



GEOTECHNICAL INVESTIGATION
BURT SPRINGS COLLECTION GALLERY AND BOOSTER STATION
2900 EAST CANYON ROAD
SPRINGVILLE, UTAH

PREPARED FOR:

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PROJECT NO. 1150617

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EXECUTIVE SUMMARY

1. The subsurface materials encountered in the area of the proposed booster station consist of approximately 4 feet of fill overlying clayey sand that extends to the depth investigated, approximately 15½ feet below the pavement surface. The pavement section consists of approximately 3 inches of asphaltic concrete overlying approximately 6 inches of base course. The subsurface materials encountered in collection areas consist of up to approximately 6 feet of fill overlying natural gravel that extends to the maximum depth investigated, approximately 29½ feet. A clay layer was encountered in Boring B-3 from approximately 9 to 12 feet below the surrounding ground surface.

Practical auger refusal was encountered in Boring B-3 at a depth of approximately 25½ feet.

2. Subsurface water was encountered in Borings B-1 and B-2 at depths of approximately 3 to 5½ feet, respectively. No subsurface water was encountered in Boring B-3.
3. Excavations that extend below the water level should be dewatered during excavation and initial fill and concrete placement. Temporary, unretained excavations up to approximately 15 feet deep and properly dewatered may be constructed with side slopes of 1 ½ horizontal to 1 vertical or flatter. Shoring will likely be needed for steeper excavation slopes.
4. The measured water level is approximately 13 feet above the assumed basement floor level. The need to provide a perimeter drain to lower the water level below the proposed basement floor level or design the structure for hydrostatic uplift should be considered for the project.
5. The site is located in an area mapped as having a "moderate" potential for liquefaction. The Wasatch fault is mapped to extend in a general northwest/southeast direction approximately 70 feet northeast of Boring B-1. Additional studies would be needed to provide a better understanding of potential liquefaction and fault hazards at the site. Such studies are beyond the scope of this report.
6. The proposed building may be supported on spread footings bearing on at least 2 feet of structural fill extending down to the natural soil and may be designed using an allowable net bearing pressure 1,500 pounds per square foot.
7. Geotechnical information related to foundations, subgrade preparation and materials is included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed spring collection gallery and booster station to be located at 2900 East Canyon Road in Springville, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for the proposed construction. The study was conducted in general accordance with our proposal dated July 17, 2015.

Field exploration was conducted to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Samples obtained during the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil and to define conditions at the site for our engineering analysis. Results of the field exploration and laboratory tests were analyzed to develop recommendations for the proposed foundations and collection gallery construction.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

The booster station site consists of an area between a pond and a steep hillside that slopes up to vacant land to the east. There is a building on the site with asphalt paved access roads to the north and east of the building. There is a ditch that extends in a general northwest/southeast direction west of the building. The hillside south, east and north of the existing building is vegetated with trees, brush and grasses.

The existing building is a single-story, concrete structure with a slab-on-grade floor. Several power and water lines run through the site to and from the building.

FIELD STUDY

The field study was conducted on November 2 and 3, 2015. Three borings were drilled at the approximate locations indicated on Figure 1 using 8-inch diameter, hollow-stem auger powered by a truck-mounted drill rig. The borings were logged and samples obtained by an engineer from AGECEC. Logs of the subsurface conditions encountered in the borings are shown on Figure 2 with legend and notes on Figure 3.

SUBSURFACE CONDITIONS

The subsurface materials encountered in the area of the proposed booster station consist of approximately 4 feet of fill overlying clayey sand that extends to the depth investigated, approximately 15½ feet below the pavement surface. The pavement section consists of approximately 3 inches of asphaltic concrete overlying approximately 6 inches of base course. The subsurface materials encountered in collection areas consist of up to approximately 6 feet of fill overlying natural gravel that extends to the maximum depth investigated, approximately 29½ feet. A clay layer was encountered in Boring B-3 from approximately 9 to 12 feet below the surrounding ground surface.

Practical auger refusal was encountered in Boring B-3 at a depth of approximately 25½ feet.

A description of the various materials encountered in the borings follows:

Base Course - The base course consists of poorly-graded sand with silt and gravel. It is slightly moist and brown.

Results of a gradation test performed on the base course are presented on Figure 5.

Fill - The fill consists of silty and clayey gravel with sand. The fill is moist and dark brown.

