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SOIL AND GEOLOGY STUDY
FALCON HIGHLANDS
WOODMAN ROAD AND TAMLIN ROAD
EL PASO COUNTY, COLORADO

Prepared for

Realty Development Services
P.O. Box 1538
Colorado Springs, Colorado 80901

Attn: Joe Grossi

December 21, 2001
Revised January 24, 2002

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Kristen A. Andrew-Hoeser
Professional Engineering Geologist

KAH/ek

Encl.

Entech Job No. 39431
2MSW/rep/2001/39431sgws Rev

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

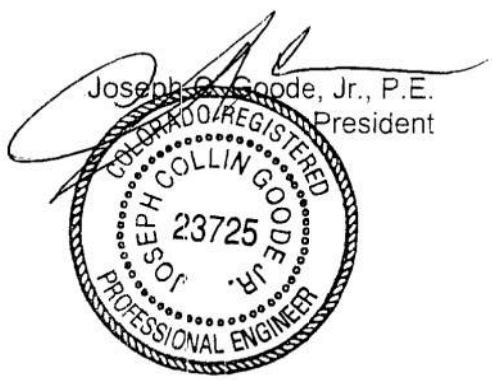

TABLE OF CONTENTS

1.0 SUMMARY

Project Location

The project lies in a portion a of Section 12, Township 13 South, Range 65 West, in El Paso County, Colorado. The site is south of Woodmen Road and west of Meridian Road and Tamlin Road, northwest of Falcon, Colorado.

Project Description

Total acreage involved in the development is approximately 400 acres. It is our understanding that the development is to consist of approximately 532 residential lots ranging from 8,000 square feet to 37,000 square feet in size. A school site and open space are also proposed. We also understand that the development will utilize a central water and sewer system with Woodmen Hills Metropolitan District.

Scope of Report

This report is intended to present a geologic investigation and treatment of engineering geologic hazards.

Land Use and Engineering Geology

This site was found to have hazards associated with shallow groundwater, surface waters and a floodplain which will impose constraints on development and land use. Shallow groundwater will result in constraints with respect to depth of excavation. Other hazards include hydrocompaction, expansive soils, and artificial fill. These conditions will be discussed in greater detail in Section 5.3 of this report.

It is our opinion that the proposed development can be completed if the groundwater and surface drainage are properly mitigated. If the recommended mitigation techniques are followed, groundwater problems after development will be minimal. 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 Section 12, Township 13 South, Range 65 West, in El Paso County, Colorado. The site is located south of Woodmen Road and west of Tamlin Road, northwest of Falcon, Colorado. The approximate boundaries of the site are as shown on the Vicinity Map, Figure 1.

The topography of the site is gently sloping over the majority of the site. The major drainages on-site trend in southerly to southeasterly directions. No water was observed flowing in any of the drainages on site at the time of this investigation, however, evidence of periodic shallow water was observed in the vegetation and surface soils. The boundaries of the site are shown on the USGS map, Figure 2. Previous land uses have been agricultural as the area has been primarily used as grazing and pasture land. The site contains primarily low grasses over the entire site. A few scattered trees were observed on the small property east of Tamlin Road. Site photographs are included in Appendix C. The approximate locations and directions of the photographs are indicated on the Geology Map, Figure 9.

Total acreage involved in the proposed development is approximately 400 acres. It is our understanding that the proposed development will consist of approximately 532 single family residential lots ranging in size from 8,000 to 37,000 square feet. Open space and a school are also proposed. The Development Plan is presented in Figure 3. The area will be serviced by central water and sewer system with Woodmen Hills Metropolitan District.

3.0 SCOPE OF THE REPORT

The scope of this report will include the following:

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

4.0 FIELD INVESTIGATION

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

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

A subsurface investigation was performed as part of the field investigation. This investigation consisted of drilling 22 test borings. The borings were drilled with a power driven continuous flight auger drill rig to depths of 15 and 20 feet. Samples were obtained during drilling using the Standard Penetration Test, ASTM D-1586, utilizing a 2-inch O.D. Split Barrel Sampler and a California Sampler. Results of the penetration tests are shown on the drilling logs to the right of the sampling point. The drilling logs are included in Appendix A of this report. The locations of the test borings are shown on the Development Plan (Figure 3), the Geology Map (Figure 9) and the Depth to Bedrock Map (Figure 10).

Laboratory testing was performed to classify and determine soils engineering characteristics. Laboratory tests include moisture content, ASTM D-2216, grain size analysis, ASTM D-422, and Atterberg Limits, ASTMD-4318. Swell tests include FHA swell testing and Denver Swell/Consolidation Testing. Results of the laboratory testing are included in Appendix B. A Summary of Laboratory Test Results is presented in Table 1.

Reports by others performed on this site include a Master Development Drainage Plan and Preliminary Drainage Report by URS, dated July 13, 2001 (Reference 1), a Drainage Basin Planning Study for the Falcon Area by URS, dated December 15, 2000 (Reference 2), and a Wetlands Delineation Study by K-S and Company, dated August 3, 2000 (Reference 3). Other investigations done in the area of the site have included a Soil and Geology Study performed for Falcon Vista Subdivision south of the site by Entech Engineering, Inc. (Reference 4). These investigations were used in evaluating this 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 15 miles or so to the west is a major structural feature known as the Rampart Range Fault, marking 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 very gently dipping in a northerly direction. The rocks in the area of the site are sedimentary in nature, and typically Tertiary to Upper Cretaceous in age. The bedrock underlying the site itself are the Dawson-Denver formations. Overlying these formations are unconsolidated deposits of alluvium, eolian, man-made and residual soils. The site's stratigraphy will be discussed in more detail in the following section.

5.2 Soil Conservation Service

The Soil Conservation Service has mapped 3 soil types on the site (Figure 4)(Reference 5). In general, they are fairly similar ranging from loamy sand to sandy loam. Soils are described as follows:

Type	Description
8	Blakeland loamy sand, 1-9% slopes
9	Blakeland Complex loamy sand, 4-9% slopes
19	Columbine gravelly sandy loam, 0-3% slopes

Complete descriptions of each soil type are presented in Figures 5 through 7. The soils have generally been described to have rapid to very rapid permeabilities. All the types have been described by the Soil Conservation Service to provide good support for home sites. The potential for flooding is present in some areas on Soil Type 19. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have slight to moderate erosion hazards with the hazard of soil blowing severe.

5.3 Site Stratigraphy

Five mappable units were identified on this site which, from youngest to oldest, are identified as follows:

- **Qaf** **Artificial Fill of Holocene Age:** These are man-made fill deposits associated with erosion berms on-site

- **Qal** **Recent Alluvium of Holocene Age:** These are recent stream deposits associated with some of the drainages on-site.

- **Qp** **Piney Creek Alluvium of Holocene Age:** This material is a water deposit alluvium, typically classified as a silty to well-graded sand, brown to dark brown in color and of moderate density. The Piney Creek Alluvium can sometimes be very highly stratified containing thin layers of very silty and clayey soil.

- **Qes** **Eolian Sand of Quaternary Age:** These deposits are medium to fine grained soil deposited on the site by the action of the prevailing winds from the west and northwest. They typically occur as large dune deposits or narrow ridges. These soil types are typically tan to brown in color, and tend to have a very uniform or well sorted gradation. These materials tend to have a relatively high permeability and low density.

- **TKd** **Dawson-Denver Formations of Tertiary to Cretaceous Age (undifferentiated): These** formations typically consist of Arkosic Sandstone with interbedded fine grained sandstone, siltstone and claystone. The bedrock encountered in the test borings consisted of gray sandy claystone and some clayey sandstone. Overlying this formation is a variable layer of residual soil derived from the in-situ weathering of the bedrock on site. The clays and claystones are typically expansive.

The formations listed above were mapped from field reconnaissance, the test borings drilled on site, and the Geologic Map of the Pueblo 1x2 Quadrangle, South-Central Colorado, distributed by the USGS in 1979 (Reference 6). (Figure 8) These deposits were difficult to differentiate in the field during the course of our investigation; therefore, locations and boundaries are approximate, as shown on the Geology Map, Figure 9.

5.4 Soil Conditions

The soils encountered in the test borings consisted of slightly silty to silty and clayey sand (SW-SM, SM, SC), silt (ML), and clay (CL), overlying claystone (CL, CH), and slightly silty to clayey sandstone (SW-SM, SC). The upper soils were encountered at loose to dense states and moist to wet conditions. The clayey soils and claystone are slightly to very highly expansive. An FHA swell pressure of 1515 psf was measured in the clayey silts. A Denver Swell of 0.1% was measured on the clays. An FHA Swell pressure of 574 psf and a Denver Swell of 0.1% were measure on the clayey sands. An FHA Swell pressure of 933 psf and a Denver Swell of 2.0% were measured on the clayey sandstone. FHA Swell pressures of 1563 psf, 1970 psf and 3939 psf were measured on the claystone. Denver Swells of 1.2% and 6.3% were measured on the claystone. Bedrock was encountered at depths ranging from 1 to greater than 15 feet in the test borings. A Summary of Laboratory Test Results is presented in Table 1. The Depth to Bedrock and Groundwater is shown on Table 2. A Depth to Bedrock Map is presented in Figure 10.

5.5 Groundwater

Groundwater was encountered at depths ranging from 3 feet to 13 feet in many of the test borings. Groundwater was encountered at depths shallower than 10 feet in Test Boring Nos. 2, 3, 5, 7, 13, 14, 15, 16, and 20. Groundwater was not encountered in Test Boring Nos. 6, 9, 10, 11, 12, 18, 21 and 22 during or subsequent to drilling which were drilled to 15 feet. A table showing the depth to groundwater is presented in Table 2.

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

6.0 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

As mentioned previously, mapping has been performed on this site to produce an Engineering Geology Map (Figure 9). This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. These geologic conditions and the recommended mitigation techniques are as follows:

sw *Seasonal High Groundwater Area*

In these areas, we would anticipate periodically high subsurface moisture conditions and frost heave potential. The Engineering Geology Map shows areas with high groundwater conditions during our investigation. Seepage areas on the north side of the site are also indicated.

Mitigation: In these locations, shallow foundations are recommended. Foundations must have a minimum 30-inch depth for frost protection. This recommendation applies to residential as well as commercial development. In areas where high subsurface moisture conditions are anticipated periodically, subsurface perimeter drains and underslab drains or capillary breaks may be necessary to dewater the excavation. Drain details are presented in Figures 11 and 12. Basements or useable areas located below grade are not recommended. It may be desirable on some lots to build up the building area to raise the foundation further above the groundwater level. Any grading in these areas should be done to direct surface flow around construction to avoid areas of ponded water. Further investigation will be necessary to determine the goundwater depth at each individual building site. Some areas along the northern portions of the site appear to be caused from seepage, possibly at the Dawson-Denver Contact (Reference 3). Areas of shallow groundwater are also indicated by the dark areas on the aerial photograph of the site (Figure 13). Areas of perched water are also possible across much of the site due to permeable sands associated eolian sands overlying impermeable claystones. Some dewatering may be necessary on the site.

psw *Potentially seasonal High Groundwater Area*

In these areas, we would anticipate the potential for periodic high subsurface moisture conditions and frost heave potential. These areas did not indicate the yearly presence of shallow groundwater as the seasonal high groundwater areas did, however, based on

topography, site conditions or groundwater measured in the test borings. These areas were mapped as having the potential for high groundwater during high moisture periods or years. The same mitigation recommendations for Seasonal High Groundwater areas apply to these Potentially Seasonal High Groundwater areas. Further investigation of each building site may be necessary to delineate the depth to groundwater. Groundwater may be at sufficient depth to not affect shallow foundations in these areas.

fp *Floodplain*

Portions of the site lie within a floodplain zone according to the FIRM Map No. 08041CO575F, dated March 17, 1997 (Figure 14)(Reference 7). The approximate FEMA floodplain boundaries are also indicated on the Engineering Geology Map, Figure 9. The FEMA floodplain boundaries do not follow existing drainages and proposed development of the site includes channelizing the floodplain (Reference 1). It is our understanding a Conditional Letter of Map Revision (CLOMR) is to be submitted for the site. The exact location of the floodplain will be required prior to development. Exact locations of floodplain and specific drainage studies are beyond the scope of this report. Those areas that currently lie within the FEMA floodplain area will require approval of the Drainage Basin Report prior to construction. Finished floor levels must be located a minimum of one foot above floodplain levels.

af *Artificial Fill*

These are man-made fill deposits associated with small erosion berms on site.

Mitigation: Small erosion berms could be penetrated by foundations. Should any uncontrolled fill be encountered beneath foundations, removal and recompaction at 90% of Modified Proctor Dry Density, ASTM D-1557 will be required.

ex *Expansive Soils*

Expansive soils were encountered in some of the test borings drilled on site. The expansive soils are highly sporadic, therefore, none have been indicated on the map. Additionally, expansive claystones were encountered at depths that may affect foundations on site. The soils are slightly to very highly expansive and can cause differential movement in the structure foundations.

Mitigation: Should expansive soils be encountered within 3 feet below the foundation, mitigation will be necessary. Mitigation of expansive soils may include overexcavation and replacement with non-expansive structural fill at 90% of Modified Proctor Dry Density, ASTM D-1557. Drilled pier foundation systems are another option in areas of highly expansive soils. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement with compacted non-expansive soils has been successful in minimizing slab movements. Final recommendations should be determined after additional investigation of each building site.

Hydrocompaction: Areas in which this hazard has been identified are acceptable as building sites. However, in areas identified for this hazard classification, we anticipate a potential for settlement movements upon saturation of these surficial soils. The low density, uniform grain sized, windblown sand deposits are particularly susceptible to this type of phenomenon.

Mitigation: The potential for settlement movement is directly related to saturation of the soils below the foundation areas. Therefore, good surface and subsurface drainage is extremely critical in these areas in order to minimize the potential for saturation of these soils. The ground surface around all permanent structures should be positively sloped away from the structure to all points, and water must not be allowed to stand or pond anywhere on the site. We recommend that the ground surface within 10 feet of the structures be sloped away with a minimum gradient of five percent. If this is not possible on the upslope side of the structures, then a well-defined swale should be created to intercept the surface water and carry it quickly and safely around and away from the structures. Roof drains should be made to discharge well away from the structures and into areas of positive drainage. Where several structures are involved, the overall drainage design should be such that water directed away from one structure is not directed against an adjacent building. Planting and watering in the immediate vicinity of the structures, as well as general lawn irrigation, should be minimized.

Areas of loose soils may also be encountered in these areas. Should loose soils be encountered beneath foundations, recompaction of the upper 2 feet of soil at 90% of Modified Proctor Dry Density, ASTM D-1557 may be required.

It should be noted that periodic shallow groundwater is anticipated across much of the site. Minimal excavation is recommended for the site. A minimum 30-inch depth is recommended for frost protection; however, deeper (basements) excavations are not recommended. Excavation depths can be reduced by building or filling the areas around the houses to provide frost protection. Unstable soil conditions will be encountered where groundwater is present. Some dewatering and soil stabilization of the excavation using shot rock or geofabric may be necessary. Builders should be cognizant of the potential for the occurrence of subsurface water during construction on-site. Installation of utilities will likely require trench stabilization.

6.1 Relevance of Geologic Conditions to Land Use Planning

As mentioned earlier in this report, the development will be primarily residential with school and open space areas. The existing geologic and engineering geologic conditions will impose constraints on some development and construction. The most significant problems affecting development will be those associated with shallow groundwater and surface drainage on site. Basements or useable areas below grade are not recommended for areas with shallow water. Site grading may allow for basement construction. Soil stabilization will likely be required where groundwater is encountered in excavations and utility trenches. Building elevations should be kept as high as possible with the ground surface positively slopes away from the structure at all points. Dewatering of some of the building sites may be necessary.

Soil susceptible to erosion will also require consideration during development. Erosion problems are extremely common throughout the region and may be satisfactorily mitigated through proper engineering design and construction of drainage systems.

Floodplain determination is beyond the scope of this report. Channelization of the floodplain has been proposed. Some areas may require approval of the Drainage Report that excludes them from the FEMA floodplain prior to construction. The potential exists for seasonally high subsurface moisture conditions across much of the site. The proposed drainage channel on the east side of the site will help to control and lower groundwater conditions. Areas of groundwater seepage on the northern portions of the site may require drainage systems in order to dewater the area.

The soils were encountered at loose to dense states. Spread footing foundations are anticipated for the site. Areas of loose soils may require recompaction of the upper 2 feet of soil. Expansive layers may also be encountered in the soil and bedrock on this site. These areas are sporadic, therefore no areas were indicated on the maps. Expansive soils, if encountered, will require special foundation design. These soils will not prohibit development.

Areas of hydrocompaction are associated with the eolian sand deposits on site. The potential for settlement due to saturation of the soils exists in these areas. Good surface and subsurface drainage is required in these areas in order to minimize the potential for saturation of these soils.

In summary, the soils will provide suitable support for shallow foundations on site. Groundwater and surface drainage will affect construction on the site. Stabilization of soils will likely be required where groundwater is encountered in the excavations.

7.0 ECONOMIC MINERAL RESOURCES

Some of the sand associated with the eolian and alluvial materials on-site could be considered a low grade sand resource. According to the Aggregate Resource Maps, the site is mapped as upland deposits (Reference 8). Considering the silty nature of these soils and the relative abundance of similar materials throughout the region, they would be considered to have little significance as an economic resource.

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 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 revegetation 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 revegetate 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 CLOSURE

It is our opinion that constraints associated with shallow groundwater and drainage will be imposed on development and construction of the site. Shallow foundations are recommended for the site. Basements are not recommended on much of the site in its present grade. Site grading may allow for basements in some areas, should they be raised high enough above the groundwater level.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and nonhomogeneous 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. Individual investigations for building sites will be required prior to construction. Construction and design personnel should be made familiar with the contents 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.

