ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

GEOLOGIC HAZARD STUDY
TUTT BOULEVARD AT COTTONWOOD CREEK
COTTONWOOD CREEK DETENTION BASIN PR-2
PARCEL NOS. 53060-00-118, 53062-00-001, & 53062-01-004
COLORADO SPRINGS, COLORADO

Prepared for

City of Colorado Springs – Stormwater Enterprise
30 S. Nevada Ave, Suite 401
Colorado Springs, Colorado 80903

Attn: Jeff Dunn

February 19, 2020

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

LLL/ao

Reviewed by:

Joseph C. Goodwin, P.E.
President

COLORADO LICENSED
JOSEPH COLLIN GOODWIN JR
23725
2.19.2020
PROFESSIONAL ENGINEER

Encl.

Entech Job No. 200254
AAprojects/2020/200254 geohaz

CITY OF COLORADO SPRINGS

APPLICATION FORM FOR GEOLOGIC HAZARD REPORT

Applicant: City of Colorado Springs – Stormwater Enterprise Telephone 719-385-5440 Fax _____

Address: 30 S. Nevada Ave _____ Zip Code 80903 _____ e-mail jeffer.dunn@coloradosprings.gov

Premises Involved: Development Plan/Subdivision Plat Name: Tutt Boulevard at Cottonwood Creek – Cottonwood Creek Stormwater Detention Basin PR-2

Tax Schedule No(s). 53060-00-118, 53062-00-001, & 53062-00-004
(This can be obtained from the El Paso County Tax Assessor located at 27 E. Vermijo Avenue on the 2nd Floor; phone: 520-6600 or at their web site http://www.land.elpasoco.com)

GEOLOGIC HAZARD REPORT REQUIRED: (FIVE (5) PRELIMINARY COPIES)

An application review fee will be required to accompany these applications (make checks payable to City of Colorado Springs). The fee schedule is as follows:

Review of Geologic Hazard Reports	City Planning Fee: $300 plus any Colorado Geological Survey Review Cost Over $300
	City Engineering Fee: $284

The following documents have been included and considered as part of this report (checked off by individual(s) preparing the geologic report):

Development Plan: _____

Landscape Plan (if applicable): _____

Grading Plan: _____

Drainage Report (necessary if debris and/or mud flow hazard is present): _____

ENGINEERS STATEMENT

I hereby attest that I am qualified to prepare a Geologic Hazard Study in accordance with the provisions of Section 504 of the Geologic Hazards Ordinance of Colorado Springs. I am qualified as:

_____X_____ Professional Geologist as defined by CRS 34-1-201(3); or,

_____ Professional Engineer as defined by Board Policy Statement 50.2 - "Engineering in Natural Hazard Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. Board authority as defined by CRS 12-25-107(1).

Submitted by: _____ Date: 2/19/2020
Logan L. Langford, P.G., Entech Engineering, Inc.

This Geologic Hazard Study is filed in accordance with the Zoning Code of the Code of the City of Colorado Springs, 2001, as amended.

_____ _____
City Engineer Date

_____ _____
City Planning Director Date

Table of Contents

FIGURES

APPENDICES

1.0 SUMMARY

Project Location:

The project lies in a portion of the NW¼ of Section 6, Township 13 South, Range 65 West, of the 6th Principal Meridian. The site is located at the intersection of Tutt Boulevard and Cowpoke Road, in the northeastern portion of Colorado Springs, Colorado.

Project Description:

Total acreage involved in the project is approximately 8 acres. The proposed improvments/development consists of the Cottonwood Creek Stormwater Detention Basin PR-2 and embankment construction for the extension of Tutt Boulevard north of Cottonwood Creek. Significant regrading and drainage improvements are proposed.

Scope of Report:

The report presents the results of our subsurface soil and geologic investigation and treatment of engineering geologic hazard study. This study utilized the results of our previous subsurface investigation, geologic reconnaissance, a review of available maps, aerial photographs, stability analysis and our conclusions with respect to the impacts of the geologic conditions on development.

Land Use and Engineering Geology:

Geologic conditions will impose constraints on development of the site. These include areas of artificial fill, expansive soils, potentially unstable, and unstable slopes, and floodplain areas. Site conditions will be discussed in greater detail in this report. This site was found to be suitable for the proposed development if the recommendations in this report are implemented. 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 NW¼ of Section 6, Township 13 South, Range 65 West, of the 6th Principal Meridian, in the northeastern portion of Colorado Springs, Colorado. The site is located at the intersection of Tutt Boulevard and Cowpoke Road, in the northeastern portion of Colorado Springs, Colorado. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is generally moderately to steeply sloping with steep slopes along Cottonwood Creek through the central portion of the site. Significant regrading of the site is proposed as part of the drainage improvements. The area of the site is indicated on the USGS Map, Figure 2. The site contains primarily field grasses, cacti, yuccas and weeds with scattered trees and brush along Cottonwood Creek. Site photographs are included in Appendix A. Approximate locations and directions of the photographs are indicated on Figure 3.

The site is currently zoned as RR-5, R1-6, DF, AO, and SS (Rural Residential, Single Family Residential, Design Flexibility, Airport Overlay, and Streamside Overlay). The site does not lie within the hillside overlay. Total acreage involved in the proposed development is approximately 8 acres. The proposed development consists of the Cottonwood Creek Stormwater Detention Basin PR-2 and embankment construction for the extension of Tutt Boulevard north of Cottonwood Creek. Significant regrading and drainage improvements are proposed. A new stormwater detention basin is proposed in the central portion of the site to the east of Tutt Boulevard. The Site Plan/Test Boring Location Map is presented in Figure 3, and the Site Plan with proposed grading is presented in Figure 4.

A Subsurface Soil Investigation for the proposed drainage improvements was previously prepared by Entech Engineering, dated April 3, 2018 (Reference 1). Information from this report was used in evaluating the site. Test Boring Logs and Summary of Laboratory Testing Results from the previous investigation are included in Appendix B.

3.0 SCOPE OF THE REPORT

The scope of this report included 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 position of mappable units within the subject property are shown on the Geologic Map Figure 6. 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. The field mapping was performed by personnel of Entech Engineering, Inc. on February 3, 2020.

Previous reports on the site include a Subsurface Soil Investigation by Entech Enginering, Inc. dated April 3, 2018, Reference 1. Information from the report was used in evaluating the site. Six test borings were drilled as a part of the investigation. The borings were drilled with a power-driven continuous flight auger drill rig to depths of 15 to 20 feet below grade surface (bgs). The locations of the test borings are included on the Site Plan/Test Boring Location Map, Figure 3. The drilling logs are included in Appendix B. The proposed grading and channel improvements are shown on the Site Plans with Proposed Improvements, Figures 4 and 5.

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 9½ 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 northeasterly direction. The rocks in the area of the site are sedimentary in nature, and typically Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson Formations are unconsolidated deposits of alluvial, colluvial and residual soils, and man-made artificial fill soils. The site's stratigraphy will be discussed in more detail in Section 5.2.

5.2 Site Stratigraphy

The Falcon NW Quadrangle Geology Map, showing the site, is presented in Figure 5 (Reference 5). The Geology Map prepared for the site is presented in Figure 6. Four mappable units were identified on the site, which are described as follows:

- **Qal** **Recent Alluvium of Holocene Age:** These are recent stream deposits that have been deposited along the Cottonwood Creek Drainage in the northern portion of the site. These materials consist of silty to clayey sands and sandy clays. Some of these alluviums contain highly organic soils.

- **Qaf** **Artificial Fill of Holocene Age:** These materials man-made fill deposits associated with fill piles, Tutt Boulevard roadway embankment, and drainage improvements associated with the Cumbres Vista Water Quality Basin located in the southeastern portion of the site. Fill was encountered in Test Boring No. 3 to a depth of 4 feet bgs.

