ROCKY MOUNTAIN GEOTECHNICAL, INC.
Achieving Harmony with Earth

SUBSURFACE SOILS INVESTIGATION
AND GEOLOGIC HAZARD REPORT
CIMARRON NORTHCREST NO. 3
COLORADO SPRINGS, COLORADO

December 28, 1982

Trend Development Systems
10190 Bannock Street, Suite 246
Denver, CO 80221

Gentlemen:

Transmitted herewith is the report giving the results of a subsurface soils investigation and geologic hazard study for the proposed residential construction at Cimarron Northcrest No. 3 in Colorado Springs, Colorado.

Respectfully submitted,

ROCKY MOUNTAIN GEOTECHNICAL

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Geotechnical Engineer

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SUMMARY

Project Location: This project is located in the eastern portion of Colorado Springs, and is bounded by the Chicago Rock Island and Pacific Railroad to the south and east, Constitution Avenue to the north and Peterson Road to the west.

Project Description: This project is to consist of the construction of prefabricated single family and multi-family residential structures. A commercial site will be located in the extreme northwest corner of the property.

Soil Type at Foundation Level: At typical shallow foundation depths, soils on this site were found to consist of stratified silty to clayey sand and sandy clay and silt.

Foundation Type: A shallow foundation system consisting of continuous footings beneath bearing walls and isolated spread footings beneath columns and other points of concentrated load would be appropriate to transfer the weight of the proposed structures to the bearing soil. For residential construction on this site, the prefabricated form system which tapers to a 16-inch footing appears to be appropriate.

Bearing Capacity: The bearing capacity at typical shallow foundation depths was found to vary across the site depending on the bearing soil. The maximum allowable bearing capacity was found to range from 2000 psf to 3500 psf, with no minimum dead load requirement.

Floor Slabs: Floor slabs should be separated from structural components to allow for vertical movement. Control joints are recommended at a 30-foot maximum spacing each way.

Drainage: Positive surface drainage is essential. In addition, a subsurface perimeter drain would be recommended around living areas or usable space located below finished exterior grade.

Land Use and Engineering Geology: In general, this site was found to be suitable for the proposed type of development. However, areas were encountered where the prevailing geologic conditions will impose certain constraints upon development and land use. These include areas subject to a potential for the phenomenon of hydrocompaction. These conditions will be discussed in much greater detail in the body of this report.

More complete discussion and additional recommendations can be found in the body of this report. All recommendations are subject to the limitations set forth herein.

GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION:

This site is located in the eastern portion of the city of Colorado Springs, Colorado. The site is bounded on the south and east by the Chicago Rock Island and Pacific Railroad, to the north by Constitution Avenue, and to the west by Peterson Road. The location of this project is indicated on the enclosed Site Location Diagram.

It is our understanding that this project will consist of the construction of single family and multi-family residential structures. A commercial area is planned in the extreme northwest corner of the site. The residential structures will be prefabricated and prefabricated foundation form systems will be used to provide for foundation walls which taper to 16-inch wide spreadfootings at the bearing level. Foundation loads for this type of construction are anticipated to range from light to moderate in magnitude. The foundation system for the commercial structure will be cast-in-place concrete, and the foundation loads are expected to be moderate.

FIELD INVESTIGATION:

The field investigation on this site consisted of the drilling of 19 test borings, located as shown on the enclosed geologic map. The test borings were advanced with a power-driven rotary drilling rig to depths ranging from 19 to 20 feet below the ground surface. Soil samples were obtained utilizing a two-inch OD split-barrel sampler. Bulk sampling methods were also utilized. The results of the Standard Penetration Tests, ASTM D-1586, are shown on the Drilling Logs to the right of the sampling points in the column labeled "Blows per Foot". For example, a value of 16 in this column indicates that 16 hammer blows were required to achieve 12 inches of penetration of the sampling spoon into the soil strata. In all cases, the Standard Penetration Tests were performed using a hammer weighing 140 pounds, which was dropped from a height of 30 inches for each blow. Samples were typically attempted at intervals of 5 feet, or staggered as deemed necessary by our field representative during drilling. Field logs are available for inspection upon request to our office.

With respect to the geologic reconnaissance, our field investigation on this site consisted of detailed field mapping resulting in the production of a detailed geologic map of the significant surficial deposits. This mapping also produced an engineering geologic map identifying pertinent geologic hazards affecting development. Due to the relative simplicity of geologic conditions on this particular site, these two maps were combined into a single map for this report. Our mapping procedures involved field reconnaissance and measurements and air photo reconnaissance and interpretation.

LABORATORY TESTING PROGRAM:

The laboratory testing program consisted of moisture content determination, ASTM D-2216, on each of the soil samples recovered from the field. The soil samples were grouped based on visual classification and the laboratory classification test series was performed on each group. The test series included grain size analysis, ASTM D-422, liquid limit, ASTM D-423, and plastic limit and plasticity index, ASTM D-424. A laboratory swell test was performed on the soil material which exhibited a swell potential. The results of the moisture content testing are shown on the Drilling Logs to the right of the sampling points in the column labeled "Water Content". The results of the classification tests and the swell test are shown on the enclosed Laboratory Test Results Sheet for each soil type.

GENERAL GEOLOGY:

Pysiographically, the site lies in the extreme western portion of the Great Plains Physiographic Province. Approximately ten miles 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 northeasterly direction. The rocks in the area of the site are sedimentary in nature, and typically Tertiary to Cretaceous in age, spanning the boundary between the Cenozoic and Mesozoic eras of geologic time. On this particular site, however, no outcrops of the underlying bedrock were observed. Bedrock is obscured by a thick cover of alluvial materials of Quaternary Age. The bedrock present immediately beneath this alluvium is the Dawson Arkose Formation of Cretaceous age. The site's stratigraphy will be discussed in more detail in the following section.

SITE STRATIGRAPHY

Two mappable geologic units were identified on this site, which may be identified as follows:

Q_{al} - Alluvium of Quaternary Age: This material is a water deposited alluvium, typically occurring as a silty to clayey sand, brown to light brown in color.

Q_{es} - Eolian Sand of Quaternary Age: These deposits are medium to fine grained sands, silty sands and silt, often clayey, brown to light brown in color. They have been deposited on the site by the action of prevailing winds from the west and northwest. They typically occur as large stabilized dune deposits.

The approximate location and boundaries of the above described deposits will be found in the geologic map in the Appendix of this report. A more detailed description of the soil types observed in drilling will be found in the following section.

SUBSURFACE SOIL CONDITIONS:

The soil profile encountered during drilling can be divided into a three-layer system. Each soil sample was classified in accordance with the Unified Soil Classification System. The first material, Soil Type No. 1, was classified as a low plasticity clay (CL), while the second and third materials, Soil Types No. 2 and No. 3, were classified as silty sand (SM). The silty sand of Soil Type No. 2 appeared to be an eolian sand while the silty sand of Soil Type No. 3 appeared to be a residual soil derived from the Dawson formation. The occurrence of each soil type can be seen on the enclosed Drilling Logs, along with a further description of each unit.

No free water surface or ground water table was observed in any of the test borings placed on this site. Subsurface moisture content would be expected to increase following development and construction, due to the influence of drainage alterations and landscape irrigation.

ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS:

As mentioned previously, detailed mapping has been performed on this site to produce and engineering geology map which will be found in the Appendix of this report. This map shows the location of various geologic hazards of which the developers should be cognizant during the planning, design and construction stages of the project. For this particular site, the only significant geologic hazard is as follows:

h - Hydrocompaction Area: Areas in which this hazard has been identified are acceptable as building sites. However, in areas identified for this hazard classification, we anticipate a high potential for large settlement movements from saturation of these surficial soils. The low density, uniform grain sized, windblown sand and silt deposits are particularly susceptible to this type of phenomenon. Although the alluvial soil present on site in the valley floor areas may also have a mild settlement potential, the potential magnitude of movement is not so severe as to be considered a serious threat to permanent structures on site.

Mitigation: The potential for this large settlement movement is directly related to saturation of the soil below the foundation area. 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 at all points, and water must not be allowed to stand or pond anywhere on the site. We would recommend that the ground surface within 10-feet of the structures be sloped away with a minimum gradient of roughly 5% where possible. 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 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.

ECONOMIC MINERAL RESOURCES:

Some of the sand associated with the eolian sand deposits could be considered a low grade sand resource. However, in general, these materials contain far too much silt and clay to make them valuable as an aggregate source.

EROSION CONTROL:

The soil types observed on this site are moderate to highly susceptible to wind erosion and moderate 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 palliatives may be required to control the dust. However, once construction has been completed and vegetation reestablished, the potential for wind erosion should be considerably reduced.

With regard to water erosion, for the typical soils observed on site, allowable velocities for unvegetated and unlined earth channels would be on the order of two to three feet per second depending on the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of four to six feet per second depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material will 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 will 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 other special erosion 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 sheet wash 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 steeper than 3 horizontal:1 vertical will become increasingly more difficult to revegetate successfully. Due to the rather mild topographic conditions on this particular site, we would generally not anticipate steep cut slopes. However, should cut slopes exceed a gradient of 3:1, recommendations pertaining to the vegetation of cut and fill slopes should involve input from a qualified landscape architect and/or the Soil Conservation Service.

CONCLUSIONS AND RECOMMENDATIONS:

The discussion in this section is based upon the subsurface soil conditions encountered in the test borings and on the building characteristics previously described. If subsurface conditions differing from those described in this report are noted during construction or the project characteristics are significantly altered, then Rocky Mountain Geotechnical should be notified so that our recommendations can be reviewed and adjusted if necessary.

A shallow foundation system consisting of continuous footings beneath all bearing walls and isolated spread footings beneath columns and other points of concentrated load would be appropriate to transfer the weight of the proposed residential and commercial structures to the bearing soil. Based on the soil types encountered during the drilling program, foundations may be proportioned on the basis of an allowable bearing capacity ranging from 2000 to 3500 psf maximum with no minimum dead load requirement. However, inspection of the foundation excavation should be made prior to final foundation design to determine the recommended allowable bearing capacity.

It is our understanding that foundation construction for the residential structures on this site will utilize prefabricated forms, which will result in a foundation wall with a 16-inch footing at the bearing level. For typical residential construction, the contact stress imposed by a 16-inch footing foundation would not be expected to exceed the lowest maximum allowable bearing capacity previously mentioned. Based on the soils encountered during the drilling program, no minimum dead load requirement is warranted. However, if an expansive soil is encountered on any site and maintenance of a minimum dead load becomes necessary, then consideration must be given to altering the foundation system to meet the minimum dead load requirement.

We suspect that a cast-in-place concrete foundation system will be used for the commercial structure. Test borings TH-18 and TH-19 were placed in the vicinity of this building. Based on the results of the borings in this area, an allowable bearing capacity of 2000 psf should be used for proportioning shallow foundations. No minimum dead load pressure would be required for this structure based on the available soils information.

Foundation walls which will retain in excess of four feet of soil may be designed on the basis of an equivalent active hydrostatic fluid pressure of 32 pcf.

Floor slabs, if used, should be placed directly on grade on this site. A capillary break or a gravel bed would not be required.

Due to the stratified nature of the soils on this site, the potential for subsurface seepage does exist. Thus, we would recommend that a subsurface perimeter drain line be used around any living areas or usable space located below finished exterior grade. The perimeter drain line should consist of a perforated plastic pipe, surrounded by a gravel bed with an appropriate sand filter or filler fabric. The drain line should be set to flow by gravity to a daylighted outfall or to a sump and pump.

Additional recommendations pertaining to the design and construction of shallow foundation systems will be found in the appendix of this report under "General Design and Construction Specifications for Shallow Foundations".

We hope this report has provided you with the recommendations you required and that it is presented in an understandable way. Should any of the points be unclear or should you desire additional information, please do not hesitate to contact our office. It should also be pointed out that due to the nature of data obtained by random sampling of such variable and heterogeneous material as soil, it is important that we be informed of any differences observed between subsurface conditions encountered during construction and those outlined in the body of this report. Construction and design personnel should be made familiar with the contents of this report. Reporting such discrepancies to Rocky Mountain Geotechnical soon after they have been discovered will be greatly appreciated and will possibly help avoid construction problems.

Rocky Mountain Geotechnical appreciates the opportunity to have worked with you on this project and looks forward to the prospect of working with you again in the future. We will be happy to service any of your geotechnical engineering or quality control testing needs.

GENERAL DESIGN AND CONSTRUCTION SPECIFICATIONS FOR SHALLOW FOUNDATIONS:

1. Shallow foundations should be located a minimum depth of 2.5 feet below the ground surface for frost protection.
2. Where balancing of foundation pressures is indicated to be of importance, the following general criteria should be applied: Balancing of foundation pressures should be on the basis of dead load only for single-story structures with floor slab on grade, or dead load plus one-half live load for multi-story structures or single-story structures with structural floor. Isolated pad foundations not located beneath grade beams are typically associated with much higher live load to dead load ratios. We would, therefore, recommend that isolated column pads be balanced on somewhat higher pressures, or on the basis of dead load plus one-quarter live load.
3. Stemwalls should be designed as grade beams capable of spanning at least 12 feet under the design load. Reinforcing should be placed at both top and bottom of the grade beam.
4. Floor slabs should be separated from structural portions of the foundation to allow for vertical movement. In the case of all structures resting on expansive soils (those having a recommended minimum dead load pressure) all non-bearing partitions should be voided at either the top or bottom (preferably at the bottom) to allow for slab movement without affecting the structure above. In order to help control slab cracking, control joints would be recommended at a 30-foot maximum spacing each way.

