October 27, 2023

Nick Salter
Tailwaters at Stagecoach LLC
5 Murray Road Unit B4
Edwards, Colorado 81632

Re: Geotechnical Exploration and Geologic Hazard Evaluation
Proposed Tailwaters at Stagecoach Subdivision
Routt County, Colorado
Western Slope Geotech Project No. 23-1076

Dear Nick,

Western Slope Geotech, Inc. (WSG) has completed the geotechnical exploration and geologic hazard evaluation you requested for the proposed Tailwaters at Stagecoach Subdivision to be developed within a parcel of land located in the Stagecoach area of Routt County, Colorado. 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 proposed subdivision improvements and evaluation of geologic hazards and preliminary geotechnical design and construction recommendations for potential residence foundations and associated 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 geotechnical recommendations. The conclusions and recommendations outlined in this report are based on the results of field and laboratory explorations and WSG's experience with subsurface conditions and similar construction in this area.

PROPOSED CONSTRUCTION

Based on our review of preliminary subdivision plans, WSG understands subdivision improvements will include development of multiple new roadways with unretained cuts and fills up to approximately 7 feet in height. Realignment of County Road 16 and County Road 18A is anticipated in the southern portion of the site. Municipal water and sewer

utilities will be extended into the development along the new roadways from existing mains located along Morrison Creek. Overlot grading is anticipated to be minor and limited to fills of approximately 5 feet or less.

Current plans indicate the property will be subdivided into 164 single-family and duplex residential lots and 10 multi-family (tri-plex and four-plex) properties. Some commercial building lots are also anticipated near the intersection of County Roads 16 and 18A.

Building foundation loads associated with residential development are expected to be relatively light, with continuous wall loads less than 3 kips per lineal foot and individual column loads less than 30 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 along the east side of County Road 16 and 18A in the Stagecoach area of Routt County, Colorado. The site generally consists of approximately 97-acres of vacant and mostly undisturbed rural land. The property is bordered on the west by County Roads 16 and 18A and vacant and undisturbed land to the east. The Little Morrison Creek drainage is located along the eastern edge of the property and is outside of proposed development areas. Site vegetation consists mainly of grasses, weeds and sagebrush.

Site elevations generally range from 7250’ to 7360’ (msl). Site topography is variable and generally ranges from gently to moderately sloping down to the east and north. Visual evidence of slope instability was not observed.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

WSG’s field exploration program consisted of the observation of eleven (11) exploratory test pits generally located along proposed roadway alignments. The test pits were advanced to obtain information about the subsurface profile, groundwater conditions and obtain material samples for laboratory testing. Approximate test pit locations are shown on Figure 1.

The subsurface conditions encountered in the test pits were variable and generally consisted of a layer of topsoil and organics overlying natural lean clay, sand and gravel overlying sandstone bedrock of the Browns Park Formation to the maximum depth

explored, 11 feet below existing ground surface. Graphic logs of the exploratory test pits are shown on Figures 2 and 3 and associated legend and notes are shown on Figure 4.

A layer of topsoil and organics was encountered at the ground surface in all test pits and varied from approximately 18 to 42 in thickness.

Sand was encountered beneath the topsoil in test pit 1. The sand was silty to sand and silt, non-plastic, medium dense, fine grained, moist and light brown. A sample of the sand classified as an SM-ML soil in accordance with the Unified Soil Classification System (USCS).

Lean clay was encountered beneath the topsoil in test pits 8 and 10. The lean clay was sandy to very sandy, low plastic, stiff, moist and light brown. Samples of the lean clay classified as CL soils in accordance with the USCS.

Gravel was encountered beneath the topsoil in test pits 7 and 9. The gravel was sandy and slightly silty, non-plastic, medium dense, moist and brown. Samples of the gravel classified as GP and GM-GP soils in accordance with the USCS.

Sandstone bedrock was encountered beneath the topsoil in most test pits. The sandstone was very silty to sandstone-siltstone, low to non-plastic, weathered to very hard, fine grained, lightly to well cemented, moist and light brown to tan. Samples of the sandstone classified as SM and SM-ML soils in accordance with the USCS.

It should be noted that practical rig refusal was encountered at depths of 4½ and 7 feet in test pits 4 and 11, respectively, in very hard bedrock.

Swell-consolidation tests conducted on samples of the lean clay indicates the materials tested displayed nil (negligible) to low swell potentials under wetting and constant (1,000 psf) loading conditions. Swell-consolidation tests conducted on samples of the sandstone bedrock indicates the materials tested also displayed nil to low swell potentials under wetting and constant (1,000 psf) loading conditions. Swell-consolidation test results are presented on Figures 5 through 8 and summarized according to risk category on Table A below. Laboratory test results are also summarized on Table 1.

Table A

Slab Performance Risk Category	Representative Percent Swell (500 psf Surcharge)	Representative Percent Swell (1,000 psf Surcharge)	Test Results	
			Lean Clay	Sandstone
Low	0 to <3	0 to <2	2	2
Moderate	3 to <5	2 to <4	0	0
High	5 to <8	4 to <6	0	0
Very High	>8	>6	0	0

Groundwater seepage was not encountered in the test pits at the time of excavation. Groundwater levels will vary seasonally and over time based on water levels in the irrigation ditch, seasonal runoff conditions, weather conditions, site development, 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.

GEOLOGIC SETTING AND HAZARDS

Geologic Setting

The following geologic mapping resources were reviewed by Soilogic. This information and our interpretations are incorporated into this report: *Geologic Map of the Northernmost Gore Range and Southernmost Park Range, Grand, Jackson and Routt Counties, Colorado, USGS Miscellaneous Investigations Series, Map I-1114, George L. Snyder, 1980. Surficial Geologic Map of the Steamboat Springs 30' x 60' Quadrangle, Grand, Jackson and Routt Counties, Colorado, USGS Miscellaneous Investigations Series, Map I-1825, R.L. Madole, 1991*. Routt County Geologic Hazard Maps, (in-person, Routt County GIS Department, Routt County Courthouse, 2023).

