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SOIL, GEOLOGY, AND GEOLOGIC HAZARD STUDY
STERLING RANCH HOMESTEAD NORTH FILING NO. 2
PARCEL NO. 11
EL PASO COUNTY, COLORADO

Prepared for

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Attn: Chaz Collins

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Respectfully Submitted,

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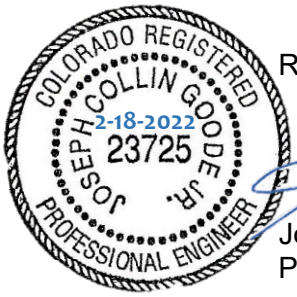

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Encl.

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1.0 SUMMARY

Project Location:

The project lies in a portion of the SE ¼ of Section 28, Township 12 South, Range 65 West of the 6th Principal Meridian. The site is located southeast of the intersection of Vollmer Road and Poco Road, north of the proposed Briargate Parkway, in El Paso County, Colorado.

Project Description:

Total acreage involved in the project is approximately 36 acres. The proposed development is to consist of single-family residential development. Sterling Ranch Homestead North Filing No. 2 consists of 74 lots. The development will be serviced by Woodmen Hills Metropolitan District.

Scope of Report:

The report presents the results of our geologic investigation and treatment of engineering geologic hazard study. 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:

The site was found to be suitable for development. Geologic conditions will impose some minor constraints on development. These include areas of artificial fill, potentially unstable slopes, potential expansive soils, floodplain, and potentially seasonal shallow groundwater areas. Artificial fill is associated with earthen dams located in the drainage along the eastern boundary of the site. The potentially unstable slopes and floodplains are associated with the drainage along the eastern portion of the site. Areas of potentially seasonal shallow groundwater occur in minor drainage swales on the site. Shallow bedrock will also be encountered on portions of the site. 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 a portion of the SE ¼ of Section 28, Township 12 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. The site is located east of Vollmer Road, approximately one-mile north of Woodmen Road. The site is located north of proposed Briargate Parkway and southeast of the intersection of Volmer Road and Poco Road. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is generally gently sloping to the south with some minor areas of moderate to steep slopes along Sand Creek, which flows in a southerly direction along the eastern boundary of the site. Minor flows of water were observed in Sand Creek at the time of this investigation. The area of the site is indicated on the USGS Map, Figure 2. Previous site uses have included grazing and pasture lands. Existing sand and gravel quarries lie to the southeast of the site, east of Sand Creek. The vegetation on site consists primarily low field grasses and weeds.

Total acreage involved in the proposed development is approximately 36 acres. The proposed development is single-family residential. The development is to be serviced by Woodmen Hills Metropolitan District. The overall master plan for the Sterling Ranch Development, including Homestead North Filing No. 2, is presented in Figure 3. The development plan for Homestead North Filing No. 2 is presented in Figure 4. Site photographs, taken on February 14, 2022, are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 4. It is our understanding there is on-going on-site grading and creek bank stabilization with drainage improvements and a regional trail corridor constructed in the area of Sand Creek south of the site. The proposed grading is also indicated on Figure 4.

3.0 SCOPE OF THE REPORT

The scope of this report will include the following:

- A geologic analysis of the site utilizing published geologic data, and subsurface soils information.
- Detailed site-specific mapping of major geographic and geologic features.
- Identification of geologic hazards and impacts on the proposed development.
- Recommended mitigation of geologic hazards where they affect development.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of bedrock features and significant surficial deposits. The Natural Resources Conservation Service (Reference 1), previously the Soil Conservation Service (Reference 2) survey was reviewed to evaluate the site.

The positions of mappable units within the subject property are shown on the Geologic Map (Figure 7). 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 (Figure 7).

Eight (8) test borings were drilled by Entech Engineering, Inc. as a part of this investigation. The borings were drilled with a power-driven continuous flight auger drill rig to 20 feet. Test Boring Nos. 4 through 8 are located within Homestead North Filing Nos. 1 and 2. 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 Plan, Figure 4. 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 tests included Swell/Consolidation Testing, ASTM D-4546. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

Geologic Hazard Studies were previously performed by Entech Engineering, Inc. for the entire Sterling Ranch development, October 31, 2009 (Reference 3) and January 20, 2009 (Reference 4). Two of the test borings from the previous investigations were located on the subject site (Homestead North Filing Nos. 1 and 2). The locations of the test borings are indicated on Figure 4. The Test Boring Logs and Laboratory Test Results are included in Appendix D. Information from these reports was used in evaluating the site.

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 10 miles to the west is a major structural feature known as 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 northeasterly direction (Reference 5). The rocks in the area of the site are sedimentary in nature, and typically Tertiary to Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson Formation are unconsolidated deposits of artificial, residual, and alluvial soils. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Survey

The Natural Resources Conservation Service (Reference 1), previously the Soil Conservation Service (Reference 2) has mapped one soil type on the site (Figure 5). In general, the soils consist of loamy sand. Soils are described as follows:

Soil Type	Description
71	Pring coarse sandy loam, 3-8% slopes: Dark grayish brown to brown coarse sandy loam. Permeability is rapid. Erosion hazard is moderate. Good potential for home sites.

Complete descriptions of the soils are presented in Appendix E (Reference 2). The soils have generally been described to have rapid permeabilities. Limitations to development are varied on the different soil types and include frost action potential. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The soils have been described to have moderate erosion hazards.

5.3 Site Stratigraphy

The Falcon NW Quadrangle Geologic Map showing the site is presented in Figure 6 (Reference 6). The Geology Map prepared for the site is presented in Figure 7. Four mappable units were identified on this site, which are described as follows:

- **Qaf** **Artificial Fill of Quaternary Age:** These are man-made fill deposits associated with earthen embankments located in the drainage along the eastern boundary of the site.

- **Qal** **Recent Alluvium of Quaternary Age:** These are recent stream deposits that have been deposited along the main channel of Sand Creek and some minor drainage swales that cross the site. These materials consist of silty to clayey sands and sandy clays. Some of these alluviums may contain highly organic soils.

- **Qb** **Broadway Alluvium of Pleistocene Age:** These materials consist of stream terrace deposits. The Broadway Alluvium typically consists of silty to clayey gravelly sands. This deposit is usually highly stratified and may contain lenses of silt, clay or cobbles. This deposit correlates with Qam: Middle Alluvium, as mapped by the Colorado Geological Survey (Figure 6, Reference 6).

- **Tkd** **Dawson Formation of Tertiary to Cretaceous Age:** The Dawson formation typically consists of arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone. Overlying this formation is a variable layer of residual and/or colluvium soils. The residual soils were derived from the in-situ weathering of the bedrock materials on-site. The colluvium soils have been transported by the action of sheetwash and gravity. These soils consisted of silty to clayey sands and sandy clays.

The soils listed above were mapped from site-specific mapping of the site, the *Geologic Map of the Falcon NW Quadrangle* by Madole, 2003 (Reference 6), the *Reconnaissance Geologic Map of Colorado Springs and Vicinity, Colorado* by Scott and Wobus in 1973 (Reference 7), and *the Geologic Map of the Colorado Springs-Castle Rock Area Front Range Urban Corridor, Colorado*, by Trimble and Machette, 1979 (Reference 8). The test borings from the subsurface investigation by Entech Engineering, Inc. were also used in evaluating the site.

5.4 Soil Conditions

Three soil and rock types were encountered in the test borings drilled on the site. Type 1: silty to slightly silty sand and clayey sand (SM, SM-SW, SC); Type 2: very silty to slightly silty sandstone and clayey sandstone bedrock (SM, SM-SW, SC); and Type 3: sandy to very sandy claystone bedrock (CL). Each material type was classified using the results of the laboratory testing and the Unified Soil Classification System (USCS). The bedrock encountered in the borings was classified as soil in that the upper bedrock zone could be penetrated using conventional soil drilling and sampling techniques.

Soil Type 1 classified as silty to slightly silty sand and clayey sand (SM, SM-SW, SC). The sands were encountered in all of the test borings at the existing ground surface and extending to depths ranging from one foot to 14 feet below ground surface (bgs). Standard Penetration

Testing on the sand resulted in N-values of 10 to 43 blows per foot (bpf), indicating medium dense to dense states. Water content and grain size testing resulted in water contents of approximately 1 to 16 percent, with approximately 8 to 19 percent of the soil size particle passing the No. 200 sieve. Atterberg limits testing resulted in non-plastic results. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight indicating the sand exhibits negligible for below grade concrete degradation.

Soil Type 2 was classified as very silty to slightly silty sandstone and clayey sandstone bedrock (SM, SM-SW, SC). The sandstone was encountered in all of the test borings, below Soil Type 1, at depths ranging from approximately one to 14 feet bgs and extending to depths ranging from 9 to 19 feet and to the termination of the borings (20 feet). Standard Penetration Testing on the sandstone resulted in N-values of 38 to greater than 50 bpf indicating dense to very dense states. Water content and grain size testing resulted in water contents of 2 to 19 percent, with approximately 10 to 42 percent of the soil size particles passing the No. 200 sieve. Atterberg limits testing resulted in non-plastic results. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight indicating the sandstone exhibits negligible for below grade concrete degradation.

Soil Type 3 was classified as sandy to very sandy claystone bedrock (CL). The claystone was encountered in three of the test borings (Test Boring Nos. 3, 5, and 8) at depths ranging from 9 to 19 feet bgs and extending to depths ranging from 14 to 18 feet and to the termination of Test Boring No. 8 (20 feet). Standard Penetration Testing on the claystone resulted in N-values greater than 50 bpf, indicating hard consistencies. Water content and grain size testing resulted in water contents of 14 to 21 percent with approximately 59 to 93 percent of the soil size particles passing the No. 200 sieve. Atterberg limits testing resulted in a liquid limit of 33 and a plastic index of 10. FHA Swell Testing resulted in a swell pressure of 430 psf, indicating low expansion potential. Swell/Consolidation Testing of the claystone resulted in a volume change of 2.9 percent, indicating moderate to high expansion potential. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight indicating the claystone exhibits negligible for below grade concrete degradation.

Test Boring logs are included in Appendix B. A Summary of the Laboratory Test Results for each of the soil and rock types is presented in Table 1 and a presentation of the overall Laboratory Test Results is included in Appendix C. Bedrock depths are summarized in Table 2.

5.5 Groundwater

Groundwater was encountered in four of the test borings (Test Boring Nos. 1, 5, 6, and 8) at depths ranging from 8.5 to 18 feet bgs. Groundwater was not encountered in the other test borings which were drilled to 20 feet. Groundwater depths are summarized in Table 2. Fluctuations in the groundwater conditions may occur due to conditions such as variations in rainfall, precipitation infiltration and development of nearby areas. Areas of floodplains and potentially seasonal shallow groundwater have been identified on the site. These areas will be discussed in the following section.

6.0 ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

Detailed mapping has been performed on this site to produce an Engineering Geology Map (Figure 7). 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 artificial fill, potentially unstable slopes, potentially expansive soils, floodplains, and potentially seasonal shallow groundwater areas. The following hazards have been addressed:

Expansive Soils - Constraint

Expansive soils were encountered in some of the test borings drilled on-site and as a part of the previous investigations (References 3 and 4). The site is classified in areas of low to moderate swell potential according to the *Map of Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado* by Hart, 1974 (Reference 9); however, highly expansive clays and claystone are typically encountered in the area. These areas are sporadic; therefore, none have been indicated on the map. Expansive clays and claystone, if encountered, can cause differential movement in the structure foundation.

Mitigation: Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum 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 upon 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 can be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Subsidence Area - Hazard

Based on a review of a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 10) and the mining report for the Colorado Springs coalfield (Reference 11), the site is not undermined. The closest underground mines in the area are 6 miles to the southwest and the site is not mapped within any potential subsidence zones.

Slope Stability and Landslide Hazard

The majority of the slopes on-site are gently sloping and do not exhibit any past or potential unstable slopes or landslides. Some of the steeper slopes along Sand Creek have been identified as potentially unstable slopes. The mitigation recommendation for these areas is as follows:

Potentially Unstable Slopes - Constraint

Some of the steep slopes along the Sand Creek drainage have been identified as potentially unstable. Considerable care must be exercised in these areas not to create a condition which would tend to activate instability.

Mitigation: According to the grading plan shown on Figure 7, Much of this area is to be regraded or avoided by development. Building should be avoided on any remaining potentially unstable slopes unless stabilized. A setback of 20 feet from the crest of these slopes is recommended. Stabilization could involve regrading to slope angles no steeper than 3:1 or the use of engineer-designed retaining walls, tiebacks, or buttresses. Where retaining walls are not used, erosion protection may be necessary to prevent undercutting

by the creek during periods of high water. It is our understanding the project will include drainage improvements and the construction of a regional trail along the Sand Creek drainage and stabilization of the slopes will be a part of the improvements. Specific slope stabilization recommendations are beyond the scope of this report.