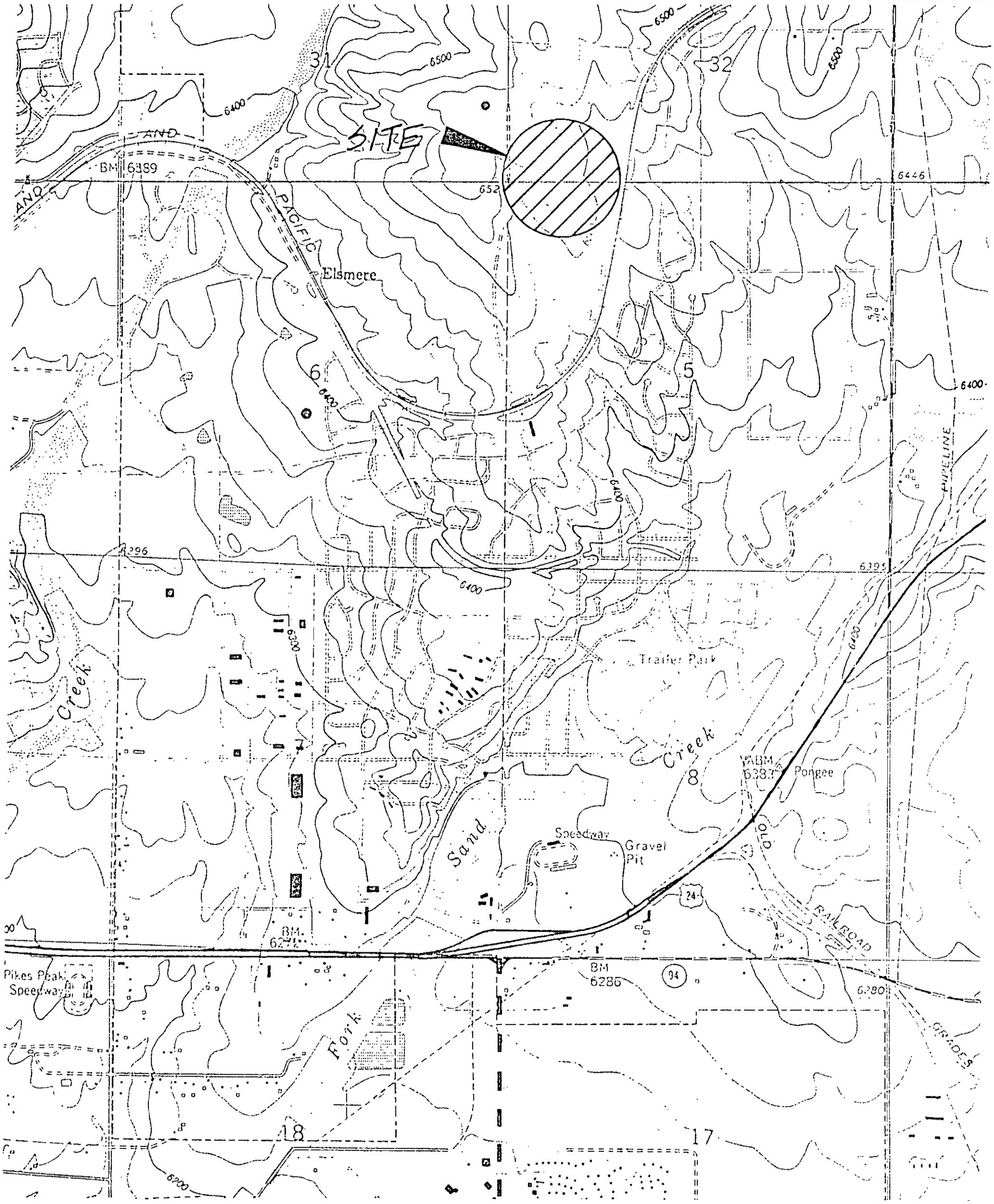
5. The ground around the structures should be positively sloped away from the structure at all points, and water must not be allowed to stand or pond anywhere on the site. The ground surface within 10 feet of the structures should be sloped away with a minimum gradient of roughly 5% in landscaped areas and 2% in paved areas where possible. 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 structure. Roof drains should be made to discharge well away from the structure 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.

6. Backfill placed around the foundation and in utility trench areas should be compacted to a minimum of 90% of maximum Proctor density, ASTM D-698. Materials should be placed in lifts having a compacted thickness of 6 inches or less, and at a moisture content conducive to good compaction (generally within plus or minus 2% of the optimum Proctor moisture content). Mechanical methods should be used in the placement of backfill. No water flooding techniques of any type should be used in the compaction of backfill on the site.

If it is not possible to fully comply with compaction recommendations around the foundation area, then it must be recognized that a considerable amount of settlement is likely to occur in this backfill over time, and the higher permeability material will collect subsurface water. In such cases, care must be taken to maintain positive grading around the structure, over time, so that flatwork is not permitted to drain into the structure and that a depression or water trap is not created immediately against the foundation area.

7. After consideration of the sulfate content and/or other engineering properties of the soils on the site, a Type II cement is recommended for use in all concrete in contact with the soil on the site. Under no circumstances should calcium chloride ever be used in a Type II cement.

8. The open foundation excavation should be inspected prior to construction of the foundation in order to verify that no anomalies are present, that materials of the proper design bearing capacity have been encountered, and that no soft spots or debris are present in the foundation area.



SITE LOCATION DIAGRAM
CIMARRON NORTHCREST - FILING 3
COLORADO SPRINGS, COLORADO

N

SCALE: 1"= 2000'

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LOG OF TEST HOLE NO. 1	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, CLAYEY, SLIGHTLY SILTY, LOW DENSITY, LOW MOISTURE, LIGHT BROWN		▨		BULK	13.3	1
		▨	■	9	17.4	1
		▨	■	12	11.5	1
MODERATE DENSITY AT 5'	5	▨				
		▨	■	19	7.4	1
	10	▨				
HIGH DENSITY AT 14'		▨	■	20	9.6	1
	15	▨				
SANDIER AT 17'		▨				
	20					
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO. 2	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, CLEAN TO SILTY TO CLAYEY, LOW TO MODERATE DENSITY, LOW MOISTURE, LIGHT BROWN		▨				
		▨	■	12	6.0	1
	5	▨				
HIGH DENSITY AT 10'		▨	■	21	7.3	1
	10	▨				
		▨		BULK	7.6	1
		▨	■	20	8.0	1
	15	▨				
SAND, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN		▨	■	30	4.1	1
	20					
	25					
	30					
	35					
	40					
	45					
	50					

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LOG OF TEST HOLE NO. 3	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, SILTY TO CLAYEY, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN	5		■	21	9.2	1
	10		■	22	9.2	1
	15		■	23	9.1	1
FINE TO COARSE SAND, SILTY, TRACE GRAVEL, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN	20		■	19	24	3
	25					
	30					
	35					
	40					
	45					
	50					

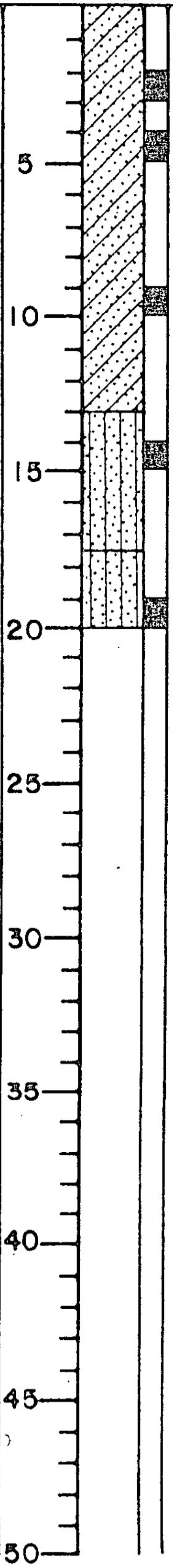
LOG OF TEST HOLE NO. 4	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, SILTY TO CLAYEY, HIGH DENSITY, LOW TO MODERATE MOISTURE, LIGHT TO MEDIUM BROWN	5		■	17	7.5	1
CLAY LENS AT 9'	10		■	20	8.5	1
FINE TO COARSE SAND, SILTY, TRACE GRAVEL, HIGH DENSITY, LOW MOISTURE, LIGHT TO MEDIUM BROWN	15		■	25	16.5	3
	20		■	37	3.9	3
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO. 5

