CMG Engineering, Inc.
P.O.Box 5159
1097 Trumble Creek Road
Kalispell, MT 59903-5159

Office: 406-257-8156
Fax: 406-257-8179
http://www.cmgengineering.com

November 10, 2016

Jackola Engineering and Architecture, PC
2250 Hwy 93 South
Kalispell, MT 59901

Attention: Mr. Rory Young, PE

Subject: Geotechnical Investigation
Southside Estates Subdivision
Kalispell, Montana
CMG Job No. 16-220

At your request, CMG Engineering, Inc. (CMG) has conducted a geotechnical investigation for the planned Southside Estates Subdivision in Kalispell, Montana. The Vicinity Map, Figure 1, shows the general location of the site. The investigation was conducted to evaluate subsurface materials, conditions at the site, and develop recommendations for site preparation, earthwork, general foundation guidelines, subsurface drainage, utility trench backfill, and asphaltic concrete (AC) pavement sections. The investigation included a review of existing subsurface information for the site vicinity, subsurface explorations, field and laboratory testing, and engineering analyses. This report describes the work accomplished and provides our conclusions and recommendations for use in the design and construction of the proposed project. CMG has strived to perform the investigation and develop recommendations in a manner consistent with the degree of care that is presently standard to the geotechnical engineering profession.

PROJECT DESCRIPTION

The project site is located on the south side of Kalispell, Montana. The subsurface exploration locations were conducted in the vicinity of the planned improvements and are shown on the Site Plan, Figure 2. Available design details and information provided by the Project Team indicate the proposed subdivision will consist of approximately thirty-six lots with utilities and asphaltic concrete paved road access. We anticipate one- and two-story single family residences with concrete slab-on-grade floors or crawl spaces will be planned for the lots. No below grade finished spaces are planned for this development. We anticipate that maximum column and continuous wall loads will be less than 50 kips and 3 kips per lineal ft, respectively. We anticipate utility trench depths will range from about 6 to 12 ft deep.

The project site has historically been used as a pasture; however, the site has most recently been used as an area to place excess soil and material during development and house construction

in the subdivisions to the north. The site is relatively flat with a gradual slope downward to the southeast. Planned earthwork will consist of cuts and fills up to about 10 feet thick.

SITE DESCRIPTION

General

The project site is bordered by a residential subdivision to the north, an open field and a residence to the east, a commercial wrecking yard to the south, and the US Hwy 93 bypass to the west. Evidence of existing structures or past development of the site was not evident, with the exception of significant fill material being placed on the site.

Topography

Review of the available topographic survey information provided by you, indicates the high point of the site is near the northwest corner at elevation 2,940 ft and the site generally slopes downward to the southeast to an elevation of 2,932 ft. The current uneven topography is the result of fill being placed on the site over the past 10 to 20 years.

Geology

The project site lies in the Rocky Mountain Trench bounded by the Salish Mountains to the West and the Swan Range to the East. The trench was traversed by the Flathead Glacier and was covered by substantial areas of glacial lakes during recession of the ice mass. The surficial geology of the area consists of silts and clays deposited by glacial lakes and sands and gravels deposited during more turbulent times. The soils are underlain by glacial till soils consisting of silty gravel with large cobbles and boulders that were deposited during glaciation of the area.

SUBSURFACE CONDITIONS

General

Subsurface materials and conditions at the site were investigated on September 23 and 27, 2016 with six borings, designated B-1 through B-6, and eight test pits designated TP-1 through TP-8. The borings were drilled to depths of 10.3 to 20.3 ft, and the test pits were excavated to depths of 6.5 to 8.5 ft below the ground surface. The approximate locations of the subsurface explorations are shown on Figure 2. A detailed discussion of the field exploration and laboratory testing programs completed for this investigation are provided in Appendix A. Logs of the borings and test pits are provided in Appendix A on Figures 1A through 14A.

Soils

Typical soils observed at the ground surface consist of fill material comprised of lean clay over the original topsoil layer. The topsoil is underlain by silt and lean clay soils. For the purpose of discussion, the materials and soils disclosed by the subsurface investigation have been grouped into the following categories:

1. FILL and TOPSOIL

2. **Sandy SILT**
3. **Lean CLAY**

1. FILL and TOPSOIL. All borings advanced for this project encountered topsoil comprised of silty clay with abundant organics at the ground surface. The topsoil is generally dark brown with a heavily rooted zone to a depth of about 2 to 8 inches; however, abundant roots were observed to depths as deep as 36 inches in a few of the test pits. The relative consistency of the silty clay soils is medium stiff to stiff. The topsoil zone ranges from 2 to 8 inches thick with an average thickness of approximately 6 inches. The topsoil is underlain by fill comprised primarily of lean clay soils.

The lean clay fill material contains some small percentages of sand and gravel in some areas and generally contains scattered organics. Based on SPT blow counts and visual observations of the test pits, it appears the fill material is soft to hard. Moisture contents of 17 to 19 percent indicate the fill is moist and near the optimum moisture content for compaction. The fill extends to depths of 1.5 to 6.5 ft, and is underlain by the original ground surface. Some areas appear to have been stripped of organics prior to filling; however, in other areas, the preexisting topsoil layer was encountered. Boring B-4 and Test Pits TP-1, TP-4, TP-5, TP-6, and TP-8 encountered a 3 inch to 12 inch thick topsoil layer beneath the fill at depths of 2.5 to 6.5 ft. The fill material and topsoil are underlain by sandy silt or lean clay soils.

2. Sandy SILT. Borings B-2 and B-6 encountered sandy silt at depths of 3.5 and 3.8 ft, respectively. The sand portion is fine grained. SPT blow counts of 13 to 27 indicated the sandy silt is stiff to very stiff. Moisture contents of 15 to 23 indicate the silt is moist. The sandy silt layer is approximately 3 ft thick and is underlain by lean clay.