Lean Clay - The lean clay is very stiff, slightly moist and brown.

Laboratory tests conducted on a sample of the clay indicate it has a natural moisture content of 11 percent and a natural dry density of 87 pounds per cubic foot (pcf).

Clayey Sand - The clayey sand is very loose to medium dense, wet and dark brown.

Laboratory tests conducted on samples of the clayey sand indicate it has natural moisture contents of 20 and 23 percent and natural dry densities of 80 and 102 pcf. An Atterberg limits test conducted on the clayey sand indicate that it has a liquid limit of 36 percent and a plasticity index of 21.

The results of a consolidation test indicate that the clayey sand is moderately compressible under light to moderate loads. The results of the consolidation test are presented on Figure 4.

Silty Gravel with Sand - The silty gravel is dense to very dense, slightly moist and light brown.

Laboratory tests conducted on a sample of the gravel indicate it has a natural moisture content of 2 percent and a natural dry density of 122 pcf.

The results of a gradation test conducted on the gravel are presented on Figure 6.

Poorly-graded Gravel with Silt and Sand - The gravel is medium to very dense, wet and light brown.

Laboratory tests of the gravel indicate it has natural moisture contents of 6 to 15 percent and natural dry densities of 113 to 115 pcf. Results of gradation tests of the gravel are presented on Figures 5 and 6.

Results of the laboratory tests are summarized on Table I and are included on the logs of the borings.

SUBSURFACE WATER

The water in Borings B-1 and B-2 (near the existing booster station) was measured at depths of approximately 3 and 5½ feet, respectively, 16 days after drilling. No water was encountered in Boring B-3. Fluctuations in water levels can be expected with time. An evaluation of such water level fluctuations is beyond the scope of this report.

PROPOSED CONSTRUCTION

We understand that a new booster pump station building is planned north of the existing building. We understand the building will have plan dimensions of approximately 16 by 20 feet and will consist of a single-story, masonry structure with a 12 foot deep basement.

If the proposed construction or building loads are significantly different from those described above, we should be notified so that we can reevaluate our recommendations.

RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results and the proposed construction, the following recommendations are given:

A. Site Grading

We anticipate that there will be small amounts of grade change for the proposed construction and the main floor level will be within approximately 2 feet of the existing ground surface. The building plans provided show the basement floor 12½ feet below the main floor level.

1. Subgrade Preparation

Prior to placing grading fill or base course, unsuitable fill, topsoil, organics, debris and other deleterious material should be removed.

2. Excavation

We anticipate that excavation in the clayey sand can be accomplished with standard duty excavation equipment. Heavy-duty excavation equipment may be required for excavations extending into the dense gravels, particularly for confined excavations such as utility trenches.

Excavations that extend below the water level should be dewatered. The water level should be maintained below the base of the excavation during initial fill and concrete placement. Free-draining gravel with less than 5 percent passing the No. 200 sieve should be used for fill or backfill below the original water level. A layer of free-draining gravel may be needed in the base of the basement excavation to facilitate construction on the wet, loose, clayey sand subgrade. Consideration should be given to using a support fabric prior to placement of free-draining gravel.

3. Excavation Slopes

Temporary, unretained excavations up to approximately 15 feet deep and properly dewatered may be constructed with side slopes of 1 ½ horizontal to 1 vertical or flatter. Shoring will likely be needed for steeper excavation slopes.

4. Materials

Material placed as fill to support foundations should be nonexpansive granular soil. The gravel meeting the recommendations given below for imported fill may be used as structural fill in the proposed building area or as site grading fill or backfill, if the topsoil, organics, oversize particles and other deleterious materials are removed. The clay and clayey sand are not recommended for use as fill below the proposed building area, but may be used as site grading fill, retaining wall and utility trench backfill outside the proposed building area if the organics debris and other deleterious materials are removed.

Moisture conditioning of the on-site materials may be needed to facilitate compaction. Drying of the soil may not be practical during cold or wet periods of the year.

Listed below are materials recommended for imported structural fill.

