December 5, 2023

Charlie MacArthur
1885 Bear Drive
Steamboat Springs, Colorado 80487

Re: Geotechnical Subsurface Exploration
Proposed MacArthur Residence
Bald Eagle Lake
Routt County, Colorado
Western Slope Geotech Project No. 23-1083

Dear Charlie,

Western Slope Geotech, Inc. (WSG) has completed the geotechnical subsurface exploration you requested for your proposed residence to be constructed within a tract of land located within Section 33, Township 6 North, Range 84 West of the 6th P.M., Routt County, Colorado. The site is also generally known as Bald Eagle Lake. The results of our subsurface exploration, laboratory testing and pertinent geotechnical engineering recommendations are included with this report.

PURPOSE AND SCOPE OF WORK

The purpose of this exploration and associated reporting is to provide geotechnical design and construction recommendations for the proposed residential structure and other site improvements. WSG's scope of work included field exploration, laboratory testing and the preparation of this report summarizing the data obtained and outlining our recommendations for foundation design and construction and support of floor slabs and exterior flatwork. The conclusions and recommendations outlined in this report are based on our assumptions regarding proposed construction, results of field exploration, laboratory testing and WSG's experience with subsurface conditions and similar construction in this area.

PROPOSED CONSTRUCTION

Based on review of available plans, WSG understands proposed construction will consist of a one to two-story, wood framed structure constructed with an attached garage and slab-on-grade floor system. Lower floor level will be constructed slightly above existing site grades.

Site grading to develop finished grades around the structure could include unretained fills up to approximately 2 feet in height.

Foundation loads for the structure are expected to be relatively light, with continuous wall loads less than 3 kips per lineal foot and individual column loads less than 50 kips. If the assumed construction and loading conditions vary substantially from those assumed, WSG should be contacted to reevaluate the recommendations in this report.

SITE DESCRIPTION

The project site is located west of Highway 40, just south of the Steamboat Springs, Colorado city limits. Overall, the property generally consists of approximately 70 acres of vacant land including both undisturbed and disturbed areas. Previous activity at the site included a gravel mining operation that resulted in a small lake that occupies the northern portion of the property. South of the lake, site development included a gravel access road, gravel parking and equipment storage areas and a wood framed ski jump ramp.

The proposed building site was located just south of the south edge of the lake and the site appeared to have previous site grading fills, however depth and extent were not readily apparent. Site vegetation consisted of grass and weeds. The Yampa River is located just within the northern property boundary.

Building site topography was relatively flat due to previous site grading and appeared to slope gently down to the north. Based on site observations, it appears that a maximum elevation difference of approximately 1 to 2 feet exists across the building site.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

WSG's field exploration program consisted of the observation of four (4) exploratory test and profile pits across the building and a potential OWTS Soil Treatment Area (STA) site. The test and profile pits were advanced to obtain information about the subsurface profile,

groundwater conditions and obtain material samples for laboratory testing. Approximate test and profile pit locations are shown on Figure 1.

Subsurface conditions encountered in the test pits were variable and generally consisted of a layer of topsoil and organics overlying man-mage fill, natural sand and sandy gravel to the maximum depth explored, 8 feet below existing ground surface. Graphic logs of the exploratory test pits and associated legend and notes are shown on Figure 2.

Topsoil and organics were encountered at the ground surface in all test and profile pits and was estimated to vary from approximately 6 to 24 inches in thickness.

Man made fill consisting mainly of gravel was encountered beneath the topsoil layer in test pits 1 and 2. The gravel fill was silty, non-plastic, loose to medium dense, moist and light brown.

Natural sand was encountered beneath the topsoil in test pit 3 and profile pit 1. The sand was silty to clean, non-plastic, loose, medium to coarse grained, dry to moist and light brown.

