TERRADYNE
Engineers, Geologists & Environmental Scientists

7000 North Broadway #107
Denver, CO 80220
Phone: 303.463.9317

Report On: 10226 Hartwood - Open Hole Report

Lab No: 3547-1
Report No: C24028-0106
Page 1 of 1

Project No: C24028 **Cust No:** 00100

Client: Meritage Construction
Michael Fischer
8400 E Crescent Pkwy #200
Greenwood Village, CO 80111

Project: Paint Brush

Engineer: Terradyne - Denver
Contractor: Meritage Construction
Location: 10226 Hartwood

Report Date: 05/17/2025

Sample Date: 05/12/2025
Sampled By: Stone, Ashley

Report Project number C241043 dated June 28,2024

The excavation for the planned structure at 10226 Hartwood was completed and subgrade exposed. The subgrade is consistent and firm and appears adequate for support of the exposed structure.

Test Method Visual Observation

Remarks: Terradyne was onsite for the visual inspection of the subgrade after excavation to bearing depth has been performed. The subgrade is firm and consistent with the material expected in the geo report. It appears adequate for support of the proposal structure

Orig: Meritage Construction Attn: Michael Fischer
(1-ec copy)
1-ec Terradyne - Denver Attn: Beau Pearl
1-ec Meritage Construction Attn: James Saldivia
1-cc Laboratory

Respectfully Submitted,
Terradyne

COLORADO LICENSED
BEAU PEARL
60055
PROFESSIONAL ENGINEER

05/17/2025
Beau Pearl

GRAF ENGINEERING

12837 W. 54TH Place
Arvada, CO 80002
Office: (303) 715-9885

May 21, 2025

Meritage Homes
7900 E. Union Avenue, Suite 400
Denver, Colorado 80237

Attn: Jared Stanton

Subject: **Footing Form Observation**
10226 Hartwood Drive
Lot 102, Filing 14, Paint Brush Hills Subdivision
El Paso County, Colorado

Dear Jared,

As requested, a footing form observation for the subject site was performed on May 13, 2025.

At the time of our observation, the widths, and depths of the footing forms as well as the reinforcing steel for the isolated footing pads and void material appeared to have been placed in general conformance with the construction drawings. Footing dowels, for the footing/wall interface, were on site.

The dimensions, overall geometry, step locations, and desired options have not been, and will not be, verified by this office. Frost protection requirements have also not been verified. These items should be reviewed by others. Bearing capacity of the soils supporting the footings located closer than 45 degrees from the bottom of the excavation are to be verified by the geotechnical engineer of record.

This office was not present during concrete placement and cannot verify that the conditions remain as observed. It is the responsibility of others to verify these items remain as designed.

This office did not, and does not, conduct open excavation observations or verify soil bearing conditions. Observation of the footing forms does not relieve the builder of the requirement to verify open excavation soil conditions with the geotechnical engineer of record. This letter is contingent on verification by the geotechnical engineer of record that the onsite soils meet the criteria presented in the soils report for this lot.

The scope of our site visit was limited to the items listed above.

Please contact this office if you have any questions or require clarification.

Sincerely,
Graf Engineering, LLC

COLORADO LICENSED
JEREMIAH WILLIS
51269
05/22/2025
PROFESSIONAL ENGINEER
5/21/2025

Jeremiah Willis, P.E.

Jeremiah Willis, P.E.

Digitally signed by Jeremiah Willis, P.E.
DN: C=US, E=jeremiah@grafengineering.com, O="Graf Engineering, LLC.", OU=Engineering, CN="Jeremiah Willis, P.E."
Date: 2025.05.22 12:40:38-06'00'

JRG - cc: file

Report of Geotechnical Engineering Evaluation

Proposed Paint Brush Hills Subdivision
Peyton, Colorado

Prepared for:

Pat Iffrig
Director of Land Development

Prepared by:

Terradyne Engineering
15403 East 17th Avenue, Suite E
Aurora, Colorado 80011

Terradyne Project No.: C241043

August 6, 2024

August 6, 2024

Terradyne Engineering, Inc.
15403 E. 17th Avenue, Suite E,
Aurora, CO 80010
Office: (303) 463-9317
Fax: (303) 463-9321
www.terradyne.com

Attn: **Pat Iffrig**
Director of Land Development
8400 E Crescent Parkway | Suite 200 | Greenwood Village, CO 80111
O: 303-406-4388 | C: 215-380-9398
Pat.Iffrig@meritagehomes.com

Re: **Report of Geotechnical Engineering Evaluation**
Proposed Paint Brush Hills Subdivision
(Lot 102)
Near Londonderry Drive and Devoncove Drive,
Peyton, Colorado
Terradyne Project No.: C241043

Dear Pat Iffrig:

As requested, Terradyne Engineering, Inc. has completed the Report of Geotechnical Engineering Evaluation for the proposed project. This report includes the results of the field investigation and laboratory testing as well as recommendations for site preparation and building foundation design.

Based on our investigation, it is our opinion that the proposed construction is feasible from the geotechnical standpoint provided the recommendations contained herein are incorporated into the project plans and specifications. This report should be reviewed in detail prior to proceeding further with the planned development.

Terradyne appreciates and wishes to thank you for the opportunity to be of service to you on this project. If we can be of additional assistance during the materials testing-quality control phase of construction, please contact us at (303) 463-9317.

Respectfully Submitted,

Terradyne Engineering, Inc.

COLORADO LICENSED
BEAU PEARL
60055
PROFESSIONAL ENGINEER

549d664a-cc98-413e-b06a-170727471310

Digitally signed by 549d664a-cc98-413e-b06a-170727471310
DN: cn=549d664a-cc98-413e-b06a-170727471310
Reason: I am the author of this document
Location:
Date: 2024-08-12 11:18-06:00

Beau Pearl, P.E.
Branch Manager

Zijin Jiang

Zijin Jiang, E.I.T.
Geotechnical Department Manager

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The soil conditions at site Lot 102 of the proposed Paint Brush Hills Subdivision at Peyton, Colorado were explored by drilling one (1) boring to a depth of 20 feet below surface grade. The proposed construction will consist of a two-story single-family residence with a below grade level and car garage.

- The results of our exploration, laboratory testing and engineering evaluation indicate the soils underlying this site are clayey sand soils with a low potential for swell.

- Based on the information provided, it is understood that the proposed structure will be a one to two story residence with full basement. This structure is expected to create moderately low loads to be carried by the foundation systems. These structures will utilize wood frame construction. It is assumed that the maximum column loads will not exceed 2 kips, while maximum exterior wall loading will be in the range of 1.5 kip per foot.

- Terradyne recommends placing the shallow foundation system on undisturbed competent native soil.

- The proposed structure may be supported by spread or strip type footings at a minimum depth of three feet (3') feet below finished grade bearing on undisturbed competent native soil.

- The allowable bearing capacity is 2,000 psf with a minimum foundation width of 18-inch.

- The slab on grade should bear on no less than 1-foot of moisture conditioned and recompacted structural fill.

- The subgrade material should be moisture conditioned to ±2% optimum moisture content and compacted to at least 95 percent relative compaction, as determined by standard proctor test (ASTM D698). A proof-roll of the subgrade material shall be observed by the geotechnical engineer's representative.

- Groundwater was not encountered during our exploration. However, it should be noted that groundwater levels will fluctuate with seasonal climatic variations and changes in land use.

- The onsite soils can be utilized as structural fill with moisture conditioned to ±2% optimum moisture content and re-compacted to minimum 95% of maximum dry density determined by standard proctor test (ASTM D698).