SAND, SILTY TO CLAYEY, MEDIUM DENSITY, LOW TO MODERATE MOISTURE, LIGHT TO MEDIUM BROWN

FINE TO MEDIUM SAND, LOCAL CLAY LENSES, LOW DENSITY, LOW MOISTURE, LIGHT BROWN

FINE TO COARSE SAND, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN

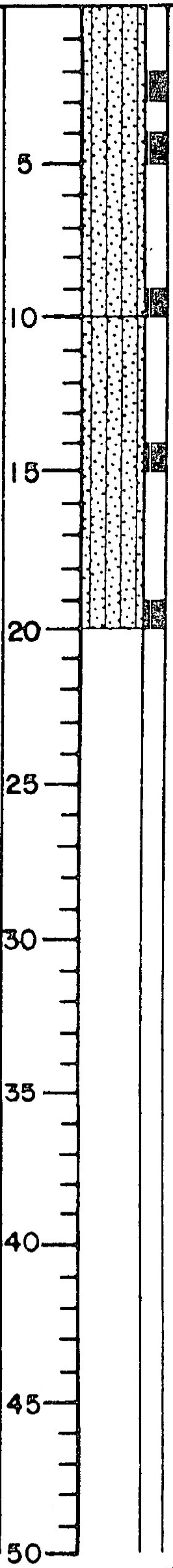


Blows per ft.	Water Content %	Soil Type
20	9.1	1
14	10.1	1
13	9.5	1
7	9.1	2
20	4.5	3

LOG OF TEST HOLE NO. 6

FINE TO MEDIUM SAND, SILTY TO CLEAN, STRATIFIED, LOW DENSITY, LOW MOISTURE, LIGHT BROWN

SILT, SANDY, MEDIUM TO HIGH DENSITY, LOW MOISTURE, LIGHT BROWN



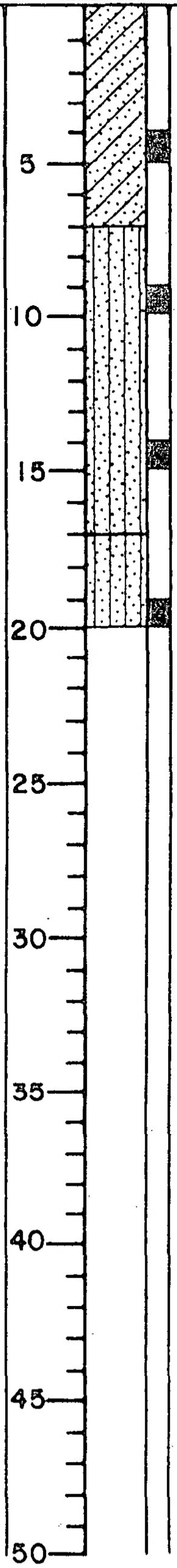
Blows per ft.	Water Content %	Soil Type
8	7.6	2
8	6.4	2
11	6.0	2
15	9.9	1
25	8.8	1

LOG OF TEST HOLE NO. 7

CLAY, SAND AND SILT, STRATIFIED, LOW DENSITY, MODERATE MOISTURE, LIGHT TO MEDIUM BROWN

FINE TO COARSE SAND, CLEAN TO SILTY, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN

FINE TO COARSE SAND, TRACE GRAVEL, HIGH DENSITY, LOW MOISTURE, BUFF TO TAN

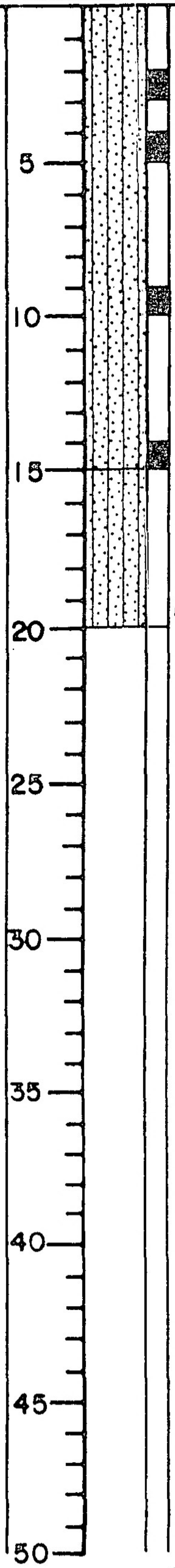


Blows per ft.	Water Content %	Soil Type
10	18.1 10.1	1
24	6.1	2
18	10.8	2
41	2.5	3

LOG OF TEST HOLE NO. 8

FINE TO COARSE SAND, CLEAN TO SILTY, LOW DENSITY, LOW MOISTURE, LIGHT BROWN

FINE TO COARSE SAND, SOME GRAVEL, MEDIUM DENSITY, LOW MOISTURE, LIGHT BROWN



Blows per ft.	Water Content %	Soil Type
3	7.7	2
4	7.9	2
5	10.0	2
12	7.8	2
BULK	2.0	3

LOG OF TEST HOLE NO. 9

LOG OF TEST HOLE NO. 9	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
FINE TO COARSE SAND, SILTY TO CLEAN, LOW DENSITY, LOW MOISTURE, LIGHT BROWN	5	▒	■	10	5.2	2
	10	▒	■	11	2.8	2
SILT, SANDY, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN	15	▒	■	19	5.6	1
	20	▒	■	19	8.9	1
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO. 10

LOG OF TEST HOLE NO. 10	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, CLAYEY TO SILTY, HIGH DENSITY, LOW TO MODERATE MOISTURE, LIGHT BROWN		▨	■	27	5.3	1
	5	▨	■	18	16.1	1
MEDIUM DENSITY AT 10'	10	▨	■	11	12.1	1
FINE TO COARSE SAND, MEDIUM DENSITY, LOW MOISTURE, LIGHT BROWN	15	▒	■	14	3.3	3
	20					
	25					
	30					
	35					
	40					
	45					
	50					

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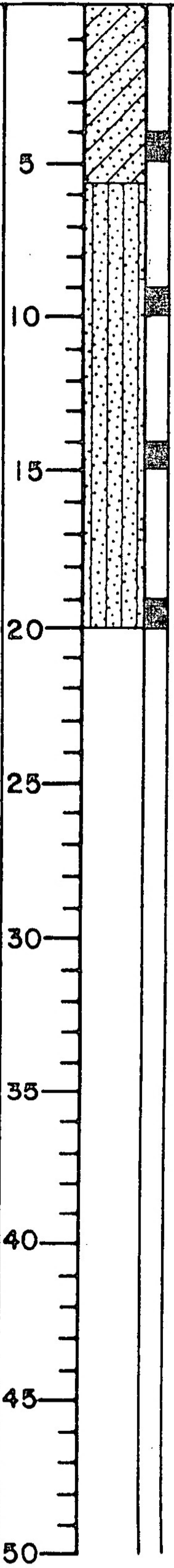
LOG OF TEST HOLE NO. 11