Gravel was encountered beneath the fill material or sand in all test and profile pits at depths ranging from 2½ to 4 feet. The gravel was sandy and clean to silty, non-plastic, medium dense, moist to wet and rust to dark gray. Samples of the gravel classified as SM-GM and GW soils in accordance with the Unified Soil Classification System. Laboratory test results are summarized on Table 1.

Groundwater seepage was encountered at depths of 5 ½ and 7 feet in test pit 3 and profile pit 1 at the time of excavation. Groundwater levels will vary seasonally and over time based on water levels in the Yampa River, weather and surface runoff conditions, site development, landscape irrigation practices and other hydrologic conditions. Perched and/or trapped groundwater conditions may also be encountered at times throughout the year. Perched water is commonly encountered in soils overlying less permeable soil layers and/or bedrock.

ANALYSIS AND RECOMMENDATIONS

General

Based on our understanding of proposed construction and subsurface conditions encountered in the test pits, it appears that natural gravel will be encountered at or near potential foundation bearing elevations. Based on WSGS's experience with similar materials, we believe the natural gravel will provide suitable bearing for lightly loaded residential foundations. Existing fill materials could also be encountered at proposed foundation grades. These fill materials should be removed and replaced with structural fill or foundations extended to suitable natural gravel.

Although seasonal high groundwater elevation is unknown at this time, it does not appear that groundwater will be encountered at or near proposed first floor elevation. Water surface elevations associated with potential Yampa River flooding events are unknown, however WSG recommends an evaluation be conducted by a qualified engineer and the findings incorporated into building plans.

Foundations

Based on the subsurface conditions encountered in the test pits, laboratory test results and WSG's experience, we recommend proposed residence foundations be supported by continuous spread footing and isolated pad foundations bearing on natural, undisturbed gravel or on structural fill placed over natural gravel and designed and constructed as outlined below:

1. WSG recommends foundation footings be placed on undisturbed gravel or structural fill placed over the gravel and designed using a maximum net allowable soil bearing pressure of 2,500 psf.
2. If structural fill is used, WSG recommends it consist of a free draining washed or screened rock materials. Structural fill should be uniformly placed and compacted in 12-inch loose lifts to at least 80% of the maximum relative density determined in accordance with ASTM D4253/4254. Structural fill should also extend out from the edge of footings on a 1(H) to 1(V) or flatter slope.
3. All footing areas should be thoroughly compacted with a mechanical compactor prior to placement of forms.

4. Footings exposed to freezing or frost conditions should be designed with adequate soil cover to prevent freezing. A minimum cover depth of 48 inches is recognized by the regional building authority as the minimum cover depth value for frost protection.
5. WSG recommends continuous footings have a minimum width of 12 inches and isolated pad foundations have a minimum width of 24 inches in order to facilitate construction and reduce the potential for development of eccentrically loaded conditions.
6. Foundation walls and grade beams should be designed to span an unsupported distance of 10 feet or the distance between pads.
7. Foundation resistance to lateral loads can be developed by passive pressure against footings and walls and sliding resistance between footings and floor slabs and the underlying soils. WSG recommends passive pressures be computed using an equivalent fluid pressure value of 250 pcf and friction resistance be calculated using a coefficient of friction of 0.30 times structural dead loads. The recommended passive equivalent fluid pressure value and coefficient of friction do not include a factor of safety.
8. WSG should be retained to observe foundation excavations to verify the subsurface conditions are consistent with those assumed.

WSG estimates settlement of footing foundations designed and constructed as outlined above and resulting from the assumed structural loads would be on the order of 1 inch or less. Differential settlement could approach the amount of total settlement estimated above.

Interior Floor Slabs

WSG understands slab-on-grade floor systems will be used for the residence lower level and attached garage floors. Based on the results of the subsurface exploration and WSG's experience with similar construction in the area, WSG believes slab-on-grade construction can be used for the structure, provided the design and construction precautions outlined below are observed.