3. Lean CLAY. Lean clay was encountered in all Borings and Test Pits at depths of 1.5 to 7.5 ft below the ground surface. The lean clay soils are laminated lakebed deposits and tend to strength diminish with depth as the moisture contents increase. SPT blow counts of 1 to 38 blows per ft indicate the lean clay is very soft to hard. Moisture contents range from 26 to 40 percent. All explorations advanced for this project were terminated in the lean clay soils at depths of 6.0 to 20.3 ft below the ground surface.

Groundwater

Groundwater was observed at varying depths across the site. Two inch diameter perforated pvc pipes were installed in Borings B-1 and B-2 for periodic groundwater measurements. In addition, an existing piezometer in the vicinity of Boring B-4 was observed and monitored during this investigation. Groundwater depths were measured 4 times during this investigation, between the initial drilling of the borings through November 2, 2016. The groundwater elevation appeared the highest in all of the piezometers on November 2, 2016, following the wettest October on record in the City of Kalispell and the surrounding area. Groundwater depths on November 2, 2016 were measured at 6.8 ft, 9.4 ft, and 5.0 ft in Borings B-1, B-2, and the existing piezometer, respectively. The groundwater depths appear to be 1 to 5.9 ft below the original ground surface elevations, prior

to filling occurring at the site. Based on CMG's observations and our knowledge of the surrounding area, CMG recommends using a conservative approach when estimating groundwater levels by assuming groundwater levels are at the original ground surface elevation prior to filling. In our opinion, previous topography maps and CMG's subsurface explorations can be used to determine the original ground surface elevation prior to filling. CMG's knowledge of the area and review of historical aerial photography indicate the majority of the filling occurred between 1995 and 2006.

ENGINEERING ANALYSIS

General

Our understanding is the proposed subdivision will consist of over 30 lots with utility construction and asphaltic concrete paved roads. Additional improvements will consist of stormwater detention basins to assist with managing stormwater runoff. Planned residences will consist of one- to two-story structures with no basements or below grade finished spaces. We anticipate that maximum column and continuous wall loads will be less than 50 kips and 3 kips per lineal ft, respectively. Asphaltic concrete paved roadways will provide access to the residential lots. We anticipate utility trench depths will range from about 6 to 12 ft deep. Planned earthwork will consist of cuts and fills up to about 10 feet thick.

Site Preparation

Site stripping will need to be conducted in all planned development areas. The removal of topsoil should extend down to existing fill soils with minimal organics. Based on observations during the subsurface investigation, we anticipate site stripping will be necessary across the entire site planned for development. The topsoil zone will likely range from about 2 inches to 8 inches thick, with an average stripping thickness of about 6 inches. Thicker areas of topsoil/organic material should be anticipated in low lying areas such as depressions, swales, and near the toe of existing slopes.

Based on past experience, the near surface lean clay soils encountered during this investigation have a relatively high fines contents and little to moderate cohesion. As a result, these soils can be easily disturbed and strength diminished during construction, particularly in relatively high moisture content areas and where seepage or surface water is allowed to pond and infiltrate. Therefore, positive site drainage is of critical importance to both construction and long-term performance of the planned structures and roadways. It is anticipated that surface runoff could provide water to the project area. Surface diversion systems should be considered necessary and will assist in maintaining the undisturbed soils and temporary slope stability of the excavations.

Earthwork

We understand it is desirable to use on-site soils for the construction of Structural Fills and utility trench backfill, when allowed by the City of Kalispell Standards. Near surface, on-site soils consist primarily of fine-grained, moisture-sensitive lean clay. Soils encountered beneath the topsoil zone are suitable for Structural Fill construction as long as the soils are free of organics or other deleterious materials, and cobbles or boulders larger than 4 inch maximum size are removed. Compaction of Structural Fill and utility trench backfill should be accomplished when moisture

contents are within 3 percent of the optimum moisture content as determined by ASTM D698. Observations in the upper 10 ft of soil during the subsurface and laboratory investigations revealed that the in situ soils are typically near or slightly wet of the optimum moisture content as determined by ASTM D698, indicating some moisture conditioning may be necessary to approach the optimum moisture content for compaction. Use of on-site, fine grained soils will be a weather-sensitive earthwork operation. It should be realized that fine grained soils can be difficult to compact, particularly during wet or cold weather. Construction of Structural Fill using fine grained soils during relatively wet weather or when temperatures are below freezing (including nightly low temperatures), will significantly reduce the efficiency of earthwork operations. Limiting mass grading to the relatively dry and warm late spring, summer or early fall months will reduce the likelihood of weather affecting construction operations.

Due to the presence of uncontrolled fill across the site, CMG recommends removal and recompaction of the fill material in all areas where settlement sensitive improvements are planned. In addition, preexisting topsoil zones, if encountered, shall be removed following removal of the fill material. Once undisturbed native soils are encountered, the existing fill (assuming it meets the requirements outlined in the Recommendations section of this report) can be placed and compacted in lifts. Due to the fine grained and clay percentage of the existing fill soils, CMG anticipates moisture conditioning and soil break up by varying methods including a farming disk implement will be necessary.

Foundation Design

Footings should be established in the native, stiff to hard lean clay or compacted Structural Fill soils. Assuming CMG recommendations are followed, we anticipate the site will be suitable for typical residential construction with above grade finished spaces.

Due to the presence of a relatively high groundwater level, CMG recommends basements and below grade living spaces not be allowed in this subdivision. However, crawl spaces with a finished level above the original ground surface elevation prior to the previous filling that occurred on the site should be suitable. CMG recommends foundation drains and emergency sump pumps be installed at all residences that contain a crawl space.