This report has been prepared for Realty Development Services 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 that this report has provided you with all the information that 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 REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS
JOB NO. 39431

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	TB20	9-10'		40	12	1515		ML	SILT, CLAYEY
2	TB3	2-3'	7.6%	NV	NP			SW-SM	SAND, SLIGHTLY SILTY
2	TB6	2-5'	27.7%	26	11	574		SC	SAND, CLAYEY, SILTY
2	TB7	10'	26.4%	27	14			SC	SAND, CLAYEY
2	TB7	10'					0.1%	SC	SAND, CLAYEY
2	TB13	2-3'	16.8%	NV	NP			SM	SAND, SILTY
2	TB16	2-3'	33.3%	21	1			SM	SAND, VERY SILTY
2	TB20	2-3'	9.0%	NV	NP			SP-SM	SAND, SLIGHTLY SILTY
3	TB19	9'					0.1%	CL	CLAY, SANDY
4	TB9	2-3'	47.2%			933		SC	SANDSTONE, VERY CLAYEY
4	TB9	2-3'					2.0%	SC	SANDSTONE, VERY CLAYEY
4	TB13	15'	11.4%	27	1			SW-SM	SANDSTONE, SILTY
5	TB1	15'	66.8%	30	15	1970		CL	CLAYSTONE, SANDY
5	TB1	15'					1.2%	CL	CLAYSTONE, SANDY
5	TB4	10'				1563		CL	CLAYSTONE, SANDY
5	TB12	10'	99.7%	56	39	3939		CH	CLAYSTONE
5	TB12	10'					6.3%	CH	CLAYSTONE

Table 2
Depth to Bedrock And Groundwater

Realty Development Services
Falcon Highlands
Job No. 39431

Test Boring No.	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)
1	11	10.5
2	10	3
3	14.5	3
4	7	12
5	6	7
6	10	dry to 13
7	11	6
8	9.5	8.5
9	1	dry to 13
10	12	dry to 12.5
11	7	dry to 11.5
12	3	dry to 11.5
13	11	9.5
14	8.5	8
15	12	8.5
16	11	8
17	9.5	11.5
18	6	dry to 13
19	9.5	13
20	10	8
21	>15	dry to 12.5
22	6	dry to 11.5

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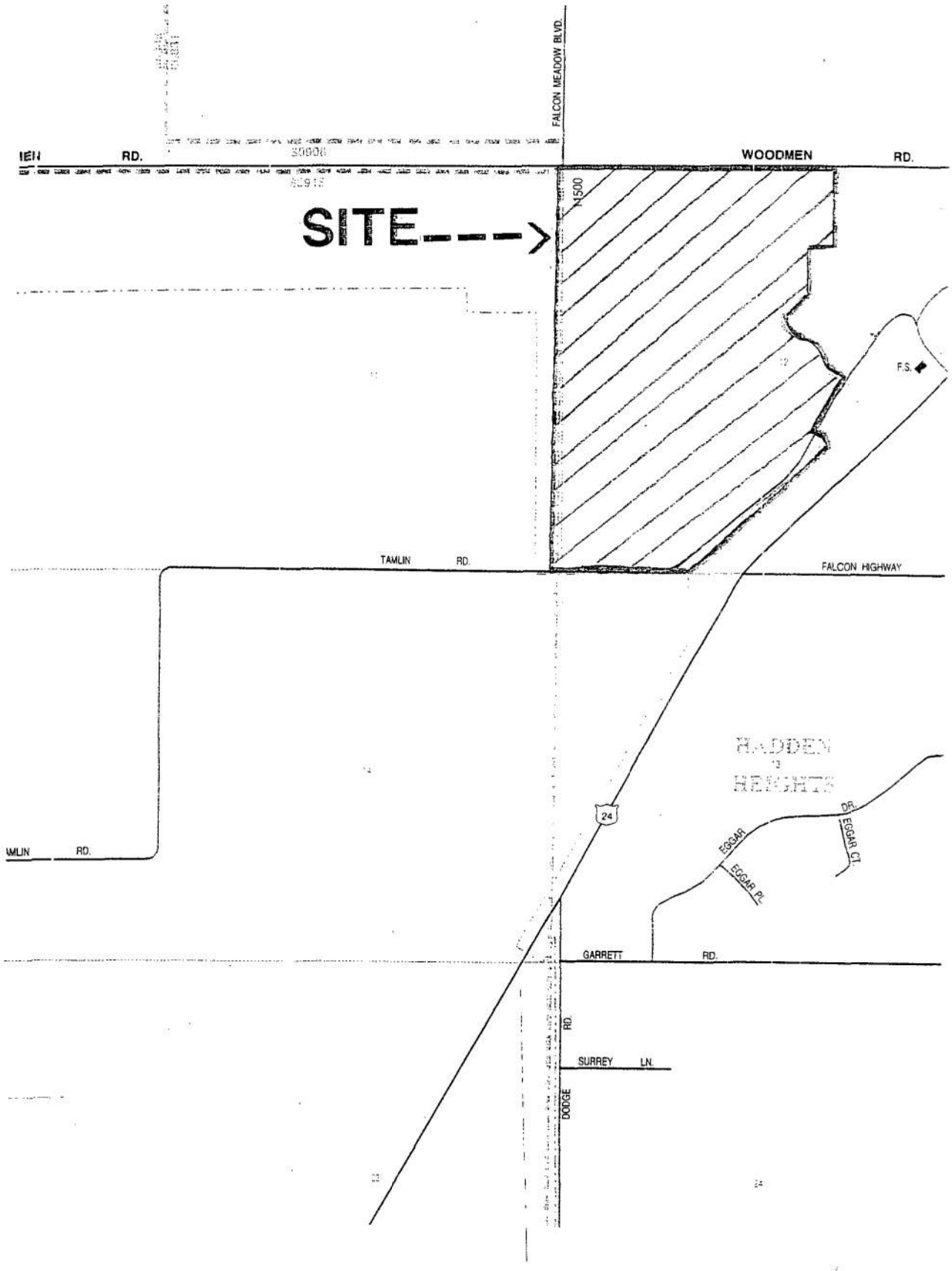
FIGURES



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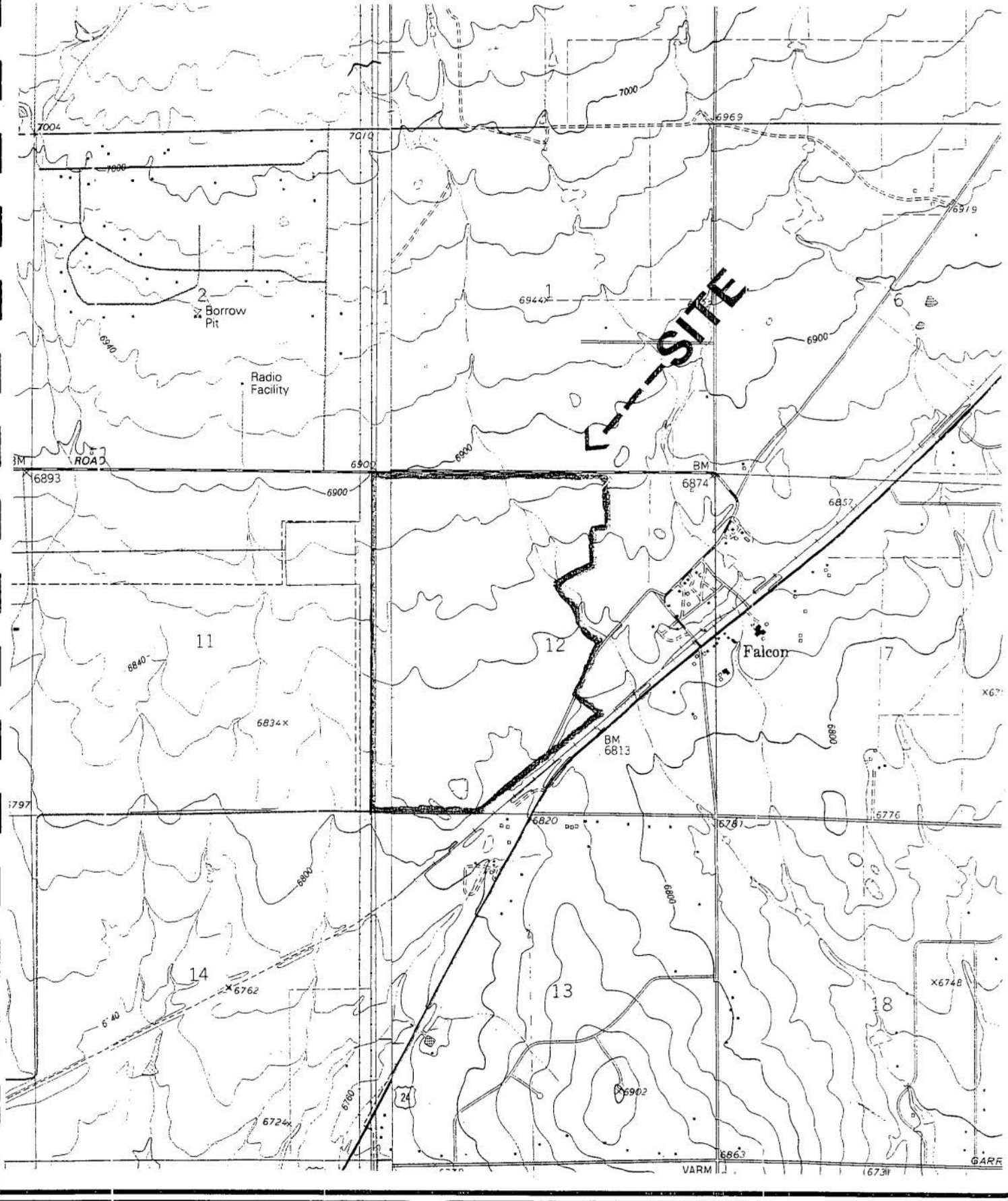
VICINITY MAP

FALCON HIGHLANDS

DRAWN:	DATE:	CHECKED:	DATE:

JOB NO.: 39431

FIC NO.: 1



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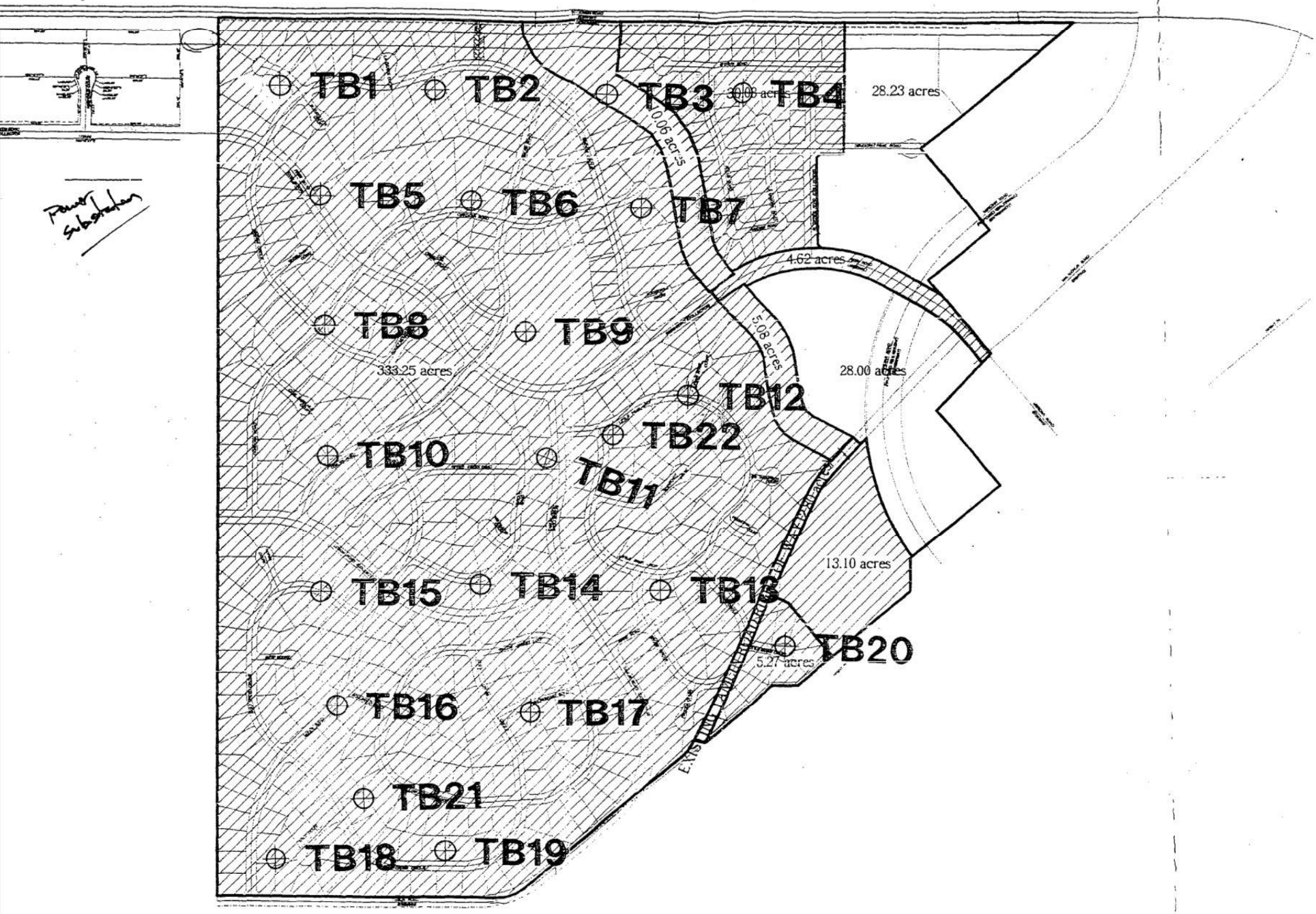
USGS MAP

FALCON HIGHLANDS

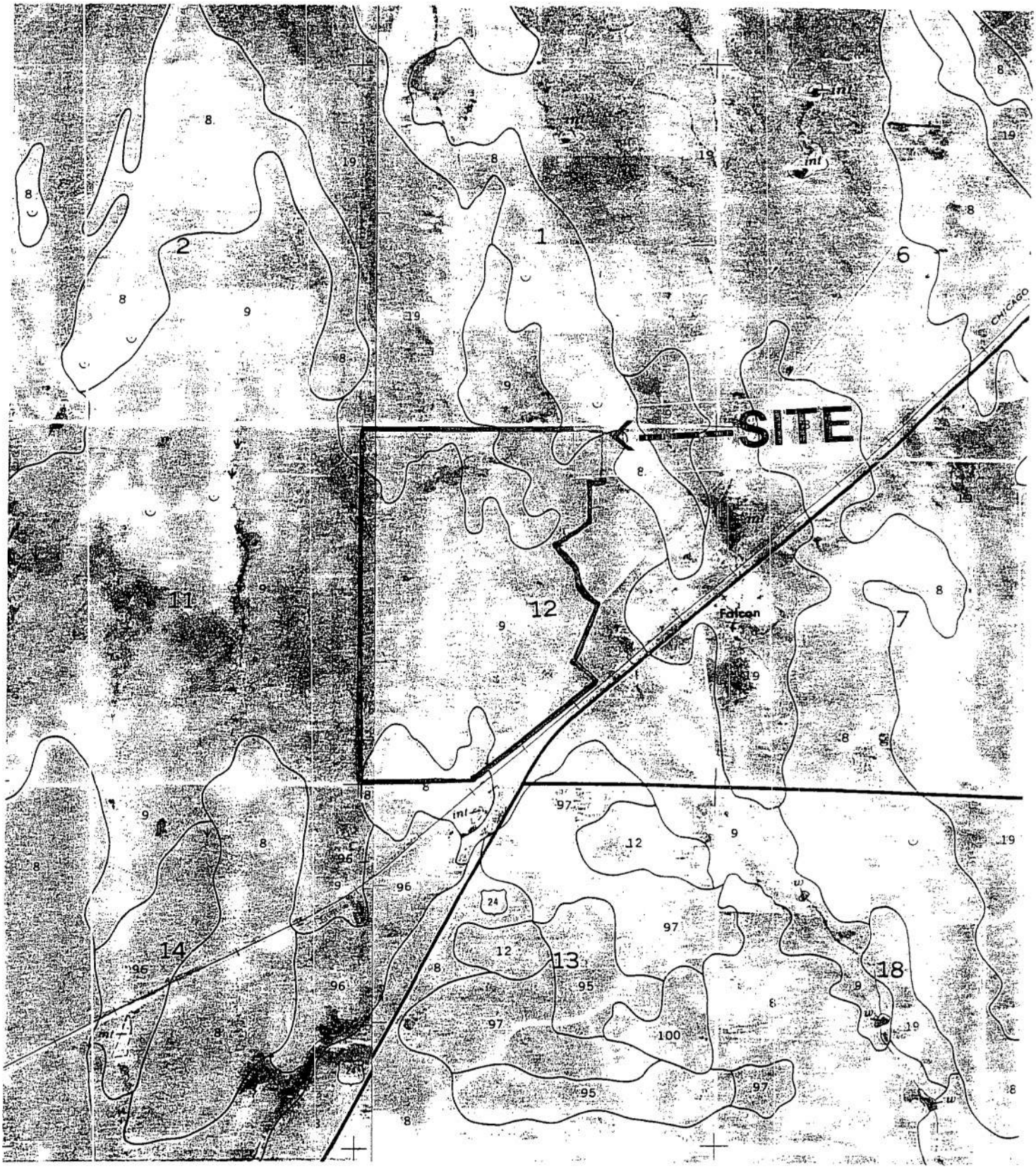
DRAWN:	DATE:	CHECKED:	DATE:

JOB NO.: 39431

FIG NO.: 2



TOTAL AREA IN HATCHING -401.41 acres



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SCS MAP

FALCON HIGHLANDS

DRAWN:	DATE:	CHECKED:	DATE:

JOB NO.: 39431

FIG NO.: 4

8—**Blakeland loamy sand, 1 to 9 percent slopes.** This deep, somewhat excessively drained soil formed in alluvial and eolian material derived from arkosic sedimentary rock on uplands. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; Truckton sandy loam, 3 to 9 percent slopes; and Stapleton sandy loam, 3 to 8 percent slopes. In some areas, mainly north of Colorado Springs in the Cottonwood Creek area, arkosic beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Organic matter content of the surface layer is medium. Surface runoff is slow, the hazard of erosion is moderate, and the hazard of soil blowing is severe.

Most areas of this soil are used for range, homesites, and wildlife habitat.

Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. This soil is best suited to deep-rooted grasses.

Proper range management is necessary to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the main limitations for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban development. Soil blowing is a hazard if protective vegetation is removed. Special erosion control practices must be provided to minimize soil losses. Capability subclass VIe.

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.

19—Columbine gravelly sandy loam, 0 to 3 percent slopes. This deep, well drained to excessively drained soil formed in coarse textured material on alluvial terraces and fans and on flood plains. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown gravelly sandy loam about 14 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Included with this soil in mapping are small areas of Stapleton sandy loam, 3 to 8 percent slopes; Blendon sandy loam, 0 to 3 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; and Fluvaquentic Haplaquolls, nearly level. In places the parent arkose beds of sandstone or shale are at a depth of 0 to 40 inches.

Permeability of this Columbine soil is very rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This soil is used mainly for grazing livestock and for wildlife habitat. It is also used for homesites.

