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PRELIMINARY GEOTECHNICAL INVESTIGATION AND GEOLOGIC HAZARDS EVALUATION LATIGO TRAILS FILINGS 9 AND 10, 78 LOTS SOUTHWEST OF EASTONVILLE ROAD AND LATIGO BOULEVARD EL PASO COUNTY, COLORADO

Prepared For:

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Project No. CS19409-115

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SCOPE

This report presents the results of our Preliminary Geotechnical Investigation for Latigo Trails Filings 9 and 10 located west of Eastonville Road and south of Latigo Bouevard in El Paso County, Colorado. Filing 9 is located in the western portion of Section 16 and Filing 10 is located in the southwest portion of Section 17, Township 12 South, Range 64 West of the 6th Principal Meridian, El Paso County, Colorado (Fig. 1). The purpose of our investigation was to evaluate the subsurface conditions to assist in due diligence and planning of site development. The scope was described in our Proposal (CS-21-0067) dated April 27, 2021. Evaluation of the property for the presence of potentially hazardous materials (Phase I Environmental Site Assessment) is not within our scope.

This report is based on our understanding of the planned construction, subsurface conditions disclosed by our exploratory drilling, test pits, and sampling, results of field and laboratory tests, engineering analysis, and our experience. It contains descriptions of the soil and bedrock conditions and groundwater levels found in our exploratory borings and test pits, preliminary discussions of site development, and preliminary design and construction criteria for foundations, floor systems, pavements, and surface and subsurface drainage. The discussions of foundations, floor systems, pavement alternatives, and septic systems are intended for planning purposes only. Additional, site-specific investigations will be necessary to design structures, pavements, and other improvements. A summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY

1. We found no geotechnical or geologic conditions that we believe preclude development of this site for construction of a residential subdivision. The occurrence of shallow bedrock may affect septic systems, grading and utility installation across the site. Expansive bedrock may influence design and construction of site improvements and structures

in some areas. We believe these concerns can be mitigated with proper planning, engineering, design, and construction.

2. Strata found in our borings generally consisted of a relatively thin surficial layer of clayey sand underlain by sandstone and claystone bedrock extending to the maximum depths explored of 20 to 30 feet. Bedrock was encountered at depths between 1 and 3.5 feet below the ground surface. Testing, and our experience, indicates the near-surface soils are generally non-expansive. The sandstone bedrock is non-expansive or exhibits low swell potential. The claystone bedrock exhibits variable expansion potential.

3. The presence of shallow bedrock widespread throughout the site areas constitutes a limiting layer for construction of on-site sewage disposal systems. We anticipate engineered systems will be necessary at the majority of the lots.

4. Groundwater was encountered in one of our borings at the time of our drilling at a depth of 28 feet. When checked approximately 24 hours after drilling, groundwater was measured in one boring at a depth of 26 feet. Groundwater elevations will vary with seasonal precipitation and landscaping irrigation.

5. The presence of expansive bedrock on the site constitutes a geologic hazard. There is risk that these materials may heave and damage slabs-on-grade and in some instances, foundations may be damaged. Where claystone is encountered within excavations, sub-excavation to a depth of 4-feet, or to sandstone, whichever occurs first, will be appropriate. Some lots may require sub-excavation to depths greater than 4-feet where thicker layers of moderately expansive claystone is present. Straight shaft drilled piers bottomed in bedrock are an appropriate alternative to sub-excavation and replacement.

6. We believe spread footings will be appropriate if underlain by natural sand, sandstone, or new moisture conditioned and densely compacted fill.

7. The natural sandstone, or new densely compacted fill should provide good support for floor slabs. Performance of slabs will be poor where claystone bedrock is present near floor levels. Sub-excavation of claystone and replacement with moisture conditioned fill can enhance performance of slabs.

8. The near-surface sand and sandstone, and fill constructed using the sand and sandstone should provide good support characteristics for pavements. We estimate minimum pavement sections of at least 3 inches of asphalt over 6 inches of aggregate base. Where clay or clay-

stone is present at or near pavement subgrade elevations, thicker pavement sections will likely be required.

9. Control of surface drainage will be critical to the performance of foundations, slabs-on-grade, and pavements. Overall surface drainage should be designed to provide rapid run-off of surface water away from structures and off pavements and flatwork. Conservative irrigation practices should be employed to avoid excess wetting.

SITE CONDITIONS

Filing 9 is an irregular shaped, elongated site of approximately 95 acres located approximately 800 feet west of Eastonville Road and immediately south of Latigo Boulevard. Existing rural residential properties lie to the west of Filing 9. Undeveloped property borders Filing 9 to the south and east. Filing 10 is an irregular shaped, elongated site of approximately 115 acres located northeast of the intersection of Water Tank Heights and Londonderry Drive. An existing detention area is present in the northern portion of Filing 9.

Vegetation consists of weeds and grasses. The site is gently to moderately rolling terrain with overall generally to the southeast. Grades vary from approximately 1 to 15 percent with the steeper grades found in drainage areas. Figure 1 shows the size, shape, and the vicinity of the site.

PROPOSED CONSTRUCTION

We understand Filings 9 and 10 will be developed with a total of 78 single-family residences on approximate 2.5 acre lots. We anticipate the proposed residence will be wood-frame, one or two-story structures with attached garages served by paved or gravel roadways and buried utilities. We understand the Meridian Ranch Metro District will provide water service. Grading plans were not available at the time this report was prepared. Grading will be limited to construction of roads, waterlines, and dry utilities. Individual on-site sewage disposal systems (septic systems) are planned.

INVESTIGATION

We investigated subsurface conditions June 14th through June 23rd, 2021 by drilling and sampling twenty exploratory borings. Additionally, we excavated a total of sixteen test pits on July 29, 2021. The approximate locations of our borings and test pits are shown on Fig. 1. The borings were drilled to depths of 20 to 30-feet below existing grades using 4-inch diameter, continuous-flight solid-stem auger and a truck-mounted CME-45 drill rig. The test pits were excavated to depths of 5 to 10-feet below existing grades using a Cat® 325 trackhoe.

Samples were obtained at approximate 5-foot intervals using a 2.5-inch diameter (O.D.) modified California barrel sampler driven by blows from an automatic 140-pound hammer falling 30 inches. Our field representative was present to observe drilling operations, log the strata encountered and obtain samples. Summary logs of the exploratory borings are presented in Appendix A. Soil samples obtained during drilling were visually classified and laboratory testing was assigned to representative samples. Swell-consolidation and gradation test results are presented in Appendix B. Laboratory test data are summarized in Table B-1.

SUBSURFACE CONDITIONS

Strata encountered in our exploratory borings generally consisted of relatively thin, surficial layers of clayey sand at the surface underlain by sandstone and claystone bedrock to the maximum depths explored of 20 to 30 feet. Some of the pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

Natural Soils

Natural clayey sand was encountered at the ground surface in each of our borings and extended to depths ranging from about 1 to 3.5 feet below the existing ground surface. We believe the sand to have a nil to low swell potential.

Bedrock

Bedrock consisting of clayey to very clayey to slightly silty to very silty sandstone, and sandy to very sandy claystone was encountered in each of the borings underlying natural soils, at depths between 1 and 3.5 feet below the ground surface. The bedrock was hard to very hard. Sandstone was encountered in each of the twenty borings drilled for this investigation and claystone was encountered in eight of the twenty borings. The bedrock is generally weakly cemented.

Twenty-one samples of the sandstone tested in our laboratory contained 9 to 48 percent silt and clay-size particles. Five samples of the sandstone exhibited measured swell between 0.3 and 1.6 percent, four samples exhibited slight compression, and one sample exhibited no movement when wetted under estimated overburden pressure. Three samples of the claystone exhibited measured swell of 0.5, 1.4, and 4.5 percent and one sample compressed 2.8 percent when wetted under estimated overburden pressure. We attribute the compression to sample disturbance. Four samples of the claystone tested in our laboratory contained 52 to 65 percent silt and clay-size particles. Two samples of the claystone exhibited measured swells of 0.6 and 2.4 percent when wetted, and two samples exhibited slight compression. We believe the samples that exhibited compression were likely disturbed and are not representative of compressible materials.

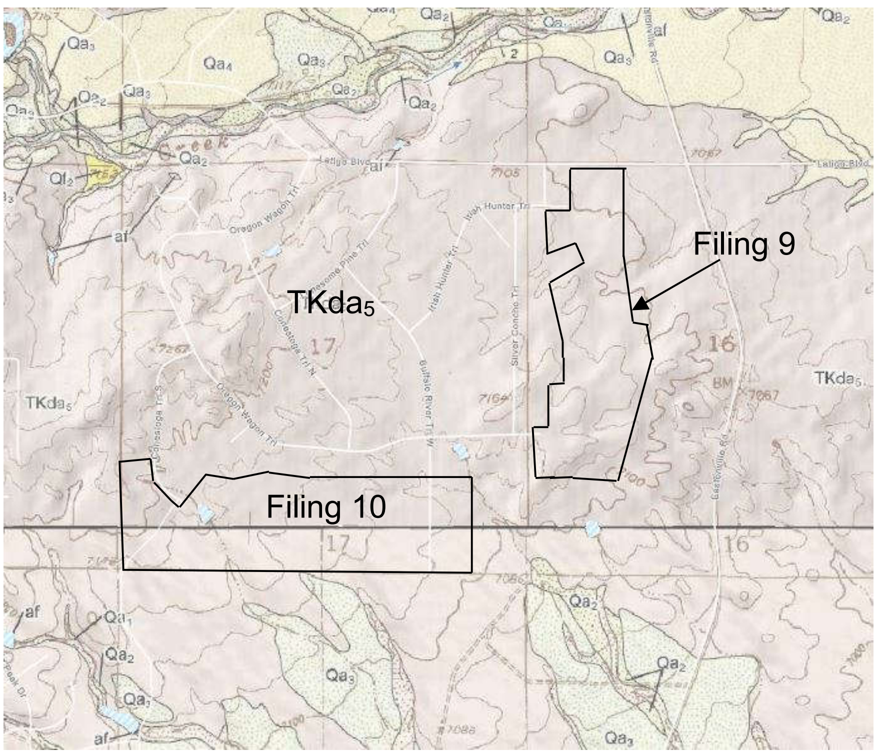
Groundwater

Groundwater was encountered in boring TH-1 at a depth of 28 feet at the time of drilling. Groundwater was not encountered in the remaining borings. When checked approximately 24 hours after drilling, groundwater was measured at a depth of 26 feet in boring TH-1. Groundwater may develop and fluctuate seasonally and rise in response to development, precipitation, and landscape irrigation.

SITE GEOLOGY

The surficial geology at the site was evaluated by reviewing published geologic maps and our site visits. The Eastonville Quadrangle Geologic Map published by the Colorado Geological Survey, covers Filing 9 and the majority of Filing 10. The southern end of Filing 10 is covered by the Falcon Quadrangle Geologic map published by the Colorado Geological Survey

The geology at the site is mapped as Dawson Formation bedrock, facies 5 ($TKda_5$). The bedrock generally consists of sandstone with occasional interbedded layers of sandy claystone. Conditions at the site were found to be similar to the mapped conditions with the exception of a surficial layer of clayey sand.



Excerpt from Eastonville and Falcon 7.5 minute Geologic Maps

GEOLOGIC HAZARDS

Geologic hazards we identified at the site include expansive soils and hard bedrock. No geologic hazards were noted that we believe preclude the proposed development. We believe potential hazards can be mitigated with proper engineering, design, and construction practices, as discussed in this report. Figs. 2 and 3 show our interpretation of the engineering geology modified from the system used by Charles Robinson & Associates (1977).

Shallow Groundwater

Groundwater was encountered in boring TH-1 during drilling at a depth of 28 feet below the existing ground surface. We measured groundwater approximately 24 hours after drilling at a depth of 26 feet. Borings TH-2 through TH-20 were dry at the time of drilling and when measured approximately 24 hours after drilling. Our borings were drilled in late spring to early summer when natural groundwater elevations are approaching seasonal highs. We expect shallow groundwater will not present a significant or widespread constraint within the development; however, areas of seasonally high groundwater may be present near drainages. Additionally, perched groundwater may develop after development where more permeable granular soils overlie less permeable bedrock.

Hard Bedrock

The sandstone and claystone of the Dawson Formation are hard to very hard and present at shallow depths within the site. The hard to very hard bedrock will be difficult to excavation and will require heavy duty excavation equipment. Deep excavations into bedrock will require rock teeth and rock buckets. Additionally, the hard bedrock constitutes a limiting layer for construction of on-site sewage disposal systems.

Expansive Soils and Bedrock

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are referred to as expansive soils. Other soils can compress significantly upon wetting and/or additional loading (from foundations or site grading fill) and are identified as compressible or collapsible soils. Much of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit compressible behavior are more likely west of the Continental Divide; however, both types of soils occur throughout the state.

Covering the ground with structures, streets, driveways, patios, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement due to heave or settlement is inevitable. Expansive bedrock is present at this site, which constitutes a geologic hazard. There is risk that foundations and slab-on-grade floors will experience heave or settlement and damage. It is critical that precautions are taken to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. Engineered planning, design and construction of grading, pavements, foundations, slabs-on-grade, and drainage can mitigate, but not eliminate, the effects of expansive and compressible soils. Sub-excavation is a ground improvement method that can be used to reduce the impacts of swelling soils.

Flooding

The entire site lies within Zone D (undetermined flood hazard) as shown on FIRM Community Map Number 08041C0494F, revised March 1997. Zone D indicates floods are possible, but not likely. Based on the topography at the site the potential for a flood to impact the area is low. During peak precipitation events, some accumulation of surface sheet flow in drainages may occur. Development will increase the relative area of impervious surfaces, which can lead to drainage problems and erosion if surface water flow is not adequately designed. Surface drainage design and evaluation of flood potential should be performed by a civil engineer as part of the project design.

Seismicity

This area, like most of Colorado, is subject to a low degree of seismic risk. The soil and bedrock units are not expected to respond unusually to seismic activity. According to the 2015 International Residential Code and based upon the results of our investigation, we judge the site classifies as Seismic Site Class C.

Erosion

The site is susceptible to the effects of wind and water erosion. Water flowing across the site in an uncontrolled manner will likely result in considerable erosion, particularly where the water flow is concentrated. The surficial sandy soils are relatively stable and resistant to wind erosion where vegetation is established. Disturbance of the vegetative cover and long-term exposure of these deposits to the erosive power of wind and water increases the potential for erosion. Maintaining vegetative cover and utilizing surface drainage collection and distribution systems will reduce the potential for erosion from wind and water.

Radon/Radioactivity

We believe no unusual hazard exists from naturally occurring sources of radioactivity on the site. However, the materials found in this area are often associated with the production of radon gas and concentrations in excess of those currently accepted by the EPA can occur. Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after a structure is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, we recommend structures be tested after they are enclosed. Commonly utilized mitigation techniques may minimize risk.

Recoverable Minerals

The project site is included in the Aggregate Resources of Colorado mapping from the Colorado Geological Survey. The mapping does not indicate any commercial sand or gravel pits near the project site. We observed no evidence of surface or subsurface mining at the site.

SITE DEVELOPMENT CONSIDERATIONS

We did not identify geotechnical conditions we believe will preclude development of the site for the proposed rural residential construction. The conditions we identified that may pose constraints to development include the occurrence of sporadic areas of expansive soils and widespread shallow bedrock. Localized areas of potentially seasonal shallow groundwater can be avoided by siting the residences away from these areas. Regional geologic conditions that may affect the site include seismicity and low-level gamma radiation. We believe these conditions can be mitigated with engineering design and construction methods commonly employed in this area. These conditions are discussed in greater detail in the following sections.

Sub-Excavation

Our investigation indicates soils with predominantly low expansion potential are present at depths likely to influence the performance of shallow foundations and slabs-on-grade. Localized areas of moderate to high expansion potential can be expected particularly in the area of boring TH-8. Our experience suggests performance of structures constructed on claystone bedrock materials can be erratic. Where present near foundation levels, sub-excavation ranging from 4 feet to 8 feet in thickness may be appropriate depending on planned finish grades and results of future lot specific investigations. This condition is not expected to be widespread throughout the development. The variable and sporadic nature of claystone beds within the Dawson Formation precludes identifying areas where sub-excavation would be required until individual lots are evaluated at the time of the lot specific soils and foundation investigation.

Sub-excavation has been used throughout Colorado with satisfactory performance for most of the sites where this ground modification method has been completed. We have seen isolated instances where settlement of sub-excavation fill has led to damage to houses supported on footings. In most cases, the settlement was caused by wetting associated with poor surface drainage or seepage, and/or poorly compacted fill placed at the horizontal limits of excavation. Wetting of the fill may cause softening and settlement.

Site Grading and Utilities

We understand grading will initially be limited to construction of utilities and roadways. Individual home sites will be graded as necessary to accommodate home construction and onsite sewage disposal systems; however, this is expected to occur on a lot by lot basis subsequent to roadway and utility construction. We recommend grading plans consider cut and fill slopes no steeper than 3:1 (horizontal to vertical).

We believe grading can be accomplished using conventional construction techniques and heavy-duty equipment. Hard to very hard bedrock should be expected in cut areas at depths of about 1 to 3 feet across the site. Based on excavation of our soil profile pits we expect utility installation will require heavy-duty trackhoes with rock buckets and rock teeth. Excavations for utilities should be braced or sloped to maintain stability and meet applicable local, state, and federal safety regulations. Based on the Occupational Safety and Health Administration (OSHA) Standards, we believe most of the soil on this site can be classified as Type C soils and the bedrock as Type A soils. Type C soils require a maximum slope inclination of 1:1.5 (horizontal to vertical) and Type A soils require a maximum slope inclination of 0.75:1.

Prior to fill placement, the ground surface in areas to be filled should be stripped of vegetation/organics, and other deleterious materials, scarified to a depth of at least 8 inches, and moisture conditioned according to the table below. Potential import fill materials should be submitted to our office for approval prior to importing to the site, and should consist of soil having less than 35 percent fines and a plasticity index less than 15.