Dampproofing or waterproofing should be provided consistent with the desired level of protection. A vapor retarding membrane (installed per the manufacturer's recommendations) beneath slab-on-grade floors should be considered in areas where moisture sensitive flooring is planned, and where extra precaution against moist floors is desired.

On-site Stormwater Disposal

We understand stormwater detention basins are planned in the vicinity of Borings B-1 and B-2. Double Ring infiltrometer testing was conducted at elevations of 2,931.2 ft in the vicinity of Boring B-1 and at 2,929.7 ft in the vicinity of Boring B-2. Final infiltration rates of 1 inch/hr and 1.5 inches/hr were measured at the Boring locations B-1 and B-2, respectively.

RECOMMENDATIONS

1.0 General Site Preparation

1.1 The removal of topsoil and other organic material, including the clearing and grubbing of surficial vegetation and root zones, should be accomplished within the construction zone prior to any earthwork construction. We anticipate an average stripping thickness of about 8 inches will be required to remove organic material and rooted zones. However, stripping thicknesses will likely fluctuate and could range from 2 inches to 1.0 ft thick. Following removal of surface organics, the underlying soils should be evaluated by a qualified geotechnical engineer for suitability as Structural Fill material. Following the evaluation, removal of existing fill material can proceed until undisturbed native soils are encountered. When encountered, the previously buried topsoil layer shall be removed.

1.2 Surface drainage should be established to direct runoff away from the construction area.

1.3 Soils encountered at the site are primarily fine-grained, moisture-sensitive soils that are easily disturbed by construction activities and traffic when moisture contents are greater than the optimum moisture content as determined by ASTM D698. Care should be taken to minimize construction traffic over moisture sensitive subgrade soils. During wet weather conditions or when moisture contents are greater than the optimum moisture content for compaction, haul roads with a minimum gravel thickness of 2 feet should be constructed over the planned subgrade. The gravel should consist of a well-graded pit run gravel with a maximum size of 3 inches with no more than 10 percent passing the No. 200 sieve. Geotextile fabric placed between the fine-grained soils and gravel for the haul road will reduce the risk of continued maintenance of the haul road during construction. Provided that the haul road is constructed over compacted Structural Fill or undisturbed native subgrade soils stripped of organics, it can be used as a portion of the subbase course for the roadways.

1.4 The stability of construction excavations and associated worker safety are the responsibility of the contractor in accordance with current OSHA regulations; this responsibility may require design by a registered professional engineer. Based on the predominant soil types encountered during our investigation, temporary construction excavations that are to be planned in accordance with OSHA provisions should assume Type B material conditions for the lean clay soils. Actual subsurface conditions at the time of excavation should be observed by a geotechnical engineer to determine whether slope flattening, bracing or other stabilization is necessary due to seepage or other unexpected conditions.

2.0 Excavation, Earthwork, and Construction Materials

2.1 Based on the subsurface and laboratory investigations, we anticipate subgrade soil moisture contents will be near or greater than the optimum moisture content for the soil in most areas. Track-mounted hydraulic excavators equipped with smooth-lipped buckets should be used to accomplish excavation to subgrade in all Structural Fill, roadway and foundation areas. The use of track-mounted equipment will reduce the risk of disturbing the underlying moisture-sensitive, fine-grained soils. Rubber-tired equipment, including graders and scrapers, used within 2 feet of subgrade elevation will greatly increase the risk of disturbing

the underlying subgrade soils.

2.2 Structural Fill constructed within proposed building footprints, roadways, engineered slopes, sidewalks, beneath utilities, and other areas that are settlement-sensitive should be comprised of soils that are free of organics and deleterious materials. All Structural Fill material should be placed in no greater than 8-inch thick lifts and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698. In addition, the moisture content of the Structural Fill at the time of compaction should be within 3 percent of the optimum moisture content as determined by ASTM D698. Cobbles and boulders larger than 4 inches maximum size should not be used as fill material. Structural Fills should consist of on-site soils or be from a material source approved by our geotechnical engineer and meet the following composition guidelines:

- The sand and gravel-size particles comprising the fill should be hard, durable rock materials that will not degrade by moistening or under mechanical action of the compacting equipment; i.e. not shale or other clayey rock types.
- The binder/fines should have maximum Liquid Limit and Plasticity Index values of 25 and 10 percent, respectively.
- No frozen, organic, or other deleterious materials should be present in the Structural Fill.

2.3 In the event fill operations are planned for the relatively wet fall, winter and spring months, the fill material shall be comprised of granular Structural Fill free of organics and deleterious materials. All granular Structural Fill material should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698. In addition, the moisture content of the granular Structural Fill at the time of compaction should be within 3 percent of the optimum moisture content as determined by ASTM D698. Granular Structural Fills should consist of aggregate from a material source approved by our geotechnical engineer and meet the following gradation and composition guidelines:

Screen or Sieve Size	Percent Passing by Weight
3-inch	100
1½-inch	85-100
No. 4	30-60
No. 200	10 maximum

- The sand and gravel-size particles comprising the fill should be hard, durable rock

materials that will not degrade by moistening or under mechanical action of the compacting equipment; i.e. not shale or other clayey rock types.

- The binder/fines should have maximum Liquid Limit and Plasticity Index values of 25 and 10 percent, respectively.

- No frozen, organic, or other deleterious materials should be present in the Structural Fill.

2.4 Fill placement shall be observed and tested by our geotechnical site representative. Any areas of rutting, excessive deformation, or other non-uniform performance should be moisture conditioned and recompacted, or removed and replaced, as recommended by our geotechnical engineer.

