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SOIL, GEOLOGY AND GEOLOGIC HAZARD STUDY CLOVERLEAF DEVELOPMENT EL PASO COUNTY, COLORADO

Prepared for

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Attn: Joe DesJardin

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Respectfully Submitted,

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Table of Contents

1.0 SUMMARY

Project Location:

The project lies in portions of the NE¼ of Section 23 and the NW¼ of Section 24, Township 11 South, Range 67 West of the 6th Principal Meridian, El Paso County, Colorado. The site is located north of Higby Road and west Cloverleaf Road, in the southeast portion of Monument, Colorado.

Project Description:

Total acreage involved in the project is 38.78 acres. The proposed development consists one hundred and forty-four (144) of single-family residential lots, detention ponds, parks, and open space areas.

Scope of Report:

The report presents the results of our geologic investigation and treatment of engineering geologic hazard study for the sketch plan submitted. This report presents the results of our geologic reconnaissance, a review of available maps, aerial photographs and our conclusions with respect to the impacts of the geologic conditions on development.

Land Use and Engineering Geology:

This site was found to be suitable for the proposed development. Geologic conditions will impose some constraints on development. These include areas of loose soils, erosion, seasonal and potentially seasonal shallow groundwater areas. Site conditions will be discussed in greater detail in this report. All recommendations are subject to the limitations discussed in the report.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in portions of the NE¼ of Section 23 and the NW¼ of Section 24, Township 11 South, Range 67 West of the 6th Principal Meridian, El Paso County, Colorado. The site is located north of Higby Road and west of Cloverleaf Road, in El Paso County, Colorado. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is generally gently to gradually sloping to the west with some moderate slopes along small ridge in the southeast part of the site. Drainages on-site flow in southerly directions. Only minor amounts of water were observed flowing in some of the drainages at the time of this investigation, however, some minor areas of ponded water were observed. The approximate boundaries of the site are indicated on the USGS Map, Figure 2. Previous site uses have included grazing and pasture land. Vegetation on site consists primarily of field grasses and weeds. Site photographs are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 3.

Total acreage involved in the proposed development is 38.78 acres. The proposed development is to consist of one hundred and forty-four (144) single-family residential lots with, parks and open space areas. The area will be serviced by central water and sewer. The preliminary grading plan presented in Figure 3A.

3.0 SCOPE OF THE REPORT

The scope of this report will include the following:

- A general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site.

The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved field reconnaissance, measurements and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identifies pertinent geologic conditions affecting development.

Additionally, six (6) test borings were drilled as a part of the preliminary subsurface soil investigation for the subdivision to determine general soil conditions. The borings were drilled with a power-driven continuous flight auger drill rig to depths of 20 to 35 feet. Samples were obtained during drilling using the Standard Penetration Test, ASTM D-1586, utilizing a 2-inch O.D. Split Barrel Sampler and a California Sampler. Results of the penetration tests are shown on the drilling logs to the right of the sampling point. The location of the test borings is shown on the Test Boring Location Map, Figure 3. The drilling logs are included in Appendix B.

Laboratory testing was performed to classify and determine the soils engineering characteristic. Laboratory tests included moisture content, ASTM D-2216, grain size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Swell/Consolidation Testing, ASTM D-4546, was conducted on select samples to evaluate the expansive/compressive characteristics of the soils. A Summary of Laboratory Test Results is presented in Table 1.

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

5.1 General Geology

Physiographically, the site lies in the western portion of the Great Plains Physiographic Province. Approximately 4 miles to the west is a major structural feature known as the Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be gently dipping in a northerly direction (Reference 1). Bedrock in the area of the site is sedimentary in nature, and typically Tertiary to Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson are unconsolidated deposits of residual and alluvial soils. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Service

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has mapped one soil type on the site (Figure 4). In general, the soils consist of loamy sands. Soils are described as follows:

Type	Description
92	Tomah-Crowfoot Loamy Sands, 3-8% slopes

Complete descriptions of the soils are presented in Appendix C. The soils have generally been described to have rapid to very rapid permeabilities. The majority of the soils have been described by the Soil Conservation Service as good potential for urban development. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have slight to moderate erosion hazards. The soil blowing hazard is severe if vegetation is removed.

5.3 Site Stratigraphy

The Monument Quadrangle Geology Map showing the site is presented in Figure 5 (Reference 4). The Geology Map prepared for the site is presented in Figure 6. Two mappable units were identified on this site, which are identified as follows:

- **Qas_1** **Younger Alluvial-Slope Deposits of Holocene to Late Pleistocene Age:** These are sheetwash and fluvial deposited sands that exists in the northern portions of the site. These materials typically consist of silty to clayey sands.

- **TKda** **Dawson Arkose Formation of Tertiary to Cretaceous Age:** The bedrock underlying the site is the Dawson Formation. This formation consists of arkosic sandstone with interbedded lenses on fine grained sandstone, claystone or siltstone. Typically, it is buff to light brown and light gray in color. Overlying the Dawson is a variable layer of residual soil derived from the in-situ weathering of the bedrock materials.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Monument Quadrangle* distributed by the Colorado Geological Survey in 2003 (Figure 5, Reference 4), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 5), and the *Geologic Map of the Denver $1^0 \times 2^0$ Quadrangle*, distributed by the US Geological Survey in 1981 (Reference 6). The test borings from the preliminary subsurface investigation were also used in evaluating the site. The Test Boring Logs are included in Appendix B and the Laboratory Test Results are summarized in Table 1 of this report.

5.4 Soil Conditions

The soils encountered in the test borings can be grouped into two general soil types. Three soil types were observed during drilling and consisted of Type 1A: sandy silt (ML), Type 1: slightly silty to silty sand (SM, SM-SW), and Type 2: clayey to very clayey and silty sandstone (SC, SM). Each soil type was classified in accordance with the Unified Soil Classification System (USCS) using the laboratory testing results and the observations made during drilling.

Soil Type 1A classified as a sandy silt (ML). The silt was encountered in Test Boring No. 6 at the existing ground surface to 4 feet below ground surface (bgs). Standard Penetration Testing of the sand resulted in N-values of 14 bpf indicating firm consistencies. Water content and grain size analysis resulted in water contents of 5 percent and approximately 85 percent of the soil particles passing the No. 200 sieve.

Soil Type 1 classified as a slightly silty to silty sand (SM, SM-SW). The sand was encountered in all the test borings from the existing ground surface to depths ranging from 7 to 24 feet below ground surface (bgs), and to the termination of Test Boring Nos. 1 and 6 (20 feet). Standard Penetration Testing of the sand resulted in N-values of 3 to 30 bpf indicating very loose to medium dense states. Water content and grain size analysis resulted in water contents of 2 to 17 percent and approximately 5 to 22 percent of the soil particles passing the No. 200 sieve. Atterberg Limits testing on samples of the sand resulted in liquid limits ranging from 35 to no value and plastic indexes ranging from 11 to non-plastic. Sulfate testing on the sand resulted in less than 0.01 percent soluble sulfate by weight, indicating negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 2 classified as a clayey to very clayey and silty sandstone (SC, SM). The sandstone was encountered in four of the test borings at depths ranging from 7 to 24 feet and extending to the termination of the borings (20-35 feet). Standard Penetration testing resulted in N-values of 30 to greater than 50 bpf, indicating dense to very dense states. Water content and grain size analysis resulted in water contents of 6 to 15 percent and approximately 12 to 42 percent of the soil particles passing the No. 200 sieve. Atterberg Limits testing on samples of the sandstone resulted in liquid limits ranging from 48 to no value and plastic indexes ranging from 22 to non-plastic. Swell/Consolidation on a sample of very clayey sandstone resulted in a volume change of 1.2 percent, indicating a low to moderate expansion potential. Expansive claystone and siltstone are commonly interbedded in the sandstone in this area. Sulfate testing on the sand resulted in less than 0.01 to 0.01 percent soluble sulfate by weight, indicating negligible potential for below grade concrete degradation due to sulfate attack.

A Summary of Laboratory Results is presented in Table 1. A Summary of the Depth to Bedrock is included in Table 2.

5.5 Groundwater

Groundwater was encountered at depths ranging from 12.5 to 33 feet in four of the test borings. A table showing the depth to groundwater is presented in Table 2. Areas of seasonal and potentially seasonal groundwater have been mapped on the site and are discussed in the following section.

Fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Isolated sand layers within the variable soil profile, sometimes only a few feet in thickness and width, can carry water in the subsurface. Water may also flow on top of the sandstone. Contractors should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site. Grading in areas of shallow water should be minimized.

6.0 ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

As mentioned previously, detailed mapping has been performed on this site to produce an Engineering Geology Map (Figure 6). This map shows the location of various geologic conditions of which the developers and planners should be cognizant during the planning, design and construction stages of the project. The hazards identified on this site include loose soils, erosion, potentially seasonal shallow groundwater, and seasonal shallow groundwater areas. The following hazards have been addressed as a part of this investigation:

Expansive Soils

While the soils encountered in the test borings drilled on-site have low expansion potential, expansive clays and claystone are common in the area and may be encountered in the subsurface on this site. The expansive soils on-site are highly sporadic, therefore, none have been indicated on the map. Expansive clays and claystone, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and dealt with on an individual basis.

Mitigation: Should expansive soils be encountered beneath foundations, mitigation will be necessary. Mitigation of expansive soils will require special foundation design. Overexcavation of 3 to 4 feet and replacement with non-expansive soils at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation which is common in the area. Drilled piers are another option that is used in areas where highly expansive soils are encountered. Typical minimum pier depths are on the order of 25 feet or more and require penetration into the

bedrock material a minimum of 4 to 6 feet, depending on building loads. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. The use of structural floors should be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Subsidence Area

Based on a review of the *Mining Report for the Colorado Springs Coal Field* (Reference 7), a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 8), the site is not undermined. The closest underground mines in the area are 10 miles to the south and the site is not mapped within any potential subsidence zones.

Slope Stability and Landslide Hazard

The slopes on-site are gently to moderately sloping and do not exhibit any past or potential unstable slopes or landslides. Preliminary grading plans indicated the small ridge in the southern portion of the site will be regraded, and lower lying areas on the site will have fil placed. Slopes should be no steeper than 3:1, if regraded unless specifically evaluated. All topsoil and organics should be removed prior to any regrading or fill placement. All new fill should be properly benched into native slopes and compacted at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557.

Rockfall Hazards

Based on our site observation, no rock outcrops or areas of rockfall hazard were observed on this site.

Areas of Erosion

These are areas that are undergoing erosion by water and sheetwash producing gullies and rill erosion. Areas of erosion were observed in the Teachout Creek drainage in the northern portion of the site, and an area along eastern side of the site along Cloverleaf Road.

Mitigation: Due to the nature of the soils on this site, virtually all the soils are subject to erosion by wind and water. Other minor areas of erosion were observed on site other than those mapped, particularly where some rill erosion has occurred. Areas of erosion can occur across the entire site, particularly if the soils are disturbed during construction. Vegetation reduces the potential for erosion. The areas identified where erosion is actually taking place may require check dams, regrading and revegetation using channel lining mats to anchor vegetation. Further recommendations for erosion control are discussed under Section 9.0 "Erosion Control" of this report. Recommendations pertaining to revegetation may require input from a qualified landscape architect and/or the Natural Resource Conservation Service (previously Soil Conservation Service).

Debris Fans

Based on site observations, debris fans were not observed in this area. Areas of recent sediment deposits were observed in some of the drainages on the site. The drainage areas are discussed below.