Table A – Compaction Specifications

Soil Type	Minimum Compaction	Moisture Content from Optimum
Clay	95% ASTM D698	+1 to +4
Sand	95% ASTM D698	-2 to +2

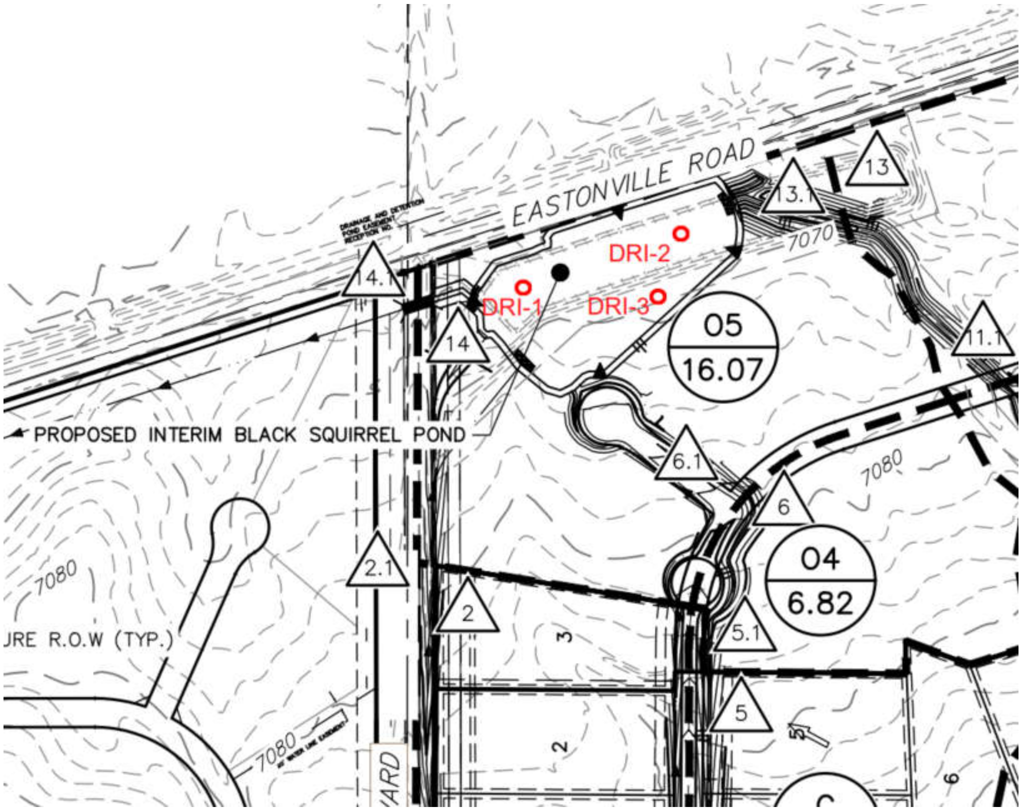
The properties of fill will affect the performance of foundations, slabs-on-grade, utilities, pavements, flatwork and other improvements. The on-site soils and excavated bedrock are suitable for use as new fill provided, they are substantially free of debris, vegetation/organics, deleterious materials, and chunks greater than 3 inches. Bedrock chunks should be broken down. Rock fragments larger than 3 inches in diameter should be removed (if present). Fill should be placed in thin loose lifts no more than 8 inches, moisture conditioned and compacted prior to placement of the next lift. The placement and compaction of new fill should be observed and density tested by our representative during construction.

GEOTECHNICAL CONSIDERATIONS FOR DETENTION BASIN

We understand a stormwater detention basin is planned at the southwest corner of Latigo Boulevard and Eastonville Road. A portion of the area has been previously rough graded as a detention basin; however, the proposed basin will be larger in area and will be finish graded with 3:1 horizontal to vertical slopes. No new fill is anticipated for construction of the pond. Grading will generally involve cuts and finish grading of the existing basin to an approximate depth of 3 to 4 feet.

The basin will not have an outlet pipe and will be designed with the expectation that stormwater will infiltrate into the ground. Accordingly, we recommend the upper 2 feet of soils within the existing pond bottom be scarified to loosen the compacted soils. Finish grading of the pond bottom should be performed in a manner that reduces compaction of the surficial soils. Use of light-weight or tracked equipment and sequencing grading in a manner that limits traffic over the pond bottom is recommended.

We performed double-ring infiltrometer (DRI) tests at three locations to obtain estimated infiltration rates. The approximate locations of the DRI tests are shown below. The DRI tests were conducted in substantial accordance with ASTM D3385–09, and consisted of driving two, open metal rings with different diameters (inner and outer) into the soils, partially filling the rings with water, and measuring the time for the water level to drop. The outer ring had a diameter of about 22.5 inches and the inner ring had a diameter of about 11.5 inches and was centered inside the larger ring. The rings were driven by hammering uniformly around the rings while using wood planks. We tamped disturbed soils and added hydrated bentonite around the base of the rings prior to adding water. The rings were then partially filled with water such that the water level inside the inner ring matched the water level in the annulus between the larger and smaller rings. The water level was recorded in 5 to 20 minute intervals.



Two tests (DR-1 and DR-2) were performed within the existing basin and results indicated infiltration rates of less than 0.1 inches per hour. We attribute the slow infiltration within the existing basin to compaction of the soils within the bottom of the basin. An additional test (DR-3) was performed outside of the existing basin, but within the area of the proposed basin. The estimated infiltration rates and soil types are presented in the table below.

SUMMARY OF RESULTS OF INFILTRATION TESTING

Test Location	Soil Type	Infiltration Rate Double-Ring Test (inches/hour)	Infiltration rate Double-Ring Test (cm/sec)
DR-1	Clayey Sand	<0.1	$<7.1 \times 10^{-5}$
DR-2	Clayey Sand	<0.1	$<7.1 \times 10^{-5}$
DR-3	Clayey Sand	7.5	5.3×10^{-3}

Using a reduction factor of 3, we recommend a design infiltration rate of 2.5 inches per hour or 1.8×10^{-3} cm/sec.

SEPTIC SYSTEMS

We understand the lots will require individual onsite sewage disposal systems. We excavated a total of sixteen soil profile pits at the locations shown on Fig. 1 in accordance El Paso County Code to evaluate the soils for septic fields. Based on our evaluation shallow bedrock is widespread across the majority of both filings. Shallow bedrock is considered a limiting layer. As such, we anticipate engineered systems will be required for most of the residences. Mounded systems utilizing import fill material are commonly used in this area. Septic fields must be located a minimum of 100 feet from wells, 50 feet from any drainages, and 25 feet from dry gulches. The results of our soil profile pits are provided in the table below.

Table B – Soil Profile Pit Layers

Soil Profile Pit	Soil Type	Depth (ft)	Soil Profile Pit	Soil Type	Depth (ft)
1	Top Soil	0-1.2	9	Topsoil	0-1
	Silty Clay Loam	1.2-3.5		Sand	1-1.9
	Sand	3.5-8		Sandy Loam	1.9-3.7
	-	-		Bedrock	3.7-8
2	Top Soil	0-1.1	10	Topsoil	1-1.3
	Sand	1.1-3.3		Sand	1.3-2
	Bedrock	3.3-6		Bedrock	2-6
3	Top Soil	0-1	11	Topsoil	0-1.3
	Sand	1-2.5		Sandy Loam	1.3-2.4
	Sandy Loam	2.5-4.5		Bedrock	2.4-6
	Bedrock	4.5-5		-	-
4	Top Soil	0-1.3	12	Topsoil	0-1
	Sandy Clay Loam	1.3-2.8		Sand	1-3
	Sandy Loam	2.8-6		Bedrock	3-8
	Bedrock	6-7		-	-
5	Top Soil	0-1	13	Topsoil	0-1.3
	Sand	1-2.2		Sand	1.3-3.1
	Sandy Loam	2.2-6.5		Bedrock	3.1-6.7
6	Top Soil	0-1.5	14	Topsoil	0-1
	Sand	1.5-3.7		Sandy Loam	1-1.7
	Loamy Sand	3.7-9		Bedrock	1.7-5.5
	Bedrock	9-10		-	-
7	Top Soil	0-0.8	15	Topsoil	0-2
	Sand	0.8-1.8		Bedrock	2-6
	Sandy Clay	1.8-6		-	-
	Bedrock	6-7.5		-	-
8	Top Soil	0-1	16	Topsoil	0-1
	Sandy Loam	1-2		Sand	1-2.3
	Bedrock	2-6		Bedrock	2.3-6.5

PAVEMENTS

Pavement subgrade will likely consist of clayey sand. Clay soils, if any, have relatively poor pavement support characteristics, while the compacted sand is considered better subgrade. We estimate a minimum pavement section of at least 3 inches of asphalt over 6 inches of aggregate base course or 6 inches of portland cement concrete based on El Paso County requirements. A full-depth asphalt pavement section of 5 inches could also be used. A design-level subgrade investigation should be done prior to paving.

BUILDING CONSTRUCTION CONSIDERATIONS

The following discussions are preliminary and are not intended for design or construction. After grading is completed, design-level investigations should be performed on a lot-specific basis.

Foundations

Our investigation indicates sandstone is the predominant material present at foundation depths. Expansive claystone is intermittently present at foundation depths. Expansive claystone is also present at deeper depths they may still influence foundations. If claystone is encountered at or near foundation depths, sub-excavation will likely be appropriate to reduce the risk of poor performance as discussed in the sub-excavation section. We expect spread footing foundations designed to apply minimum deadload will likely be appropriate for the lots. We estimate maximum allowable pressures of about 3,000 psf will be appropriate for the lots included in this investigation. Straight-shaft drilled piers bottomed in bedrock are an appropriate alternative to the sub-excavation and replacement process. Detailed soils and foundation investigations should be performed to determine the appropriate foundation types and to provide design criteria on a lot-specific basis.

Slabs-on-Grade

We expect slab-on-grade basement floors and garage floors will be appropriate for the lots investigated. The majority of lots will likely have a low risk of poor slab-on-grade performance, although based on the results of this investigation we expect localized areas with moderate to high risk of poor slab-on-grade performance. Sub-excavation can reduce moderate and high risk lots to low risk. Structurally supported basement floors are recommended on lots where the swell potential is rated as high or very high. For walk-out or garden-level basements, we recommend structurally supported basement floors be used where slab performance risk is moderate, high, or very high. Where structurally supported floors are installed in basements or over a crawlspace, the required air space depends on the materials used to construct the floor and the potential expansion of the underlying soils. The performance of floor slabs, driveways, sidewalks, and other surface flatwork may be poor where expansive soils are present, unless sub-excavation is performed.

Subsurface Drainage

Surface water can penetrate relatively permeable loose backfill soils located adjacent to residences and collect at the bottom of relatively impermeable foundation excavations, causing wet or moist conditions after construction. Foundation walls and grade beams should be designed to resist lateral earth pressures. Foundation drains should be constructed around the lowest excavation levels of basement and/or crawlspace areas. These drains should discharge to a positive gravity outlet or to a sump where water can be removed by pumping.

Surface Drainage

The performance of improvements will be influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each residence. The ground surface around the residences should be sloped to provide positive drainage away from the foundations. We recommend a slope of at least 10 percent for the first 10 feet surrounding each residence, where practical. If the distance between houses is less than 20 feet, the slope in this area should be 10 percent to the swale between houses. Where possible, drainage swales should slope at least 2 percent. Variation from these criteria is acceptable in some areas. For examples, for lots graded to direct drainage from the rear yard to the front, it is difficult to achieve the recommended slope at the high point behind the house. We believe it is acceptable to use a slope of about 6 inches in the first 10 feet at this location. A 5 percent slope can also be used adjacent to residences without basements. Roof downspouts and other water collection systems should discharge beyond the limits of backfill around structures.

Proper control of surface runoff is also important to control the erosion of surface soils. Sheet flow should not be directed over unprotected slopes. Water should not be allowed to pond at the crest of slopes. Permanent slopes should be prepared in such a way to reduce erosion.

Attention should be paid to compact the soils behind curb and gutter adjacent to streets and in utility trenches during the development. If surface drainage between preliminary development and construction phases is neglected, performance of the roadways, flatwork and foundations may be poor.

Concrete

Concrete in contact with soil can be subject to sulfate attack. We measured negligible water-soluble sulfate concentrations of less than 0.1 percent in three samples from this site. For this level of sulfate concentration, ACI 332-20 *Code Requirements for Residential Concrete* indicates there are no special requirements for sulfate resistance.

Superficial damage may occur to the above-grade exposed surfaces of concrete walls and grade beams in contact with soils, even though sulfate levels are relatively low. To control this risk and to resist freeze-thaw deterioration, the water-tocementitious materials ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or highwater tables. Concrete should be air entrained. We advocate all foundation walls and grade beams in contact with the subsoils (including the inside and outside faces of garage and crawl space grade beams) be damp-proofed.

CONSTRUCTION OBSERVATIONS

This report has been prepared for the exclusive use of BRJM, LLC and your design team for due diligence assessment and planning for the proposed project. The information, conclusions, and recommendations presented herein are based upon consideration of many factors including, but not limited to, the type of structures proposed, the geologic setting, and the subsurface conditions encountered. The conclusions and recommendations contained in the report are not valid for use by others. Standards of practice evolve in the area of geotechnical engineering. The recommendations provided are appropriate for about three years. If the site is not developed within about three years, we should be contacted to determine if we should update this report.

We recommend that CTL | Thompson, Inc. provide construction observation services to allow us the opportunity to verify whether soil conditions are consistent with those found during this investigation. If others perform these observations, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

RECOMMENDED SERVICES

Based on the results of this investigation and the proposed development being considered, we recommend the following investigations and services:

1. Construction testing and observation during site development, and building or pavement construction, including compaction testing of grading fill, utility trench backfill, and pavements;
2. Subgrade investigation and pavement design after grading;
3. Design-level soils and foundation investigations for each individual lot; and
4. Foundation installation observations.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience. Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free. Our recommendations represent our judgment of those measures that are necessary to increase the chances that the structures will perform satisfactorily. It is critical that all recommendations in this report are followed during construction. The owner must assume responsibility for maintaining the structures and use appropriate practices regarding drainage.

LIMITATIONS

Our borings were widely spaced to provide a general picture of subsurface conditions for preliminary assessment and planning purposes. The data are representative of conditions encountered only at the exact boring locations. Variations in the subsoil conditions not indicated by our borings are possible. We believe this investigation was conducted with that level of skill and care ordinarily used by geotechnical engineers practicing under similar conditions. No warranty, express or implied, is made.

f we can be of further service in discussing the contents of this report or in the analysis of the influence of the subsoil conditions on design of the structure, please call.

CTL | THOMPSON, INC.

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JMJ:WCH:cw
(3 copies)

Via e-mail: rcirwin@cmdcllc.com; bill@guman.net

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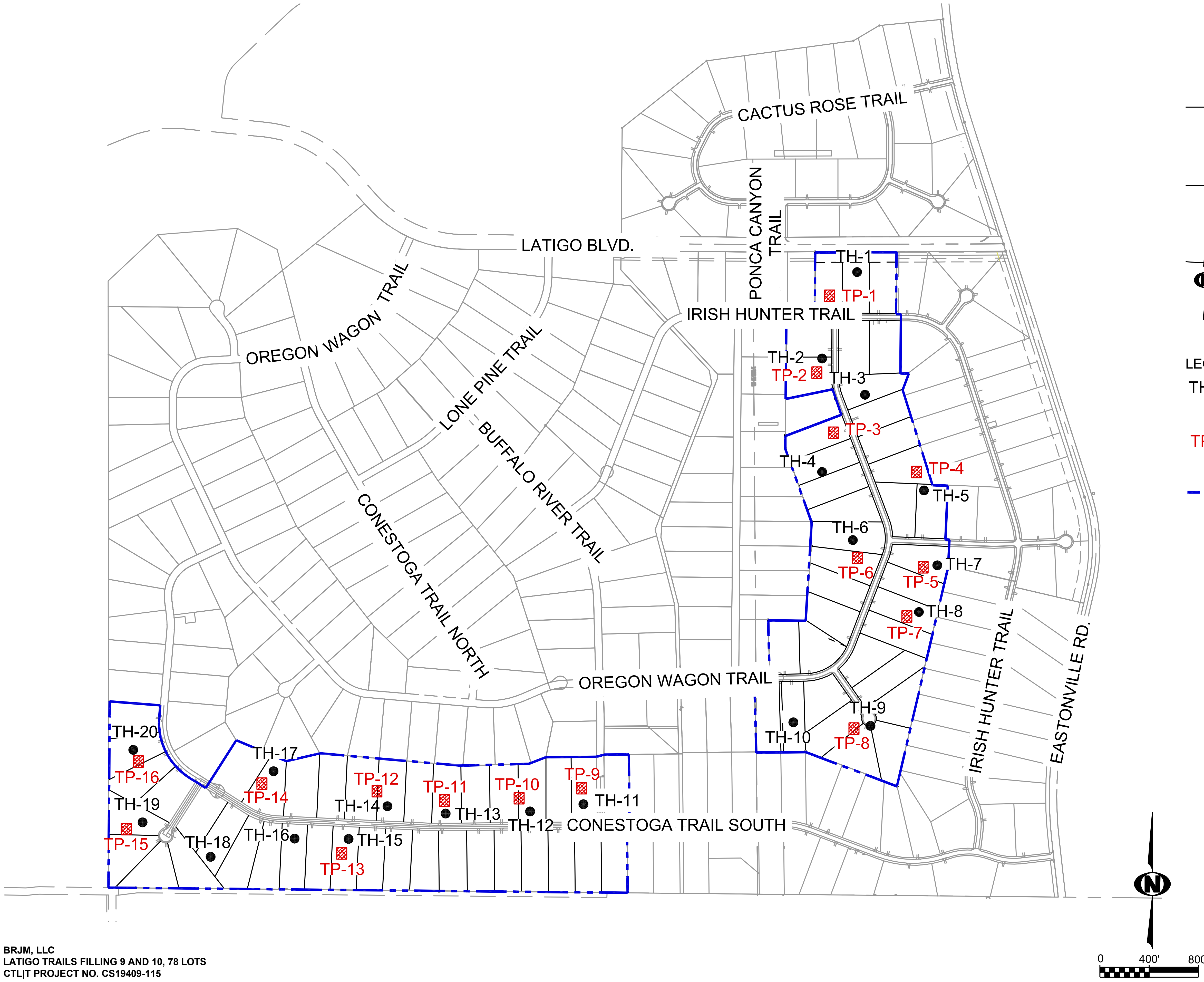
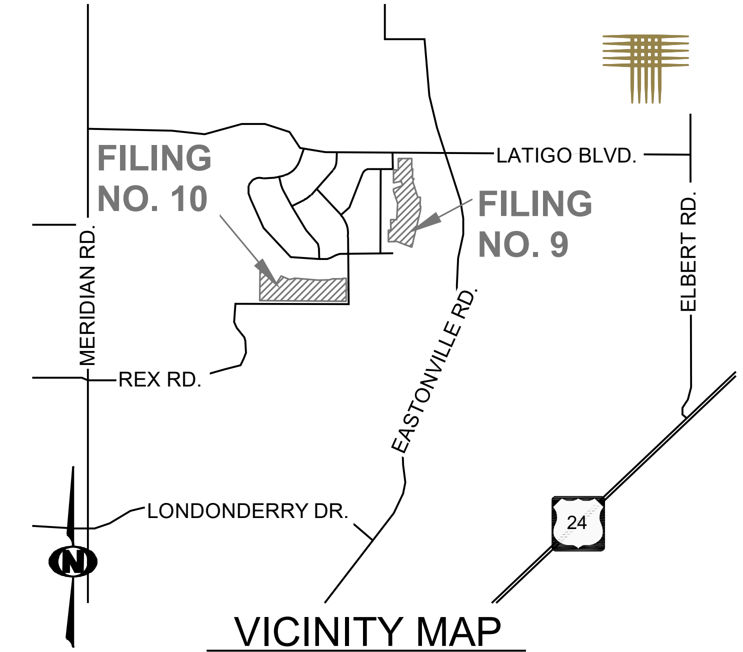
Morgan, M.L. and Barkmann, P.E., 2012, Geologic Map of the Eastonville Quadrangle, El Paso County, Colorado. Colorado Geological Survey.





