SUBSOIL AND FOUNDATION INVESTIGATION
THE WILD BLUE TERMINAL AND RESTAURANT
STEAMBOAT SKI RESORT
STEAMBOAT SPRINGS, COLORADO

Prepared by

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Prepared for

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NWCC Project NO. 19-11550

July 29, 2019

TABLE OF CONTENTS

List of Figures, Tables and Appendices.

1.0 CONCLUSIONS

Based on results of the field and laboratory investigations, NWCC, Inc. (NWCC) recommends the proposed structures be founded on footings placed on the natural sands and clays, sands and gravels, bedrock materials and/or properly compacted structural fill materials placed on the natural soils and bedrock materials.

2.0 PURPOSE AND SCOPE OF WORK

This report presents the results of the Subsoil and Foundation Investigation completed for the proposed Wild Blue Gondola Terminal and Restaurant, to be located south of Burgess Creek Road and within the Steamboat Ski Resort. The approximate location of the project site is shown in Figure #1.

The scope of our work included obtaining data from a visual inspection of the site; the excavation of eight (8) test pits; sampling of the soils and bedrock materials, and the laboratory testing of the samples obtained. This report summarizes the results of the field investigation and the laboratory test results, as well as our recommendations for foundation design, floor slabs, foundation walls and site grading based on our understanding of the proposed construction and the subsurface conditions encountered.

3.0 PROPOSED CONSTRUCTION

NWCC understands the proposed construction will consist of a restaurant/ski school building and gondola terminal/midway station. NWCC has assumed the lower levels of the buildings will be constructed with concrete slab-on-grade floor systems placed near or below the existing ground surface. We have assumed the loads generated by the proposed building structures will be moderate, typical of this type of commercial construction.

Site grading, roadway and utility construction will be required. NWCC understands that proposed cuts and fills for the site will be on the order of 5 to 15 feet or less and that the eastern portion of the site will be cut while the western portion will be filled.

4.0 SITE CONDITIONS

The project site is located south of Burgess Creek Road and north of the existing Bashor Lift Station at the Steamboat Ski Resort in Steamboat Springs, Colorado.

The site currently consists of vacant land with a bike trail running through it. Topography of the site generally slopes moderately to strongly down to the west on the order of 8 to 12 percent.

Vegetation at the site consists of deciduous bushes, grasses, wildflowers and occasional pine tree saplings and young aspen trees. It appears that numerous beetle-killed pine trees had been cut down at the site in the past.

5.0 FIELD INVESTIGATION

The field investigation was conducted on July 9, 2019. Eight (8) test pits were excavated at the approximate locations shown in Figure #2 using a CAT 320 E trackhoe provided by the client. Test pits were logged, and samples were obtained at the time of excavation by an engineer from NWCC. Graphic logs of the exploratory test pits are shown in Figure #3, and associated Legend and Notes are shown in Figure #4.

6.0 LABORATORY INVESTIGATION

Samples obtained from the test pits were examined and classified in the laboratory by the project engineer. Laboratory testing included standard index property tests including natural densities and moisture contents, dry unit weights, grain size analyses and Atterberg limits. Swell-consolidation testing was also conducted on relatively undisturbed samples of the probable foundation soils and bedrock materials. Swell-consolidation test results are shown in Figures #5 through #9 and the results are discussed in the following section. Standard Proctor Testing was conducted on a sample of probable materials to be used as fill and the results are shown in Figure #10. Results of the laboratory testing are summarized in the attached Table #1. Laboratory testing was conducted in general accordance with applicable ASTM specifications.

7.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered in the test pits were variable and generally consisted of a layer of natural topsoil and organic materials overlying natural sands and clays or sands and gravels overlying sandstone or granite bedrock to the maximum depth investigated, 13 feet beneath existing ground surface (bgs).

A layer of natural topsoil and organic materials, ranging from approximately 12 to 18 inches in thickness, was encountered at the ground surface in all test pits. The natural topsoil and organic materials were silty and sandy, very low plastic, dry to moist and dark brown in color.

Sands and clays were encountered beneath the topsoil and organic materials in Test Pits 1, 5, 6, 7, and 8 and extended to 5, 12, 6, 9 and 5 feet bgs, respectively. The sands and clays were slightly silty to silty, fine to coarse grained with occasional sandstone and schist bedrock fragments, very low to low plastic, medium dense to stiff, slightly moist to moist and brown to tan in color. Samples of the sands and clays classified as CL, SC and SC-SM soils in accordance with the Unified Soil Classification System (USCS).

Sandstone bedrock was encountered beneath the sands and clays in Test Pits 1, 6, 7 and 8 and extended to the maximum depths investigated in each test pit. The sandstone bedrock was of the Browns Park Formation, was silty to clayey to very clayey, fine to coarse-grained with occasional gravel-sized clasts, low plastic, slightly weathered to hard and tan in color. Samples of the sandstone bedrock classified as CL-SC, SM and SC soils in accordance with the USCS.

Sands and gravels were encountered beneath the topsoil and organic materials in Test Pit 2 and extended to the maximum depth investigated, 13 feet bgs. The sands and gravels were slightly silty to silty, fine to coarse-grained with occasional cobbles, very low to non-plastic, dense to very dense, moist and brown in color. A sample of the sands and gravels classified as an SM soil in accordance with the USCS.

Crystalline bedrock was encountered beneath the topsoil and organics in Test Pits 3 and 4 and extended to the maximum depths investigated in each test pit. It should be noted that refusal on very hard crystalline bedrock was encountered at 7 feet bgs in Test Pit 4. The crystalline bedrock consisted of schist and gneissic granite, was fine to coarse-textured, non-plastic, weathered to very hard, slightly moist, brown to reddish brown to gray to black and white. Samples of the crystalline bedrock classified as SM and SM-GM soils in accordance with the USCS.

Swell-consolidation testing conducted on samples of the sands and clays indicate the materials tested will exhibit a low to nil swell potential and low consolidation when wetted under a constant load. The swell-consolidation test results are shown in Figures #5 through #9, and all the other test results are summarized in the attached Table 1. A summary of the swell test results is shown in Table A below.

TABLE A
SUMMARY OF SWELL TEST RESULTS

Soil Type	Consolidation	Range of Swell (%)			
	<0	Low 0 to <2	Moderate 2 to <4	High 4 to <6	Very High >6
	Number of Samples and Percent				
Natural Sands and Clays	1	4	0	0	0
Percent	20%	80%	0%	0%	0%

Groundwater seepage was not encountered in any of the test pits at the time of excavation and no signs of a seasonal high groundwater table were observed. It should be noted that the groundwater conditions at this site can be expected to fluctuate with precipitation and seasonal runoff.

Based on the subsurface conditions encountered at the site, the laboratory test results and our review of the available literature, NWCC recommends that a Site Class C be used for the foundation designs in accordance with Table 20.3-1 in Chapter 20 of ASCE 7-10.

8.0 FOUNDATION RECOMMENDATIONS

Based on the results of the field and laboratory investigations and our experience with similar projects, NWCC believes a safe and economical foundation system will consist of spread footings or individual pads with grade beams founded on the sands and clays, sands and gravels, underlying bedrock materials or on properly compacted structural fill materials overlying the sands and clays, sands and gravels or underlying bedrock materials.

The precautions and recommendations itemized below will not prevent the movement beneath the foundation if the underlying sands and clays or bedrock materials swell. However, they should reduce the amount of differential movement beneath the foundation system.

1) Footings placed on the undisturbed natural sands and clays, sands and gravels, bedrock materials or on properly compacted structural fill materials should be designed using an allowable soil bearing pressure of 3,000 psf. Based on the swell-potential of the natural sands and clays and sandstone bedrock materials, the footings should also be designed for a minimum dead load pressure of at least 600 psf.

2) Any topsoil and organic materials or loose and soft natural soils found beneath the footings should be removed and footings extended down to the natural sands and clays, sands and gravels or bedrock materials prior to structural fill or concrete placement. Structural fill materials must consist of a non-expansive granular soil approved by NWCC. Structural fill materials should be uniformly placed and compacted in 6 to 8 inch loose lifts and compacted to at least 100% of the maximum standard Proctor density and within 2% of the optimum moisture content determined in accordance with ASTM D698 or 80% of the maximum relative density if screened or washed gravels are used as structural fill. Structural fill materials should extend out from the edge of the footings on a 1(horizontal) to 1(vertical) or flatter slope.

3) Footings may have to be narrow or interrupted to maintain the minimum dead load. The foundation design should be closely checked to assure that it distributes the loads per the allowable pressures given.

4) Foundation walls should be designed and reinforced to span an unsupported distance of 10 feet or the length between pads, whichever is greater.

5) Footings or pads should be placed well enough below final backfill grades to protect them from frost heave. Forty-eight (48) inches is typical for this location considering normal snow cover and other winter factors.

6) Based on experience, we estimate the total settlement for footings and pads designed and constructed as discussed in this section will be approximately 1 inch. Additional bearing capacity values along with the associated settlements are presented in Figure #11.

7) We strongly recommend that the client retain NWCC to observe the foundation excavations when they are near completion to identify the bearing soils and confirm the recommendations in this report, as well as test the structural fill materials placed beneath the foundations for compaction.

9.0 FLOOR SLAB RECOMMENDATIONS

NWCC has assumed the proposed buildings will be constructed with concrete slab-on-grade floor systems placed near or below the existing ground surface. On-site soils, apart from the topsoil and organic materials, are capable of supporting slab-on-grade construction. However, floor slabs present a very difficult problem where swelling materials are present near floor slab elevation because sufficient dead load cannot be imposed on them to resist the uplift pressure generated when materials are wetted and expand.

If the client elects to construct concrete slab-on-grade floor systems, we recommend the following special design and construction precautions be followed so that the amount of movement in the floor slabs can be reduced if the sands and clays or sandstone bedrock materials become wetted and swell.

1) Floor slabs should be separated from all bearing walls, columns and their foundation supports with a positive slip joint. We recommend the use of ½-inch thick cellotex or impregnated felt.

2) Interior non-bearing partition walls resting on the floor slabs should be provided with a slip joint, preferably at the bottom, so that in the event the floor slab moves, this movement is not transmitted to the upper structure. This detail is also important for wallboard and doorframes and is shown in Figure #12.

3) A minimum 6-inch gravel layer should be provided beneath all floor slabs to act as a capillary break and to help distribute pressures. Prior to placing the gravel, the excavation should be shaped so that if water does get under the slab, it will flow to the low point of the excavation. In addition, all the topsoil and organic materials and any existing fill materials should be removed prior to placement of the underslab gravels or new structural fill materials.