- **Qam** **Middle alluvium of Holocene to Pleistocene Age:** These materials consist of lower stream terrace deposits. The alluvium typically consists of silty to clayey gravelly sand. This deposit is highly stratified and may contain lenses of silt, clay or cobbles. The Middle alluvium is correlated to the Broadway Alluvium in the Denver area.

- **Qc/TKd** **Colluvium of Quaternary Age overlying the Dawson Formation of Tertiary to Cretaceous Age:** These materials consist of colluvial or residual soils overlying bedrock materials on the site. The colluvium was deposited by the action of sheetwash and gravity. The residual soils were derived from the in-situ weathering of the bedrock materials. These soils are overlying the Dawson Formation. The Dawson Formation typically consists of coarse-grained, arkosic sandstone with interbedded lenses of fine-grained sandstone, siltstone and claystone.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Falcon NW Quadrangle* distributed by the Colorado Geological Survey in 2003 (Figure 5, Reference 5). The *Reconnaissance Geologic Map of Colorado Springs and Vicinity* by Scott and Wobus, 1973 (Reference 6), the *Geologic Map of the Colorado Springs - Castle Rock area, Front Range Corridor* by Trimble and Machette, 1979 (Reference 7) and the test borings drilled on the site were also used in evaluating the site.

5.3 Soil Conditions

The soils encountered in the test borings can be grouped into five general soil and rocks types. The soils were classified using the Unified Soil Classification System (USCS).

Soil Type 1A classified as a sandy clay fill (CL). The clay fill was encountered in Test Boring No. 3 at the existing ground surface extending to a depth of 4 feet below ground surface (bgs). Standard Penetration Testing conducted on the sand fill resulted in an SPT N-value of 20 blows per foot (bpf), indicating the clay fill is stiff in terms of density. Water content of a sample of the clay fill resulted in a water content of approximately 16 percent.

Soil Type 1 classified as a clayey sand (SC). The sand was encountered in three (3) of the test borings (Test Boring Nos. 3, 4, and 6) at the existing ground surface to 9 feet bgs and extending to 2 to 11 feet bgs. Standard Penetration Testing conducted on the sand resulted in SPT N-values ranging from 20 to 22 bpf, indicating the sand is medium dense in terms of density. Water content and grain size testing of sand samples resulted in a water content of approximately 9 to 12 percent, with approximately 23 percent of the soil particle sizes passing the No. 200 sieve. Atterberg Limits testing on the sand resulted in a liquid limit of 29 and a plastic index of 12. The sand likely exhibits a low swell potential based on the low fines content.

Soil Type 2 classified as a sandy clay (CH, CL). The clay was encountered in five (5) of the test borings (Test Boring Nos. 1, 2, 3, 4, and 5) at depths ranging from the existing ground surface to 4 feet below grade, and extending to 4 to 15 feet bgs. Standard Penetration Testing conducted on the clay resulted in SPT N-values ranging from 10 to 42 bpf, indicating the clay is stiff to very stiff in terms of density. Water content and grain size testing of clay fill samples resulted in a water content of approximately 18 to 32 percent, with approximately 86 to 99 percent of the soil particle sizes passing the No. 200 sieve. Atterberg Limits testing on the clay resulted in liquid limits of 44 and 59 with plastic indexes of 27 and 33, respectively. FHA swell testing resulted in a swell pressure of 2270 psf. Swell/Consolidation Testing showed swells of 0.6 to 3.3 percent. These results indicate the clay exhibits a low to high swell potential. Sulfate tests performed on samples of the clay resulted in less than 0.01 percent sulfate by weight, indicating the clay exhibits negligible potential for concrete degradation due to below grade sulfate attack.

Soil Type 3 classified as a silty sandstone (SM). The sandstone was encountered in three (3) of the test borings (Test Boring Nos. 2, 4, and 6) at depths ranging from 6 to 15 feet bgs and extending to the depth explored (15 feet bgs) and 19 feet bgs. Standard Penetration Testing conducted on the sands resulted in SPT N-values ranging from 50 to greater than 50 bpf, indicating the sandstone is very dense in terms of density. Water content and grain size testing of sandstone samples resulted in a water content of approximately 12 to 17 percent, with approximately 23 to 27 percent of the soil particle sizes passing the No. 200 sieve. Atterberg Limits testing on the sand resulted in a liquid limit of no value and a plastic index of non-plastic. The sandstone likely exhibits a low swell potential. A sulfate test performed on a sample of the sandstone resulted in less than 0.01 percent sulfate by weight, indicating the sand exhibits

negligible potential for concrete degradation due to below grade sulfate attack.

Soil Type 4 classified as a claystone (CH, CL). The claystone was encountered in five (5) of the test borings (Test Boring Nos. 1, 2, 3, 4, and 5) at depths ranging from 4 to 19 feet below the existing ground surface and extending to 6 feet bgs and the depths explored (15 and 20 feet bgs). Standard Penetration Testing conducted on the claystone resulted in SPT N-values of 50 to greater than 50 bpf, indicating the claystone is hard to very hard in terms of consistency. Water content and grain size testing of clay samples resulted in a water content of approximately 16 to 25 percent, with approximately 84 to 98 percent of the soil particle sizes passing the No. 200 sieve. Atterberg Limits testing on the clays resulted in a liquid limit of 50 and a plastic index of 25. Swell/Consolidation Testing showed volume changes of 2.3 to 2.6 percent. These results indicate the claystone exhibits a moderate to high swell potential. Sulfate tests performed on samples of the claystone resulted in less than 0.01 percent sulfate by weight, indicating the claystone exhibits negligible potential for concrete degradation due to below grade sulfate attack.

The test borings logs are included in Appendix A. The laboratory test results are included in Appendix B and are summarized in Table 1.

6.0 ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

Mapping has been performed on this site to produce the 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 expansive soils, potentially unstable and unstable slopes, artificial fill, and floodplain areas. In accordance with the Geologic Hazards Ordinance of the City of Colorado Springs, the following hazards have been addressed.

Expansive Soils

Expansive soils were encountered in the test borings. Additionally, the native clays and bedrock associated with the Dawson Formation have expansion potential. Expansive clays will be encountered in the subsurface across the entire site. These clays can cause differential movement in the structure foundations.

Mitigation: Expansive soils encountered within 4 feet of foundation members will require mitigation. Mitigation typically involves overexcavation of up to 4 feet of the expansive soils and replacement with compacted non-expansive structural fill. Floor slabs on expansive soils should be expected to experience movement. The above recommendations will result in the slabs supported on granular structural fill. Overexcavation and replacement with non-expansive soils at a minimum of 95% of it maximum Modified Proctor Dry Density, ASTM D-1557 have been successful in minimizing slab movements. Final recommendations should be determined after additional investigation of each building site.

Artificial Fill

Areas of artificial fill were observed across the site. The artificial fill is associated with fill piles, Tutt Boulevard roadway embankment, and drainage improvements associated with the Cumbres Vista Water Quality Basin located in the southeastern portion of the site.

Mitigation: It is anticipated the fill will be removed during the proposed site grading. Any uncontrolled fill encountered beneath new fill/road areas will require removal and recompaction at a minimum of 95% of its maximum Standard Proctor Dry Density, ASTM D-698.

Landslide Hazard

Portions of Cottonwood Creek on the site were not previously included on the *Map of Potential Areas of Landslide Susceptibility in Colorado Springs* by White and Wait, 2003, distributed by the Colorado Geological Survey in 2003 (Figure 8, Reference 8), however, areas of steep slopes along Cottonwood Creek are considered as potential areas of landslide susceptibility. Areas east and west of the site along Cottonwood Creek are included on the landslide susceptibility map (Figure 8) and have been mapped as susceptible to landslides. Recent slope failures were observed along portions of the site along a cut banks of Cottonwood Creek. These slopes will be regraded during the proposed site work. The potentially unstable slopes

will be regraded to 3:1 or less.