Groundwater and Drainage Areas

Groundwater was encountered in four of the six test borings at depths ranging from 12.5 to 33 feet. Areas within the drainages on-site have been identified as potentially seasonal shallow groundwater, and the seasonal shallow groundwater area is located in a minor drainage area in the south-central portion of the site. The seasonally shallow groundwater area located in the south-central portion of the site shown on the Geology Map, Figure 6, is identified in the National Wetland Inventory as a Freshwater Emergent Wetland habitat classified as PEM1C (Palustrine – P, Emergent – EM, Persistent – 1, Seasonally Flooded – C) (Reference 9). Test Boring No. 3 is located adjacent to this area, and groundwater was encountered at 12.5 feet subsequent to drilling. In this area we would anticipate the potential for surface and near surface groundwater conditions depending on seasonal changes in precipitation and runoff. This area had saturated surface conditions and minor areas of standing water during our field mapping. This area is further discussed in the following section. No areas of the site have been mapped as floodplain zones according to the FEMA Map No. 08041CO278G, Figure 7 (Reference 10). Exact floodplain location and drainage studies are beyond the scope of this report. Groundwater areas are discussed as follows:

- *Potentially Seasonal and Seasonal Shallow Groundwater*

In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions. Areas within the drainages on-site have been identified as potentially seasonal shallow groundwater, and the seasonal shallow groundwater area is located in a minor drainage area in the south-central portion of the site, and is also identified as a wetland in the National Wetland Inventory. In this wetland area we would anticipate the potential for surface and near surface groundwater conditions depending on seasonal changes in precipitation and runoff. This area had saturated surface conditions and minor areas of standing water during our field mapping. The areas identified as potentially seasonal and seasonal shallow groundwater lie within drainages and low-lying areas that will be regraded during overlot grading. Where structures or utility trenches encroach on, or lie within these areas, the following mitigation is recommended:

Mitigation: In these locations, foundations in areas subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. Preliminary grading plans indicate the seasonally wet area will be filled. At this location and elevation, a foundation depth for frost protection of 30 inches is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of water into areas located below grade. A typical perimeter drain detail is presented in Figure 8. Where shallow groundwater is encountered, additional drains, such as capillary breaks and/or interceptor drains may be necessary typical drain details are presented in Figures 9 and 10. Unstable conditions should be expected where excavations approach the groundwater level. The use of rock, shotcrete, or geo-grids may be necessary to stabilize excavations. Additionally, swales should be created to intercept surface runoff and carry it safely around and away from structures. The drainages will be filled during site grading mitigating the seasonal shallow and potentially seasonally shallow groundwater hazards. The water table may be of sufficient depth to minimize the effects on buildings; however, groundwater may be encountered during utility trenches during site development. All soft and organic soils should be removed prior to fill placement. Stabilization of the subgrade with rock and fabric prior to placing fill may be necessary if saturated unstable conditions are encountered.

Artificial Fill

Artificial fill was not observed on the site.

Collapsible Soils

Areas of loose or potentially collapsible soils were encountered in some of the test borings drilled on-site. Should loose or collapsible soils be encountered beneath foundations, removal and recompaction with thorough moisture conditioning at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be necessary. Typically, the overexcavation extends to depths of at least 2 to 3 feet beneath foundations. Specific recommendations should be made after additional investigation of each building site

Faults

The closest fault is the Rampart Range Fault, located 4 miles to the west. No faults are mapped on the site itself. Previously Colorado was mapped entirely within Seismic Zone 1, a very low seismic risk. Additionally, the International Residential Code (IRC), 2003, currently places this area in Seismic Design Category B, also a low seismic risk. According to a report by the Colorado Geological Survey by Kirkman and Rogers, 1981, (Reference 11) this area should be designed for Zone 2 due to more recent data on the potential for movement in this area, and any resultant earthquakes.

Dipping Bedrock

The bedrock underlying the site is the Dawson Formation of Tertiary to Cretaceous Age. The Dawson in this area is gently dipping a northerly direction according to the *Geologic Structure Map of the Denver 1x2 Quadrangle, North-Central Colorado* (1981) (Reference 1). The bedrock encountered in the test borings and observed on-site did not exhibit steeply dipping characteristics; therefore, mitigation is not necessary.

Shallow Bedrock

Bedrock was encountered at 7 to 24 feet in Test Boring Nos. 2 through 5. Bedrock was not encountered in Test Boring Nos. 1 and 6 which were drilled to 20 feet. A Summary of the Depth to Bedrock is included in Table 2. Shallow bedrock may be encountered in some areas of this site, particularly those mapped as TKda: Dawson Arkose Formation. Where shallow sandstone is encountered, higher allowable bearing capacities are anticipated. Shallow claystone

may require mitigation for expansive soils. Excavations extending in the sandstone or claystone bedrock may be difficult requiring track-mounted equipment.

Radioactivity

Radon levels for the area have been reported by the Colorado Geologic Survey in the Open-File, Report No. 91-4 (Reference 12). Average radon levels of 5.77 pci/l have been measured in the area. The following is a table of radon levels in this area.

0<4 pci/l	33.33%
4<10 pci/l	66.67%
10<20 pci/l	0.00%
>20 pci/l	0.00%

Mitigation: The potential exists for radon gas to build up in areas of the site. Build-ups of radon gas can be mitigated by providing increased ventilation of basements and crawlspaces and sealing of joints. Specific requirements for mitigation should be based on-site specific testing after the site is constructed.

7.0 EROSION CONTROL

The soil types observed on the site are mildly to moderately susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed, and vegetation reestablished, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils and weathered bedrock materials become increasingly less susceptible to water erosion. For the typical soils observed on-site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased

through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap.

In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to re-vegetate successfully. Therefore, recommendations pertaining to the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

8.0 EMBANKMENT CONSTRUCTION RECOMMENDATIONS

In general, the site soils are suitable for the proposed embankment. Groundwater may be encountered in cuts for the proposed detention ponds across the site. If excavations encroach on the groundwater level unstable soil conditions may be encountered.

Any areas to receive fill should have all topsoil, organic material or debris removed. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1 or flatter on the upstream faces or 2.5:1 or flatter on the downstream face. The subgrade should be scarified and moisture conditioned to within 2% of optimum moisture content and compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM

D-1557, prior to placing new fill. Areas receiving fill may require stabilization with rock or fabric if shallow groundwater conditions are encountered.

New fill should be placed in thin lifts not to exceed 6 inches after compaction while maintaining at least 95% of its maximum Modified Proctor Dry Density, ASTM D-1557. These materials should be placed at a moisture content conducive to compaction, usually 0 to ±2% of Proctor optimum moisture content. The placement and compaction of fill should be observed and tested by Entech during construction. Entech should approve any import materials prior to placing or hauling them to the site.

9.0 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 13), the area is mapped as upland deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 14), the site is not mapped as a probable aggregate resource. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 15), the area of the site has been mapped as "Good" for industrial minerals. The sands associated with the eolian and alluvial deposits are considered a sand resource. Considering the silty to clayey nature of much of these materials and abundance of similar materials through the region and close proximity to developed land, they would be considered to have little significance as an economic resource.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 15), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active or inactive mines have been mapped in the area of the site. The *El Paso County Aggregate Resource Map* (Reference 13) has mapped coal resources in the Falcon area approximately ½ mile south of the site; however, the coal resources are estimated at 1,500 feet below the surface (Reference 8). At this depth, mining the coal would not be economical at this time. No metallic mineral resources have been mapped on the site (Reference 15).

The site has been mapped as "Fair" for oil and gas resources (Reference 15). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the geologic structure for trapping oil or gas; therefore, it would not be considered a significant resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine If the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

10.0 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

We understand that the development will consist of one hundred and forty-four (144) single-family residential lots with parks, and open space areas. It is our opinion that the existing geologic and engineering geologic conditions will impose some constraints on the proposed development and construction. The most significant hazards associated with the site are loose soils, erosion, potentially seasonal shallow groundwater, and seasonal shallow groundwater areas. These can be satisfactorily mitigated by either avoidance, regrading, or through proper engineering design, construction and drainage systems.

The upper materials are typically at loose to dense states. The medium dense to dense granular soils encountered in the upper soil profiles of the test borings should provide good support for foundations. Loose soils, if encountered beneath foundations or slabs, will require removal and recompaction. Expansive soils, although sporadic, were encountered. Expansive clayey sandstone and claystone are common in the Dawson Formation, and may require mitigation. Foundations anticipated for the site are standard spread footings possibly in conjunction with overexcavation in areas of expansive soils or loose soils. Areas containing arkosic sandstone will have high allowable bearing conditions. Expansive layers may also be encountered in the soil and bedrock on this site. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

Areas of potentially seasonal shallow groundwater and seasonal shallow groundwater, exist on this site. These areas are to be filled during site grading. According to the site plan as shown on the Geology Map, Figure 6, and the preliminary grading, Figure 3A, some of the minor drainages will be filled mitigating the hazard. Additional investigation should be performed following site grading. Where structures encroach on areas of potential shallow groundwater or construction and regrading is proposed, drains may be necessary. Typical drain details are included in Figures 8 through 10. The site does not lie within any of floodplain zones (Reference 9, Figure 7). Exact floodplain locations and drainage studies are beyond the scope of this report.

Areas of perched groundwater may be encountered on this site in areas other than those mapped. Permeable sands exist on the site that may carry water in the subsurface perched on less permeable bedrock. Groundwater was encountered at depths ranging from 12.5 to 33 feet in four of the test borings drilled on the site. Cuts in areas of shallow water should be kept to a minimum. Fluctuation in groundwater conditions may occur due to variations in rainfall, soil conditions and development of surrounding areas. Builders should be cognizant of the potential for the occurrence of subsurface water features during construction and deal with each individual problem as necessary at the time of construction. Subsurface drains and dewatering systems may be necessary in some areas where seepage and perched water occurs. Unstable conditions should be expected where excavations approach the groundwater level. Areas receiving fill will need to have all topsoil/organics removed prior to placing fill. Stabilization with geofabric or shot rock may be necessary for utility excavations or in areas of shallow groundwater where fill will be placed.

In summary, development of the site can be achieved if the items discussed above are mitigated. These items can be mitigated through proper design and construction or by avoidance. Additional investigation is recommended as grading and development plans are prepared, prior to construction.

10.0 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some constraints on development and construction of the site. The geologic hazards identified on the site can either be avoided by development or satisfactorily mitigated through proper engineering design and construction practices. The report was prepared for the proposed master plan. Additional soils investigation is recommended as the development and grading plans are prepared to provide more detailed information on soil, groundwater and bedrock.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Discrepancies should be reported to Entech Engineering, Inc. soon after they are discovered so that the evaluation and recommendations presented can be reviewed and revised if necessary. Planning and design personnel should be made familiar with the contents of this report.

This report has been prepared PT Cloverleaf, LLC for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust this report has provided you with all the information you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

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TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