Based on the prepared development plan it appears the potentially unstable slopes can be regraded or avoided. These areas are minor and there is sufficient distance for proposed setbacks for any remaining slopes.

Debris Fans - Hazard

Based on-site observations, debris fans were not observed in this area.

Groundwater and Floodplain Areas - Constraint

Areas within the detention pond drainages have been identified as areas of potentially seasonal shallow groundwater areas. The Sand Creek drainage has been mapped as a floodplain zone according to the FEMA Map No. 08041CO535G Figure 8 (Reference 12). These areas are discussed as follows:

Floodplain: Construction is not anticipated within the main channel of the Sand Creek floodway. The Sand Creek drainage is to be preserved as open space according to the Overall Site Plan, Figure 3. The proposed lots are outside the floodplain zone. It is anticipated any proposed construction considered within the floodplain zone would involve drainage improvements and channelization of the floodplain. Development within the floodplain will require approval of the Drainage Plan prior to construction. Finished floor levels must be one foot above the floodplain level. Exact floodplain locations and drainage studies are beyond the scope of this report.

Potentially 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. These areas are located in areas of minor drainage swales and low areas located on the site. According to the grading plans, these areas are to be regraded and detention ponds created. Areas of shallow groundwater may exhibit unstable subgrade conditions in terms of bearing support of construction equipment during overlot grading. Lots immediately adjacent to the detention ponds or the Sand Creek

drainage may also experience higher subsurface moisture conditions during periods of higher flows.

Mitigation: In these locations, foundations subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. 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, subsurface perimeter drains are recommended to help prevent the intrusion of water into areas located below grade. A typical perimeter drain detail is presented in Figure 9. Structures should not block drainages. Swales should be created to intercept surface runoff and carry it safely around and away from structures. Groundwater was not encountered in the test borings drilled on the site. It is anticipated groundwater will not affect shallow foundations on the majority of the site.

Artificial Fill - Constraint

Areas of artificial fill were observed associated with earthern dams east of the site. Other areas of fill associated with recent grading along Briargate Parkway may be encountered.

Mitigation: The earthen dams will be avoided by development. Where uncontrolled fill is encountered beneath foundations, mitigation will be necessary. Mitigation typically involves removal and recompaction at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557.

Faults- Hazard

The closest fault is the Rampart Range Fault, located approximately 10 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 Design Category B, also a low seismic risk. According to a report by the Colorado Geological Survey by Kirkman and Rogers, 1981, (Reference 13) 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 - Constraint

The bedrock underlying the site is the Dawson Formation of Tertiary to Cretaceous Age. The bedrock in this area is gently dipping a northeasterly direction according to the *Geologic Structure Map of the Pueblo 1x2 Quadrangle*, *South-Central Colorado* (1978) (Reference 5). The bedrock encountered in the test borings did not exhibit steeply dipping characteristics, therefore, mitigation is not necessary.

Radioactivity - Hazard

Radon levels for the Colorado Geologic Survey in the Open-File have reported the area, Report No. 91-4 (Reference 14). Radon levels ranging from 0 to 20 pci/l have been measured in the area. Only two readings have been taken in the area. One reading was between 4 and 10 pci/l and the other was less than 4 pci/l. The minimal information from this report is not sufficient to determine if radon levels are higher for this site. An occurrence of radioactive minerals has been identified 4 miles northwest of the site (Reference 15). This occurrence is associated with a limonite deposit in the Dawson Formation. The radioactivity hazard was researched by CTL/Thompson, Inc. for Wolf Ranch, west of the site (Reference 16). It was determined that the area lies within a zone that may have small deposits of low intensity radioactivity. No known occurrences exist on the site, however, radon gas originating in the bedrock underlying the site could migrate up into the upper soil profile.

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 ROADWAY AND EMBANKMENT CONSTRUCTION RECOMMENDATIONS

In general, the site soils are suitable for the proposed roadways and embankments. Groundwater should be expected to be encountered in deeper cuts and along drainage areas. If excavations encroach on the groundwater level unstable soil conditions may be encountered.

Excavation of saturated soils will be difficult with rubber-tired equipment. Stabilization using shot rock or geogrids may be necessary.

Any areas to receive fill should have all topsoil, organic material or debris removed. Prior to fill placement Entech should observe the subgrade. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1. 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. Additional investigation will be required for pavement designs once roadway grading is completed and utilities are installed.

8.0 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.

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 17), portions of the site are mapped as upland and floodplain deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 18), portions of the site are mapped as U3 – Upland deposits: sand, and V3: valley fill deposits: sand. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 19), tracts in the area of the site have been mapped as “Good” for industrial minerals. Quarries exist on the site and in the area of the site for sand and gravel, particularly in the Eolian Sand and Alluvial deposits. Based on the depth of bedrock

encountered in the test borings, it appears the majority of the thicker deposits have been excavated from the site.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 19), the tracts in the area of the site have been mapped as "Poor" for coal resources and "Little or no Potential" metallic mineral resources.

The site has been mapped as "Fair" for oil and gas resources (Reference 19). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area lack the essential elements for oil or gas.

10.0 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

The existing geologic and geotechnical conditions at the site will impose minor constraints on the proposed development and construction. Avoidance or regrading will mitigate many hazards such as potentially unstable slopes; low lying floodplain areas and areas of potentially seasonal shallow groundwater. Other constraints identified on the site such as expansive soils and artificial fill, can be mitigated through proper engineering design and construction.

The majority of the soils at typical foundation depths consist of sands, sandstone and claystone. Areas of shallow bedrock will be encountered on the site. Shallow sandstone will have higher bearing capacities. Excavation of the harder sandstone or claystone bedrock may be more difficult in some areas than others. Difficult excavation is anticipated in areas of shallow bedrock, particularly sandstone. Overlot grading and excavation for utility trenches and foundations will be affected by shallow bedrock. The use of track-mounted equipment will likely be required.

Expansive soils may be encountered in areas of this site. The expansive soils encountered in the test borings drilled on-site are sporadic; therefore, none have been indicated on the maps. Expansive soils, if encountered, will require special foundation design and/or overexcavation and replacement with non-expansive soil compacted to a minimum of 95 percent of the

maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). Other options include drilled piers.

Areas of potentially seasonal shallow groundwater have been mapped in minor drainage swales and low areas on the site. According to the grading plans, these areas are to be regraded. Structures immediately adjacent to the detention ponds or Sand Creek may experience higher water levels during periods of high moisture. Shallow groundwater areas may also affect utility installation. Geo-grids or shotrock may be necessary to stabilize excavation. In or adjacent to seasonal shallow groundwater areas, drains may be necessary to control seepage within the foundation zone. A typical perimeter drain detail is presented in Figure 9.

The floodplain areas of the Sand Creek drainage exist along the eastern boundary of the site. According to the Overall Site Plan, Figure 3, this area is to be preserved as open space. Should development be considered in the floodplain, channelization and drainage improvements would be necessary as well as raising building site grades above the floodplain level. According to the development plan, the lots are proposed outside the floodplain zone. Finished floor elevations must be a minimum of one foot above the floodplain level. Drains may be necessary for foundations immediately adjacent to the floodplain to help prevent the intrusion of water into areas below grade. Specific floodplain location and drainage studies are beyond the scope of this report.

Potentially unstable slopes exist along portions of Sand Creek east of the site. According to the grading plan the majority of these areas are to be avoided or regraded. A minimum building setback of 20 feet is recommended from the crest of any remaining potentially unstable slopes unless site-specific investigation or slope stability analysis is performed. Another option is to stabilize the slopes. Potentially unstable slopes can be typically mitigated by regrading to angles no steeper than 3 horizontal to 1 vertical or by construction of engineer-designed retaining walls. Erosion protection may be necessary along these slopes to prevent erosion by the creek. It is our understanding there will be drainage improvements that will incorporate slope stabilization and the construction of a regional trail corridor along the Sand Creek drainage.

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. Specific recommendations should be made after additional investigation prior to construction.

11.0 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.

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 for Morley – Bentley Investments, 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 MORLEY-BENTLEY INVEST.
PROJECT HOMESTEAD AT STERLING RANCH
JOB NO. 201421

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			14.0	NV	NP	<0.01			SM	SAND, SILTY
1	2	10			13.8						SM	SAND, SILTY
1	5	5			18.9	NV	NP				SM	SAND, SILTY
1	6	2-3			8.2	NV	NP				SM-SW	SAND, SLIGHTLY SILTY
1	8	5			12.3						SM	SAND, SILTY
2	2	15			10.4	NV	NP	<0.01			SM-SW	SANDSTONE, SLIGHTLY SILTY
2	3	5			17.9						SM	SANDSTONE, SILTY
2	4	5			30.5						SM	SANDSTONE, SILTY
2	4	20			42.0	NV	NP				SM	SANDSTONE, VERY SILTY
2	7	10			11.4						SM-SW	SANDSTONE, SLIGHTLY SILTY
3	3	10			60.0				430		CL	CLAYSTONE, VERY SANDY
3	5	20			58.9						CL	CLAYSTONE, VERY SANDY
3	8	15	15.6	117.8	92.5	33	10	<0.01		2.9	CL	CLAYSTONE, SANDY

TABLE 2

SUMMARY OF DEPTH TO GROUNDWATER AND BEDROCK

Test Boring	Depth to Water (ft)	Depth to Bedrock (ft)
1	16	9
2	Dry	14
3	Dry	1
4	Dry	1
5	16.5	9
6	18	9
7	Dry	1
8	8.5	8

FIGURES

N

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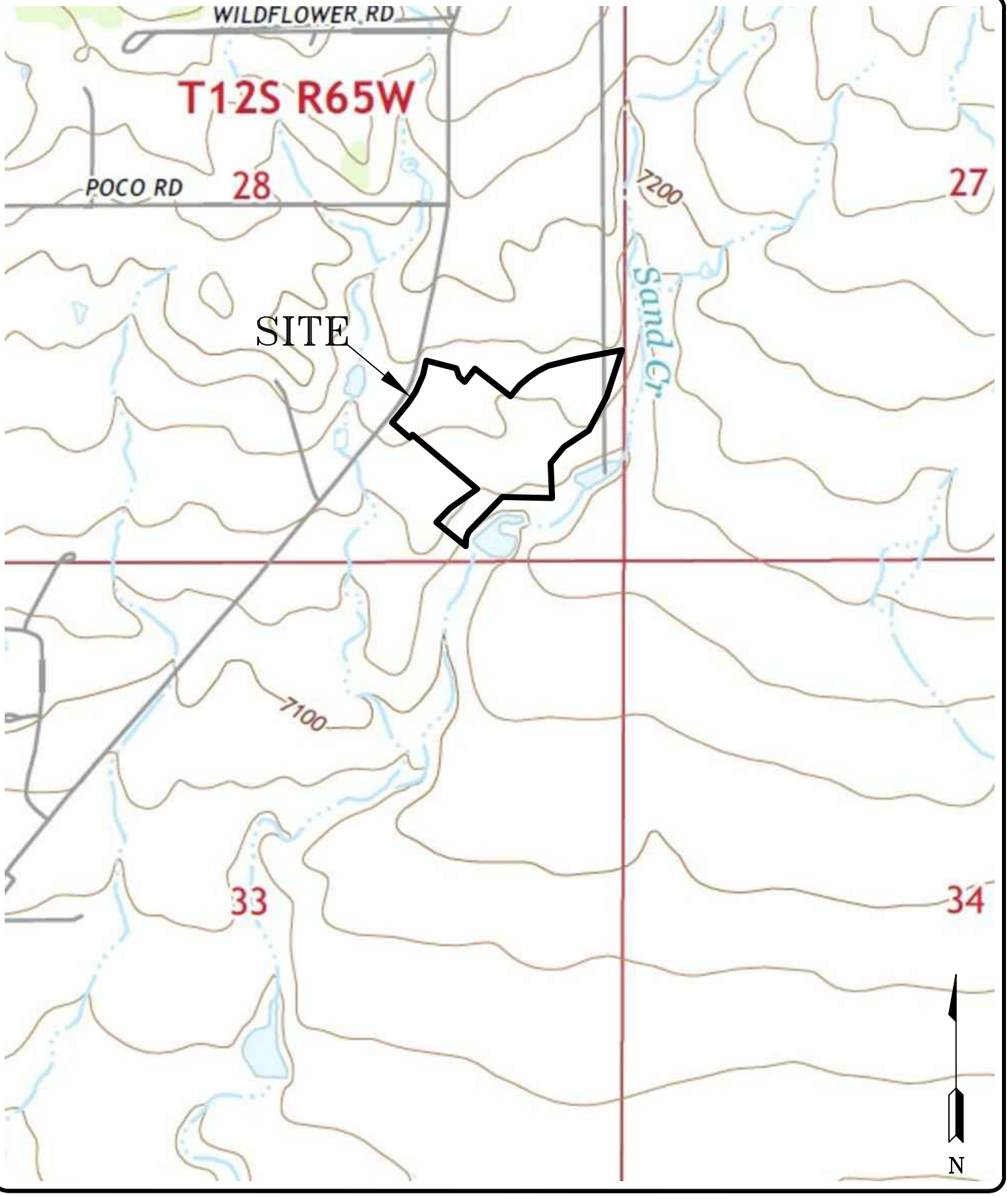
VICINITY MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/16/22		