VICINITY MAP

(NOT TO SCALE)

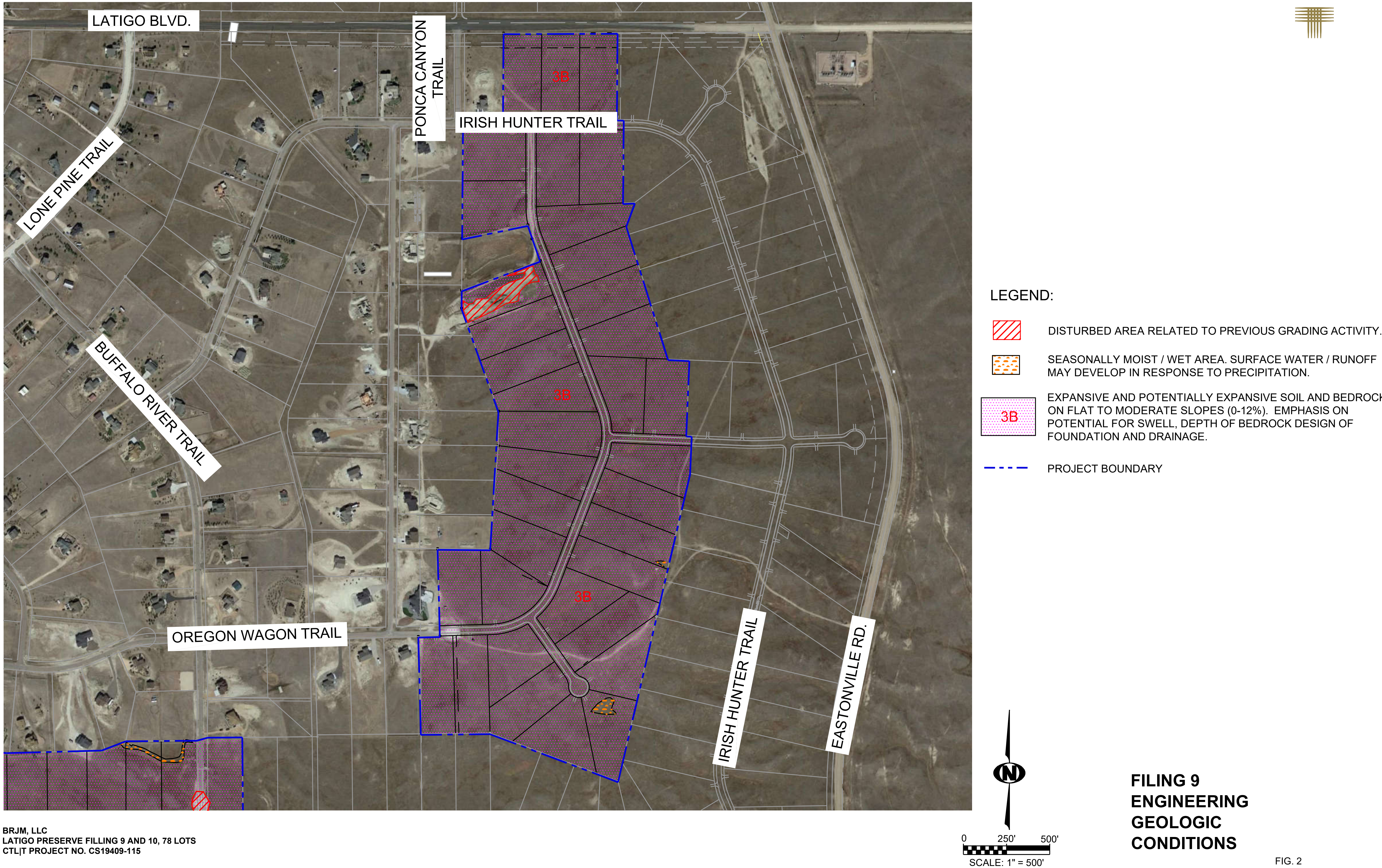
LEGEND:

TH-1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING.
TP-1 ▨	APPROXIMATE LOCATION OF SOIL PROFILE TEST PIT.
— · —	PROJECT BOUNDARY

LOCATION OF EXPLORATORY BORINGS AND SOIL PROFILE TEST PITS

FIG. 1

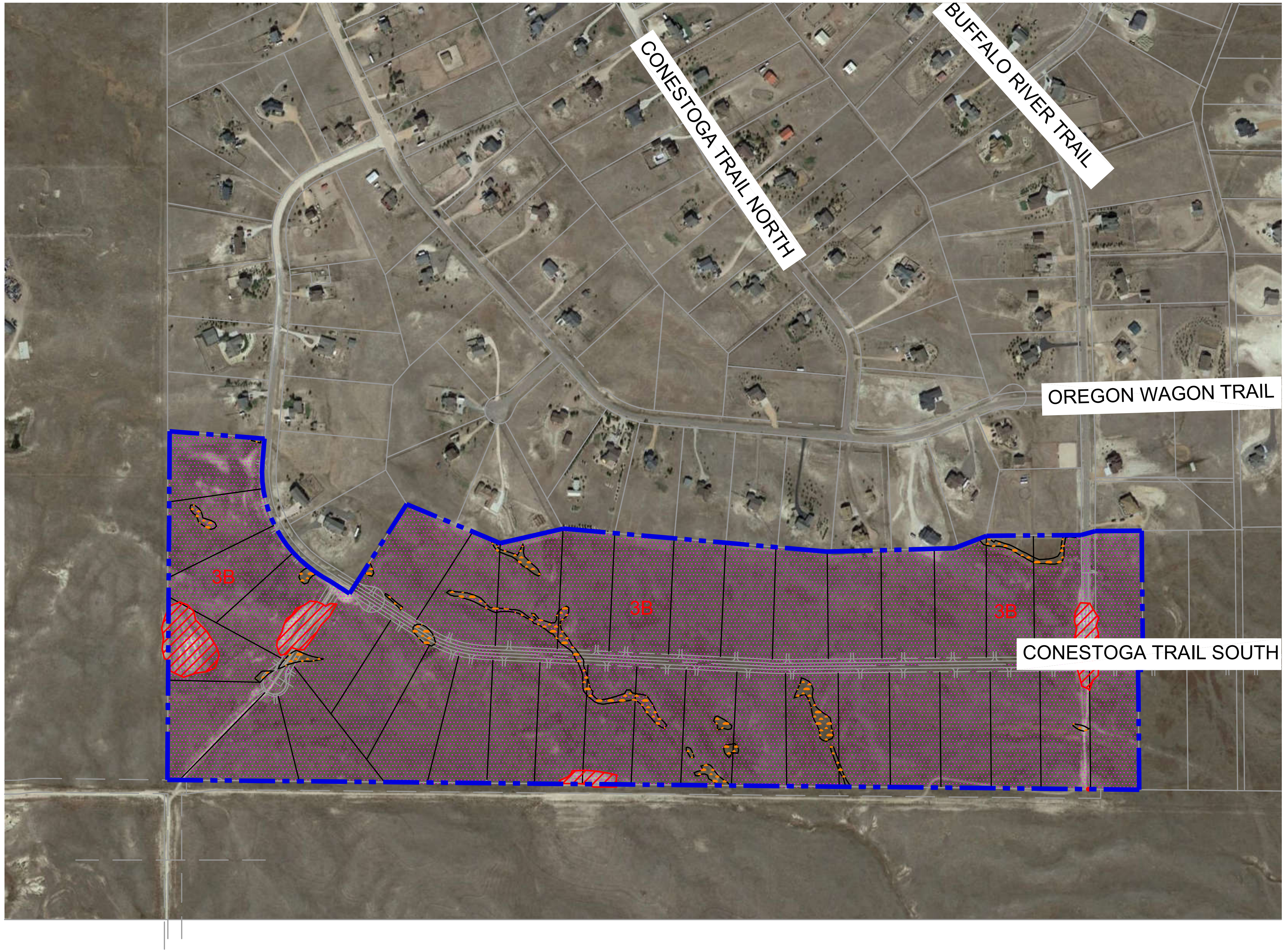
BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115



BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

FILING 9 ENGINEERING GEOLOGIC CONDITIONS

FIG. 2



LEGEND:

DISTURBED AREA RELATED TO PREVIOUS GRADING ACTIVITY.

SEASONALLY MOIST / WET AREA. SURFACE WATER / RUNOFF MAY DEVELOP IN RESPONSE TO PRECIPITATION.

3B EXPANSIVE AND POTENTIALLY EXPANSIVE SOIL AND BEDROCK ON FLAT TO MODERATE SLOPES (0-12%). EMPHASIS ON POTENTIAL FOR SWELL, DEPTH OF BEDROCK DESIGN OF FOUNDATION AND DRAINAGE.

PROJECT BOUNDARY

0 250' 500'

SCALE: 1" = 500'

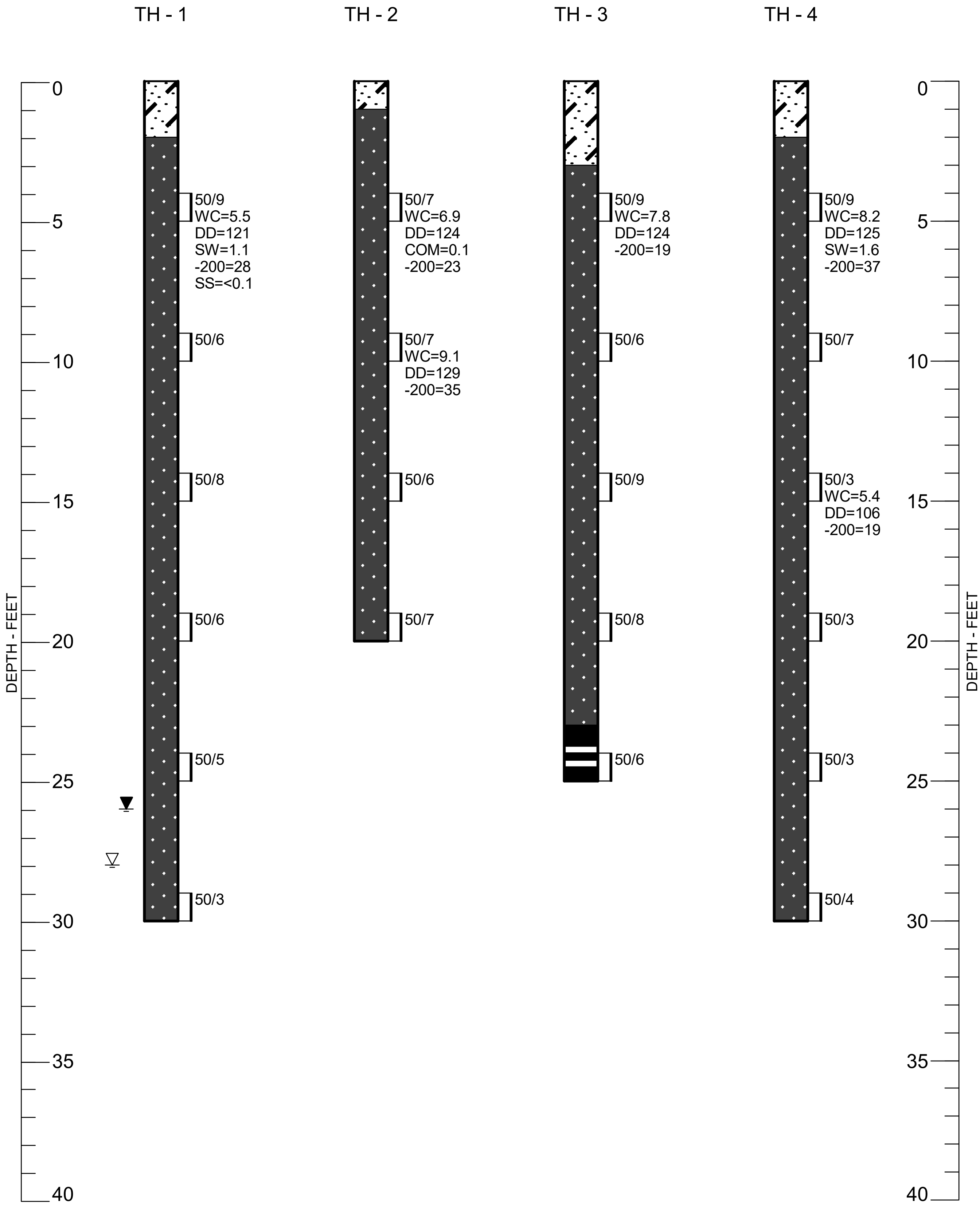
BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

FILING 10 ENGINEERING GEOLOGIC CONDITIONS

FIG. 3

APPENDIX A

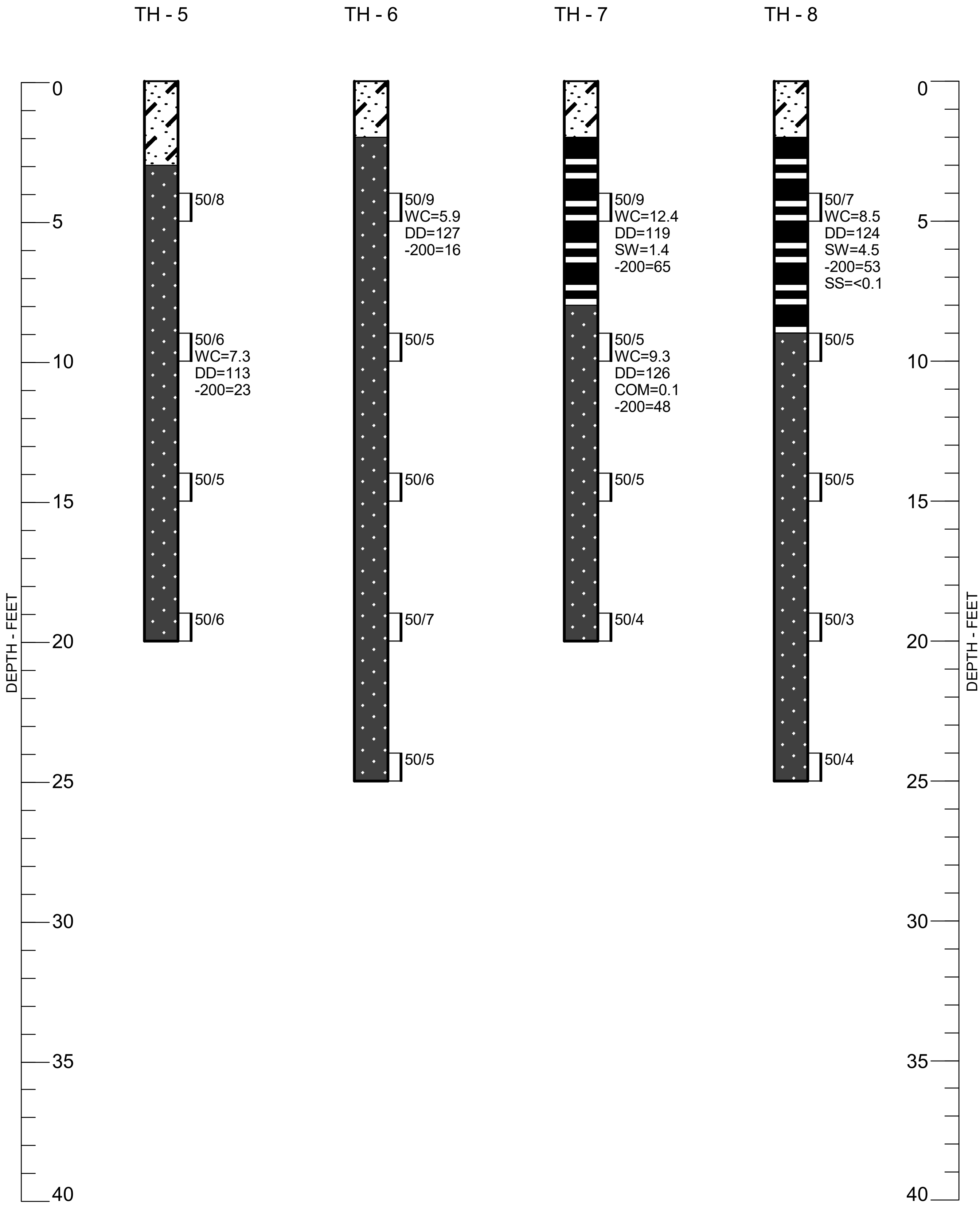
SUMMARY LOGS OF EXPLORATORY BORINGS



BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Summary Logs of Exploratory Borings