4) Floor slabs should be provided with control joints placed a maximum of 10 to 12 feet on center in each direction, depending on slab configurations, to help control shrinkage cracking. The location of the joints should be carefully checked to assure that the natural, unavoidable cracking will be controlled. The depth of the control joints should be a minimum of ¼ the thickness of the slab.

5) Underslab soils should be kept as close as possible to their in-situ moisture content. Excessive wetting or drying of these soils prior to placement of the floor slab could result in differential movement after the slabs are constructed.

6) It has been our experience that the risk of floor slab movement can be reduced by removing at least 2 feet of the expansive materials and replacing them with a well compacted, non-expansive

fill. If this is done, or if fills are required to bring the underslab soils to the desired grade, the fill should consist of non-expansive, granular materials. The fill should be uniformly placed and compacted in 6 to 8-inch lifts to at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698.

The above precautions and recommendations will not prevent floor slab movement in the event the sands and clays or sandstone bedrock materials beneath the floor slabs undergo moisture changes. However, they should reduce the amount of damage if such movement occurs. The only way to eliminate the risk of all floor slab movement is to construct a structural floor over a well-vented crawl space or void form materials.

10.0 PERIMETER DRAINAGE SYSTEM RECOMMENDATIONS

Any floor levels or crawl space areas constructed below the existing or finished ground surfaces and the foundations should be protected by underdrain systems to help reduce the problems associated with surface and subsurface drainage during high runoff periods.

Localized perched water or runoff can infiltrate the lower levels of the structures at the foundation levels. This water can be one of the primary causes of differential foundation and slab movement, especially where expansive soils and bedrock materials are encountered. Excessive moisture in crawl space areas or lower levels can also lead to rotting and mildewing of wooden structural members and the formation of mold and mold spores. Formation of mold and mold spores could have detrimental effects on the air quality in these areas, which in turn can lead to potential adverse health effects.

Drains should be located around entire perimeter of the lower levels and be placed and at least 12 inches below any floor slab or crawl space levels and at least 6 inches below the foundation voids and bottom of the footings. NWCC recommends the use of perforated PVC pipe for the drainpipe, which meets or exceeds ASTM D-3034/SDR 35 requirements, to minimize potential for pipe crushing during backfill operations. Holes in the drainpipe should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of water. Drainpipes should be surrounded with at least 12 inches of free draining gravel and should be protected from contamination by a filter covering of Mirafi 140N subsurface drainage fabric or an equivalent product. Drains should have a minimum slope of 1/8 inch per foot and be daylighted at positive outfalls protected from freezing or be led to sumps from which water can be pumped. The use of interior laterals, multiple daylights or sumps may be required for the proposed structure. Caution should be taken when backfilling so as not to damage or disturb the installed underdrains. NWCC recommends the drainage systems include a cleanout every 100 feet, be protected against intrusion by animals at outfalls and be tested prior to backfilling. NWCC also recommends the client retain our firm to observe the underdrain systems during construction to verify that they are being installed in accordance with recommendations provided in this report and observe a flow test prior to backfilling the system.

Additionally, NWCC recommends an impervious barrier be constructed to keep water from infiltrating through the voided areas and/or under the foundation walls or footings. Barrier should be constructed of

an impervious material, which is approved by this office and placed below the perimeter drain and up against the sides of the foundation walls. A typical perimeter/underdrain detail is shown in Figure #13.

Placement of and impervious membrane and/or properly compacted clays in crawl space areas to the top of the footings or at least 12 inches above the top of the foundation voids or bottom of the foundation walls should help reduce the moisture problems in these areas.

11.0 FOUNDATIONS WALLS AND RETAINING STRUCTURE RECOMMENDATIONS

Foundation walls and retaining structures, which are laterally supported and can be expected to undergo only a moderate amount of deflection (at rest), may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for imported, free draining granular backfill and 55 pcf for the on-site soils and bedrock materials.

Cantilevered retaining structures on the site can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, cantilevered structures may be designed for a lateral earth pressure computed based on an equivalent fluid unit weight of 35 pcf for imported, free draining granular backfill and 45 pcf for the on-site soils and bedrock materials.

Foundation walls and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials. An upward sloping backfill and/or natural slope will also increase the earth pressures on foundation walls and retaining structures.

NWCC recommends imported granular soils for backfilling foundation walls and retaining structures because their use results in lower lateral earth pressures. The imported granular materials should be placed to within 2 to 3 feet of the ground surface. Imported granular soils should be free draining and have less than 7 percent passing the No. 200 sieve. The granular soils behind foundation and retaining walls should be sloped from the base of the wall at an angle of at least 45 degrees from the vertical. The upper 2 to 3 feet of fill should be a relatively impervious soil or pavement structure to prevent surface water infiltration into the backfill.

Wall backfill should be carefully placed in uniform lifts and compacted to at least 95 % of the maximum standard Proctor density and within 2% of the optimum moisture content. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill materials will occur even if the material is placed correctly.

12.0 SITE DRAINAGE RECOMMENDATIONS

Proper surface drainage at the site is of paramount importance for minimizing the infiltration of surface drainage into the wall backfill and bearing soils, which could result in increased wall pressures, differential foundation and slab movement. The following drainage precautions should be observed during construction and at all times after the structures have been completed:

1) Ground surface surrounding the structures should be sloped (minimum of 1.0 inch per foot) to drain away from the structures in all directions to a minimum of 10 feet. Ponding must be

avoided. If necessary, raising the top of foundation walls to achieve a better surface grade is advisable.

2) Non-structural backfill placed around the structures should be compacted to at least 95% of the maximum standard Proctor density at or near the optimum moisture content in order to minimize future settlement of the fill. Backfill should be placed immediately after the braced foundation walls are able to structurally support the fill. Puddling or sluicing must be avoided.

3) Top 2 to 3 feet of soil placed within 10 feet of the foundations should be impervious in nature to minimize infiltration of surface water into the wall backfill.

4) Roof downspouts and drains should discharge well beyond the limits of all backfill. Roof overhangs, which project two to three feet beyond the foundations, should be considered if gutters are not used.

5) Landscaping, which requires excessive watering and lawn sprinkler heads, should be located a minimum of 10 feet from the foundation walls of the structures.

6) Plastic membranes should not be used to cover the ground surface adjacent to foundation walls.

13.0 SITE GRADING RECOMMENDATIONS

Slopes on which the proposed structures and access roads are proposed could become unstable as a result of the proposed construction. Design and construction considerations must be addressed to avoid and/or limit the potential for slope instability at the site. Although a detailed slope stability analysis is beyond the scope of this report, some general guidelines are provided below for initial planning and design. Our office should review the construction plans as they are being prepared so that we can verify that our recommendations are being properly incorporated into the plans.

1) Slopes greater than 25 percent should be avoided whenever possible for construction of permanent roads and structures.

2) Temporary cuts for foundation construction should be constructed to OSHA standards for temporary excavations. Permanent, unretained cuts for roadways or building sites should be kept as shallow as possible and should not exceed a 3(Horizontal) to 1(Vertical) or flatter configuration for the topsoil and organic materials and a 2(Horizontal) to 1(Vertical) or flatter configuration for the underlying overburden soils and weathered bedrock materials. We recommend these cuts be limited to 10 feet in height or less unless stable bedrock is encountered. The risk of slope instability will be significantly increased if groundwater seepage is encountered in the cuts. NWCC office should be notified immediately to evaluate the site if seepage is encountered or deeper cuts are planned and assess whether additional investigations and/or stabilization measures are warranted.

3) Excavating during periods of low runoff at the site can reduce potential slope instability during excavation. Excavations should not be attempted during the spring or early summer when seasonal runoff and groundwater levels are typically high.

4) Fills up to 15 feet in height can be constructed at the site and should be constructed to a 2(Horizontal) to 1(Vertical) configuration. The fill areas should be prepared by stripping any existing fill materials and topsoil and organics, scarification and compaction to at least 95% of the maximum standard Proctor density and within 2% of optimum moisture content as determined by ASTM D698. The fills should be properly benched/keyed into the natural hillsides after the natural topsoil and organic materials have been removed. The fill materials should consist of the on-site soils (exclusive of topsoil, organics or clays) and be uniformly placed and compacted in 6 to 8-inch loose lifts to the minimum density value and moisture content range indicated above.

5) Proper surface drainage features should be provided around all permanent cuts and fills and steep natural slopes to direct surface runoff away from these areas. Cuts, fills and other stripped areas should be protected against erosion by revegetation or other methods. Areas of concentrated drainage should be avoided and may require the use of riprap for erosion control. NWCC recommends that a maximum of 4 inches of topsoil be placed over the new cut and fill slopes. It should be noted that the newly placed topsoil materials may slough/slide off the slopes during the spring runoff seasons until the root zone in the vegetated cover establishes.

6) A qualified engineer experienced in this area should prepare site grading and drainage plans. The contractor must provide a construction sequencing plan for excavation, wall construction and bracing and backfilling for the steeper and more sensitive portions of the site prior to starting the excavations or construction.

14.0 LIMITATIONS

The recommendations provided in this report are based on the subsurface conditions encountered in the test pits advanced across the project site and our understanding of the proposed construction. We believe that this information gives a high degree of reliability for anticipating the behavior of the proposed structures; however, our recommendations are professional opinions and cannot control nature, nor can they assure the soils profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report.

Expansive soils and bedrock materials were encountered at the site. These soils are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of expansive soils and bedrock materials is not fully understood. The swell potential of any site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions which cannot always be predicted. The recommendations presented in this report are based on the current state of the art for foundations and floor slabs on expansive soils and bedrock. The owner should be aware that there is a risk in construction on these types of soil. Performance of the structures will depend on following the recommendations and in proper maintenance after construction is complete. As water is the main

cause for volume change in these soils, it is necessary that the changes in moisture content be kept to a minimum. This requires judicious irrigation and providing positive surface drainage away from the structures. Any distress noted in the structures should be brought to the attention of this office.

This report is based on the investigation at the described site and on the specific anticipated construction as stated herein. If either of these conditions is changed, the results would also most likely change. Therefore, we strongly recommend that our firm be contacted prior to finalizing the construction plans so that we can verify that our recommendations are being properly incorporated into the construction plans. Man-made or natural changes in the conditions of a property can also occur over time. In addition, changes in requirements due to state-of-the-art knowledge and/or legislation do from time to time occur. As a result, the findings of this report may become invalid due to these changes. Therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered. It is the responsibility of the owner or his representative to ensure that the information in this report is incorporated into the plans and/or specifications and construction of the project. It is advisable that a contractor familiar with construction details typically used to dealing with the local subsoils and climatic conditions be retained to build the structures.