CLAY, SANDY, STRATIFIED, LOW DENSITY, MODERATE MOISTURE, MEDIUM BROWN

FINE TO COARSE SAND, TRACE GRAVEL, MEDIUM TO HIGH DENSITY, LOW MOISTURE, LIGHT BROWN TO BUFF



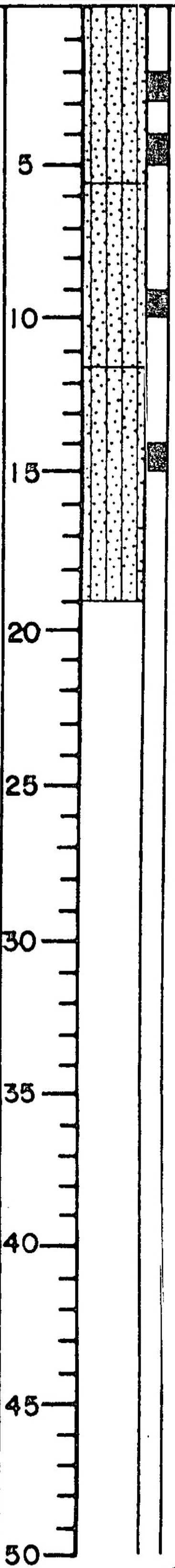
Blows per ft.	Water Content %	Soil Type
10	10.1	1
16	1.7	3
14	6.7	3
26	6.0	3

LOG OF TEST HOLE NO. 12

FINE TO MEDIUM SAND, SILTY, LOW DENSITY, LOW MOISTURE, MEDIUM BROWN

FINE TO COARSE SAND, CLEAN TO SILTY, LOW DENSITY, LOW MOISTURE, LIGHT BROWN

FINE TO COARSE SAND, SOME GRAVEL, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN TO BUFF



Blows per ft.	Water Content %	Soil Type
4	7.2	2
5	5.1	2
11	5.7	2
23	2.7	3

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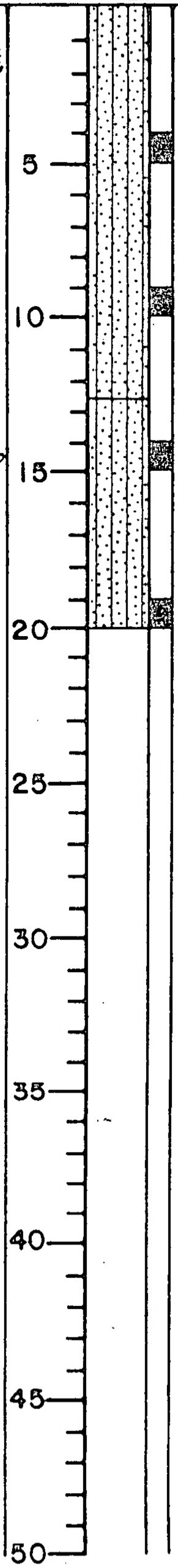
LOG OF TEST HOLE NO. 13

SAND, SILTY, LOW DENSITY, LOW MOISTURE, MEDIUM BROWN

STRATIFIED WITH CLAY LENSES AT 10'

FINE TO COARSE SAND, SOME GRAVEL, MEDIUM TO HIGH DENSITY, LOW MOISTURE, BUFF



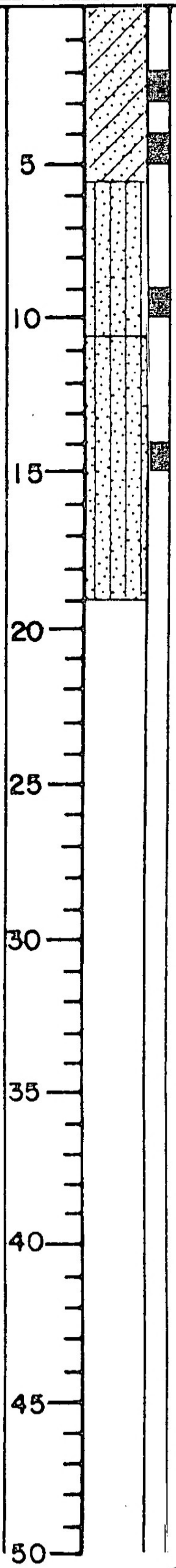
Blows per ft.	Water Content %	Soil Type
5	8.4	2
10	5.6	2
15	2.1	3
29	6.3	3

LOG OF TEST HOLE NO. 14

CLAY AND SILT, SANDY, STRATIFIED, LOW TO MEDIUM DENSITY, MODERATE TO LOW MOISTURE, MEDIUM BROWN

SAND, SILTY TO CLEAN, MEDIUM DENSITY, LOW MOISTURE, LIGHT BROWN

FINE TO COARSE SAND, SOME GRAVEL, HIGH DENSITY, LOW MOISTURE, BUFF



Blows per ft.	Water Content %	Soil Type
7	18.9	1
13	4.5	1
14	6.5	2
27	2.7	3

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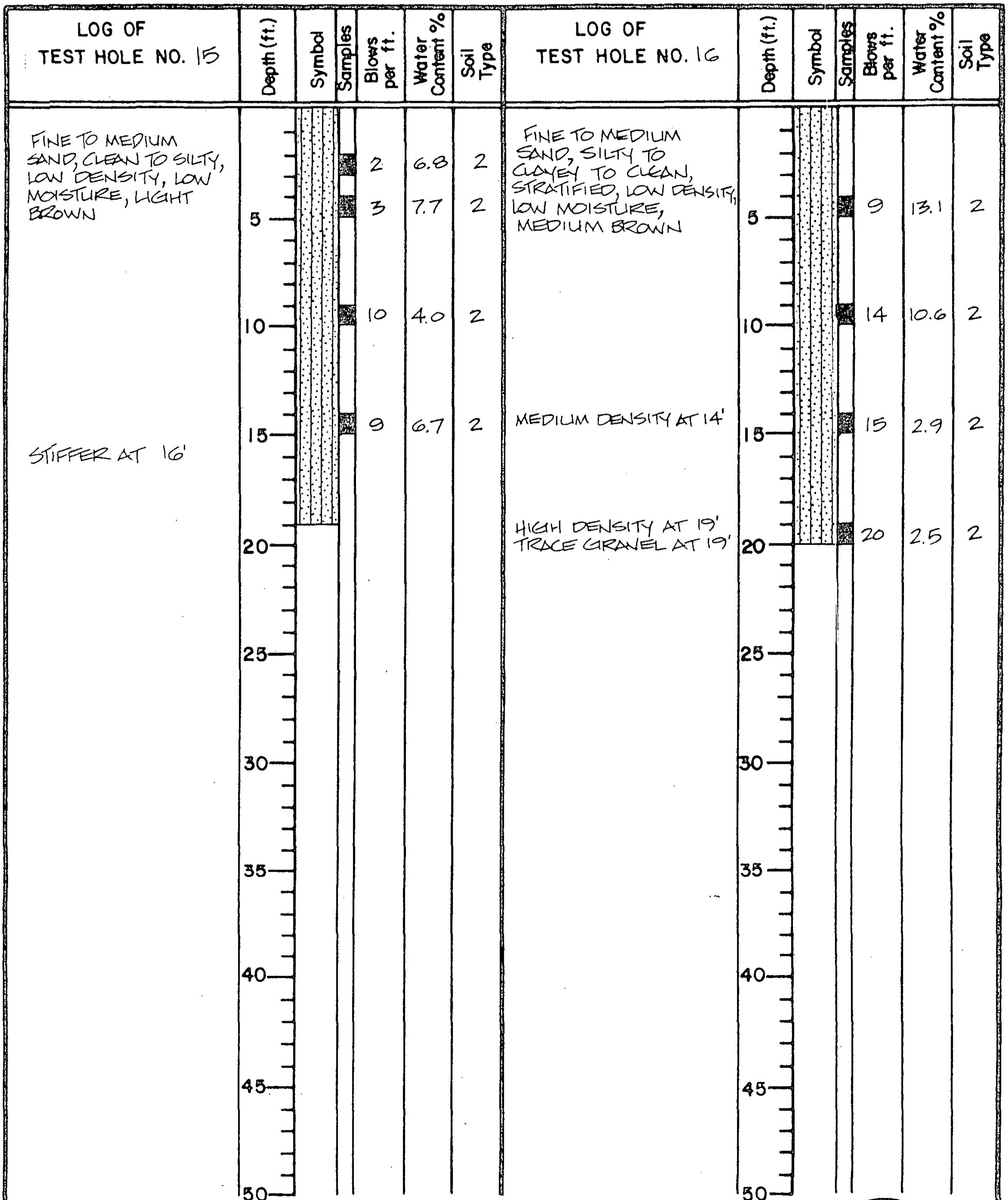