The limited information provided above is a summary of this detailed report which includes descriptions of subsurface conditions, engineering analysis, and design recommendations. The report should be read in its entirety.

1.0. INTRODUCTION

This report presents the results of our subsurface exploration and foundation analysis for Lot 102 of the proposed Paint Brush Hills Subdivision at Peyton, Colorado. The objective of this investigation was to evaluate the physical properties of the soils underlying the site in order to provide recommendations for foundation, slab support, and related earthwork for the structures. This geotechnical investigation was authorized by Pat Iffrig with a signed service agreement on May 23, 2024.

2.0. PROJECT DESCRIPTION

Terradyne understands that the proposed single-family residence will be a two-story building with a below grade level and car garage. The structure will be supported with a spread or strip type foundation for the residential area and slab on grade for garage. This report is based on wall loads not exceeding 1,500 pounds per linear foot and maximum column loads of 2,000 pounds per square foot. We have estimated the final grade being will be approximately 12 feet below the current existing grade. If the final construction plans vary from what has been assumed, please contact Terradyne for further evaluation as revisions may affect the recommendations provided in this report.

The proposed Lot 102 at Paint Brush Hills Subdivision is located at the west side of Devoncove Drive, (see Appendix A, Figure A, Site Location Map). The site is bounded by Devoncove Drive to the east and is bounded by graded lot pads to its all the other side. It is our understanding that the proposed Paint Brush Hills Subdivision will be built in the area currently preliminarily graded. The site is generally flat. The boring location was established in the field by information provided by the client (See Appendix A, Figure B, Boring Location Map). The site is located at 38.98246°, -104.63025°.

3.0. PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical investigation was to evaluate the subsurface and groundwater conditions of the site and provide geotechnical engineering recommendations for the design and construction of the residence. Our scope of services includes the following:

1) Drilling and sampling of one boring to a maximum depth of 20 feet or auger refusal;
2) Evaluation of the in-place conditions of the subsurface soils through field penetration tests;
3) Observation of the groundwater conditions during drilling operations;
4) Performing laboratory tests such as Atterberg limits, moisture content tests, free swell/consolidation tests;
5) Review and evaluation of field and laboratory tests;
6) Compilation, generalization and analysis of the field and laboratory data according to the project requirements;
7) Estimation of potential vertical heave;
8) Preparation of recommendations for the design and construction of the structures;

9) Consultations with Prime Professionals and members of the design team on findings and recommendations and the preparation of a written geotechnical engineering report for their use in the preparation of design and construction documents.

The Scope of Services does not include an environmental assessment of the presence or absence of wetlands and/or hazardous or toxic materials in the soil, surface water, groundwater, or air, in the proximity of this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

4.0. GEOTECHNICAL INVESTIGATION

The field exploration to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling the boring**,** performing standard penetration tests and obtaining samples using Modified California sampler. One (1) soil test boring was drilled at the site. The borehole was drilled to a depth of 20 feet below existing grade. An approximate boring location plan is shown on Figure B in Appendix A.

The borehole was performed with a drilling rig equipped with a rotary head. Conventional hollow stem augers were used to advance the holes and samples of the subsurface materials were obtained using a standard 2.5-inch O.D., 2.0-inch I.D., California ring sampler per ASTM D3550 (Modified California Sampler Split-Barrel Sampling of Soils). The samples were identified according to depth, encased in polyethylene plastic wrapping to protect against moisture loss, and transported to the laboratory in special containers.

4.1. Field Tests and Measurements

Penetration Tests: During the sampling procedures, standard penetration tests were performed in the boring in conjunction with split-barrel sampling (ASTM 1586). The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty inches, required to advance the split-spoon sampler one foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the two successive increments of six inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration tests indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

4.2. Boring Logs

Field logs were prepared for the borings. The logs include information concerning the boring method, samples attempted and recovered, the presence of various materials (such as clay, sand and silt) and groundwater observations. They also include an interpretation of the subsurface conditions between samples. Therefore, these logs include both factual and interpretive information.

The final log represents our interpretation of the contents of the field log and laboratory test results for the purpose delineated by our client. The final log is included in Figure E in Appendix B. A key to classification terms and symbols used on the log is presented in Figure F in Appendix B.

4.3. Laboratory Testing Program

In addition to field exploration, a laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials that are necessary to evaluate the soil parameters. All phases of the laboratory testing program were performed in general accordance with the indicated applicable ASTM Specifications presented in Table No. 1.

Table No. 1

Type of Test	Applicable Test Standard
Natural Moisture Content	ASTM D-2216
Atterberg Limits	ASTM D-4318
Denver Swell Tests	ASTM D4546
% Passing No. 200 Sieve	ASTM D1140, D422

In the laboratory, each sample was examined and classified by a geotechnical engineer. As a part of this classification procedure, the natural water content of selected specimens was determined. Liquid and Plastic Limit tests were performed on representative specimens to determine the plasticity characteristics of the different soil strata encountered. The results of these tests are presented on the appropriate boring logs.

5.0. GENERAL SUBSURFACE CONDITIONS

5.1. Subsurface Profile

Based on the Geologic Map of the Falcon NW 7.5 Minute Quadrangle, El Paso County, Colorado, the site is located within Dawson Formation[1] which is characterized as Composed of varicolored and vari-textured conglomerate, sandstone, shale, and clay derived from rocks of Front Range and deposited under a variety of continental conditions.

The soils encountered during our exploration are classified as medium dense to very dense clayey SAND (SC) with low to medium plasticity clay and fine to coarse grained sand. The soil stratigraphy at the boring location is presented on the Boring Log. The engineering characteristics

1.Reference: Soister, P.E., 1965, Geologic map of the Fort Lupton quadrangle, Weld and Adams Counties, Colorado: U.S. Geological Survey, Geologic Quadrangle Map GQ-397, scale 1:24,000

of the underlying soils, based on our field and laboratory test results, are summarized and presented in Table No. 2.

Table No. 2

Stratum		Color	Depth Range Feet	Liquid Limit Range	Plasticity Index	Blows Per Foot
1	Clayey SAND (SC)	Brown	0-20	-	-	50+

The above description generally highlights the major soil stratification features and soil characteristics. The test boring log should be consulted for specific information at the boring locations.

5.2.Swell Potential

Terradyne has reviewed the "Potentially Swelling Soils and Rock in the Front Range Urban Corridor, Colorado" by Stephen S. Hart, Dated 1972. Based on these published maps, the subject site lies within an area described as having "**Moderate Swell Potential**" designation. Moderate swell potential designation is described as "This category includes several bedrock formations and a few surficial deposits of variable thickness".

Terradyne performed ASTM D4546 Swell Testing on select samples of the recovered onsite material from the soil borings. The following table summarizes the results of the swell testing:

Boring	Depth (feet)	Moisture Content (%)	Volume Change (%)
L102	3-5	8.2	+0.0%

The laboratory swell test results are included in the individual boring logs. The test results indicate swell percentages of +0.0 when tested under a surcharge pressure of 500 psf. The surcharge values were applied based on the sample depth, with 100 psf surcharge applied for every 1 foot below the ground surface. Once the samples were hydrated under the surcharge pressure and swelling had stopped, additional pressure was applied until the sample was at or below its initial volume.

Based upon the results from the swell testing from adjacent lots in our preliminary geotechnical report, the materials encountered are classified as having a **"low"** potential for swell, therefore, swell mitigation is not required.

However, if excessive drying and rewetting of these soils is allowed to occur, the risk of swell will increase. Proper drainage and good maintenance should be followed.