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

Sincerely,
NWCC, INC.

Erika K. Hill, E.I.T.
Project Engineer

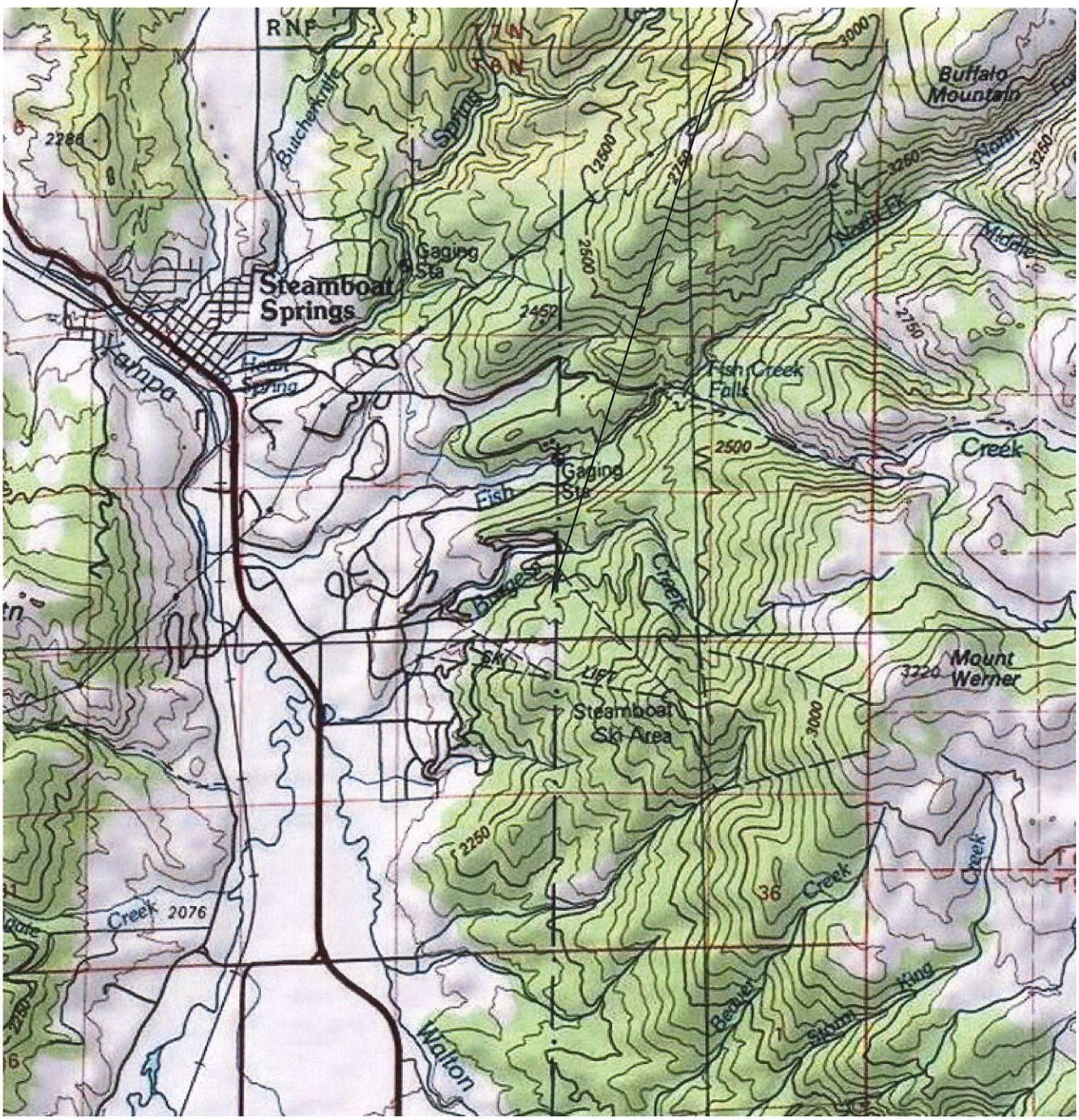
Reviewed by Brian D. Len, P.E.
Principal Engineer