The project site lies just west of the western flank of the Park Range in the southern Rocky Mountain geo-physical province. The Park Range is considered a structural geologic feature related to the late Cretaceous and early Tertiary Laramide Orogeny mountain building event. The structure generally consists of a north-south trending uplift that exposes a core of Precambrian age metamorphic and igneous rocks flanked on the east and

west by Mesozoic and Cenozoic age sedimentary rocks. Colluvial (gravity transported slope debris), alluvial (water transported outwash), glacial, and residual (weathered in-place bedrock) soils are products of ongoing weathering and erosion of bedrock and other soils that produces a highly variable depth of cover over the underlying bedrock throughout the area.

Based on WSG's review of available geologic mapping and results of our subsurface exploration at this site, site soils and bedrock consist of young alluvial gravel deposits associated with Little Morrison Creek and residual sand and clay soils overlying sandstone bedrock of the Tertiary-age Browns Park Formation. The Browns Park Formation has been interpreted as an eolian and fluvial sand and volcanic ash deposit. No geologic faults or mapped landslide deposits are present within or adjacent to the project site, and the site does not contain any mapped geologic hazards.

Geologic Hazards

Based on the results of this exploration, a review of available geologic mapping and WSG's experience with similar conditions in this area, we believe potential geologic hazards associated with this site appear to be limited to those hazards associated with building construction on expansive or collapsible soils and bedrock.

Slope Stability: WSG's site observations did not indicate the presence of unstable slope features including landslides or debris flows and instability is not anticipated due to relatively gentle site topography. The risk of shallow slope failures within overburden soils is currently low due to anchoring by existing vegetation. However, site development activities that remove vegetation and concentrate surface runoff will increase slope stability risk.

Expansive/Collapsible Soils and Bedrock: Alluvial (water-transported) and residual soil (weathered bedrock) are present across the site and include relatively thin gravel deposits near the Little Morrison Creek drainage and is various locations across other portions of the site. These materials are likely to overly sandstone bedrock of the Tertiary Browns Park formation throughout the site. Swell-consolidation testing conducted on samples of the sand, lean clay and sandstone bedrock indicate the materials tested will exhibit nil (negligible) to low swell potentials under constant loading and saturation conditions.

Building foundations placed on materials characterized as having a low swell potential can experience minor structural distress and damage as result of heaving of foundations and

floor slabs. WSG recommends geotechnical subsurface explorations be conducted at individual proposed building sites prior to design and construction to further evaluate the swell and/or consolidation potential of subsoils and bedrock based on specific proposed construction.

ANALYSIS AND RECOMMENDATIONS

Preliminary Foundation Recommendations

Based on WSG's assumptions regarding potential residential and commercial construction and development, natural sand, lean clay, gravel and sandstone bedrock may be encountered at potential foundation grades. WSG believes all subsoil and bedrock materials should be suitable for support of foundations, floor slabs and pavement structures. Preliminary foundation and floor slab design recommendations are summarized below:

- WSG believes continuous or individual spread footing foundations are feasible for foundations expected to bear on natural, undisturbed sand, lean clay and/or sandstone bedrock. Minimum dead load requirements on spread footing foundations can be used to resist uplift forces exerted on foundations where the swell potential has been evaluated as low. If moderately to highly expansive materials are encountered at foundation grades, other foundation alternatives are strongly recommended.
- The on-site soils and bedrock, exclusive of topsoil materials, are generally suitable for support of both interior and exterior floor slabs and flatwork. Interior floor slabs constructed on or near low swell potential soils and bedrock are acceptable if the owner understands the risk and consequences of movement. For areas where the swell potential of underlying soils and bedrock is low, floor slabs should be separated from foundations and allowed to move. Interior partition walls should not bear directly on floor slabs but be hung from the structure above and attached to floor slabs using a slip joint to allow vertical movement. Careful preparation of subsoils supporting exterior flatwork sites and pavement and surface drainage control should result in satisfactory performance for these features.
- Practical rig refusal was encountered on hard sandstone bedrock materials in test pits 4 and 11. Based on WSG's previous experience with these materials, we

believe excavations less than 10 feet in depth should be feasible using conventional heavy-duty excavation equipment in good working condition and with ripper teeth.

- Although groundwater was not encountered during this investigation, seasonally high runoff events typically create high moisture level conditions at building perimeters. Perimeter drainage systems could be used to reduce potential infiltration of surface runoff and groundwater into under foundation and floor slab areas.

Site Grading Design and Utility Construction

WSG understands unretained cuts and fills of up to approximately 7 feet in height are anticipated for roadway development. Municipal water and sewer utilities are anticipated to be constructed mainly within the roadway rights-of-way. Based on the proposed construction, WSG recommends the following:

1. Based on the results of the subsurface exploration, between approximately 18 and 42 inches feet of topsoil/vegetation and silt may be encountered along the proposed roadway areas. Topsoil/vegetation and silt should be removed from beneath proposed pavement areas and embankment areas to receive fill.
2. Unretained cuts and fills may be designed and constructed according to the following guidelines shown below in Table A.