5.3.Sulfate Content

Sulfate Content

A representative near-surface soil sample was tested during our investigation for soluble sulfate content. The result of this test indicates a soluble sulfate content of approximately 25 ppm by weight or negligible sulfate exposure. As such, the soils exposed are not expected to pose a potential for sulfate reaction with concrete. Per ACI 318-14 Table 19.3.1.1 the requirement of Exposure Category (S) and Class (S0) is applicable and there is no restriction on selection of cement type. The sulfate exposure is negligible.

Concrete

Laboratory test indicated that the subject site contains soil sulfate content in the negligible range (i.e., less than 150 part per million). However, it is recommended that concrete for all construction at the site utilize a widely available Type-II Portland cement with a maximum 0.50 water/cement ratio and should comply with all the requirements of the current Code. The minimum compressive strength of concrete shall be a minimum of 4000 psi at 28 days and maximum slump during placement shall be five inches. The minimum concrete cover should be 1.5-inches. Final selection of the appropriate concrete design should be made by the project structural engineer based on the local laws and ordinances and desired level of conservatism.

5.4.Groundwater Conditions

Free-flowing groundwater was not observed during drilling operations in the borings. However, it should be noted that it is possible for the groundwater table to fluctuate during the year depending upon climatic and rainfall conditions and changes to surface topography and drainage patterns. Discontinuous zones of perched water may also exist, or develop, within the overburden materials subsequent to the construction of the proposed developments. The groundwater levels present in this report are the levels that were measured at the time of our field activities. All depth readings are taken from the existing ground level at the time of our site visit and are not based upon known elevations. We recommend the contractor determine the groundwater level prior to the construction and assess any potential impacts.

6.0. GEOTECHNICAL DESIGN ENGINEERING ANALYSIS

Foundation Design Considerations: Review of the boring and test data indicates that the factors presented on the following page will affect the foundation design and construction at this site:

1) The site is underlain by clayey sand soils. Based upon geotechnical investigation and lab test results, we have recommended the foundations bears on undisturbed competent native soil and slab on grades bear on no less than 1-foot of moisture conditioned and recompacted structural fill.

2) The strengths of the underlying soils are adequate to support shallow foundation.

3) Groundwater was not encountered at a depth expected to influence construction of the proposed structure.

Structural Information: Based on the information provided, it is understood that the proposed structure will be a one to two story residence with full basement. This structure is expected to create moderately low loads to be carried by the foundation systems. These structures will utilize wood frame construction. It is assumed that the maximum column loads will not exceed 2 kips, while maximum exterior wall loading will be in the range of 1.5 kip per foot.

Vertical Movements: The potential vertical heave for slab-on grade construction at the location should be limited based upon the consistency of the onsite soils, the in-situ moisture content and the low swell potential.

The recommendations in this report have been provided to limit the potential settlement of the structure to less than 1-inch.

If the existing grade has to be raised to attain the finish grade elevation, select fill shall be placed, compacted and tested for compaction compliance by Terradyne.

7.0. FOUNDATION RECOMMENDATIONS

It is our understanding that a shallow footing foundation will be utilized for the proposed structure. Foundation should be at a minimum depth of 3 feet below finished grade on undisturbed competent native soil.

An allowable soil bearing pressure of 2,000 pounds per square foot and a minimum footing width of 18-inches (1.5') is recommended for the design of spread or strip type footings bearing on undisturbed competent native soil.

Lateral loads may be resisted by friction provided by the soil on the base of the foundation and by passive earth pressure. A coefficient of friction of 0.25 (multiplied by dead load) may be used. A passive earth pressure of 150 psf/ft may be used for footings poured on compacted in-situ soil. A factor of safety of 1.5 was used in calculating passive earth pressure. The maximum value of passive earth pressure should be limited to 2,250 psf. Frictional resistance and passive pressure resistance may be used in combination if friction coefficient or cohesion is reduced by one-third. A one-third increase in passive pressure may be used for resistance against seismic and wind loading.

In order to minimize the sensitivity of the structure to differential movement, the footings and walls should be reinforced to allow for a degree of load re-distribution should a localized zone of

the supporting soils become saturated. Stem walls should either be positively separated from the floor slabs or reinforced to prevent cracking at the slab stem wall interface.

Uplift resistance of shallow foundations formed in an open excavation should be taken as the weight of the foundation and soil above it. For design purposes, the uplift resistance should be based on total unit weights of 120 and 150 lbs. per cubic foot (pcf) for soil and concrete respectively. In areas where ground water is anticipated or in areas prone to flooding, the uplift resistance should be based on submerged unit weights (or effective unit weights) of 57.5 and 87.5 pounds per cubic foot (pcf) for soil and concrete respectively. A factor of safety of 2 is recommended for sustained loading conditions, and 1.5 for transient loading conditions.

Active earth pressures behind walls depend on wall movement, back fill slope, surcharge loads and back fill material. Onsite soil can be used as backfill material behind basement wall.

Table No. 3

Equivalent Fluid Density (PCF)	
Active Condition	40
At-rest Condition	60

The equivalent fluid densities in Table No.3 do not include the effect of seepage pressures, surcharge loads such as construction equipment, vehicular loads or future storage near the walls. If the basement wall or cantilever retaining wall can tilt forward to generate "active earth pressure" condition, the values under active condition should be used. For rigid non-yielding walls which are part of the building, the values" at rest condition" should be used. The compactive effort should be controlled during backfill operations. Over compaction can produce lateral earth pressures in excess of at rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained at minimum 95 percent of Standard Proctor (ASTM D698) maximum dry density.

The backfill behind the basement walls should be drained properly. The simplest drainage system consists of a drain located near the bottom of the wall. The drain collects the water that enters the backfill and this may be disposed of through outlets along the base of the wall via a sump pump system. To ensure that the drains are not clogged by fine particles, they should be surrounded by a granular filter wrapped in a geofabric such as Mirafi 140N or equivalent. In spite of a well-constructed toe drain, substantial water pressure may develop behind the wall if the backfill consists of clays or silts. A more satisfactory drainage system, consisting of a back drain of 12 inches to 24 inches width gravel may be provided behind the wall to facilitate to drainage.

7.1. Foundation Construction Guidelines

Significant moisture increase in the in-situ soils could create additional and/or excessive movements in the site. Accordingly, the site drainage and moisture protection provisions recommended in this report are critical design considerations.

Prior to placing concrete, all bearing surfaces must be cleared of all loose material. Disturbed material may only be re-compacted with guidance from, and after contacting Terradyne.

To verify the soil conditions and soil bearing capacity, *it is required that an open hole observation be performed.* The entire excavation must be dug down to final grade prior to the observation. If potentially expansive clay, deleterious material, or other unsuitable conditions are found, additional ***over-excavation*** of some or the entire site may be required – replacing inadequate soils with acceptable materials. Revised foundation recommendations such as the use of ***drilled piers*** may also be required at that time. We recommend the foundation subgrade be inspected for adequacy before concrete placement. Ensure that the requirements contained herein are reflected in any construction plans developed for this site.

7.2. Slab-on-Grade Construction

The Slab Performance Risk at this site is judged to be low. However, it must be understood, that changes in the water content of these soils may cause the soil to swell or shrink, which may cause movement or cracking of slabs. Potential vertical movement on the order of 1 to 2 inches is anticipated at the existing grade.

Slabs should bear on no less than 1-foot of moisture conditioned and re-compacted structural fill or should bear on at least 4" gravel and 4" compacted fill. A proof-roll of the subgrade shall be observed by the geotechnical engineer's representative. If the on-site soils are not acceptable, it is preferable to bear slabs on non-expansive imported materials. This will minimize the transfer and retention of water below the slab. Materials with a Liquid Limit below 30 and a Plasticity Index between 10 and 15 are preferred.