Slope Stability

The slopes on the northern portions of the site have been identified as potentially unstable and unstable slopes on the Engineering Geology Map (Figure 6). Slope Stability Analysis has been performed on the site. Additional discussions concerning slope stability are presented in the following sections.

- *Potentially Unstable and Unstable Slopes*

  The steep to very steep slopes along Cottonwood Creek of the site have been identified as potentially unstable and unstable. A detention pond is proposed in the central portion of the site near some of the unstable and potentially unstable slopes. It is our understanding the proposed channel/drainage improvements will mitigate the potentially unstable and unstable slopes across the site. Fill slopes should be keyed into the toe of the slope and benched into the native subgrade. The finished grade should not exceed a 3:1. Typical stabilization could involve regrading the slope to 3:1, the use of soil cement stabilization, layered geo-grid systems, soil nails or tie-back. The proposed channel improvement project along Cottonwood Creek mitigates the unstable slope areas. Slope stabilization should be designed by a professional engineer for the global slope stability.

Debris Fans

Recent debris fan deposits were not observed on this site.

Subsidence

Based on review of a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 9), the site is not undermined. The closest underground mines in the area are 6 miles to the southwest and the area is not mapped within potential subsidence zones.

Groundwater

Groundwater was encountered in two of the test borings (Test Boring Nos. 1 and 4) at depths ranging from approximately 6.5 to 16.5 feet bgs, respectively. Water levels are indicated on the Test Boring Logs in Appendix B. Groundwater will affect construction of proposed drainage

improvements and roadway embankment. Unstable conditions will be encountered where excavations approach the groundwater level. Stabilization using shot rock or geogrids may be necessary.

Saturated, unstable, organic soil and channel debris will be encountered in the channel bottom. Saturated soils encountered should be expected in the creek bottom and will require removal during channel construction. Stabilization utilizing geogrid and/or shotrock may be required in unstable soils. Rock, if used, should be 4-12 inches and worked into the subgrade to develop a stable base. An alternative to shot rock would be to utilize a layered geogrid system with road base or gravel, over the unstable, saturated areas. The first layer of geogrid would be placed directly on the soft subgrade. The second layer of geogrid is typically placed after 12 to 18 inches of gravel is placed. The use of a gravel lower layer will help transmit water through the subgrade. Stabilization methods to be used should be evaluated during site grading.

Dewatering will be required during construction. Channel flow may be diverted using berms and temporary liners to either side of the channel as work progresses. Water can also be diverted into a sump area upstream in the channel and pumped around the construction area. High creek flows should be anticipated during or following precipitation events or increased seasonal flows.

Fluctuation in groundwater conditions will 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 bedrock. Contractors should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site.

Floodplain Areas

Areas north of the site along Cottonwood Creek have been mapped as floodplain zones according to FEMA Map No. 08041CO529G (Reference 10, Figure 9). The proposed improvements are located within and outside of the mapped floodplain. Shallow groundwater conditions should be anticipated along the floodplain areas. Exact floodplain locations and specific drainage studies are beyond the scope of this report.

Faults

The closest fault is the Rampart Range Fault, located approximately 9½ mile 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 Robert M. Kirkman and William P. Rogers, Bulletin 43 (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. According to the *Geologic Structure Map of Pueblo 1x2 Quadrangle, South-Central Colorado* (1978) (Reference 12), bedrock is gently dipping to the northeast. Mitigation for steeply dipping bedrock will not be required on this site.

7.0 RADIOACTIVITY

Radon levels for the area have been reported by the Colorado Geologic Survey in the open-file, Report No. 91-4 (Reference 14). Average radon levels of 2.28 pci/l have been measured in the area. The following is a table of radon levels in this area.

0 < 4 pci/l	75.00%
4 < 10 pci/l	25.00%
10 < 20 pci/l	0.00%
> 20 pci/l	0.00%

The potential for high radon levels is present for the site. Build-up of radon gas can usually 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.

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 re-established, 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 for 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 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

It is our opinion that the existing geologic and engineering geologic conditions will impose constraints on the proposed development and construction. The most significant issues affecting development will be that of the potentially unstable and unstable slopes along the creek channel. The potentially unstable and unstable slopes are to be regraded to slopes of 3:1 or less. Other constraints such as expansive soils, and artificial fill can be mitigated through proper engineering design and construction.

Areas of artificial fill exist on the site. The artificial fill is associated with fill piles, Tutt Boulevard roadway embankment, and drainage improvements. Any uncontrolled fill encountered will require penetration or removal and recompaction at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557.

The upper soils were encountered at loose to dense consistencies. It is anticipated that the site excavation will be moderate to difficult. Track-mounted equipment will likely be required due to the dense bedrock and steep to very steep site conditions. Recommendations are presented in the Subsurface Soil Investigation for the site (Reference 1). Potentially unstable and unstable slopes exist north of the site. These slopes are associated with the Cottonwood Creek drainage channel and will be significantly regraded to 3:1 or less slopes. The fill slopes should be keyed into the native material at the toe of the slope, and benched up the slope.

A floodplain exists along Cottonwood Creek immediately north of the site (Reference 10, Figure 9). The proposed structures are well above the physiographic floodplain level. (Figure 6). Exact floodplain locations and drainage studies are beyond the scope of this report. Finished floor levels must be a minimum of one foot above the floodplain level.

In summary, land use development and construction on the site is possible if the existing conditions are properly mitigated or avoided. It is anticipated the unstable and potentially unstable slopes will be regraded and stabilized as a part of the Cottonwood Creek channel improvements. Geologic conditions on-site can be satisfactorily mitigated by either avoidance or proper engineering design and construction practices.

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 on-site can be either avoided or mitigated using 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. Reporting such discrepancies to Entech Engineering, Inc. soon after they are discovered would be greatly appreciated and could possibly help avoid construction and development problems. Additional investigation for the building sites is recommended prior to site grading or construction. Planning and design personnel should be made familiar with the contents of this report.

This report has been prepared for City of Colorado Springs Stormwater Enterprise 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.

BIBLIOGRAPHY

1. Entech Engineering, Inc. April 3, 2018. *Subsurface Soil Investigation, Cottonwood Creek Embankment at Tutt Boulevard, Cowpoke Road and Tutt Boulevard, Colorado Springs, Colorado.* Entech Engineering Job No. 171943.

2. Natural Resource Conservation Service. September 23, 2016. *Web Soil Survey.* United States Department of Agriculture. http://websoilsurvery.sc.egov.usda.gov

3. United States Department of Agriculture Soil Conservation Service. June 1981. *Soil Survey of El Paso County Area, Colorado.*

4. Madole, Richard F., 2003. *Geologic Map of the Falcon NW Quadrangle, El Paso County, Colorado.* Colorado Geological Survey. Open-File Report 03-8.

5. Scott, Glen R. and Wobus, Reinhard A. 1973. *Reconnaissance Geologic Map of Colorado Springs and Vicinity.* Colorado U. S. Geological Survey. Map MF-482.

6. Trimble, Donald E. and Machette, Michael N. 1979. *Geologic Map of the Colorado Springs-Castle Rock area, Front Range Urban Corridor, Colorado.* U.S. Geological Survey Map I-847-F.

7. White, Jonathan, L. and Wait, T.C. 2003. *Map of Potential Areas of Landslide Susceptibility in Colorado Springs, El Paso County, Colorado.* Colorado Geological Survey. Map Series 42.