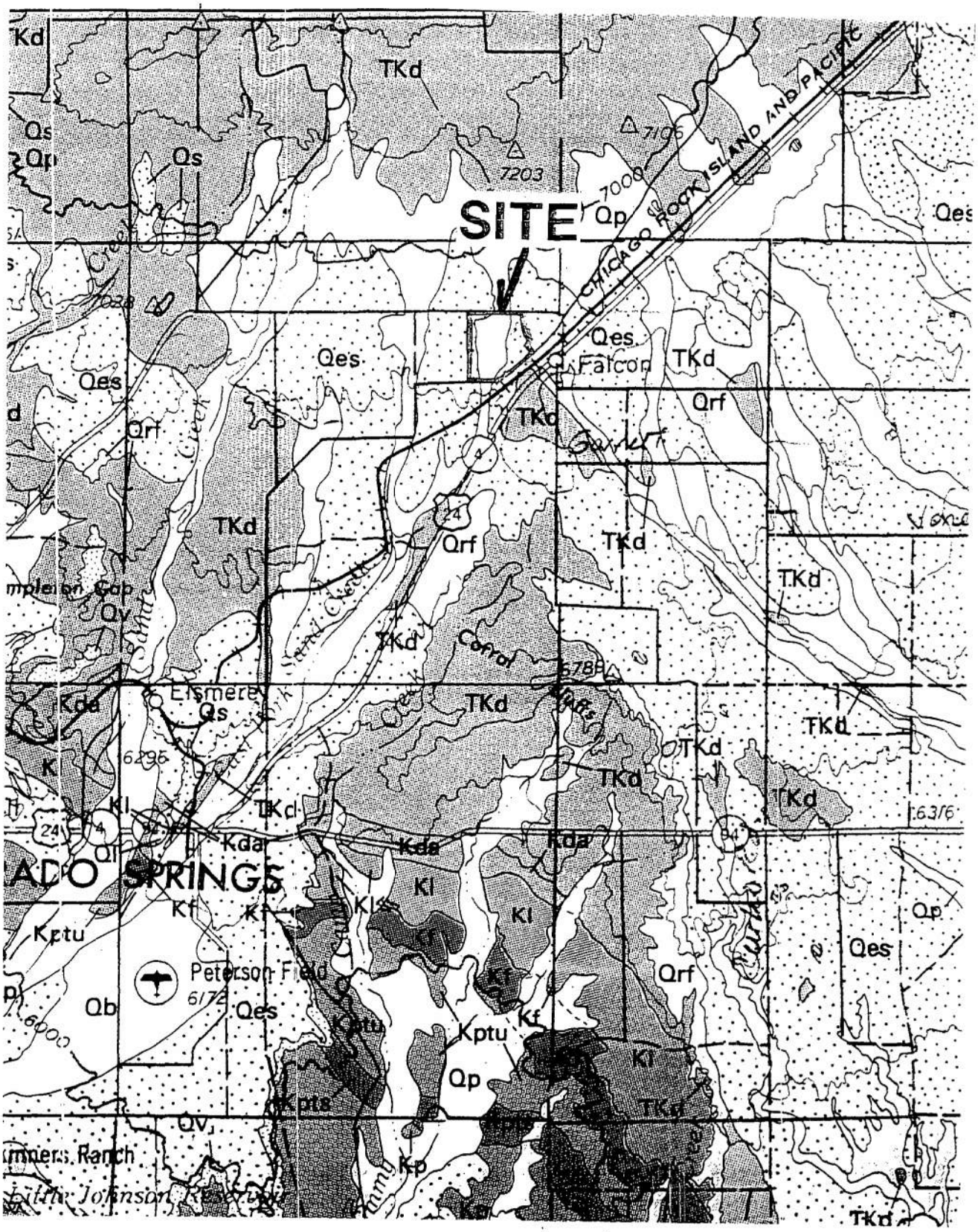
Native vegetation is mainly western wheatgrass, sideoats grama, needleandthread, and little bluestem. The main shrub is true mountainmahogany.

Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal limitations to the establishment of trees and shrubs. The soil is so loose that trees need to be planted in the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

Rangeland wildlife, such as pronghorn antelope, cottontail, coyote, and scaled quail, is best adapted to life on this droughty soil. Forage production is typically loam, and proper livestock grazing management is necessary if wildlife and livestock share the range. Livestock watering developments are also important and are used by various wildlife species.

The main limitation of this soil for urban development is a hazard of flooding in some areas. Care must be taken when locating septic tank absorption fields because of possible pollution as a result of the very rapid permeability of this soil. Capability subclass VIe.



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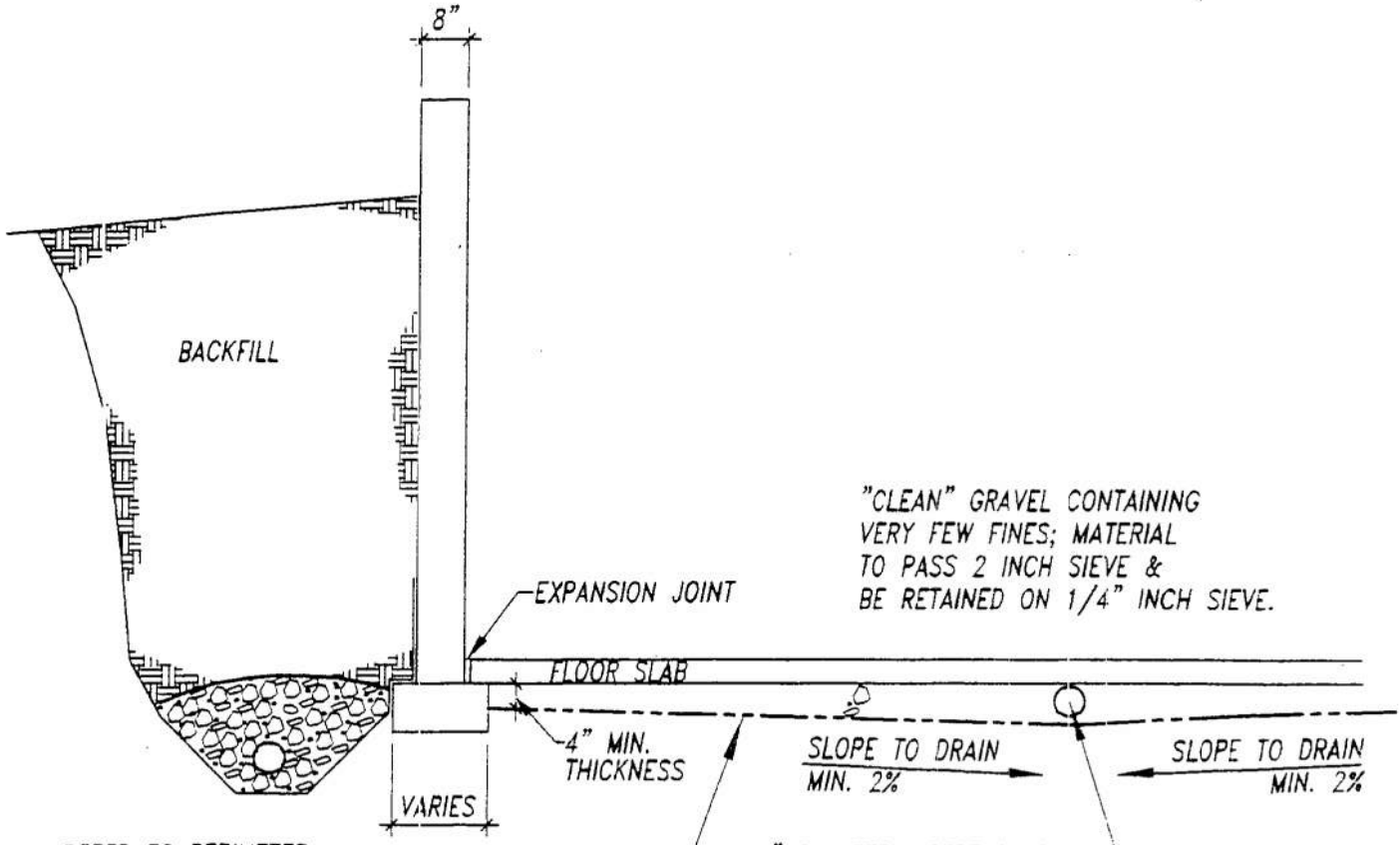
COLORADO GEOLOGY MAP
FALCON HIGHLANDS

DRAWN:	DATE:	CHECKED:	DATE:

JOB NO.: 39431
FIG NO.: 5



DR	C. WALTON
CHK	
DATE	
SCALE	NTS
JOB	39431
SHEET	11

TYP. UNDERSLAB DRAINAGE
LAYER (CAPILLARY BREAK)

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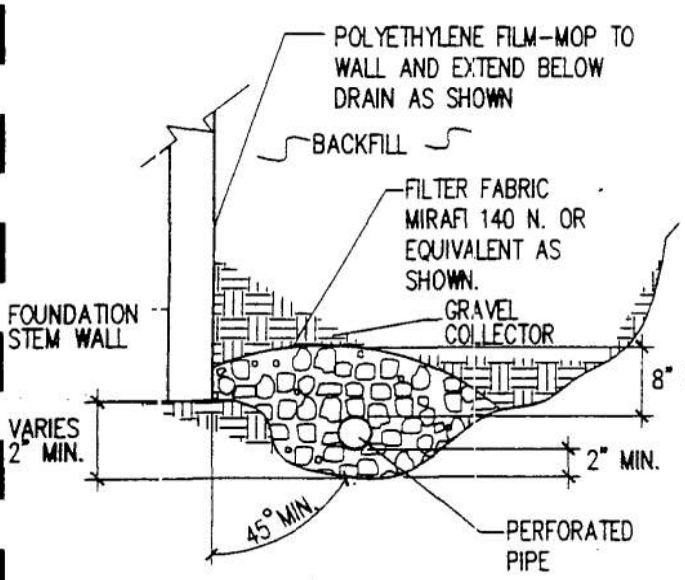
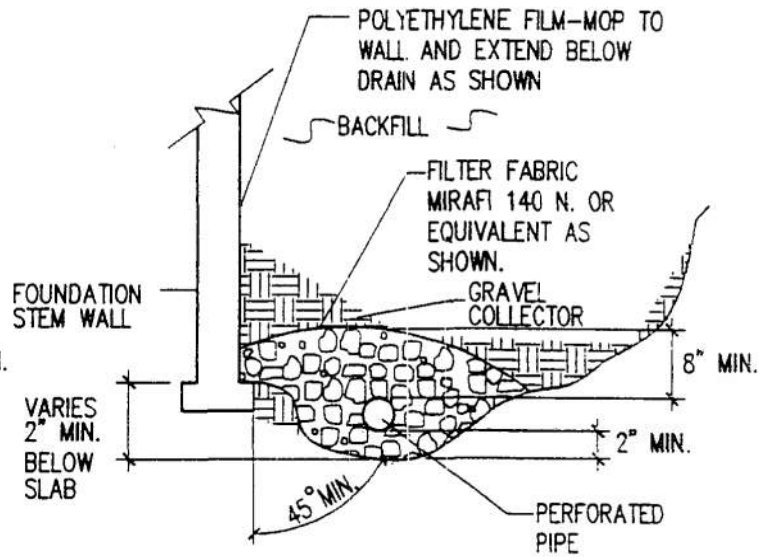
REVISION	BY





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.

SCALE:	NTS
JOB NO:	3902.1
FIG NO:	12

PERIMETER DRAIN DETAILS

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N

LEGEND

PECIAL FLOOD HAZARD AREAS INUNDATED Y 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

LOODWAY AREAS IN ZONE AE

THER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

THER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

NDEVELOPED COASTAL BARRIERS

Identified 1990

Otherwise Protected Areas

s are normally located within or adjacent to Special .

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.

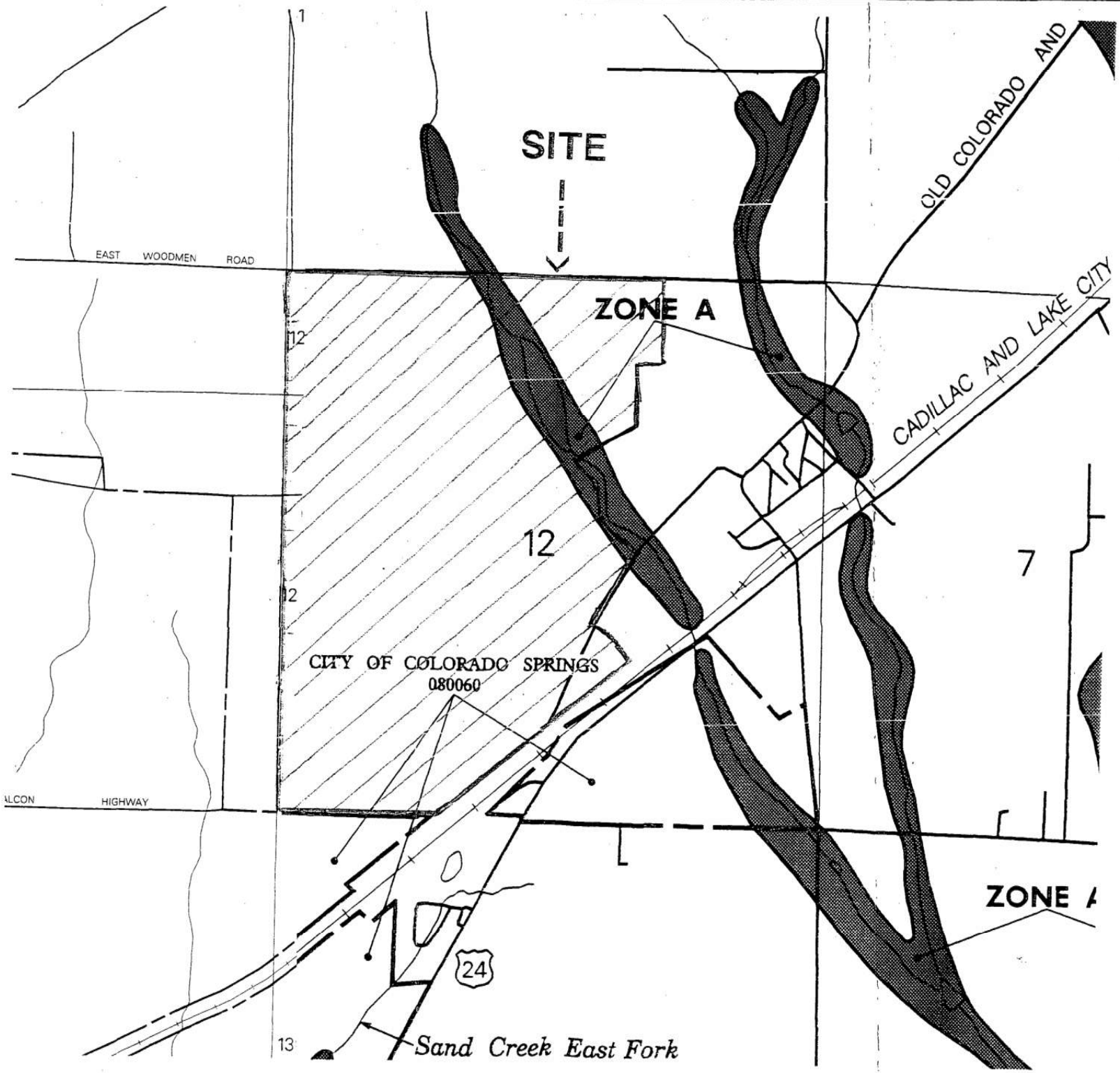
Cross Section Line

Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.

Elevation Reference Mark

River Mile

22'30" Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.



APPENDIX A: Test Borings

TEST BORING NO. 1
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 10.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			37	1.6	2	SAND, SILTY, FINE TO COARSE GRAINED, LIGHT BROWN, DENSE, DRY
5			40	1.7	2	
10			29	15.0	3	CLAY, SANDY, GRAYISH BROWN, STIFF, MOIST
						CLAYSTONE, SANDY, GRAY, HARD, MOIST
15			50/5"	12.3	5	
20						

TEST BORING NO. 2
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 3', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
						TOPSOIL 0-1'
			25	14.6	2	SAND, COARSE GRAINED, LIGHT BROWN, MEDIUM
5			31	14.5	2	DENSE TO DENSE, WET
10			38	16.5	3	CLAY, SANDY, GRAY, VERY STIFF, WET
						CLAYSTONE, SLIGHTLY SANDY TO VERY SANDY,
15			50/4"	11.0	5	GRAY, HARD, MOIST
20						

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TEST BORING LOG

Drawn	Date	Checked	Date
		KAT	

Job No. 39431
Fig. No. A-1

TEST BORING NO. 3
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 3', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	TOPSOIL 0-1'				
	SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, LIGHT BROWN, DENSE TO MEDIUM DENSE, WET		32	12.4	2
5			18	17.7	2
10			29	13.0	2
15	SANDSTONE, CLAYEY, MEDIUM GRAINED, GRAY, VERY DENSE, WET		50/8"	11.8	4
20			50/1"	20.5	4

TEST BORING NO. 4
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 12', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SLIGHTLY SILTY, FINE GRAINED, LIGHT BROWN, MEDIUM DENSE, MOIST		17	6.2	2
5			21	7.1	2
	CLAYSTONE, SANDY, GRAY, HARD, MOIST				
10			50/11"	15.8	5
15			50/5"	13.3	5
20					

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TEST BORING LOG

Drawn	Date	Checked	Date
		[illegible]	12/12/01

Job No. 39431
Fig. No. A-2

TEST BORING NO. 5
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 7', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			21	4.3	2
5			33	7.4	2
			50 / 11"	15.4	5
10					
			50 / 4"	11.1	4
15					
20					

SAND, SLIGHTLY SILTY, FINE GRAINED, LIGHT BROWN, MEDIUM DENSE TO DENSE, MOIST

CLAYSTONE, SLIGHTLY SANDY, GRAY, HARD, MOIST

SANDSTONE, CLAYEY, GRAY, VERY DENSE, WET

TEST BORING NO. 6
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

DRY TO 13', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	4.4	2
5			23	19.6	2
			27	12.8	3
10					
			50 / 5"	11.6	5
15					
20					

SAND, CLAYEY, SILTY, FINE TO MEDIUM GRAINED, DARK BROWN TO BROWN, MEDIUM DENSE, MOIST TO WET

CLAY, SANDY, GRAY, STIFF, MOIST

CLAYSTONE, SANDY, GRAY, HARD, MOIST

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TEST BORING LOG

Drawn	Date	Checked	Date
			12/

Job No. 39431
Fig. No. A-3

TEST BORING NO. 7
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 6', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			50 / 11"	1.5	2
5			48	3.0	2
10			9	14.9	2
15			50 / 6"	9.0	5
20					

SAND, SILTY, SLIGHTLY GRAVELLY, FINE TO COARSE GRAINED, LIGHT BROWN, VERY DENSE TO DENSE, DRY TO MOIST

SAND, CLAYEY, MEDIUM GRAINED, GRAY, LOOSE, VERY MOIST

CLAYSTONE, SANDY, GRAY HARD, MOIST

TEST BORING NO. 8
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 8.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			25	4.8	2
5			7	7.1	2
10			34	20.1	5
15			50 / 12"	22.0	5
20			50 / 4"	12.0	5

SAND, SILTY, CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, DRY

SAND, FINE TO COARSE GRAINED, LIGHT BROWN, LOOSE, MOIST

CLAYSTONE, SILTY, GRAY, VERY STIFF TO HARD, WET

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KAF	12/20/01

Job No. 39431
Fig. No. A-4

TEST BORING NO. 9
DATE DRILLED 12/8/01
Job # 39431

REMARKS

DRY TO 13', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					3
			50 / 8"	7.6	4
5			50 / 10"	4.1	4
10			50 / 9"	9.0	5
15			50 / 4"	14.4	5
20					

CLAY, SANDY SANDSTONE, VERY CLAYEY, FINE GRAINED, LIGHT GRAY, VERY DENSE, MOIST, CALCAREOUS SANDSTONE, VERY SILTY, FINE GRAINED, LIGHT BROWN, VERY DENSE, MOIST

CLAYSTONE, SLIGHTLY SANDY, GRAY, HARD, MOIST

TEST BORING NO. 10
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

DRY TO 12.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			15	3.6	2
5			22	2.4	2
10			21	2.8	2
15			50 / 7"	8.5	4
20					

SAND, FINE TO MEDIUM GRAINED, LIGHT BROWN, MEDIUM DENSE, MOIST

SANDSTONE, VERY CLAYEY, SILTY, FINE TO MEDIUM GRAINED, GRAY, VERY DENSE, MOIST

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KAH	12/20/01

Job No. 39431
Fig. No. A-5

TEST BORING NO. 11
DATE DRILLED 12/8/01
Job # 39431

REMARKS

DRY TO 11.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			10	1.9	2
5			12	6.9	2
10			50 7"	9.9	4
15			50 7"	10.9	4
20					

SAND, VERY SILTY TO SLIGHTLY SILTY, FINE GRAINED, LIGHT BROWN LOOSE TO MEDIUM DENSE, DRY TO MOIST

SANDSTONE, SILTY, CLAYEY, MEDIUM TO COARSE GRAINED, LIGHT BROWN TO GRAYISH BROWN, VERY DENSE, VERY MOIST

TEST BORING NO. 12
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

DRY TO 11.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			46	11.0	3
5			50 8"	9.4	5
10			40	19.9	5
15			50 9"	19.6	5
20					