COLORADO LICENSED
BRIAN D. LEN
25750
PROFESSIONAL ENGINEER
7/30/19

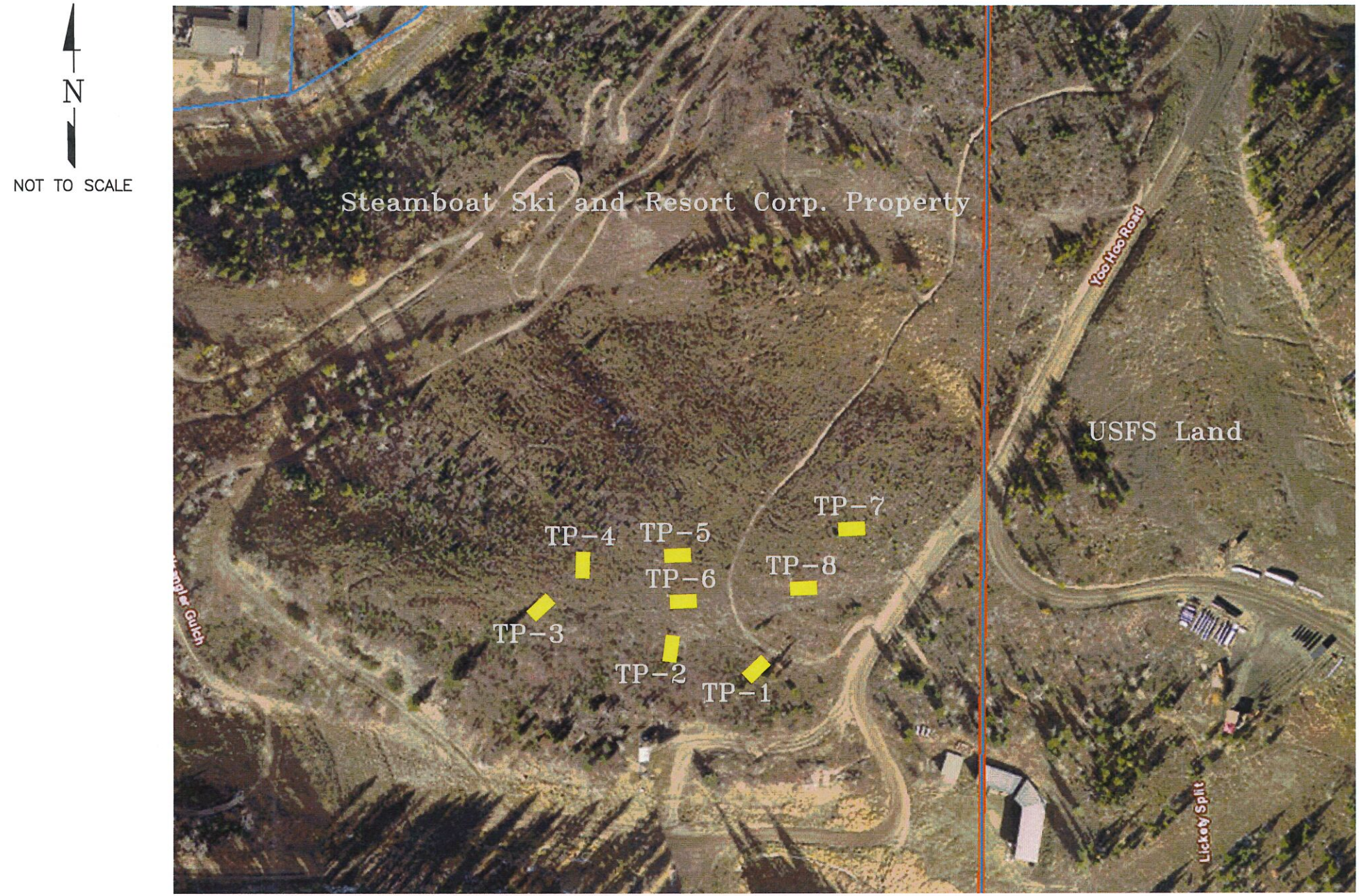
N

NOT TO SCALE

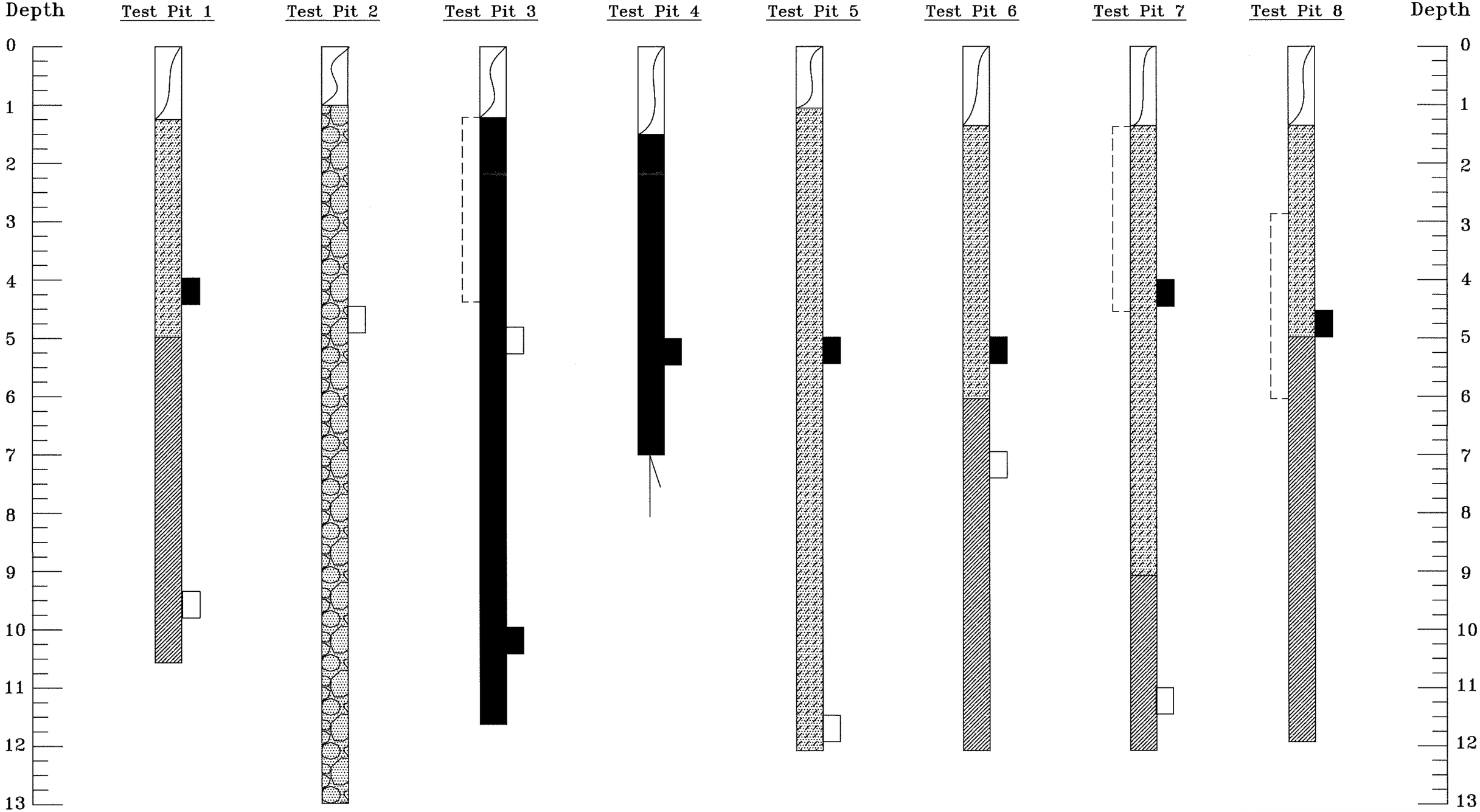
PROJECT SITE



Title: VICINITY MAP	**Date:** 7/17/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing
Job Name: The Wild Blue Terminal and Restaurant	**Job No.** 19-11550	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: Steamboat Ski Resort, Steamboat Springs, CO	**Figure** #1	



Title: SITE PLAN/LOCATION OF TEST PITS		**Date:** 7/17/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: The Wild Blue Terminal and Restaurant		**Job No.** 19-11550	
LOCATION: Steamboat Ski Resort, Steamboat Springs, CO		**Figure** #2	



NWCC
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Title:
Logs of Exploratory Test Pits

Job Name:
The Wild Blue Terminal and Restaurant

Location:
Steamboat Ski Resort, Steamboat Springs, CO

Job No.: 19-11550 | Date: 7/23/19 | Fig. #3

LEGEND:

NATURAL TOPSOIL AND ORGANICS: Silty and sandy, very low plastic, dry to moist and dark brown.

SANDS AND CLAYS: Slightly silty to silty, fine to coarse grained with occasional sandstone and schist bedrock fragments, very low to low plastic, medium dense to stiff, slightly moist to moist and brown to tan.

SANDSTONE BEDROCK: Browns Park Formation, silty to clayey to very clayey, fine to coarse grained with occasional gravel-sized clasts, low plastic, slightly weathered to hard and tan.

SANDS AND GRAVELS: Slightly silty to silty, fine to coarse grained with occasional cobbles, very low to non-plastic, dense to very dense, moist and brown.

CRYSTALLINE BEDROCK: Schist and gneissic granite, fine to coarse-textured, non-plastic, weathered to very hard, slightly moist, brown to reddish brown to gray to black and white.

California Liner Hand Drive Sample.

Small Disturbed Bag Sample

Large Disturbed Sample

Indicates trackhoe refusal on hard bedrock.

NOTES:

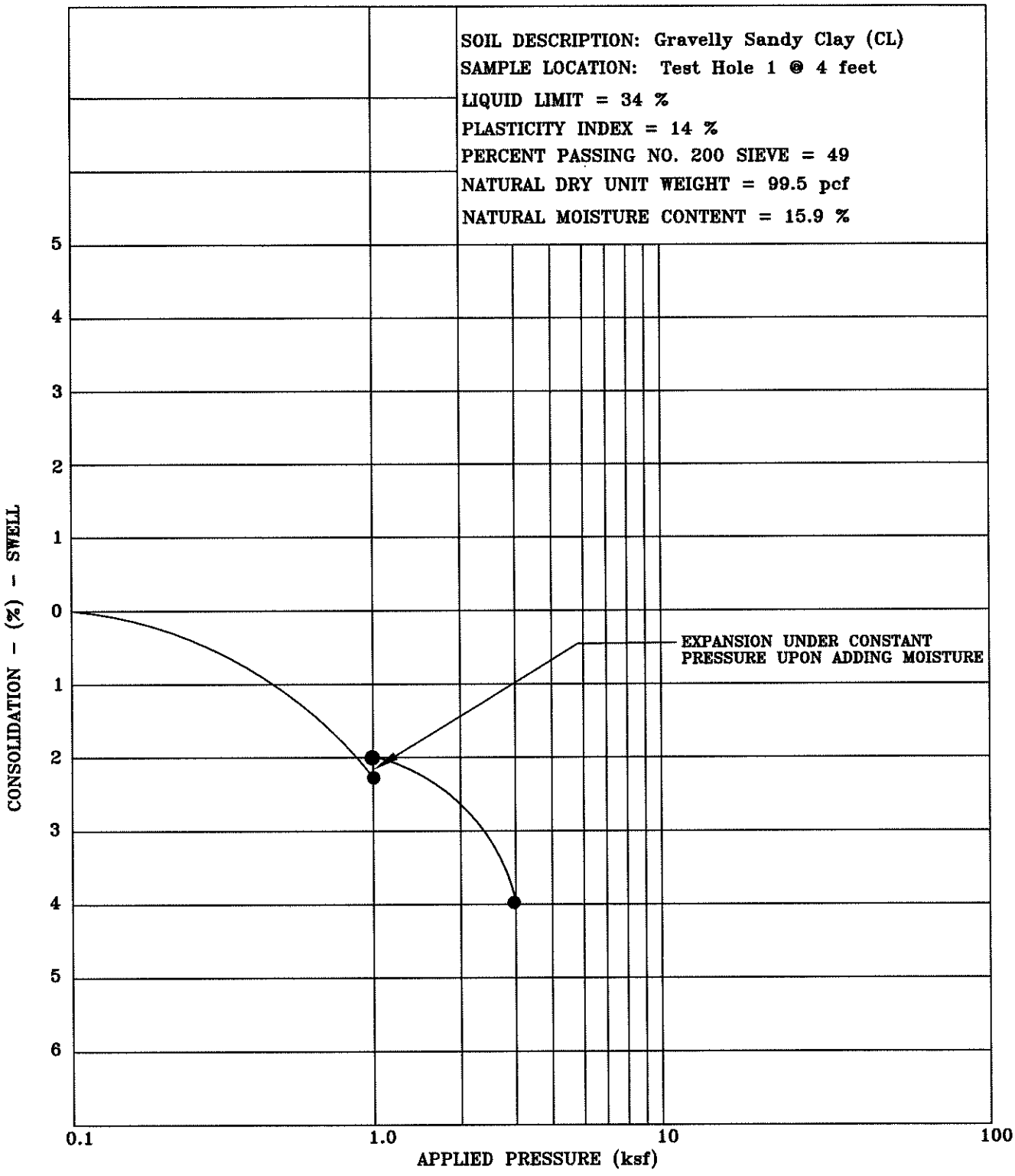
1) Test pits were excavated on July 9, 2019 with a CAT 320 E trackhoe provided by the client.

2) Locations of the test pits were determined in the field by pacing from existing topographic features.

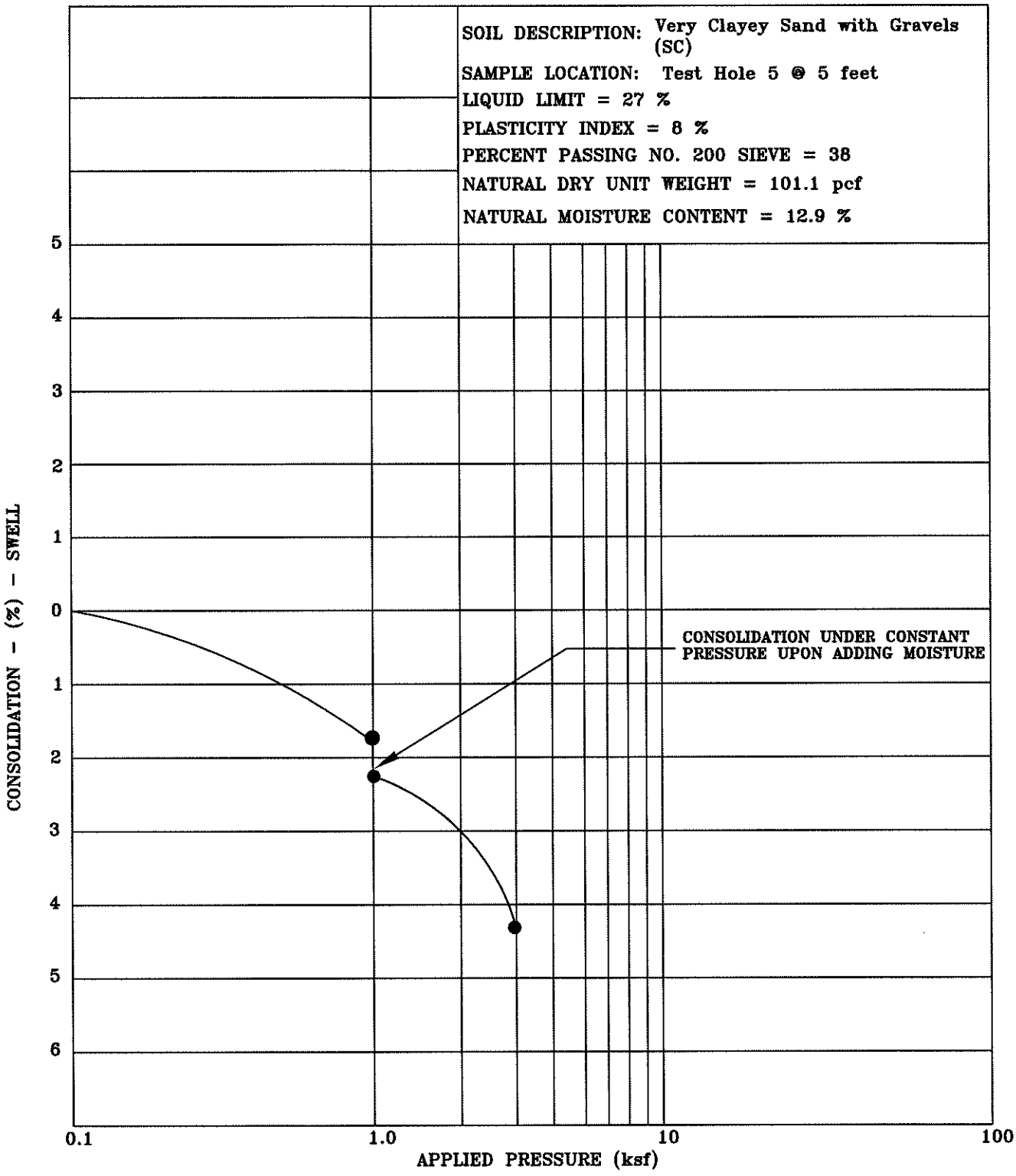
3) Elevations of the test pits were not measured and logs are drawn to the depths investigated.