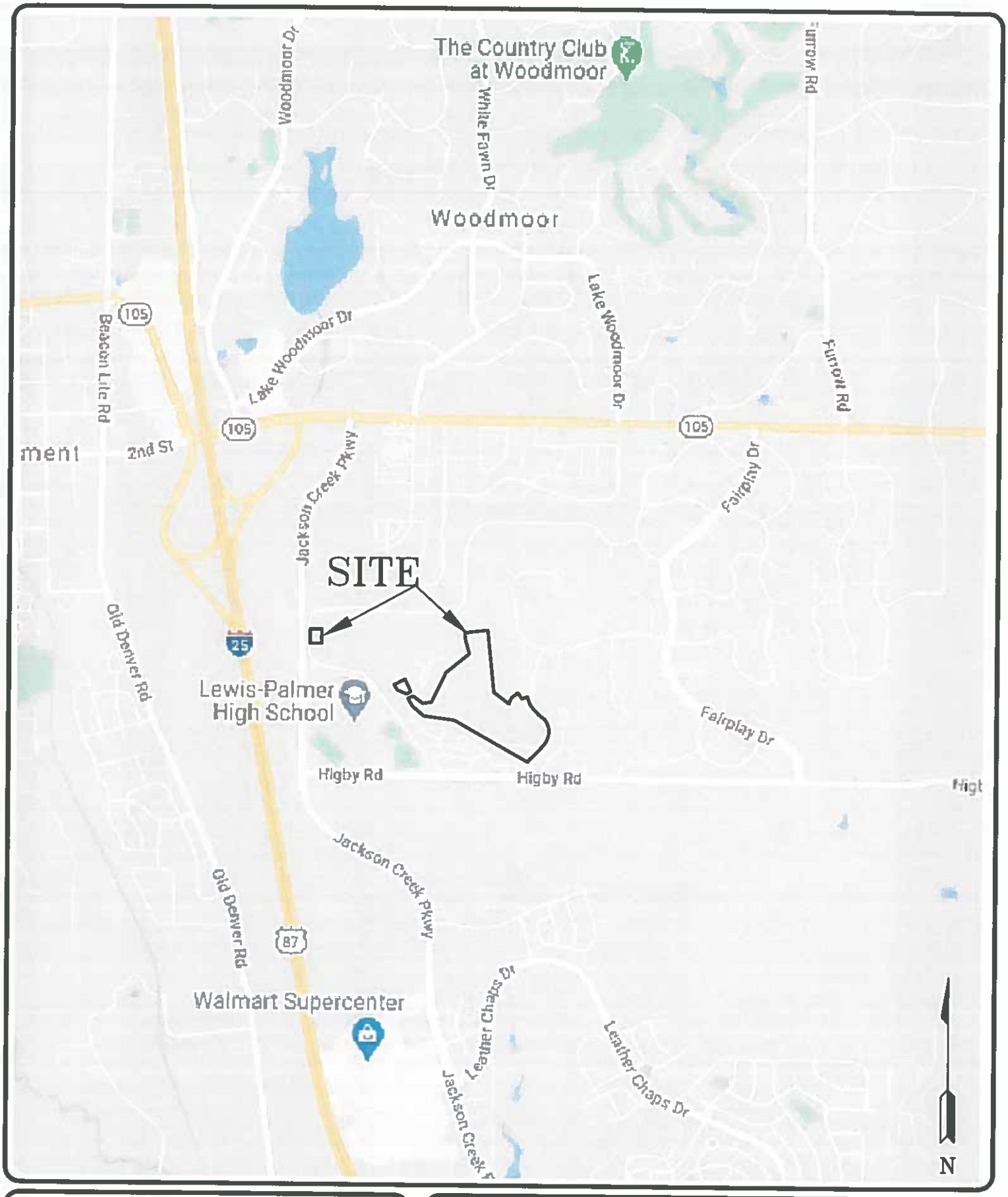
CLIENT PT CLOVERLEAF, LLC
PROJECT CLOVERLEAF SITE
JOB NO. 200100

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1	2-3			21.5	NV	NP	<0.01			SM	SAND, SILTY
1	2	5			16.5						SM	SAND, SILTY
1	3	5			13.1						SM	SAND, SILTY
1	4	5			5.0	NV	NP				SM-SW	SAND, SLIGHTLY SILTY
1	5	10			14.9	35	11				SM	SAND, SILTY
1	6	15			13.8						SM	SAND, SILTY
1A	6	2-3			84.6						ML	SILT, SANDY
2	2	15			23.0	39	17	0.01			SC	SANDSTONE, CLAYEY
2	3	10	16.1	106.9	42.0	48	22	<0.01		1.2	SC	SANDSTONE, VERY CLAYEY
2	4	30			12.3						SM	SANDSTONE, SILTY

Table 2: Summary of Depth to Bedrock and Groundwater

Test Boring No.	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)
1	>20	13.5
2	14	>18.5
3	8	12.5
4	24	33
5	7	13.5
6	>20	>20

FIGURES



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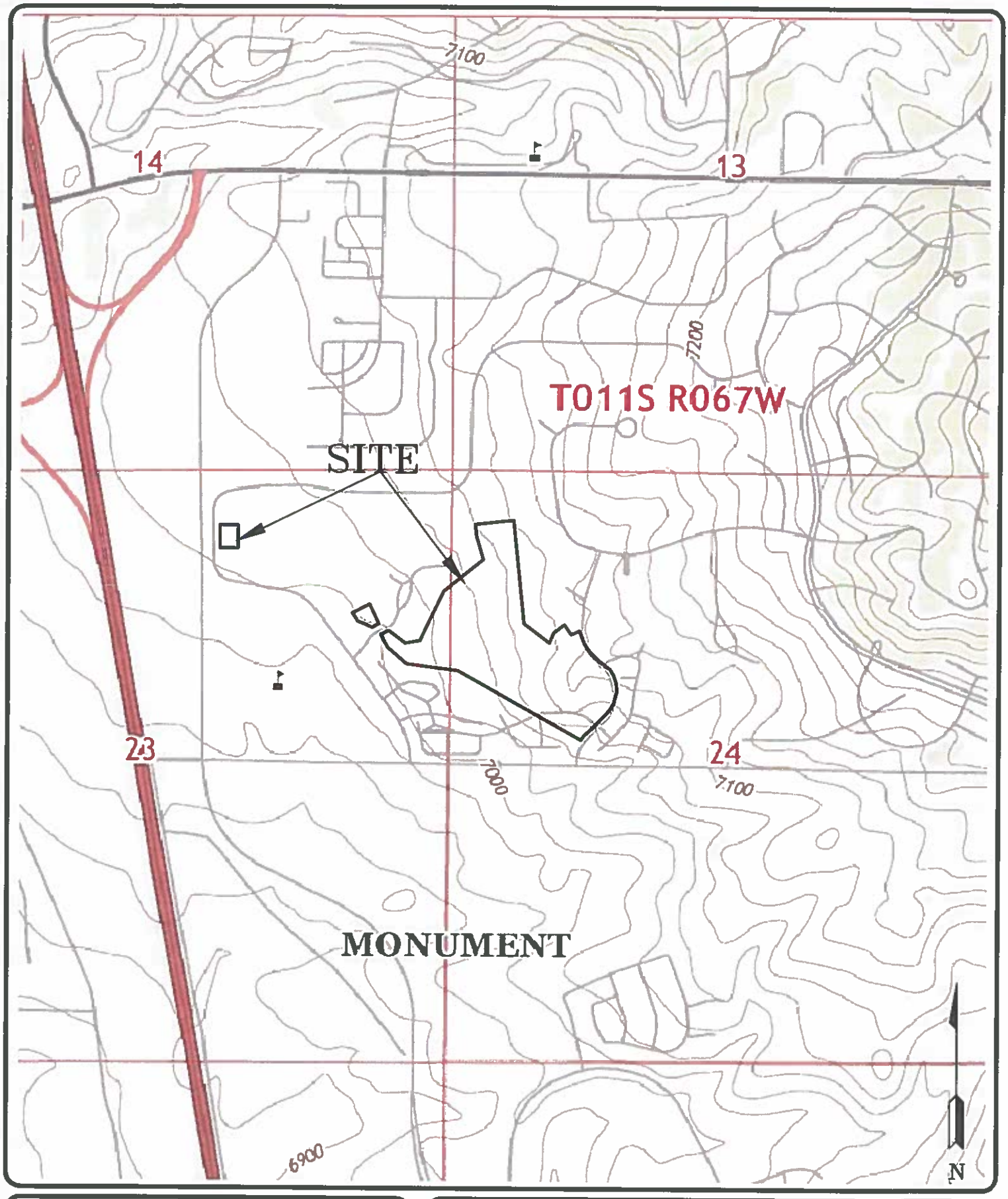
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/24/20		

JOB NO.: 200100

FIG NO.: 1



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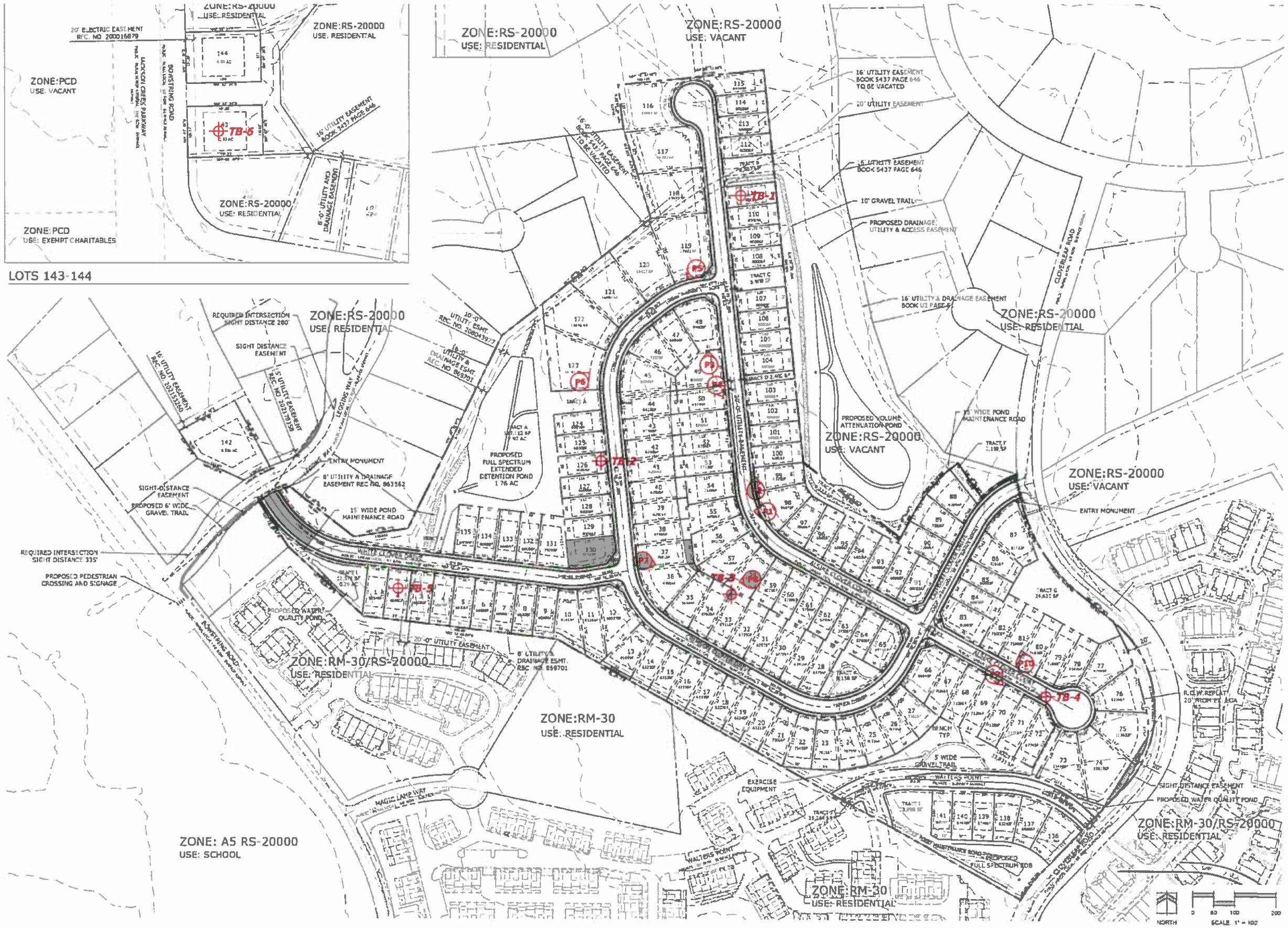
USGS MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/24/20		

JOB NO.: 200100

FIG NO.: 2



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

P2 - APPROXIMATE TEST PIT LOCATION AND NUMBER

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SITE PLAN/TEST BORING LOCATION MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN: JJL
CHECKED:
DATE: 3/22/21
SCALE: AS SHOWN
JOB NO. 200100
FIGURE No. 3

CLOVERLEAF LAYOUT F
GRADING PLAN

ADDITIONAL PURCHASE AREA: 3.89 AC
ORIGINAL PURCHASE AREA: 33.33 AC

EARTHWORK
CUT: 154,525 CY
FILL: 127,650 CY
Net: 26,875 CY (C)

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

2000-5158.00
CLOVERLEAF LAYOUT F
GRADING PLAN
2020-02-25
SHEET 1 OF 1

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Fort Collins 970-491-9888 • www.jrengineering.com

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PRELIMINARY GRADING PLAN
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PROTERRA PROPERTIES, LLC