JOB NO.: 201421

FIG NO.: 1



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USGS TOPOGRAPHY MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/16/22		

JOB NO.: 201421

FIG NO.: 2

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OVERALL STERLING RANCH DEVELOPMENT PLAN
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN	LLL
CHECKED	
DATE	2/16/22
SCALE	AS SHOWN
JOB NO.	201421
FIGURE No.	3

Homestead Filing No. 5
37.60 AC
0.5 AC Lots: 10
0.25 AC Lots: 67

SITE

Homestead North
Filing No. 2
6,000- 9,100 SF
Lots: 74

Homestead North
Filing No. 1
7,800-6,000 SF
Lots: 73

1 (Classic)
ed 19.5 ac
.04
ac

LOAD

RETREAT AT TIMBERRIDGE

WETLANDS MAPPED BY BRISTLECONE ECO

Detention
2.5 ac

Detention 2 ac

Detention 2 ac

Commercial Lots
14.8 ac

PRP. UTILITY ESMT

O.S.
BUFFER

PROPOSED COLLECTOR

DETENTION

DETENTION

DETENTION

BRIARGATE PARKWAY

BRIARGATE PARKWAY

DINES BOULEVARD

PARK

35.00 AC
SCHOOL SITE

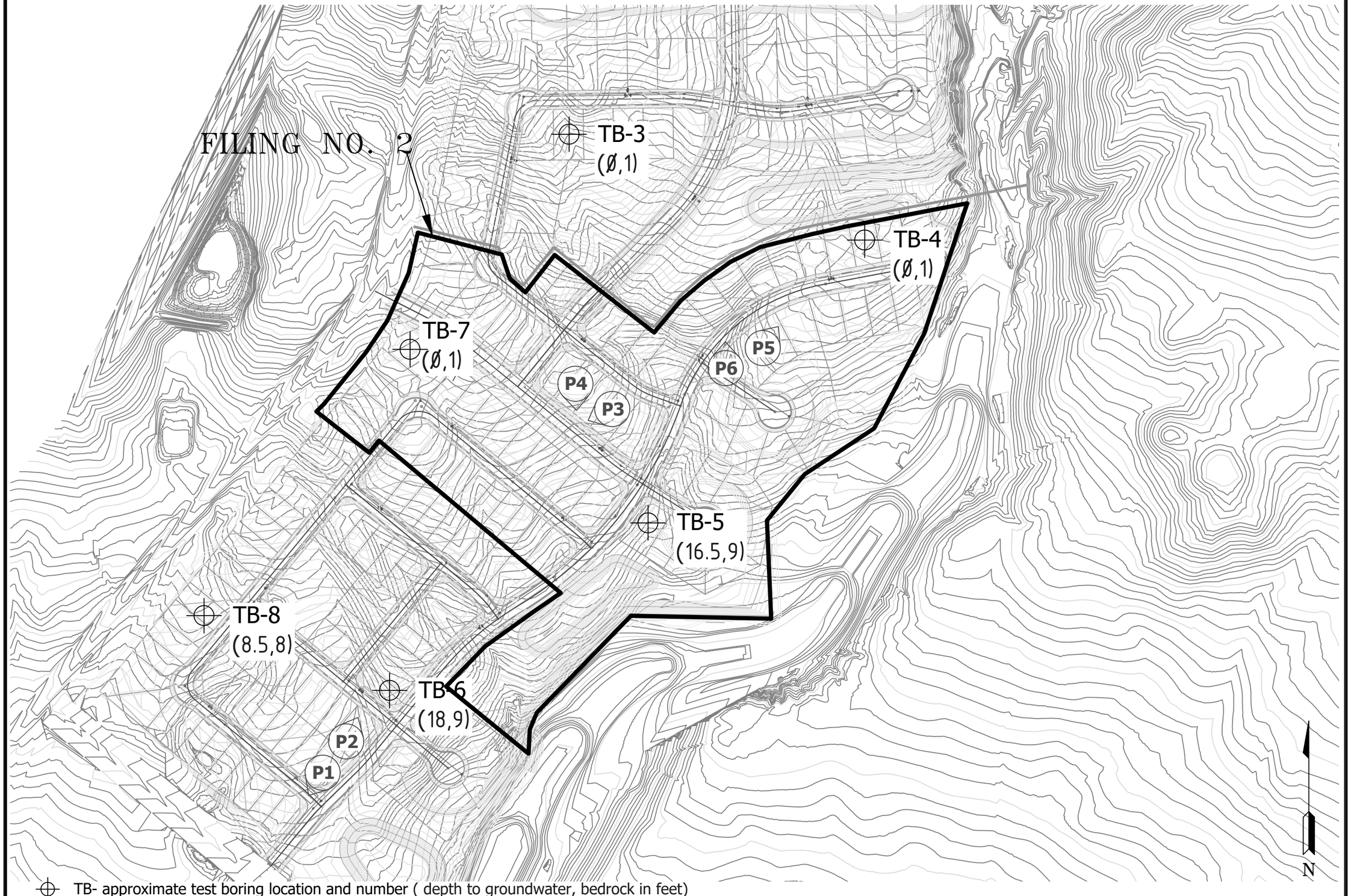
Commercial Lots
25 ac

THE RANCH

N

9		
11		
12		
18	44 LOTS	(6,000-8,400 SF)
37	331 LOTS	(6,000-8,400 SF)
36	142 LOTS	(6,000-8,400 SF)
13	97 LOTS	(MIDTOWN)
19	79 LOTS	(MIDTOWN)
35	411 LOTS	(5,000 SF MIN.)
30	74 LOTS	(5,000 SF MIN.)
34	59 LOTS	(6,000-7,200 SF)
3		
2		
22	58 LOTS	(6,000-8,400 SF)
14	70 LOTS	(TOWNHOMES)
20	56 LOTS	(4-PACK)
15	75 LOTS	(4-PACK)
21	64 LOTS	(TOWNHOMES)
33	106 LOTS	(6,000-7,200 SF)
26		

WHEATLAND DRIVE
RYEGATE WAY
SCOBY COURT
BEAVER BROOK DRIVE
BEAVER BROOK DRIVE
WARRADA WAY
LIMESTONE WAY
CUT BANK DRIVE
LODGE GRASS WAY
HIDDEN WAY
FLOWERFIELD WAY



TB- approximate test boring location and number (depth to groundwater, bedrock in feet)

P2 - approximate location and number of photograph

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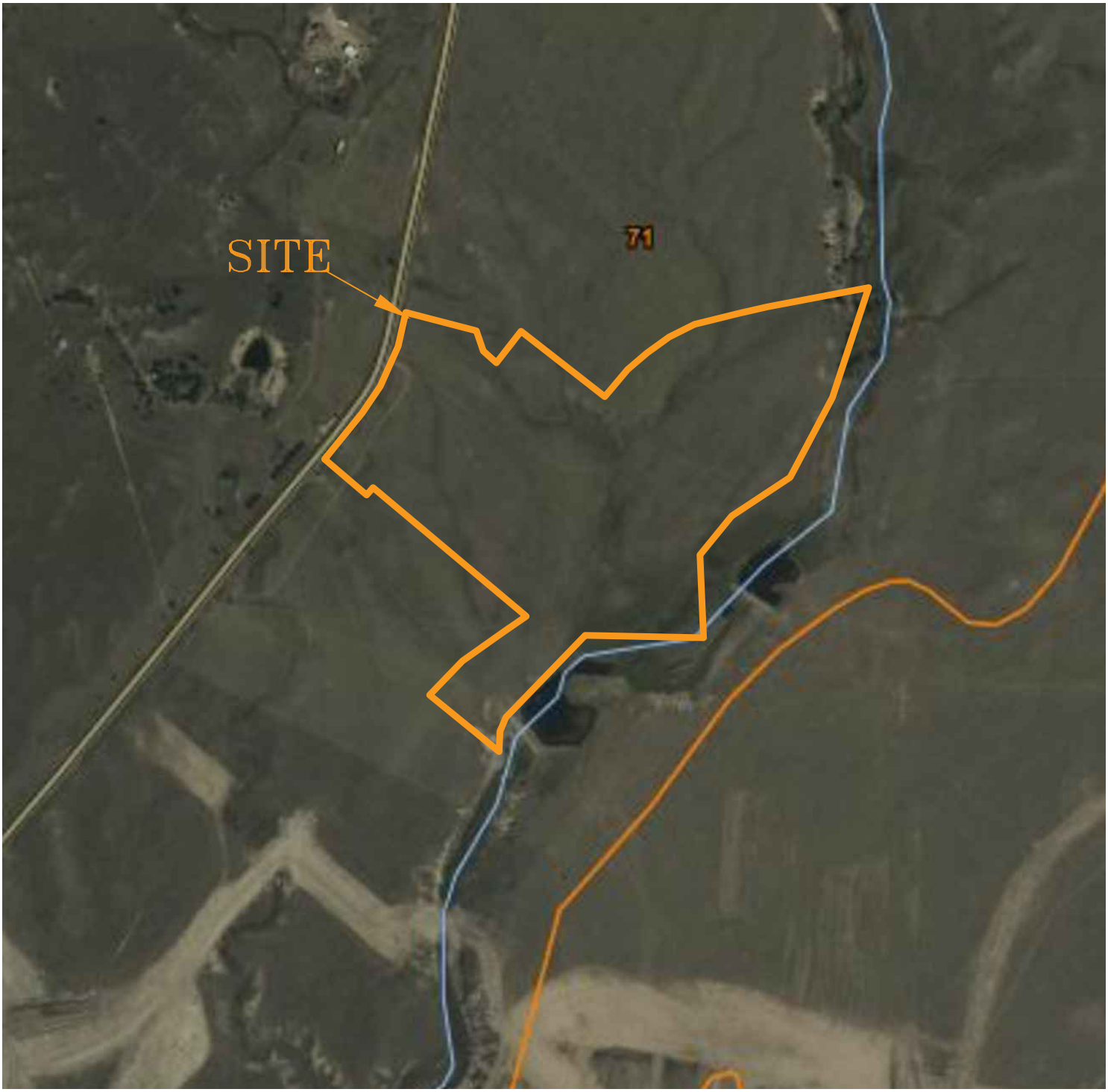
SITE PLAN/TEST BORING LOCATION MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN	LLL
CHECKED	
DATE	2/16/22
SCALE	AS SHOWN
JOB NO.	201421
FIGURE No.	4