LOG OF TEST HOLE NO. 15

FINE TO MEDIUM SAND, CLEAN TO SILTY, LOW DENSITY, LOW MOISTURE, LIGHT BROWN

STIFFER AT 16'

Blows per ft.	Water Content %	Soil Type
2	6.8	2
3	7.7	2
10	4.0	2
9	6.7	2

LOG OF TEST HOLE NO. 16

FINE TO MEDIUM SAND, SILTY TO CLAYEY TO CLEAN, STRATIFIED, LOW DENSITY, LOW MOISTURE, MEDIUM BROWN

MEDIUM DENSITY AT 14'

HIGH DENSITY AT 19'
TRACE GRAVEL AT 19'

Blows per ft.	Water Content %	Soil Type
9	13.1	2
14	10.6	2
15	2.9	2
20	2.5	2

LOG OF TEST HOLE NO. 17	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
SAND, SILTY TO CLAYEY, LOW TO MEDIUM DENSITY, LOW MOISTURE, MEDIUM BROWN	5		▪	9	8.9	1
	10		▪	13	8.1	1
	15		▪	17	8.6	1
HIGH DENSITY AT 19'	20		▪	24	10.0	1
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO. 18	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
FINE TO MEDIUM SAND, SILTY TO CLAYEY, LOW DENSITY, LOW MOISTURE, LIGHT TO MEDIUM BROWN	5		▪	4	9.6	2
CLEANER AT 10'	10		▪	8	5.1	2
	15		▪	14	3.2	2
FINE TO COARSE SAND, HIGH DENSITY, LOW MOISTURE, BUFF	20		▪	26	2.8	3
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO. 19	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
FINE TO MEDIUM SAND, SILTY TO CLAYEY, MEDIUM DENSITY, LOW MOISTURE, LIGHT TO MEDIUM BROWN	5		■	13	4.3	2
	10		■	12	4.2	2
FINE TO COARSE SAND, SOME GRAVELS, HIGH DENSITY, LOW MOISTURE, LIGHT BROWN TO BUFF	15		■	25	1.7	3
	20		■	30	3.7	3
	25					
	30					
	35					
	40					
	45					
	50					

LOG OF TEST HOLE NO.	Depth (ft.)	Symbol	Samples	Blows per ft.	Water Content %	Soil Type
	5					
	10					
	15					
	20					
	25					
	30					
	35					
	40					
	45					
	50					

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LABORATORY TEST RESULTS

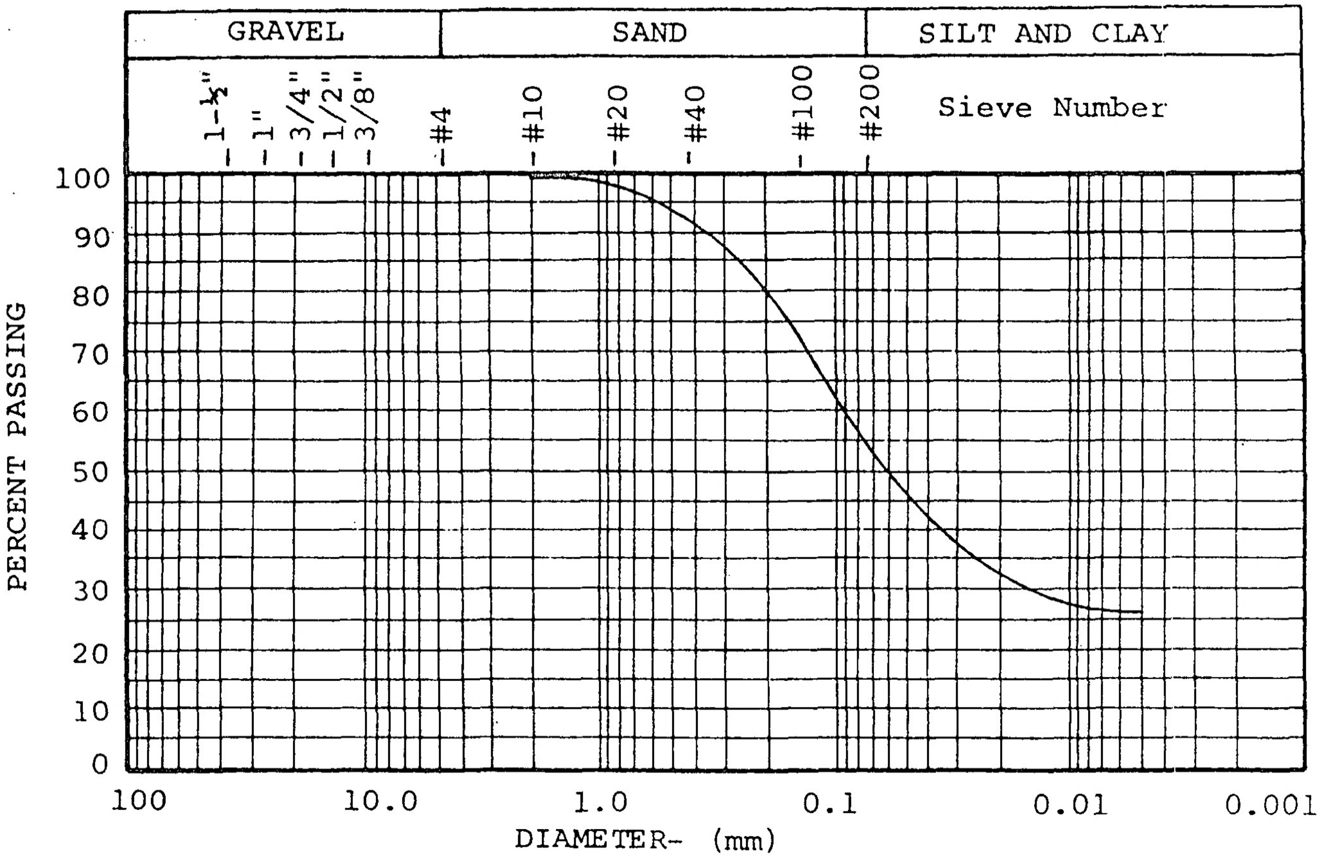
Soil Type No. 1 Unified Classification CL