Slabs shall be isolated from foundation components by slip joints constructed to allow the independent movement of the slab. Slabs shall also be separated from any utility components by isolation joints. Mechanical equipment resting on slabs must be fitted with expandable/collapsible sections in order to allow movement of the slab without damage to the equipment or to the structure.

Non-bearing partition walls must be constructed with a minimum of **2** inches of float to allow for movement of the slab without damaging any part of the structure. All doors shall be constructed with at least 1-inch gap at floor level. It is the owner's responsibility to monitor and maintain all floats and gaps as necessary. If additional information on float is needed, please contact Terradyne.

Slabs must be appropriately reinforced to resist the anticipated loads as well as the effects of the supporting soils. Floor slabs must also be scored in accordance with the American Concrete Institute (ACI) recommendations in order to control cracking of the slab due to shrinkage or other factors. These scores should be a maximum of 12 feet apart.

7.3. Seismic Parameters

The project site is located within a municipality that employs the International Building Code, 2021 edition. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site. As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 1000 feet of the ground surface. To define the Site Class for this project, we have interpreted the expected results of soil testing borings drilled with the project site and estimated appropriate soil properties below grade to a depth of 100 feet, as permitted by Section 1613.2.2 of the code. The estimated soil properties were based upon data available in published geologic reports and our experience with subsurface conditions in the general site area.

Based upon our evaluation, it is our opinion that the subsurface conditions within the site are consistent with the characteristics of Site Class D as defined in Table 1613.2.2 (ASCE 7-10, Table 20.3-1) of the building code.

The USGS-NEHRP interpolated probabilistic ground motion values near latitude 38.98246°, -104.63025° obtained from the USGS geohazards web page are as follows:

Period (seconds)	**2% probability of Event in 50 years (g)**	**Site Coefficients**	**Maximum Spectral Acceleration Parameters**	**Design Spectral Acceleration Parameters**	
0.189 (Ss)	0.201	$F_a = 1.6$	$S_{ms} = 0.303$	$S_{DS} = 0.202$	$T_0 = 0.088$
0.056 (S_1)	0.060	$F_v = 2.4$	$S_{m1} = 0.133$	$S_{D1} = 0.089$	$T_S = 0.441$
			$S_{ms} = F_a S_s$	$S_{DS} = ⅔ * S_{MS}$	$T_0 = 0.2 * S_{D1}/S_{DS}$
			$S_{M1} = F_v S_1$	$S_{D1} = ⅔ * S_{M1}$	$T_s = S_{D1}/S_{DS}$

The site Coefficients, Fa and Fv presented in the above table were interpolated from IBC Tables 1613.2.3(1) and 1613.2.3(2) as a function of the site classification and mapped spectral response acceleration at the short (S_S) and 1 second (S_1) periods.

7.4. Utilities

Utilities that project through slab-on-grade floors shall be designed with either some degree of flexibility or with sleeves in order to prevent damage to these lines should vertical movements occur.

7.5. Contraction, Control and/or Expansion Joints

Contraction, control and/or expansion joints shall be designed and placed in various portions of the structure. Properly planned placement of these joints will assist in controlling the degree and location of material cracking that occurs due to soil movements, material shrinkage, thermal affects and other related structural conditions.

8.0. CONSTRUCTION GUIDELINES

8.1. Construction Monitoring

As Geotechnical Engineer of Record for this project, Terradyne, shall be involved in monitoring the foundation installation and earthwork activities. The performance of any foundation system is not only dependent on the foundation design, but is strongly influenced by the quality of construction. Prior to construction, please contact our office so that a Foundation and Earthwork Monitoring Plan can be incorporated into the Project Quality Control Program.

8.2. Site Preparation

It is our understanding that onsite soil can be utilized as structural fill. In any areas where soil-supported floor slabs or pavement are to be constructed, vegetation and all loose or organic material shall be stripped and removed from the site. Subsequent to stripping operations, the subgrade shall be proof-rolled to identify soft zones. Any soft zone detected shall be removed to a firm subgrade soils and replaced with compacted suitable soils to reach subgrade level. Upon the acceptance of proof-rolling operations the subgrade shall be scarified to a minimum depth of 8 inches, moisture conditioned and compacted to a 95 percent of maximum dry density as determined by ASTM D698, at a moisture content between +/- 2 percentage points of optimum moisture content. The exposed subgrade shall not be allowed to dry out prior to placing structural fill.

If the site requires imported fill, the imported fill material shall be with maximum liquid limit of 35 percent and plasticity index (PI) between 5 and 20. The fill shall be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698, within ± 2 percentage points of optimum moisture content. Any imported soil should be tested and approved by the geotechnical engineer or his representative prior to use.

8.3. Drainage

Groundwater seepage was not encountered during drilling operations. However, minor groundwater seepage may be encountered within the proposed building foundation and grading excavations at the time of construction, especially after periods of heavy precipitation. Small quantities of seepage may be removed by conventional sump and pump methods of dewatering.

8.4. Temporary Drainage Measures

Temporary drainage provisions shall be established to minimize water runoff into construction areas. If standing water does accumulate, it shall be removed by pumping as soon as possible. Adequate protection against sloughing of soils shall be provided for workers and inspectors entering the excavations. This protection shall meet OSHA and other applicable building codes.

8.5. Control Testing and Field Observation

Subgrade preparation and select structural fill placement shall be monitored by the project geotechnical engineer or his representative. As a guideline, at least one in-place density test shall be performed for each 2,500 square feet of compacted surface lift. A minimum of two density tests shall be performed on the subgrade or per lift of compaction. Any areas not meeting the required compaction shall be re-compacted and retested until compliance is met.

8.6. Earthwork and Foundation Acceptance

Exposure to the environment may weaken the soils at the foundation bearing level if the excavation remains open for long periods of time. Therefore, it is recommended that all foundation excavations be extended to final grade and the footings constructed as soon as possible to minimize potential damage to bearing soils. The foundation bearing level shall be free of loose soil, ponded water or debris sand, and shall be inspected and approved by the geotechnical engineer or his representative prior to concreting.

Foundation concrete shall not be placed on soils that have been disturbed by rainfall or seepage. If the bearing soils are softened by surface water intrusion during exposure or by desiccation, the unsuitable soils must be removed from the foundation excavation and replaced prior to placement of concrete.

Subgrade preparation and fill placement operations shall be monitored by the geotechnical engineer or his representative. As a guideline, at least one in-place density test shall be performed for each 2,500 square feet of compacted surface lift. Any areas not meeting the required compaction shall be recompacted and retested until compliance is met.

9.0. DRAINAGE AND MAINTENANCE

Final drainage is important for the performance of the proposed structures and pavement. Landscaping, plumbing, and downspout drainage are also important. It is vital that all roof drainage be transported away from the building so that water does not pond around it, which can result in a soil volume change underneath the building. Plumbing leaks should be repaired as soon as possible in order to minimize the magnitude of a moisture change under the slab**. Large trees and shrubs shall not be planted in the immediate vicinity of the structures, since root systems can cause a substantial reduction in soil volume in the vicinity of the trees during dry periods.**

Adequate drainage shall be provided to reduce seasonal variations in moisture content of foundation soils. All pavement and sidewalks within 10-feet of the structures shall be sloped away from the structures to prevent ponding of water around the foundations. Final grades within 10-feet of the structure shall be adjusted to slope away from structures preferably at a minimum slope of 3 percent. Maintaining positive surface drainage throughout the life of the structure is essential.