CLAY, SLIGHTLY SILTY, CALICHE, DARK GRAY, VERY STIFF, MOIST

CLAYSTONE, SANDY, CALICHE, DARK GRAY, HARD, MOIST

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KM	12/26/01

Job No. 39431
Fig. No. A-6

TEST BORING NO. 13
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 9.5', 12/13/01

SAND, SILTY TO SLIGHTLY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST TO VERY MOIST

SANDSTONE, SILTY, MEDIUM GRAINED, GRAY, VERY DENSE, WET

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			23	2.5	2
5			29	3.3	2
10			11	8.5	2
15			50/6"	15.4	4
20					

TEST BORING NO. 14
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 8', 12/13/01

SAND, SILTY, MEDIUM TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			18	2.4	2
5			13	3.2	2
10			50/9"	13.0	4
15			50/5"	11.3	4
20					

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KAF	12/20/01

Job No. 39431
Fig. No. A-7

TEST BORING NO. 15
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 8.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			21	3.6	2
5			13	3.4	2
10			37	12.7	2
15			50/7"	18.5	4
20					

TOPSOIL 0-1'

SAND, SILTY, GRAVELLY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST

SAND, MEDIUM GRAINED, LIGHT BROWN, DENSE, WET

SANDSTONE, CLAYEY, GRAY, VERY DENSE, WET

TEST BORING NO. 16
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 8', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			22	4.4	2
5			19	5.2	2
10			38	12.1	2
15			50/7"	24.5	5
20					

SAND, VERY SILTY, FINE TO MEDIUM GRAINED, BROWN TO LIGHT BROWN, MEDIUM DENSE, MOIST

SAND, FINE TO COARSE GRAINED, LIGHT BROWN, DENSE, WET

CLAYSTONE, VERY SILTY, BLUISH GREEN, HARD, WET

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TEST BORING LOG

Drawn	Date	Checked	Date
		KAH	12/26/01

Job No. 39431
Fig. No. A-9

TEST BORING NO. 17
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 11.5', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			10	3.4	2
5			27	4.8	2
10			38	20.9	
15			50/6"	21.3	5
20					

SAND, SLIGHTLY SILTY TO CLAYEY, FINE GRAINED, LIGHT BROWN, LOOSE TO MEDIUM DENSE, MOIST

CLAYSTONE, GRAYISH BLUE, VERY STIFF TO HARD, MOIST

TEST BORING NO. 18
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

DRY TO 13', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			11	3.4	2
5			19	4.3	2
					5
10			45	20.8	5
15			50/7"	16.2	5
20					

SAND, SLIGHTLY SILTY, FINE GRAINED, LIGHT BROWN, MEDIUM DENSE, MOIST

WEATHERED CLAYSTONE, OLIVE, VERY STIFF, MOIST

CLAYSTONE, GREY, HARD, MOIST

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KAF	12/20/01

Job No. 39431
Fig. No. A-9

TEST BORING NO. 19
DATE DRILLED 12/8/01
Job # 39431

REMARKS

WATER AT 13', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	3.6	2
5			14	3.0	2
10			32	18.1	3
15			50/4"	16.0	5
20					

TOPSOIL 0-1'

SAND, SILTY, FINE GRAINED, LIGHT BROWN, MEDIUM DENSE, MOIST

CLAY, SANDY, GRAY, VERY STIFF, MOIST

CLAYSTONE, SANDY, GRAY, HARD, MOIST

TEST BORING NO. 20
DATE DRILLED 12/8/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS

WATER AT 8', 12/13/01

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			8	2.4	2
5			11	2.9	2
10			14	25.1	1
15			50/10"	28.2	5
20					

SAND, SLIGHTLY SILTY, FINE TO MEDIUM GRAINED, LIGHT BROWN, LOOSE TO MEDIUM DENSE, MOIST

SILT, CLAYEY, GREY, FIRM, MOIST

CLAYSTONE, SLIGHTLY SANDY, BLUISH GRAY, HARD, MOIST

ENTECH ENGINEERING, INC.

TEST BORING LOG

Drawn	Date	Checked	Date
		KAH	12/30/01

Job No. 39431
Fig. No. A-11

TEST BORING NO. 21
DATE DRILLED 12/13/01
Job # 39431

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 12.5', 12/21/01						
SAND, SLIGHTLY SILTY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST	5			13	7.5	2
	10			16	6.7	2
SAND, CLAYEY, FINE GRAINED, MEDIUM DENSE, MOIST	15			15	18.3	2
	20					

TEST BORING NO. 22
DATE DRILLED 12/13/01
CLIENT REALTY DEVELOPMENT SERVICES
LOCATION FALCON HIGHLANDS

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 11.5', 12/21/01						
SAND, SILTY, FINE GRAINED, BROWN						2
CLAY, DARK BROWN, STIFF, MOIST	5			22	8.8	3
CLAYSTONE, SILTY, BROWN, HARD, MOIST	10			50/5"	15.8	5
*BULK SAMPLE TAKEN	15			*	17.5	5
	20					

ENTECH ENGINEERING, INC.

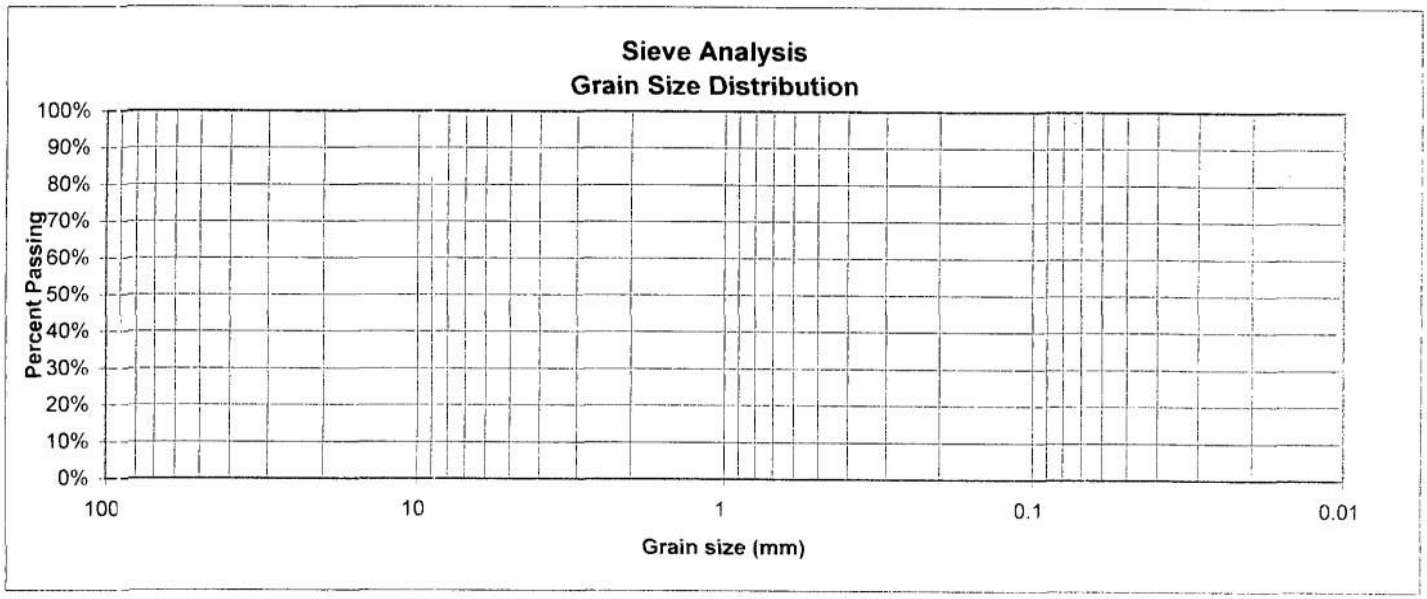
TEST BORING LOG

Drawn	Date	Checked	Date
		RPH	12/26/01

Job No. 39431
Fig. No. A-11

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	ML	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	1	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB20	JOB NO.	39431
DEPTH	9-10'	TEST BY	DG



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

Atterberg Limits	
Plastic Limit	28
Liquid Limit	40
Plastic Index	12

Swell	
Moisture at start	13.7%
Moisture at finish	31.5%
Moisture increase	17.8%
Initial dry density (pcf)	94
Swell (psf)	1515

ENTECH ENGINEERING, INC.

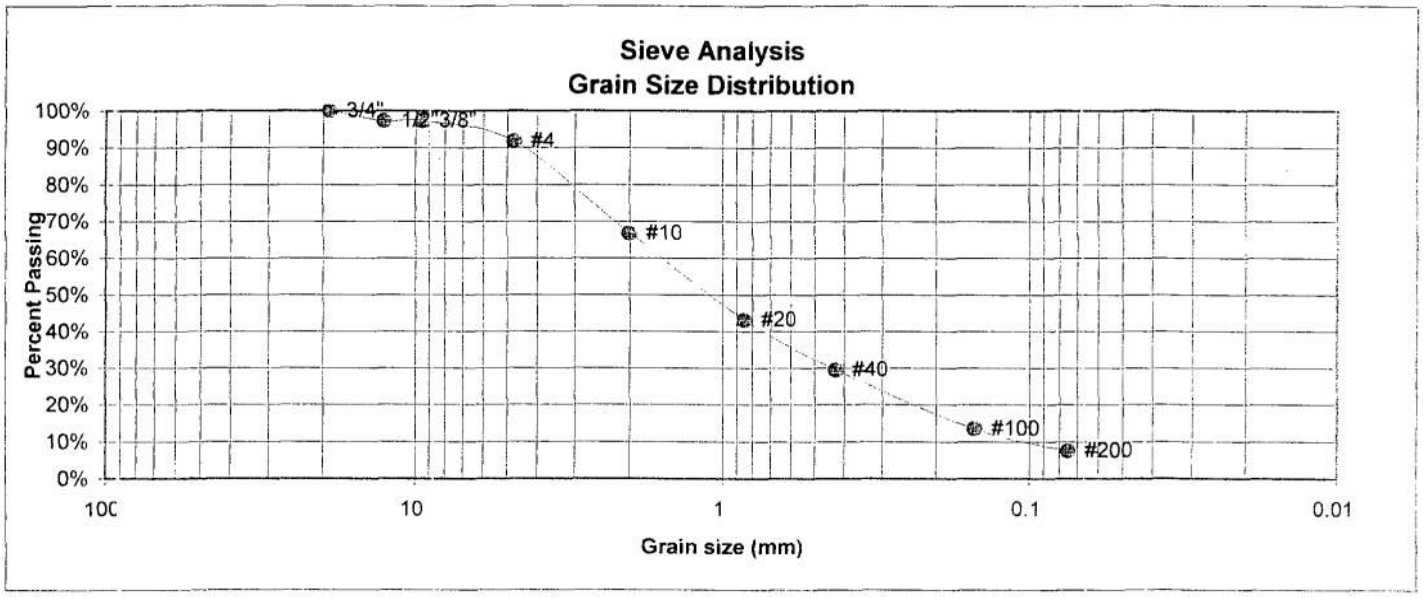
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAL	

Job No. 39431

Fig. No. 5-1

UNIFIED CLASSIFICATION	SW-SM	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB3	JOB NO.	39431
DEPTH	2-3'	TEST BY	DG



U.S Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	100.0%
1/2"	97.3%
3/8"	97.3%
4	91.7%
10	66.7%
20	43.2%
40	29.5%
100	13.6%
200	7.6%

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)	

ENTECH ENGINEERING, INC.

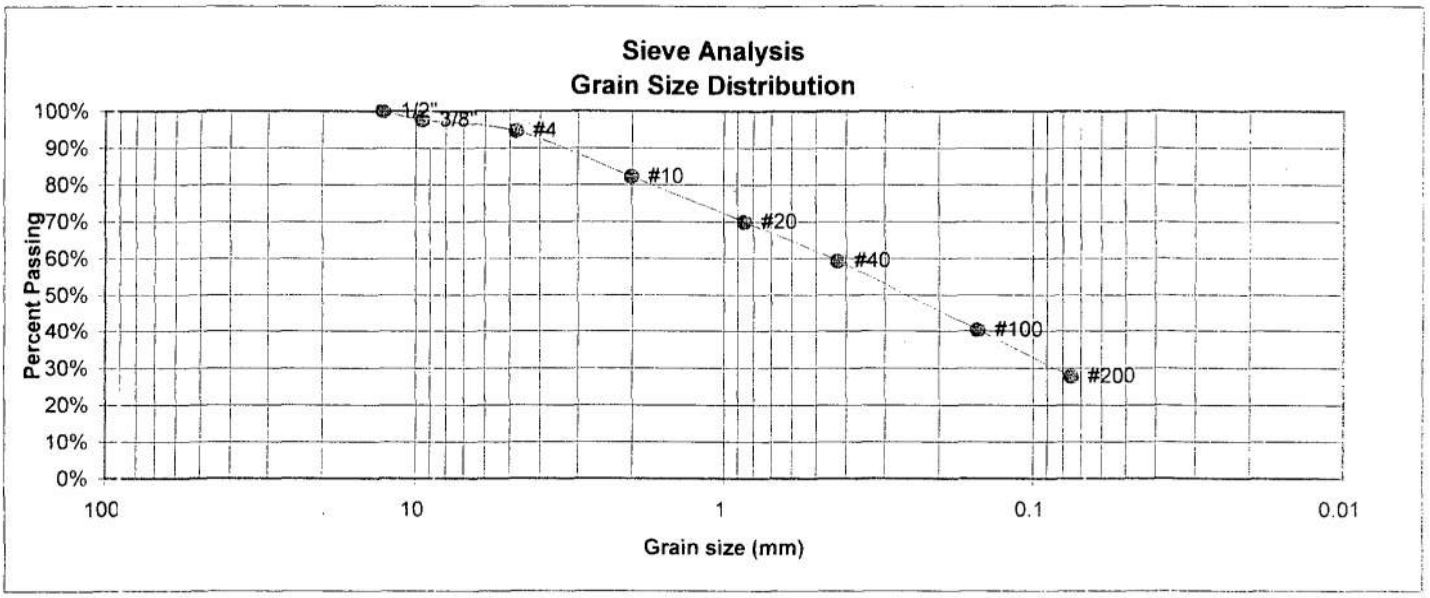
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAR	12/21/11

Job No. 39431

Fig. No. B-2

UNIFIED CLASSIFICATION	SC	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB6	JOB NO.	39431
DEPTH	2-5'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.6%
4	94.7%
10	82.2%
20	69.9%
40	59.3%
100	40.3%
200	27.7%

Atterberg Limits	
Plastic Limit	15
Liquid Limit	26
Plastic Index	11

Swell	
Moisture at start	7.7%
Moisture at finish	16.9%
Moisture increase	9.2%
Initial dry density (pcf)	106
Swell (psf)	574

ENTECH ENGINEERING, INC.

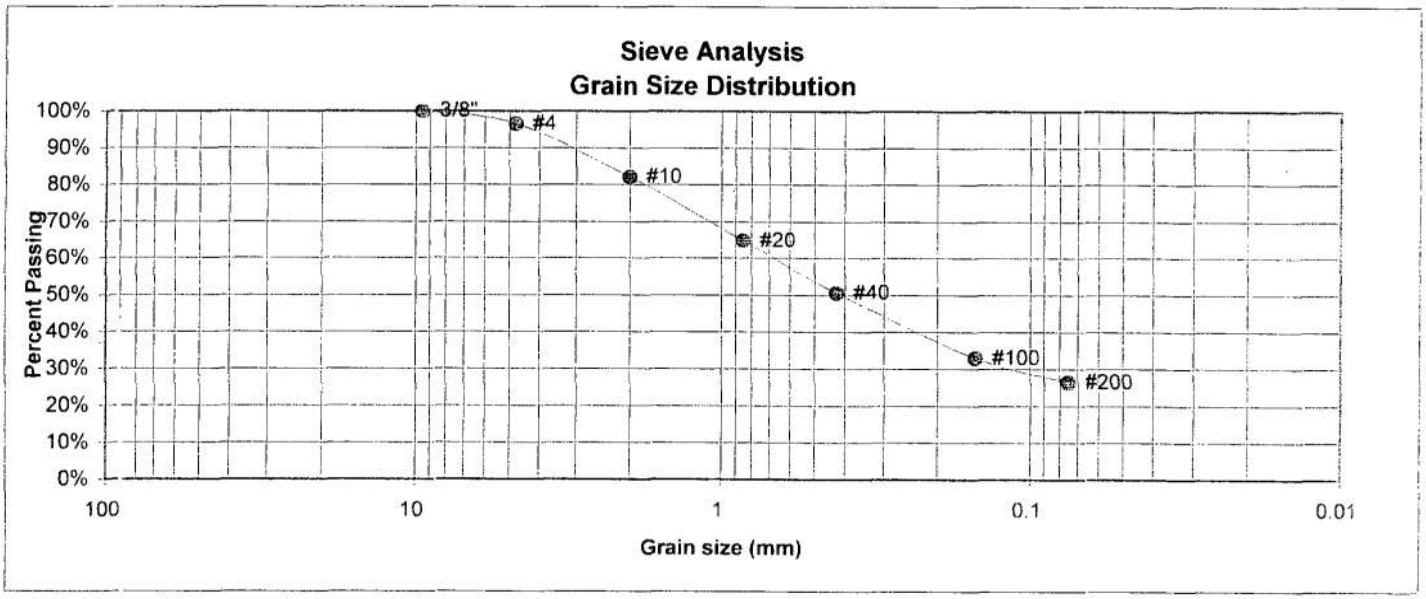
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAK	12/2004

Job No. 39431

Fig. No. 5-5

UNIFIED CLASSIFICATION	SC	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB7	JOB NO.	39431
DEPTH	10'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.5%
10	82.1%
20	64.8%
40	50.6%
100	33.0%
200	26.4%

Atterberg Limits	
Plastic Limit	13
Liquid Limit	27
Plastic Index	14

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

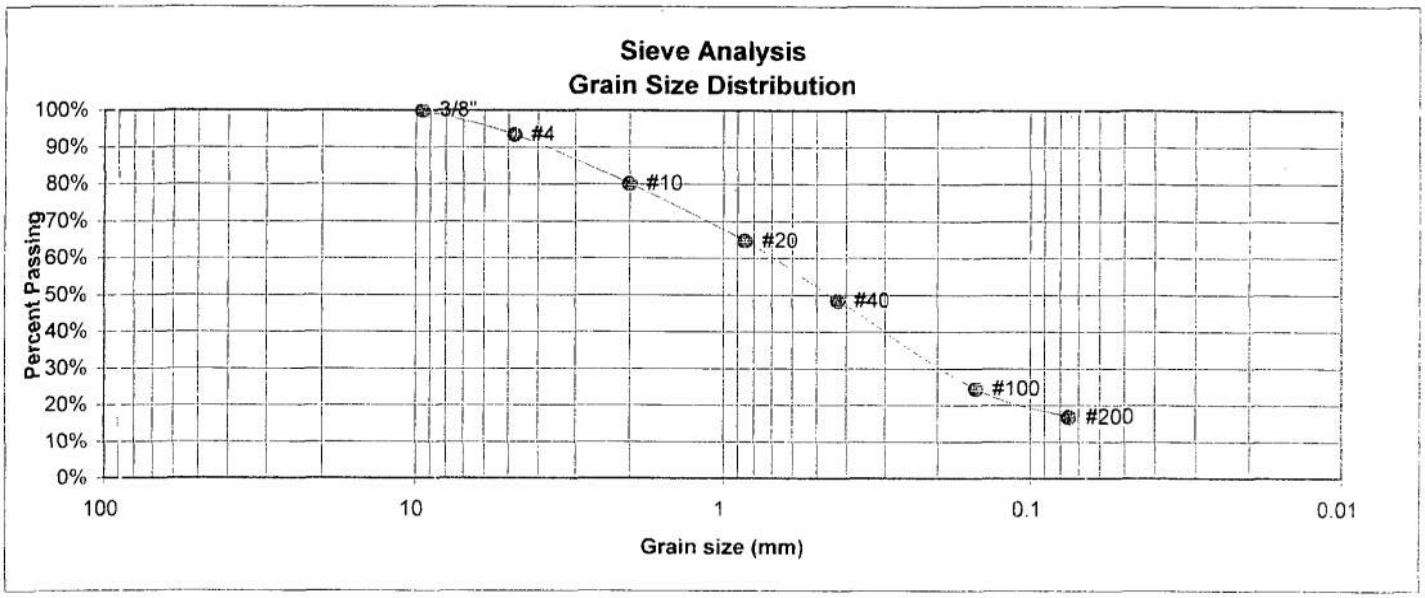
ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		MLH	12/26/01

Job No. 39431
Fig. No. 5-4

UNIFIED CLASSIFICATION	SM	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB13	JOB NO.	39431
DEPTH	2-3'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2'	
3/4"	
1/2"	
3/8"	100.0%
4	93.4%
10	80.1%
20	64.7%
40	48.4%
100	24.5%
200	16.8%

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)	

ENTECH ENGINEERING, INC.