8. Dames and Moore. 1985. *Colorado Springs Subsidence Investigation.* State of Colorado Division of Mined Land Reclamation.

9. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for the City of Colorado Springs, Colorado.* Map Numbers 08041CO529G.

10. Kirkman, Robert M. and Rogers, William P. 1981. *Earthquake Potential in Colorado.* Colorado Geological Survey. Bulletin 43.

11. Scott, Glen R. Taylor, Richard B. Epis, Rudy C. and Wobus, Reinhard A. 1978. *Geologic Structure Map of the Pueblo 1x2 Quadrangle, South-Central Colorado.* U.S. Geologic Survey Map. 1-1022.

12. Himmelreich, John W. Jr. and Noe, David D. 1999. *Map of Areas Susceptible to Differential Heave in Expansive, Steeply Dipping Bedrock, City of Colorado Springs, Colorado.* Colorado Geological Survey. Map Series 32.

13. Colorado Geological Survey. 1991. *Results of the 1987-88 EPA Supported Radon Study in Colorado.* Open-file Report 91-4.

FIGURES

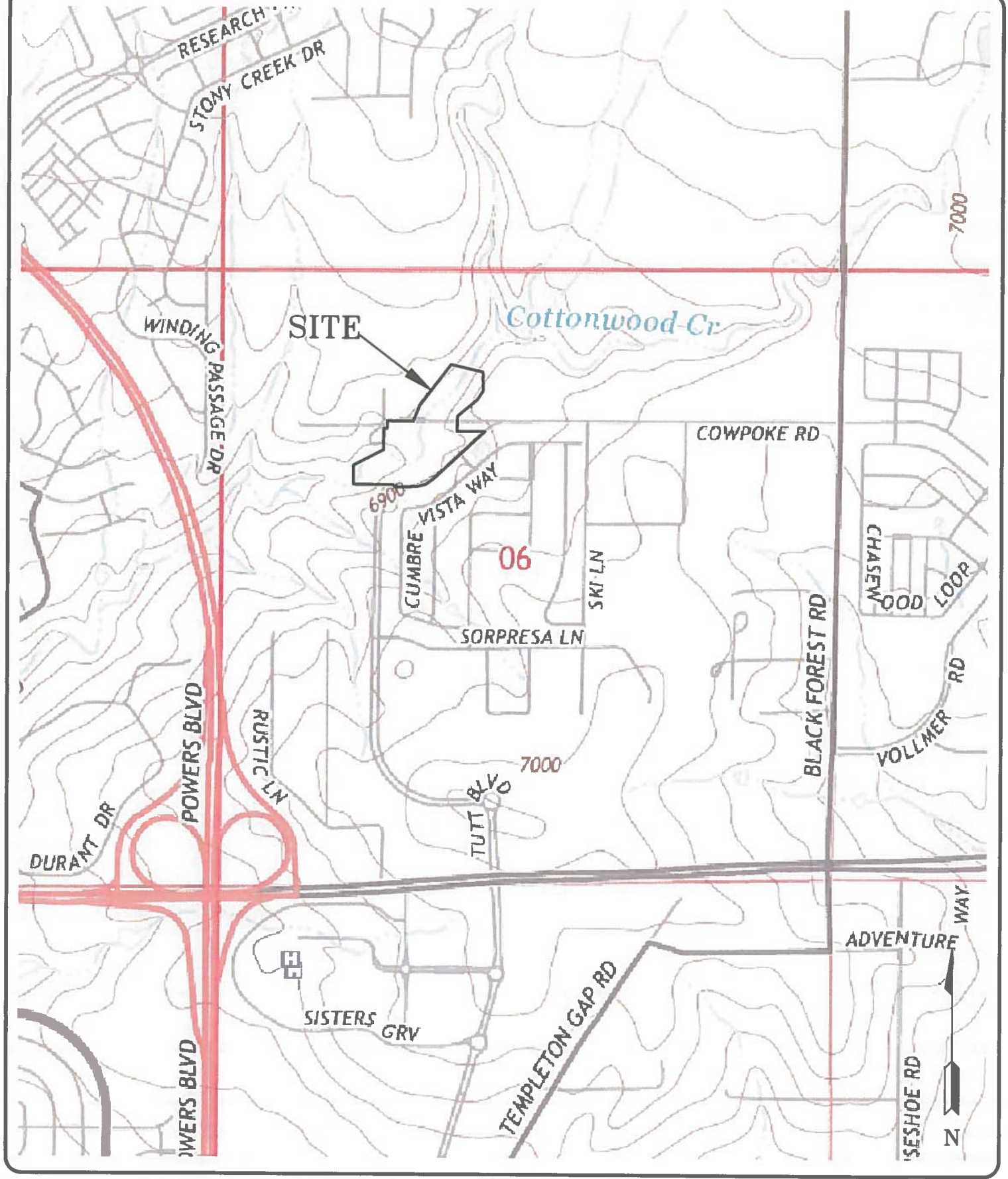
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS – STORMWATER ENTERPRISE

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/7/20		

JOB NO.: 200254

FIG NO.: 1



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

USGS MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS – STORMWATER ENTERPRISE

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/7/20		

JOB NO.: 200254

FIG NO.: 2

TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

P1 - APPROXIMATE PHOTOGRAPH LOCATION AND DIRECTION

REVISION	BY

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

SITE PLAN/TEST BORING LOCATION MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS - STORMWATER ENTERPRISE

DRAWN	LLL
CHECKED	
DATE	2/7/20
SCALE	AS SHOWN
JOB NO.	200254
FIGURE No.	3

TRAIL COORDINATE

PT.NO.	N	E	ELEV	DESCRIPTION
T101	8297.4464	24338.3605	6865.	TART CL
T102	8317.1931	24360.9791	6568 0	PC
T103	8402.7470	24507.7221	6873.3	PT
T104	8428.6332	24581.3777	6876 0	BEGIN UNDERPASS
T105	8475.0528	24713.4580	6879 5	END UNDERPASS
T106	8481.9829	24733.1767	6878 1	END UNDERPASS
T107	8514 6991	24779 3037	6875.8	TRAIL INTERSECTION
T108	8519.6690	24782 7338	6876.0	PT
T109	8568.0826	24816 1474	6878.0	PC
T110	8611.4919	24829 4169	6881.3	PT
T111	8501 8258	24797.9561	6873.0	PC
T112	8468.6491	24809 6902	6867.8	PT
T113	8448.4816	24803.7423	6867.0	E D TURN-AROUND

TRAIL CURVE DATA

T1 R=450.00 =21 76

T2 R=100 00 L=62 87' =36.02

T3 R=75 00' L=46 12'

T4 R=30 00' L=37 60' =71 82*

PROPOSED TUTT BLVD. RIGHT-OF-WAY

FOR STREET PLAN AND PROFILE, SEE TUTT BOULEVARD EXTENSION PLANS.

HUBERTO LOPEZ & BIANCA MAGELLIAN

RD. STA 11+52.65 =TRAIL STA 10+00 PEDESTRIAN UNDERPASS. FOR DETAILS, SEE SHEET 19.

CONSTRUCTION ACTIVITIES WITHIN THIS AREA ARE PROHIBITED.

20' CONSTRUCTION EASEMENT

FUTURE TRAIL(NIC)

STA 5+17.67 24.906° BEND

STA 3+97 50 45° BEND

STA 3+56.25 INV=44.0

OUTLET STRUCTURE SEE DETAILS SHT 13

STA 2+59.21 EL 39.0

VILLAGE CAPITAL CORP.