3.0 Site Drainage

3.1 Finished site grades should be positively sloped away from foundation and backfill zones. Upslope grading should be designed and maintained to route runoff away from the building areas.

4.0 Asphaltic Concrete Pavement

4.1 In preparation for subbase placement, the subgrade shall be proof-rolled with a loaded 10 yd^3 dump truck and evaluated for yielding, deflecting, and "pumping" areas. Any areas where rutting, yielding, or other non-uniform subgrade performance is observed, should be repaired and improved as recommended by our geotechnical engineer. Undisturbed native lean clay soils or Structural Fill compacted to a minimum of 95 percent of the maximum dry density and within 3 percent of the optimum moisture content as determined by ASTM D698 are the assumed pavement subgrade materials.

4.2 The following flexible pavement thickness design sections assume typical low volume residential light duty traffic assumptions apply. The pavement sections assume construction procedures and material requirements as outlined in the *Montana Public Works Standard Specifications, Sixth Edition, 2010*, are followed.

Pavement Component	**Thickness (inches)**
Asphaltic Concrete Pavement	4
3/4 inch minus Crushed Base Course	3
3 inch minus Subbase Course	12

5.0 Construction Services and Quality Control

5.1 Geotechnical observation should be provided to monitor the site preparation, earthwork, and

sitework stages of construction. These geotechnical services should ascertain that subsurface conditions are reasonably consistent with those determined by our investigation, and that site and foundation preparation are consistent with our recommendations.

CONCLUSION

The foregoing recommendations present our initial geotechnical input for design and construction of the project. In order for these recommendations to be properly incorporated in the subsequent design and construction stages we recommend that our geotechnical and construction materials engineering staff remain involved with the project to ascertain that our recommendations have been properly interpreted both during design and construction. These services will reduce the potential for misinterpretation of subsurface conditions and geotechnical design recommendations that are important in the preparation of project plans, specifications and bid documents.

LIMITATIONS

CMG Engineering, Inc. has strived to prepare this report in accordance with generally accepted geotechnical engineering practices in this area solely for use by the client for design purposes and is not intended as a construction or bid document representing subsurface conditions in their entirety. The conclusions and recommendations presented are based upon the data obtained during the investigation as applied to the proposed design and construction details discussed in this report. The nature and extent of variations between the subsurface explorations may not become evident until construction. If variations are then exposed, it will be necessary to reevaluate the recommendations of this report.

If changes in the concept and design data are planned, the recommendations contained in this report shall not be considered valid unless the changes are reviewed by our geotechnical engineer, and a written response is provided.

Sincerely,

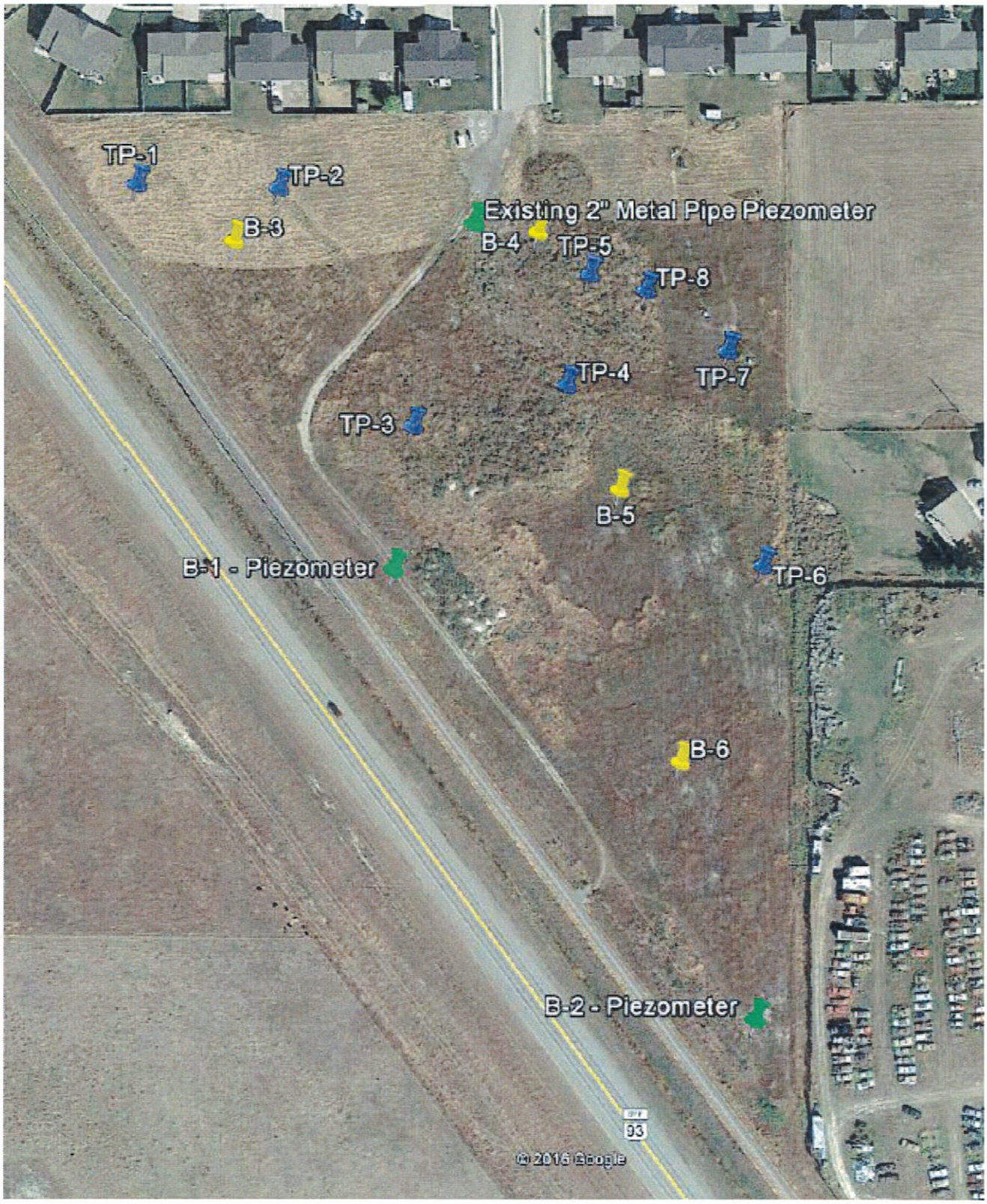
Joshua C. Smith, P.E.
Senior Geotechnical Engineer

