of the sections being studied. The nomograph is presented below. The required pavement section for the clayey silt (CBR-Value 5) is a structural number (SN) of 3.2 for the subdivision.



Design Nomograph for Flexible Pavement

In the CAPA design method, the sum of the structural numbers of each material must equal the required structural number calculated in the nomographs. The thickness of the base course is multiplied by its appropriate coefficient and added to the pavement thickness multiplied by its appropriate coefficient.

Coefficients for different structural materials are:

Hot Mix Asphalt	HMA	0.44/inch
Aggregate Base Course (Class 6 Roadbase)	ABC	0.12/inch
Aggregate Sub Base Course (pit-run Gravel)	ASC	0.10/inch

Below are pavement section alternatives for the subdivision.

Subdivision Road Recommendations

R-Value	18K-ESAL	RF	Sn	HMA	ABC	ASC
				0.44	0.12	0.10
5	500,000	85%	3.2	3.0	16.0	0
5	500,000	85%	3.2	3.0	6.0	12
5	500,000	85%	3.2	4.0	12.0	0
5	500,000	85%	3.2	4.0	6.0	8

A range of options are presented to offer the designers economic alternatives as well as total section thickness for grading options.

SUBGRADE PREPARATION

As with a shallow foundation, the key to a long-lasting roadway is to control the moisture of the subgrade. A well-designed drainage plan is required to avoid ponding water near the pavement. Equally important is preparing the subgrade for the base course. The top 1 foot of subgrade should be moisture conditioned and compacted to 95% of the maximum dry density as determined by the Standard Proctor test (ASTM D-698 - AASHTO T99) at +/- 2% of the optimum moisture content or 90% of the value of a Modified Proctor (ASTM D-1557). Without a firm base it is difficult to obtain proper compaction in that one foot below the base course. Base preparation generally requires scarifying the base of the excavation (8"-10" deep), moisture conditioning it, then compacting it.

Base course should be placed in lift thickness compatible with the size of compaction equipment used. In no case shall lift thickness exceed 12 inches. Compaction testing should be conducted to the standards for roadway construction. Compaction of pit run material should be verified by proof rolling. Roadbase should be greater than 95% of the maximum dry density determined by a Modified Proctor Test (ASTM 1557 - AASHTO T180) with a moisture content within 2% of optimum.

LIMITATIONS

Based on our subsurface investigation, there were no geologic conditions that would prohibit the development of this property as proposed.

The analysis and recommendations submitted in this report are based on the test excavations, field observations and laboratory testing. The nature and extent of variation may not become evident until construction. If variations then appear, it will be necessary to reevaluate the recommendations in this report.

It is recommended that the geotechnical engineer be provided the opportunity for general review of the final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. It is also recommended that the geotechnical engineer, or a qualified geo-technician under his supervision, be retained to provide continuous engineering services during construction of the foundation, excavations, and earthwork phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to modify these recommendations in the event that subsurface conditions differ from those anticipated. This report does not constitute a warranty either expressed or implied, as no one can predict the long-tern changes in subsurface moisture conditions resulting from improper grading, excessive irrigation by the home owner or neighbors or other causes during and after construction.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Respectfully Submitted:
CAPSTONE ENTERPRISES WEST, LLC

Martin W. Chenoweth, PE
Registered Professional Engineer

MWC