FUTURE TUTT BOULEVARD

10' D-10-R

5' D-10-R

15' D-10-R

EX 54" SD

EX 18" SD

EX GAS

PROP 4" GAS

TYPE BOX BASE MH

STA 7+17 INLET STRUCTURE. SEE PLAN SHT. 9

54" RCP

FOR PROFILE, SEE SHT. 14.

PROFILE STA 6+00 8' x 14' CBC FOR PROFILE SEE SHT. 7

TOW=82.0

TOW =91.0

TOW=78.0

TOW =89.0

OW =91.0

6' THICK GRAVEL MAINT. ACCESS. SEE DETAIL, SHT 21

30' R

MATCHLINE STA 11+00 SEE SHEET 6

STA 10+49 SILL OF DROP INV 6863.75

EX 42" RCP

TYPE 1 MH

42" RCP

FOR PROFILE SEE SHEET 8

CUT FF WALL @ OUTLET. SEE DETAIL SHEET 8.

CUMBRES VISTA WATER QUALITY BASIN

6881.6

TYPE I BOX BASE MH

COWPOKE ROAD

EX W

EX SS

EX GAS

MH

3:1 MAX

STA 8+60 CREST OF FLOW SPREADER SEE SHEET 10

FUTURE 6' SIDEWALK (NIC)

FOR WQ FACILITY PLANS & DETAILS, SEE SHT. 14.

WQ MAINT. ACCESS. SEE DETAIL SHEET 21.

CUMBRE VISTA NO.1

LEGEND

- STREAM CENTERLINE
- TYPE L SOIL/ RIPRAP
- TYPE M SOIL/RIPRAP
- SOIL CEMENT
- GROUTED BOULDERS

COTTONWOOD CREEK COORDINATES

PT.NO.	N	E	ELEV.	DESCRIPTION
P03	8212.3498	24416.0438	6839.0	BEGIN RIPRAP
P04	8281.1343	24441 2066	6844.0	STA 3+56 BEGIN CBC
P05	8318.7053	24454.9509	6845.56	STA 3+97 BEND CBC
P06	8369.4185	24564.1711	6850.22	STA 5+18 BEND CBC
P07	8369.4185	24763.5029	6858.0	STA 7+17 END CBC
P08	8369.4185	24805.2679	6860.5	PC
P09	8359.4164	24832.0542	-	RP FLOW SPREADER
P10	8404.4919	24897.9523	6862.3	CREST FLOW SPREADER
P11	8499.5285	24944.9181	6862.8	PT
P12	8635.4450	24954.5437	6866.2	PC

COTTONWOOD CREEK CURVE DATA

P01 R=140 00' L=210.13' =85.96"

P02 R=285 00' L=244 97' =42.25"

BID ITEM QUANTITIES FOR TYPE L SOIL/RIPRAP AND TYPE M SOIL/RIPRAP ARE BASED UPON SURFACE AREA (SY) SHOWN ON THIS DRAWINGS.

Computer File Information	
Creation Date:	By
Last Modification Date:	By
File Path	
Sheet Model Name.	
Microstation Ver.	

STATEMENT·

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGNER ENGINEER AS HAVING RESPONSIBILTY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.

SCALE FOR FULL SIZE (22"x34" SHEET)
HORIZ 1"=30' VERT N/A

Index of Revisions

No	Description	Date
1		
2		
3		
4		

COLORADO SPRINGS

Kiowa Engineering Corporation

Structure			
Designer:	RNW	Date:	10/31/2019
Sheet Subset			
Cadd:	EAK	Date:	10/31/2019
Subset Sheets			
Checker:	RNW	Date:	10/31/2019

100% BIDDING PLANS

COTTONWOOD CREEK STORMWATER DETENTION BASIN PR-2

DETENTION BASIN SITE PLAN

DRAINAGE BASIN: COTTONWOOD CREEK BASIN

JOB NO. 17043 SHEET 5 OF 24

FIGURE 4

LEGEND

STREAM CENTERLINE

TYPE L SOIL/ RIPRAP

TYPE M SOIL/RIPRAP

SOIL CEMENT

GROUTED BOULDERS

TRAIL COORDINATES

PT.NO.	N	E	ELEV.	DESCRIPTION
T200	8713.2553	24688.6614	6896.8	START TRAIL, FL TUTT
T201	8714.7594	24828.3046	6888.5	TRAIL INTERSECTION
T202	8715.0446	24854.7821	6886.7	PC
T203	8733.2413	24887.8881	6883.9	PT
T204	8861.0424	24970.9668	6887.3	PC
T205	8949.1855	25043.8713	6889.56	PT
T206	9023.7141	25121.4882	6893.0	END TRAIL

CURVE DATA

T5 R=40.00' L=39.34' Δ=56.36°

T6 R=800.00' L=114.64' Δ=13.14°

COTTONWOOD CREEK COORDINATES

PT.NO.	N	E	ELEV.	DESCRIPTION
P13	8645.3656	24955.4207	6868.25	CREST DROP
P14	8843.8128	25068.5018	6869.43	PT
P15	8882.6600	25120.6161	6874.5	CREST DROP
P16	8933.4601	25188.7655	6874.7	PC
P17	9000.6198	25259.9656	6875.5	END OF PROJECT

COTTONWOOD CREEK CURVE DATA

P03 R=576.78' L=100.08' Δ=9.94°

STA 15+00 END TRAIL 110' LT
END MSE WALL 112' LT
TOW=94.0
BOW=93.0

WENDY STREAM DRIVE

FOR TYPICAL CHANNEL SECTIONS, SEE SHEET 15.

COTTONWOOD CREEK

TOW=94.0
BOW=92.0

TOW=92.0
BOW=90.0

MSE RETAINING WALL
SEE SHEET 18

WESTBROOK FILING NO.3

PROPOSED TUTT BLVD. RIGHT-OF-WAY

PROPOSED FUTURE FLOW LINES

EX GAS

FUTURE TUTT BOULEVARD

3:1 MAX.

FUTURE TRAIL (MSC)

CUT OFF WALL AT OUTLET, SEE SHEET 8.
FOR PROFILE, SEE SHEET 8.
TYPE II MH

STA 16+00
END SOIL/RIPRAP
INV. 6975.5

TOW=90.0
BOW=86.0

FUTURE
12' MULTI-PURPOSE
TRAIL, SEE SHT. 20
FOR DETAILS.

STA 11+63 124' LT
BEGIN MSE WALL
TOW=89.0
BOW=88.0

STA 14+15 CREST OF DROP
EL=74.5

EX 24" SD
TO REMAIN

EXISTING WATER
QUALITY BASIN.

REMINGTON AT
WOLF RANCH
FILING NO.2

CITY STD. DRIVEWAY.
SEE DETAIL SHT. 18

GRAVEL MAINTENANCE
ACCESS. SEE DETAIL SHT 21

STA 13+40 SILL OF DROP
EL=69.48

OLD COWPOKE ROAD
RIGHT-OF-WAY TO BE VACATED

EX 2" GAS

EX 2" GAS

PROP 4" GAS

STA 11+13 CREST OF DROP
EL=68.25

PROPOSED TUTT
BLVD. RIGHT-OF-WAY

MATCH SHEET 5

BID ITEM QUANTITIES FOR TYPE L SOIL/RIPRAP AND TYPE M SOIL/RIPRAP ARE BASED UPON SURFACE AREA (SY) SHOWN ON THIS DRAWINGS.

GRAPHIC SCALE
30 0 15 30
(IN FEET)
1 inch = 30 ft

Computer File Information	
Creation Date:	By:
Last Modification Date:	By:
File Path	
Sheet Model Name:	
Microstation Ver	

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGNER ENGINEER AS HAVING RESPONSIBILTY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.