Jeffrey J. Schmidt
Project Geologist

Project:	Southside Estates Subdivision Kalispell, Montana	**Job Number:** **Date:**	16-220 November 7, 2016

Vicinity Map

CMG Engineering, Inc.
Kalispell, MT
FIGURE 1



Project:	Southside Estates Subdivision Kalispell, Montana	**Job Number:** **Date:**	16-220 November 7, 2016

Site Plan

CMG Engineering, Inc.
Kalispell, MT
FIGURE 2

APPENDIX A

Field Explorations and Laboratory Testing

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATIONS

General

The subsurface materials and conditions at the site were investigated by CMG on September 23 and 27, 2016, with six borings designated B-1 through B-6, and eight test pits designated TP-1 through TP-8. The locations of the subsurface explorations are shown on the Site Plan, Figure 2. All field explorations were observed by an experienced engineer or geologist provided by our firm, who maintained a detailed log of the materials disclosed during the course of the work. The following subsections contain a detailed description of the field investigation completed for this project.

Borings

Borings B-1 through B-6 were completed to depths of 10.3 to 20.3 ft. The borings were drilled with hollow-stem auger techniques using a truck-mounted Mobile B61 drill rig provided and operated by Crowley Environmental Drilling of Butte, Montana. Disturbed samples were obtained from the borings at 2.5- to 5-ft intervals of depth. Disturbed samples were obtained using a standard split-spoon sampler and undisturbed samples were obtained using a thin-walled shelby-tube sampler when deemed appropriate. At the time of sampling, the Standard Penetration Test (SPT) was conducted. This test consists of driving a standard split-spoon sampler into the soil a distance of 18 in. using a 140-lb hammer dropped 30 in. The number of blows required to drive the sampler the last 12 in. is known as the Standard Penetration Resistance, or N-value. The N-values provide a measure of the relative density of granular soils, such as sand, and the relative consistency or stiffness of cohesive soils, such as silt and clay. The soil samples obtained in the split-spoon sampler were carefully examined in the field, and representative portions were saved in airtight plastic bags for further examination and physical testing in our laboratory. Logs of the borings are provided on Figures 1A through 6A. Each log presents a descriptive summary of the various types of materials encountered and notes the depth where the materials and/or characteristics of the materials change. To the left of the descriptive summary, the numbers and types of samples taken during drilling operations are indicated. To the right, N-values are shown graphically, along with the natural moisture contents, Atterberg Limits, and Torvane shear strength values.

Test Pits

Test Pits TP-1 through TP-8 were completed to depths ranging from 6.5 to 8.5 ft. The test pits were excavated using a track mounted excavator, provided and operated by Tyler Massie of Kalispell, Montana. Grab samples were obtained from the sidewalls of the excavations and from the backhoe bucket at about 3- to 4-ft intervals of depth. Soil samples obtained in the field were saved in airtight plastic bags for further examination and physical property testing in the laboratory. Logs of the test pits are provided on Figures 1A through 8A. Each log presents a descriptive summary of the various types of materials encountered and notes the depth where the materials and/or characteristics of the materials change.

LABORATORY TESTING

General

All samples obtained from the subsurface explorations were returned to our laboratory where the physical characteristics of the samples were noted, and field classifications were modified where necessary. The laboratory testing program completed by CMG for this project consisted of natural moisture contents.

Natural Moisture Content

Natural moisture content determinations were made in conformance with ASTM D2216. The results are shown on the boring logs, Figures 1A through 14A.

BORING LOG

B-1

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

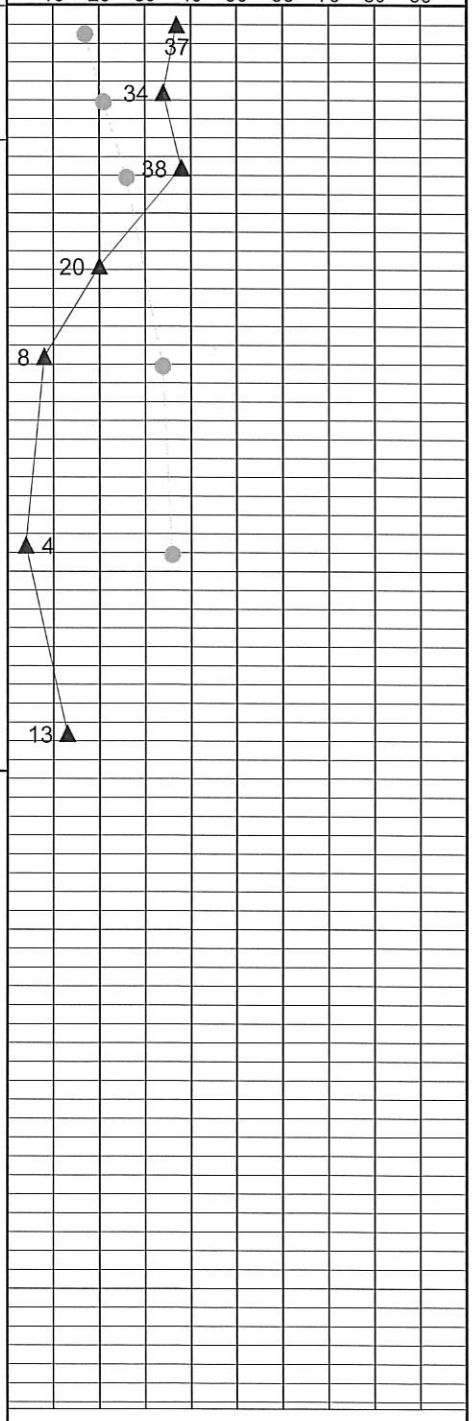
PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2934.2'
LOGGED BY: Jeff Schmidt
GW:
GW(2): ▼ 6.8'