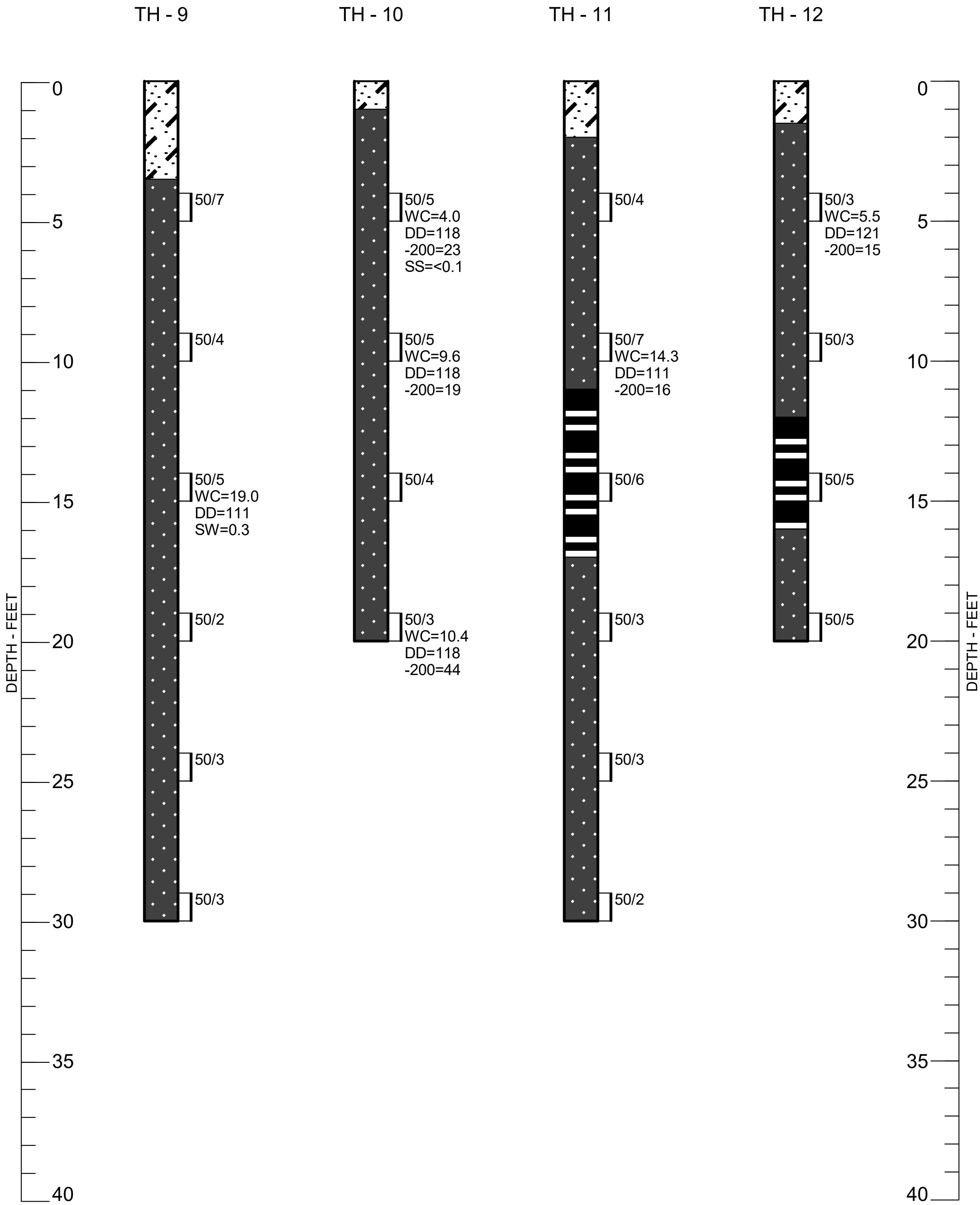
FIG. A-1



BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Summary Logs of Exploratory Borings

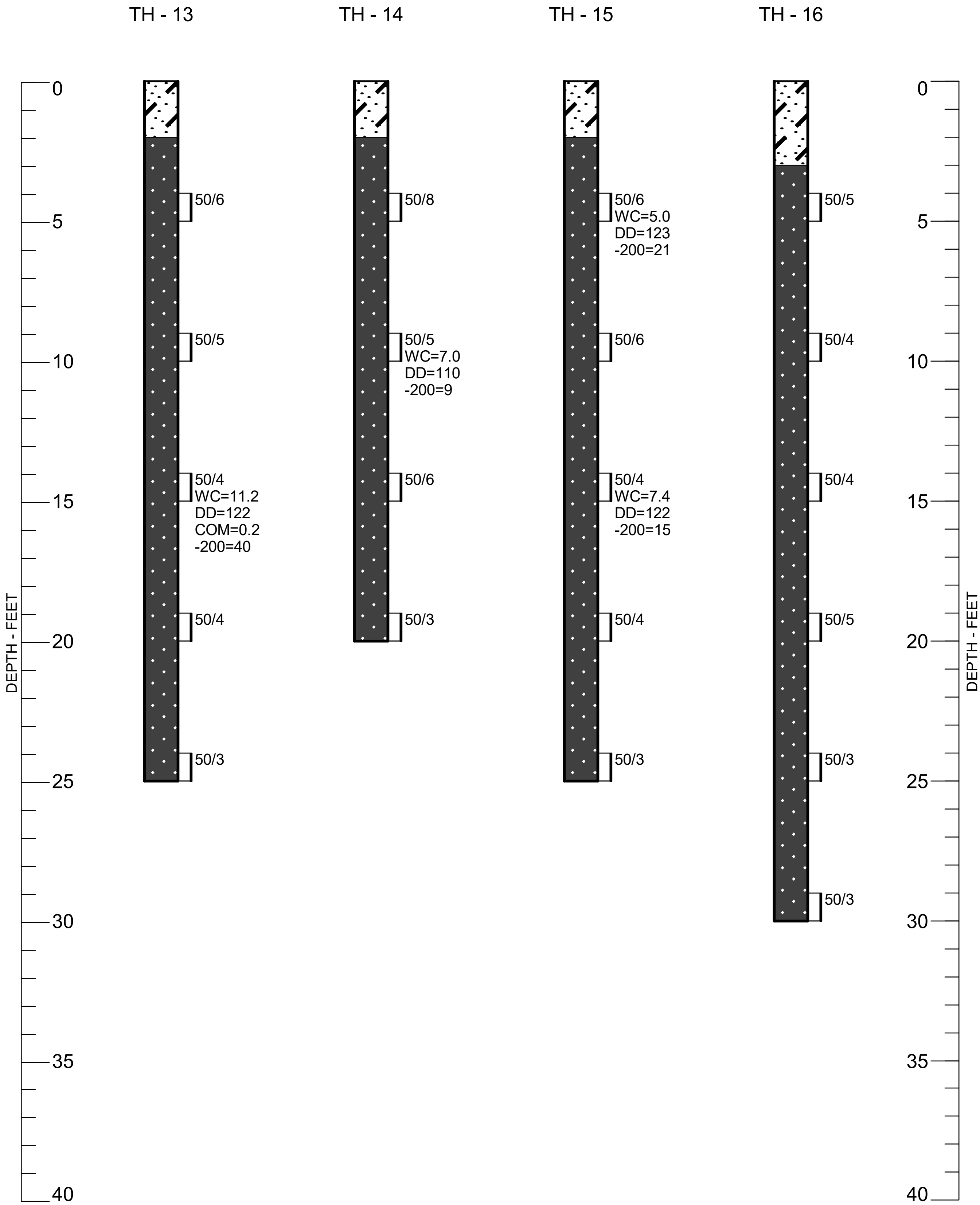
FIG. A-2



BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Summary Logs of Exploratory Borings

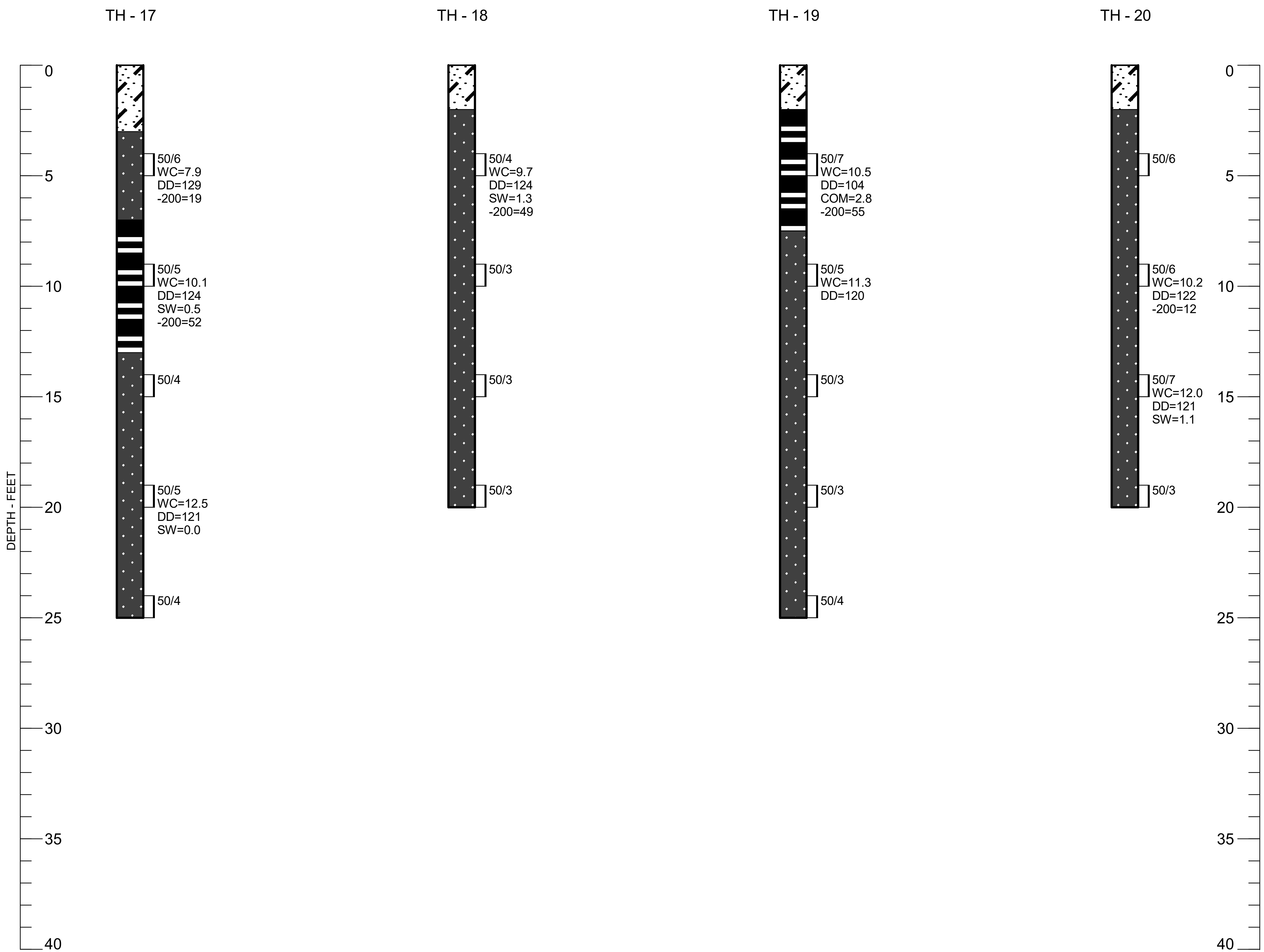
FIG. A-3



BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Summary Logs of Exploratory Borings

FIG. A-4



LEGEND:

CLAY, SAND, SLIGHTLY MOIST TO MOIST, LIGHT BROWN TO BROWN (SC).

SANDSTONE, SLIGHTLY SILTY TO VERY SILTY, CLAYEY TO VERY CLAYEY, HARD TO VERY HARD, DRY TO MOIST VARIOUS SHADES OF BROWN AND GRAY.

CLAYSTONE, SANDY TO VERY SANDY, VERY HARD, SLIGHTLY MOIST TO MOIST, GRAY TO BROWN.

DRIVE SAMPLE. THE SYMBOL 50/7 INDICATES 50 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 7 INCHES.

GROUNDWATER LEVEL MEASURED AT TIME OF DRILLING.

GROUNDWATER LEVEL MEASURED AFTER DRILLING.

NOTES:

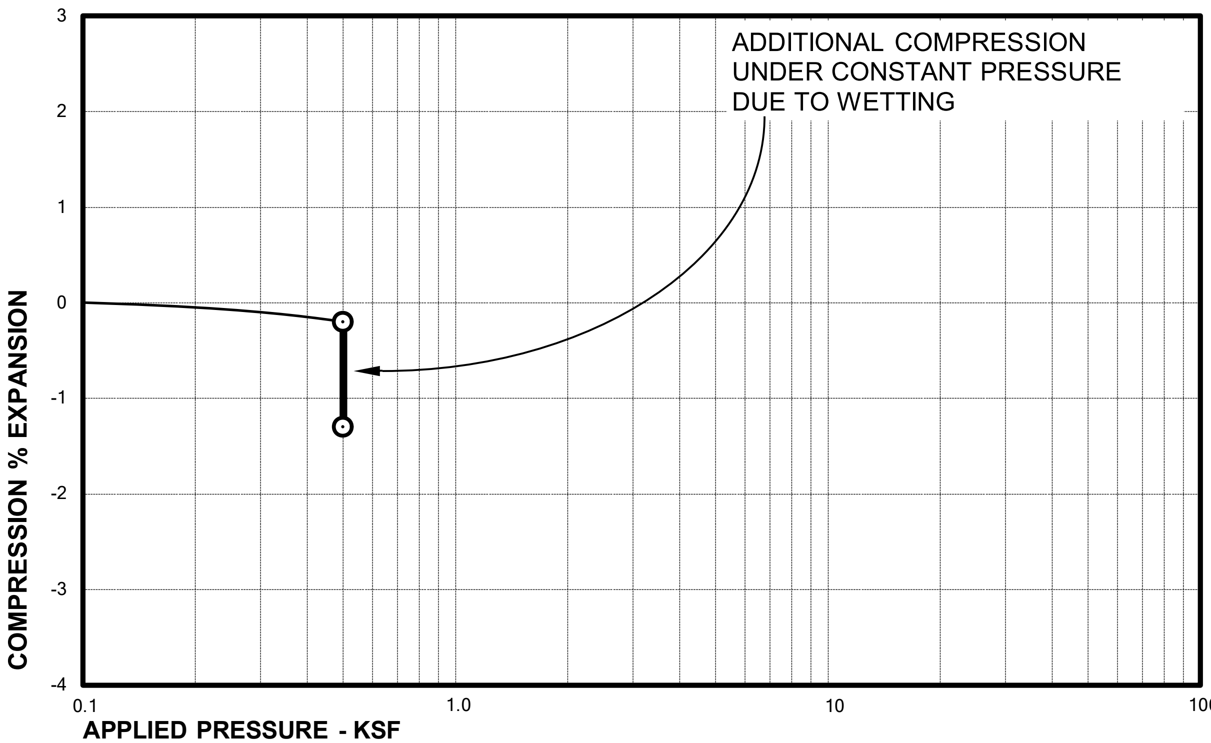
1. THE BORINGS WERE DRILLED JUNE 14, 21, 22, AND 23 2021 USING A 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A CME-45, TRUCK-MOUNTED DRILL RIG.
2. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.
3. WC - INDICATES MOISTURE CONTENT. (%)
   DD - INDICATES DRY DENSITY. (PCF)
   SW - INDICATES SWELL WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE. (%)
   COM - INDICATES COMPRESSION WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE. (%)
   -200 - INDICATES PASSING NO. 200 SIEVE. (%)
   SS - INDICATES WATER-SOLUBLE SULFATE CONTENT. (%)

BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Summary Logs of Exploratory Borings

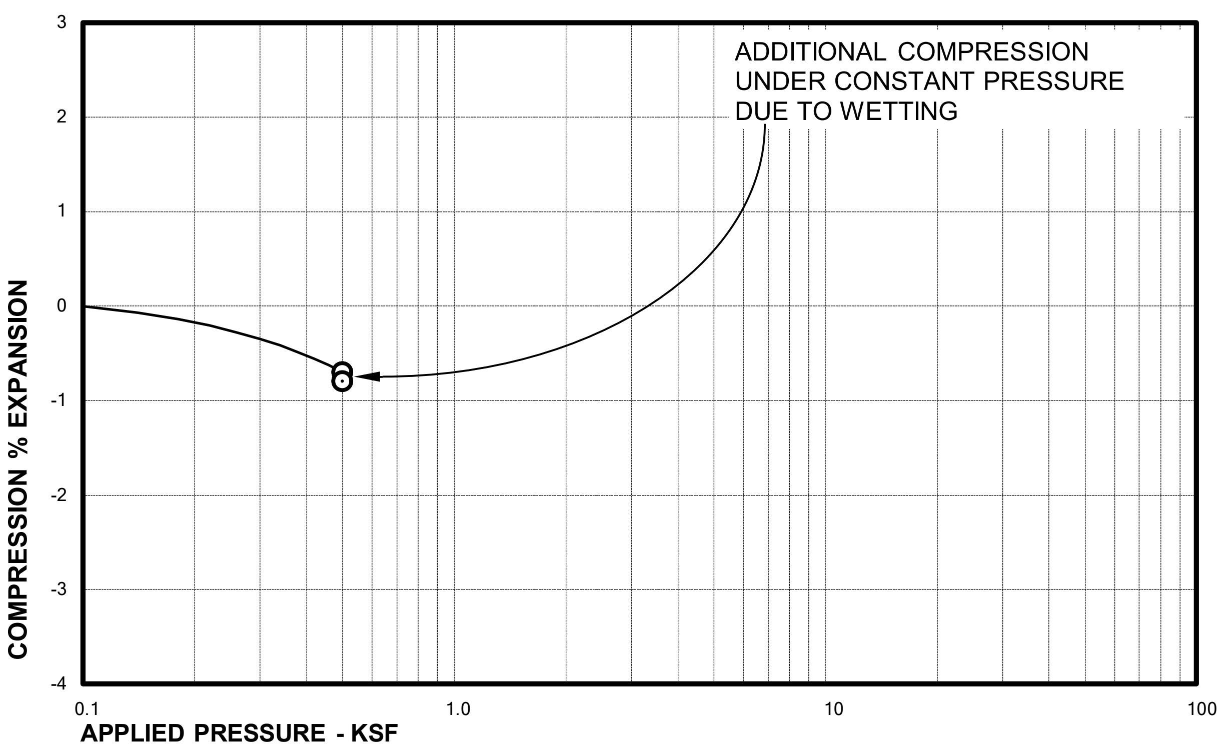
APPENDIX B

LABORATORY TEST RESULTS
TABLE B-1 – SUMMARY OF LABORATORY TESTING



Sample of SANDSTONE, CLAYEY
From TH-1 AT 4 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 5.5 %