1. Topsoil and any existing fill materials should be removed from all underslab areas. Removal of existing silty sand is also recommended. After stripping, all underslab areas should be thoroughly compacted using a mechanical compactor prior to placement of underslab fill.
2. Underslab fill materials should consist of either approved Low Volume Change (LVC) soils or imported non-expansive materials and compacted to at least 95% of the maximum standard Proctor density within 2% of optimum moisture content (ASTM D698). On-site sandy gravel material should be suitable for use beneath floor slabs but may require moisture conditioning prior to use.
3. Floor slabs should be underlain by a minimum 6-inch layer of free draining gravel. The gravel layer will help provide uniform support and aid in underslab drainage.
4. Floor slabs should be constructed with control joints located a maximum of 12 feet on center to control natural, unavoidable cracking associated with concrete shrinkage that commonly occurs during curing. Control joint locations should be carefully selected to intersect slab intrusions and other locations where shrinkage cracking is common.

Perimeter Drainage and Underdrainage Systems

WSG typically recommends a perimeter drainage system be installed at all perimeter foundations of residential structures. Under slab drainage systems are recommended where high groundwater conditions are anticipated within 2 feet of finished floor elevation.

Properly constructed perimeter drainage systems enhance site drainage, help reduce the potential for development of hydrostatic pressures behind the below-grade walls and reduce the potential for water infiltration beneath footings and into underslab and crawl space areas. Due to flat site topography and underlying natural gravels, WSG believes that the requirements for a typical perimeter drainage system can be waived. In addition, it does not appear that groundwater will be encountered within 2 feet of floor elevation and, therefore an under slab drainage system is not recommended at this time.

A perimeter drainage system should generally consist of a 4-inch diameter perforated PVC drainpipe covered by a minimum of twelve (12) inches of free-draining gravel and covered with filter fabric (Mirafi 140N or equivalent) to prevent intrusion of fines. The high point

of the drainpipe should be placed at approximate footing grade (or at least 6 inches below proposed crawl space grade) around the perimeter foundation footings, constructed with a minimum 1% slope to a daylighted outfall. For building areas with at-grade floor slabs, minimum drainage system burial depths of 24-inches may be suitable. Care should be taken during drain installation to avoid disturbing those soils providing support to the footing bearing soils extending down at an approximate 1(H) to 1(V) slope from the bottom edges of the footings. Daylighted outfalls should be protected from small animal intrusion and backflow.

Lateral Earth Pressures and Foundation Backfill

Lateral Earth Pressures: Foundation walls should be designed to resist lateral pressures associated with foundation backfill materials and existing site soils. Materials affecting lateral pressures are located within the area extending from the base of the foundation wall upward at an approximate 1(H) to 1(V) angle. Recommended lateral earth pressure design values to be used in foundation wall design are provided in Table B shown below. All values presented assume drained conditions (no hydrostatic loads) and sufficient wall deflection is achieved for activation of active earth pressure conditions.

Table B

Design Pressure Condition	Equivalent Fluid Pressure (pcf)
Active	35
At-Rest	45
Passive	250

Variables that affect active lateral earth pressures include but are not limited to the classification and swell potential of the backfill soils, backfill compaction and geometry, wetting of the backfill soils, surcharge loads and point loads developed in the backfill materials. The recommended equivalent fluid pressure values do not include a factor of safety or an allowance for hydrostatic loading. Use of expansive soil backfill, excessive compaction of the wall backfill, or surcharge loads placed adjacent to the foundation walls can add to the lateral earth pressures causing the equivalent fluid pressure values used in design to be exceeded.

Foundation Backfill: Backfill placed adjacent to below-grade walls should consist of LVC potential and relatively impervious soils free from organic matter, debris and other objectionable materials. The on-site sand or gravel could be suitable for use as wall backfill but may require processing and moisture conditioning prior to placement. Imported LVC soils would also be suitable for foundation backfill but should be approved by WSG prior to use. WSG recommends foundation backfill soils be uniformly placed in maximum 9-inch loose lifts, moisture conditioned to within +/-2 percent of optimum moisture content and compacted to at least 95 percent of the maximum standard Proctor dry density (ASTM D698) for imported LVC soils.