N

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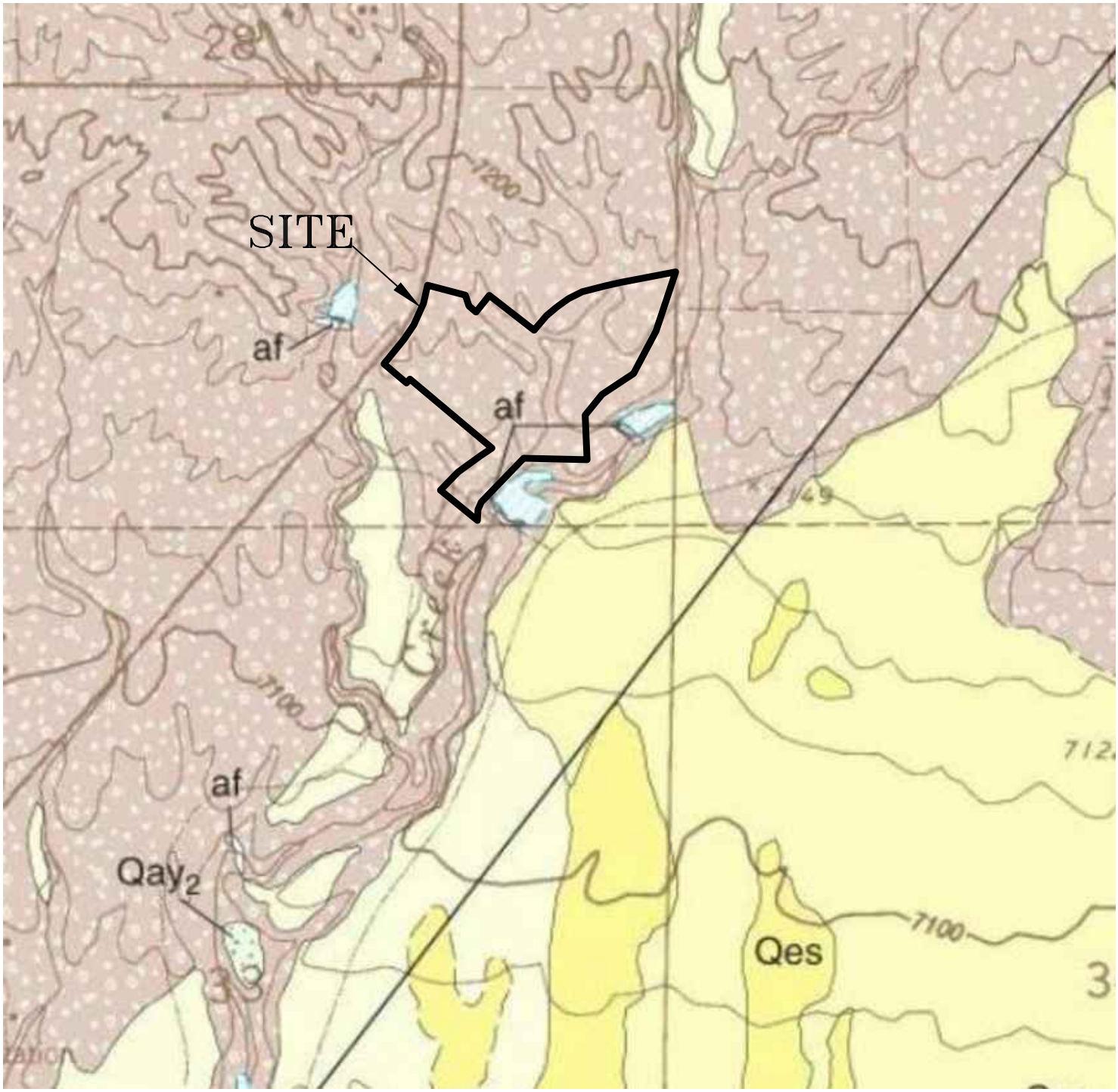
SOIL SURVEY MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/16/22		

JOB NO.: 201421

FIG NO.: 5



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FALCON NW QUADRANGLE GEOLOGY MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/16/22		

JOB NO.: 201421

FIG NO.: 6

Legend:

Qaf -	*Artificial Fill of Holocene Age:* man-made fill deposits
Qal -	*Recent Alluvium of Holocene Age:* recent water deposited materials
Qb -	*Broadway Alluvium of Quaternary Age:* water deposited sand, terrace deposits
Tkd -	*Dawson Formation of Tertiary to Cretaceous Age:* arkosic sandstone with siltstone and claystone lenses
fp -	*floodplain*
psw -	*potentially seasonal shallow groundwater area*
pu -	*potentially unstable slopes*
w -	*ponded water*

N

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GEOLOGY/ENGINEERING GEOLOGY MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN	LLL
CHECKED	
DATE	2/16/22
SCALE	AS SHOWN
JOB NO.	201421
FIGURE No.	7

N

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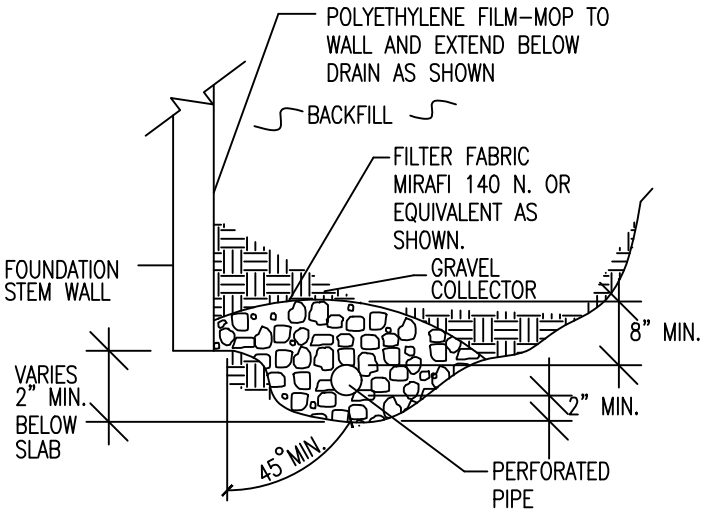
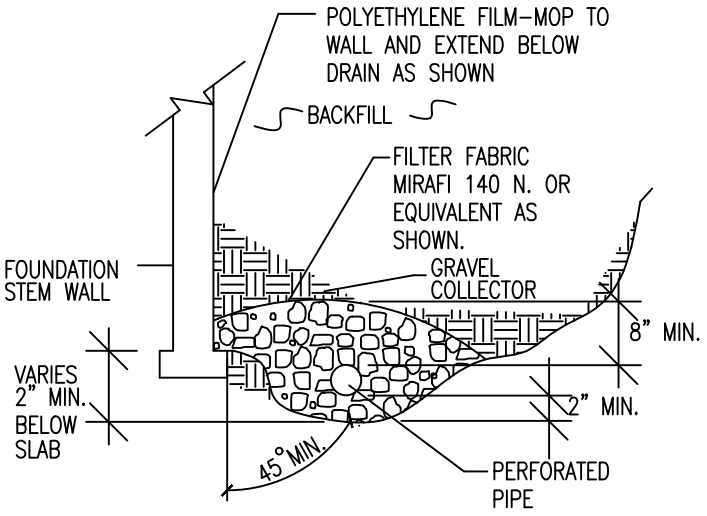
FLOODPLAIN MAP
STERLING RANCH HOMESTEAD NORTH FIL. NO. 2
PARCEL 11
COLORADO SPRINGS, COLORADO
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/16/22		

JOB NO.: 201421

FIG NO.: 8





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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505 ELKTON DRIVE
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PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:

JOB NO.: 201421

FIG NO.: 9

APPENDIX A: Site Photographs

1

Looking west southern portion of the site.

February 14, 2022

2

Looking north from the southern portion of the site.

February 14, 2022

Job No. 201421

3

Looking west from the central portion of the site.

February 14, 2022

4

Looking south from the central portion of the site.

February 14, 2022

Job No. 201421

5

Looking northeast from the northeastern portion of the site.

February 14, 2022

6

Looking north from the northeastern portion of the site.

February 14, 2022

Job No. 201421

APPENDIX B: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 7/14/2020
Job # 201421

REMARKS

WATER @ 16', 7/16/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Description
			30	2.8	1	6" TOPSOIL, SAND, SILTY, FINE TO COARSE GRAINED, TAN, DENSE, DRY TO MOIST
5			37	6.7	1	
10			50/7"	6.3	2	SANDSTONE, SILTY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST TO WET
15			50/6"	8.1	2	
20			50/6"	19.1	2	

TEST BORING NO. 2
DATE DRILLED 7/14/2020
CLIENT MORLEY-BENTLEY INVESTMENTS
LOCATION HOMESTEAD - STERLING RANCH

REMARKS

DRY TO 19', 7/16/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Description
			30	1.7	1	6" TOPSOIL, SAND, SILTY, FINE TO COARSE GRAINED, TAN, DENSE TO MEDIUM DENSE, DRY TO MOIST
5			27	5.3	1	
10			39	8.3	1	
15			50/9"	7.6	2	SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST
20			50/5"	11.2	2	

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421
FIG NO.: B- 1

TEST BORING NO. 3
DATE DRILLED 7/14/2020
Job # 201421

REMARKS

DRY TO 19', 7/16/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			50/10"	3.5	2
5			50/11"	4.5	2
10			50/6"	13.8	3
15			50/5"	6.5	2
20			50/4"	10.1	2

6" TOPSOIL, SAND, SILTY, TAN
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST

CLAYSTONE, VERY SANDY, GREEN BROWN, HARD, MOIST

SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN TO DARK BROWN, VERY DENSE, MOIST

TEST BORING NO. 4
DATE DRILLED 7/16/2020
CLIENT MORLEY-BENTLEY INVESTMENTS
LOCATION HOMESTEAD - STERLING RANCH

REMARKS

DRY TO 19', 7/17/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			38	1.7	2
5			46	3.6	2
10			50/10"	7.6	2
15			50/6"	8.2	2
20			50/6"	1.7	2

SAND, SILTY, TAN
WEATHERED SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, DENSE, DRY TO MOIST

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

SANDSTONE, VERY SILTY, FINE GRAINED, GREEN BROWN, VERY DENSE, MOIST TO DRY

TEST BORING NO. 5
DATE DRILLED 7/16/2020
Job # 201421

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 16.5', 7/17/20						
6" TOPSOIL, SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO DENSE, MOIST				25	12.6	1
	5			43	7.5	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST	10			50/7"	7.7	2
SANDSTONE, CLAYEY, FINE GRAINED, GREEN BROWN, VERY DENSE, MOIST	15			50/6"	14.5	2
CLAYSTONE, VERY SANDY, GRAY BROWN, HARD, MOIST	20			50/6"	21.3	3

TEST BORING NO. 6
DATE DRILLED 7/16/2020
CLIENT MORLEY-BENTLEY INVESTMENTS
LOCATION HOMESTEAD - STERLING RANCH

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 18', 7/17/20						
6" TOPSOIL, SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY				10	1.0	1
SAND, CLAYEY, FINE GRAINED, GREEN BROWN, MEDIUM DENSE, MOIST	5			18	15.6	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, GREEN BROWN, VERY DENSE, MOIST	10			50/5"	7.3	2
	15			50/7"	9.1	2
	20			50/8"	13.6	2

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421
FIG NO.: B- 3

TEST BORING NO. 7
DATE DRILLED 7/16/2020
Job # 201421

REMARKS

DRY TO 19', 7/17/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
					1	6" TOPSOIL, SAND, SILTY, TAN
			50/11"	8.4	2	SANDSTONE, SILTY TO SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST
5			50/6"	9.8	2	
10			50/11"	9.6	2	
15			50/10"	10.7	2	SANDSTONE, CLAYEY, FINE GRAINED, BROWN, VERY DENSE, MOIST
20			50/6"	9.3	2	SANDSTONE, SILTY, FINE TO COARSE GRAINED, GREEN BROWN, VERY DENSE, MOIST

TEST BORING NO. 8
DATE DRILLED 7/16/2020
CLIENT MORLEY-BENTLEY INVEST.
LOCATION HOMESTEAD - STERLING RANCH

REMARKS

WATER @ 8.5', 7/17/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
					1	6" TOPSOIL, SAND, SILTY, FINE TO COARSE GRAINED, BROWN
			10	1.7	1	TO TAN, MEDIUM DENSE, DRY TO MOIST
5			20	3.5	1	
10			50/11"	16.4	2	SANDSTONE, SILTY, FINE GRAINED, BROWN, VERY DENSE, MOIST
15			50/9"	14.8	3	CLAYSTONE, SANDY, GREEN BROWN, HARD, MOIST
20			50/6"	11.0	2	SANDSTONE, SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST

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

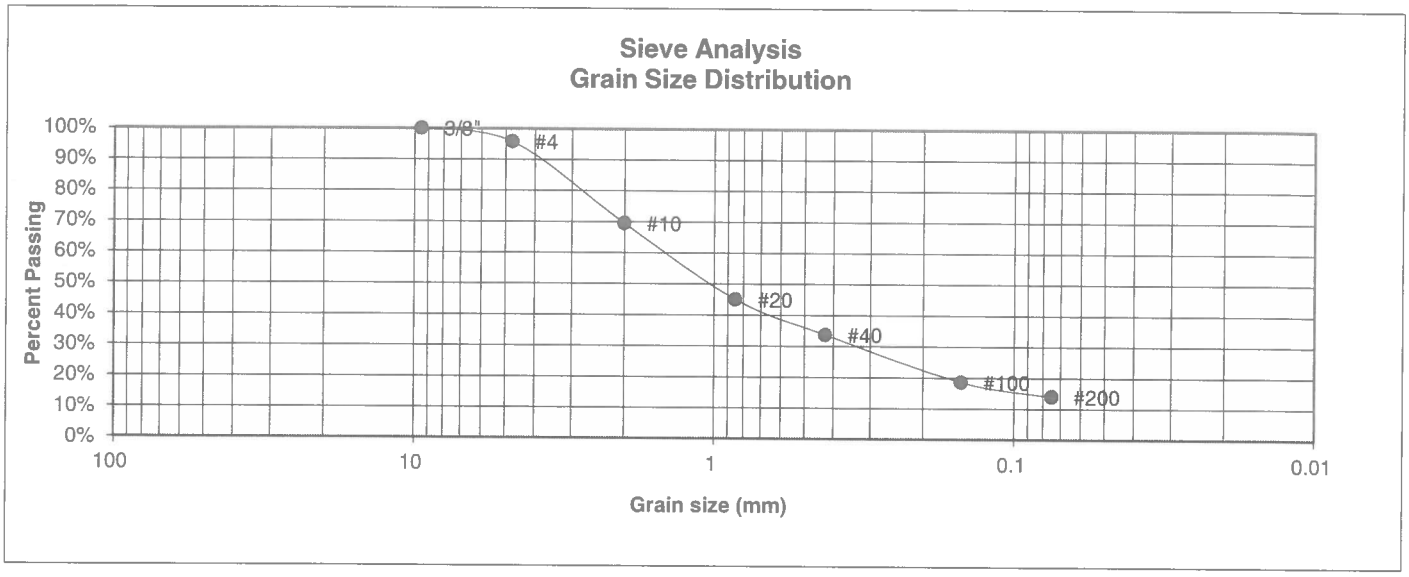
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421
FIG NO.: B- 4