Table A

Material Type	Unretained Slope Configuration
Topsoil & Overburden Soils	2(H):1(V)
Sandstone Bedrock	1(H):1(V)

3. Steeper slopes are feasible in competent bedrock materials; however, shallow sloughing is common in newly completed cut slopes prior to establishment of vegetation, especially where hard bedrock materials are present.
4. Shallower (less steep) slopes than those given above are also often desirable to help facilitate revegetation efforts.
5. Fill materials may consist of on-site materials exclusive of topsoil/vegetation and 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 (ASTM D698). All fills should be benched or keyed into hillsides exceeding 25 percent grade using minimum 4-foot benches.

6. Proper drainage should be provided and maintained around all cuts, fills, and roadway surfaces. Areas of concentrated drainage should either be piped or otherwise protected from erosion using riprap or other appropriate methods.
7. Subsoil and bedrock materials should be suitable for use in utility trench backfill. The materials will likely require moisture conditioning (adding moisture or drying out) to attain minimum compaction requirements. Soil moisture conditions are expected to vary considerably based on precipitation and runoff conditions at the time of construction. WSG recommends utility trench backfill be uniformly placed and compacted to at least 95% of the maximum standard Proctor density within 2% of optimum moisture content (ASTM D698).
8. All disturbed areas should be protected from erosion by revegetation or other appropriate means.

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 exploration provide an indication of subsurface conditions at the test pit sites 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 excavation. 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 or other experienced geotechnical engineers should also be retained to provide testing and observation services during construction to help evaluate compliance with project plans and specifications.

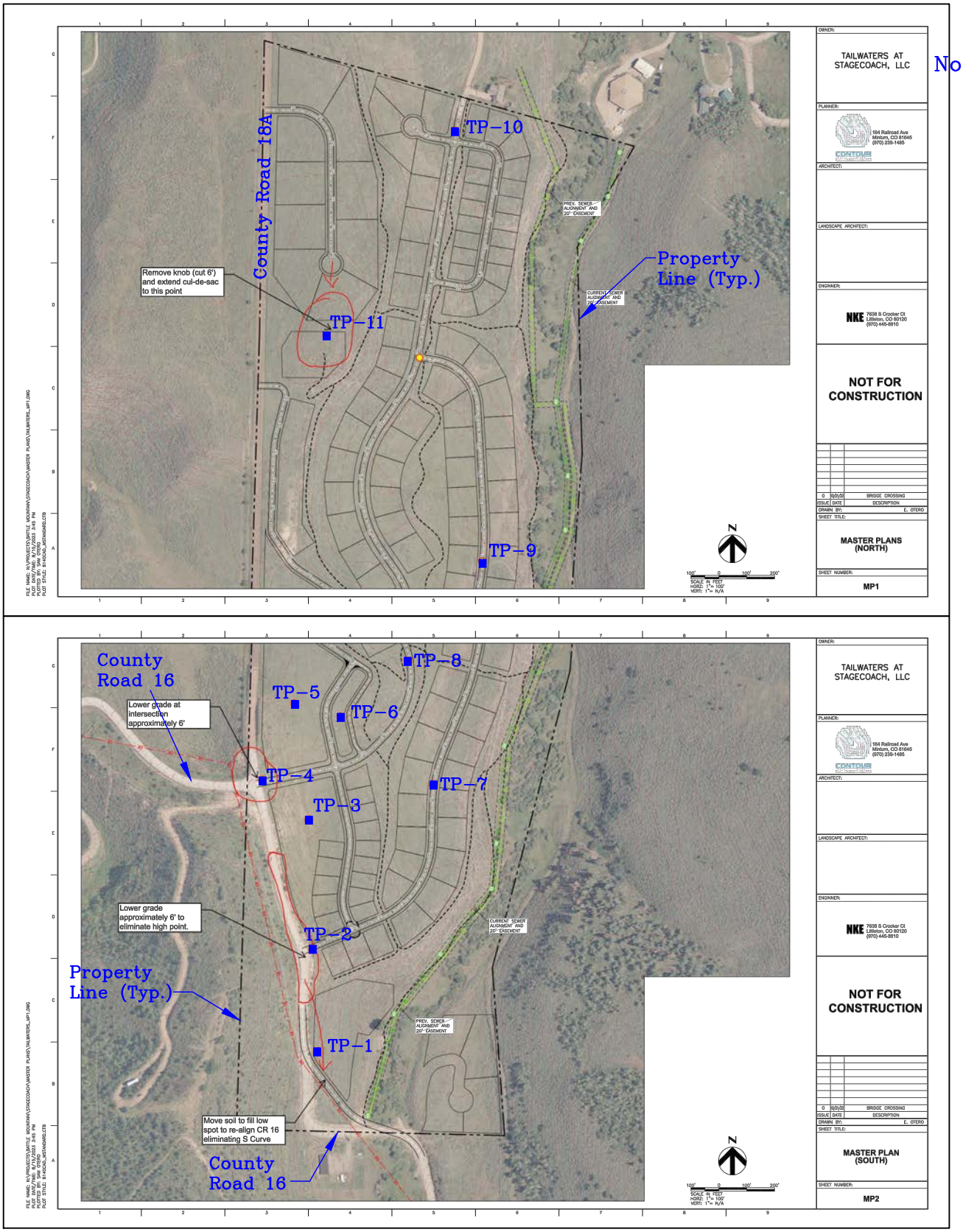
This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with the generally accepted standard of care for the profession. No warranties express or implied, are made. The conclusions and recommendations contained in this report should not be considered valid in the event that 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