Foundation wall backfill operations should be conducted only after proper bracing and support is provided. Structural engineer approval is recommended. Excessive lateral stresses resulting in displacement, distress and damage to foundation walls can occur when insufficient bracing is in place or heavy mechanical compaction equipment is used. WSG recommends compaction of unbalanced foundation wall backfill soils be completed using light mechanical or hand compaction equipment.

Exterior Flatwork

Any topsoil/vegetation and any existing fill should be stripped/removed from proposed flatwork areas prior to fill or concrete placement. WSG recommends the exposed subgrade be scarified to a depth of 6-inches, moisture conditioned to within +/-2% of optimum moisture content and compacted to at least 95% of the maximum standard Proctor density. WSG recommends fill supporting flatwork consist of approved granular materials, processed and moisture conditioned on-site gravel uniformly placed in 9-inch loose lifts, moisture conditioned and compacted to the values indicated above with a limited risk of post-construction movement. All fill materials should be approved by WSG prior to use.

Subgrade soils expected to receive exterior flatwork concrete should be evaluated closely evaluated immediately prior to concrete placement. If areas of disturbed, wet and softened, or dry subgrade soils are encountered at that time, reworking of those materials or removal/ replacement procedures may be required.

Drainage

Positive drainage is imperative for satisfactory long-term performance of the proposed building foundations, floor slabs and associated site improvements. WSG recommends

positive drainage be developed away from the structure during construction and maintained throughout the life of the site improvements. Twelve (12) inches of fall in the first 10 feet away from the building is recommended. Flatter slopes could be considered in hardscape areas. If some settlement of the backfill soils occurs adjacent to the building, the original grade and associated positive drainage outlined above should be immediately restored.

Care should be taken in the planning of landscaping to avoid features which could result in the fluctuation of the moisture content of the foundation bearing and/or flatwork subgrade soils. We recommend watering systems be placed a minimum of 5 feet away from the perimeter of the structure and be designed to discharge away from all site improvements. Gutter systems should be considered to help reduce the potential for water ponding adjacent to the residence, with the gutter downspouts, roof drains or scuppers extended to discharge a minimum of 5 feet away from structural, flatwork and pavement elements. Water which is allowed to pond adjacent to the site improvements can result in unsatisfactory performance of those improvements over time. The use of area drain inlets and subsurface piping is recommended to aid in rapid runoff of surface water from areas of concentrated drainage and/or limited surface runoff capability.

SITE GRADING

Based on WSG's assumptions regarding site grading, WSG assumes unretained fills of up to 2 feet in height could be constructed for site development. Based on proposed construction, WSG recommends the following:

1. Unretained cuts and fills should be constructed to a 2(H) to 1(V) or flatter slope configuration. Flatter slopes are often desirable to help facilitate revegetation efforts.

2. Areas to receive fills should be stripped of organics and any existing fill materials prior to fill placement, scarified to at least 12 inches, moisture conditioned and uniformly compacted prior to fill placement.

   Fill materials supporting driveways or other settlement-sensitive landscaping features should consist of approved materials. These fills should be uniformly placed and compacted in 9-inch loose lifts to at least 95% of the maximum standard

Proctor density within +/-2% of optimum moisture content for on-site materials and +/-2% for LVC or granular imported materials (ASTM D698).

3. Proper drainage should be provided and maintained around all cuts, fills, buildings, and driveway surfaces. Special attention should be given to channeling or routing drainage around and away from site fills and retaining structures. Excessive or uncontrolled surface and subsurface drainage could lead to erosion and poor site fill performance and/or slope failure.

4. All disturbed areas should be protected from erosion by revegetation or other appropriate methods. Areas of concentrated drainage should be protected by use of rip rap or other appropriate methods.