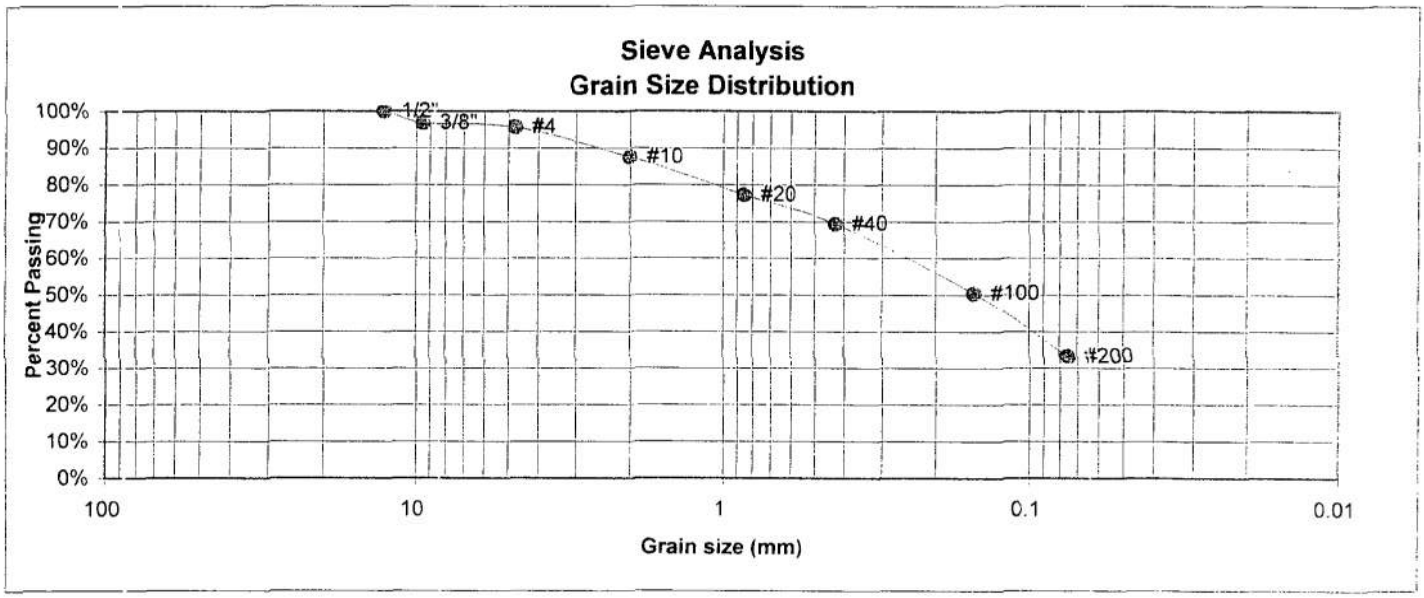
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KLH	12/26/12

Job No. 39431

Fig. No. B-5

UNIFIED CLASSIFICATION	SM	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB16	JOB NO.	39431
DEPTH	2-3'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.8%
4	95.7%
10	87.5%
20	77.3%
40	69.4%
100	50.5%
200	33.3%

Atterberg Limits	
Plastic Limit	20
Liquid Limit	21
Plastic Index	1

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

ENTECH ENGINEERING, INC.

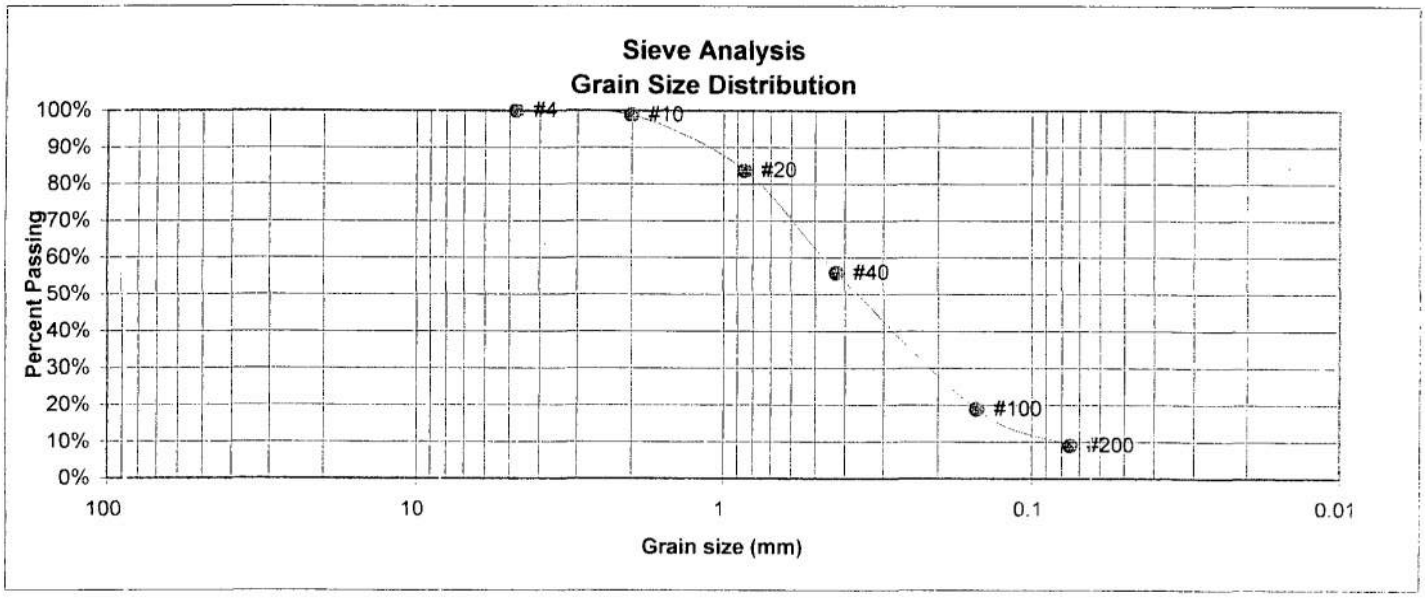
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		[illegible]	[illegible]

Job No. 39431

Fig. No. 5-b

UNIFIED CLASSIFICATION	SP-SM	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	2	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB20	JOB NO.	39431
DEPTH	2-3'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.8%
20	83.7%
40	55.9%
100	18.8%
200	9.0%

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)	

ENTECH ENGINEERING, INC.

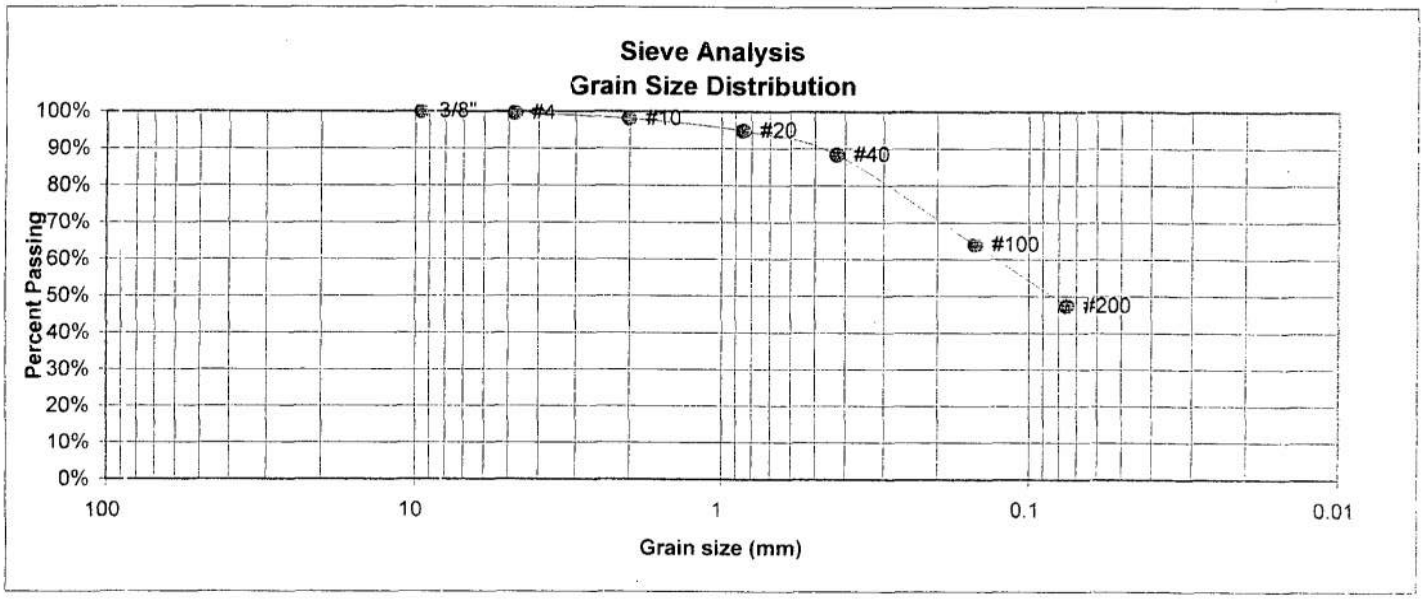
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		RAH	12/20/01

Job No. 39431

Fig. No. E-7

UNIFIED CLASSIFICATION	SC	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	4	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB9	JOB NO.	39431
DEPTH	2-3'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2'	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	98.1%
20	94.8%
40	88.3%
100	64.0%
200	47.2%

Atterberg Limits

Plastic Limit

Liquid Limit

Plastic Index

Swell

Moisture at start	8.0%
Moisture at finish	19.7%
Moisture increase	11.7%
Initial dry density (pcf)	105
Swell (psf)	933

ENTECH ENGINEERING, INC.

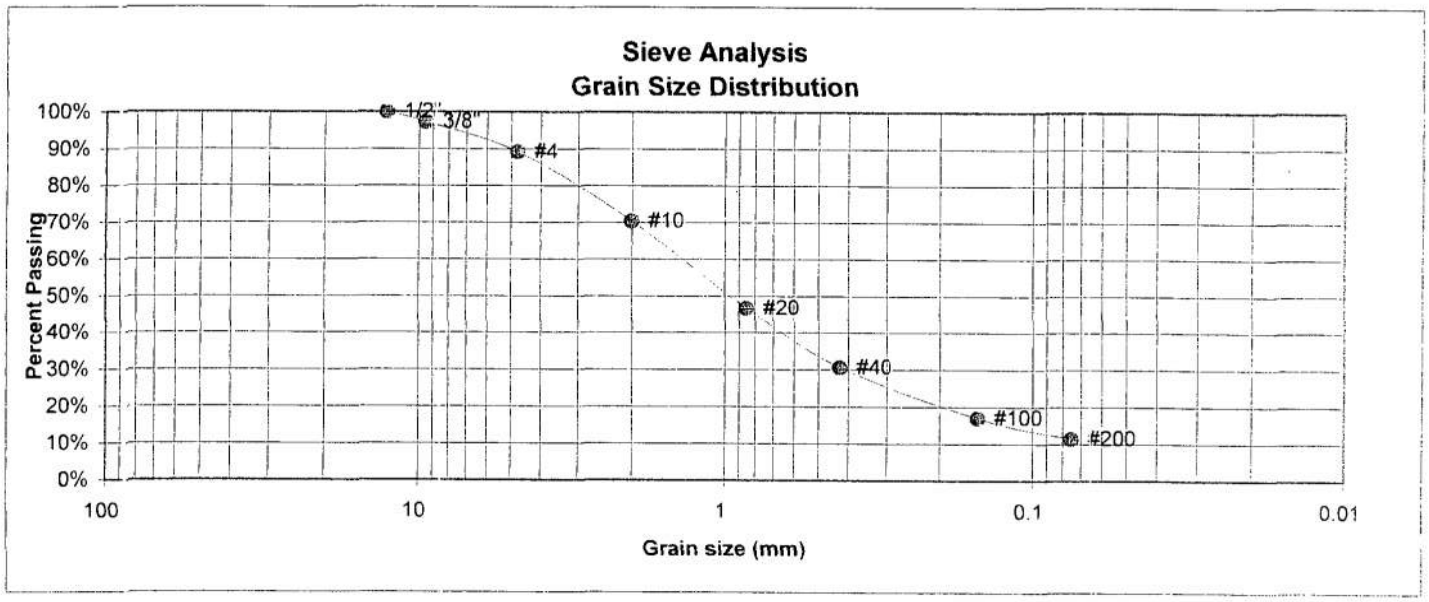
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAE	12/26/10

Job No. 39431

Fig. No. E-8

UNIFIED CLASSIFICATION	SW-SM	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	4	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB13	JOB NO.	39431
DEPTH	15'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.3%
4	89.2%
10	70.3%
20	46.6%
40	30.6%
100	17.0%
200	11.4%

Atterberg Limits	
Plastic Limit	26
Liquid Limit	27
Plastic Index	1

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

ENTECH ENGINEERING, INC.

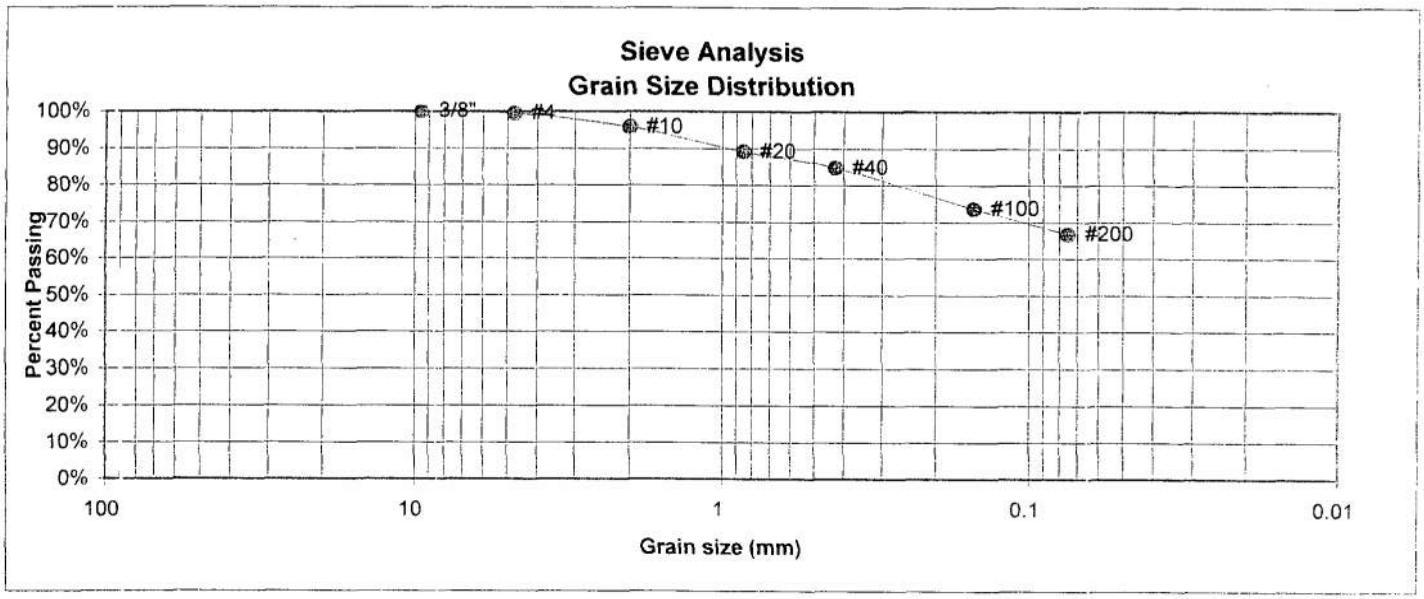
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KLH	10-26-01

Job No. 39431

Fig. No. B-9

UNIFIED CLASSIFICATION	CL	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	5	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB1	JOB NO.	39431
DEPTH	15'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.4%
10	95.8%
20	89.2%
40	84.8%
100	73.7%
200	66.8%

Atterberg Limits	
Plastic Limit	15
Liquid Limit	30
Plastic Index	15

Swell	
Moisture at start	12.6%
Moisture at finish	18.6%
Moisture increase	6.0%
Initial dry density (pcf)	110
Swell (psf)	1970

ENTECH ENGINEERING, INC.