In areas with pavement or sidewalks adjacent to the new structure, a positive seal must be provided and maintained between the structures and the pavement or sidewalk to minimize seepage of water

into the underlying supporting soils. Post-construction movement of pavement and flat-work is not uncommon. Maximum grades practical shall be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades shall take into consideration post construction movement of flatwork, particularly if such movement would be critical. Normal maintenance shall include inspection of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.

There are several factors related to civil and architectural design and/or maintenance that can significantly affect future movements of the foundation and floor slab systems.

1. Where positive surface drainage cannot be achieved by grading the ground surface adjacent to the buildings, a complete system of gutters and downspouts shall carry runoff water a minimum of 10-feet from the completed structures.
2. Planters located adjacent to the structures shall preferably be self-contained. Sprinkler mains shall be located a minimum of five feet from the building line.
3. Planter box structures placed adjacent to the building shall be provided with a means to assure concentrations of water do not infiltrate the subsoils stratigraphy.
4. Large trees and shrubs shall not be planted closer to the foundations than a horizontal distance equal to roughly their mature height due to their significant moisture demand upon maturing.
5. Moisture conditions shall be maintained "constant" around the edge of the slabs. Ponding of water in planters, in unpaved areas, and around joints in paving and sidewalks can cause slab movements beyond those predicted in this report.
6. Roof drains shall discharge on pavement or be extended away from the structures. Ideally, roof drains shall discharge to storm sewers by closed pipe.

Trench backfill for utilities shall be properly placed and compacted, as outlined in this report, and in accordance with the requirements of local City, County and/or State Standards. Since granular bedding backfill is used for most utility lines, the backfilled trench shall be prevented from becoming a conduit and allowing an access for surface or subsurface water to travel toward the new structures. Concrete cut-off collars or clay plugs shall be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.

The potential vertical heave values estimated and stated under "Vertical Movements" are based on the provision that positive drainage shall be maintained to divert water away from the building and adjacent pavement. If this drainage is not maintained, the wetted front may occur below the assumed fifteen feet depth, and the resulting vertical heave may be 2 to 3 times greater than the stated values shown in this report. Utility leaks may also cause similar high movements to occur.

Foundation Drain (if proposed)

The drain lines should consist of a minimum 4-inch-diameter, perforated, rigid PVC drainpipe placed in the bottom of a trench excavated at the base of the over excavated zone. The slab subgrade should be crowned near the center of the building and sloped towards the exterior sides of the structure(s) at a minimum slope of 2%.

A geomembrane liner with a minimum thickness of 20-mils overlain by a gravel drainage layer should be placed on top of the subgrade under the entire floor slab area. Geomembrane is intended to collect water that seeps through joints or cracks in the slab to prevent water from migrating into the underlying soils and/or bedrock. The geomembrane should be chemically or mechanically adhered to the foundation walls to prevent water from seeping behind the geomembrane.

A perimeter drain would then be provided above the geomembrane. The underdrain pipes should be covered with a free draining gravel consisting of aggregate with less than 5% passing the No. 200 sieve, less than 30% passing the No. 4 sieve, and having a maximum aggregate size of 1 ½ inches. The gravel surrounding the pipe should be wrapped in a geotextile filter fabric to prevent migration of fines into the pipe. The base of the over excavation should be graded to slope towards the drain lines with a minimum slope of ½%. The overall underdrain pipe system should be sloped at a minimum slope of ½% to an overall site subdrain collection system or to a sump or sumps where water can be removed by pumping or gravity drainage.

Sumps should be provided with alarms and/or redundant pumps in the event the pumping equipment malfunctions. In addition, the drain lines should be provided with appropriately spaced cleanouts for maintenance and inspection, which we recommend be performed. on a routine basis. An over-designed sump and pump capacity is desirable in the event subsurface water conditions change. We also believe that standby pump capacity and standby generators should be provided in the event of pump or energy failure.

10.0. SHORING

Shoring of excavations and design of shoring systems are governed by federal, state, and local regulations. The design of shoring systems on this project is beyond the scope of our services. The owner or the contractor should retain a shoring design professional to design shoring systems for excavations on this site.

11.0. LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from one (1) boring drilled at the site. This report may not reflect the exact variations of the soil conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. If variations appear evident, it will be necessary to re-evaluate our recommendations after performing on-site observations and tests to establish the engineering significance of any variations. The project geotechnical engineer should review the final plan for the proposed building so that he may determine if changes in the foundation recommendations are required. The project geotechnical engineer declares that the findings, recommendations or professional advice contained herein have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechnical engineering and engineering geology. No other warranties are implied or expressed.

This report is valid until site conditions change due to disturbance (cut and fill grading) or changes to nearby drainage conditions or for 3 years from the date of this report, whichever occurs first. Beyond this expiration date, Terradyne shall not accept any liability associated with the engineering recommendations in the report, particularly if the site conditions have changed. If this report is desired for use for design purposes beyond this expiration date, we highly recommend drilling additional borings so that we can verify the subsurface conditions and validate the recommendations in this report.

This report has been prepared for the exclusive use of Pat Iffrig from Meritage Homes for the specific application to the site Paint Brush Hills Subdivision (Lot 102) in Peyton, Colorado.

APPENDIX A

N

Source: Google Maps, 2024

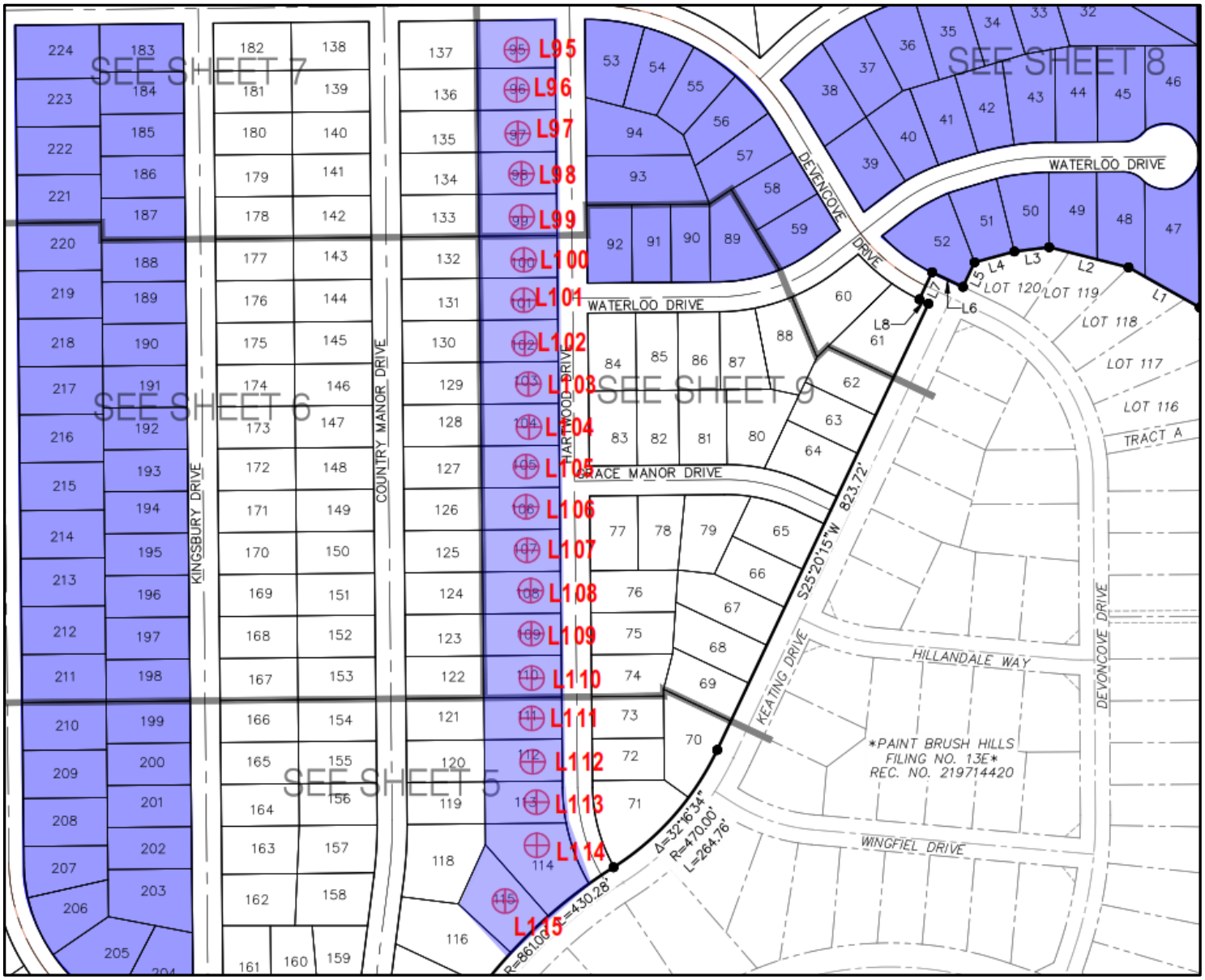
Report of Geotechnical Engineering Evaluation
Proposed Paint Brush Hills Subdivision
Near Londonderry Drive and Devoncove Drive,
Peyton, Colorado
(GPS Coordinator: 38.9828, -104.6337)