5. Construction safety is the sole responsibility of the contractor. The contractor is responsible for determining the appropriate OSHA slope criteria for the soils conditions encountered and implementing it during construction. The contractor shall be responsible for all means, methods, techniques, sequencing, and operations during construction. All excavation activities should meet minimum OSHA, state or local trenching and excavation safety standards.

GENERAL COMMENTS

This report was prepared based upon the data obtained from the completed site exploration, engineering analysis and WSG's experience with similar construction in this area. The subsurface conditions encountered during this investigation provide an indication of subsurface conditions at the test pit locations only. Variations in subsurface conditions can occur relatively short distances away. This report does not reflect any variations which may occur across the site or away from the test pit locations. If variations in the subsurface conditions anticipated become evident, the geotechnical engineer should be notified immediately so that further evaluation can be completed and when warranted, alternative recommendations provided.

The scope of services for this project does not include either specifically or by implication any biological or environmental assessment of the site or identification or prevention of pollutants or hazardous materials or conditions. Other studies should be completed if concerns over the potential of such contamination or pollution exist.

WSG should be retained to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. WSG should also be retained to provide testing and observation services during construction to help evaluate compliance with project plans and specifications.

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 the generally accepted standard of care for the profession. No warranties express or implied, are made. The conclusions and recommendations contained in this report should not be considered valid if any changes in the nature, design or location of the project as outlined in this report are planned, unless those changes are reviewed, and the conclusions of this report modified and verified in writing by the geotechnical engineer.

Western Slope Geotech appreciates the opportunity to be of service to you on this project. If you have any questions concerning the enclosed information or if we can be of further service to you in any way, please do not hesitate to contact us.

Very Truly Yours,
Western Slope Geotech, Inc.

Harold Schlicht, P.E.
Principal Engineer

I, 2023

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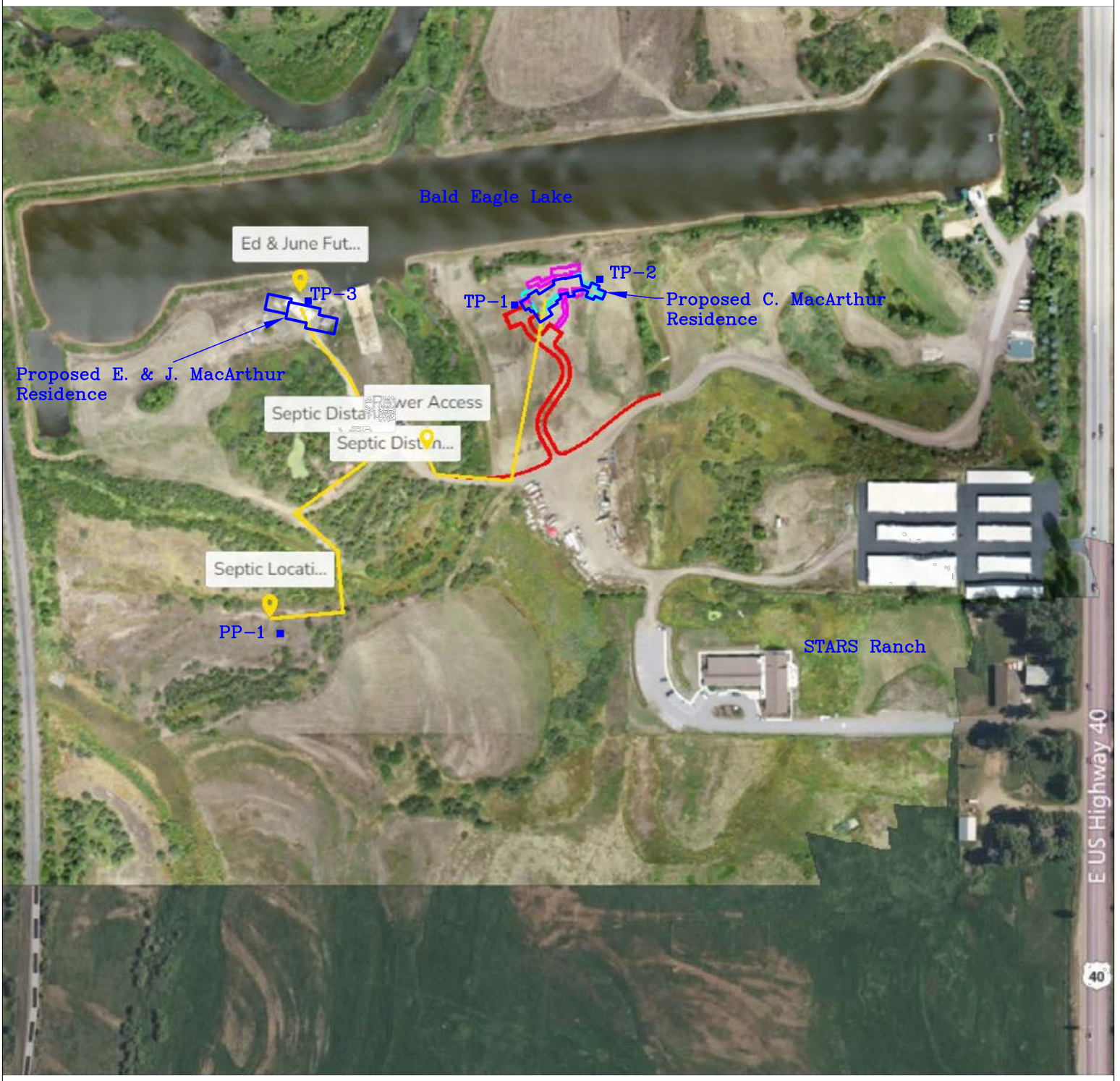
No Scale