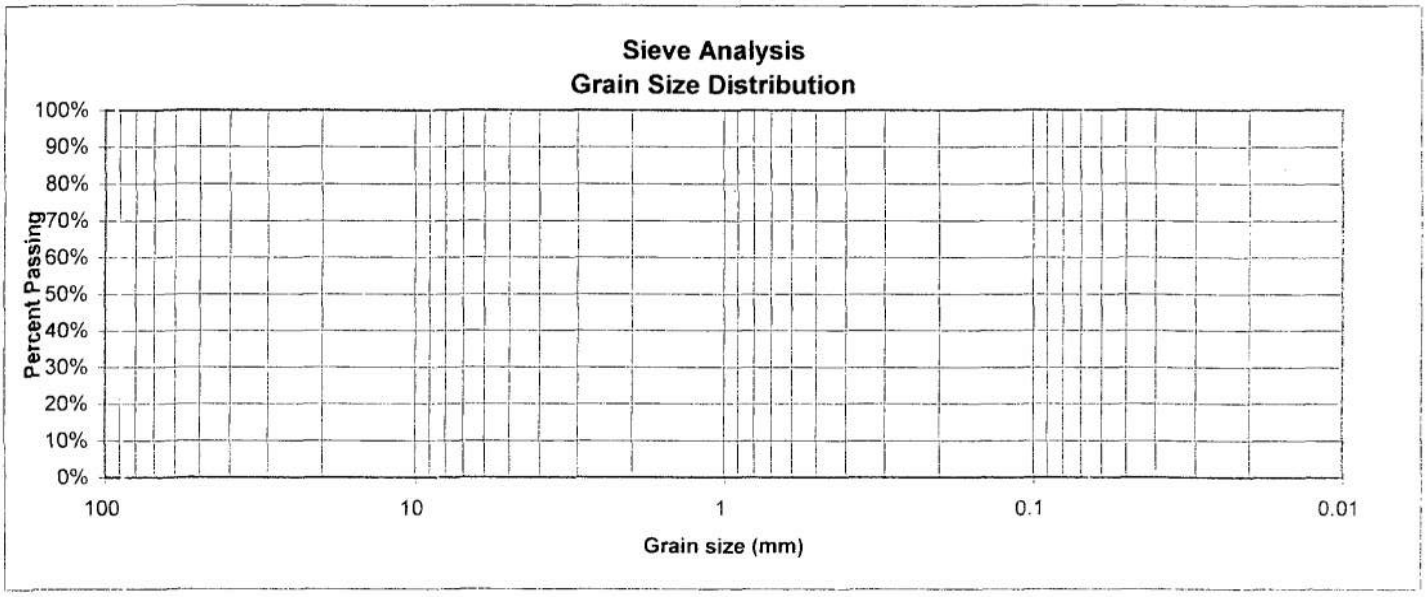
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAH	12/26/10

Job No. 39431

Fig. No. B-10

UNIFIED CLASSIFICATION	CL	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	5	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB4	JOB NO.	39431
DEPTH	10'	TEST BY	DG



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

Atterberg Limits	
Plastic Limit	
Liquid Limit	
Plastic Index	
Swell	
Moisture at start	11.0%
Moisture at finish	18.8%
Moisture increase	7.8%
Initial dry density (pcf)	109
Swell (psf)	1563

ENTECH ENGINEERING, INC.

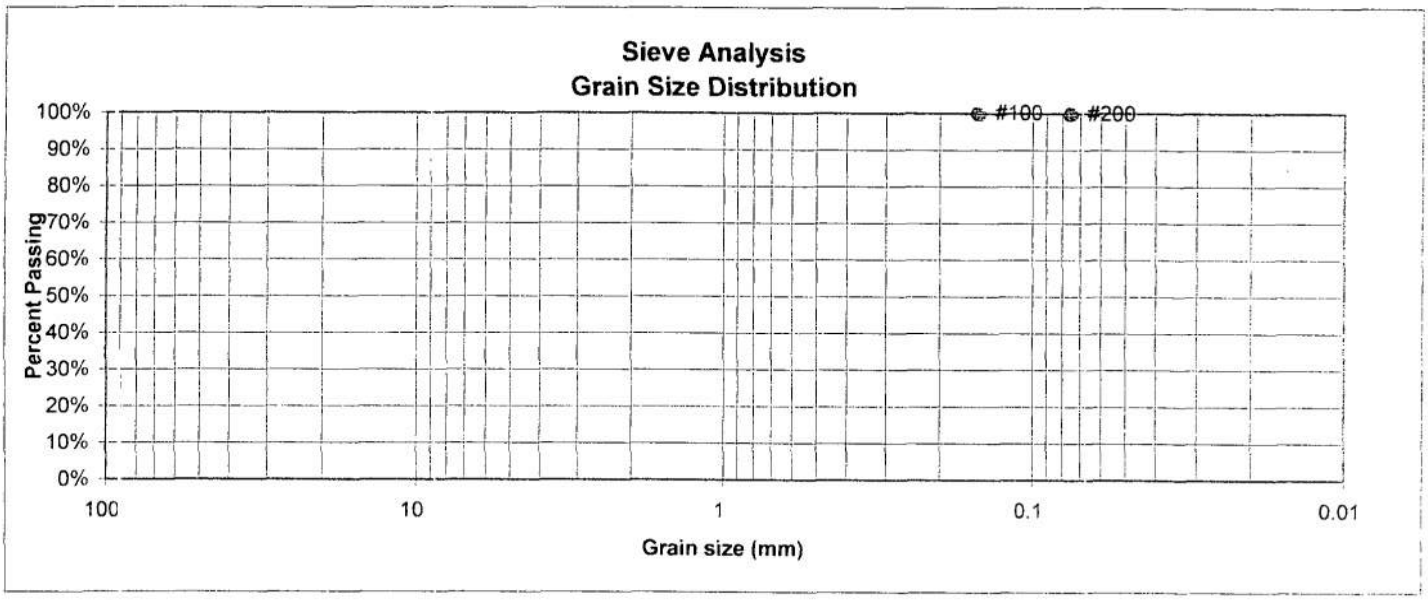
LABORATORY TEST RESULTS

Drawn	Date	Checked	Date
		KAH	12/26/07

Job No. 39431

Fig. No. B-11

UNIFIED CLASSIFICATION	CH	CLIENT	REALTY DEVELOPMENT
SOIL TYPE #	5	PROJECT	FALCON HIGHLANDS
TEST BORING #	TB12	JOB NO.	39431
DEPTH	10'	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	99.7%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	56
Plastic Index	39

Swell	
Moisture at start	13.9%
Moisture at finish	23.8%
Moisture increase	10.0%
Initial dry density (pcf)	103
Swell (psf)	3939

ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

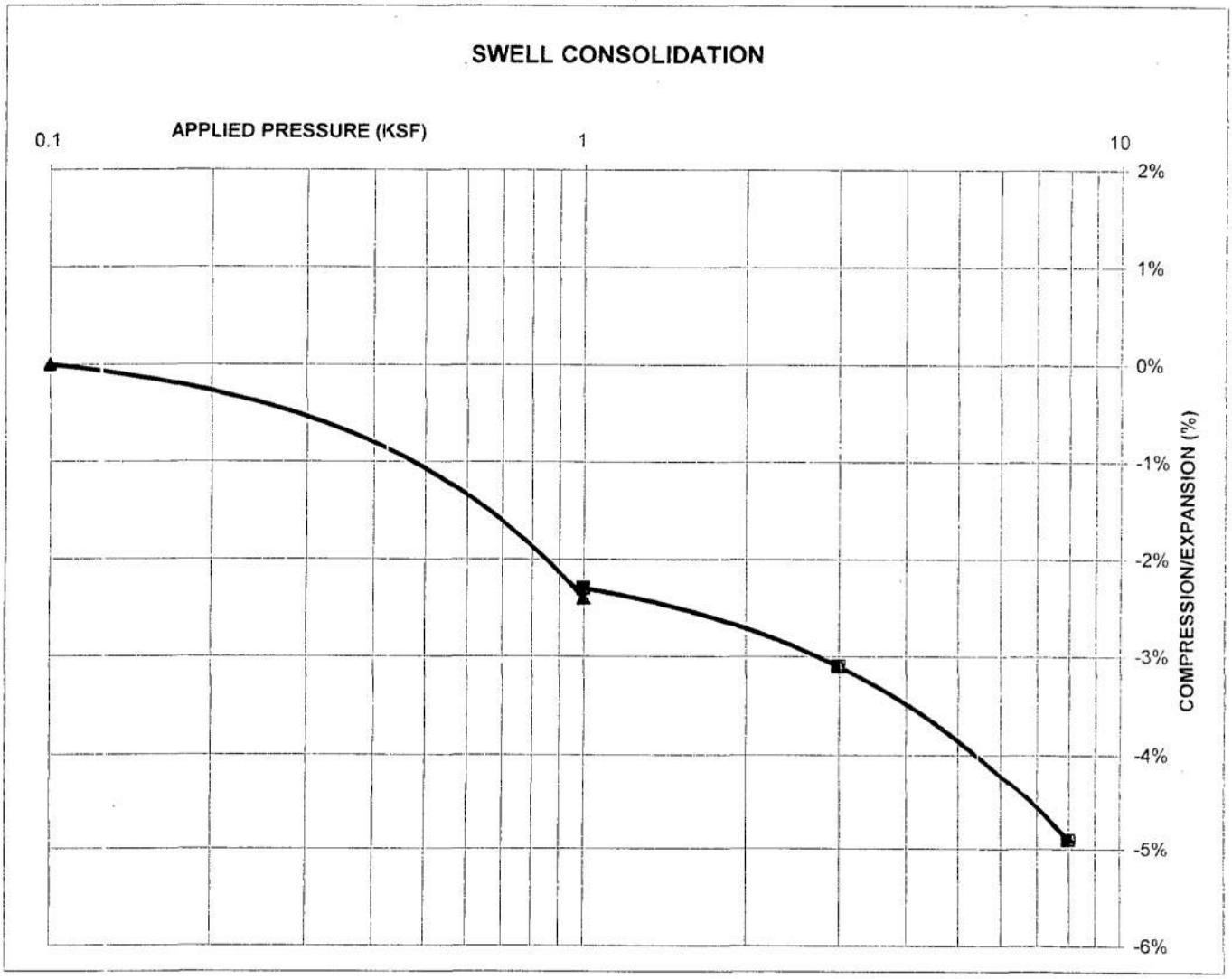
Drawn	Date	Checked	Date
		KAH	12/26/10

Job No. 39431
Fig. No. B-12

CONSOLIDATION TEST RESULTS

SAMPLE FROM:	TB7	AT DEPTH	10'
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			116
NATURAL MOISTURE CONTENT			15.4%
SWELL/CONSOLIDATION (%)			0.1%

JOB NO. 39431
CLIENT REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS



ENTECH ENGINEERING, INC.

SWELL CONSOLIDATION TEST RESULTS

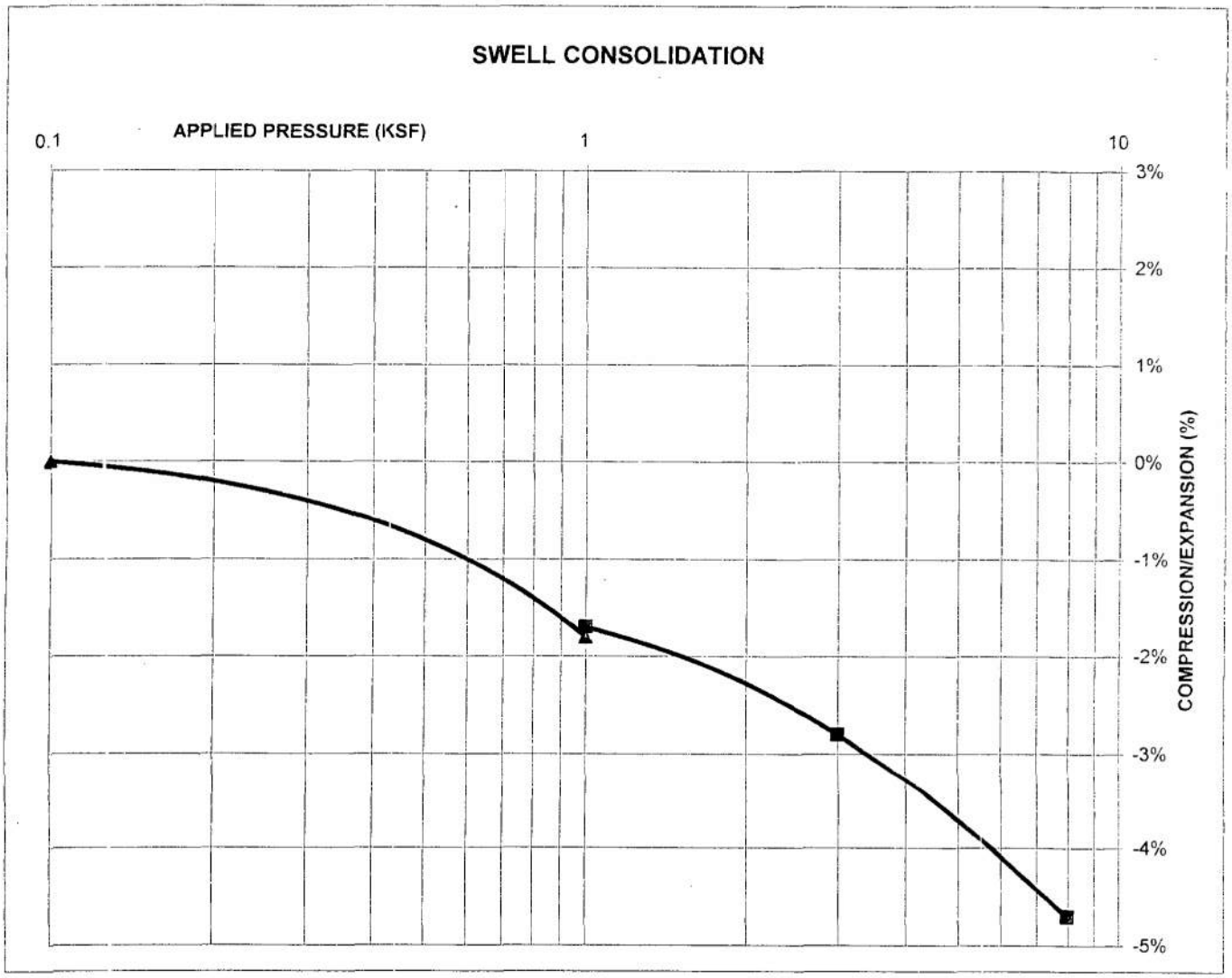
Drawn	Date	Checked	Date
		KAH	12/21/10

Job No. 39431
Fig. No. 5-13

CONSOLIDATION TEST RESULTS

SAMPLE FROM:	TB19	AT DEPTH	9'
DESCRIPTION	CL	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			107
NATURAL MOISTURE CONTENT			18.4%
SWELL/CONSOLIDATION (%)			0.1%

JOB NO. 39431
CLIENT REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS



ENTECH ENGINEERING, INC.

SWELL CONSOLIDATION TEST RESULTS

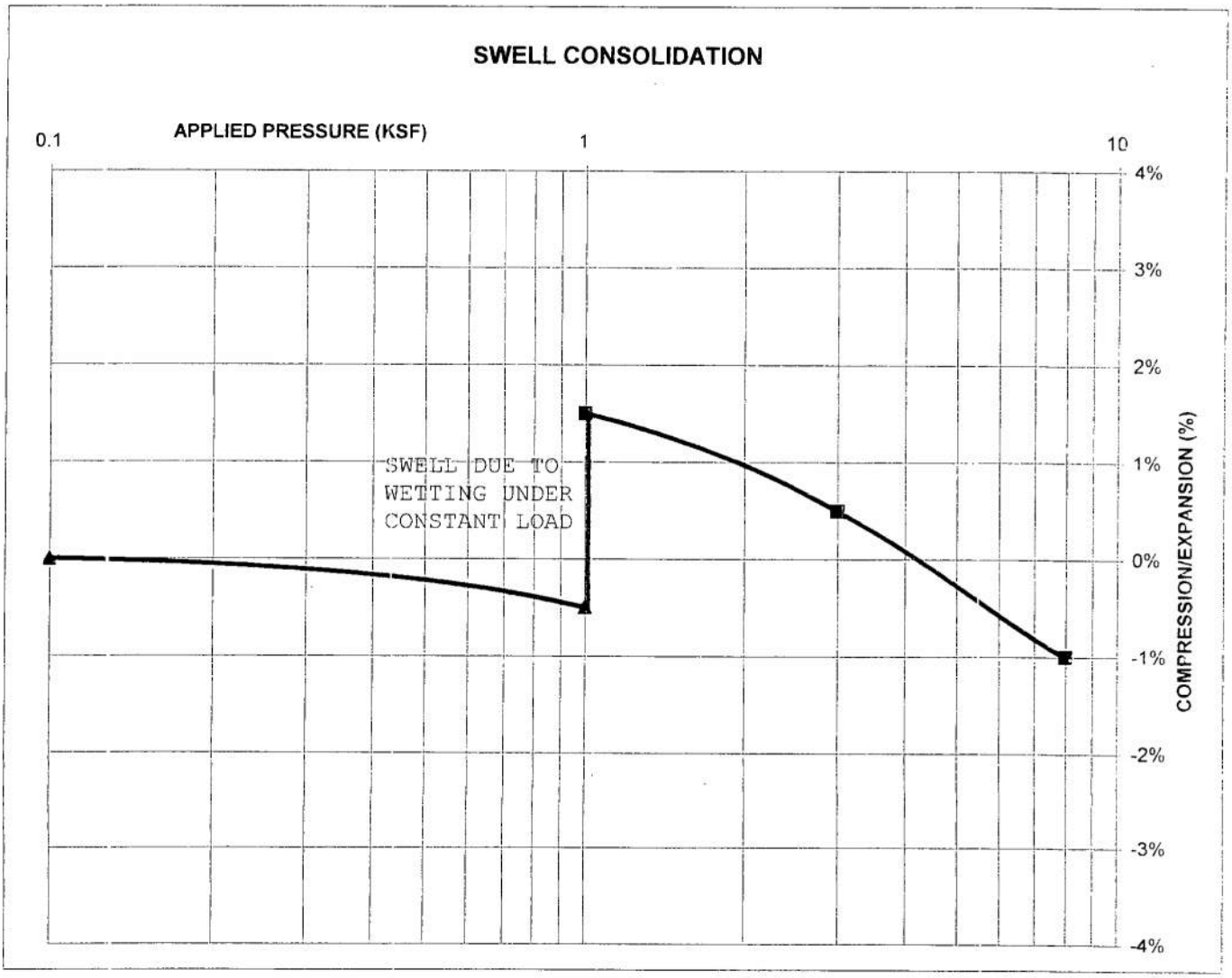
Drawn	Date	Checked	Date
		RAH	12/20/01

Job No. 39431
Fig. No. B-12

CONSOLIDATION TEST RESULTS

SAMPLE FROM:	TB9	AT DEPTH	2-3'
DESCRIPTION	SC	SOIL TYPE	4
NATURAL UNIT DRY WEIGHT (PCF)			119
NATURAL MOISTURE CONTENT			8.6%
SWELL/CONSOLIDATION (%)			2.0%

JOB NO. 39431
CLIENT REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS



ENTECH ENGINEERING, INC.