SCALE: FOR FULL SIZE (22"x34" SHEET)
HORIZ.: 1"=30' VERT.: N/A

Index of Revisions

No.	Description	Date
1		
2		
3		
4		

COLORADO SPRINGS

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

Structure	Designer: RNW	Date:	10/31/2019
Sheet Subset	Cadd: EAK	Date:	10/31/2019
Subset Sheets	Checker: RNW	Date:	10/31/2019

100% BIDDING PLANS

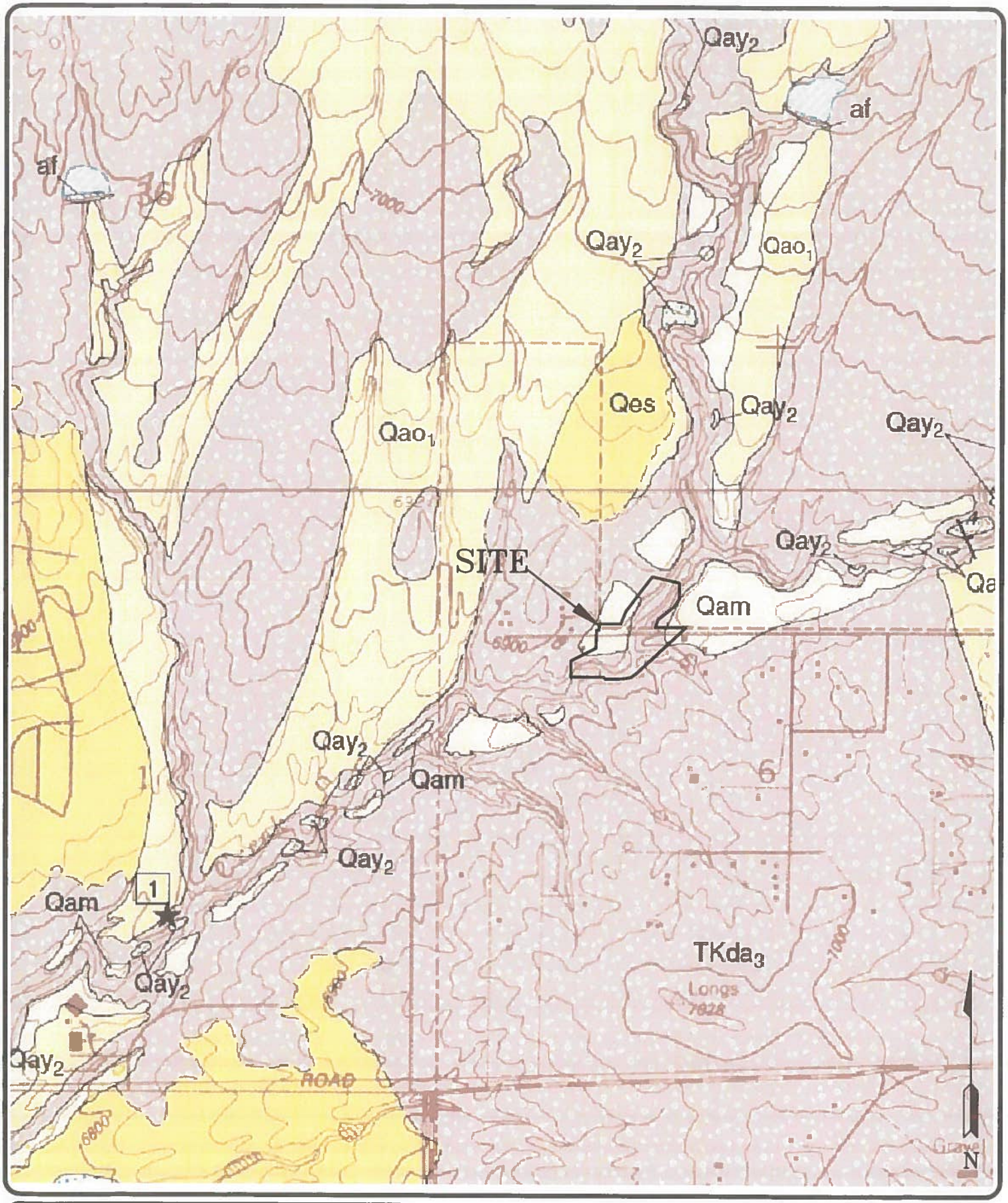
COTTONWOOD CREEK STORMWATER DETENTION BASIN PR-2

DETENTION BASIN SITE PLAN

DRAINAGE BASIN: COTTONWOOD CREEK BASIN

JOB NO. 17043 SHEET 6 OF 24

FIGURE 5



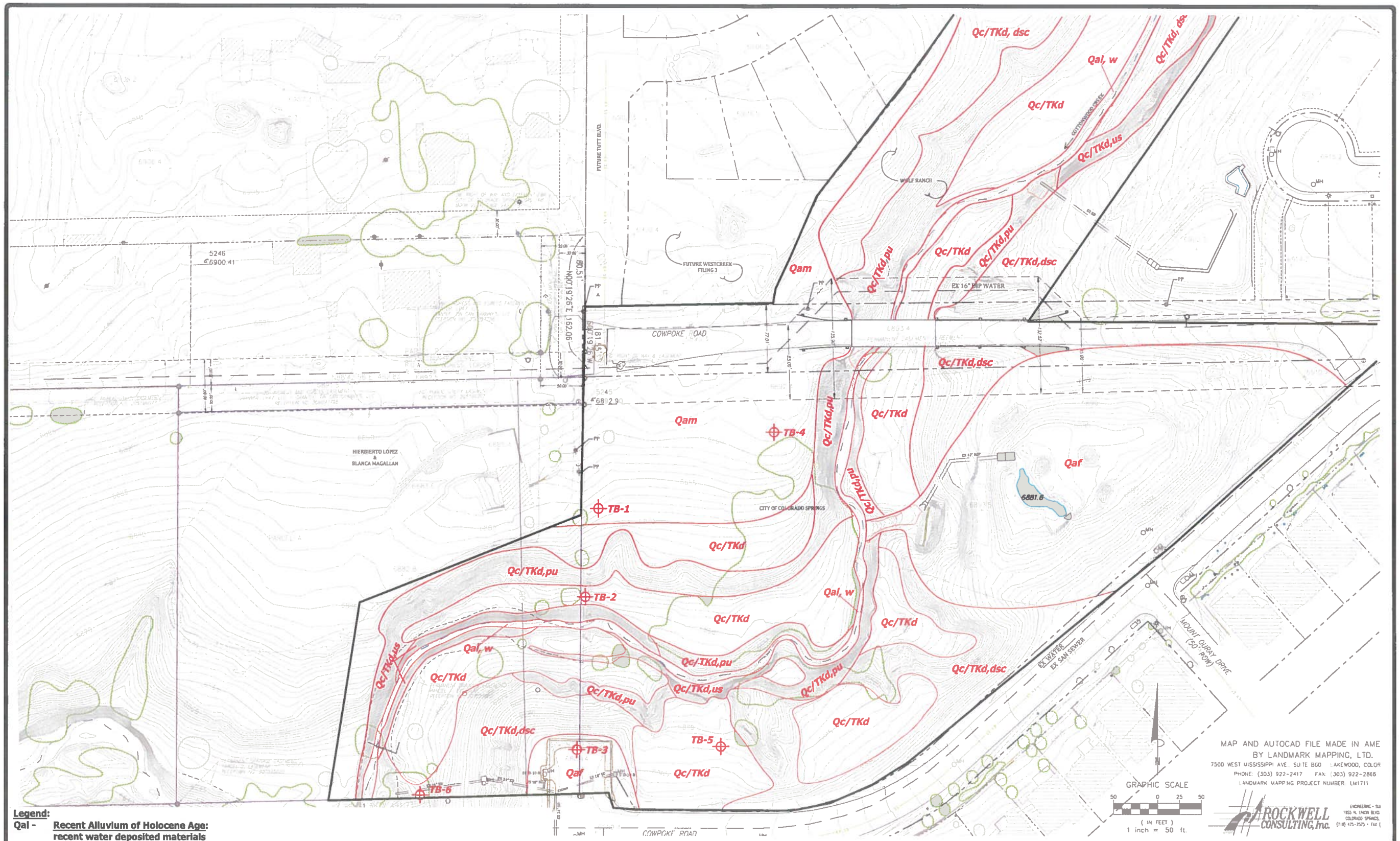
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