DRAWN: LLL
CHECKED:
DATE: 4/6/20
SCALE: AS SHOWN
JOB NO.: 200100
FIGURE No.: 3A

N

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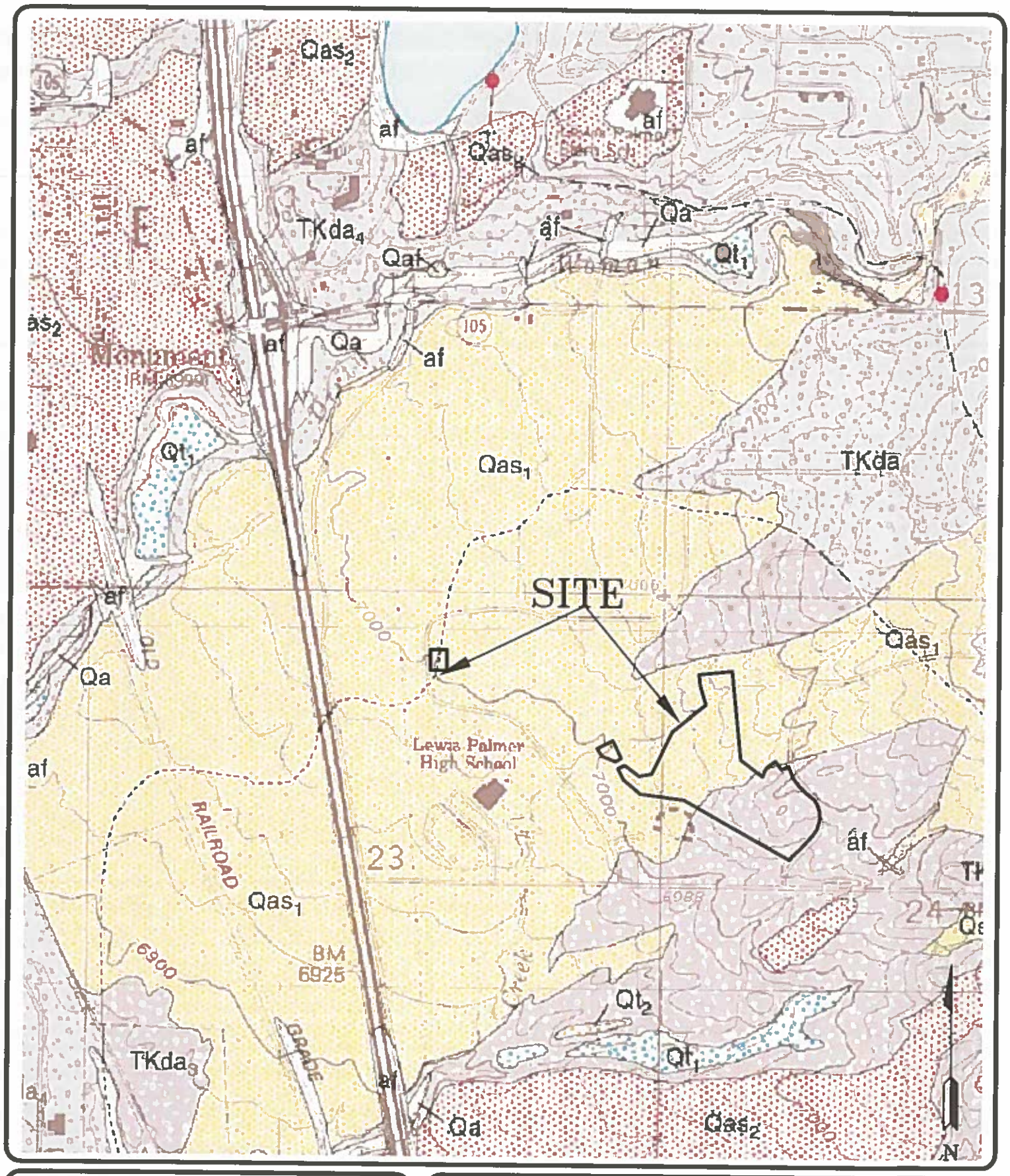
SOIL SURVEY MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/24/20		

JOB NO.: 200100

FIG NO.: 4



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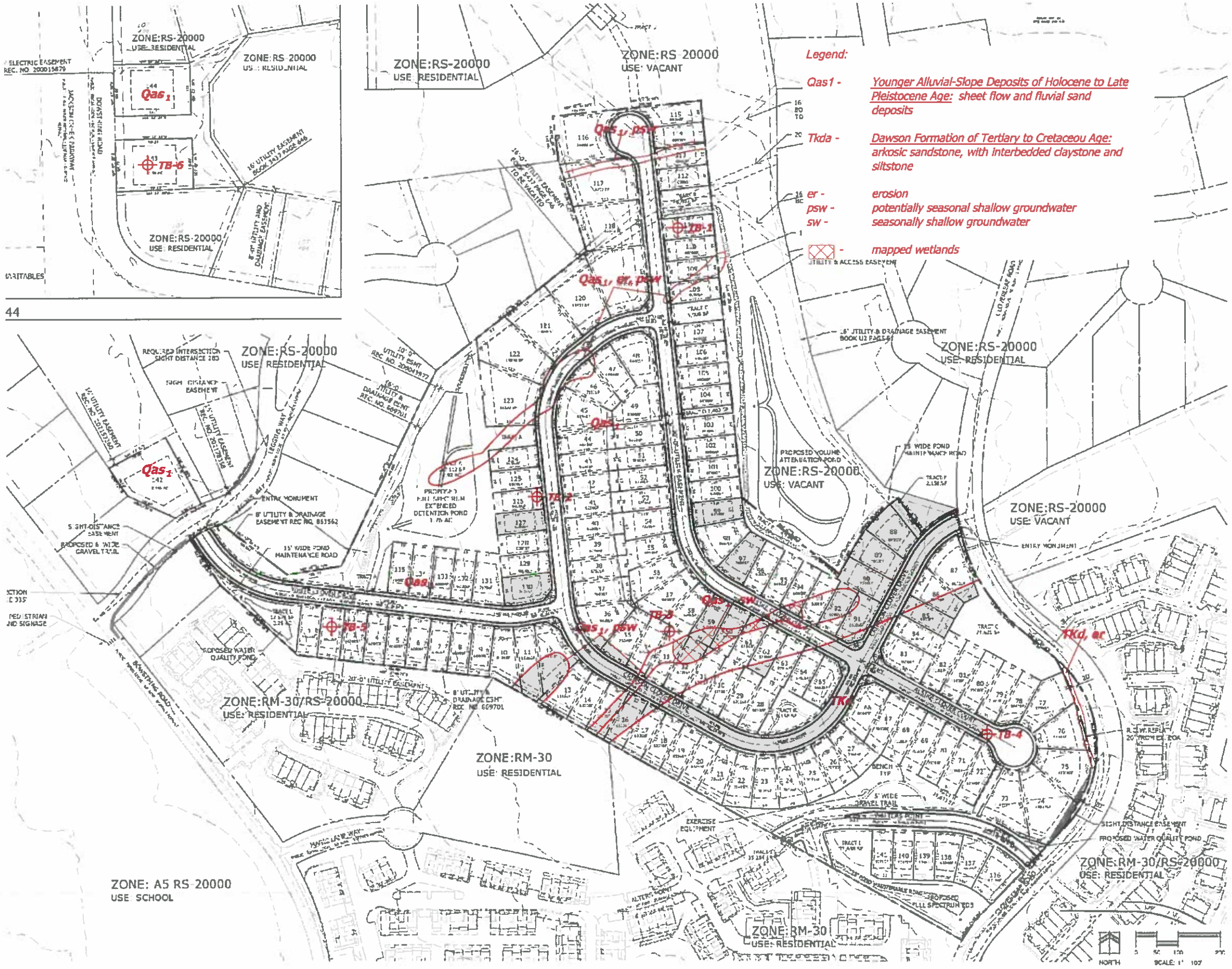
COLORADO SPRINGS, CO. 80907 (719) 531-5599

MONUMENT QUADRANGLE GEOLOGY MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/24/20		

JOB NO.: 200100

FIG NO.: 5



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

REVISION	BY

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ENGINEERING GEOLOGY MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN	LLL
CHECKED	
DATE	3/22/21
SCALE	AS SHOWN
JOB NO.	200100
FIGURE No.	6

N

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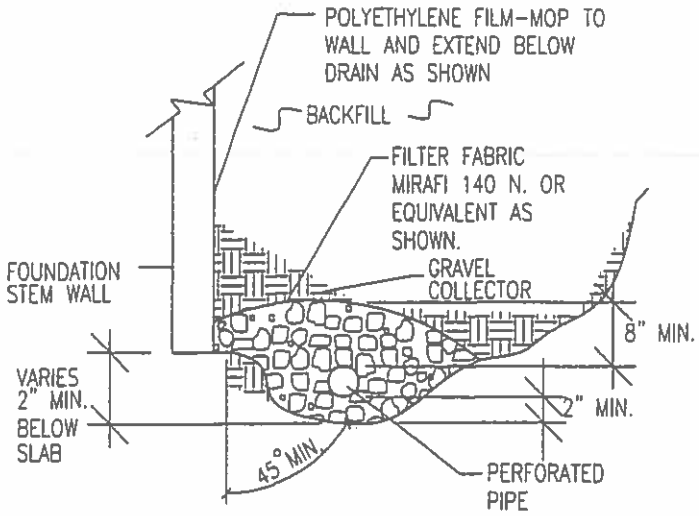
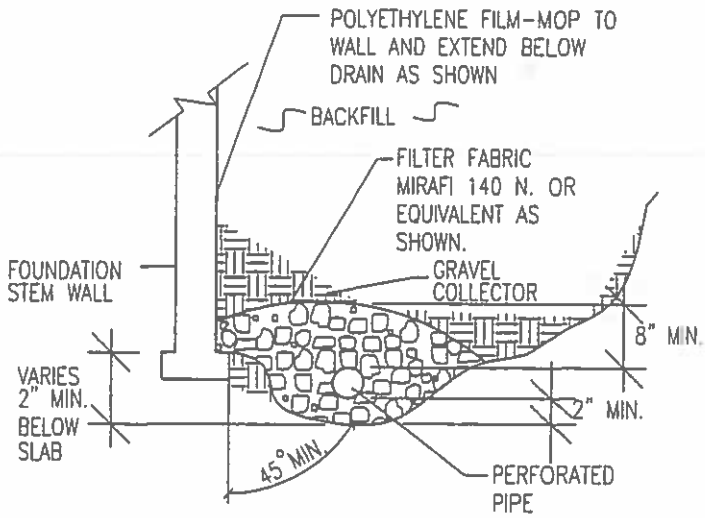
FLOODPLAIN MAP
CLOVERLEAF DEVELOPMENT
HIGBY ROAD & CLOVERLEAF ROAD
MONUMENT, CO
FOR: PT CLOVERLEAF, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/24/20		