APPENDIX C: Laboratory Test Results

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	1	JOB NO.	201421
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	95.7%
10	69.5%
20	45.1%
40	33.7%
100	18.6%
200	14.0%

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

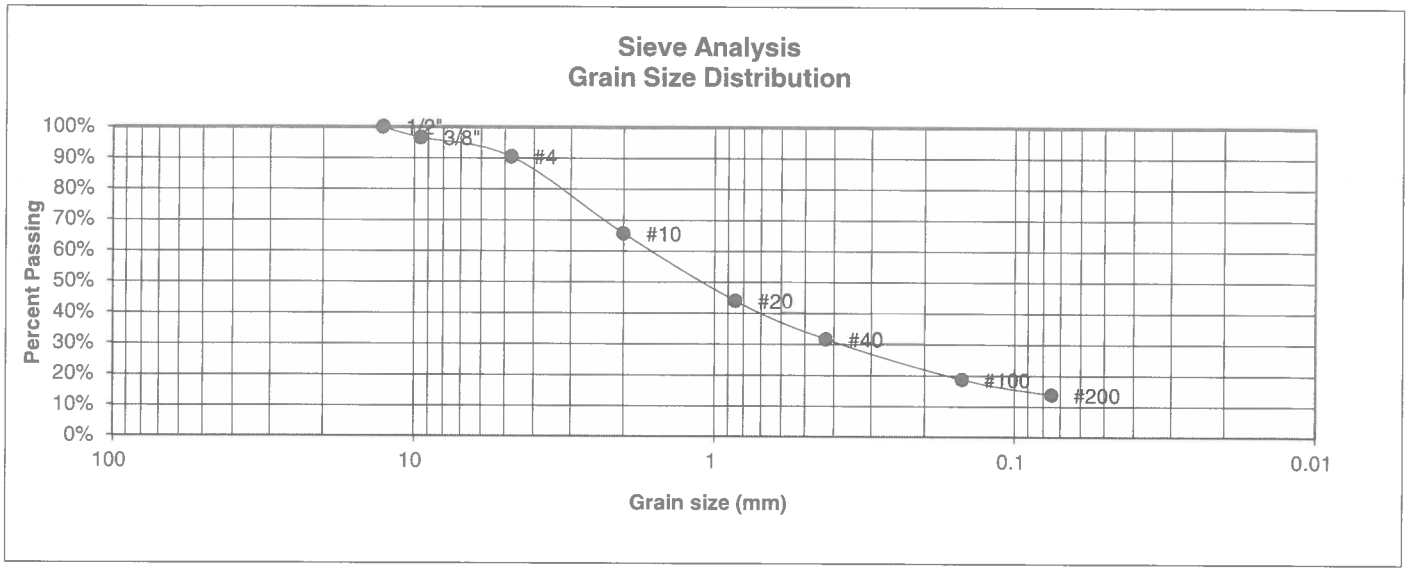
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-1

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	2	JOB NO.	201421
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.6%
4	90.5%
10	65.7%
20	44.0%
40	31.7%
100	18.7%
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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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

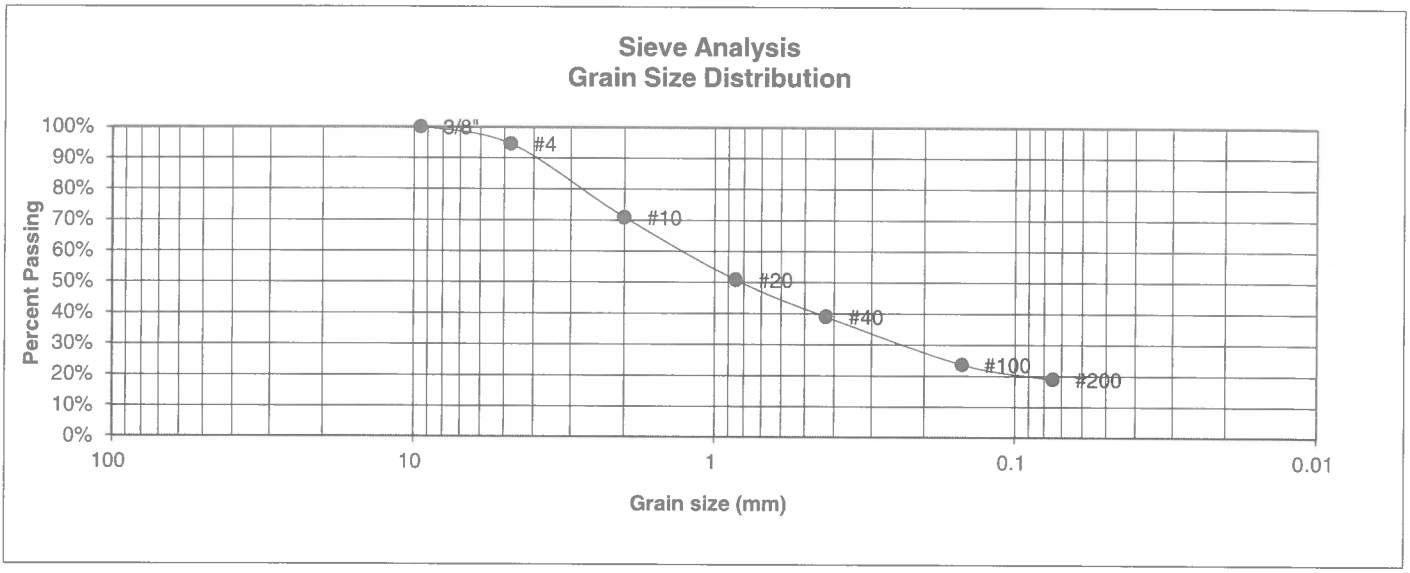
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-2

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	5	JOB NO.	201421
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.5%
10	70.9%
20	50.8%
40	39.0%
100	23.6%
200	18.9%

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

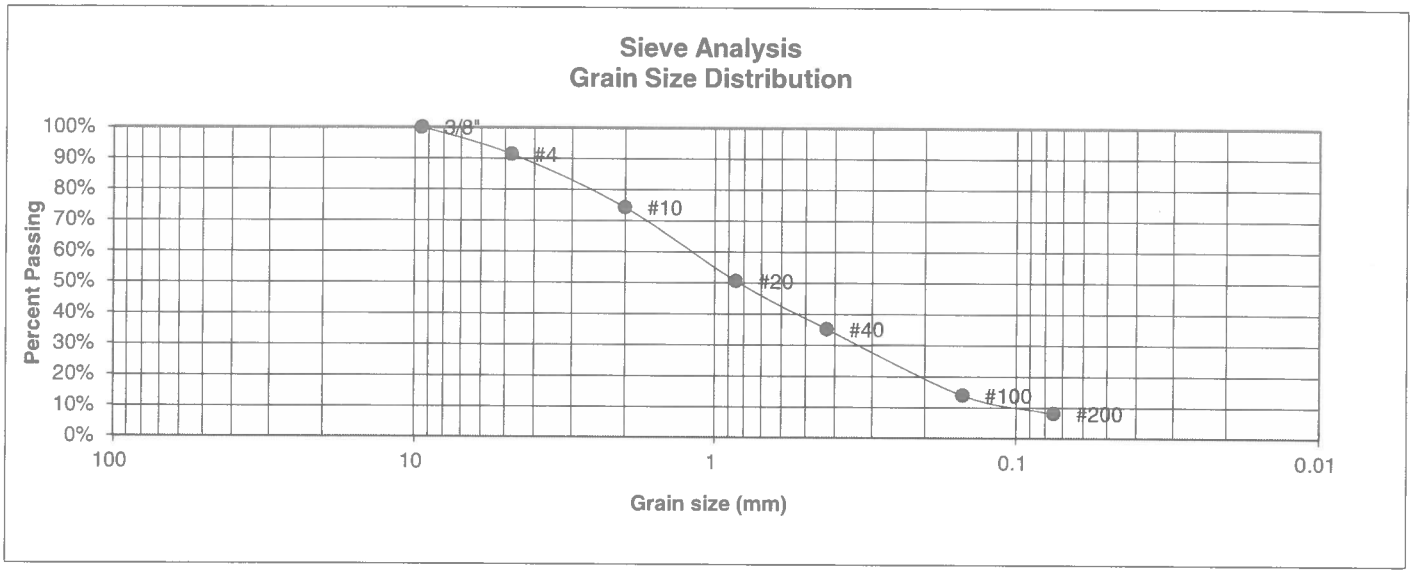
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-3

UNIFIED CLASSIFICATION	SM-SW	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	6	JOB NO.	201421
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	91.4%
10	74.3%
20	50.6%
40	35.2%
100	14.0%
200	8.2%

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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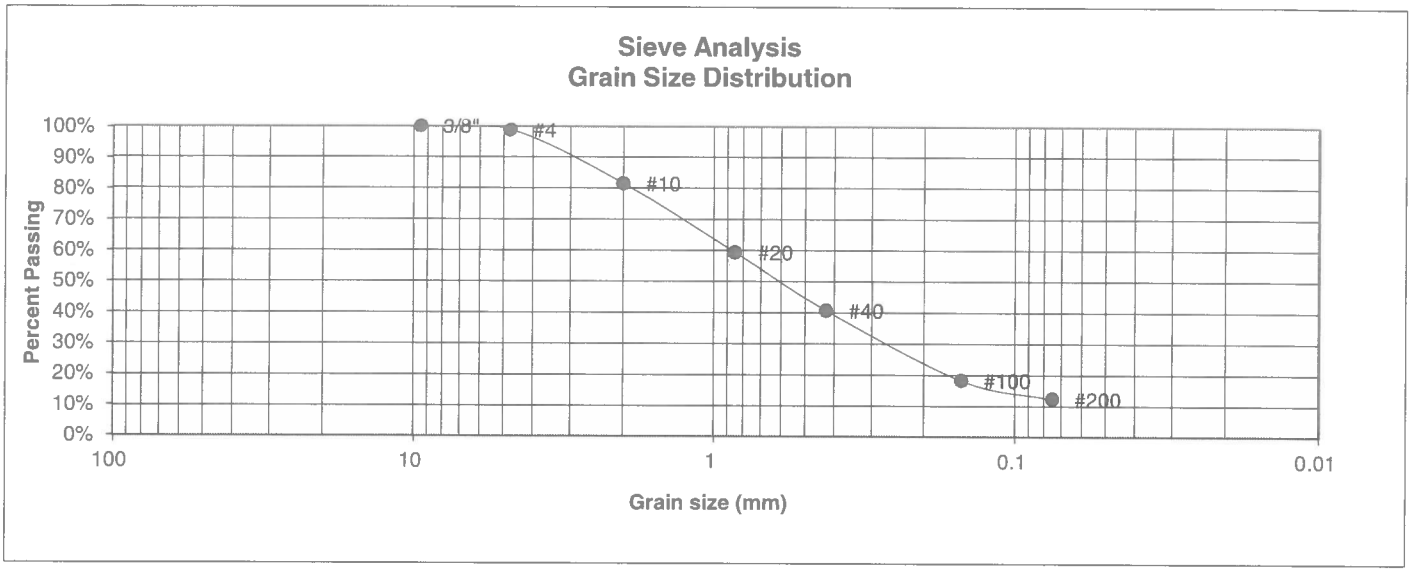
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-4

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	8	JOB NO.	201421
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.8%
10	81.5%
20	59.4%
40	40.6%
100	18.2%
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)