Cc: Tim McGuire – Contour Design Collective



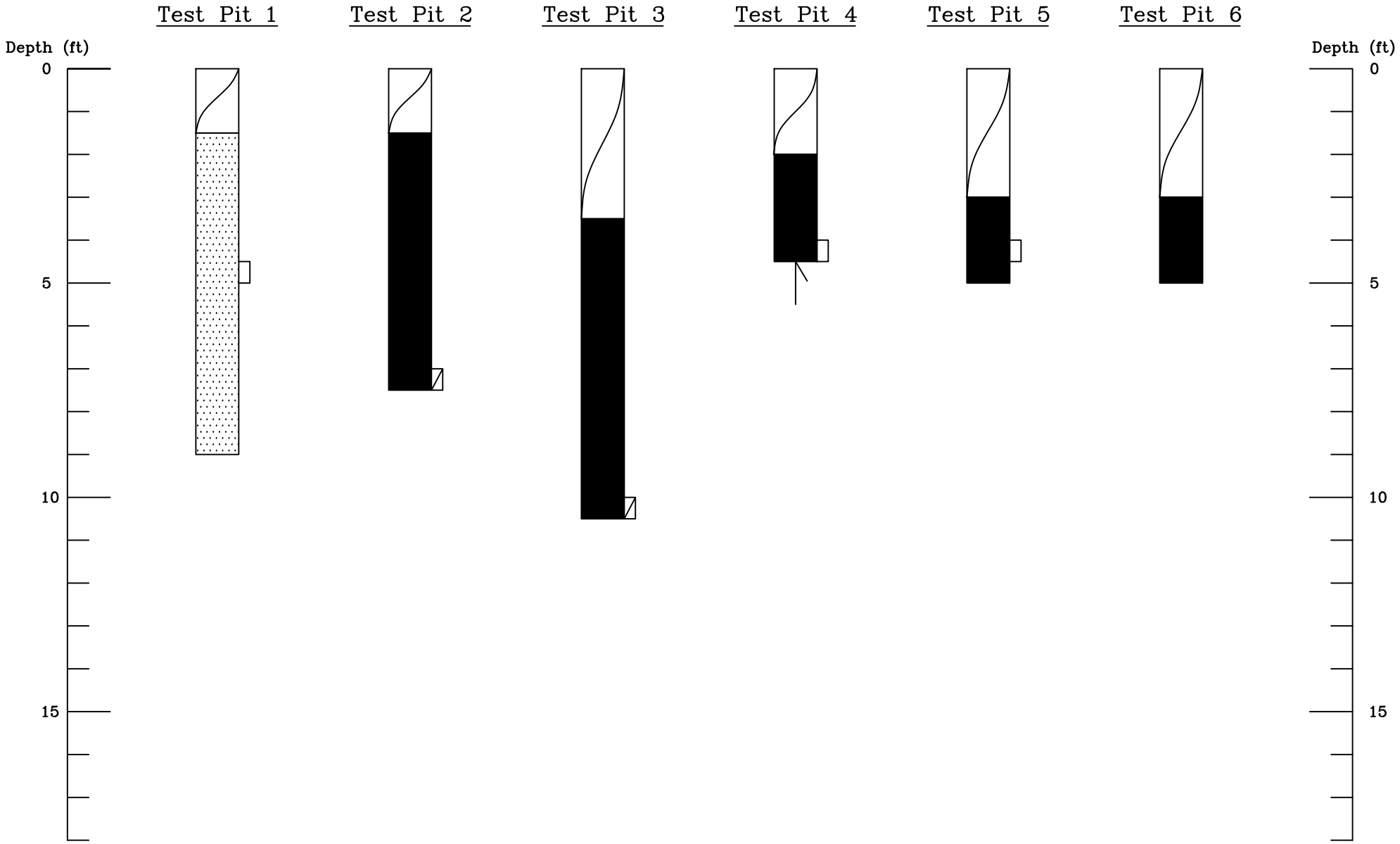
SITE PLAN/LOCATION OF TEST PITS

Project Name: Tailwaters at Stagecoach

Location: Routt County, CO

WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO

Project No.: 23-1076	Drawn/Checked:HS
Date: 10/26/23	Figure No.: 1



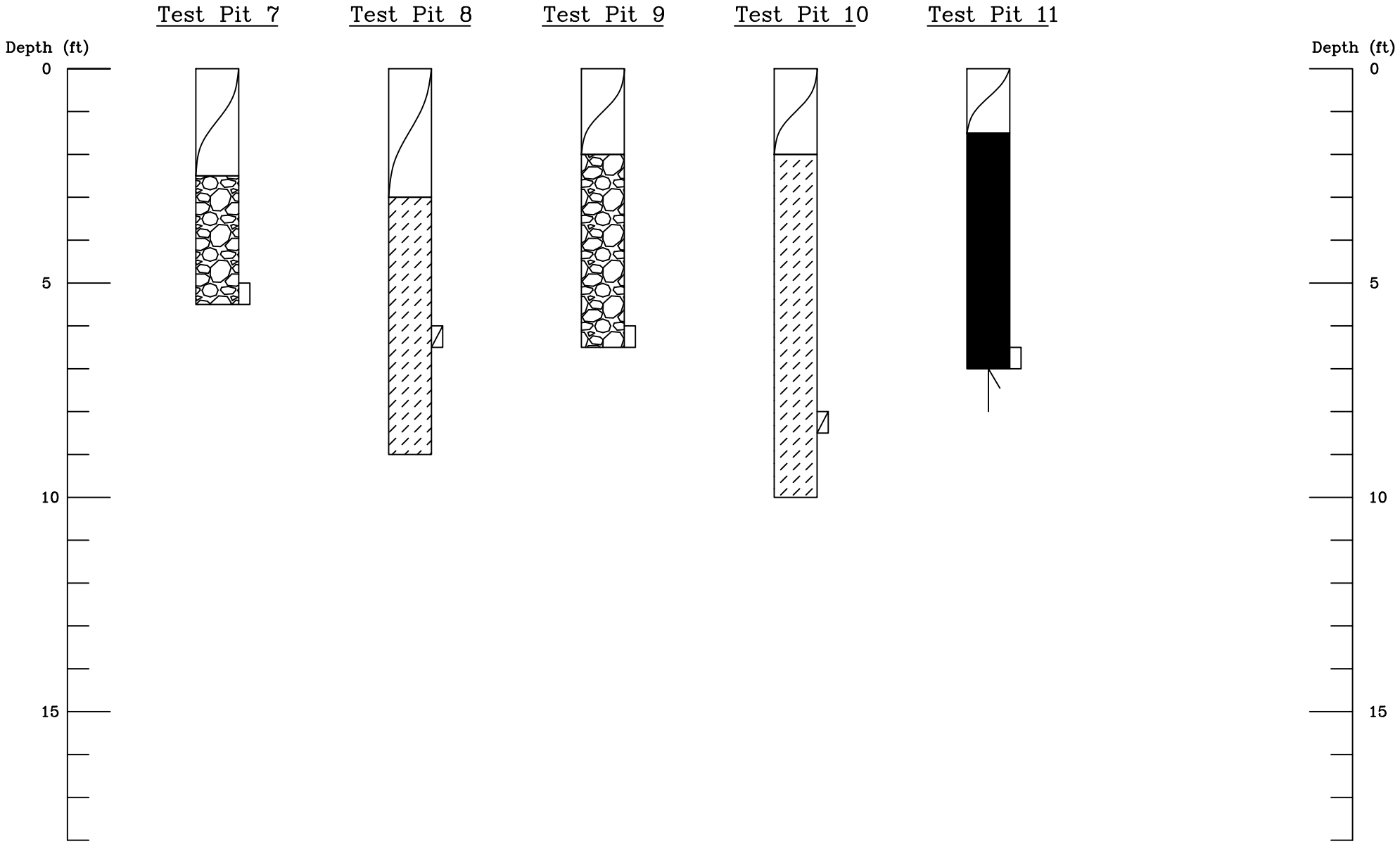
LOGS OF EXPLORATORY TEST PITS

Project Name: Tailwaters at Stagecoach

Location: Routt County, CO

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Project No.: 23-1076	Drawn/Checked: HS/HS
Date: 10/26/23	Figure No.: 2



LOGS OF EXPLORATORY TEST PITS

Project Name: Tailwaters at Stagecoach

Location: Routt County, CO

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Project No.: 23-1076	Drawn/Checked: HS/HS
Date: 10/26/23	Figure No.: 3

Legend

TOPSOIL & ORGANICS.