Job No. 99G

Project CIMARRON NORTHCREST, FILING NO. 3

Date 12-27-82

Test by KA



Sieve size	% Passing
1-½"	
1"	
3/4"	
1/2"	
3/8"	
#4	100
#10	99.9
#20	97.9
#40	92.5
#100	70.9
#200	59.4
.061MM	53.6
.021MM	33.3
.005MM	25.9

Atterberg Limits:

Liquid Limit 25

Plastic Limit 12

P. I. 13

Shrinkage Limit

SWELL:

12.3 % Moisture at Start

15.5 % Moisture at Finish

3.2 % Moisture Increase

0.12 % Volume Change

112.7 pcf Initial Dry Density

373 psf Swell

BEARING:

3000 psf maximum

0 psf minimum

SULFATES:

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LABORATORY TEST RESULTS

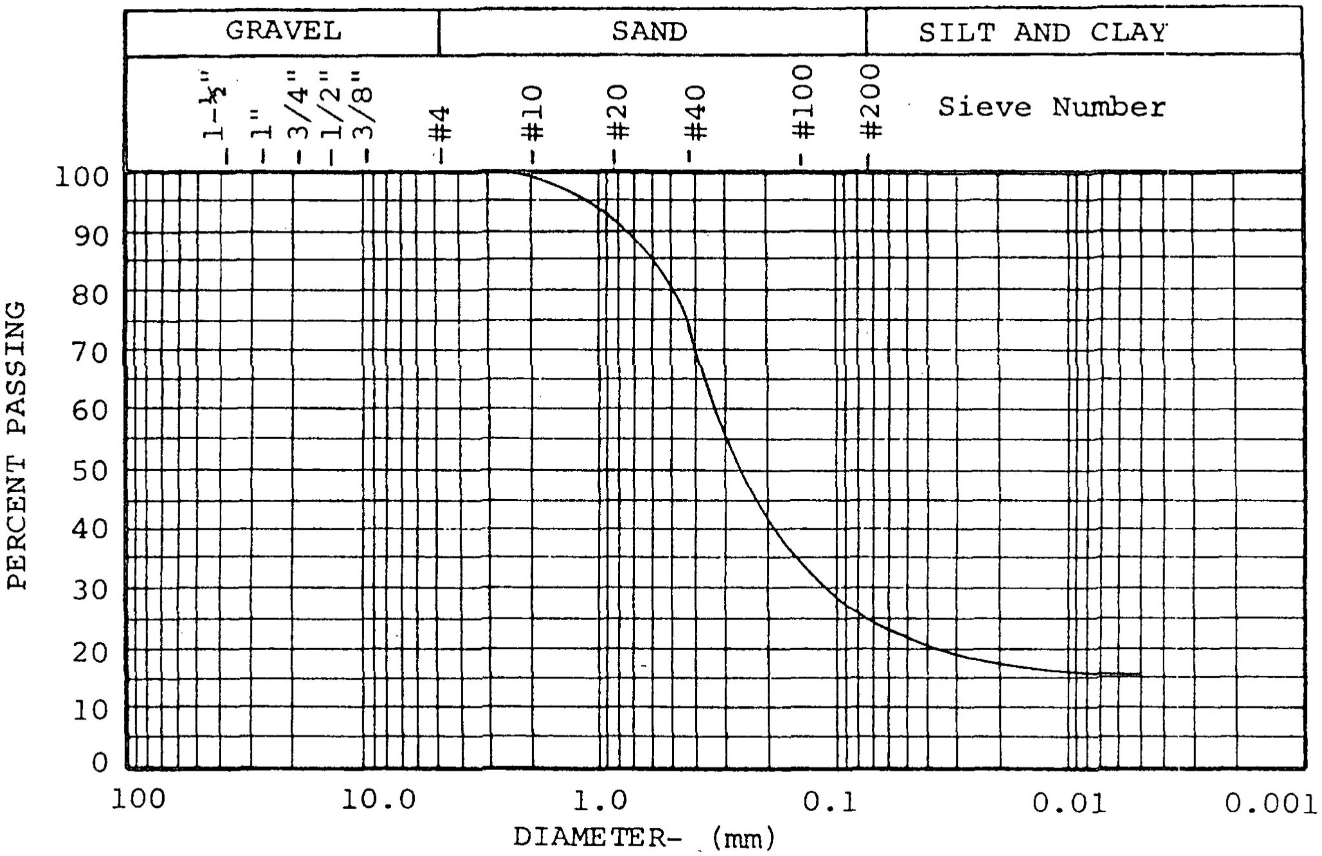
Soil Type No. 2 Unified Classification SM

Job No. 99G

Project CIMARRON NORTHCREST, FILING NO. 3

Date 12-27-82

Test by KA



Sieve size	% Passing
1-½"	
1"	
3/4"	
1/2"	
3/8"	
#4	100
#10	99.2
#20	91.8
#40	74.7
#100	33.8
#200	24.9
.022MM	17.9
.005MM	14.9

SWELL:

______ % Moisture at Start

______ % Moisture at Finish

______ % Moisture Increase

______ % Volume Change

______ pcf Initial Dry Density

______ psf Swell

BEARING:

2000 psf maximum

0 psf minimum

SULFATES: ______

Atterberg Limits:

Liquid Limit NP

Plastic Limit NP

P. I. NP

Shrinkage Limit ______

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LABORATORY TEST RESULTS

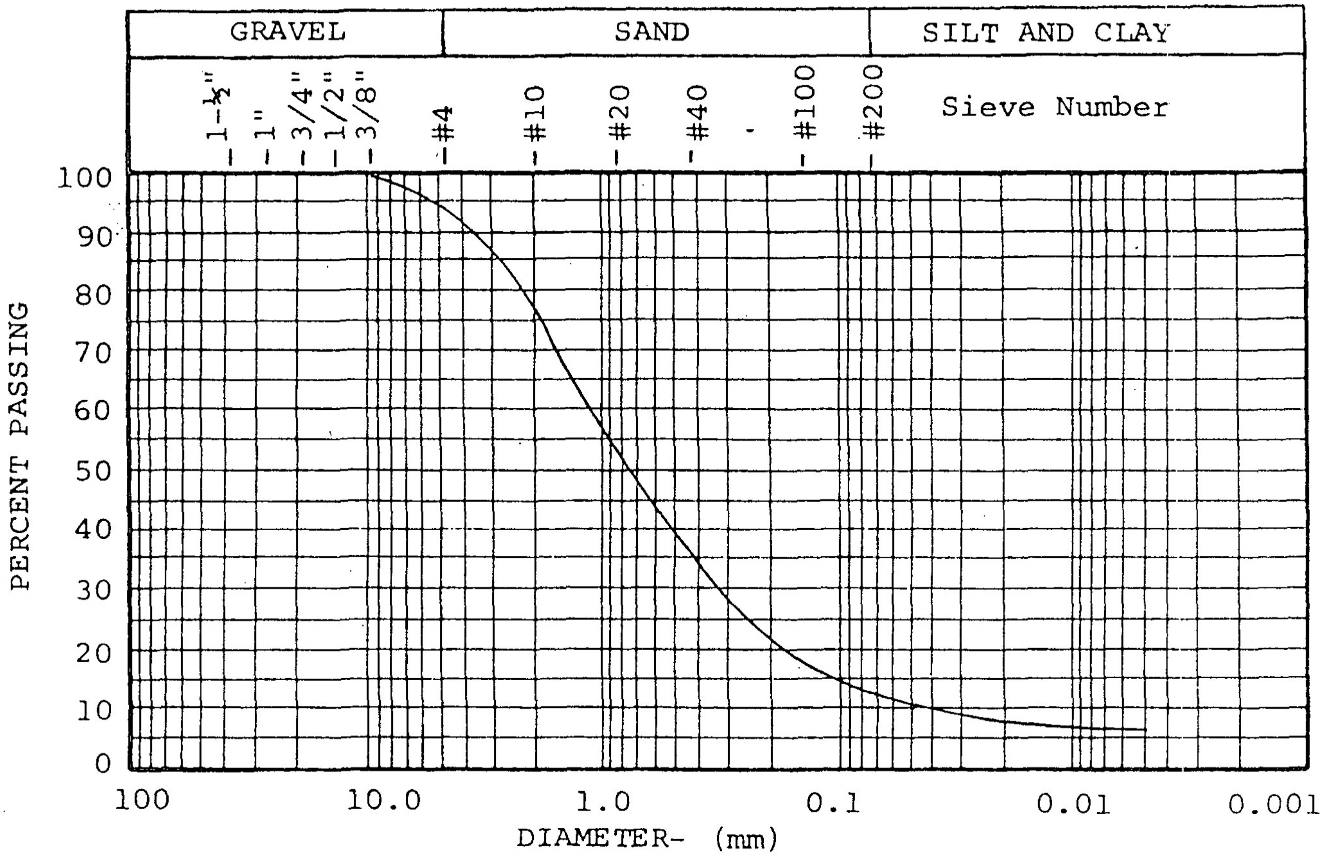
Soil Type No. 3 Unified Classification SM