JOB NO.: 200100

FIG NO.: 7





NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

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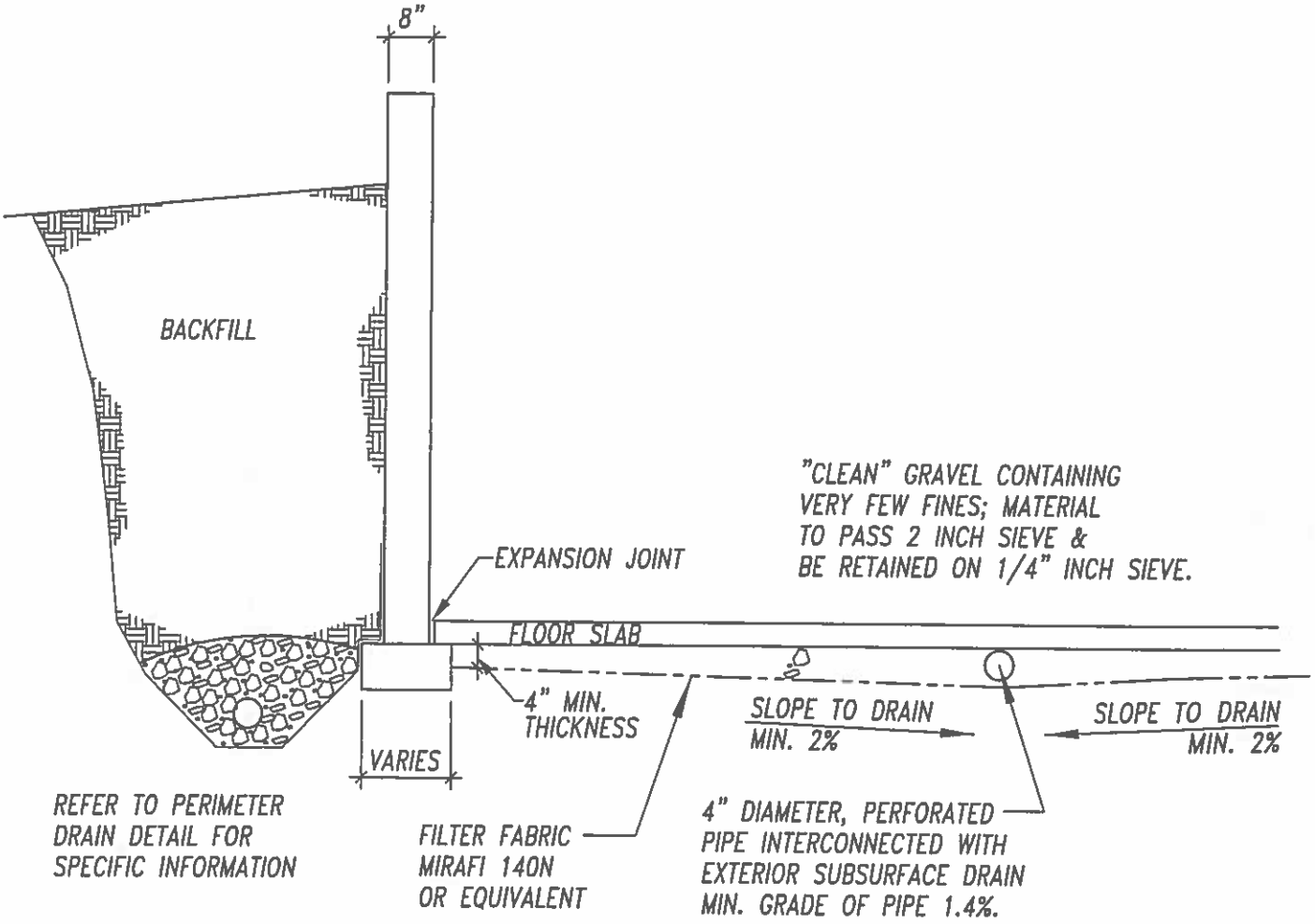
EXTERIOR PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
M. VAN KAMPEN			

JOB NO.: 200100

FIG NO.: 8



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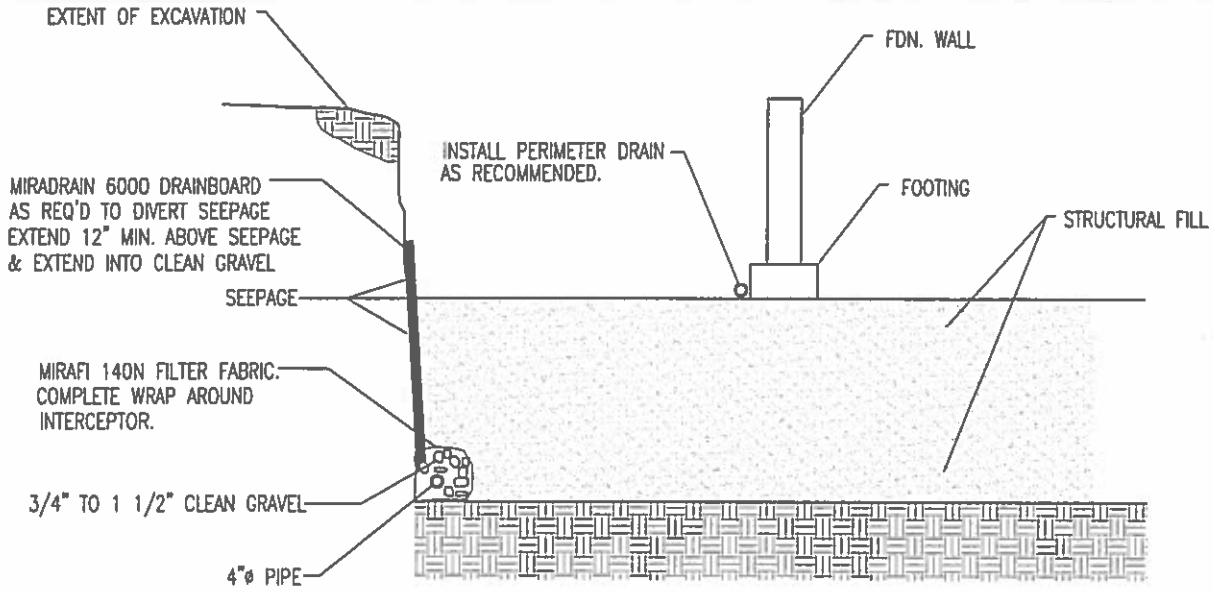
TYP. UNDERSLAB DRAINAGE LAYER (CAPILLARY BREAK)

DRAWN:	DATE:	DESIGNED:	CHECKED:

JOB NO.: 200100

FIG NO.: 9



NOTE:
EXTEND INTERCEPTOR DRAIN TO DAYLIGHT

INTERCEPTOR DRAIN DETAIL

N.T.S.

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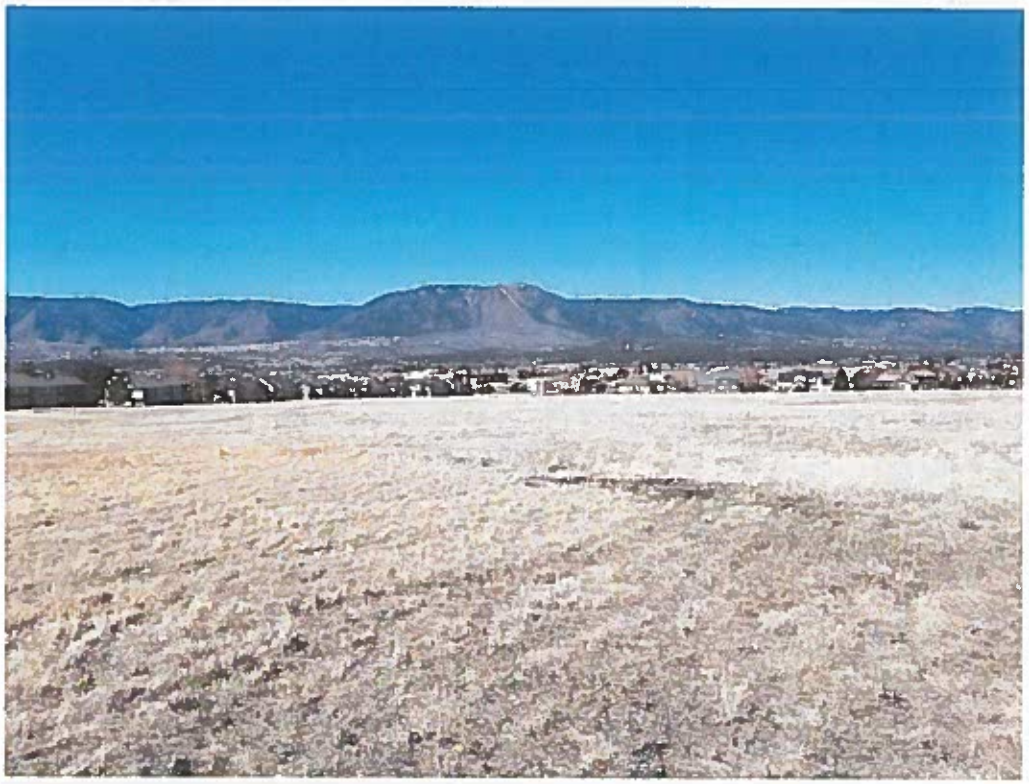
COLORADO SPRINGS, CO. 80907 (719) 531-5599

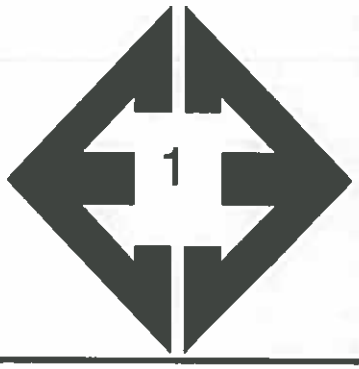
INTERCEPTOR DRAIN DETAIL			
DRAWN BY:	DATE DRAWN:		CHECKED:

JOB NO.: 200100

FIG. NO.: 10

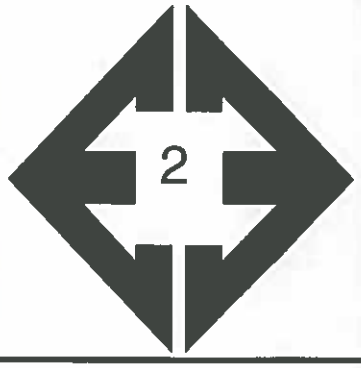
APPENDIX A: Site Photographs





Looking west from central portion of the site.

April 6, 2020



Looking north from south-central portion of the site.

April 6, 2020

Job No. 200100

3

Looking north from northern portion of the site.

April 6, 2020

4

Looking south from the northern portion of the site.

April 6, 2020

Job No. 200100

5

Looking southwest from the northern portion of the site.

April 6, 2020

6

Looking northeast along Teachout Creek in the northwestern portion of the stie.

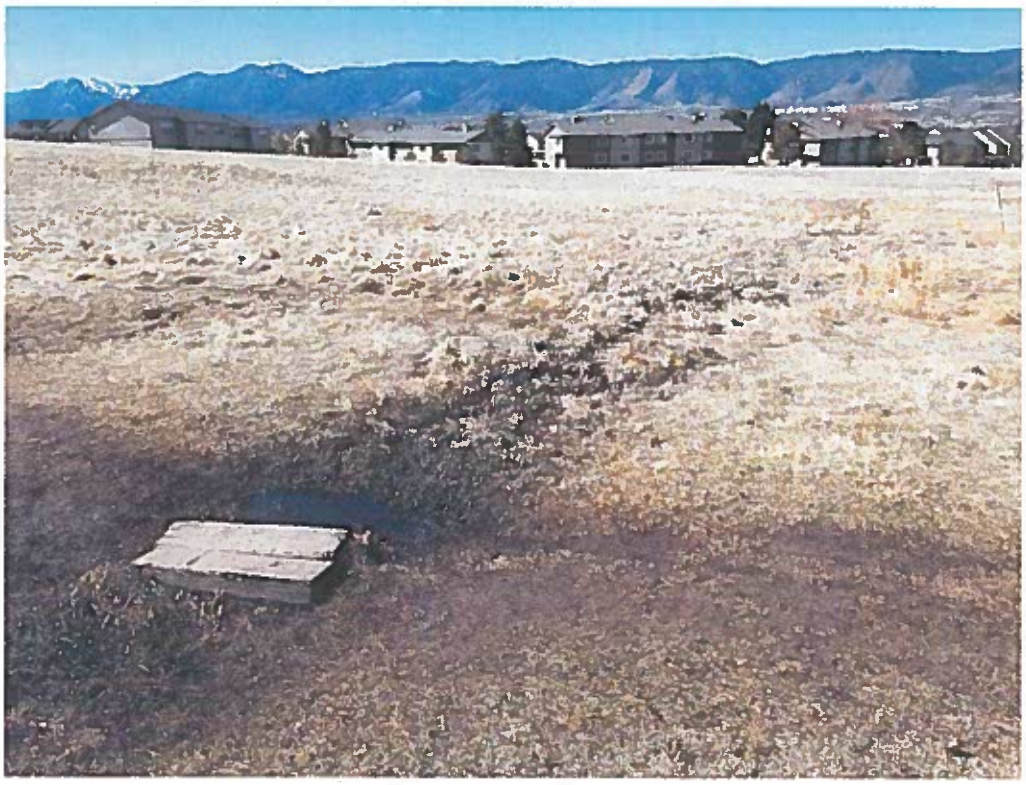
April 6, 2020

Job No. 200100

7

Looking east along seasonally wet area in the central portion of the site.

April 6, 2020



8

Looking west along seasonally wet area in the central portion of the site.

April 6, 2020

Job No. 200100

9

Looking southeast from the southeastern portion of the site.

April 6, 2020

10

Looking north from the southeast portion of the site.