Terradyne Engineering, Inc.

Site Location map

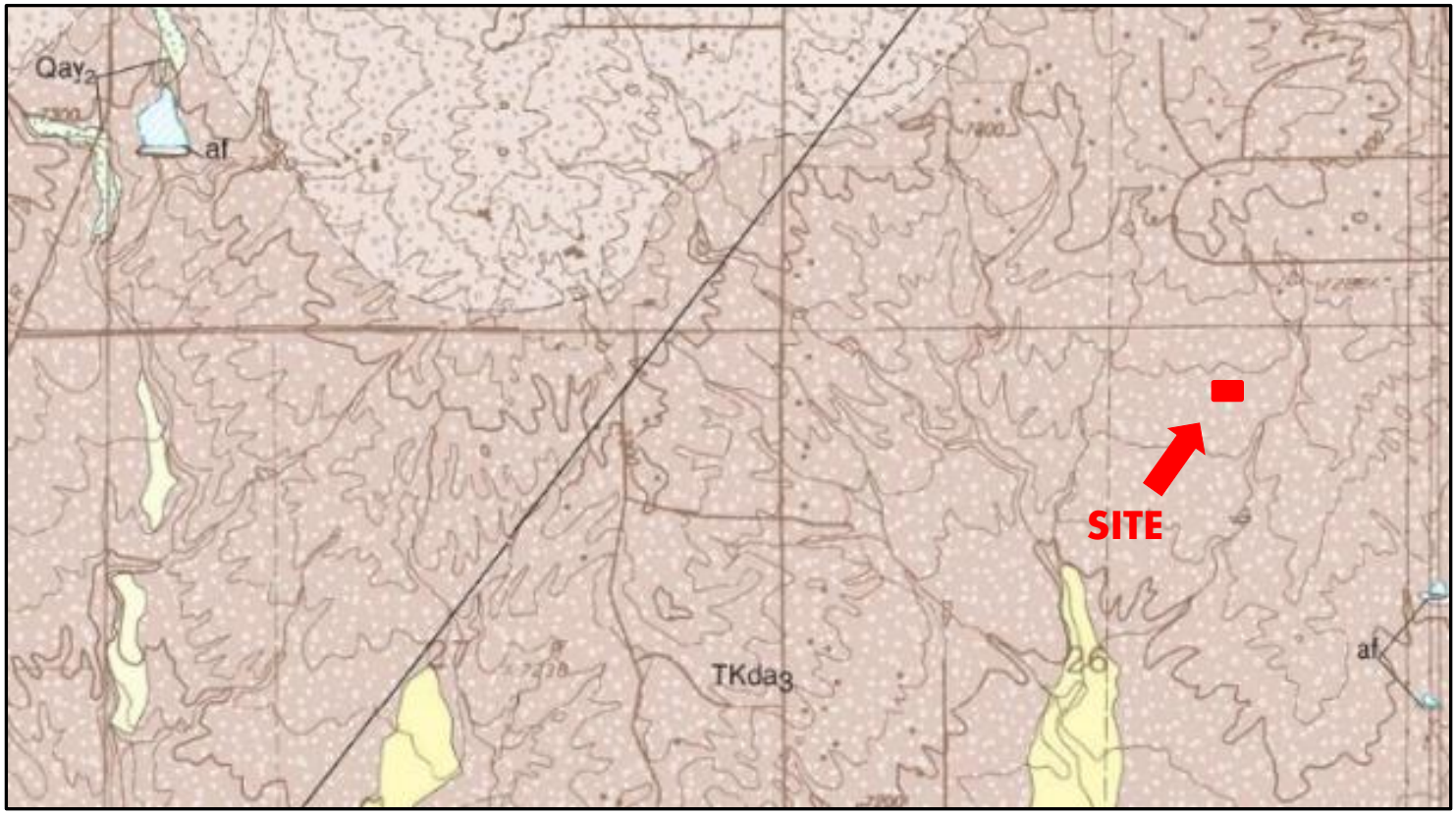
Terradyne Project No.: C241043

Figure: A



Approximate Boring Location

Report of Geotechnical Engineering Evaluation **Proposed Paint Brush Hills Subdivision** Near Londonderry Drive and Devoncove Drive, Peyton, Colorado (GPS Coordinator: 38.9828, -104.6337)	**Terradyne Engineering, Inc.**	
	Boring Location map	
	Terradyne Project No.: C241043	Figure: B



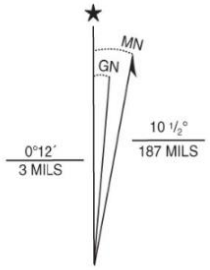
SCALE 1: 24,000

1 0.5 0 1 MILE

UNITS:

TKda3

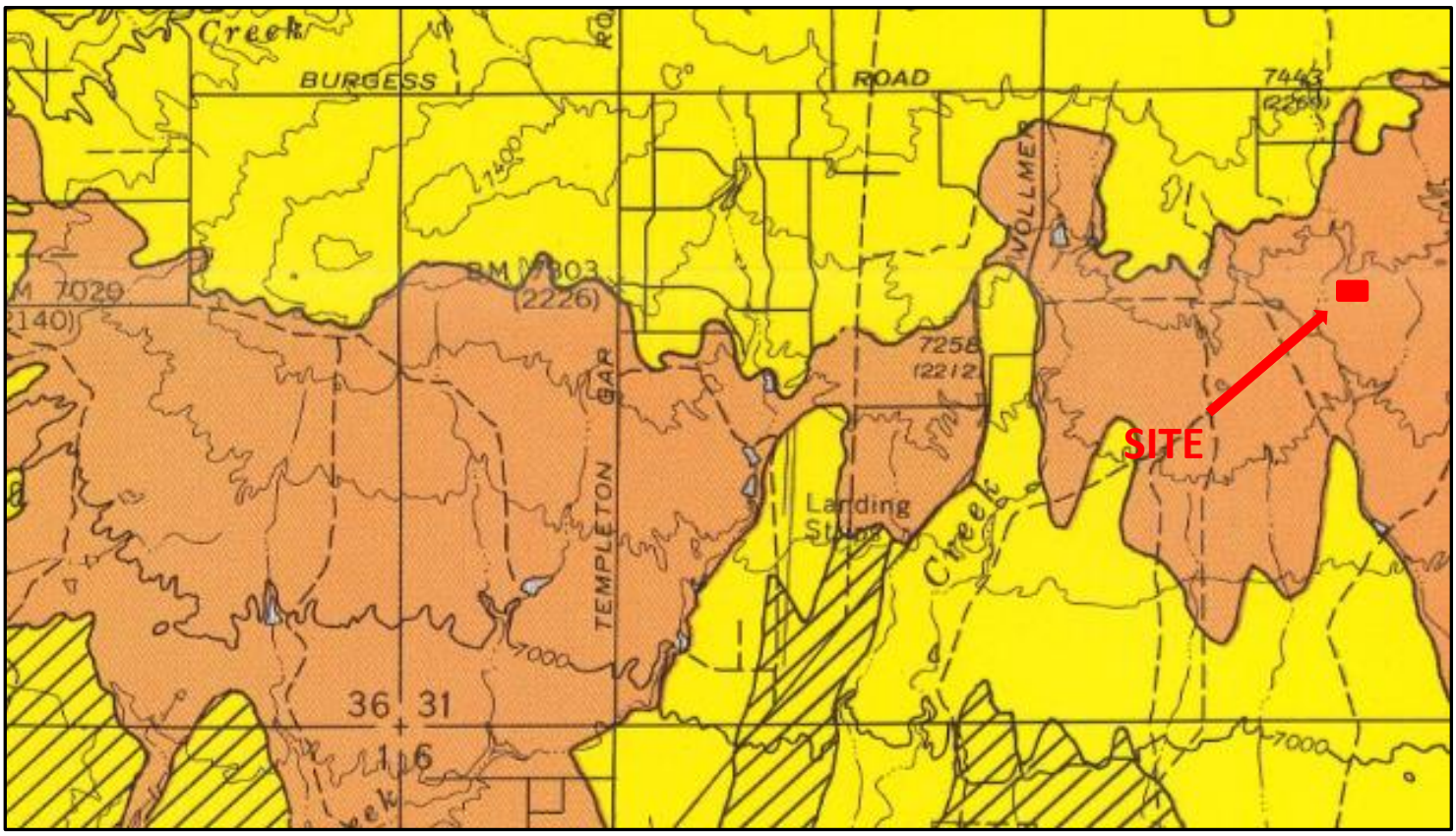
Dawson Formation (Upper Cretaceous, Paleocene and Eocene)



UTM GRID AND 1975 MAGNETIC NORTH DECLINATION AT CENTER OF MAP DIAGRAM IS APPROXIMATE

Map Reference: Madole, R.F., 2003, Geologic Map of the Falcon NW 7.5 Minute Quadrangle, El Paso County, Colorado: Colorado Geological Survey, Open-File Report OF-03-08, scale 1:24,000

Report of Geotechnical Engineering Evaluation **Proposed Paint Brush Hills Subdivision** Near Londonderry Drive and Devoncove Drive, Peyton, Colorado (GPS Coordinator: 38.9828, -104.6337)	**Terradyne Engineering, Inc.**
	Regional Geologic Map
Terradyne Project No.: C241043	Figure: C



SCALE 1:100,000

1 ½ 0 1 2 3 4 5 MILES

5000 0 5000 10 000 15 000 20 000 25 000 FEET

1 5 0 1 2 3 4 5 KILOMETERS

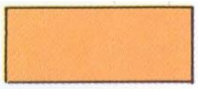
13°
TRUE NORTH
MAGNETIC NORTH
DECLINATION AT
CENTER OF SHEET

Map Reference: Hart, Stephen S. "EG-07 Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado." Soil Engineering. Environmental Geology. Denver, CO: Colorado Geological Survey, Department of Natural Resources, 1974. https://doi.org/10.58783/cgs.eg07.fzwb5432. CGS Publications. https://coloradogeologicalsurvey.org/publications/potentially-swelling-soil-rock-front-range-urban-corridor-colorado/.

Report of Geotechnical Engineering Evaluation **Proposed Paint Brush Hills Subdivision** Near Londonderry Drive and Devoncove Drive, Peyton, Colorado (GPS Coordinator: 38.9828, -104.6337)	**Terradyne Engineering, Inc.**
	Swell Map
Terradyne Project No.: C241043	Figure: D

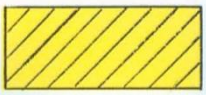
VERY HIGH SWELL POTENTIAL: *This category includes only bedrock or weathered bedrock. The precautions listed below under "high swell potential" must be utilized. Although construction in these areas is often unavoidable, alternate non-construction uses might be considered for such areas.*

HIGH SWELL POTENTIAL: *This category generally includes only bedrock, weathered bedrock, and colluvium. Careful site investigation, special foundation design, and proper post-construction landscaping and maintenance are required to prevent or minimize damage.*



MODERATE SWELL POTENTIAL: *This category includes several bedrock formations and a few surficial deposits of variable thickness. Special foundation designs are generally ncessary to prevent damage.*

LOW SWELL POTENTIAL: *This category includes several bedrock formations and many surficial deposits. The thickness of the surficial deposits may be variable, therefore, bedrock with a higher swell potential may locally be less than 10 ft below the surface.*



WINDBLOWN SAND OR SILT: *Although this material generally has low swell potential, the upper 6 inches to 12 inches may locally have moderate swell potential. Windblown material may be subject to severe settlement or hydrocompaction when water is allowed to saturate the deposits. The thickness of windblown material may be very variable, therefore, bedrock with higher swell potential may locally be less than 10 ft below the surface.*

Report of Geotechnical Engineering Evaluation **Proposed Paint Brush Hills Subdivision** Near Londonderry Drive and Devoncove Drive, Peyton, Colorado (GPS Coordinator: 38.9828, -104.6337)	**Terradyne Engineering, Inc.**	
	Swell Map (Continue)	
	Terradyne Project No.: C241043	Figure: D2

APPENDIX B

Boring Logs

Project: **Proposed Single-Family Residence**
Project Location: **Paintbrush Hills Subdivision**
Terradyne Project Number: **C241043**

Log of Boring L102

Sheet 1 of 1

Date(s) Drilled **7/8/24**	TERRADYNE Engineers, Geologists & Environmental Scientists	
Drilling Method **Solid Stem Auger**		Total Depth of Borehole **20 feet bgs**
Drill Rig Type **CME**		Approximate Surface Elevation
Groundwater Level and Date Measured **Not encountered**	Sampling Method(s) **Mod Cal**	
Borehole Backfill **With native soil**	Location **See Boing Location Map**	

Depth (feet)	Sample Type	N=blows/ft (SPT) T=inches/100 blows (THD)	PP (tsf)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Passing #200 Sieve, %	LL, %	PL, %	PI, %	UC, tsf	REMARKS AND OTHER TESTS
0					Clayey SAND, brown, slightly moist, dense to very dense, fine to coarse grained sand, low plasticity clay								
5		N=50+				8.2							Swell=+0.0%
10		N=50+				8.5		30					
15		N=50+				10.3							
20		N=50+				7.3		38					
					End of boring at 20 feet No groundwater No caving Backfilled with native soil								
25													
30													
35													