LEAN CLAY: Sandy to very sandy, low plastic, stiff, moist and light brown.

SAND: Very silty to sand and silt, non–plastic, medium dense, fine grained, moist and light brown.

GRAVEL: Sandy and slightly silty, non–plastic, medium dense, moist and brown.

SANDSTONE: Very silty to sandstone–siltstone, low to non–plastic, weathered to very hard, fine grained, lightly to well cemented, moist and light brown to tan.

Hand Drive Sample – California liner sample.

Small disturbed bag sample.

Depth at which practical rig refusal was encountered.

Notes

1) Test pits were excavated on October 10, 2023 with a Cat 315 trackhoe.

2) Test pit locations were determined by the client and are shown approximately on the site plan provided.

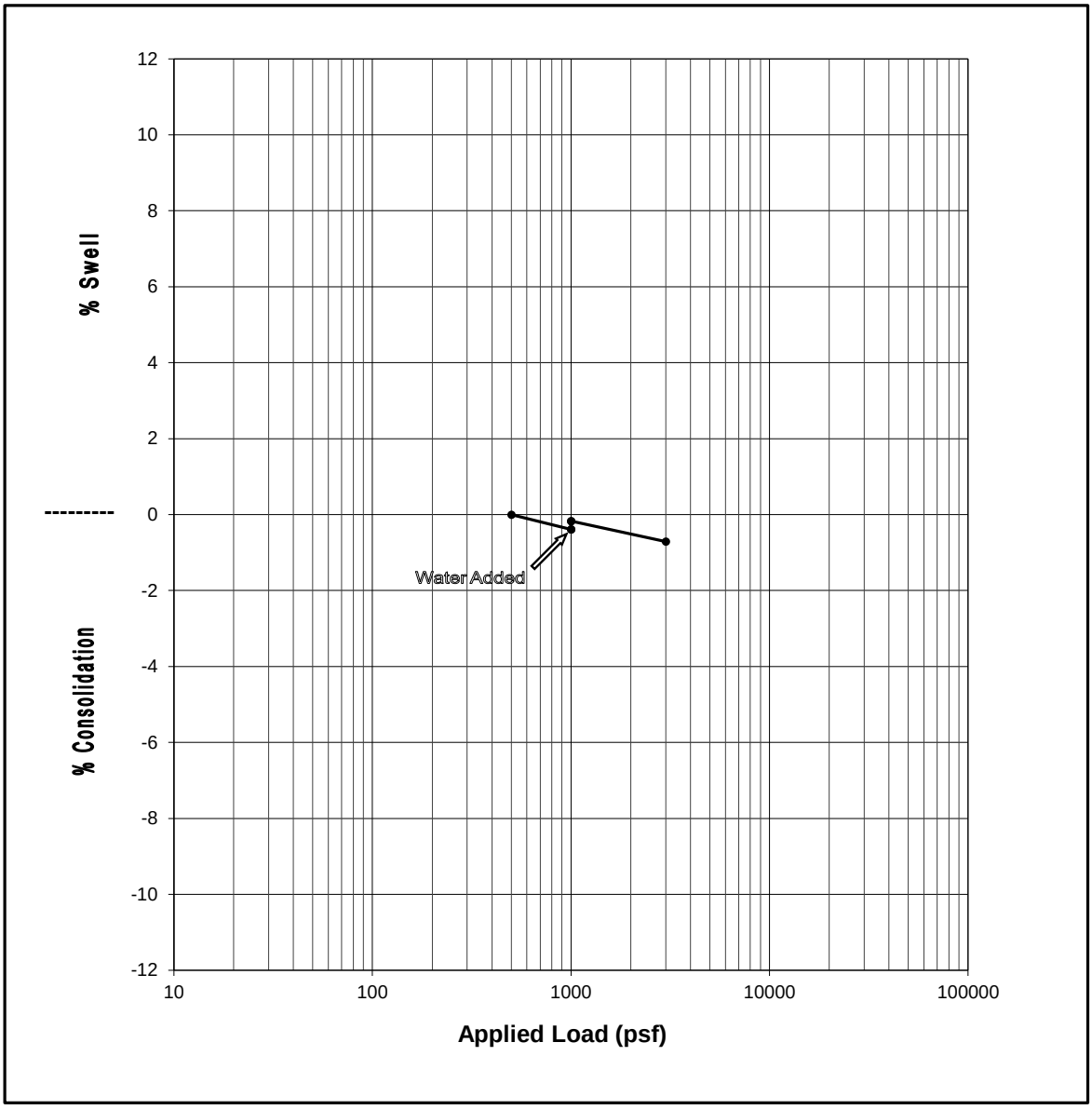
3) Test pit and hole elevations were not determined and logs are drawn to the depths explored.