Sample of SANDSTONE, SILTY
From TH-2 AT 4 FEET

DRY UNIT WEIGHT= 124 PCF
MOISTURE CONTENT= 6.9 %

BRJM, LLC
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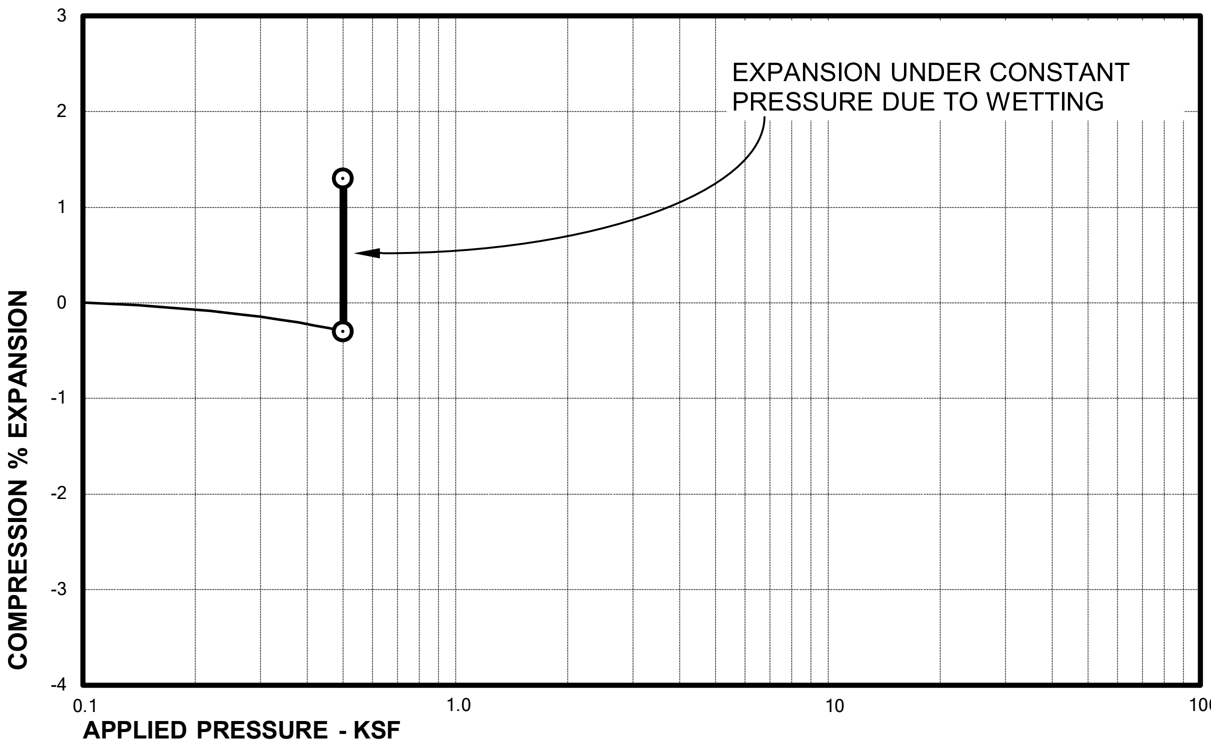
CTL|T PROJECT NO. CS19409-115

Swell Consolidation Test Results

FIG. B-1

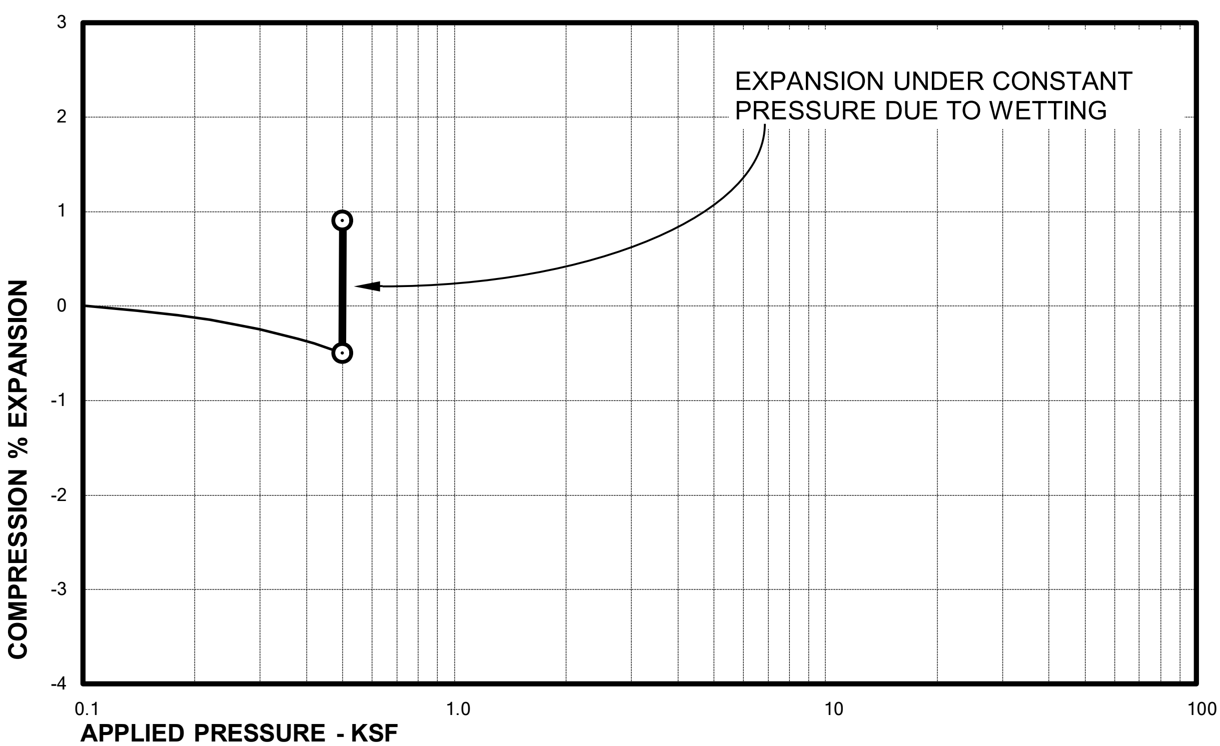


Sample of SANDSTONE, VERY CLAYEY

From TH-4 AT 4 FEET

DRY UNIT WEIGHT= 125 PCF

MOISTURE CONTENT= 8.2 %



Sample of CLAYSTONE, SANDY

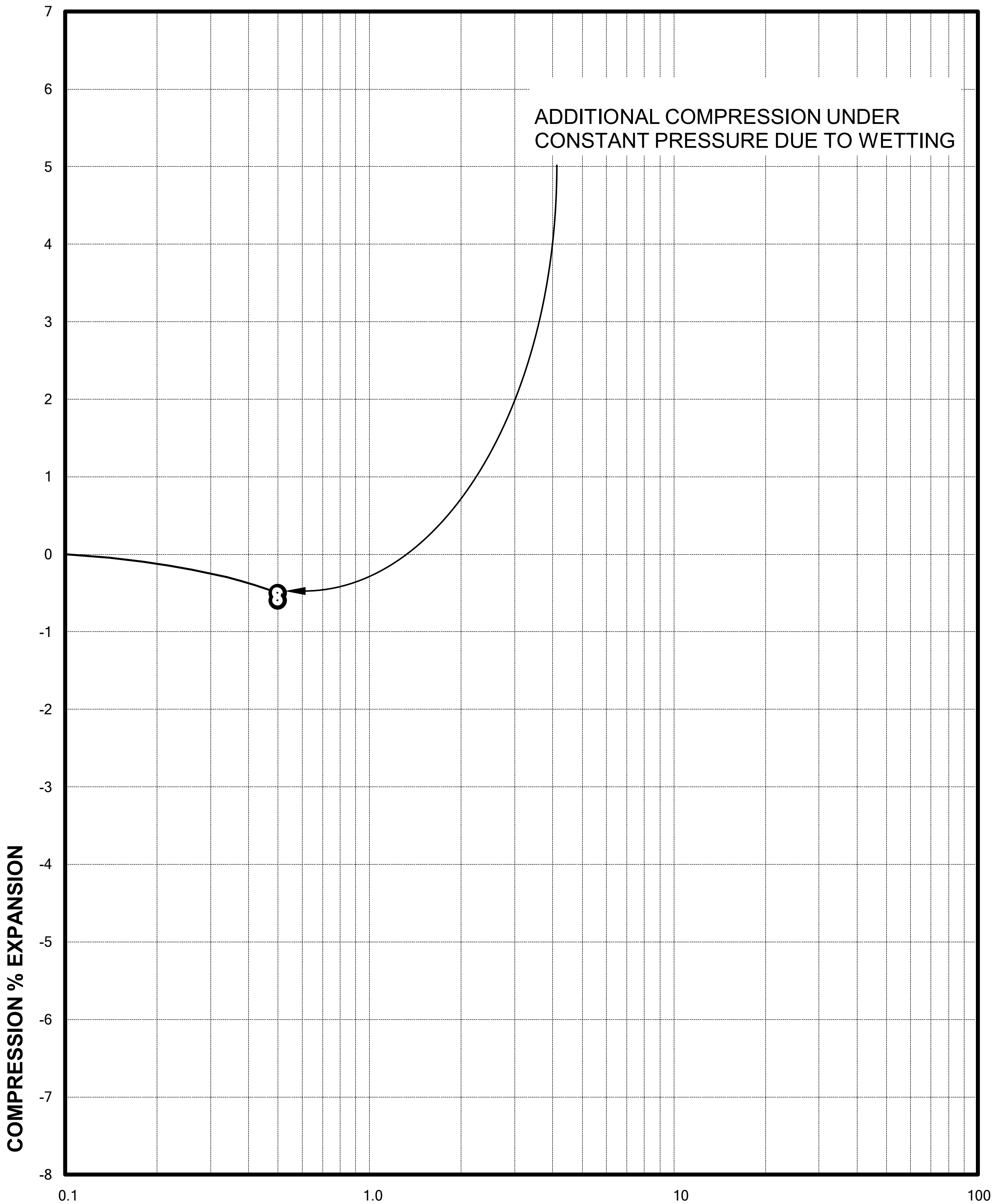
From TH-7 AT 4 FEET

DRY UNIT WEIGHT= 119 PCF

MOISTURE CONTENT= 12.4 %

Swell Consolidation Test Results

FIG. B-2



APPLIED PRESSURE - KSF

Sample of SANDSTONE, VERY CLAYEY

From TH-7 AT 9 FEET

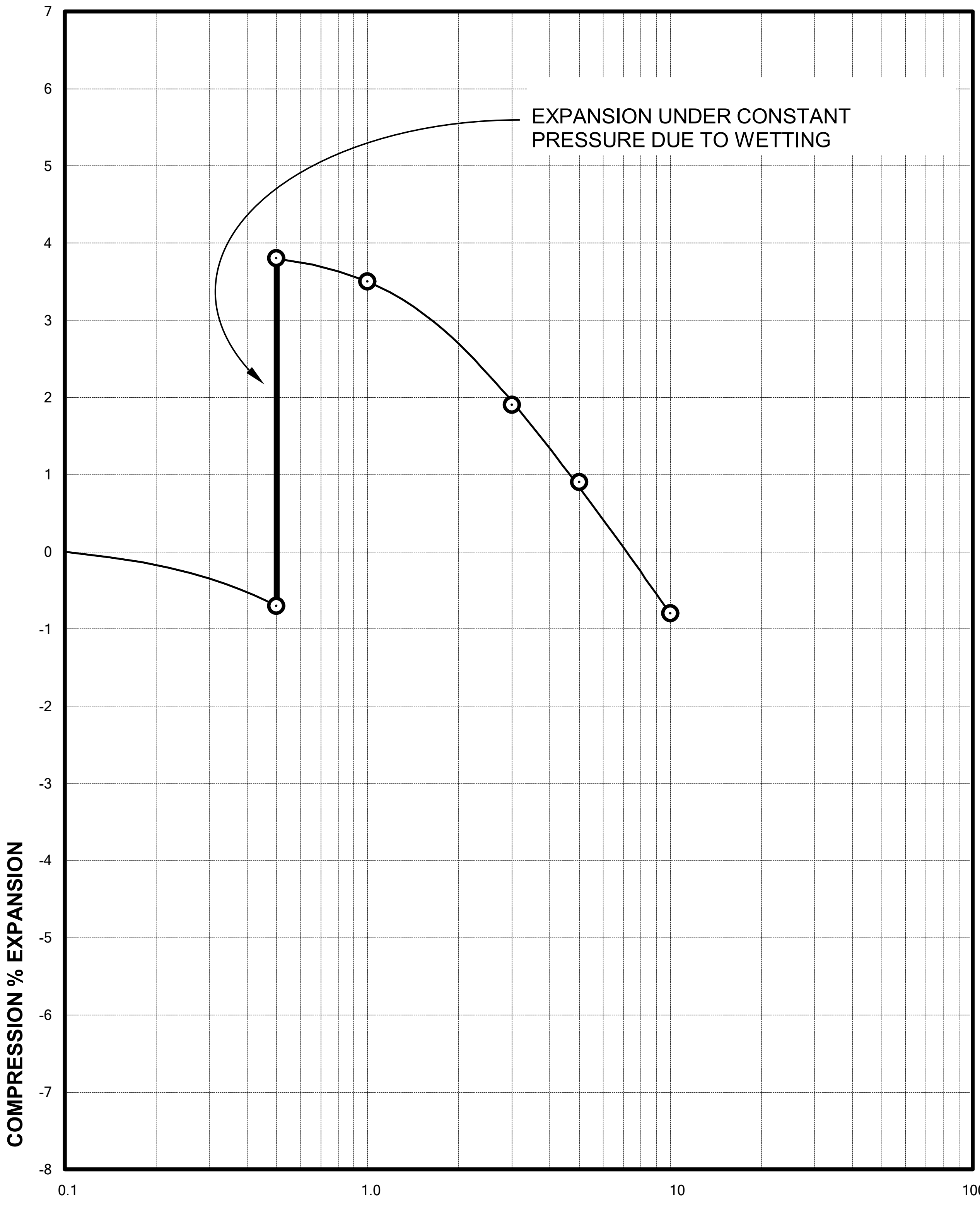
DRY UNIT WEIGHT= 126 PCF

MOISTURE CONTENT= 9.3 %

BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Swell Consolidation Test Results