SWELL CONSOLIDATION TEST RESULTS

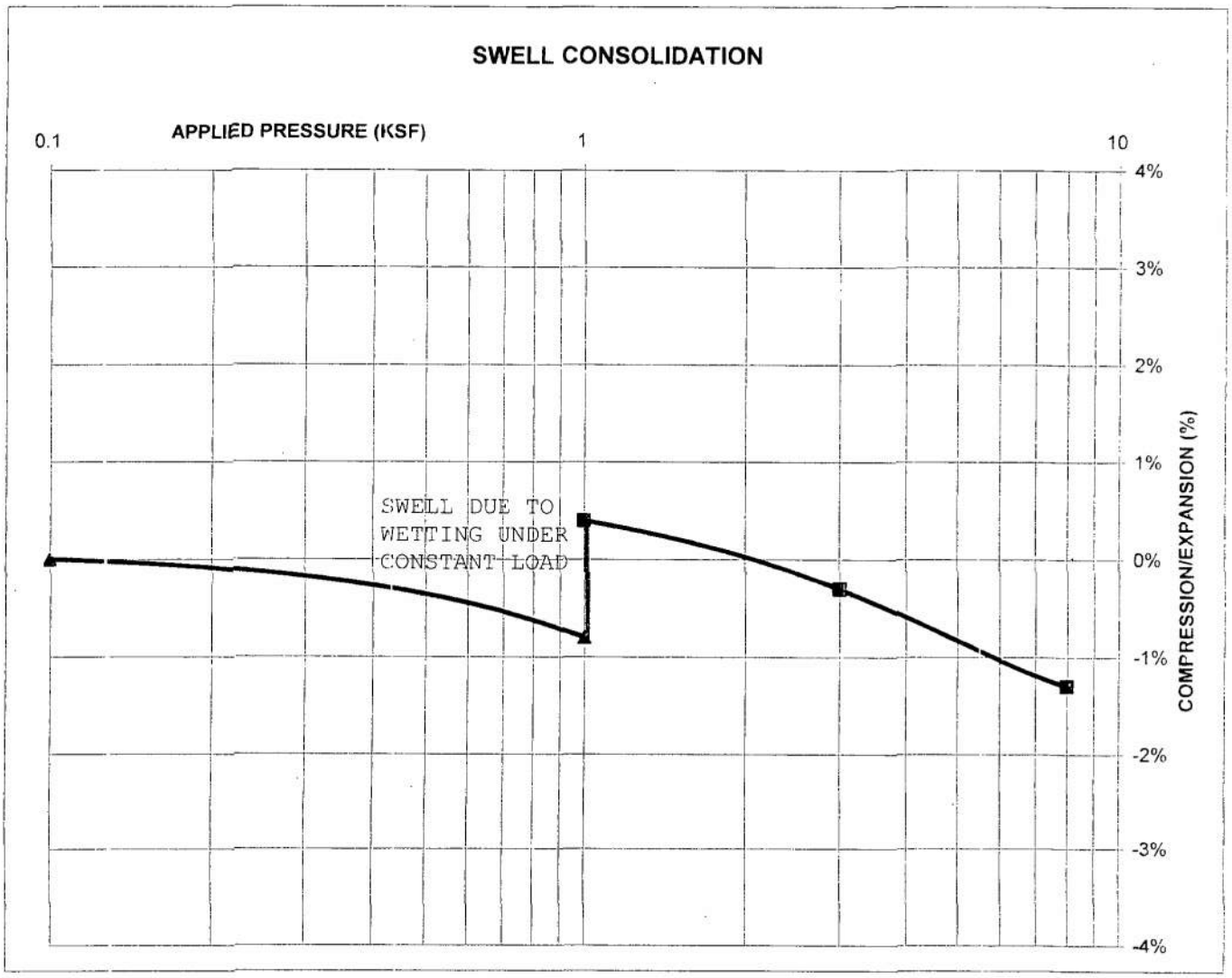
Drawn	Date	Checked	Date
		KAS	12/26/01

Job No. 39431
Fig. No. 5-15

CONSOLIDATION TEST RESULTS

SAMPLE FROM:	TB1	AT DEPTH	15'
DESCRIPTION	CL	SOIL TYPE	5
NATURAL UNIT DRY WEIGHT (PCF)			122
NATURAL MOISTURE CONTENT			12.4%
SWELL/CONSOLIDATION (%)			1.2%

JOB NO. 39431
CLIENT REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS



ENTECH ENGINEERING, INC.

SWELL CONSOLIDATION TEST RESULTS

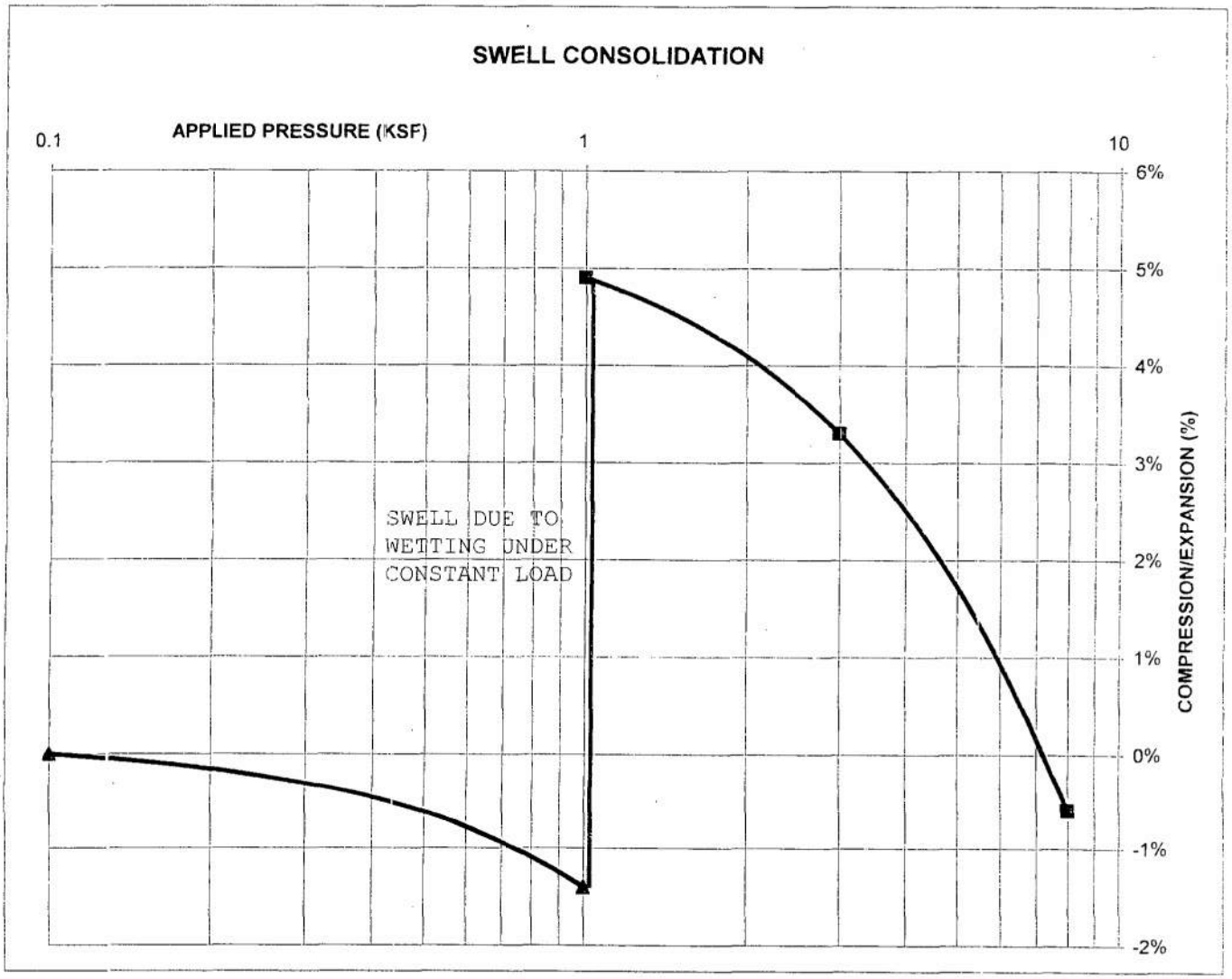
Drawn	Date	Checked	Date
		KAH	12/26/01

Job No. 39431
Fig. No. D-16

CONSOLIDATION TEST RESULTS

SAMPLE FROM:	TB12	AT DEPTH	10'
DESCRIPTION	CH	SOIL TYPE	5
NATURAL UNIT DRY WEIGHT (PCF)			105
NATURAL MOISTURE CONTENT			23.1%
SWELL/CONSOLIDATION (%)			6.3%

JOB NO. 39431
CLIENT REALTY DEVELOPMENT
PROJECT FALCON HIGHLANDS



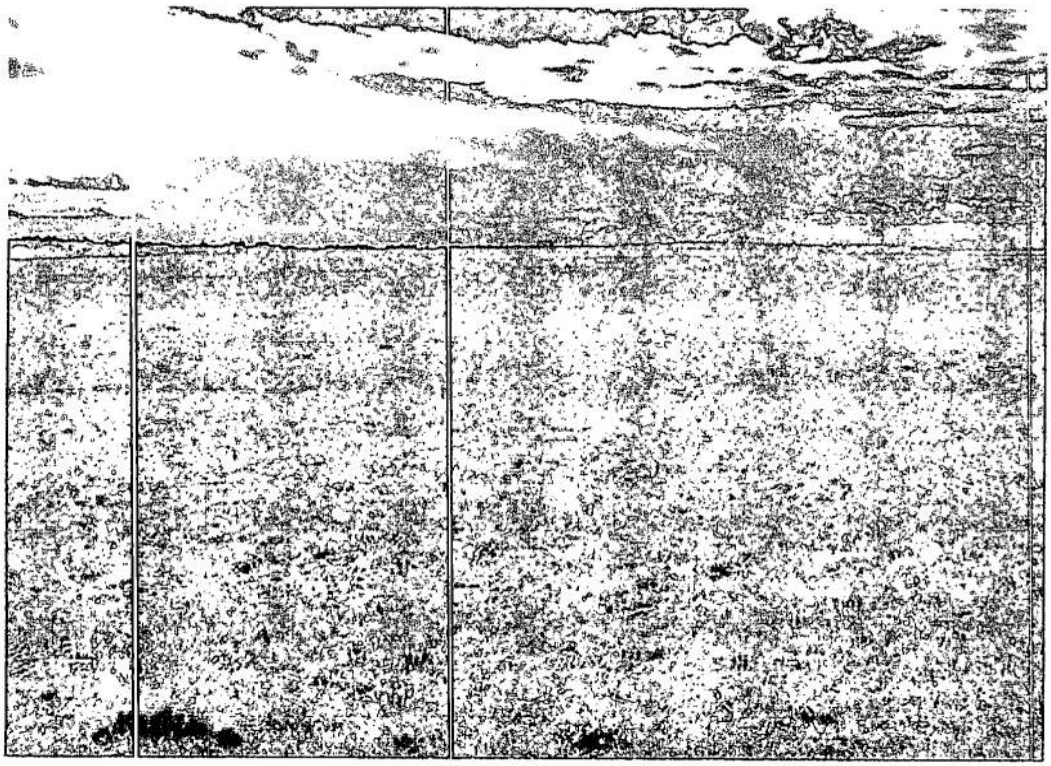
ENTECH ENGINEERING, INC.

SWELL CONSOLIDATION TEST RESULTS

Drawn	Date	Checked	Date
		KLH	12/26/01

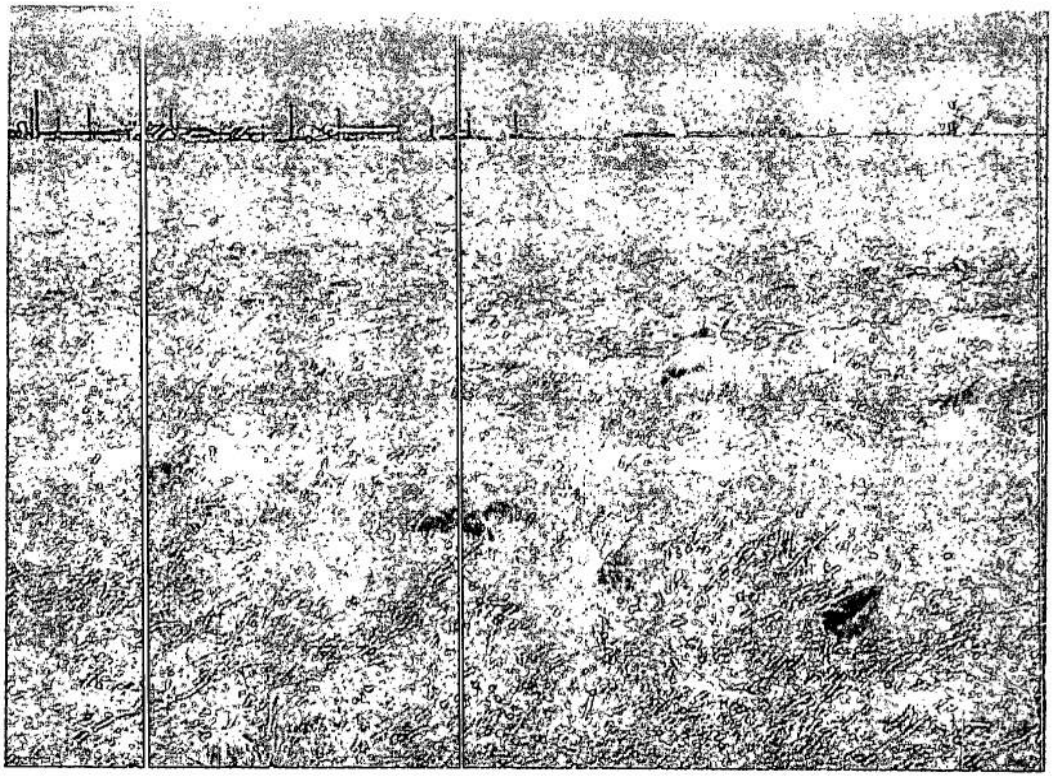
Job No. 39431
Fig. No. B-17

APPENDIX C: Site Photographs



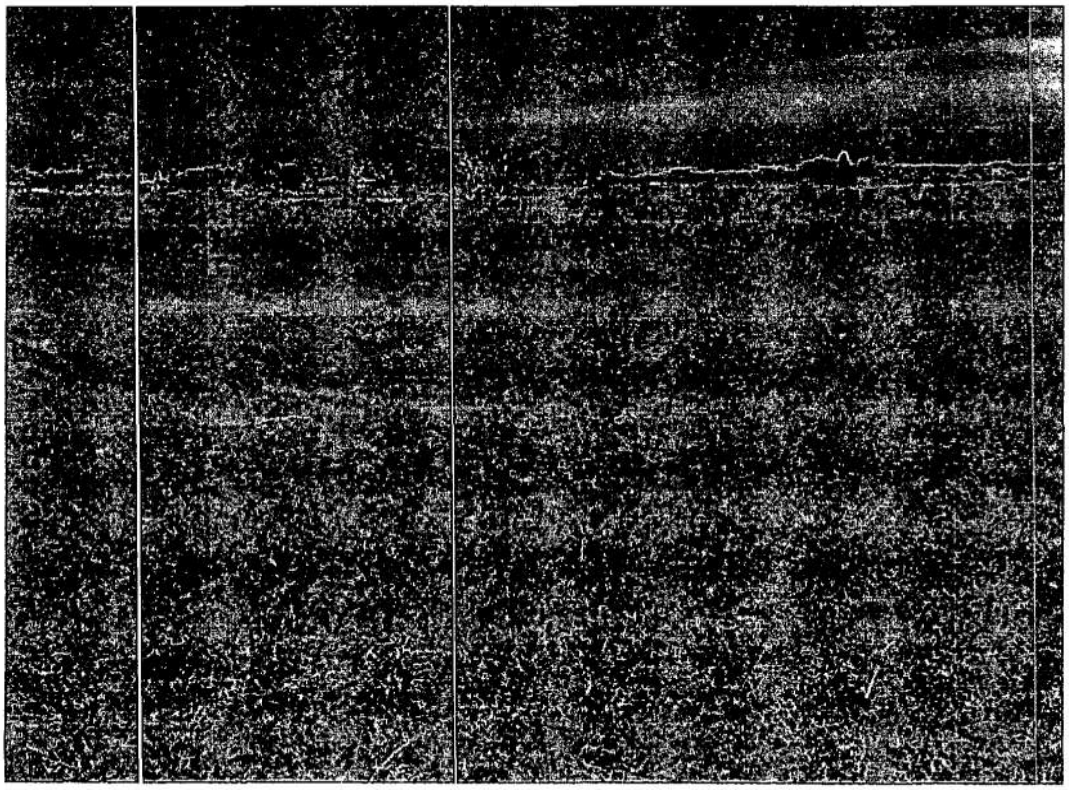
1

From center of site looking south.



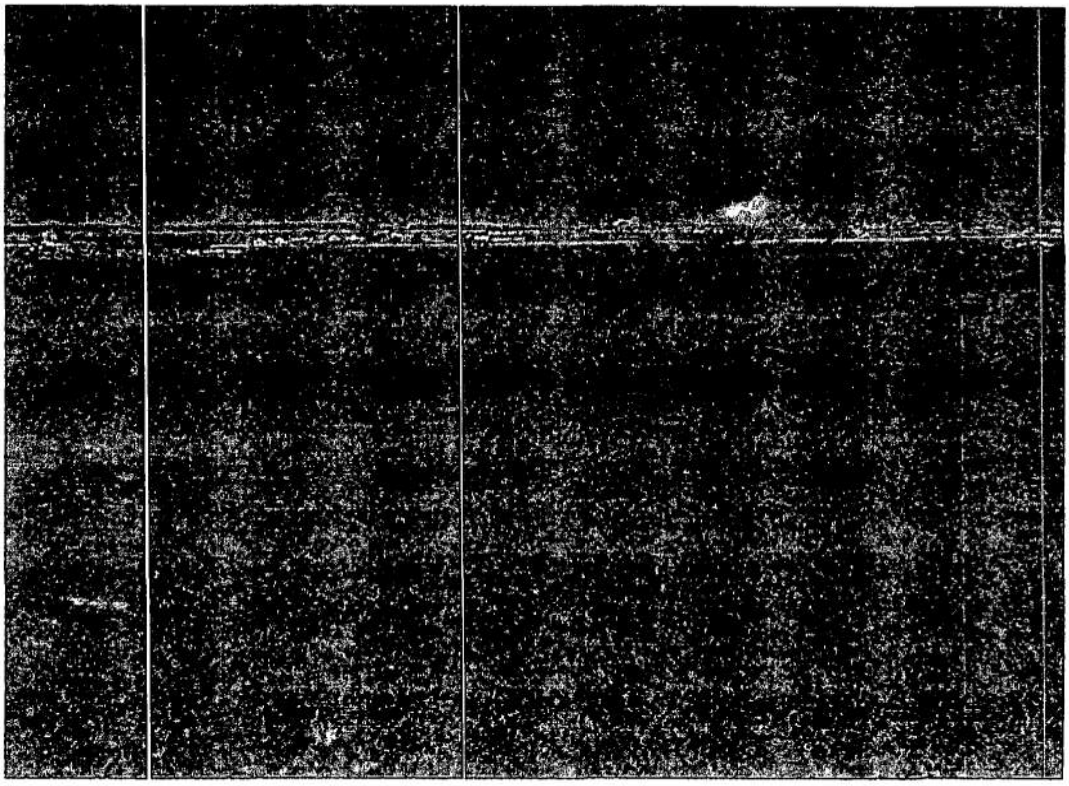
2

Northeast portion of site, seasonally wet area, looking east.