4) Lines between materials types indicated on the test pit and hole logs are approximate and transitions may be gradual.

LEGEND & NOTES

Project Name: Tailwaters at Stagecoach	WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO	
Location: Routt County, CO	Project No.: 23–1076	Drawn/Checked:HS/HS
	Date: 10/26/23	Figure No. 4

SWELL/CONSOLIDATION TEST SUMMARY

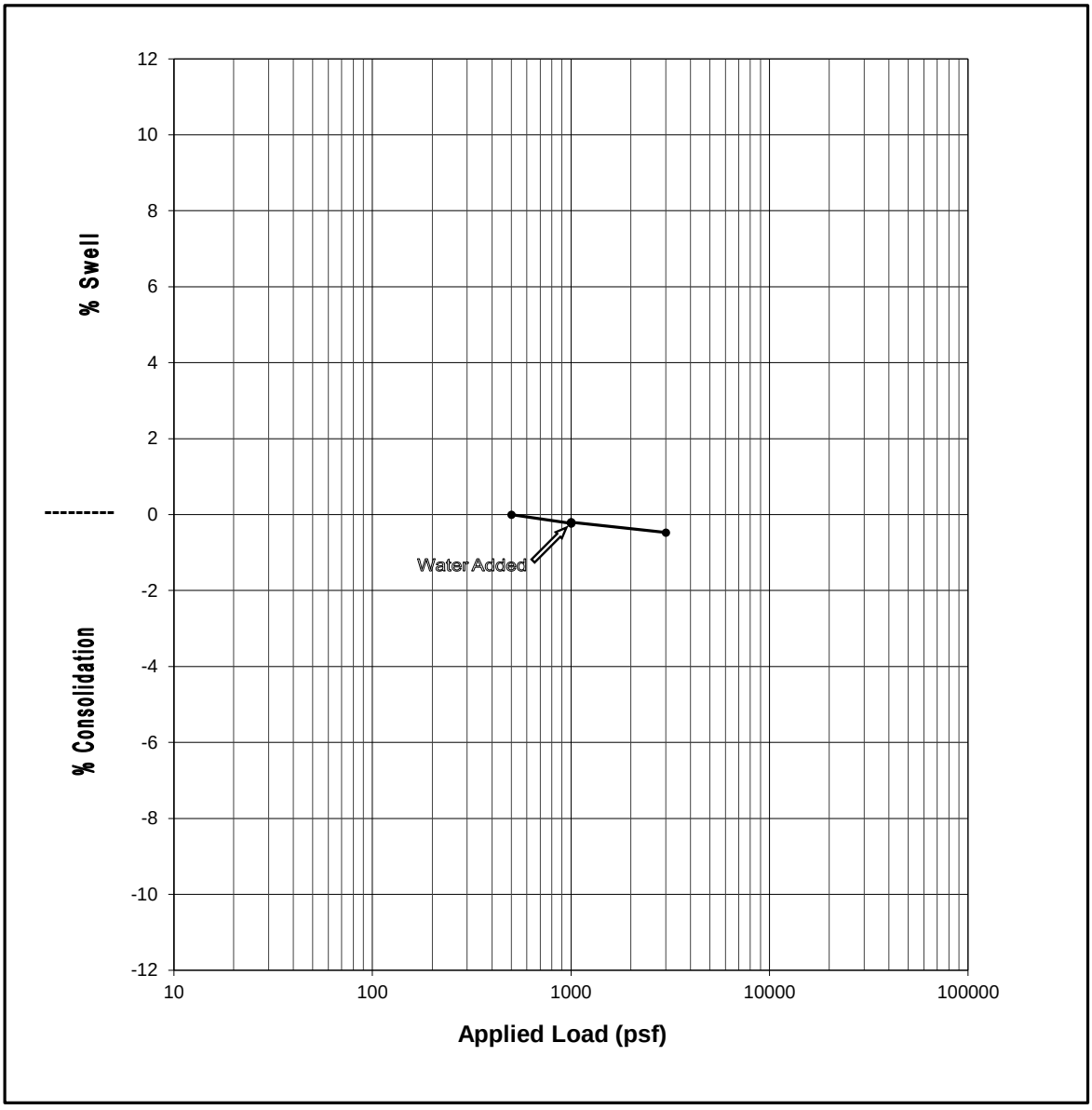


Sample ID: TP-2 @ 7'			
Sample Description: Sandstone (SM)			
Initial Moisture	15.9%	Liquid Limit	NV
Final Moisture	30.6%	Plasticity Index	NP
% Swell @ 1000 psf	0.2%	% Passing #200	38.2%
Swell Pressure	1,500 psf	Dry Density	82.9 pcf