FALCON NW QUADRANGLE GEOLOGIC MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS – STORMWATER ENTERPRISE

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/7/20		

JOB NO.: 200254

FIG NO.: 6



Legend:

Qal - **Recent Alluvium of Holocene Age:**
recent water deposited materials

Qaf - **Artificial Fill Deposits of Holocene Age:**
man-made fill deposits

Qam - **Middle Alluvium of Holocene to Pleistocene Age:**
stream terrace desposited sands with possible silt, clay and cobble lenses

Qc/TKd - **Colluvium of Quaternary Age Overlying Dawson Formation Facies unit five of Tertiary to Cretaceous Age:**
sheetwash and residual soil deposits overlying arkosic sandstone with interbedded siltsone and claystone

dsc - downslope creep
pu- potentitially unstable slopes
us- unstable slopes
w- flowing water
⊕ - approximate test boring location

REVISION	BY

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907
(719) 531-5599

GEOLOGY/ENGINEERING GEOLOGY MAP
THE CREEK AT COTTONWOOD APARTMENTS
LOT 1, POWERWOOD FILING NO. 2
COLORADO SPRINGS, CO.
FOR: VILLAGE CAPITAL GROUP

DRAWN	LLL
CHECKED	
DATE	4/16/18
SCALE	AS SHOWN
JOB NO.	180545
FIGURE No.	7

SHADED AREAS INDICATE AREAS MAPPED AS SUSCEPTIBLE TO LANDSLIDES

N

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

LANDSLIDE SUSCEPTIBILITY MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS – STORMWATER ENTERPRISE

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/7/20		

JOB NO.: 200254

FIG NO.: 8

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

FLOODPLAIN MAP
TUTT BOULEVARD AT COTTONWOOD CREEK
COLORADO SPRINGS, CO.
FOR: CITY OF COLORADO SPRINGS – STORMWATER ENTERPRISE

DRAWN:	DATE:	CHECKED:	DATE:
LLL	2/7/20		

JOB NO.: 200254

FIG NO.: 9

APPENDIX A: Site Photographs

1

Looking north from the eastern portion of the site.

February 3, 2020

2

Looking west from eastern portion of the site.

February 3, 2020

Job No. 200254

3

Looking north along Cottonwood Creek in the central portion of the site.

February 3, 2020

4

Looking west along Cottonwood Creek in the central portion of the site.

February 3, 2020

Job No. 200254

5

Looking east along Cottonwood Creek along the unstable slopes.

February 3, 2020

6

Looking east the western portion of the site.

February 3, 2020

Job No. 200254

APPENDIX B: Test Boring Logs & Summary of Laboratory Test Results, Entech Job No. 171943

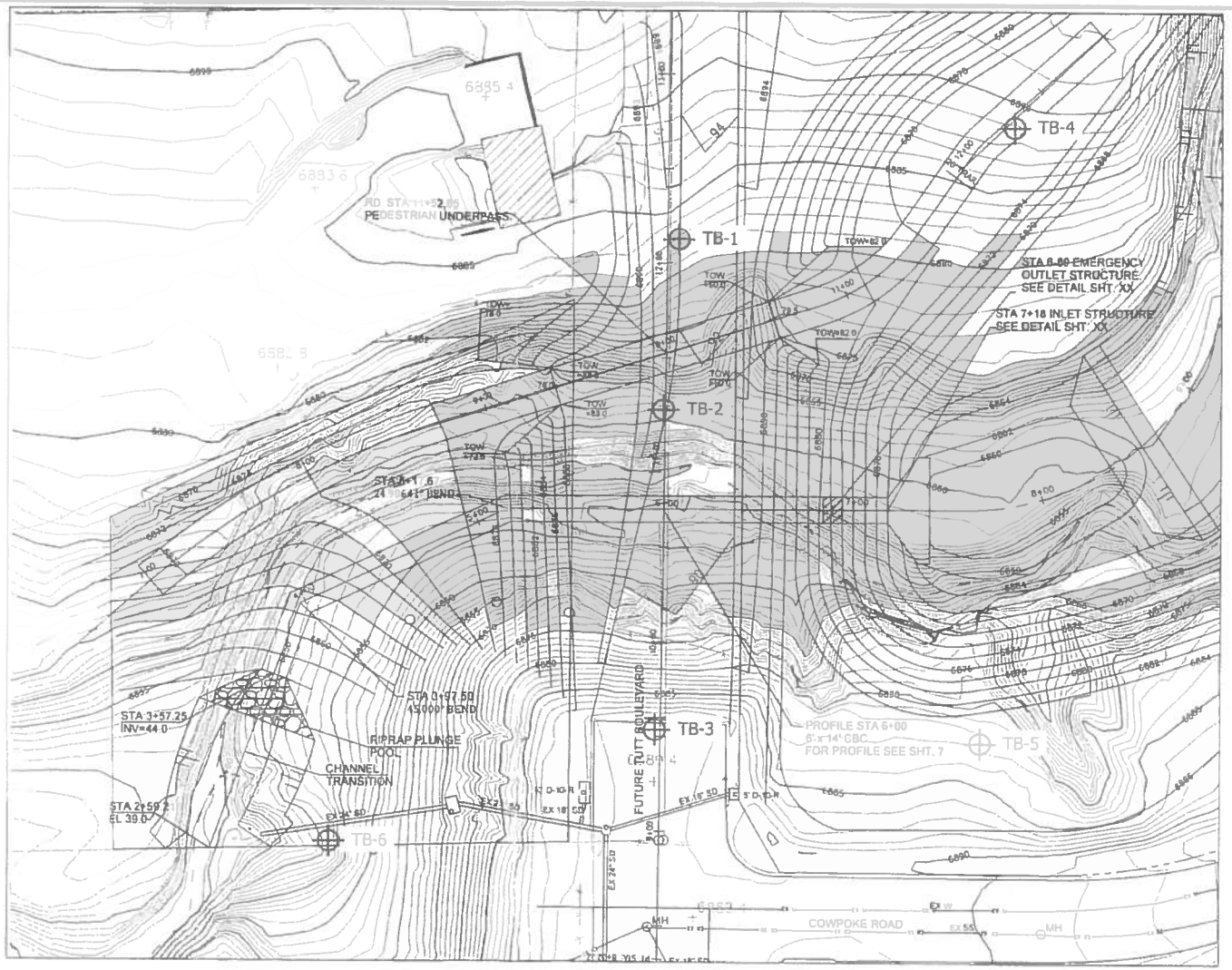
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT KIOWA ENGINEERING
PROJECT EMBANKMENT AT TUTT BLVD.
JOB NO. 171943

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	6	2-3			23.4	29	12				SC	SAND, CLAYEY
2	1	2-3	21.9	105.4	97.2	59	33			0.6	CH	CLAY, SANDY
2	3	2-3	16.9	98.2	85.8	44	27	<0.01		3.3	CL	CLAY, SANDY
2	4	5			99.3				2270		CL	CLAY, SANDY
2	5	5	23.1	94.5	98.5			<0.01		2.0	CL	CLAY, SANDY
3	2	10			23.4	NV	NP				SM	SANDSTONE, SILTY
3	6	10			27.2			<0.01			SM	SANDSTONE, SILTY
4	3	15	26.1	99.9	98.4	50	25	<0.01		2.6	CH	CLAYSTONE
4	5	15	18.8	103.1	84.1					2.3	CL	CLAYSTONE, SANDY

VICINITY MAP
N.T.S.