4) The lines between materials shown on the logs represent the approximate boundaries between material types and transitions may be gradual.

Title: LEGEND AND NOTES	Date: 7/22/19	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing
Job Name: The Wild Blue Terminal and Restaurant	Job No. 19-11550	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80477
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #4	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 7/22/19	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19–11550	
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #5	



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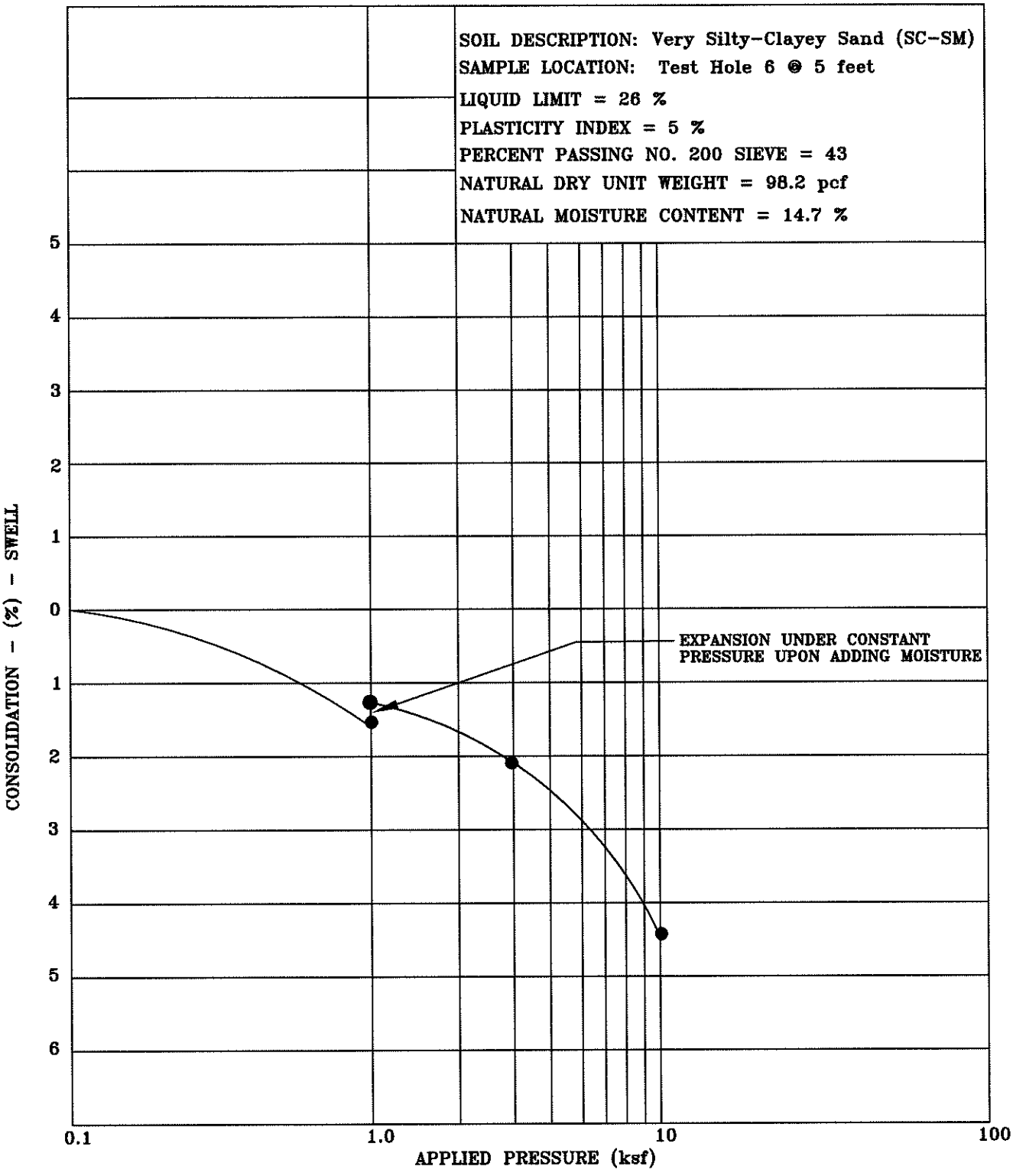
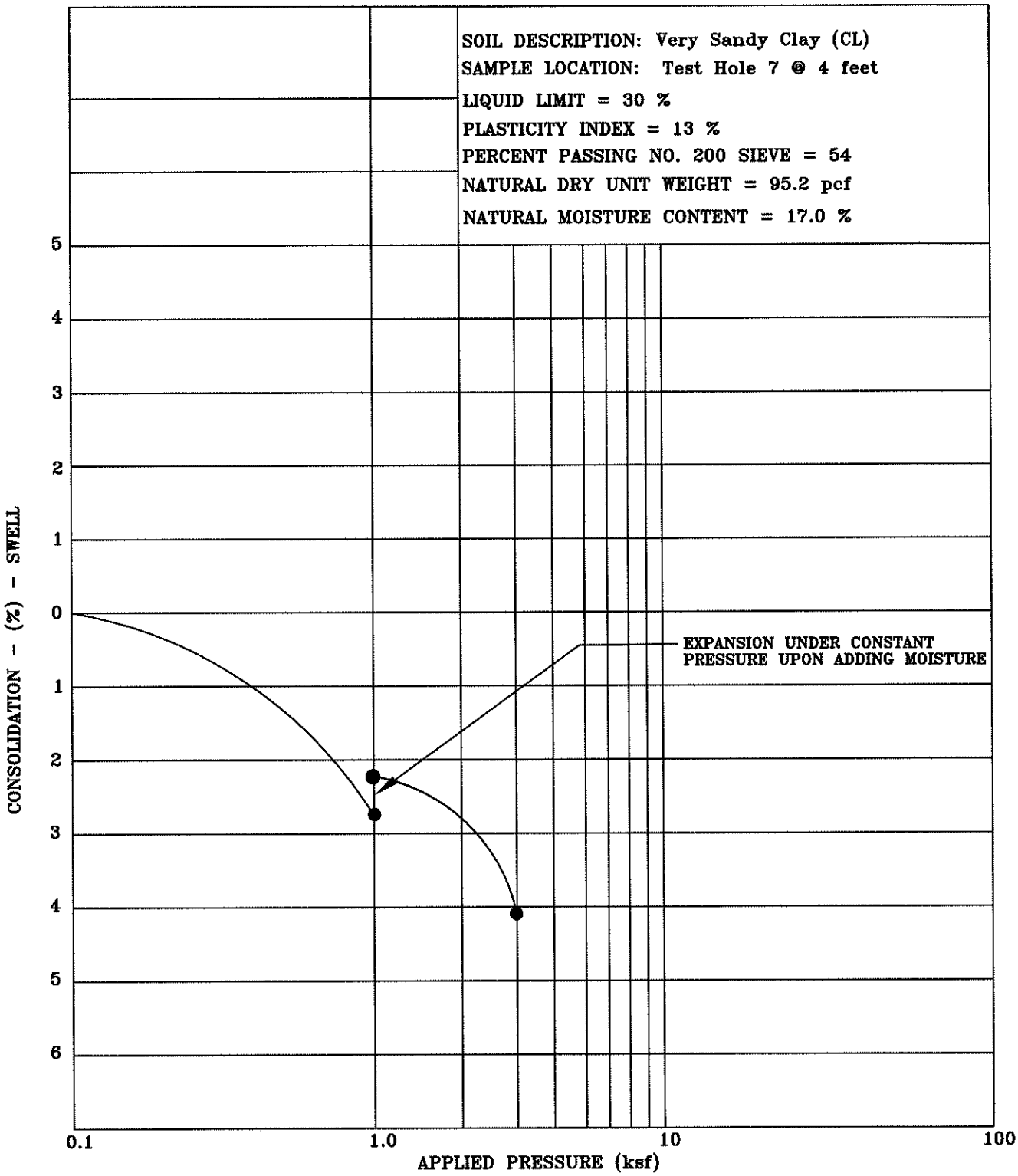
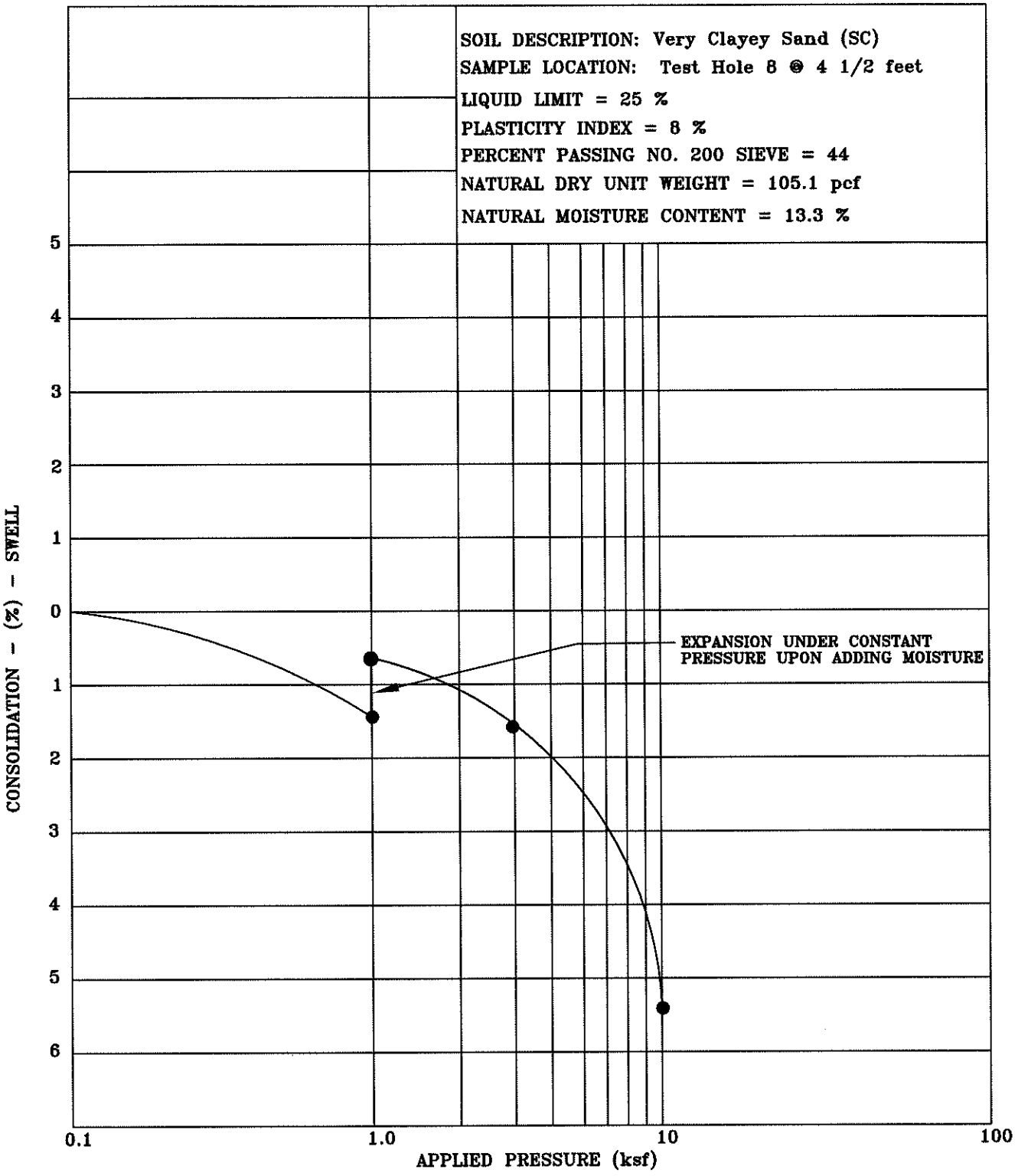
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19-11550	
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #6	