Project Name: Tailwaters at Stagecoach	Project No.: 23-1076
Location: Routt County, CO	Date: 10/24/23
Drawn/Checked: HS/HS	Figure No. : 5

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

SWELL/CONSOLIDATION TEST SUMMARY

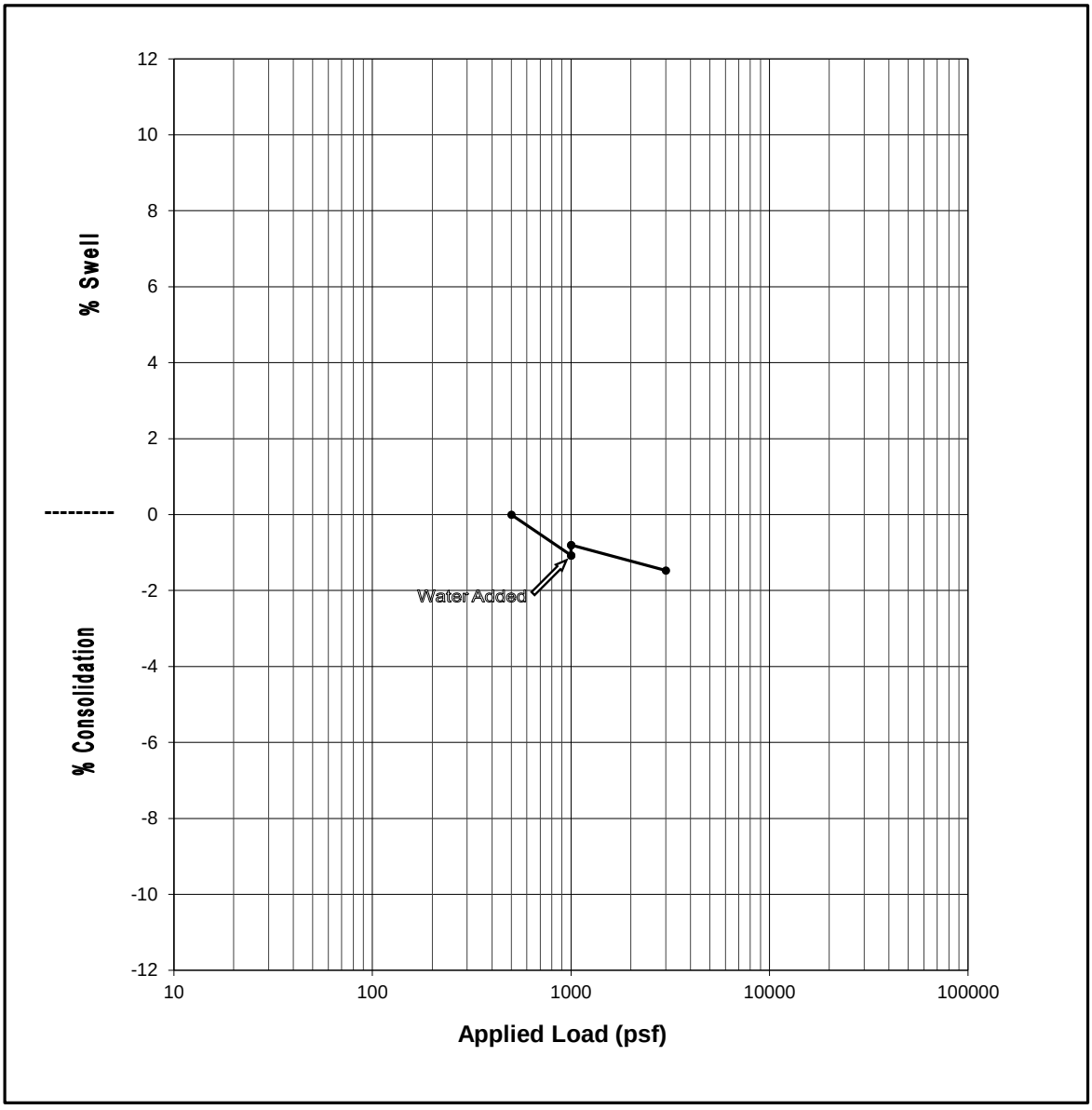


Sample ID: TP-3 @ 9 1/2'			
Sample Description: Sandstone (SM)			
Initial Moisture	10.5%	Liquid Limit	NV
Final Moisture	24.7%	Plasticity Index	NP
% Swell @ 1000 psf	0.0%	% Passing #200	34.8%
Swell Pressure	<1,000 psf	Dry Density	94.5 pcf

Project Name: Tailwaters at Stagecoach	Project No.: 23-1076
Location: Routt County, CO	Date: 10/24/23
Drawn/Checked: HS/HS	Figure No. : 6