FIG. B-3



Sample of CLAYSTONE, VERY SANDY

From TH-8 AT 4 FEET

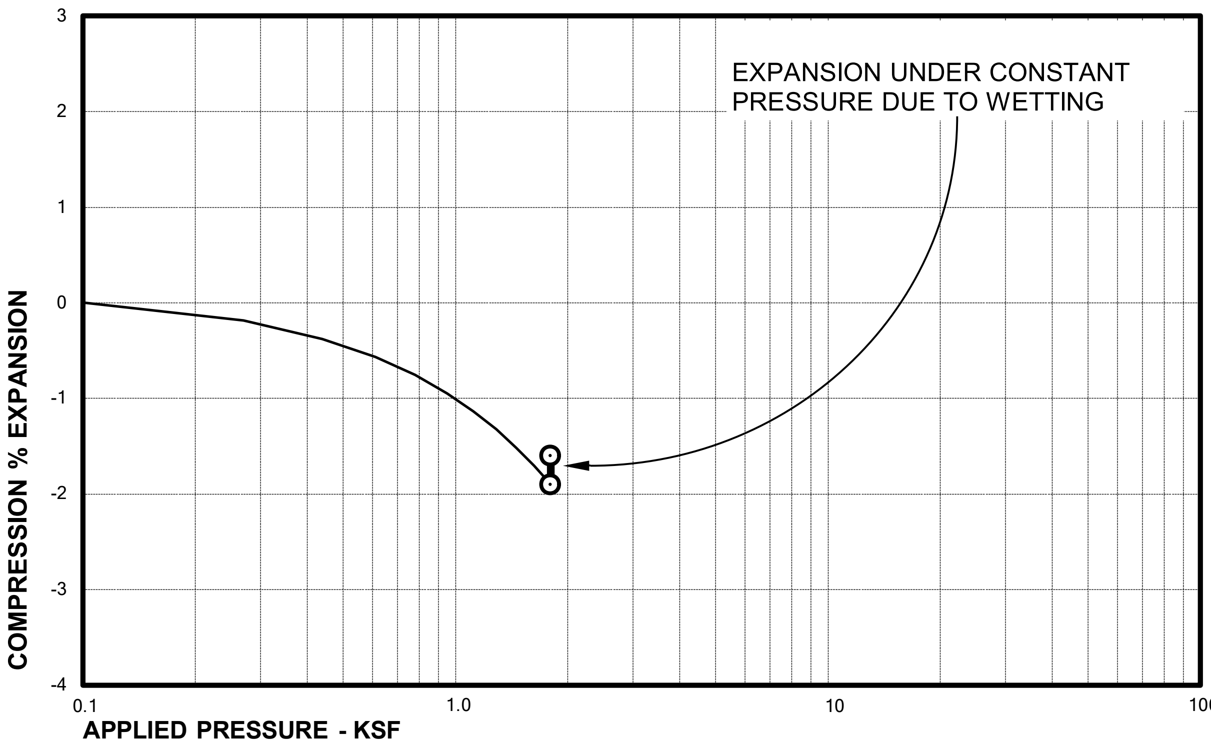
DRY UNIT WEIGHT= 124 PCF

MOISTURE CONTENT= 8.5 %

BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

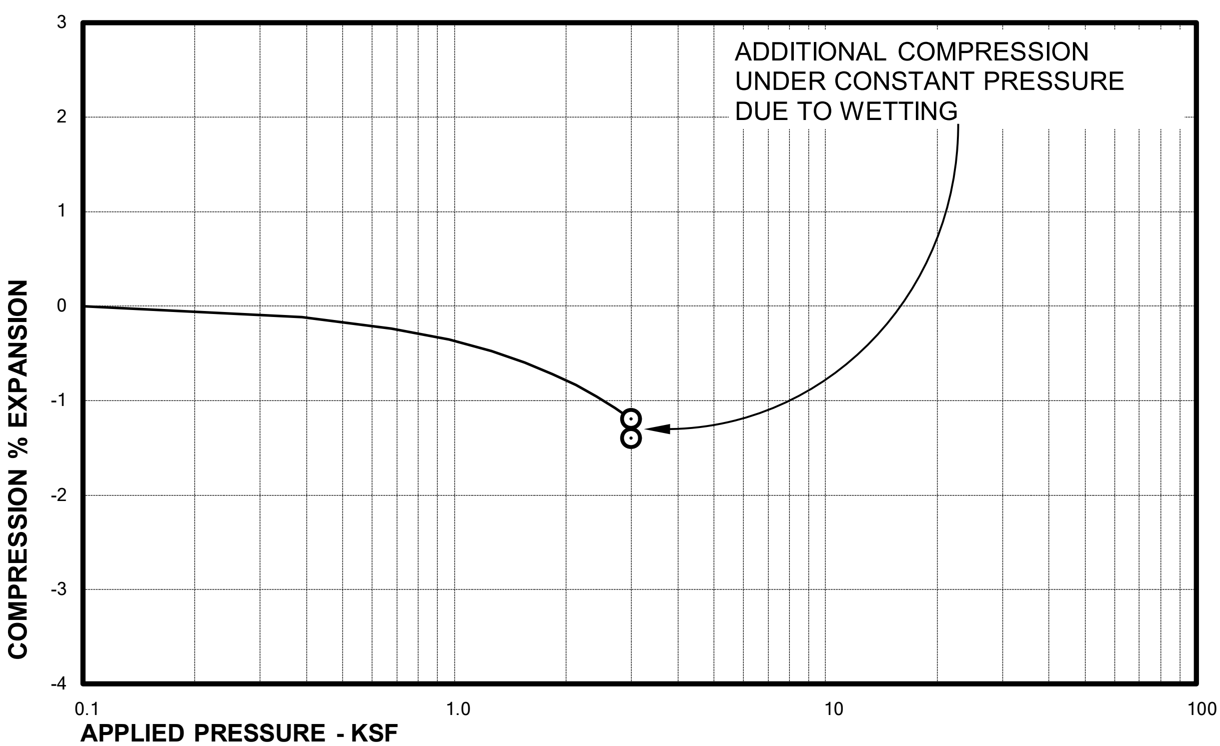
Swell Consolidation Test Results

FIG. B-4



Sample of SANDSTONE, VERY CLAYEY
From TH-9 AT 14 FEET

DRY UNIT WEIGHT= 111 PCF
MOISTURE CONTENT= 19.0 %

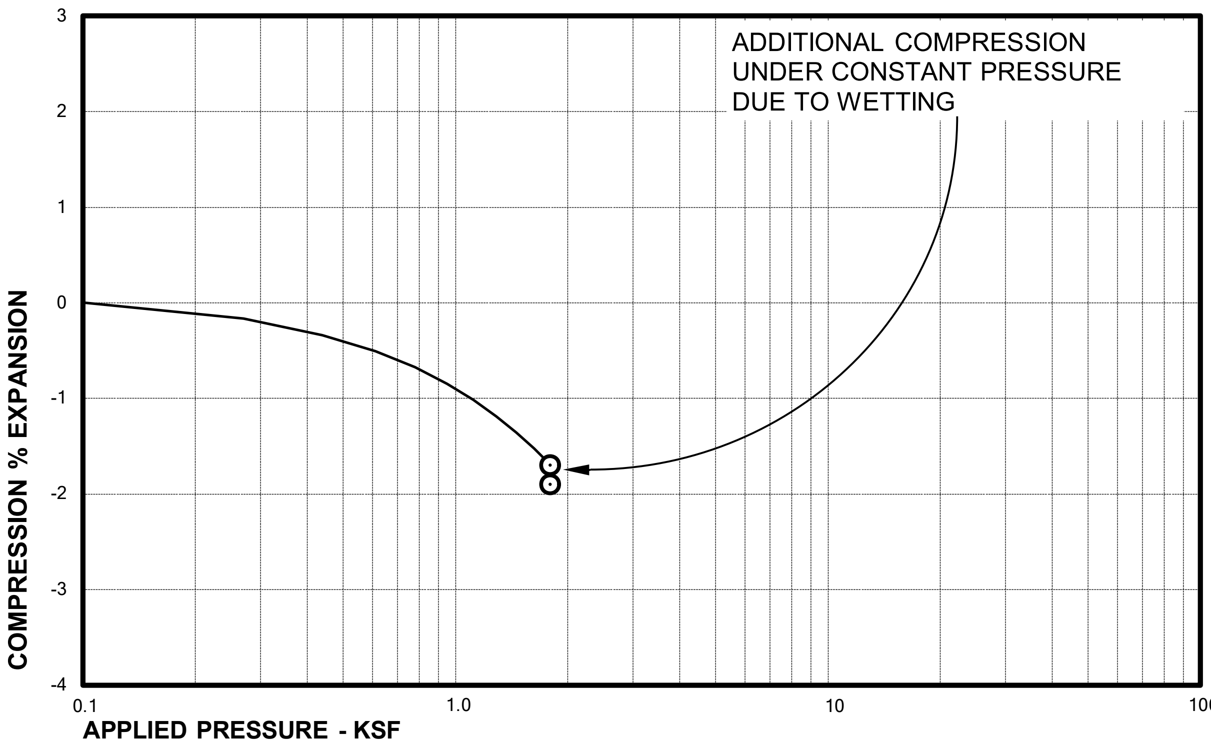


Sample of SANDSTONE, CLAYEY
From TH-11 AT 24 FEET

DRY UNIT WEIGHT= 111 PCF
MOISTURE CONTENT= 14.3 %

Swell Consolidation Test Results

FIG. B-5

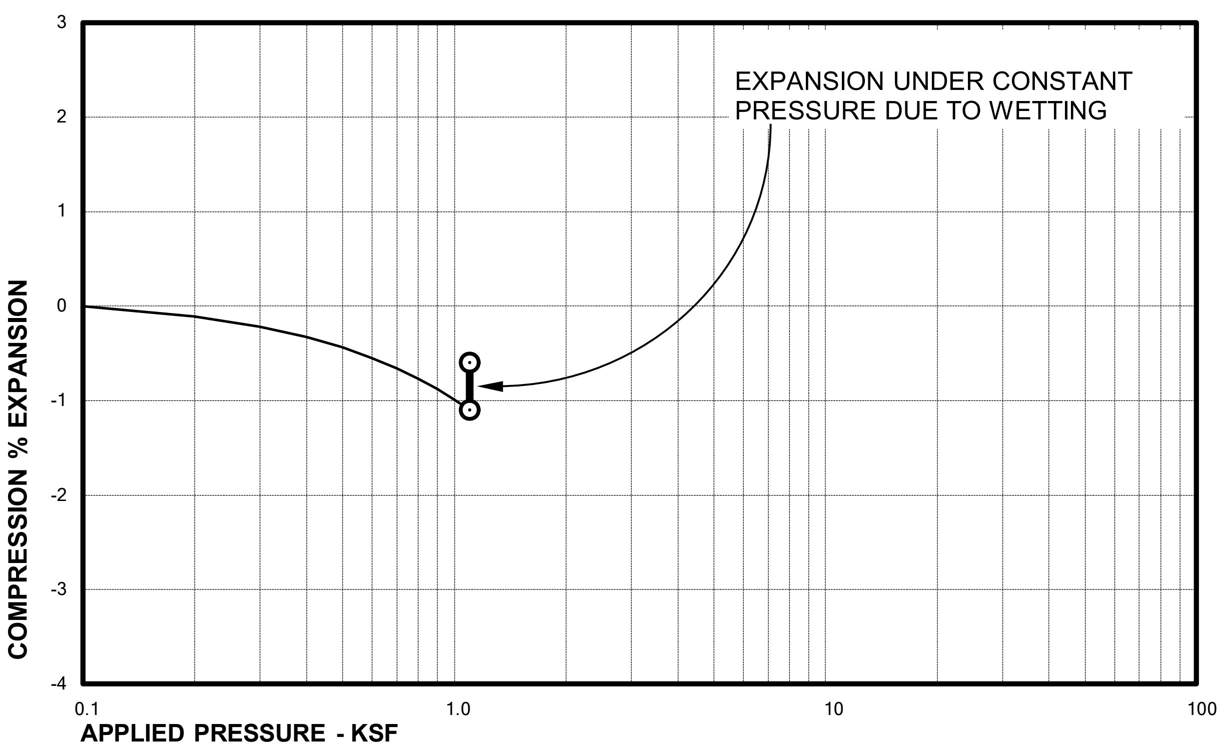


Sample of SANDSTONE, VERY SILTY

From TH-13 AT 14 FEET

DRY UNIT WEIGHT= 122 PCF

MOISTURE CONTENT= 11.2 %



Sample of CLAYSTONE, VERY SANDY

From TH-17 AT 9 FEET

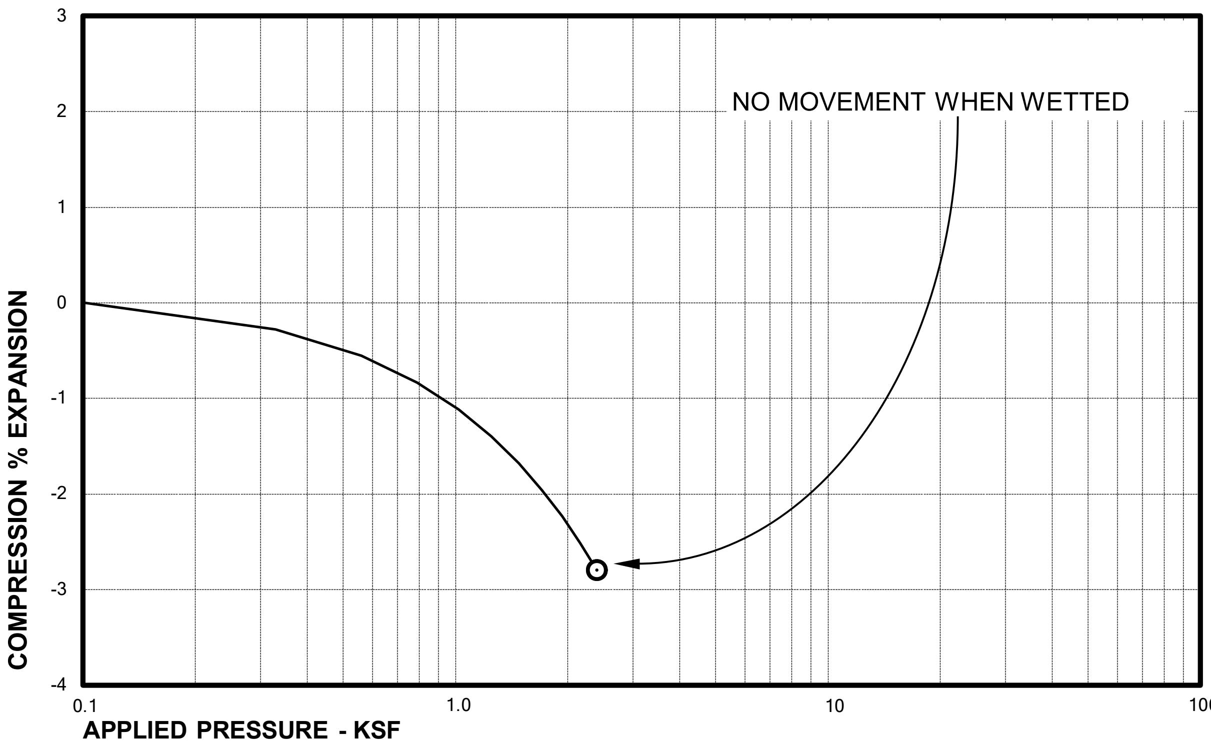
DRY UNIT WEIGHT= 124 PCF

MOISTURE CONTENT= 10.1 %

BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

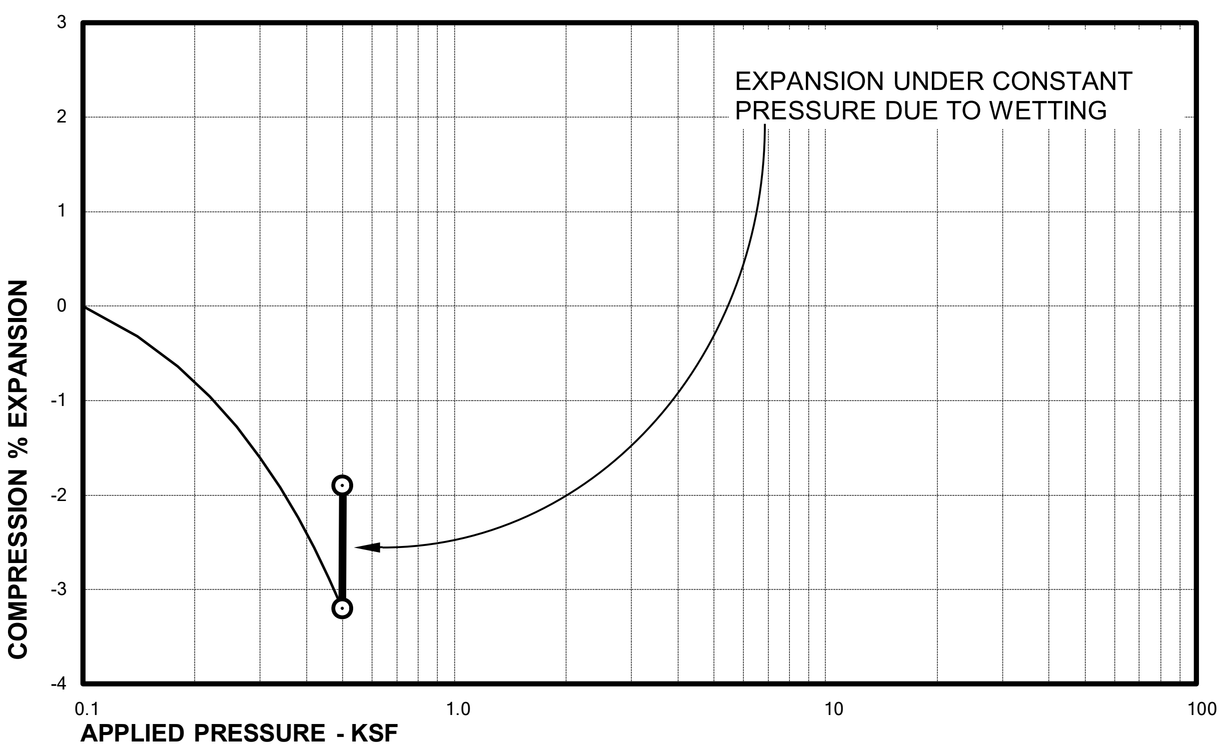
Swell Consolidation Test Results

FIG. B-6



Sample of SANDSTONE
From TH-17 AT 19 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 12.5 %



Sample of SANDSTONE, VERY CLAYEY
From TH-18 AT 4 FEET

DRY UNIT WEIGHT= 124 PCF
MOISTURE CONTENT= 9.7 %

BRJM, LLC
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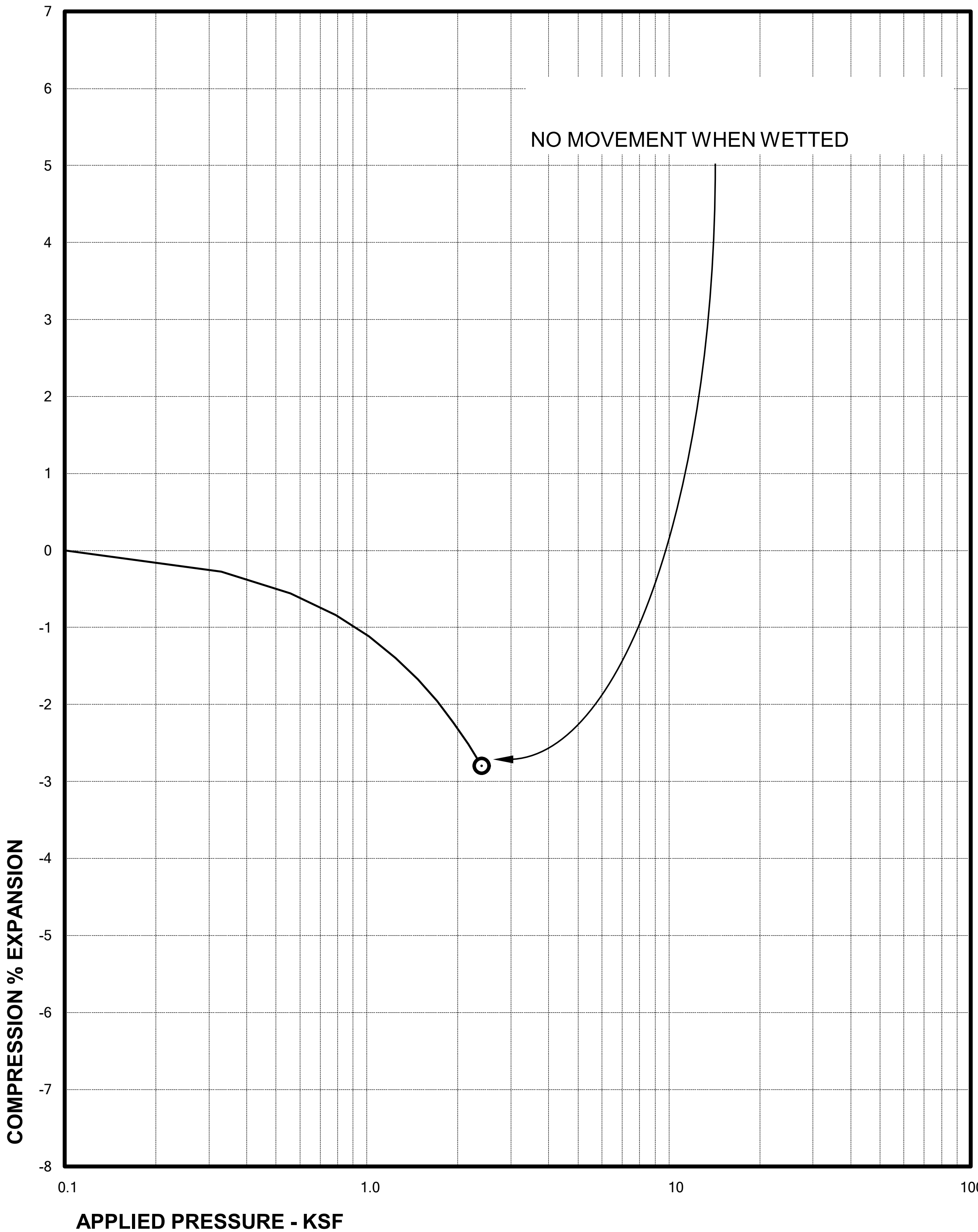
CTL|T PROJECT NO. CS19409-115