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; hard, damp to moist, dark brown and gray
		S-2	1.8		Topsoil to 2 inches
5		S-3			Lean CLAY; hard, moist to very moist, laminated, gray and pinkish brown
		S-4			▼ medium stiff to stiff and very moist to wet below 8.8 ft.
10		S-5			
15		S-6			
20		S-7	20.3		Bottom of Boring B-1 @ 20.3 ft.
25					
30					
35					

TEST RESULTS

Plastic Limit ├──────┤ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)



2" diameter perforated pvc pipe installed to 18.8 ft. for periodic groundwater monitoring. Groundwater Elevation at 2,927.4 ft on November 2, 2016 (6.8 ft below Ground Surface).

BORING LOG

B-2

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2932.7'
LOGGED BY: Jeff Schmidt
GW:
GW(2): ▼ 9.4'

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; hard, damp to moist, scattered sand and gravel, dark brown and gray
		S-2			Topsoil to 2 inches
		S-3	3.5		Sandy SILT; very stiff, moist, fine grained sand, brown
5		S-4	6.2		Lean CLAY; stiff to medium stiff, moist to very moist, laminated, gray and pinkish brown
		S-5			▼ very moist to wet below 13.8 ft.
10					Soft @ 18.8 ft.
		S-6			
15					
		S-7			
20			20.3		Bottom of Boring B-2 @ 20.3 ft.
25					
30					
35					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)

10 20 30 40 50 60 70 80 90

25
43
27
12
7
6
1

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

2" diameter perforated pvc pipe installed to 18.8 ft. for periodic groundwater monitoring. Groundwater Elevation at 2,923.3 ft on November 2, 2016 (9.4 ft below Ground Surface).

BORING LOG

B-3

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

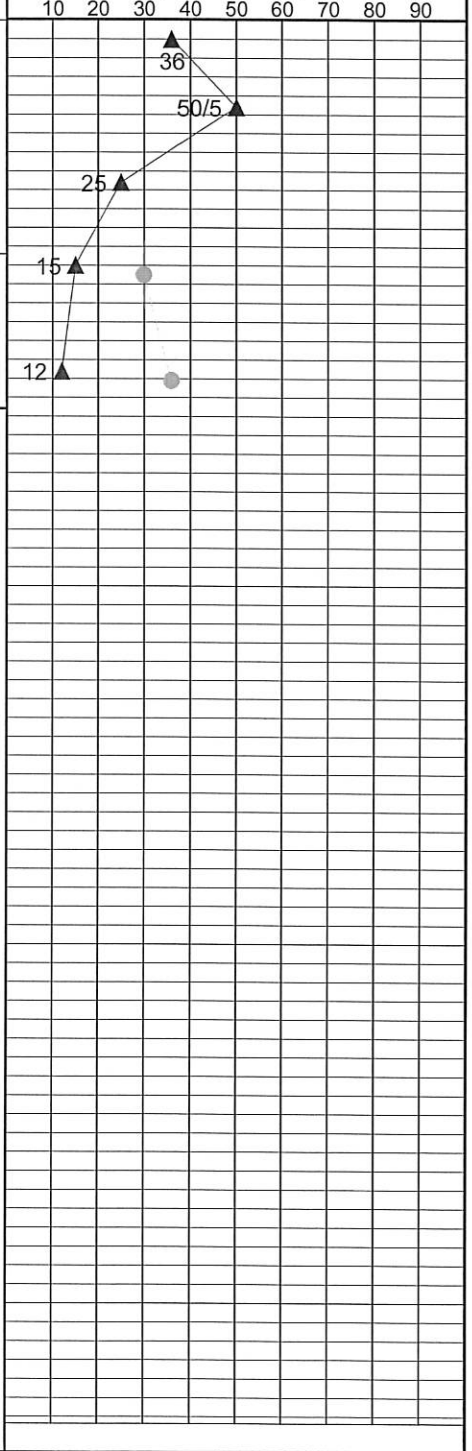
PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2939.4'
LOGGED BY: Jeff Schmidt
GW:
GW(2):

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; hard, damp, scattered gravel, dark brown and gray Topsoil to 2 inches
5		S-2			
		S-3			
		S-4	6.2		Lean CLAY; very stiff to stiff, very moist, laminated, gray and pinkish brown
10		S-5			
			10.3		Bottom of Boring B-3 @ 10.3 ft.
15					
20					
25					
30					
35					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)



Groundwater encountered; however, not measured due to time required for equilibration.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

BORING LOG

B-4

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2937.2
LOGGED BY: Jeff Schmidt
GW:
GW(2):

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; hard, damp, dark brown and gray
		S-2			Topsoil to 3 inches
		S-3	4.0		Topsoil: Lean CLAY; very stiff, moist, abundant organics, dark brown
5		S-4	5.0		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
		S-5			
10			10.3		Bottom of Boring B-4 @ 10.3 ft.
15					
20					
25					
30					
35					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)

10 20 30 40 50 60 70 80 90

41
25
24
17
22

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Groundwater encountered; however, not measured due to time required for equilibration.