April 6, 2020

Job No. 200100

APPENDIX B: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 1/29/2020
Job # 200100

REMARKS

WATER @ 13.5', 1/30/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST TO WET				
			12	5.2	1
5			18	3.2	1
10			16	4.4	1
15			21	11.5	1
20			28	17.2	1

TEST BORING NO. 2
DATE DRILLED 1/29/2020
CLIENT PT CLOVERLEAF, LLC
LOCATION CLOVERLEAF SITE

REMARKS

DRY TO 20', 1/29/20
CAVED TO 18.5', 1/30/20, DRY

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				
			12	4.7	1
5			21	11.8	1
10	CLAYEY LENSE		28	15.3	1
15	SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST		50 / 7"	12.7	2
20			50 / 7"	10.0	2

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/24/20

JOB NO.: 200100
FIG NO.: B- 1

TEST BORING NO. 3
DATE DRILLED 1/29/2020
Job # 200100

REMARKS

WATER @ 12.5', 1/30/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			16	4.7	1
5			25	11.8	1
10			50 / 10"	15.3	2
15			50 / 6"	12.7	2
20			50 / 10"	10.0	2

SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST

SANDSTONE, VERY CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST

SANDSTONE, SILTY, FINE TO COARSE GRAINED, GRAY, VERY DENSE, MOIST

TEST BORING NO. 4
DATE DRILLED 1/29/2020
CLIENT PT CLOVERLEAF, LLC
LOCATION CLOVERLEAF SITE

REMARKS

WATER @ 33', 2/12/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			3	1.8	1
5			15	3.1	1
10			24	5.2	1
15			19	7.5	1
20			12	11.0	1
25			30	10.4	2
30			50 / 6"	10.6	2
35			50 / 5"	9.7	2

SAND, SILTY TO SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO MEDIUM DENSE, MOIST

WEATHERED TO FORMATIONAL SANDSTONE, SILTY, FINE TO COARSE GRAINED, GRAY BROWN, DENSE TO VERY DENSE, MOIST

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/24/20

JOB NO. 200100
FIG NO. B- 2

TEST BORING NO. 5
DATE DRILLED 1/29/2020
Job # 200100

REMARKS

WATER @ 13.5', 2/12/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST		14	6.9	1
5			11	3.9	1
	SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST				
10			50 / 11"	10.6	2
15			50 / 7"	5.8	2
	SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, GRAY, VERY DENSE, MOIST				
20			50 / 6"	11.0	2

TEST BORING NO. 6
DATE DRILLED 6/16/2020
CLIENT PT CLOVERLEAF, LLC
LOCATION CLOVERLEAF SITE

REMARKS

DRY TO 20', 6/18/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SILT, SANDY, TAN, FIRM, MOIST		14	5.4	1A
5	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO VERY DENSE, MOIST		50	3.9	1
10			17	3.6	1
15			22	6.0	1
20			30	4.8	1

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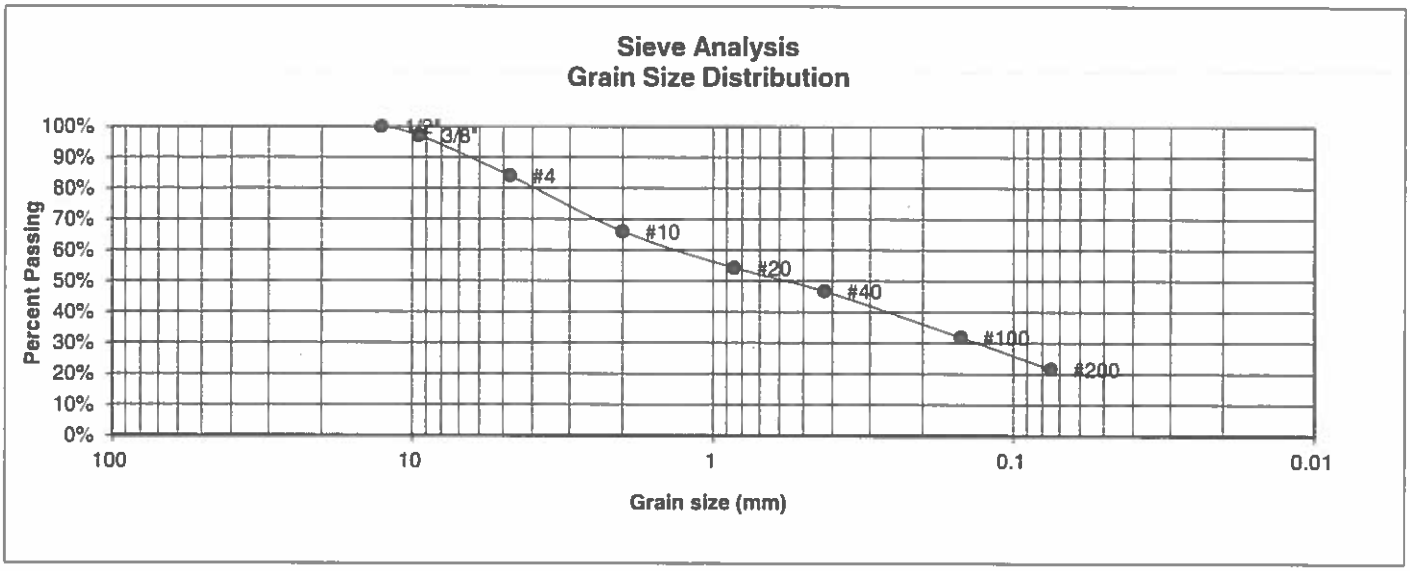
TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/24/20

JOB NO.: 200100
FIG NO.: B- 3

APPENDIX C: Laboratory Testing Results

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	1	JOB NO.	200100
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.0%
4	84.0%
10	66.0%
20	54.3%
40	46.8%
100	31.9%
200	21.5%

Atterberg Limits	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

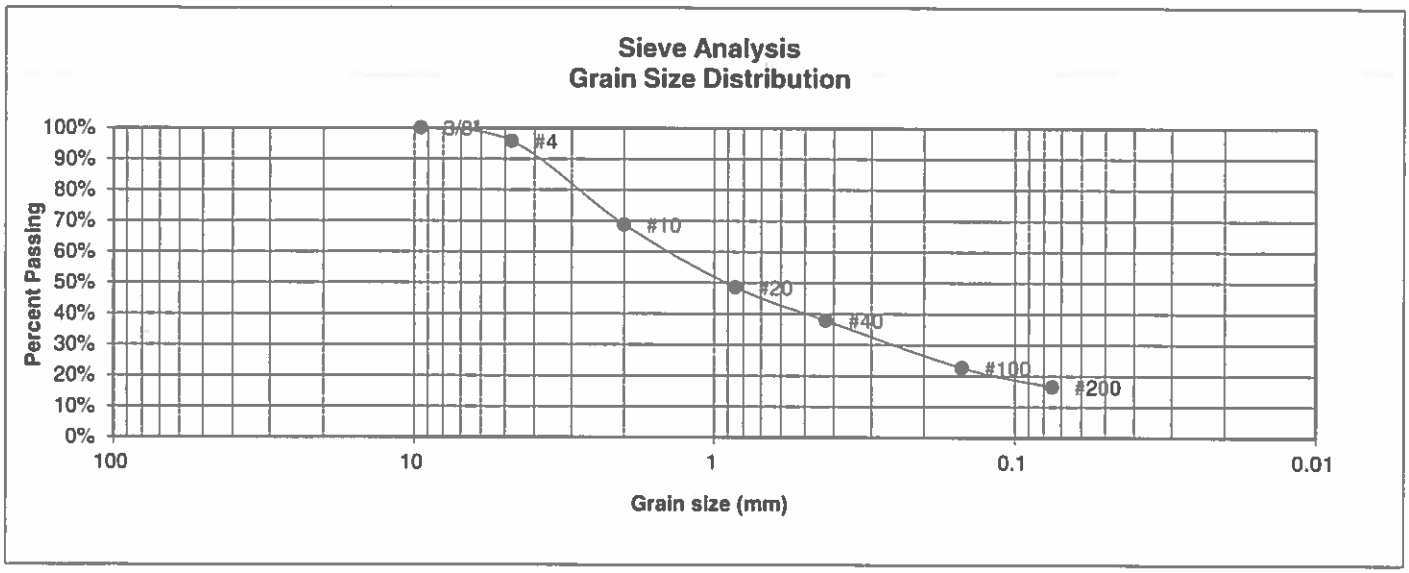
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: C-1

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	2	JOB NO.	200100
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.8%
10	68.7%
20	48.5%
40	37.8%
100	22.6%
200	16.5%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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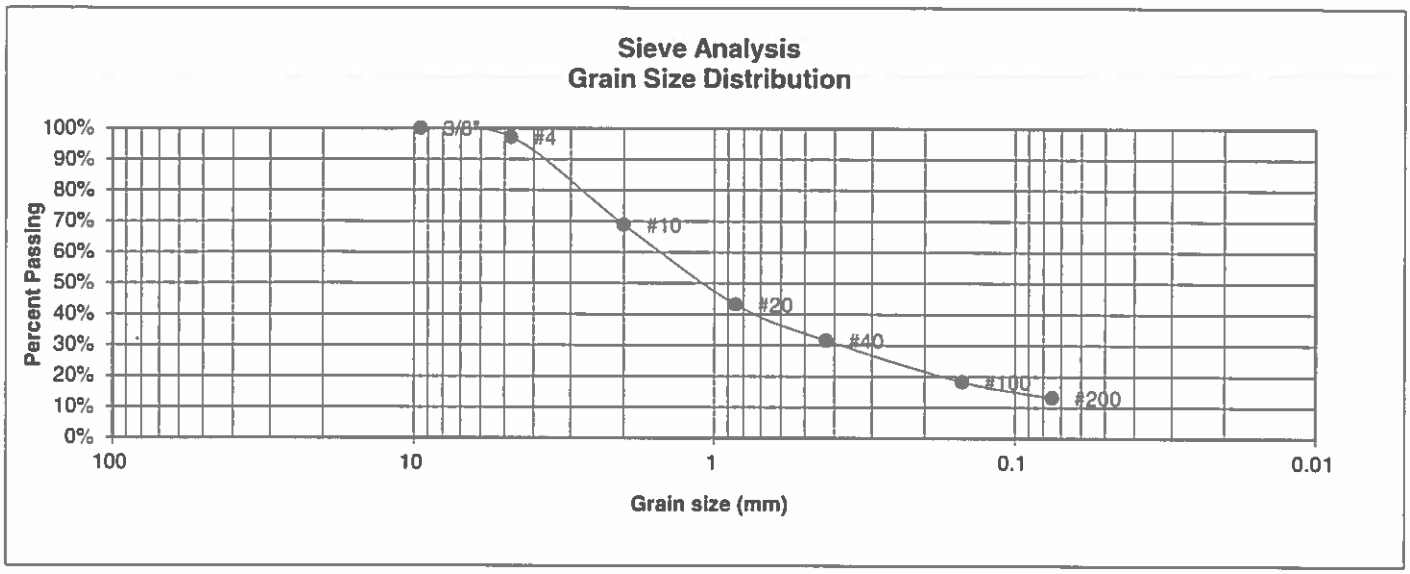
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100
FIG NO.: C-2

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	3	JOB NO.	200100
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.1%
10	68.9%
20	43.1%
40	31.6%
100	18.2%
200	13.1%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