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

LABORATORY TEST RESULTS

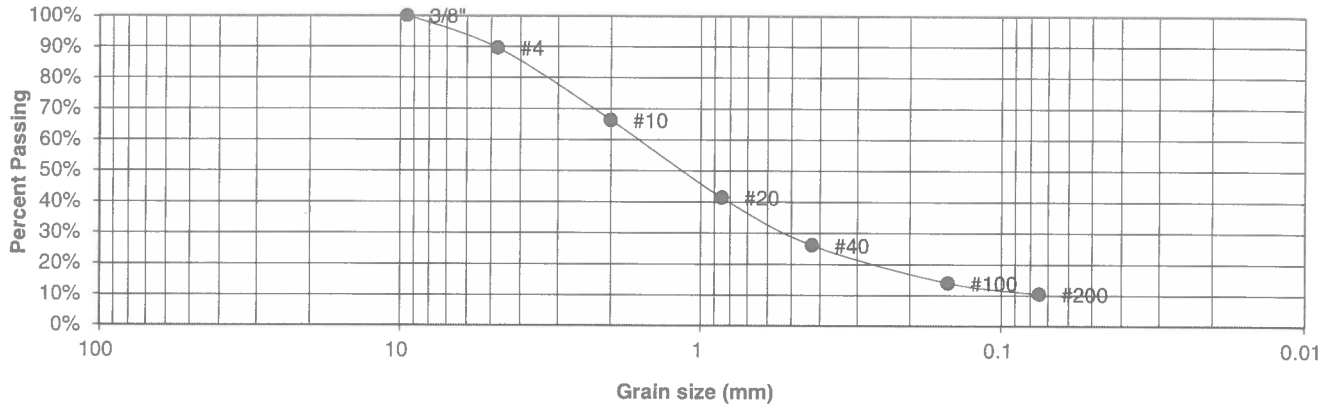
DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-5

UNIFIED CLASSIFICATION	SM-SW	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	2	JOB NO.	201421
DEPTH (FT)	15	TEST BY	BL

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	89.5%
10	66.3%
20	41.4%
40	26.1%
100	14.0%
200	10.4%

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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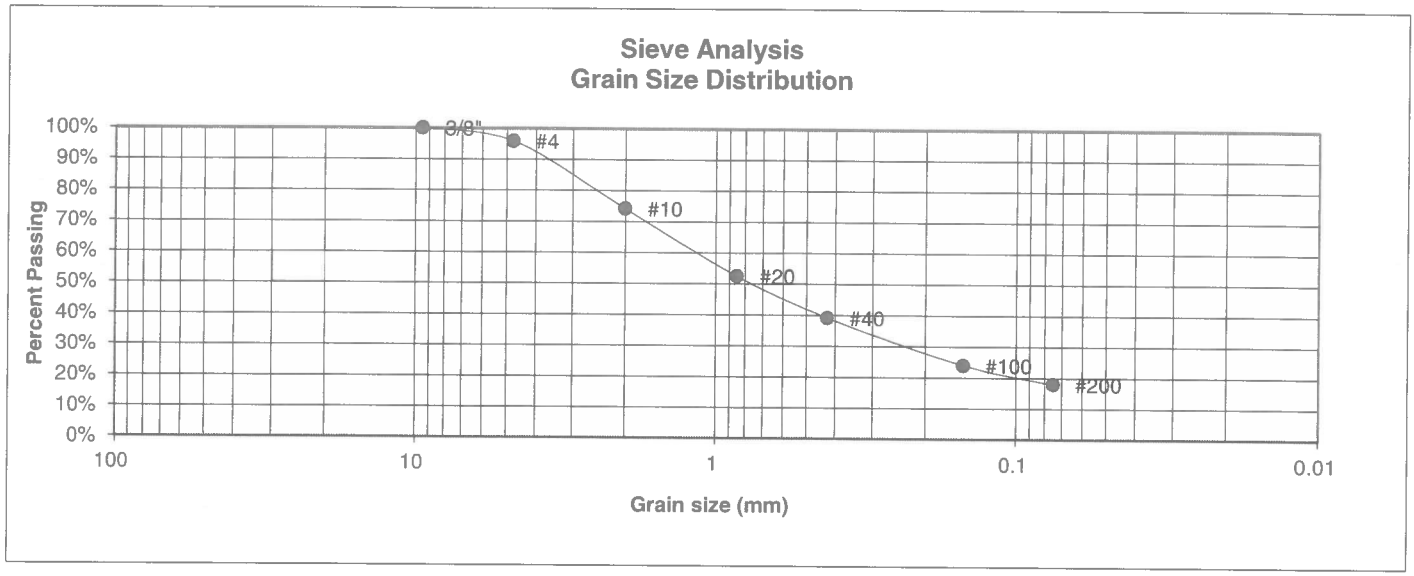
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-6

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	3	JOB NO.	201421
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.9%
10	74.1%
20	52.5%
40	39.1%
100	24.0%
200	17.9%

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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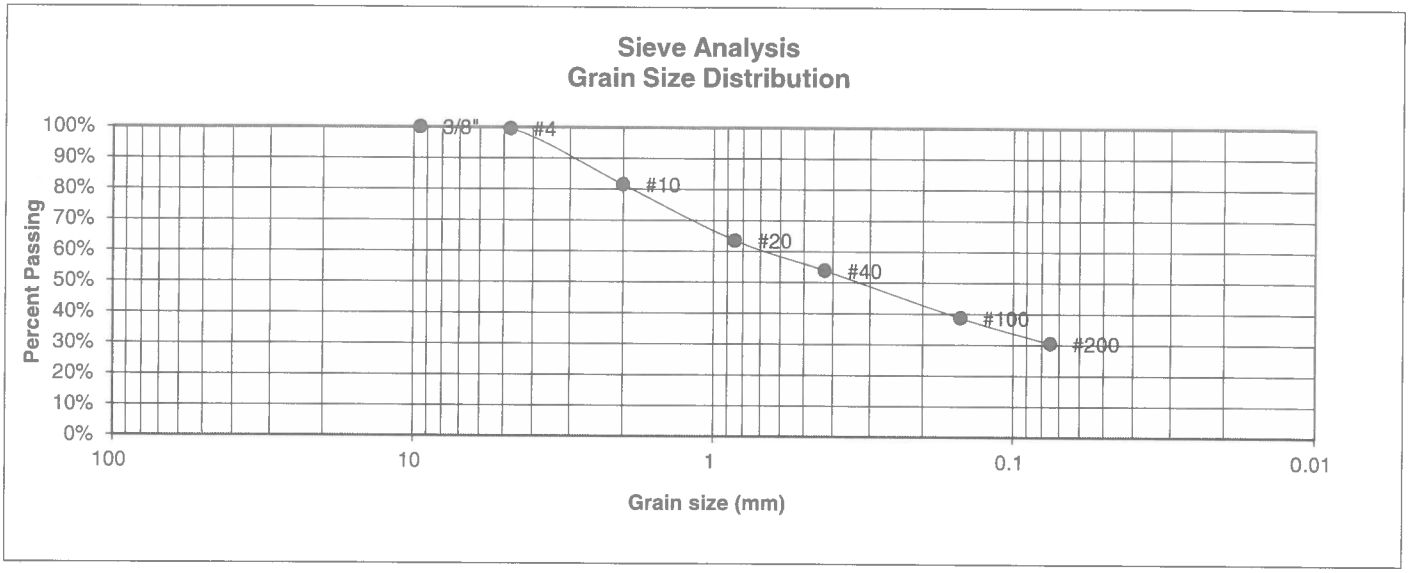
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-7

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	4	JOB NO.	201421
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	81.5%
20	63.5%
40	53.8%
100	38.7%
200	30.5%

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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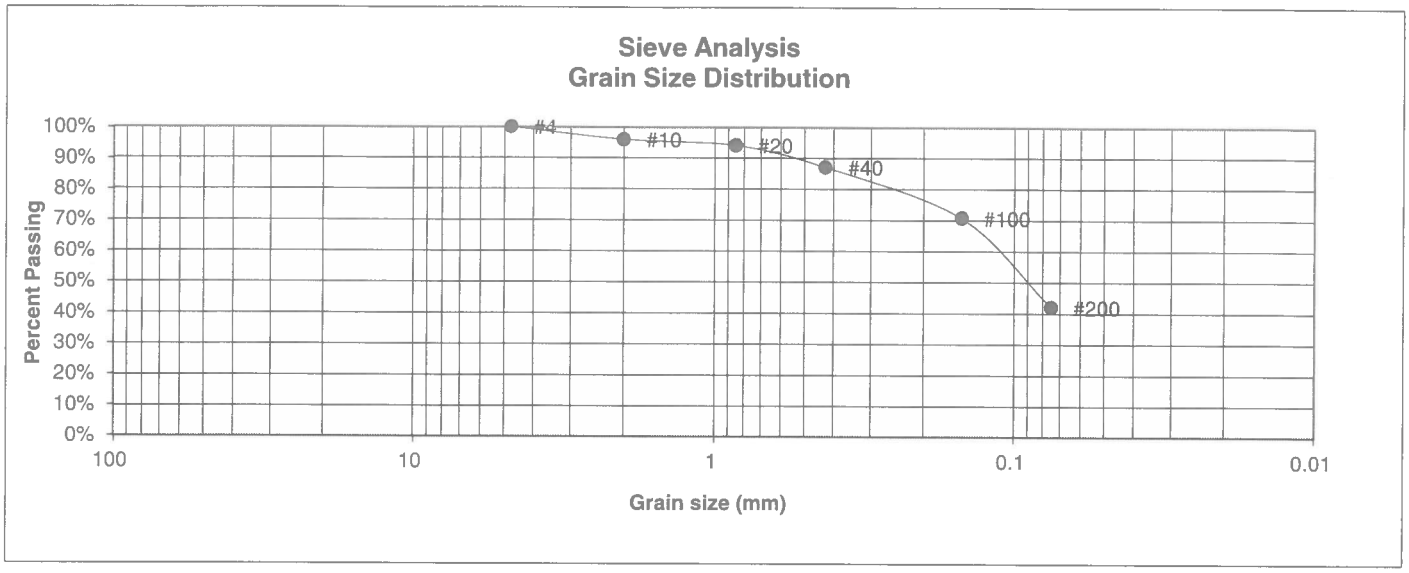
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-8

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	4	JOB NO.	201421
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	95.9%
20	94.0%
40	87.0%
100	70.7%
200	42.0%

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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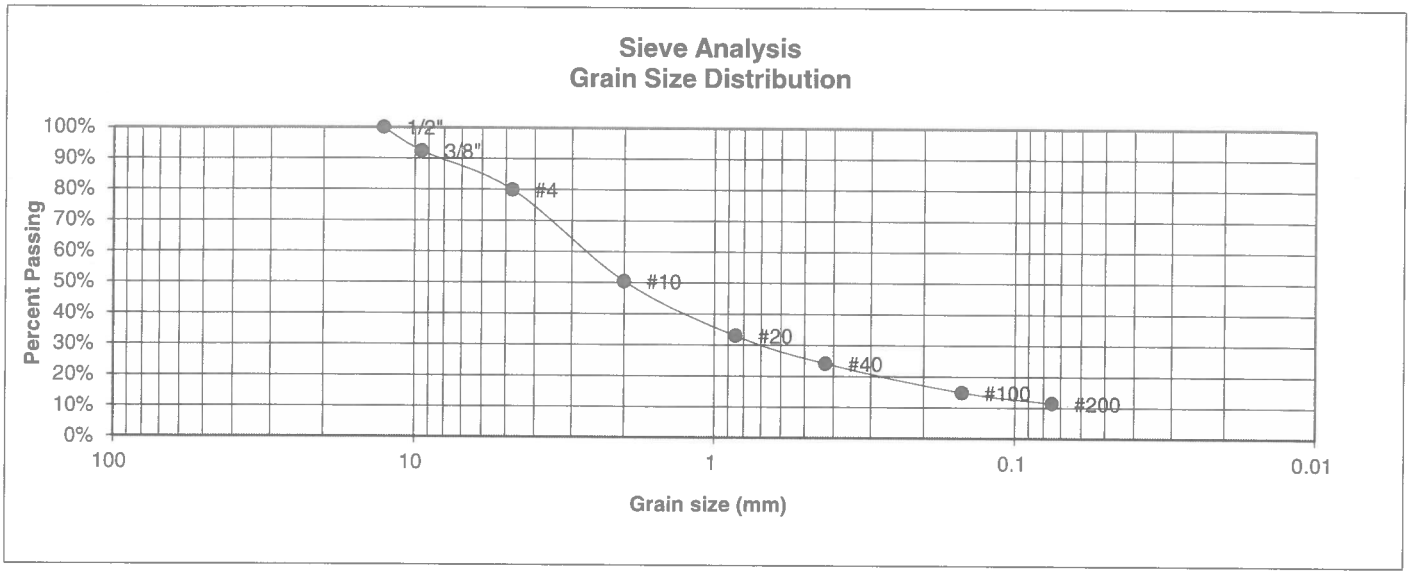
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-9

UNIFIED CLASSIFICATION	SM-SW	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	7	JOB NO.	201421
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	92.3%
4	79.9%
10	50.4%
20	33.0%
40	24.1%
100	14.8%
200	11.4%