C:\Users\Jimmy Jiang\OneDrive - Terradyne Engineering, Inc\GEO\2024\Projects\Engineering\C241043 - Paint Brush Hills Meritage Homes\Boring Log\7-8-24 drilling\C241043.bg4[template BGS.tpl]

Figure E

Project: **Proposed Single-Family Residence**
Project Location: **Paintbrush Hills Subdivision**
Terradyne Project Number: **C241043**

Key to Log of Boring

Sheet 1 of 1

Depth (feet)	Sample Type	N=blows/ft (SPT) T=inches/100 blows (THD)	PP (tsf)	Graphic Log	MATERIAL DESCRIPTION	Water Conte	Dry Unit We	Passing #2C	LL, %	PL, %	PI, %	UC, tsf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12	13	14

COLUMN DESCRIPTIONS

1. Depth (feet): Depth in feet below the ground surface.
2. Sample Type: Type of soil sample collected at the depth interval shown.
3. N=blows/ft (SPT) T=inches/100 blows (THD): N: Number of blows to advance SPT sampler 12 inches or distance shown, OR T: Penetration in inches of THD Cone for 100 blows
4. PP (tsf): The Relative Consistency of the soil, measured by Pocket Penetrometer in tons/square foot
5. Graphic Log: Graphic depiction of the subsurface material encountered.
6. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
7. Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
8. Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.
9. Passing #200 Sieve, %: The percent fines (soil passing the No. 200 Sieve) in the sample.
10. LL, %: Liquid Limit, expressed as a water content
11. PL, %: Plastic Limit, expressed as a water content.
12. PI, %: Plasticity Index, expressed as a water content.
13. UC, tsf: Unconfined compressive strength.
14. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

SPT: Standard Penetration Test
THD: Texas Dept. of Transportation Cone Penetrometer Test
LL: Liquid Limit, percent
PL: Plastic Limit, percent
PI: Plasticity Index, percent
PP: Pocket Penetrometer
UC: Unconfined compressive strength test, Qu, in ksf

TYPICAL MATERIAL GRAPHIC SYMBOLS

Clayey SAND (SC)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Auger sampler
- Bulk Sample
- 3-inch-OD California w/ brass rings
- CME Sampler
- Grab Sample
- 2.5-inch-OD Modified California w/ brass liners
- Pitcher Sample
- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting, AW)
- Minor change in material properties within a stratum
- Inferred/gradational contact between strata
- Queried contact between strata

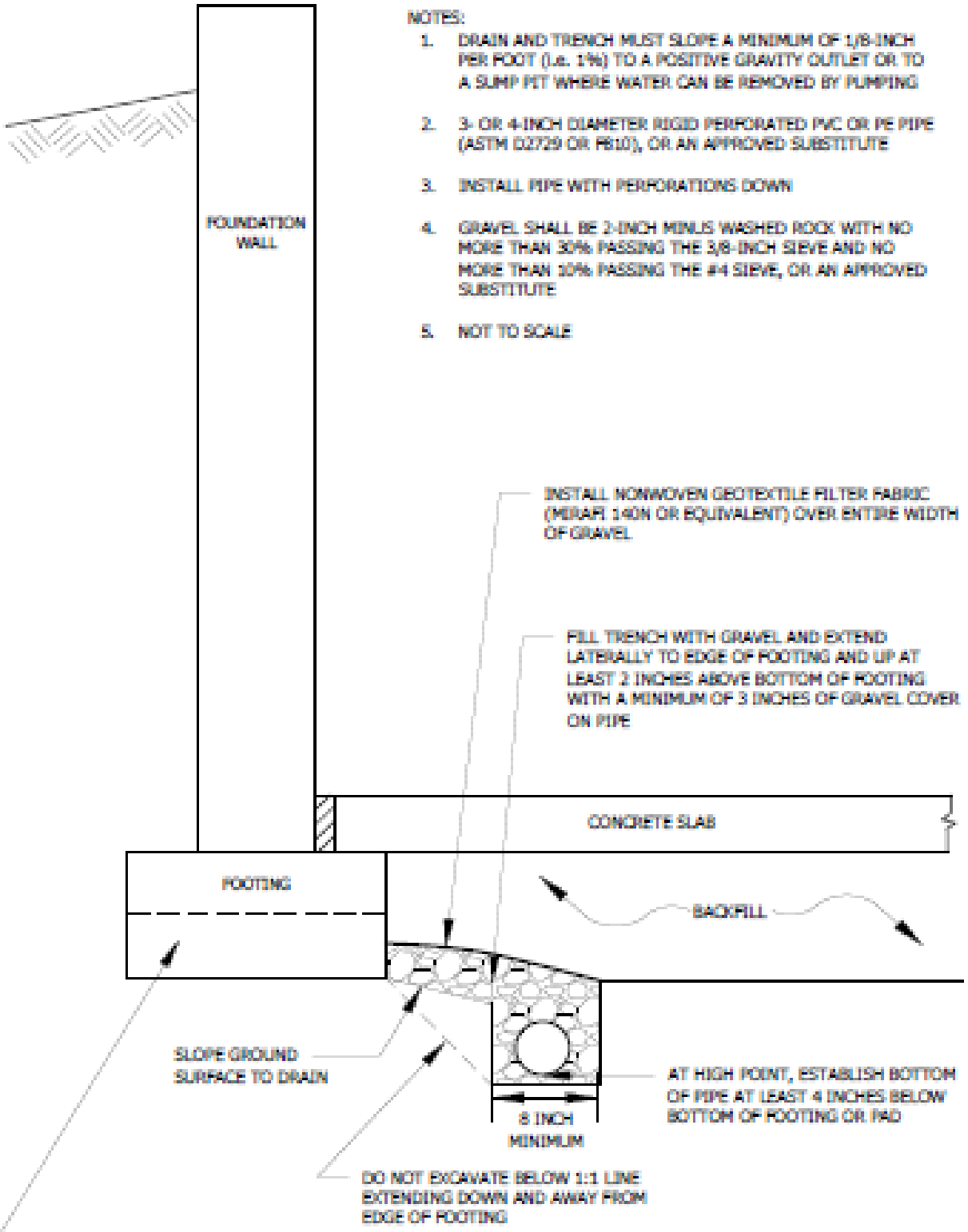
GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure F

NOTES:

1. DRAIN AND TRENCH MUST SLOPE A MINIMUM OF 1/8-INCH PER FOOT (i.e. 1%) TO A POSITIVE GRAVITY OUTLET OR TO A SUMP PIT WHERE WATER CAN BE REMOVED BY PUMPING
2. 3- OR 4-INCH DIAMETER RIGID PERFORATED PVC OR PE PIPE (ASTM D2729 OR PB10), OR AN APPROVED SUBSTITUTE
3. INSTALL PIPE WITH PERFORATIONS DOWN
4. GRAVEL SHALL BE 2-INCH MINUS WASHED ROCK WITH NO MORE THAN 30% PASSING THE 3/8-INCH SIEVE AND NO MORE THAN 10% PASSING THE #4 SIEVE, OR AN APPROVED SUBSTITUTE
5. NOT TO SCALE



CREATE MINIMUM 4-INCH PATHWAYS THROUGH OR UNDER. THE FOOTING WITH SOLID PIPE OR FOUNDATION VOID MATERIAL. PATHWAYS SHOULD BE BENEATH EACH WINDOW WELL AND AT MAXIMUM 15 FOOT INTERVALS AROUND THE FOUNDATION

TERRADYNE
Engineers, Geologists & Environmental Scientists

Foundation Drain Illustration	Figure G

DRAFT | JULY 2019