CMG Engineering, Inc.

BORING LOG

B-5

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

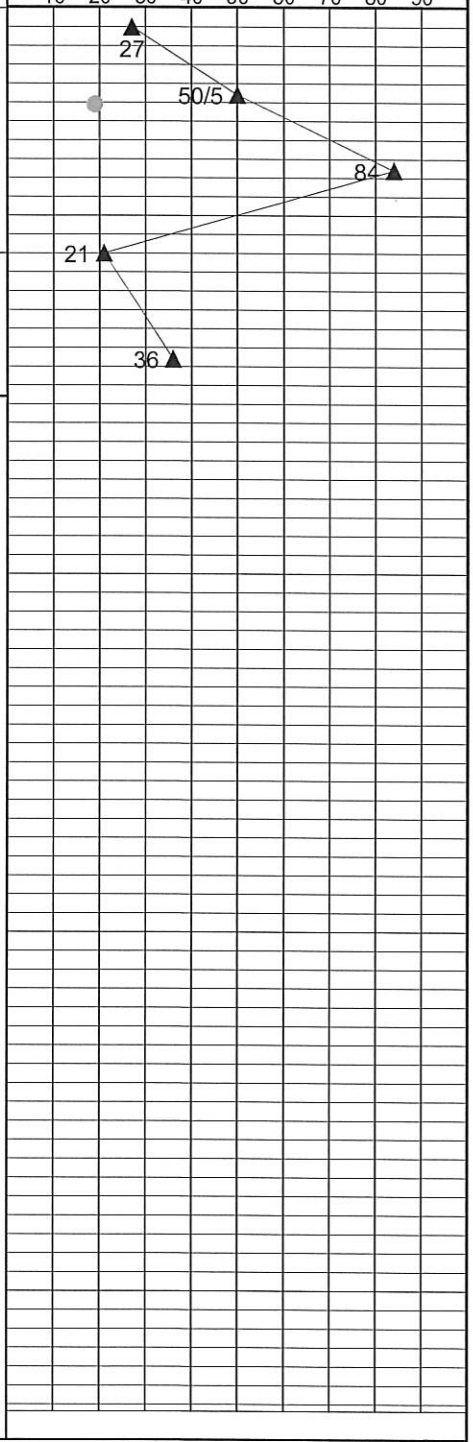
PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2932.1'
LOGGED BY: Jeff Schmidt
GW:
GW(2):

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; very stiff, damp, scattered gravel, dark brown and gray Topsoil to 2 inches
5		S-2			
		S-3			
		S-4	6.5		Lean CLAY; hard to very stiff, moist to very moist, laminated, gray and pinkish brown
10		S-5			
			10.3		Bottom of Boring B-5 @ 10.3 ft.
15					
20					
25					
30					
35					

TEST RESULTS

Plastic Limit ├──────┤ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)



This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Groundwater encountered; however, not measured due to time required for equilibration.

BORING LOG

B-6

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

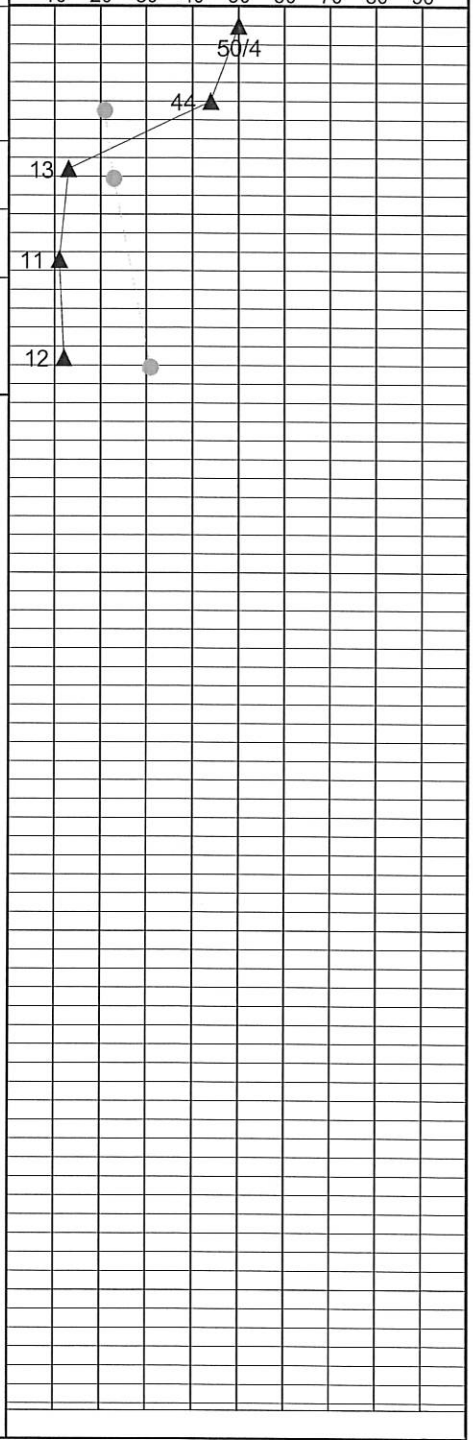
PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
DRILLER: Crowley Environmental
METHOD: Hollow-Stem Auger

PROJECT NO.: 16-220
DATE: 9-23-16
ELEVATION: 2932.9
LOGGED BY: Jeff Schmidt
GW:
GW(2):

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0		S-1	0.0		Fill: Lean CLAY; hard, damp, scattered gravel, dark brown and gray
		S-2	2.0		Topsoil to 2 inches
		S-3	3.8		Lean CLAY; hard to stiff, moist, laminated, gray and pinkish brown
5		S-4	6.2		Sandy SILT; stiff, very moist, fine grained sand, interbedded clay layers, brown
		S-5			Lean CLAY; stiff, moist to very moist, laminated, gray and pinkish brown
10			10.3		Bottom of Boring B-6 @ 10.3 ft.
15					
20					
25					
30					
35					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
N-values ▲ (Blows per foot)



Groundwater encountered; however, not measured due to time required for equilibration.