Swell Consolidation Test Results

FIG. B-7



Sample of SANDSTONE

From TH-17 AT 19 FEET

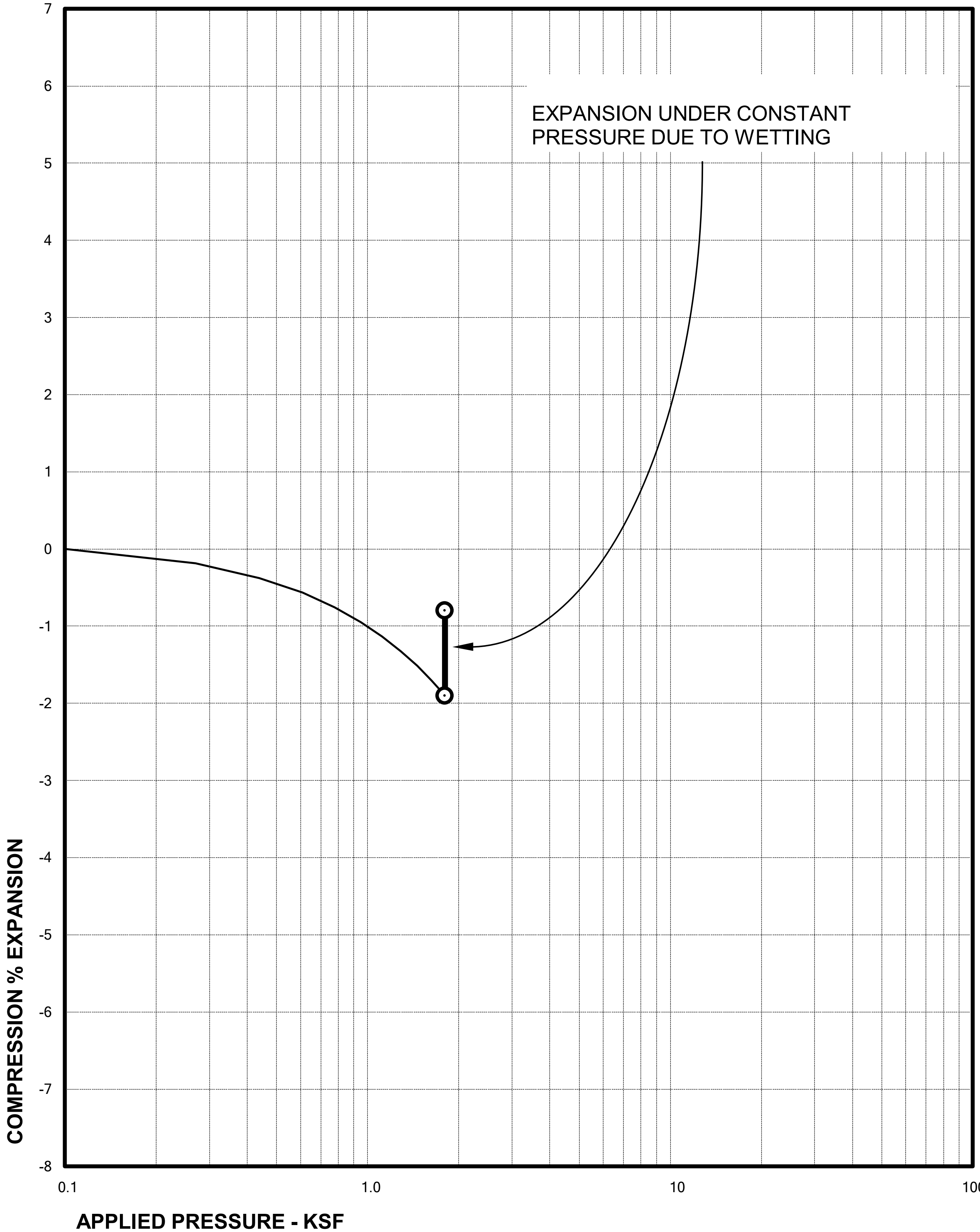
DRY UNIT WEIGHT= 121 PCF

MOISTURE CONTENT= 12.5 %

BRJM, LLC
LATIGO TRAILS FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Swell Consolidation Test Results

FIG. B-7



Sample of SANDSTONE, CLAYEY
From TH-20 AT 14 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 12.0 %

BRJM, LLC
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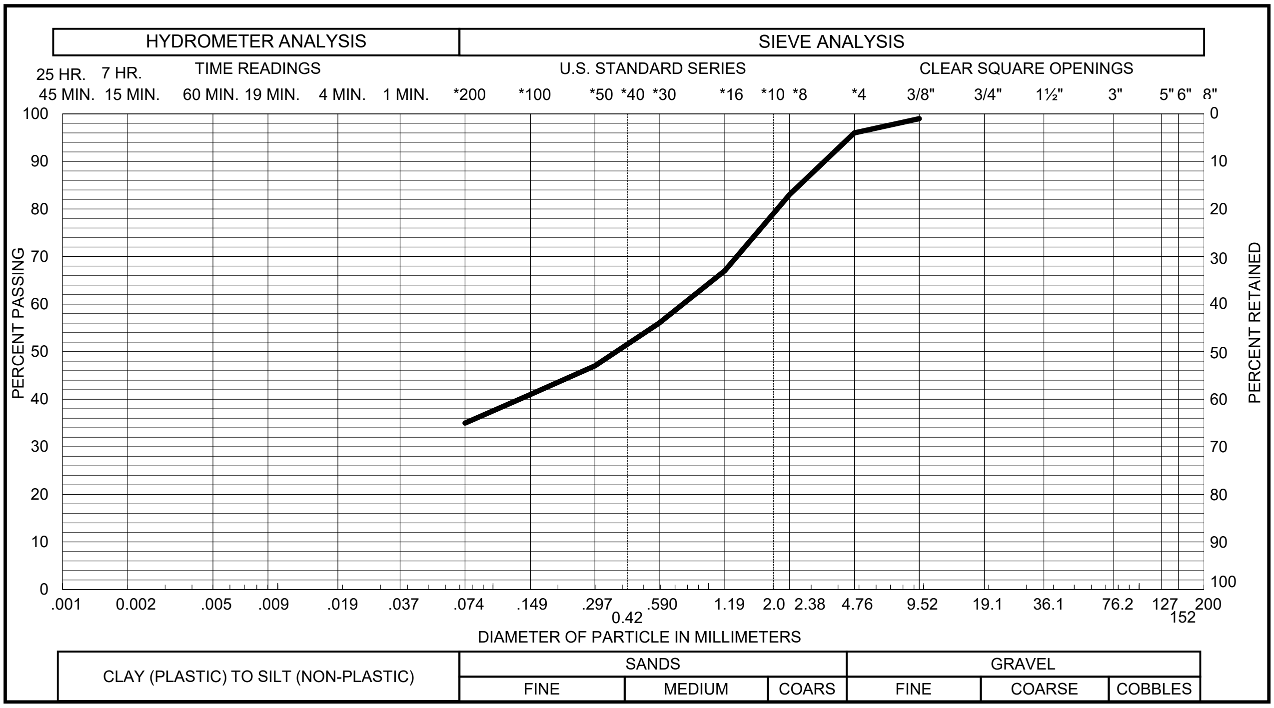
CTL|T PROJECT NO. CS19409-115

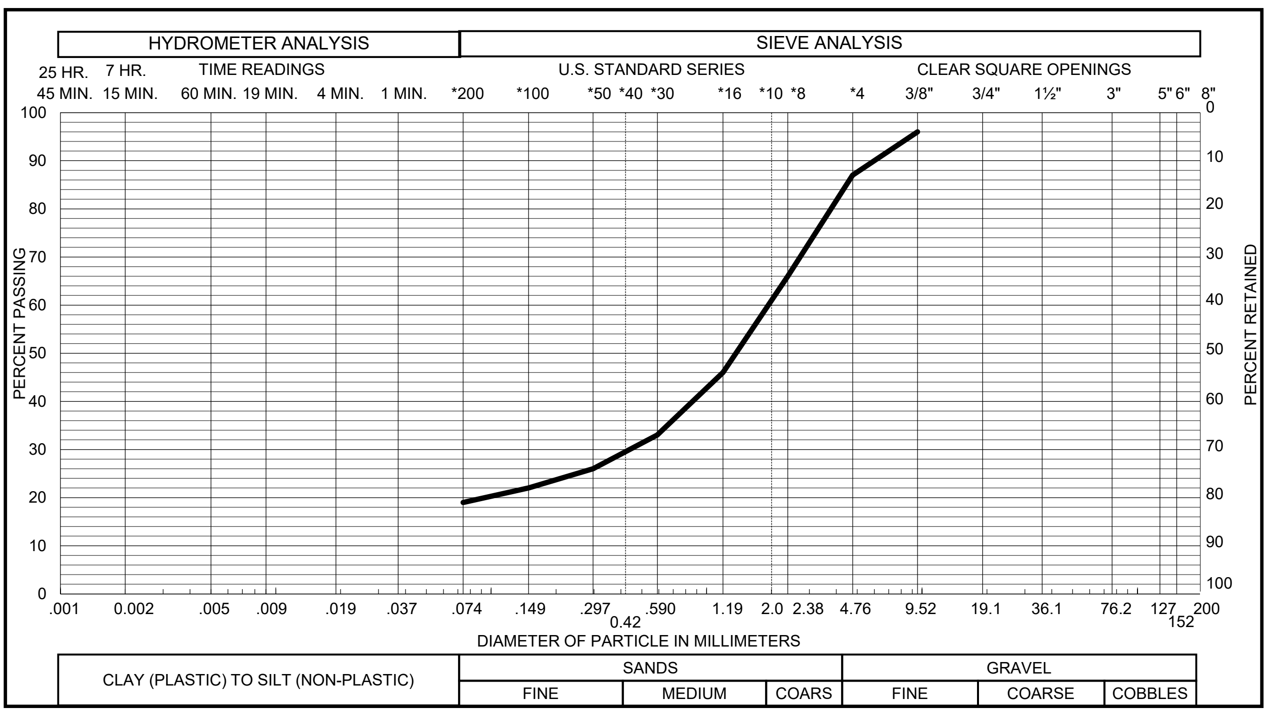
Swell Consolidation Test Results

FIG. B-9



Sample of SANDSTONE, SILTY
From TH - 2 AT 9 FEET

GRAVEL 4 % SAND 61 %
SILT & CLAY 35 % LIQUID LIMIT %
PLASTICITY INDEX %



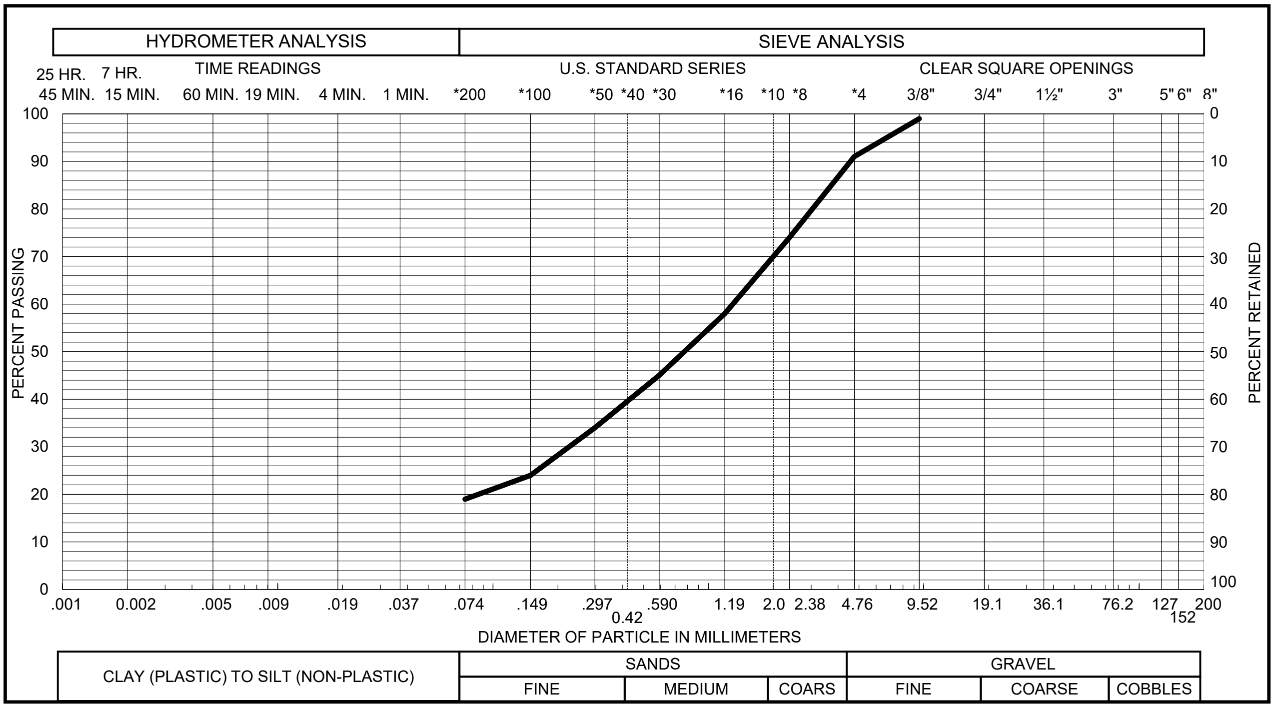
Sample of SANDSTONE, SILTY
From TH - 3 AT 4 FEET

GRAVEL 13 % SAND 68 %
SILT & CLAY 19 % LIQUID LIMIT %
PLASTICITY INDEX %

BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

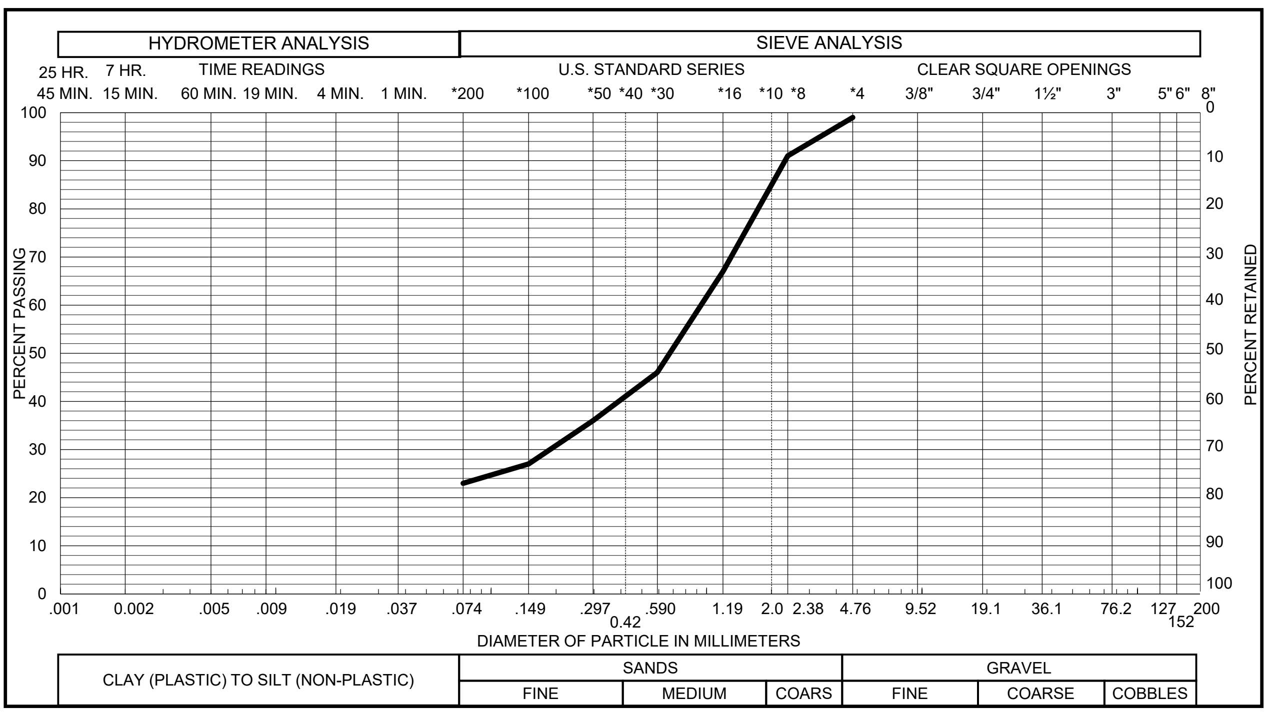
Gradation Test Results

FIG. B-10



Sample of SANDSTONE, SILTY
From TH - 4 AT 14 FEET

GRAVEL 9 % SAND 72 %
SILT & CLAY 19 % LIQUID LIMIT %
PLASTICITY INDEX %



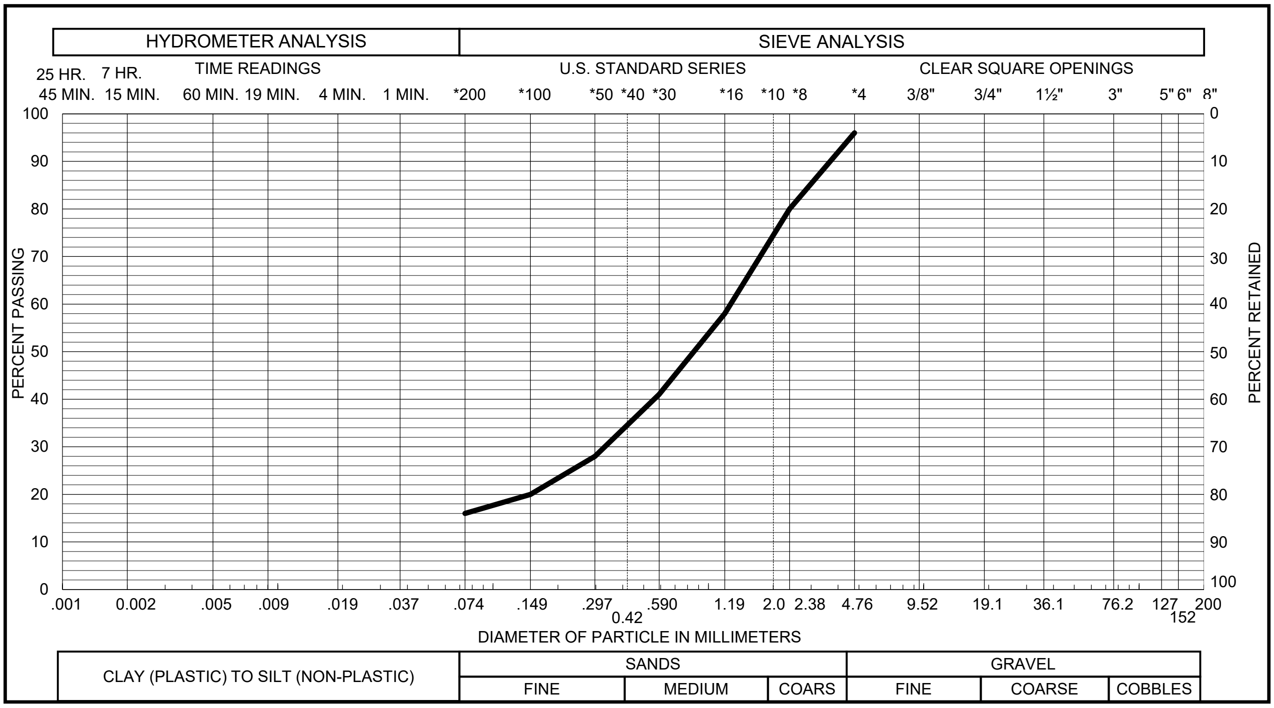
Sample of SANDSTONE, SILTY
From TH - 5 AT 9 FEET