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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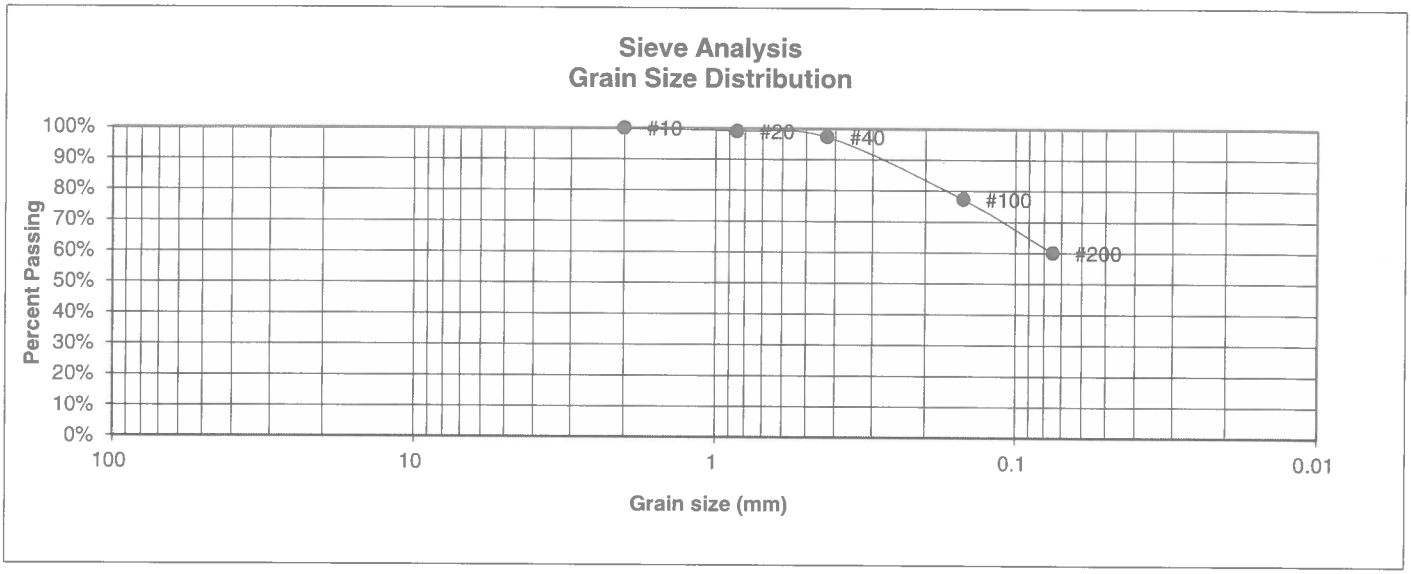
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-10

UNIFIED CLASSIFICATION	CL	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	3	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	3	JOB NO.	201421
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	100.0%
20	99.1%
40	97.3%
100	77.3%
200	60.0%

Atterberg Limits

Plastic Limit

Liquid Limit

Plastic Index

Swell

Moisture at start	14.1%
Moisture at finish	18.6%
Moisture increase	4.5%
Initial dry density (pcf)	104
Swell (psf)	430

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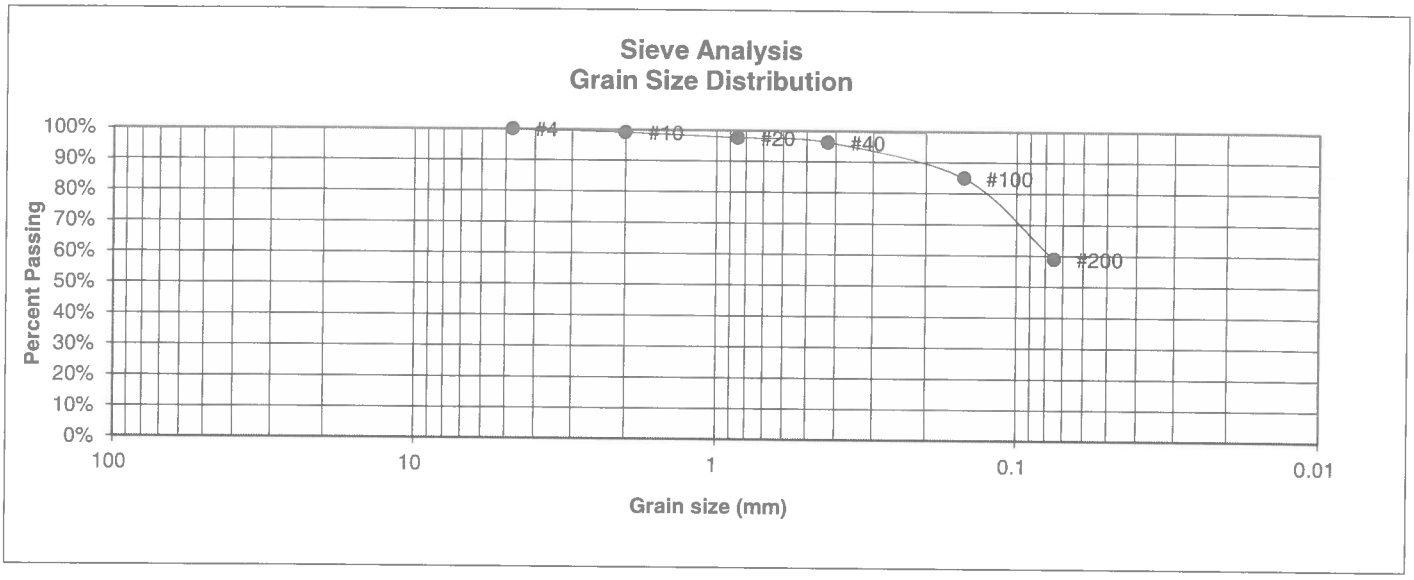
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-11

UNIFIED CLASSIFICATION	CL	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	3	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	5	JOB NO.	201421
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.1%
20	97.5%
40	96.2%
100	84.9%
200	58.9%

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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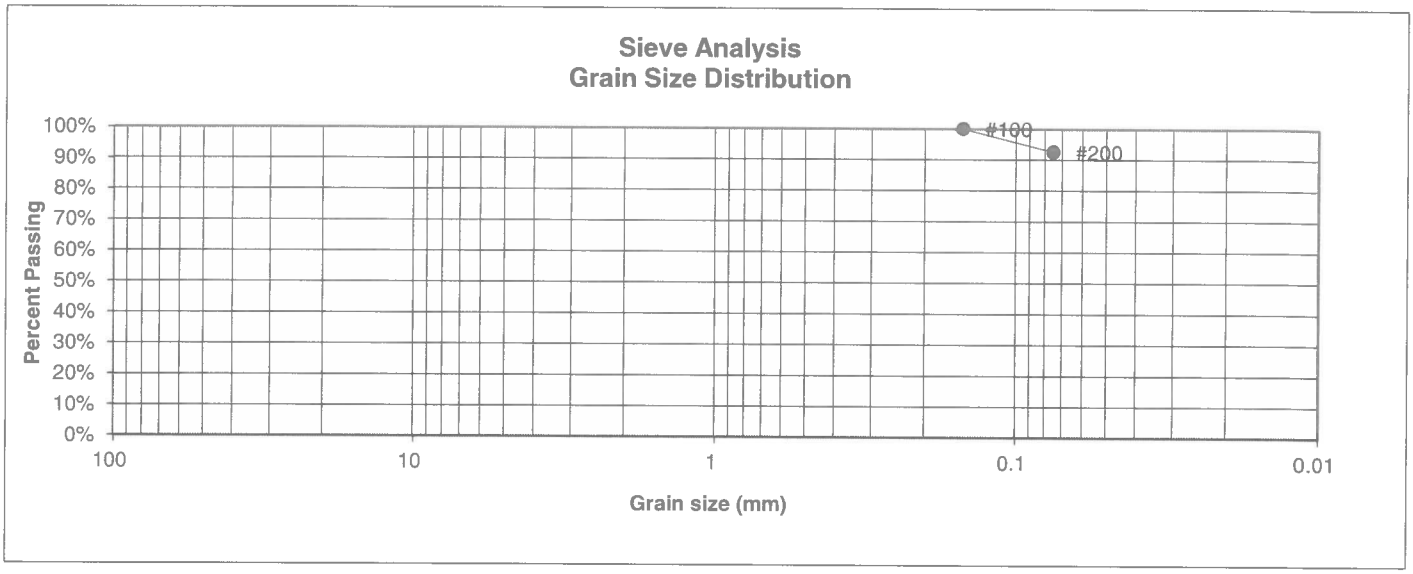
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-12

UNIFIED CLASSIFICATION	CL	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	3	PROJECT	HOMESTEAD - STERLING RANCH
TEST BORING #	8	JOB NO.	201421
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	92.5%

Atterberg Limits

Plastic Limit	23
Liquid Limit	33
Plastic Index	10

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	7/20/20

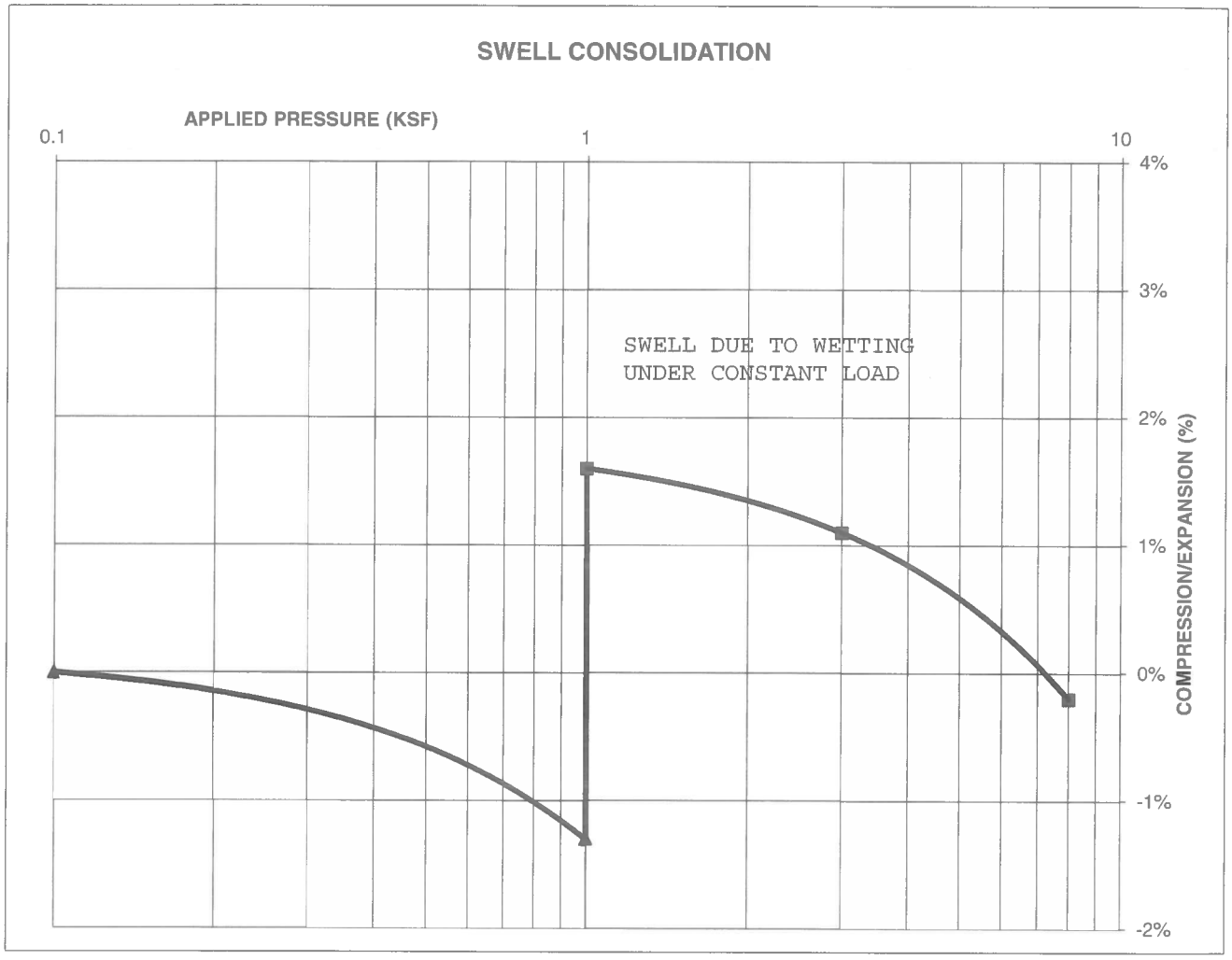
JOB NO.: 201421

FIG NO.: C-13

CONSOLIDATION TEST RESULTS

TEST BORING #	8	DEPTH(ft)	15
DESCRIPTION	CL	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			118
NATURAL MOISTURE CONTENT			15.6%
SWELL/CONSOLIDATION (%)			2.9%