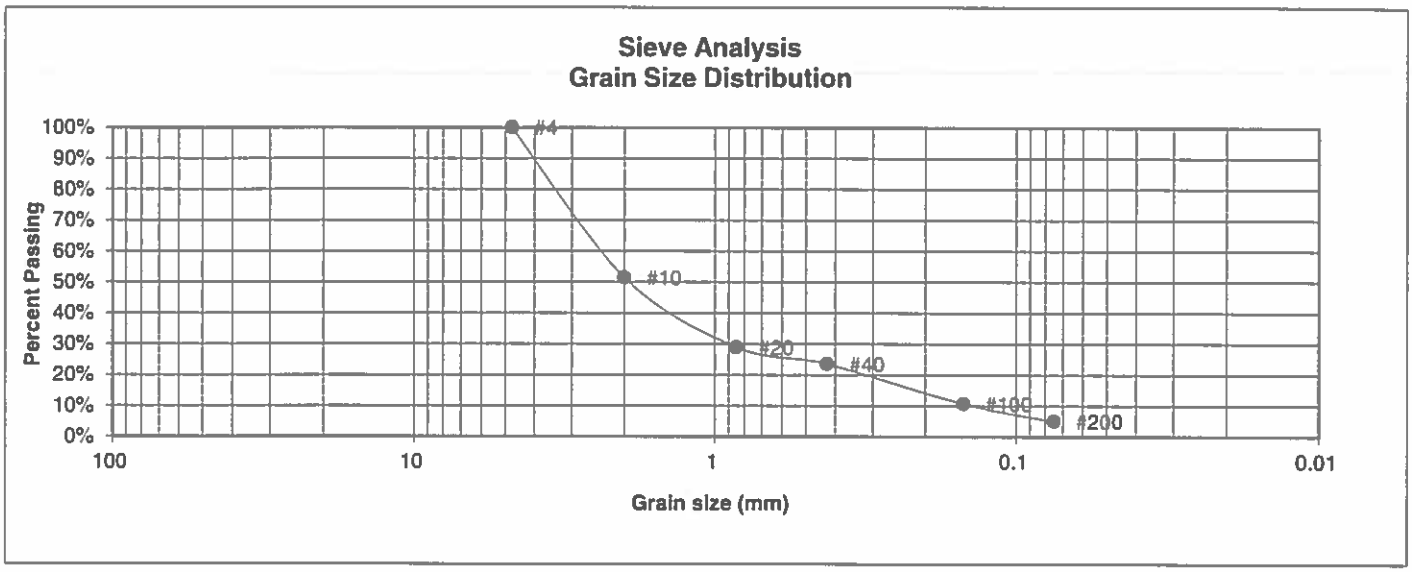
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/24/20

JOB NO.: 200100

FIG NO.: C-3

UNIFIED CLASSIFICATION	SM-SW	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	4	JOB NO.	200100
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	51.4%
20	29.0%
40	23.6%
100	10.7%
200	5.0%

Atterberg Limits	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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COLORADO SPRINGS, COLORADO 80907

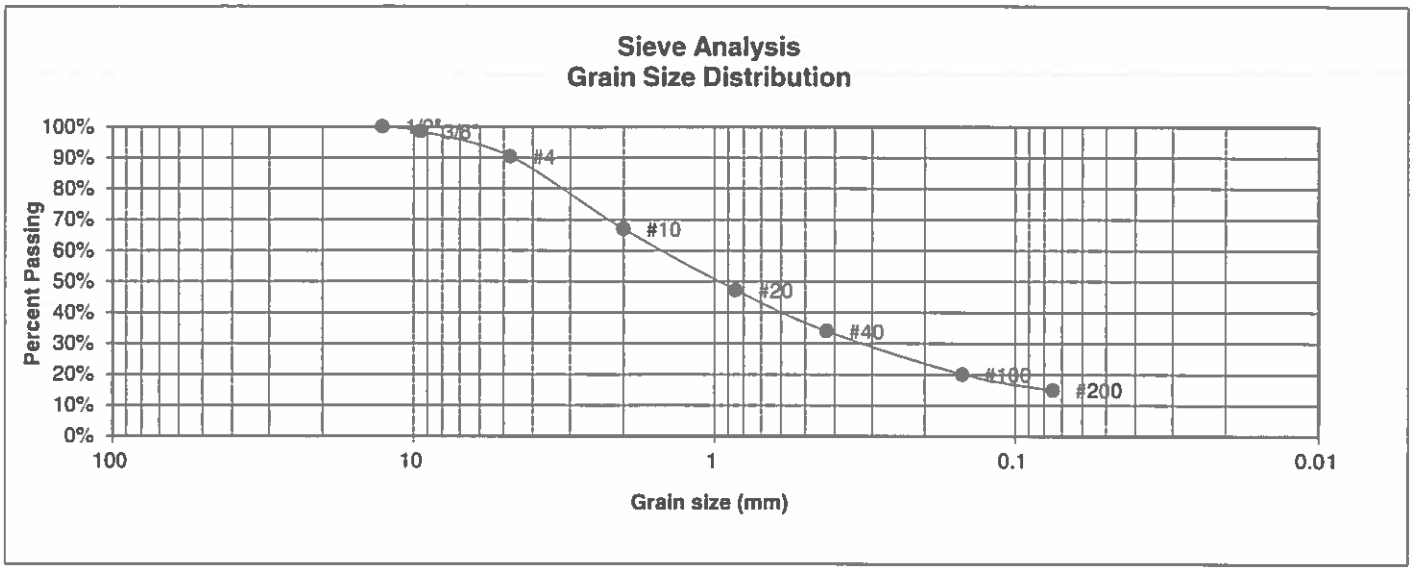
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: L-4

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	5	JOB NO.	200100
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.5%
4	90.4%
10	67.0%
20	47.2%
40	34.0%
100	20.1%
200	14.9%

Atterberg Limits	
Plastic Limit	24
Liquid Limit	35
Plastic Index	11

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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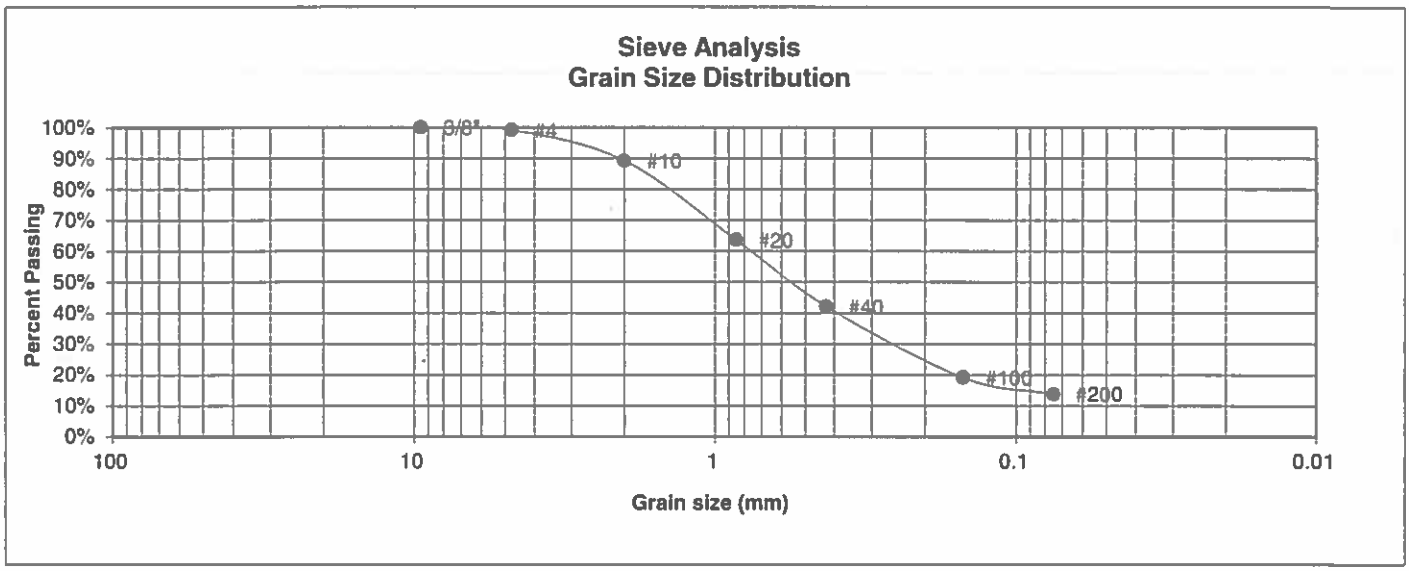
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: C-5

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1	PROJECT	CLOVERLEAF SITE
TEST BORING #	6	JOB NO.	200100
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.1%
10	89.2%
20	63.6%
40	42.1%
100	19.1%
200	13.8%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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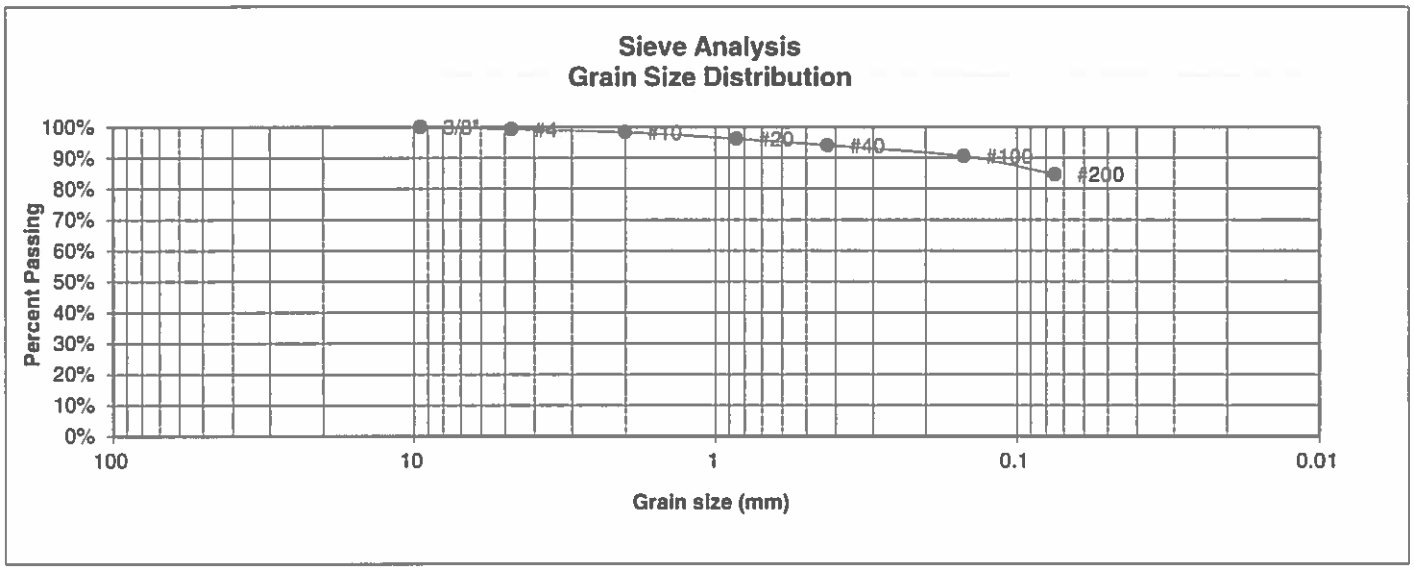
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/24/20

JOB NO.: 200100

FIG NO.: C-6

UNIFIED CLASSIFICATION	ML	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	1A	PROJECT	CLOVERLEAF SITE
TEST BORING #	6	JOB NO.	200100
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.2%
10	98.3%
20	96.2%
40	94.0%
100	90.6%
200	84.6%

Atterberg Limits

Plastic Limit

Liquid Limit

Plastic Index

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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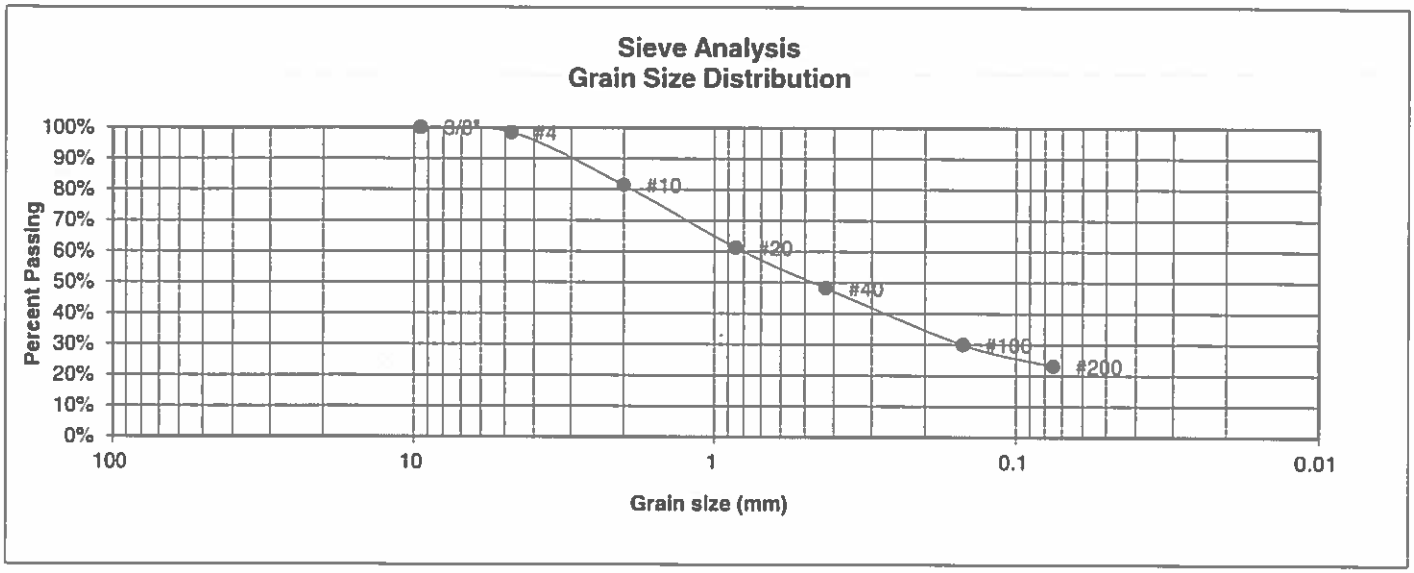
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: C-7