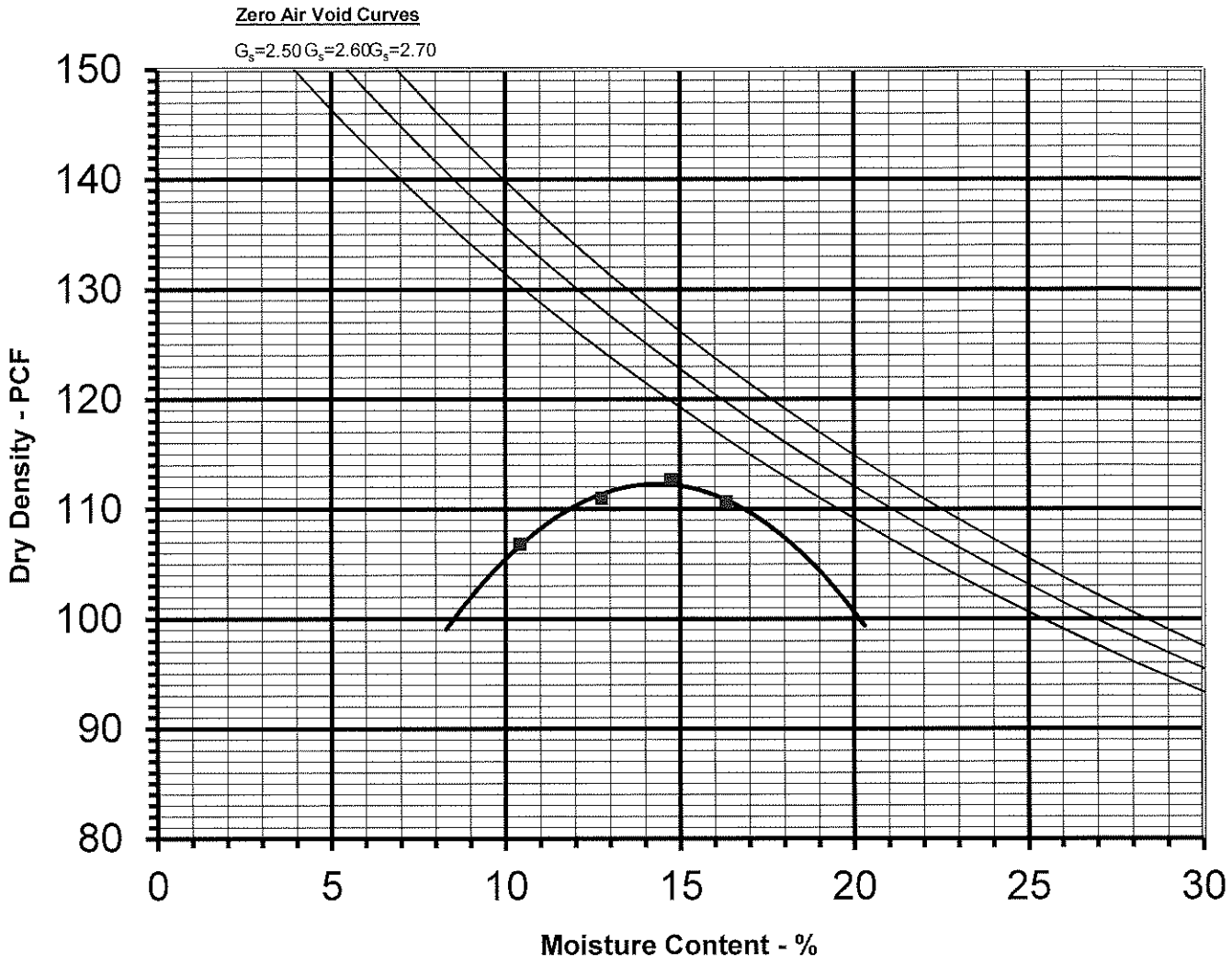
Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 7/22/19	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19-11550	
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #7	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 7/22/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19-11550	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #8	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 7/22/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2560 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19–11550	
Location: Steamboat Ski Area, Steamboat Springs, CO		Figure #9	



Job Name: The Wild Blue Terminal and Restaurant			**PROCTOR TEST RESULTS**
Sample Location: Onsite Composite Sample			
Soil Description: Very Clayey Sand with Gravels (SC)			**Sample No.**: 1P
Maximum Dry Density: 112.3 pcf	**Opt. Moisture Content**: 14.3 %		**Procedure**: ASTM D698
Liquid Limit: 26 %	**Plasticity Index**: 7		**Date**: 7/22/2019
Gravel: 4 % **Sand**: 60 %	**Silt & Clay (-200)**: 36 %		**Job No**: 19-11550 **Figure #10**

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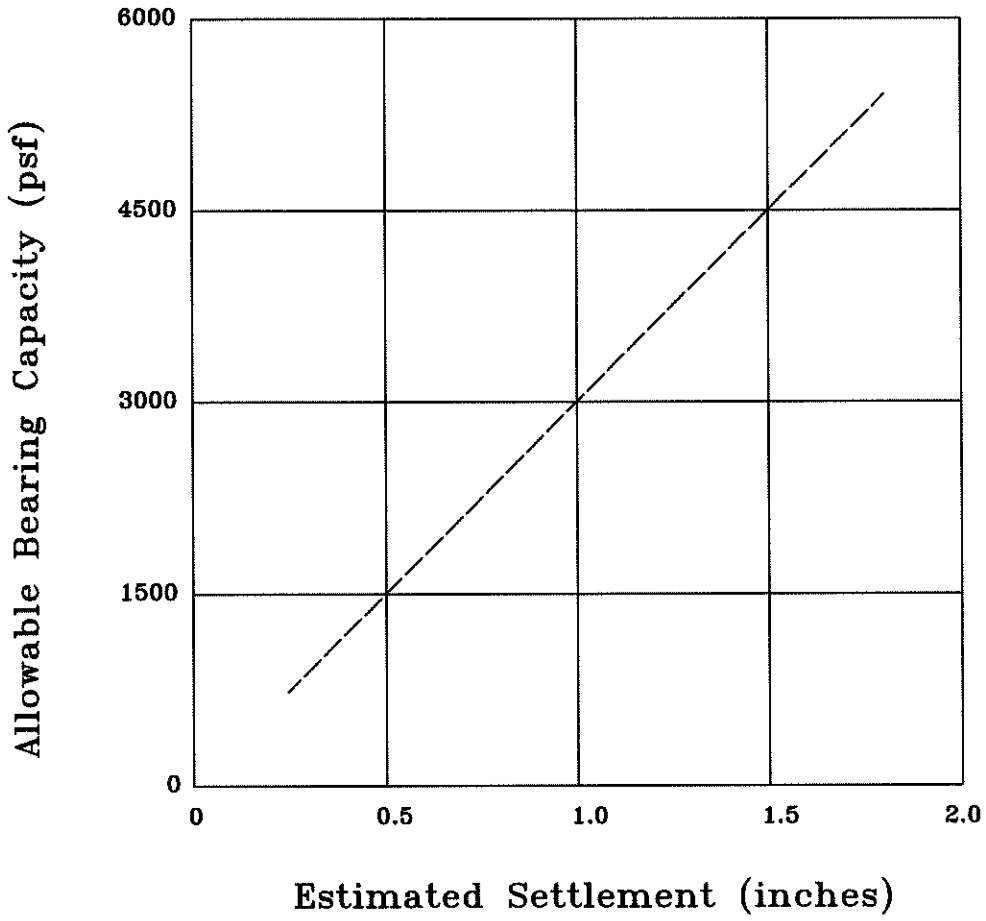
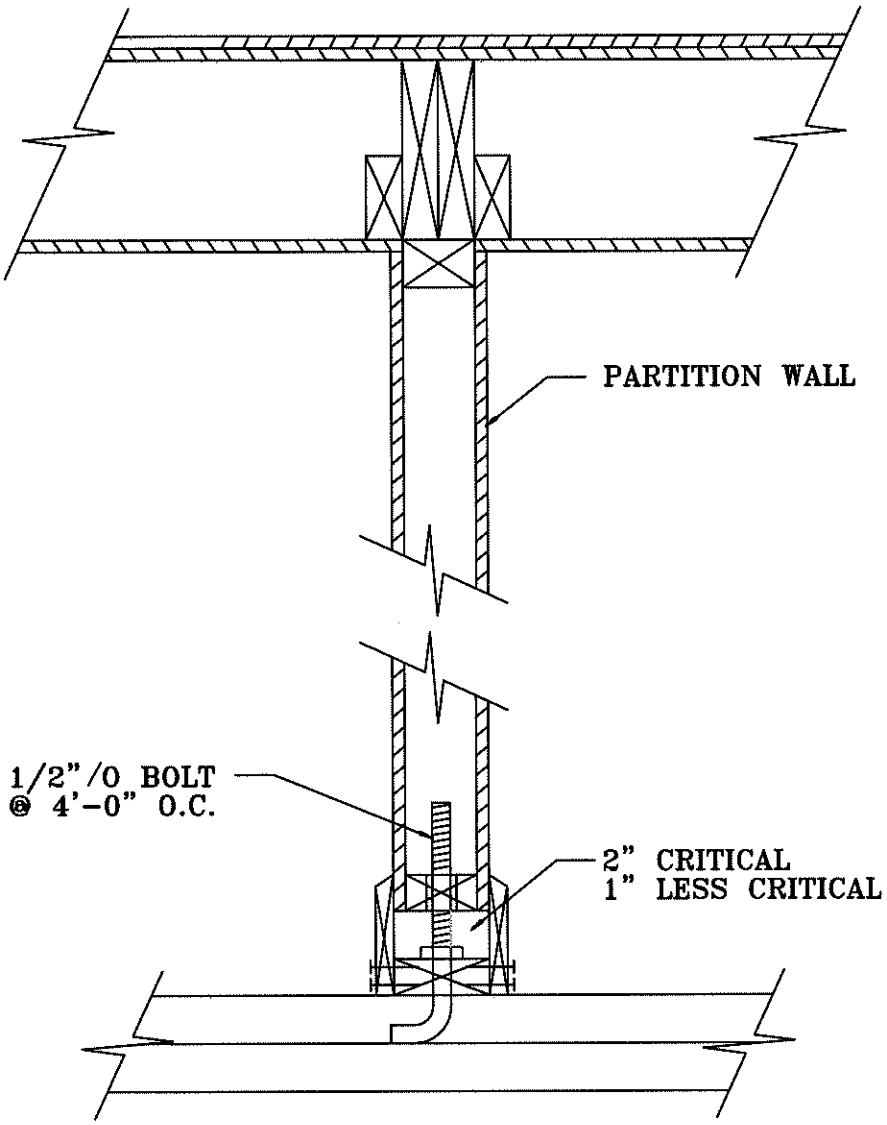


Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART	**Date:** 7/22/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing
Job Name: The Wild Blue Terminal and Restaurant	**Job No.** 19-11550	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80477
Location: Steamboat Ski Resort, Steamboat Springs, CO	**Figure** #11	



Title: HUNG PARTITION WALL DETAIL		Date: 7/22/19
Job Name: The Wild Blue Terminal and Restaurant		Job No. 19-11550
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #12

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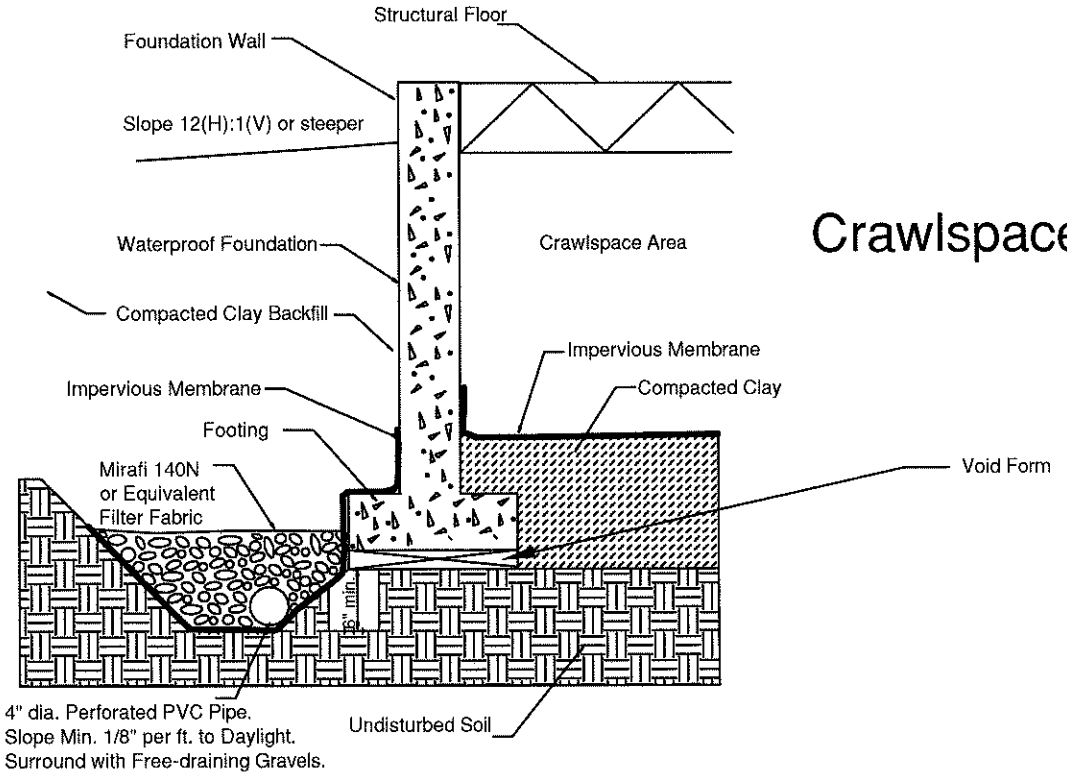
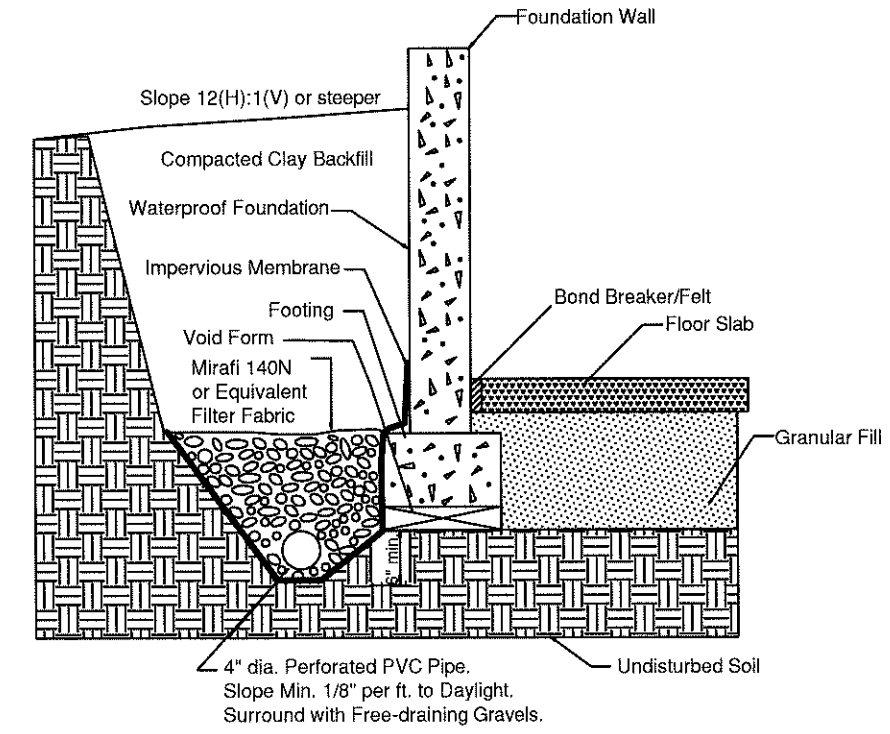


Crawlspace Area



Floor Slab

Title: PERIMETER/UNDERDRAIN DETAIL		**Date:** 7/22/19
Job Name: The Wild Blue Terminal and Restaurant		**Job No.** 19-11550
Location: Steamboat Ski Resort, Steamboat Springs, CO		**Figure** #13

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NWCC, Inc.

TABLE 1, PAGE 1 of 2

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION		PERCENT PASSING No. 200 SIEVE	UNCONFINED COMPRESSIVE STRENGTH (PSF)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST HOLE	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	4	15.9	99.5	34	14	16	34	49		Gravelly Sandy Clay	CL
1	9 1/2	15.0		30	15	1	51	48		Sandstone–Claystone Bedrock	CL–SC
2	4 1/2	7.7		NV	NP	20	70	10		Gravelly Slightly Silty Sand	SM
3	5	7.1		NV	NP	0	83	17		Weathered Schist Bedrock	SM
3	10 1/2	8.2		NV	NP	18	71	11		Weathered Schist–Gneiss Bedrock	SM
4	5	6.4		24	3	44	45	9		Weathered Granite Bedrock	SM–GM

NV = No Value

NP = Non Plastic

JOB NUMBER: 19–11550

NWCC, Inc.

TABLE 1, PAGE 2 of 2

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION		PERCENT PASSING No. 200 SIEVE	UNCONFINED COMPRESSIVE STRENGTH (PSF)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST HOLE	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
5	5	12.9	101.1	27	8	7	55	38		Very Clayey Sand with Gravels	SC
6	5	14.7	98.2	26	5	0	57	43		Very Silty-Clayey Sand	SC-SM
6	7	13.4		25	3	0	67	33		Sandstone Bedrock	SM
7	4	17.0	95.2	30	13	0	46	54		Very Sandy Clay	CL
7	11	11.0		25	10	3	63	34		Sandstone Bedrock	SC
8	4 1/2	13.3	105.1	25	8	0	56	44		Very Clayey Sand	SC
1P	-	8.3		26	8	4	60	36		Very Clayey Sand with Gravels	SC

NV = No Value

NP = Non Plastic

JOB NUMBER: 19-11550

NorthWest Colorado Consultants, Inc.
Geotechnical / Environmental Engineering • Materials Testing

March 10, 2021

Steamboat Ski and Resort Corp.
Lance Miles
2305 Mr. Werner Circle
Steamboat Springs, CO 80487

Job Number: 19-11550

Subject: Additional Foundation and Floor Slab Recommendations, Greenhorn Ranch and Wild Blue Gondola, Steamboat Ski Resort, Steamboat Springs, Colorado.

Lance,

This report presents additional foundation and floor slab recommendations for the proposed Wild Blue Gondola terminal and restaurant to be located at the proposed Greenhorn Ranch to be developed south of Burgess Creek Road and within the Steamboat Ski Resort. A Subsoil and Foundation Investigation report was previously prepared by NWCC, Inc. (NWCC) under this job number and dated July 29, 2019.