Job No. 99G

Project CIMARRON NORTHCREST, FILING NO. 3

Date 12-27-82

Test by KA



Sieve size	% Passing
1-½"	
1"	
3/4"	
1/2"	
3/8"	100
#4	94.9
#10	76.1
#20	53.5
#40	37.0
#100	16.9
#200	13.4
.022 MM	8.1
.005 MM	5.2

Atterberg Limits:

Liquid Limit NP

Plastic Limit NP

P. I. NP

Shrinkage Limit ______

SWELL:

______ % Moisture at Start

______ % Moisture at Finish

______ % Moisture Increase

______ % Volume Change

______ pcf Initial Dry Density

______ psf Swell

BEARING:

3500 psf maximum

0 psf minimum

SULFATES: ______

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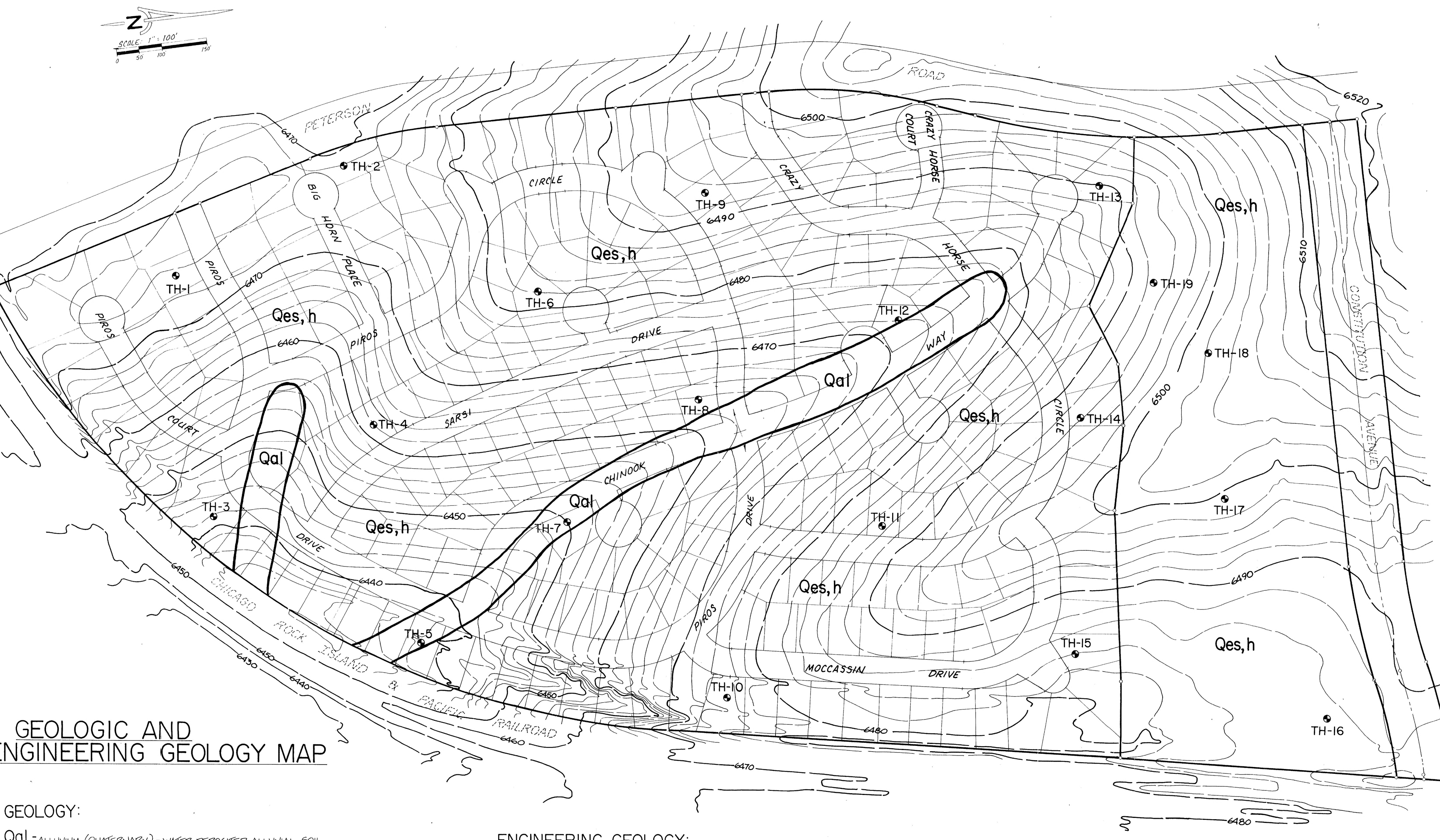

GEOLOGIC AND ENGINEERING GEOLOGY MAP

GEOLOGY:

Qal - ALLUVIUM (QUATERNARY) - WATER DEPOSITED ALLUVIAL SOIL CONSISTING OF SILTY TO CLAYEY SAND, BROWN TO LIGHT BROWN IN COLOR.

Qes - EOLIAN SAND (QUATERNARY) - WINDBLOWN SAND, SILTY SAND, AND SILT, OFTEN CLAYEY, BROWN TO LIGHT BROWN IN COLOR.

ENGINEERING GEOLOGY:

h - HYDROCOMPACTION AREA - AREA HAVING A POTENTIAL FOR LARGE SETTLEMENTS IF PERMITTED TO BECOME SATURATED.

● TH-2 TEST BORING LOCATION

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NO	DESCRIPTION	DATE	BY

REVISIONS

Costin Engineering
CIVIL ENGINEERING AND LAND SURVEYING
2775 WEST HAMPDEN AVE. ENGLEWOOD, COLORADO 80110
TELEPHONE: (303) 762-0630

CIMARRON NORTHCREST
FILING NO. 3

DRAWN
DESIGN
DATE 12
PROJECT
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