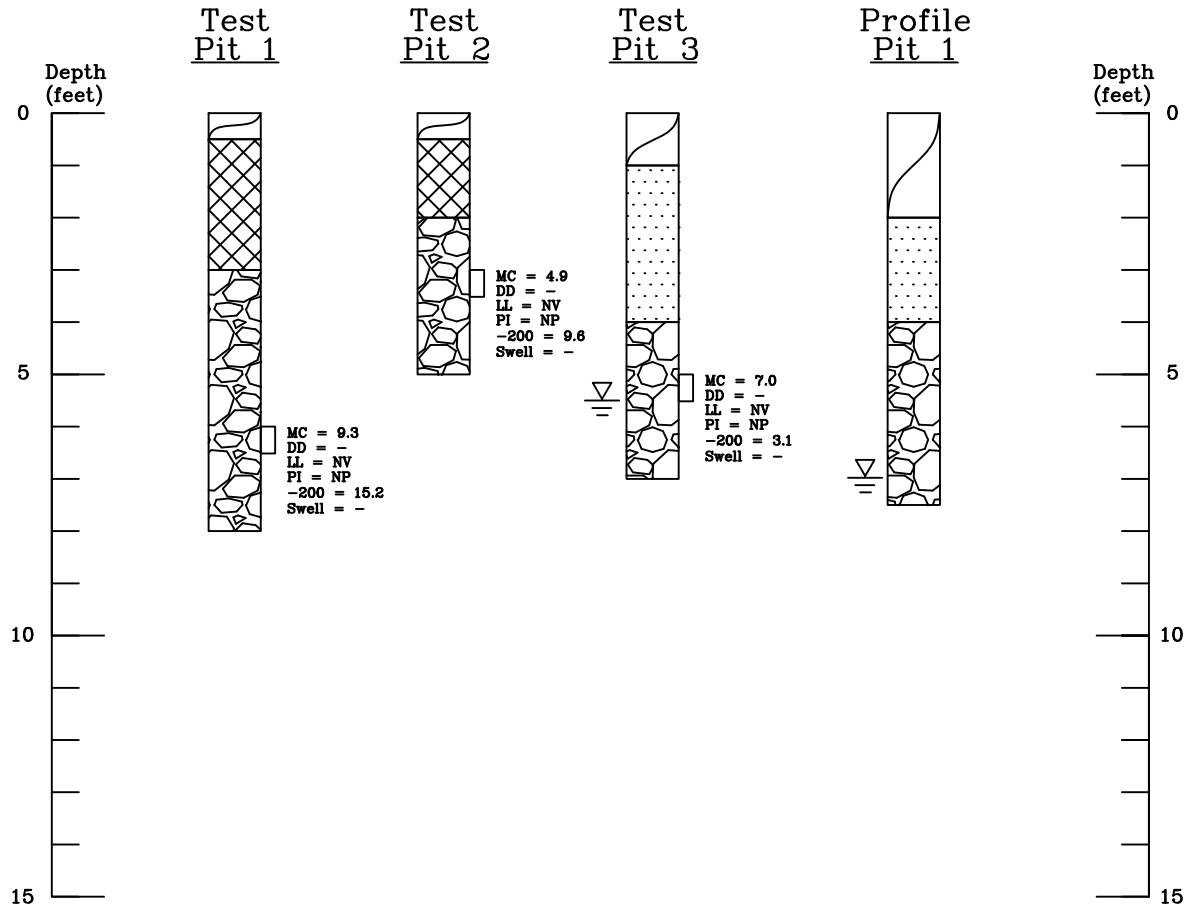
SITE PLAN/LOCATION OF TEST PITS

Project Name: Proposed MacArthur Residences

Location: Bald Eagle Lake, Routt County, CO

WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO

Project No.: 23-1083	Drawn/Checked:HS
Date: 12/4/23	Figure No.: 1



Legend:

TOPSOIL/ORGANICS.

GRAVEL FILL: Sandy and silty, non–plastic, loose to medium dense, moist and light brown.

SAND: Silty to clean, non–plastic, loose, medium to coarse grained, dry to moist and light brown.

GRAVEL: Sandy and clean to silty, non–plastic, medium dense, moist to wet and rust to dark gray.

Depth at which groundwater seepage was encountered.

Notes:

1) Test pits were excavated on 8/24/23 with a Bobcat E50 trackhoe.

2) Locations of test pits were determined by taping from existing and proposed features in the field and shown on the site plan provided.

3) Test pit elevations were not determined and logs are drawn to the depths explored.

4) Lines between materials types are approximate and transitions may be gradual.