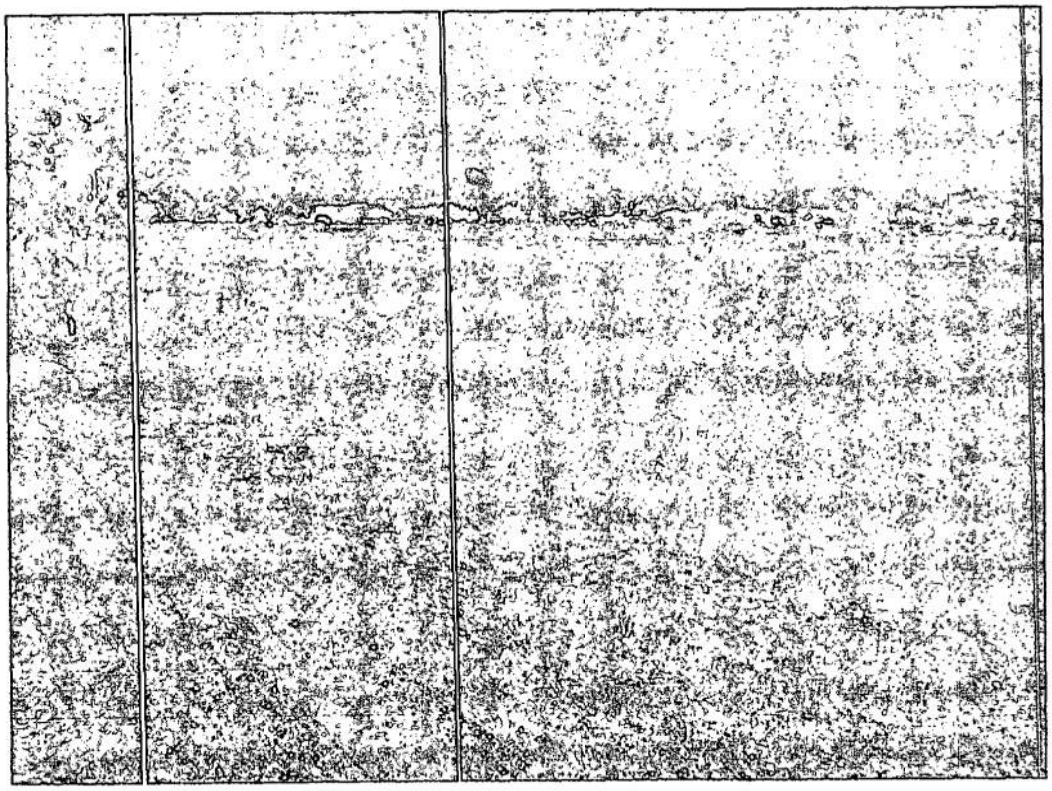
3

From southwest corner of site, looking east.



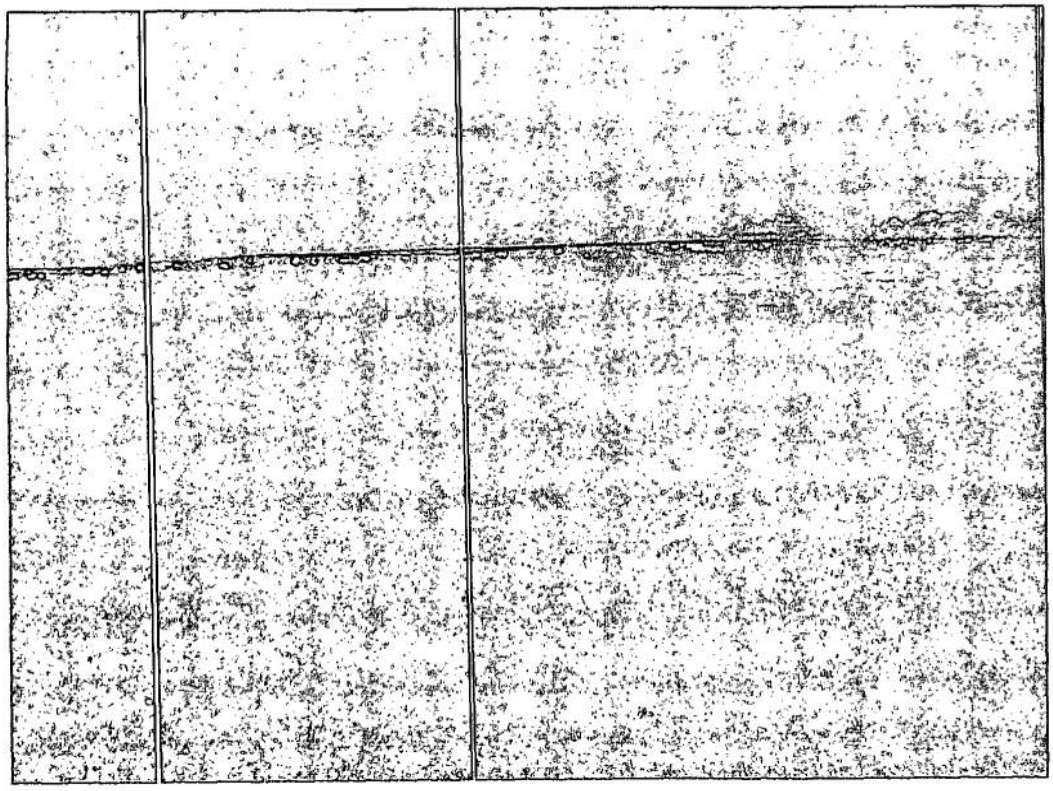
4

From southwest corner of site, looking north.



5

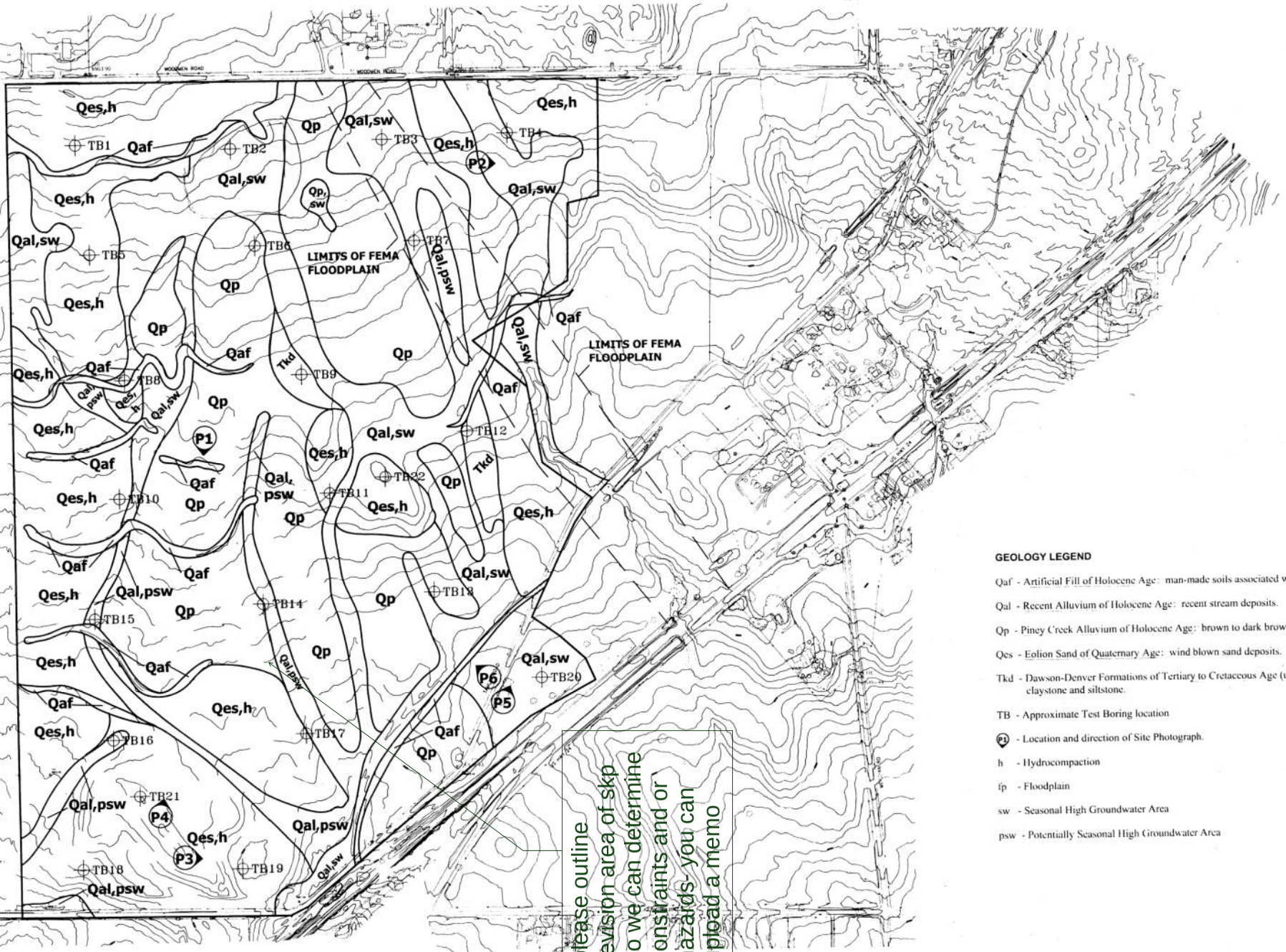
Looking northeast from Tamlin Road at southeast portion of site.



6

Looking northwest from southeast portion of site.

not legible



please outline revision area of skp so we can determine constraints and or hazards- you can upload a memo

GEOLOGY LEGEND

Qaf - Artificial Fill of Holocene Age: man-made soils associated with erosion berms

Qal - Recent Alluvium of Holocene Age: recent stream deposits.

Qp - Piney Creek Alluvium of Holocene Age: brown to dark brown, silty to clayey sands.

Qes - Eolion Sand of Quaternary Age: wind blown sand deposits.

Tkd - Dawson-Denver Formations of Tertiary to Cretaceous Age (undifferentiated): Sandstone, claystone and siltstone.

TB - Approximate Test Boring location

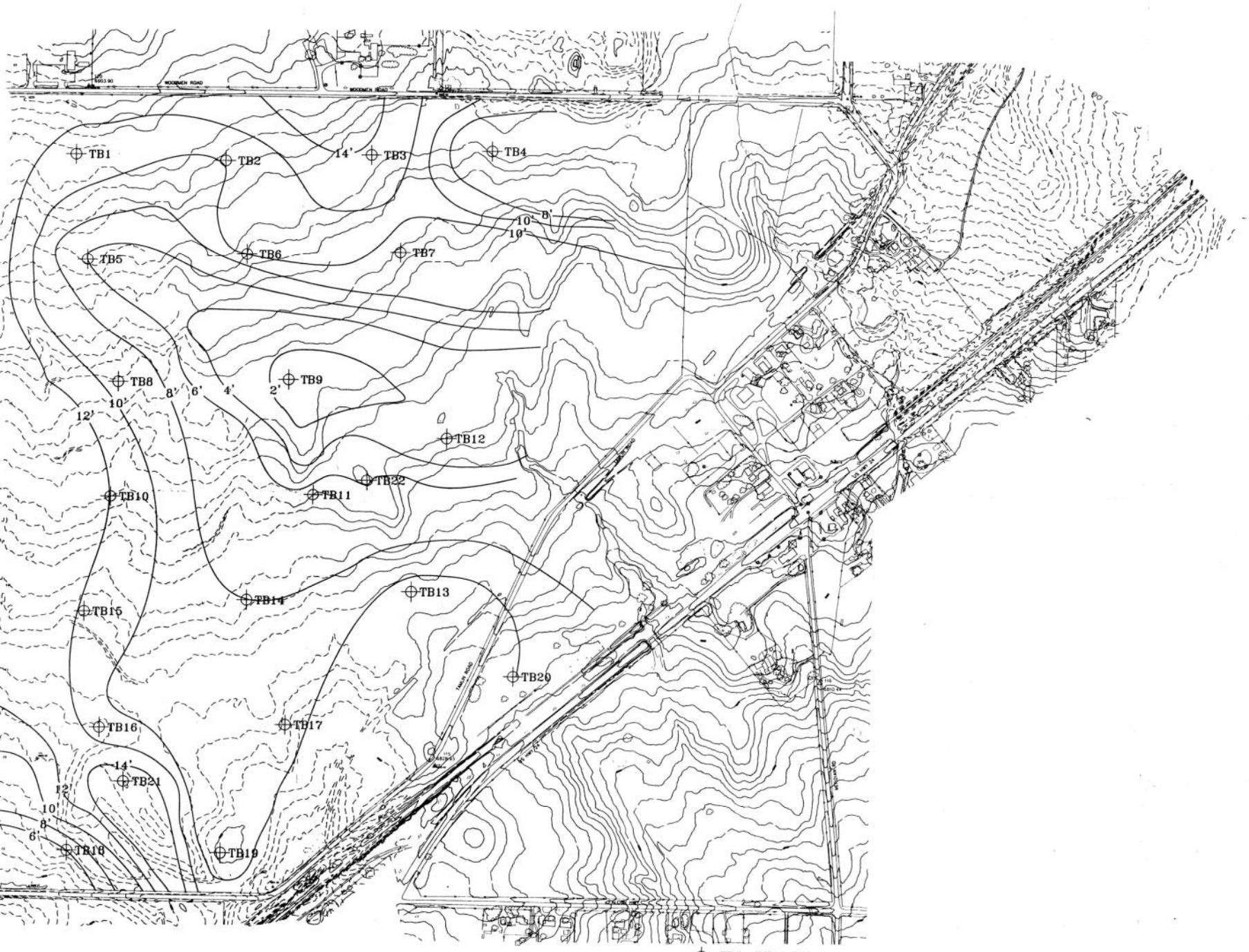
P1 - Location and direction of Site Photograph.

h - Hydrocompaction

fp - Floodplain

sw - Seasonal High Groundwater Area

psw - Potentially Seasonal High Groundwater Area



TB# INDICATES TEST BORING NUMBER AND APPROXIMATE LOCATION

DEPTH TO BEDROCK MAP

DRAWN:
CHECKED:
DATE:
SCALE:
JOB NO.

ENTECH
ENGINEERING, INC.

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

November 22, 2004

Realty Development Services
25 North Tejon Street, Suite 300
Colorado Springs, Colorado 80903

Attn: Mike Scott

Re: Addendum to Soil and Geology Study
Falcon Highlands Filing 2
Woodmen Road and Tamlin Road
El Paso County, Colorado

Dear Mr. Scott:

As requested, personnel of Entech Engineering, Inc. have reviewed the development and grading plans for Falcon Highlands Filing 2. Reference is made to the Soil and Geology Study for Falcon Highlands prepared by Entech Engineering, Inc., revised January 23, 2002 (Entech Job No. 39431).

The proposed development and grading plans are prepared by Terra Nova Engineering, Inc., dated October 14, 2004 (Job No. 0429.00) are presented in Figure 1. Areas to be cut include knolls on the property composed of Eolian Sand where bedrock and groundwater is deeper and areas for detention ponds in the southern portion of the site. Areas where groundwater is shallower are to be filled. This will further raise many areas above the groundwater level. Mitigation for seasonal shallow groundwater may still be necessary in some areas where the groundwater level approaches foundation levels. Foundations should be kept as high as possible above the groundwater levels and should penetrate a minimum of 30 inches for frost protection. The use of subsurface drains may be necessary to help prevent the intrusion of water into areas below grade. Additional investigation of each building site may be necessary to delineate the depth to groundwater.

It is our opinion that the geologic conditions will impose some constraints on construction on this site. These conditions can be satisfactorily mitigated through proper engineering design and construction practices. The geologic conditions and recommended mitigation techniques have been discussed in the Soil and Geology Study (Entech Job No. 39431). It is our opinion that development of this site can be achieved if the geologic conditions are properly mitigated.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Kristen A. Andrew-Hoeser
Professional Engineering Geologist

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

COLORADO REGISTERED JOSEPH COLLIN GOODE 23725 11/22/04 PROFESSIONAL ENGINEER

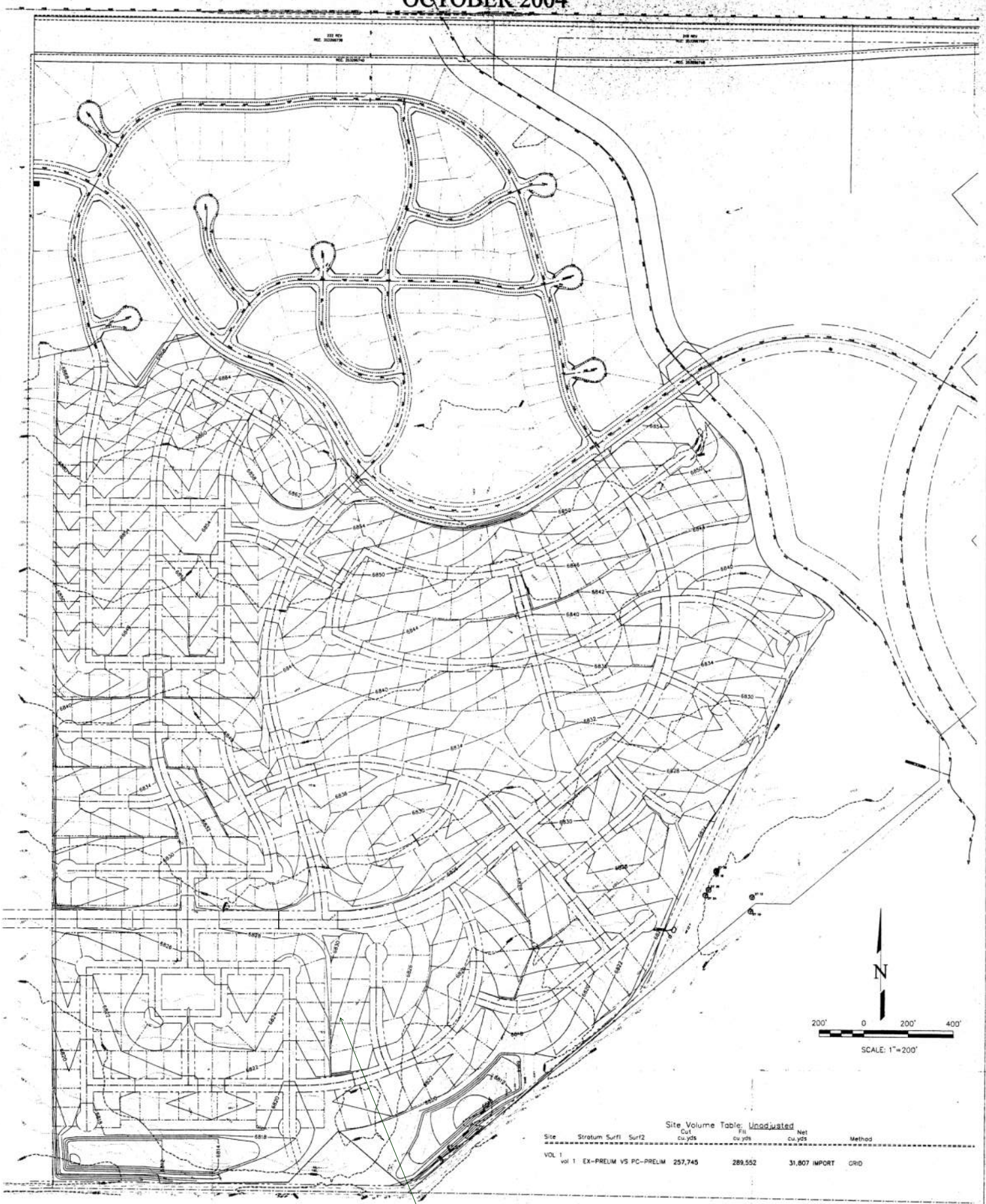
KAH/ek

Encl.

Entech Job No. 31784
2MSW/ltrs/2004/31784Adden

PRELIMINARY EARTHWORKS EXHIBIT

OCTOBER 2004



Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut cu.yds	Fill cu.yds	Net cu.yds	Method
VOL 1	vol 1	EX-PRELIM	VS PC--PRELIM	257,745	289,552	31,807 IMPORT	GRID

provide a resion to this sheet (SKP area impacted-can be a separate memo-)

JOB NO. 31784

FIC. NO.: 1

FALCON HIGHLANDS FILING NO. 2

125 N. WAHSATCH AVE., SUITE 101

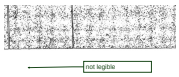
PREPARED FOR:

UNTIL SUCH TIME AS THESE

REVISIONS

Soils & Geology Report_V1 comment.pdf Markup Summary 12-7-2021

dsdparsons (3)



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please outline revision area of skp so we can determine constraints and or hazards- you can upload a memo

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provide a resion to this sheet (SKP area impacted-can be a separate memo-)