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

SWELL/CONSOLIDATION TEST SUMMARY

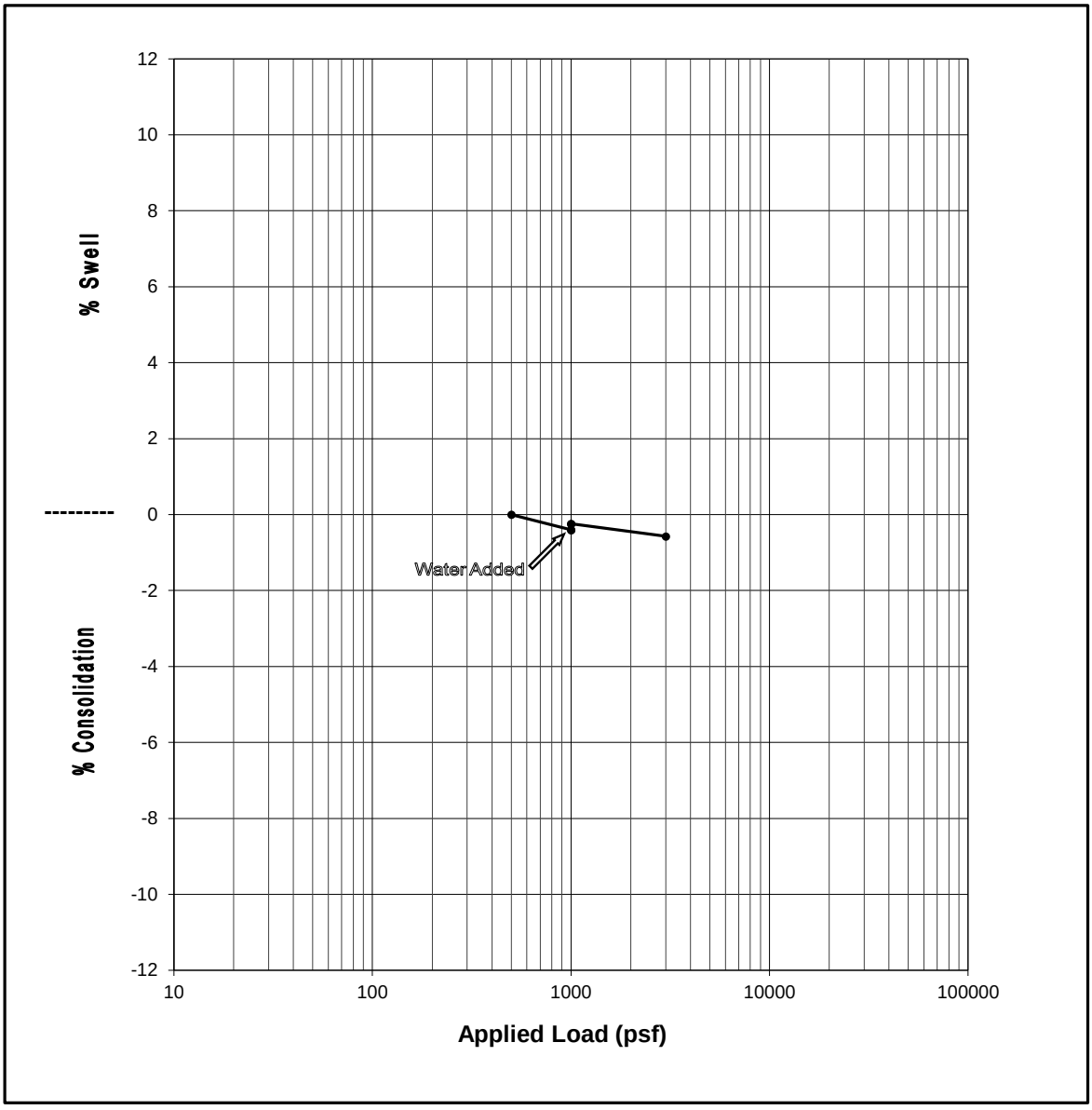


Sample ID: TP-8 @ 6'			
Sample Description: Very Sandy Clay (CL)			
Initial Moisture	22.7%	Liquid Limit	26
Final Moisture	20.5%	Plasticity Index	8
% Swell @ 1000 psf	0.3%	% Passing #200	61.6%
Swell Pressure	1,500 psf	Dry Density	99.5 pcf

Project Name: Tailwaters at Stagecoach	Project No.: 23-1076
Location: Routt County, CO	Date: 10/24/23
Drawn/Checked: HS/HS	Figure No. : 7

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: TP-10 @ 8'			
Sample Description: Sandy Clay (CL)			
Initial Moisture	16.5%	Liquid Limit	26
Final Moisture	29.8%	Plasticity Index	5
% Swell @ 1000 psf	0.2%	% Passing #200	73.7%
Swell Pressure	1,800 psf	Dry Density	84.8 pcf

Project Name: Tailwaters at Stagecoach	Project No.: 23-1076
Location: Routt County, CO	Date: 10/24/23
Drawn/Checked: HS/HS	Figure No. : 8

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Table 1
Summary of Laboratory Test Results

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Project No.: 23-1076

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	4 1/2-5 1/2	11.4	-	0	49	51	NV	NP			Sandstone-Siltstone	SM-ML	
TP-2	7	15.9	82.9	0	62	38	NV	NP	0.2	1500	Sandstone	SM	
TP-3	9 1/2	10.5	94.5	0	65	35	NV	NP	0.0	<1000	Sandstone	SM	
TP-4	4	15.3	-	0	54	46	NV	NP			Sandstone-Siltstone	SM-ML	
TP-5	4-5	12.5	-	0	49	51	23	4			Sandstone-Siltstone	SM-ML	
TP-7	5	4.9	-	62	31	7	NV	NP			Sandy Gravel	GP	
TP-8	6	22.7	99.5	0	38	62	26	8	0.3	1500	Very Sandy Lean Clay	CL	
TP-9	6	7.7	-	66	23	11	27	5			Silty, Sandy Gravel	GM-GP	
TP-10	8	16.5	84.8	0	26	74	26	5	0.2	2500	Sandy Lean Clay	CL	
TP-11	6 1/2	11.6	-	0	51	49	NV	NP			Sandstone-Siltstone	SM-ML	