5) Groundwater measurements were made at the time of excavation and levels may vary.

MC = Natural Moisture Content (%)
DD = Natural Dry Density (pcf)
LL = Liquid Limit
PI = Plasticity Index
-200 = Percent Passing No. 200 Sieve
Swell = Percent Swell Under 500 or 1,000 psf surcharge

LOGS, LEGEND & NOTES

Project Name: Proposed Regan Residence

Location: Lot 2, Yurevitch Subdivision, Routt County, CO

WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO

Project No.: 23–1063	Drawn/Checked:HS/HS
Date: 9/1/23	Figure No. 2

Table 1
Summary of Laboratory Test Results

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Project No.: 23-1083

Test Hole/ Pit	Depth (ft)	Natural Moisture Content (%)	Dry Density (pcf)	Grain Size Analysis			Atterberg Limits		Swell Test Data		Soil or Bedrock Type	USCS Classification	AASHTO Classification
				Gravel (%)	Sand (%)	Silt/ Clay (%)	LL (%)	PI (%)	Swell(+) Consol.(-)	Swell Pressure (psf)			
TP-1	6-7	9.3	-	46	39	15	NV	NP	-	-	Silty Sand & Gravel	SM-GM	
TP-2	4	4.9	-	70	20	10	NV	NP	-	-	Sandy Gravel	GW	
TP-3	5-6	7.0	-	74	23	3	NV	NP	-	-	Sandy Gravel	GW	