JOB NO. 201421
CLIENT MORLEY-BENTLEY INVEST.
PROJECT HOMESTEAD - STERLING RANCH



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421
FIG NO.: L-14

CLIENT	MORLEY-BENTLEY INVESTMENTS	JOB NO.	201421
PROJECT	HOMESTEAD - STERLING RANCH	DATE	7/20/2020
LOCATION	HOMESTEAD - STERLING RANCH	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	SM-SW	<0.01
TB-8	15	3	CL	<0.01

QC BLANK PASS

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LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	7/20/20

JOB NO.: 201421

FIG NO.: C-15

APPENDIX D: Test Boring Logs and Laboratory Test Results from Entech Job No. 82556

TEST BORING NO. 31
DATE DRILLED 8/14/2006
Job # 82556

REMARKS

WATER AT 8', 8/16/06

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, GRAVELLY, FINE TO COARSE GRAINED, DARK BROWN, MEDIUM DENSE, MOIST			19	6.1	1
CLAY, SANDY, TAN, STIFF, MOIST	5		24	18.8	2
SANDSTONE, SILTY, FINE TO COARSE GRAINED, LIGHT GRAY, VERY DENSE, MOIST TO WET	10		50/7"	12.6	3
	15		50/4"	10.4	3
	20				

TEST BORING NO. 32
DATE DRILLED 8/14/2006
CLIENT MORLEY BENTLEY
LOCATION STERLING RANCH

REMARKS

WATER @ 11', 8/16/06

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
SAND, SILTY, BROWN					2
CLAY, SANDY, BROWN			37	5.0	1
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST TO VERY MOIST	5		23	8.7	1
	10		14	13.6	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, LIGHT BROWN, VERY DENSE, VERY MOIST	15		50/5"	17.5	3
CLAYSTONE, SILTY, LIGHT BROWN, HARD, MOIST	20		*	11.2	4
			50/5"	10.8	4

* - BULK SAMPLE TAKEN

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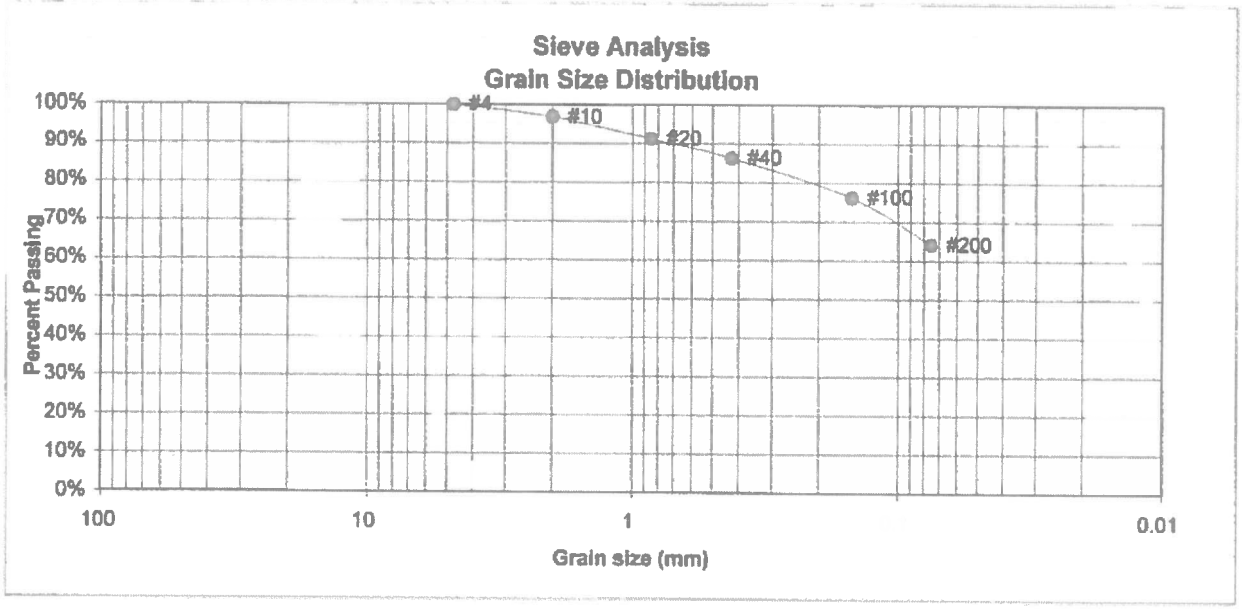
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		KAW	9/5/06

JOB NO.: 82556
FIG NO.: P-1

UNIFIED CLASSIFICATION	CL	CLIENT	MORLEY BENTLEY
SOIL TYPE #	2	PROJECT	STERLING RANCH
TEST BORING #	31	JOB NO.	82556
DEPTH (FT)	5	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	96.8%
20	91.2%
40	86.3%
100	76.2%
200	64.2%

Atterberg Limits

Plastic Limit	15
Liquid Limit	40
Plastic Index	25

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:
		KAH	9/5/06

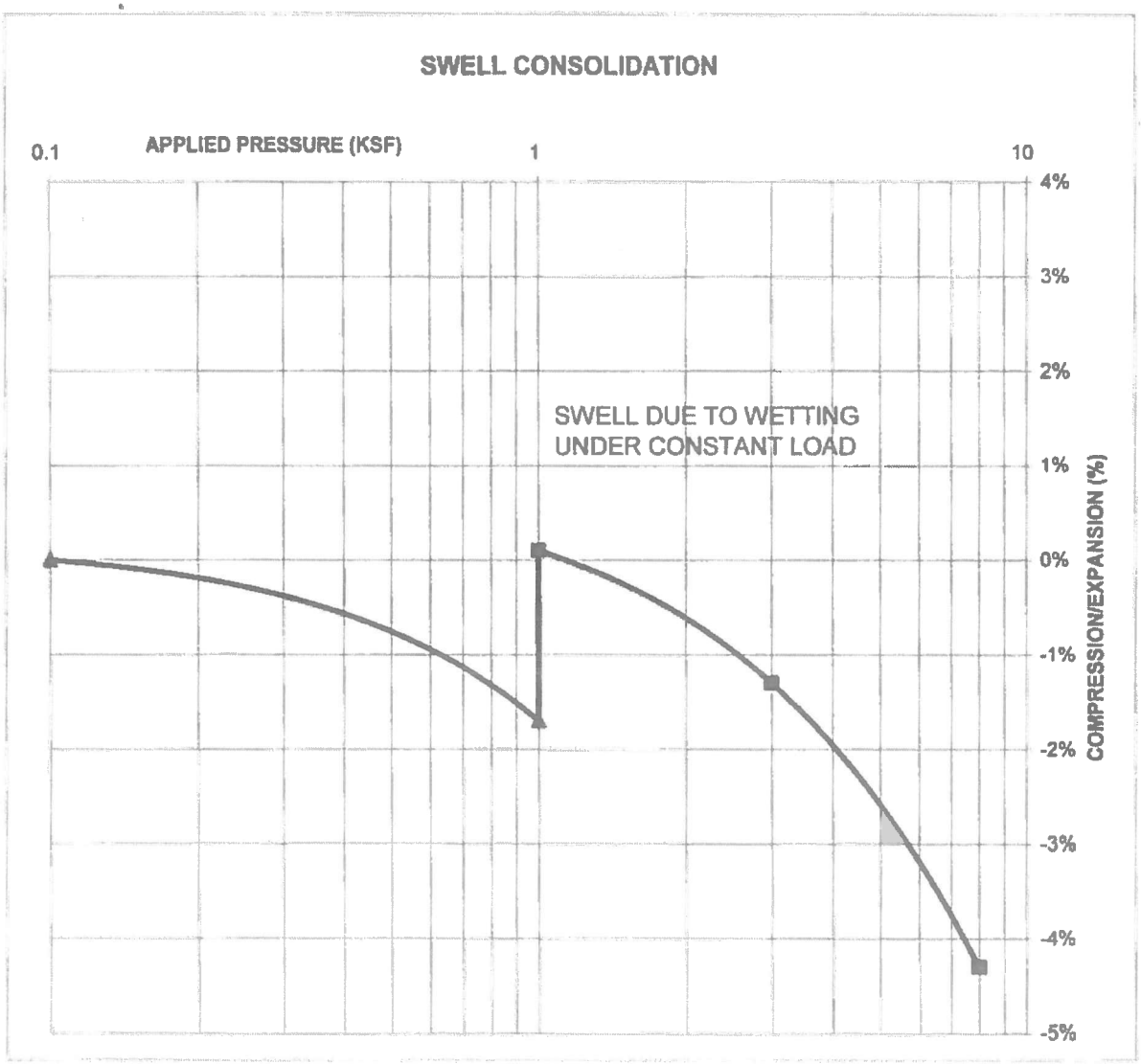
JOB NO.: 82556

FIG NO.: D-2

CONSOLIDATION TEST RESULTS

TEST BORING #	31	DEPTH(FT)	5
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			95
NATURAL MOISTURE CONTENT			27.9%
SWELL/CONSOLIDATION (%)			1.8%

JOB NO. 82556
CLIENT MORLEY BENTLEY
PROJECT STERLING RANCH



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			9/5/06

JOB NO.: 82556
FIG NO.: P-3

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT MORLEY BENTLEY
PROJECT STERLING RANCH
JOB NO. 82556

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	4	2-5			10.0	NV	NP	<0.01			SM-SW	SAND, SLIGHTLY SILTY
1	9	5			22.4						SM	SAND, SILTY
1	12	5			8.6						SM-SW	SAND, SLIGHTLY SILTY
1	17	2-3			11.7						SM-SP	SAND, SLIGHTLY SILTY
1	19	5			15.9						SM	SAND, SILTY
1	20	10			10.7						SM-SW	SAND, SLIGHTLY SILTY
1	25	2-5			8.4						SM-SW	SAND, SLIGHTLY SILTY
1	26	5			17.3						SM	SAND, SILTY
1	41	5			44.1	23	7		574		SC-SM	SAND, VERY CLAYEY-SILTY
1	42	2-3			7.4						SM-SW	SAND, SLIGHTLY SILTY
1	44	5-10			5.7						SM-SW	SAND, SLIGHTLY SILTY
2	7	5	5.6	98.0		29	13			-2.3	CL	CLAY, SANDY
2	13	2-3			54.6				455		CL	CLAY, VERY SANDY
2	21	7						0.10	4179		CL	CLAY, SANDY
2	23	7							1085		CL	CLAY, SANDY
2	27	9							2300		CL	CLAY, SANDY
2	31	5	27.9	95.4	64.2	40	25			1.8	CL	CLAY, SANDY
2	34	2-5			51.6	27	13				CL	CLAY, VERY SANDY
3	5	15	10.4	118.6		24	11			-0.1	SC	SANDSTONE, CLAYEY
3	6	15-20			14.8			0.01			SM	SANDSTONE, SILTY
3	11	10			17.1						SM	SANDSTONE, SILTY
3	13	10			36.0						SM	SANDSTONE, SILTY
3	14	5			20.4						SM	SANDSTONE, SILTY
3	18	15							456		SM	SANDSTONE, SILTY
3	22	5	23.3	100.7	21.1	NV	NP			0.0	SM	SANDSTONE, SILTY
3	28	5-10			17.8						SM	SANDSTONE, SILTY
3	29	7							485		SC	SANDSTONE, CLAYEY
3	30	10			9.1						SM-SW	SANDSTONE, SLIGHTLY SILTY
3	33	5			14.4						SM	SANDSTONE, SILTY
3	35	15			11.1						SM-SW	SANDSTONE, SLIGHTLY SILTY
3	36	2-5			18.7				1014		SC	SANDSTONE, CLAYEY

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
3	38	5			13.3						SM	SANDSTONE, SILTY
3	39	15	11.0	124.3	42.8	33	16			1.0	SC	SANDSTONE, VERY CLAYEY
3	40	2-3							360		SM-SC	SANDSTONE, SILTY, CLAYEY
4	1	5	13.4	117.8	68.1					0.9	CL	CLAYSTONE, SANDY
4	3	7			55.3	32	18		846		CL	CLAYSTONE, VERY SANDY
4	24	2-3							1757		CL	WEATHERED CLAYSTONE, SANDY
4	25	10							1845		CL	CLAYSTONE, SANDY
4	33	15	24.3	100.7	73.0	51	28			2.7	CH	CLAYSTONE, SANDY
4	40	15	14.8	117.6	71.5	38	16	0.00		1.0	CL	CLAYSTONE, SANDY
4	43	20	12.6	121.0						0.3	CL	CLAYSTONE, SANDY

APPENDIX E: Soil Survey Descriptions

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 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 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020