Proposed Construction: NWCC understands the proposed construction will consist of a temporary sprung structure to be used as a restaurant/ski school building and permanent gondola terminal/midway station. A maintenance building will also be constructed at the site. Based on review of the plans and recent discussions with the design team, NWCC understands that between approximately 9 to 26 feet of fill materials will be placed prior to construction. Fill materials will likely consist of on-site soils. The sprung structure has a footprint of 60 by 80 feet and will be placed on fill ranging from approximately 26 feet in thickness in the northeast corner to 9 feet in thickness in the southwest corner. We have assumed the loads generated by the proposed building structures will be moderate, typical of this type of commercial construction.

Previous Recommendations: Based on our understanding of the proposed construction, modifications to the recommendations for the design and construction of the foundation and retaining walls, perimeter drainage system, site grading and surface drainage will not be required at this time.

Previous shallow foundation recommendations are still valid; however, if the client elects to place footings on more than 5 feet of fill materials, the owner must be willing to accept the risk of at least 3 ½ inches of long term settlement and up to 2 ½ inches of differential settlement across the proposed structures placed on the excessive amount of fill materials.

NWCC has provided additional deep foundation recommendations, as shown below. Previous floor slab recommendations should be followed along with additional recommendations provided in this report.

Summary: NWCC recommends the proposed structures to be placed on greater than 5 feet of structural fill materials be placed on deep foundations advanced through the proposed fill materials and into natural soils or bedrock materials. The original foundation recommendations consisting of spread footings or individual pads with grade beams placed on the natural sands and clays, sands and gravels, bedrock materials or less than 5 feet of properly compacted structural fill materials, will still be feasible.

Although properly compacted structural fill materials over 5 feet in thickness would have adequate bearing capacity to support shallow foundations, settlement of these fill materials and foundations would be a major concern. To reduce the risk of settlement for structures constructed on more than 5 feet of fill materials, NWCC recommends using deep foundation systems advanced through the fill materials and into the natural soils or bedrock materials. Options for deep foundation systems would include helical piles, drilled piers or rammed aggregate piers.

If the client elects to place the shallow foundations on greater than 5 feet of properly compacted fill materials, the owner must be willing to accept risk of long-term and differential settlement of the fill materials. Total settlements would likely be greater than 3 ½ inches in areas with more than 20 feet of fill, and differential settlements on the order of 2 ½ inches could occur across the proposed structures placed on varying amounts of fill materials. Settlement of these fill materials would likely occur over 5 to 20 years. If the proposed materials are not compacted to 100% of the Standard Proctor maximum density and within 2% of the optimum moisture content as determined by ASTM D698 and recommended by NWCC, settlements could be much greater.

Based on the subsurface conditions encountered at the site and the laboratory test results, NWCC recommends Site Class C be used for the foundation designs in accordance with Table 20.1-1 in Chapter 20 of ASCE 7.

Deep Foundation Recommendations:

Helical Piles: NWCC believes a deep foundation consisting of helical screw piles advanced into the natural soils or bedrock materials may be a feasible alternative to the spread footing foundation systems in areas with greater than 5 feet of proposed fill materials. Helical piles could be a favorable foundation system underneath the temporary sprung structure since helical piles can typically be removed after the temporary structure is removed and replaced with the permanent structure.

Utilizing this type of foundation, each column is supported on a single or group of screw piles and the structures are founded on grade beams or pier caps that are supported by a series of piles. Load applied to the piles is transmitted to the natural soils through the end bearing pressure at the helices of the screw pile. Foundation movement should be less than ½-inch if the following design and construction conditions are observed.

The helical screw pile foundation system should be designed by a qualified engineer, using industry standards and be installed by a licensed/certified installer. If pile groups are required, we recommend a minimum pile spacing of 3 times the largest helix to achieve the maximum capacity of each individual pile. Lateral loads should be resisted using battered piles or tiebacks or through passive soil pressures against foundation walls or grade beams.

We strongly recommend that at least three test piles be advanced at the site so that the torque versus depth relationships can be established and the proper shaft and helix size and type can be determined. A representative of this office should observe the test pile installation, as well as observe the helical screw pile installations for the foundation system.

NWCC also recommends the following:

- Minimum 8-inch diameter helix;
- Minimum installation torque of 4,000 ft-lbs;
- Full-time installation observation by a qualified special inspector;
- Review of the Contractor's quality control plan regarding instrumentation calibration and testing, materials QC, and pile installation procedures.
- Refusal in fill materials will not be acceptable.

Drilled Piers: An alternative deep foundation system is straight-shaft skin friction/end bearing piers drilled into the underlying natural soils or bedrock materials. Foundation movement (< ½ inch) should be within tolerable limits if the following design and construction precautions are observed.

1) A minimum pier diameter of 12 inches and a minimum pier length of 20 feet are recommended. A maximum pier length to diameter ratio of 25 is also recommended.

2) Piers should be designed using an allowable skin friction value of 900 psf for the portion of the pier penetrating the natural soils or properly compacted structural fill materials. The upper 5 feet of penetration should be neglected in the skin friction calculations. A drill rig of sufficient size, type and operating condition should be used so bottom of the piers can be cleaned out properly and minimum length requirements can be met. If bottom of piers are properly cleaned and approved by an engineer from this office, then an allowable end bearing pressure of 3,000 psf for the natural sands and clays or sands and gravels may be used in the design. Higher skin-friction and end bearing values may be used if the bedrock materials are encountered at the base of the piers.

3) Piers should be reinforced their full length with at least one #5 reinforcing rod for each 16 inches of pier perimeter.

4) Piers should be properly cleaned and dewatered prior to steel and concrete placement. If groundwater is encountered, casing and dewatering equipment may be required to reduce water

infiltration and caving in the piers constructed at this site. The concrete should not be placed in more than 3 inches of water unless the tremie or pump method are used.

5) A 4-inch void should be provided beneath grade beams to prevent swelling soils from exerting uplift forces on grade beams and to concentrate pier loadings. A void should also be provided beneath necessary pier caps.

6) We strongly recommend that at least two test holes or test piers be drilled at the building site prior to starting the pier drilling operations. The test holes/piers should be drilled to evaluate the deeper subsoil/bedrock conditions and verify the recommendations given above.

7) A representative of NWCC must observe the test hole and pier drilling operations.

Rammed Aggregate Piers: A third option for a deep foundation system would consist of rammed aggregate piers (RAP). The RAP are typically constructed to bridge poor bearing soils or soils with high settlement potential, such as the proposed fill materials. The RAP extend down to a suitable bearing layer, such as the underlying natural sands and clays, sands and gravels or bedrock materials. A RAP foundation system should develop an end bearing pressure of at least 4,000 psf for aggregate piers founded in the natural sands and clays, sands and gravels, bedrock materials. A RAP foundation system has the advantage of not only supporting shallow foundation elements, but also of supporting floor slab areas and improving the engineering characteristics of the fill materials between the piers, thus decreasing the potential for floor slab movement if structural slabs or structural floors over crawlspaces are not used. A RAP foundation system could be a favorable foundation system underneath the temporary sprung structure since the rammed aggregate materials will not need to be removed after the temporary structure is removed and the permanent structure is constructed.

RAP foundation elements are designed as proprietary foundation systems. If a RAP foundation system is selected, NWCC should be contacted to coordinate with the RAP contractor/design team during foundation design.

A 4-inch void should be provided beneath grade beams to concentrate pier loadings and reduce impact from settling soils. A void should also be provided beneath necessary pier caps.

Floor Slab Recommendations: Floor slab recommendations outlined in the original report should be followed along with these additional considerations. NWCC understands the sprung structure will likely be constructed with concrete slab-on-grade floor systems placed over approximately 9 to 26 feet of on-site fill materials. Properly compacted fill materials can support slab-on-grade construction; however, settlement of these fill materials would likely result in at least 3 ½ inches of total slab movement and up to 2 ½ inches of differential slab movement.

Based on the anticipated settlement of the proposed fill materials, we recommend that structural floor systems over well-ventilated crawlspaces or void form materials be used for the proposed structures. It should be noted that the installation of RAP foundation system would significantly reduce the floor slab settlements.

Settlement potential of slabs placed directly on proposed fill materials can also be reduced by limiting the on-site fill thickness to 10 feet or less. This can be done by replacing some of the on-site fill materials underneath the slabs with lightweight fill materials, such as geofoam. If the on-site fill thickness is kept consistent across each building footprint, risk of differential slab settlement can also be reduced.

Limitations: The recommendations provided in this report are based on the soils and bedrock materials encountered at this site and NWCC's understanding of the proposed construction. NWCC believes this information gives a high degree of reliability for anticipating behavior of the proposed structures; however, NWCC's recommendations are professional opinions and cannot control nature, nor can they assure the soils profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report.

Expansive soils and bedrock materials were encountered at this site. These soils and bedrock materials are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of expansive soils is not fully understood. The swell or consolidation potential of any site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions, which cannot always be predicted. Recommendations presented in this report and the previously completed report are based on the current state-of-the-art building practices for foundations and floor slabs on expansive soils/bedrock materials. The owner must be made aware there is a risk in construction on these types of soil/bedrock. Performance of the structures will depend on following the recommendations and in proper maintenance after construction is complete. As water is the main cause for volume change in the soils/bedrock materials, it is necessary that the changes in moisture content be kept to a minimum. This requires judicious irrigation and providing positive surface drainage away from the structures. Any distress noted in the structures should be brought to the attention of NWCC.

This report is based on the investigation at the described site and on specific anticipated construction as stated herein. If either of these conditions is changed, the results would also most likely change. Therefore, NWCC strongly recommends that our firm be contacted prior to finalizing the construction plans so that we can verify our recommendations are being properly incorporated into the construction plans. Man-made or natural changes in the conditions of a property can also occur over time. In addition, changes in requirements due to state-of-the-art knowledge and/or legislation can occur. As a result, the findings of this report may become invalid due to these changes. Therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered. It is the responsibility of the owner or his representative to ensure that the information in this report is incorporated into the plans and/or specifications and construction of the project.

If you have any questions regarding this report or if NWCC may be of further service, please do not hesitate to contact us.

Sincerely,
NWCC, INC.

Erika K. Hill, P.E., P.G.
Project Engineer

Reviewed by: Brian D. Len, P.E.
Principal Engineer

cc: Kate Leggett – ESA Architects
Eric Smith – ESA Architects
Erik Griepentrog – Landmark Engineering
Bryan Sculthorpe - Saunders
Adam Cleveland - Saunders
Charlie Roos - Anthem Structural
Chris Cushing – SE Group
Ryan Stone - EW Partners