TEST BORING MAP
N.T.S.

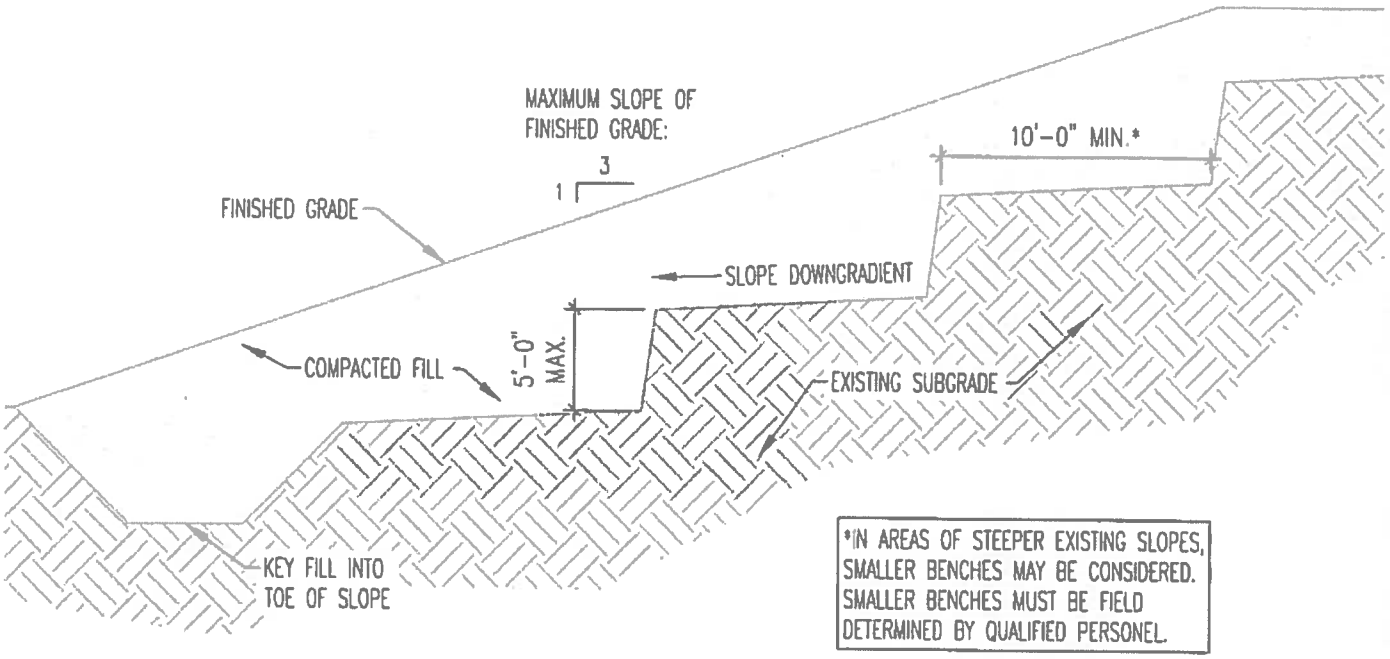
TB-2- APPROXIMATE TEST BORING LOCATION AND NUMBER

REVISION	BY

ENTECH ENGINEERING, INC.
565 ELKTON DRIVE, COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY/TEST BORING MAP
COTTONWOOD CREEK
EMBANKMENT @ TUTT BOULEVARD
COLORADO SPRINGS, CO.
FOR: KIOWA ENGINEERING, INC.

DESIGN AMN
CHECKED AMN
DRAWN
01/05/17
SCALE AS SHOWN
JOB NO 171043
FIGURE No. 1



EMBANKMENT BENCH CROSS-SECTION

N.T.S.

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

EMBANKMENT BENCH CROSS-SECTION
COTTONWOOD CREEK EMBANKMENT @ TUTT BLVD
COLORADO SPRINGS, CO
FOR: KIOWA ENGINEERING

DRAWN BY:	DATE DRAWN:	DESIGNED BY:	CHECKED:
AMN	3/29/18	AMN	

JOB NO.: 171943

FIG. NO.: 2

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 12/15/2017
Job # 171943

REMARKS

WATER @ 6.5', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			19	32.4	2	CLAY, SANDY, GRAY BROWN, STIFF TO VERY STIFF, VERY MOIST
5			30	20.0	2	
10			20	32.0	2	
15			50/7"	16.3	4	CLAYSTONE, VERY SILTY, SANDY, BLUE GRAY, HARD, MOIST
20						

TEST BORING NO. 2
DATE DRILLED 12/15/2017
CLIENT KIOWA ENGINEERING
LOCATION EMBANKMENT AT TUTT BLVD.

REMARKS

DRY TO 14', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			21	23.8	2	CLAY, SANDY, GRAY BROWN, STIFF, MOIST
5			50	20.7	4	CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST
10			50/7"	16.5	3	SANDSTONE, SILTY, FINE GRAINED, BLUE GRAY, VERY DENSE, MOIST
15			50/6"	11.5	3	
20						

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

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			1/5/18

JOB NO.: 171943
FIG NO.: A- 1

TEST BORING NO. 3
DATE DRILLED 12/15/2017
Job # 171943

REMARKS

DRY TO 19', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			20	15.5	1A	FILL 0-4', CLAY, SANDY, BROWN, STIFF, MOIST
5			31	22.5	2	CLAY, SANDY, DARK BROWN, VERY STIFF, MOIST
10			22	8.5	1	SAND, CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST
15			50/10"	24.9	4	CLAYSTONE, BROWN TO BLUE GRAY, HARD, MOIST
20			50/7"	22.3	4	

TEST BORING NO. 4
DATE DRILLED 12/15/2017
CLIENT KIOWA ENGINEERING
LOCATION EMBANKMENT AT TUTT BLVD.

REMARKS

WATER @ 16.5', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
					1	SAND, SILTY, BROWN
			10	27.0	2	CLAY, SANDY, GRAY BROWN, FIRM TO VERY STIFF, MOIST
5			27	23.1	2	
10			41	18.1	2	
15			40	21.2	2	
					3	SANDSTONE, SILTY, BROWN
20			50/9"	21.5	4	CLAYSTONE, SANDY, BLUE GRAY, HARD, MOIST

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

TEST BORING LOG

DRAWN	DATE.	CHECKED:	DATE.
		JW	2-6-18

JOB NO 171943
FIG NO A- 2

TEST BORING NO. 5
DATE DRILLED 12/15/2017
Job # 171943

REMARKS

DRY TO 14', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			25	27.6	2
5			33	26.4	2
10			42	18.3	2
15			50 10"	22.2	4
20					

CLAY, SANDY, BROWN, STIFF TO VERY STIFF, MOIST

CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST

TEST BORING NO. 6
DATE DRILLED 12/15/2017
CLIENT KIOWA ENGINEERING
LOCATION EMBANKMENT AT TUTT BLVD.

REMARKS

DRY TO 15', 12/18/17

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			22	10.7	1
5			20	12.0	1
10			50	14.2	3
15			50 7"	12.8	3
20					

SAND, CLAYEY, FINE GRAINED, GRAY BROWN, MEDIUM DENSE, MOIST

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

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

TEST BORING LOG

DRAWN:	DATE	CHECKED: AV	DATE: 2-6-18

JOB NO: 171943
FIG NO: A- 3