GRAVEL 1 % SAND 76 %
SILT & CLAY 23 % LIQUID LIMIT %
PLASTICITY INDEX %

BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

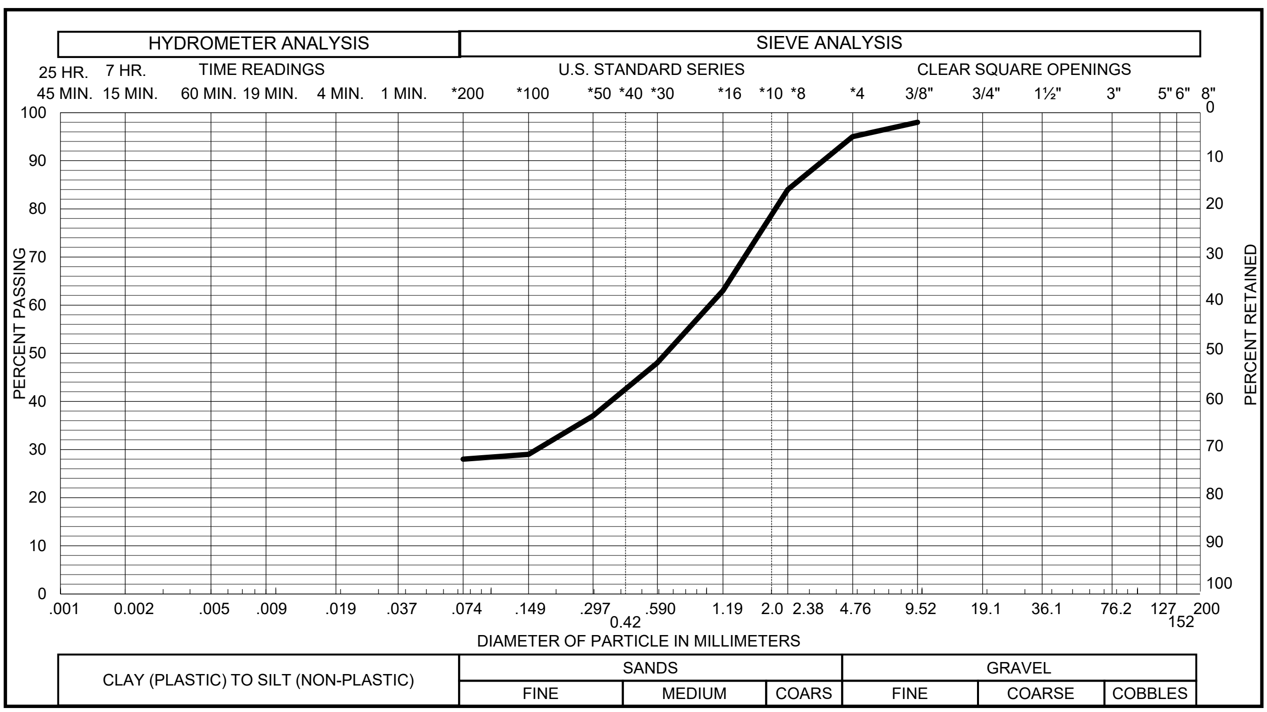
Gradation Test Results

FIG. B-11



Sample of SANDSTONE, SILTY
From TH - 6 AT 4 FEET

GRAVEL 4 % SAND 80 %
SILT & CLAY 16 % LIQUID LIMIT %
PLASTICITY INDEX %



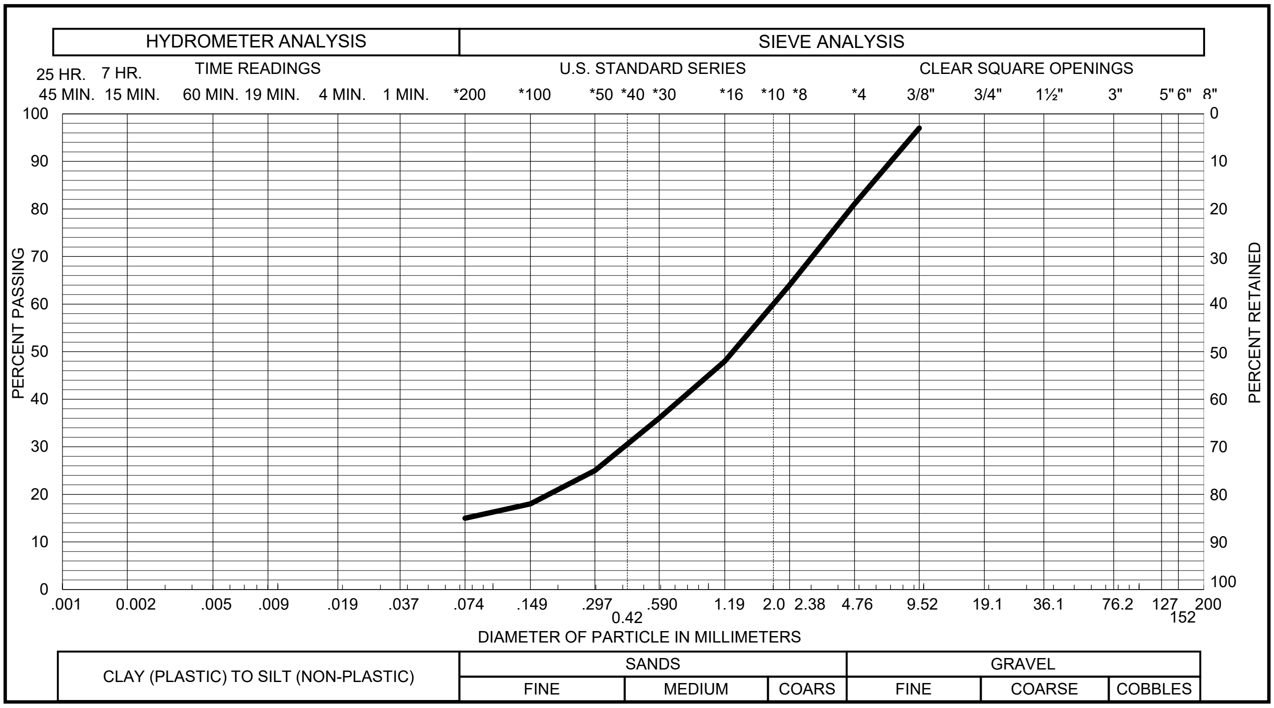
Sample of SANDSTONE, CLAYEY
From TH - 10 AT 4 FEET

GRAVEL 5 % SAND 67 %
SILT & CLAY 28 % LIQUID LIMIT %
PLASTICITY INDEX %

BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Gradation Test Results

FIG. B-12



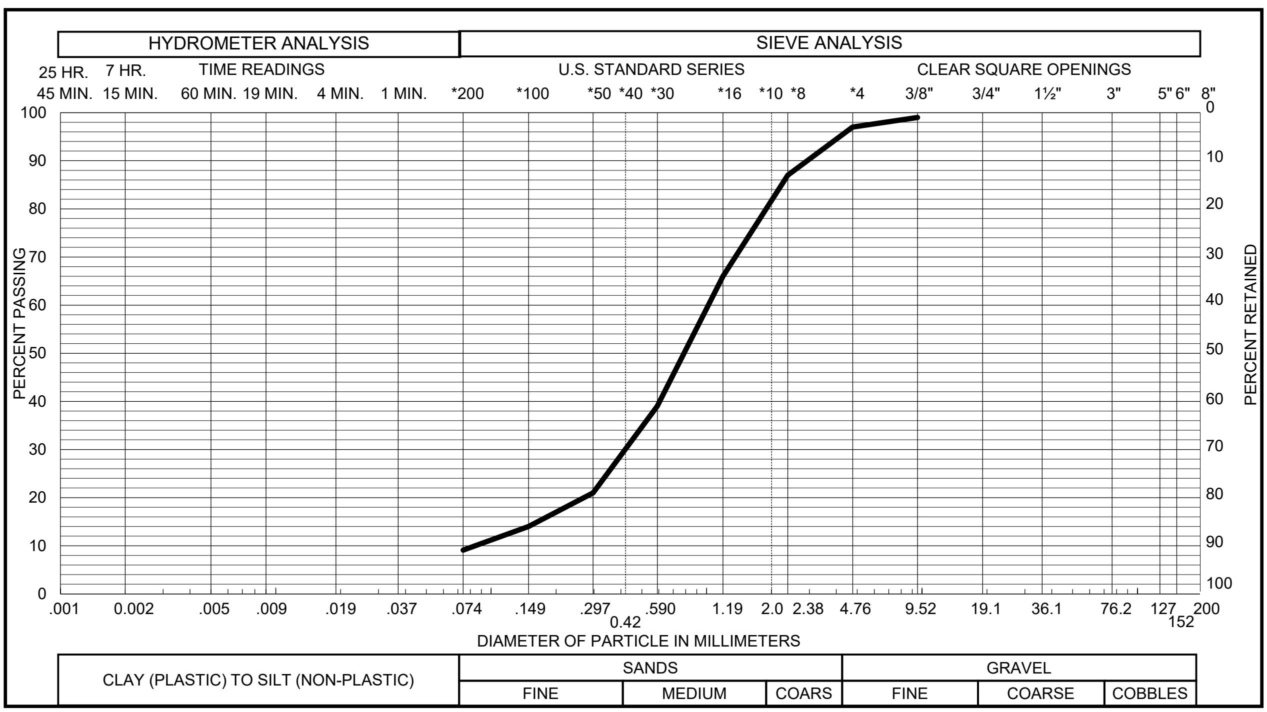
Sample of SANDSTONE, SILTY

From TH - 12 AT 4 FEET

GRAVEL 19 % SAND 66 %

SILT & CLAY 15 % LIQUID LIMIT %

PLASTICITY INDEX %



Sample of SANDSTONE, SLIGHTLY SILTY

From TH - 14 AT 9 FEET

GRAVEL 3 % SAND 88 %

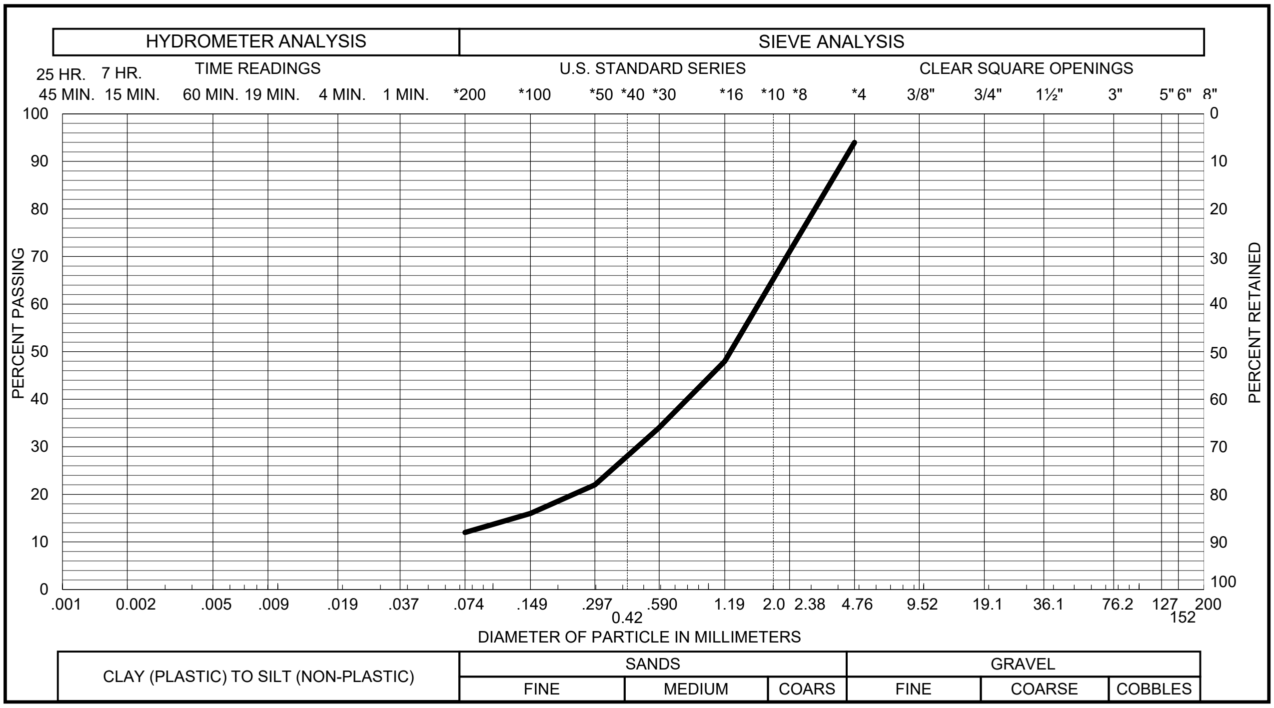
SILT & CLAY 9 % LIQUID LIMIT %

PLASTICITY INDEX %

BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

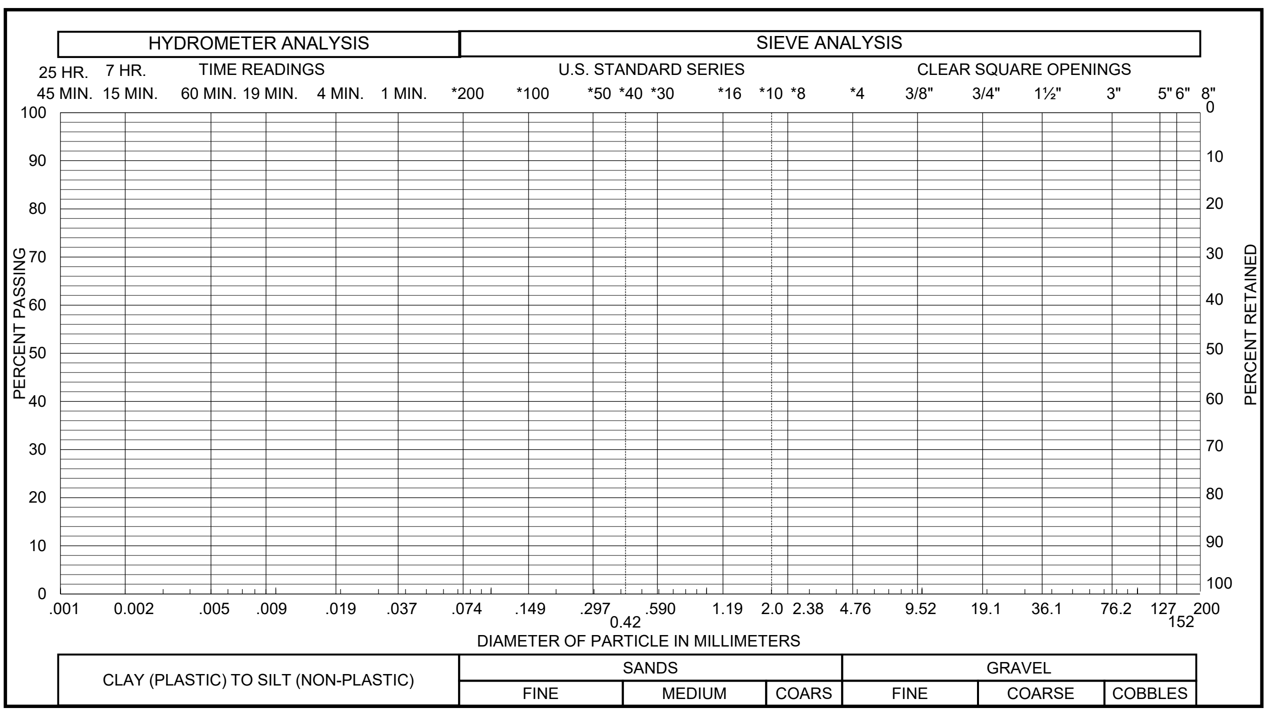
Gradation Test Results

FIG. B-13



Sample of SANDSTONE, SLIGHTLY SILTY
From TH - 20 AT 9 FEET

GRAVEL 6 % SAND 82 %
SILT & CLAY 12 % LIQUID LIMIT %
PLASTICITY INDEX %



Sample of
From

GRAVEL % SAND %
SILT & CLAY % LIQUID LIMIT %
PLASTICITY INDEX %

BRJM, LLC
LATIGO PRESERVE FILLING 9 AND 10, 78 LOTS
CTL|T PROJECT NO. CS19409-115

Gradation Test Results

FIG. B-14

TABLE B-I

SUMMARY OF LABORATORY TESTING
CTL|T PROJECT NO. CS19409-115

BORING	DEPTH (FEET)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS		SWELL TEST RESULTS*		PASSING NO. 200 SIEVE (%)	WATER SOLUBLE SULFATES (%)	DESCRIPTION
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)	SWELL (%)	SWELL PRESSURE (PSF)			
TH-1	4	5.5	121			1.1		28	<0.1	SANDSTONE, CLAYEY
TH-2	4	6.9	124			-0.1		23		SANDSTONE, SILTY
TH-2	9	9.1	129					35		SANDSTONE, SILTY
TH-3	4	7.8	124					19		SANDSTONE, SILTY
TH-4	4	8.2	125			1.6		37		SANDSTONE, VERY CLAYEY
TH-4	14	5.4	106					19		SANDSTONE, SILTY
TH-5	9	7.3	113					23		SANDSTONE, SILTY
TH-6	4	5.9	127					16		SANDSTONE, SILTY
TH-7	4	12.4	119			1.4		65		CLAYSTONE, SANDY
TH-7	9	9.3	126			-0.1		48		SANDSTONE, VERY CLAYEY
TH-8	4	8.5	124			4.5		53	<0.1	CLAYSTONE, VERY SANDY
TH-9	14	19.0	111			0.3				SANDSTONE, VERY CLAYEY
TH-10	4	4.0	118					23	<0.1	SANDSTONE, CLAYEY
TH-10	9	9.6	118					19		SANDSTONE, CLAYEY
TH-10	19	10.4	118					44		SANDSTONE, VERY CLAYEY
TH-11	9	14.3	111					16		SANDSTONE, CLAYEY
TH-11	24	14.3	111			-0.2				SANDSTONE, CLAYEY
TH-12	4	5.5	121					15		SANDSTONE, SILTY
TH-13	14	11.2	122			-0.2		40		SANDSTONE, VERY SILTY
TH-14	9	7.0	110					9		SANDSTONE, SLIGHTLY SILTY
TH-15	4	5.0	123					21		SANDSTONE, SILTY
TH-15	14	7.4	122					15		SANDSTONE, SILTY
TH-17	4	7.9	129					19		SANDSTONE, CLAYEY
TH-17	9	10.1	124			0.5		52		CLAYSTONE, VERY SANDY
TH-17	19	12.5	121			0.0				SANDSTONE
TH-18	4	9.7	124			1.3		49		SANDSTONE, VERY CLAYEY
TH-19	4	10.5	104			-2.8		55		CLAYSTONE, VERY SANDY
TH-19	9	11.3	120							SANDSTONE, CLAYEY
TH-20	9	10.2	122					12		SANDSTONE, SLIGHTLY SILTY
TH-20	14	12.0	121			1.1				SANDSTONE, CLAYEY

* SWELL MEASURED WITH ESTIMATED IN-SITU OVERBURDEN PRESSURE.
NEGATIVE VALUE INDICATES COMPRESSION.