TEST PIT LOG

TP-1

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2940.3'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; stiff to very stiff, damp to moist, dark brown and gray Topsoil to 2 inches Abundant roots to 18 inches
2.5					
5			5.0		Topsoil: Lean CLAY; stiff, moist, abundant organics, dark brown
			6.0		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
7.5			6.5		Bottom of Test Pit TP-1 @ 6.5 ft.
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and shall not be interpreted as being indicitive of the site.

Groundwater not encountered.

Figure 7A PAGE 1 of 1 **CMG Engineering, Inc.**

TEST PIT LOG

TP-2

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2938.5'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; stiff to medium stiff, damp to very moist, scattered gravel, dark brown and gray Topsoil to 8 inches Abundant roots to 24 inches
2.5			5.0		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
5			6.5		Bottom of Test Pit TP-2 @ 6.5 ft.
7.5					
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Groundwater not encountered.

TEST PIT LOG

TP-3

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision **PROJECT NO.:** 16-220
CLIENT: Jackola Engineering **DATE:** 9-27-16
LOCATION: See Site Plan **ELEVATION:** 2937.2'
SUBCONTRACTOR: Tyler Massie **LOGGED BY:** Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY with Gravel; soft, damp, abundant roots, dark brown Topsoil to 6 inches
2.5			2.0		Fill: Lean CLAY; stiff, moist, scattered organics, brown and dark brown
5					
7.5			6.5		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
10			7.5		Bottom of Test Pit TP-3 @ 7.5 ft.
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

Groundwater not encountered.

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Figure 9A PAGE 1 of 1 **CMG Engineering, Inc.**

TEST PIT LOG

TP-4

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2937.6'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; soft to very stiff, damp to moist, dark brown and gray Topsoil to 6 inches Abundant roots to 36 inches
2.5					
5					
			6.5		Topsoil: Lean CLAY; stiff, moist, abundant organics, dark brown
7.5			7.0		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
			8.0		Bottom of Test Pit TP-4 @ 8.0 ft.
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Groundwater not encountered.

TEST PIT LOG

TP-5

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2937.9'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; soft to stiff, damp to moist, scattered gravel, dark brown and gray Topsoil to 6 inches
2.5					
5			5.0		Topsoil: Lean CLAY; stiff, moist, abundant organics, dark brown
			5.5		Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
7.5			7.0		Bottom of Test Pit TP-5 @ 7.0 ft.
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Groundwater not encountered.

CMG Engineering, Inc.

TEST PIT LOG

TP-6

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
CLIENT: Jackola Engineering
LOCATION: See Site Plan
SUBCONTRACTOR: Tyler Massie
METHOD: Excavator

PROJECT NO.: 16-220
DATE: 9-27-16
ELEVATION: 2931.7'
LOGGED BY: Jeff Schmidt
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; medium stiff to stiff, damp to moist, scattered gravel, dark brown and gray Topsoil to 6 inches
2.5			2.5 2.7		Topsoil: Lean CLAY; stiff, moist, abundant organics, dark brown Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
5					
7.5			6.0		Bottom of Test Pit TP-6 @ 6.0 ft.
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Groundwater not encountered.

TEST PIT LOG

TP-7

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2933.3'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; medium stiff to stiff, damp to moist, scattered gravel, dark brown and gray
			1.5		Topsoil to 6 inches
2.5					Lean CLAY; very stiff, moist to very moist, laminated, gray and pinkish brown
5					
			6.0		Bottom of Test Pit TP-7 @ 6.0 ft.
7.5					
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and shall not be interpreted as being indicitive of the site.

Groundwater not encountered.

TEST PIT LOG

TP-8

File: 16-220 Pintail Subdivision Date Printed: 11/10/2016

PROJECT: Southside Estates Subdivision
PROJECT NO.: 16-220
CLIENT: Jackola Engineering
DATE: 9-27-16
LOCATION: See Site Plan
ELEVATION: 2936.8'
SUBCONTRACTOR: Tyler Massie
LOGGED BY: Jeff Schmidt
METHOD: Excavator
GW: ▽

DEPTH (feet)	SAMPLERS	SAMPLE NO.	DEPTH (feet)	SOIL TYPE	MATERIAL DESCRIPTION
0			0.0		Fill: Lean CLAY; medium stiff to very stiff, damp to moist, scattered gravel and cobbles, scattered to abundant organics, dark brown and gray
					Topsoil to 8 inches
2.5					Abundant roots to 18 inches
5					
			6.0		Fill: GRAVEL with Clay and Sand; dense, damp, abundant cobbles, dark brown
			6.5		Topsoil: Lean CLAY; stiff, moist, abundant organics, dark brown
7.5			7.5		Lean CLAY; stiff to medium stiff, very moist, laminated, gray and pinkish brown
			8.5		Bottom of Test Pit TP-8 @ 8.5 ft.
10					
12.5					
15					
17.5					

TEST RESULTS

Plastic Limit ⊢——⊣ Liquid Limit
Water Content ● (percent)
10 20 30 40 50 60 70 80 90

This information pertains only to this test pit and should not be interpreted as being indicitive of the site.

Groundwater not encountered.