UNIFIED CLASSIFICATION	SC	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	2	PROJECT	CLOVERLEAF SITE
TEST BORING #	2	JOB NO.	200100
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.4%
10	81.4%
20	61.2%
40	48.2%
100	30.0%
200	23.0%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	39
Plastic Index	17

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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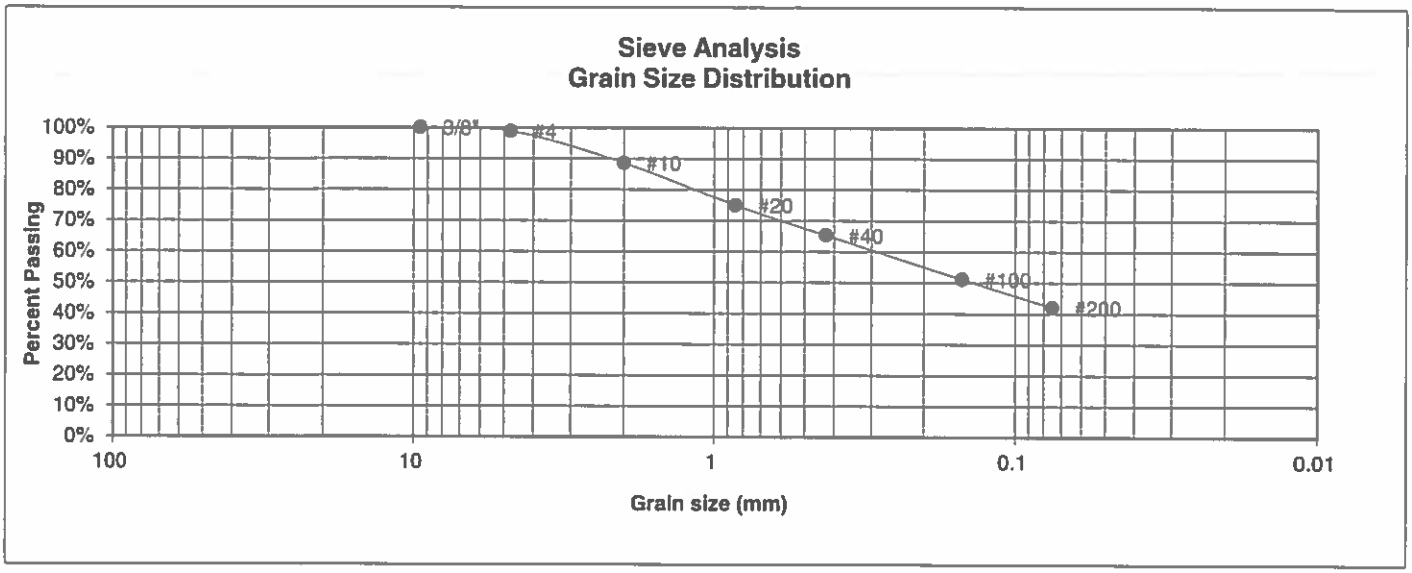
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: C-8

UNIFIED CLASSIFICATION	SC	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	2	PROJECT	CLOVERLEAF SITE
TEST BORING #	3	JOB NO.	200100
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.9%
10	88.6%
20	75.0%
40	65.3%
100	51.2%
200	42.0%

Atterberg Limits	
Plastic Limit	26
Liquid Limit	48
Plastic Index	22

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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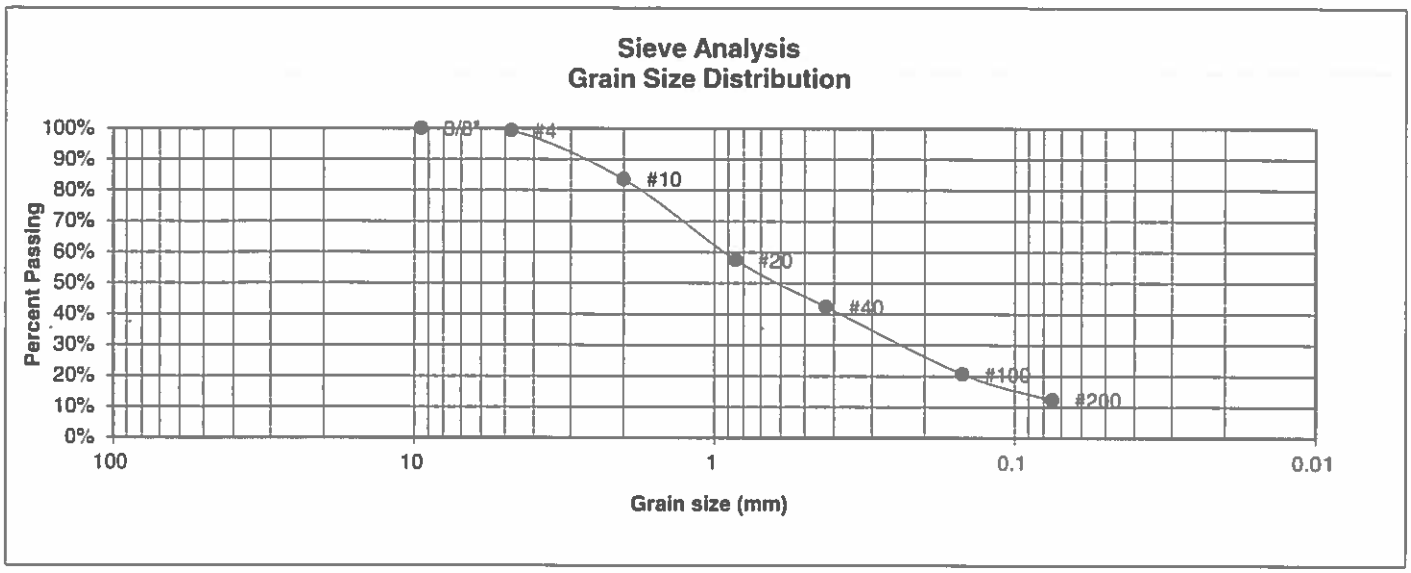
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO.: 200100

FIG NO.: C-9

UNIFIED CLASSIFICATION	SM	CLIENT	PT CLOVERLEAF, LLC
SOIL TYPE #	2	PROJECT	CLOVERLEAF SITE
TEST BORING #	4	JOB NO.	200100
DEPTH (FT)	30	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	83.6%
20	57.5%
40	42.4%
100	20.7%
200	12.3%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

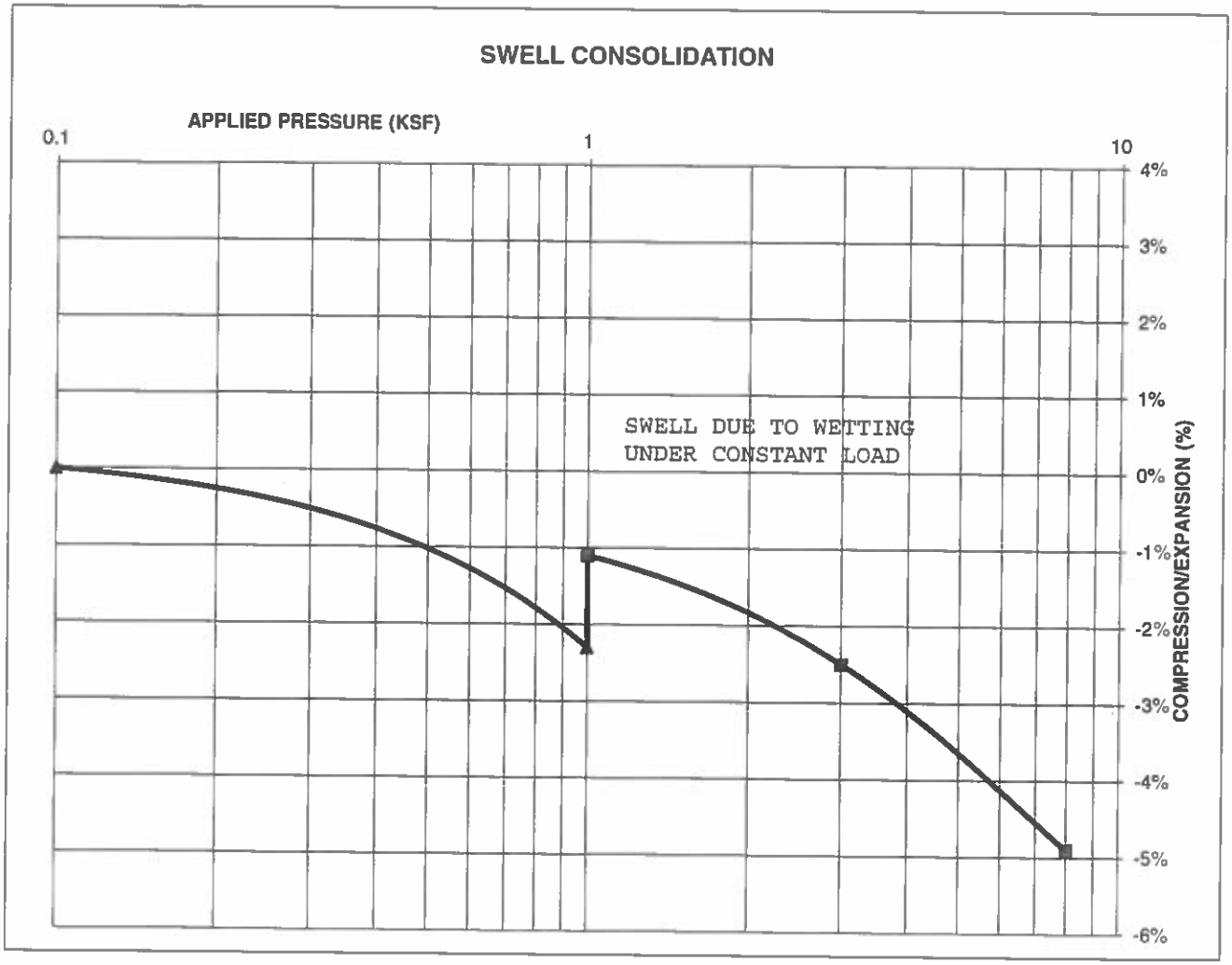
JOB NO.: 200100

FIG NO.: C-10

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			107
NATURAL MOISTURE CONTENT			16.1%
SWELL/CONSOLIDATION (%)			1.2%

JOB NO. 200100
CLIENT PT CLOVERLEAF, LLC
PROJECT CLOVERLEAF SITE



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/12

JOB NO.: 200100
FIG NO.: C-11

CLIENT	PT CLOVERLEAF, LLC	JOB NO.	200100
PROJECT	CLOVERLEAF SITE	DATE	2/11/2020
LOCATION	CLOVERLEAF SITE	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	2-3	1	SM	<0.01
TB-2	15	2	SC	0.01
TB-3	10	2	SC	<0.01

QC BLANK PASS

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LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/24/20

JOB NO: 200100

FIG NO: C-12

APPENDIX D: Soil Survey Descriptions

El Paso County Area, Colorado

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills

Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019