Fill to Support	Recommendation
Footings	Non-expansive granular material Passing No. 200 sieve < 35 % Liquid Limit < 30 % Maximum size 4 inches
Floor Slab (Upper 4 inches)	Non-expansive granular material Passing No. 200 sieve < 5 % Maximum size 2 inches
Floor Slab	Non-expansive granular material Passing No. 200 sieve < 50 % Liquid Limit < 30 % Maximum size 6 inches

5. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill to Support	Compaction
Foundations	≥95%
Concrete flatwork	≥90%
Landscaping	≥85%
Retaining wall backfill	85 - 90%

To facilitate the compaction process, the fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

Fill placed for the project should be frequently tested for compaction during placement and compaction.

B. Foundations

1. Bearing Material

The proposed building may be supported on spread footings bearing on at least 2 feet of structural fill extending down the natural soil. Structural fill should extend out away from the edge of footings at least a distance equal to the depth of fill placed beneath footings.

Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed foundation areas.

2. Bearing Pressure

Spread footings bearing on at least 2 feet of structural fill may be designed using an allowable net bearing pressure of 1,500 pounds per square foot.

3. Settlement

We estimate that total and differential settlement will be less than 1 inch for footings designed as indicated above.

4. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind and seismic loads.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil.

Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed floor slabs.

2. Underslab Sand and/or Gravel

A 4-inch layer of free draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the floor slab for ease of construction and to promote even curing of the slab concrete.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for footings placed on the on-site materials or on compacted structural fill is controlled by sliding resistance between the footing and the foundation material. A friction value of 0.35 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move.

Soil Type	Active	At-Rest	Passive
Clay and Silt	50 pcf	65 pcf	250 pcf
Sand and Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 30 pcf for the active condition, increased by 15 pcf for the at-rest condition

and decreased by 30 pcf for the passive condition. This assumes a peak horizontal ground acceleration of 0.48g for a 2 percent probability of exceedance in a 50 year period (IBC, 2012).

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve ultimate soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Faulting and Liquefaction

1. Liquefaction

The site is located in an area mapped as having a "moderate" potential for liquefaction (Anderson and others, 1994). Subsurface conditions encountered to the depth investigated suggest that liquefaction could be a potential hazard at the site. Evaluating liquefaction hazard at the site is beyond the scope of this report.

2. Faulting

The surface trace of the Wasatch fault is mapped to extend in a general northwest/southeast direction approximately 70 feet northeast of Boring B-1 (Black and others, 2003). A fault study would be needed to provide a better understanding of potential fault hazards at the site. Such a study is beyond the scope of this report.

3. Seismicity

Listed below is a summary of the site parameters for the International Building Code 2012:

a.	Site Class	D
b.	Short Period Spectral Response Acceleration, S_s	1.06g
c.	One Second Period Spectral Response Acceleration, S_1	0.40g

F. Subsurface Drains

The measured water level is approximately 13 feet above the assumed basement floor level. The need to provide a perimeter subsurface drain to lower the water level below the proposed basement floor level or design the structure for hydrostatic uplift should be considered for the project. The perimeter drain system should consist of at least the following items:

1. The underdrain system should consist of a perforated pipe installed in a gravel filled trench around the perimeter of the subgrade floor portion of the building.
2. The flow line of the pipe should be placed at least 18 inches below the finished floor level and should slope to a sump or outlet where water can be removed by pumping or by gravity flow.
3. If placing the gravel and drain pipe requires excavation below the bearing level of the footing, the excavation for the drain pipe and gravel should have a slope no steeper than 1 horizontal to 1 vertical so as not to disturb the soil below the footing.
4. A filter fabric should be placed between the natural soil and the drain gravel. This will help reduce the potential for fine-grained material filling in the void spaces of the gravel.
5. The subgrade floor slab should have at least 6 inches of free-draining gravel placed below it and the underslab gravel should connect to the perimeter drain.

6. Consideration should be given to installing cleanouts to allow access into the perimeter drain should cleaning of the pipe be required in the future.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled at the approximate location indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



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by rs

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DJN/rs

REFERENCES

Anderson, L. R., Keaton, J. R. and Bischoff, J. E., 1994; Liquefaction Potential Map for Utah County, Utah Geological Survey Contract Report 94-8.

Black, B.D., Hecker, S., Hylland, M.D., Christenson, G.E., and McDonald, G.N., 2003; Quaternary fault and fold database and map of Utah; Utah Geological Survey Map 193DM.

International Building Code, 2012; International Code Council, Inc. Falls Church, Virginia.



0 30 60 feet
Approximate Scale

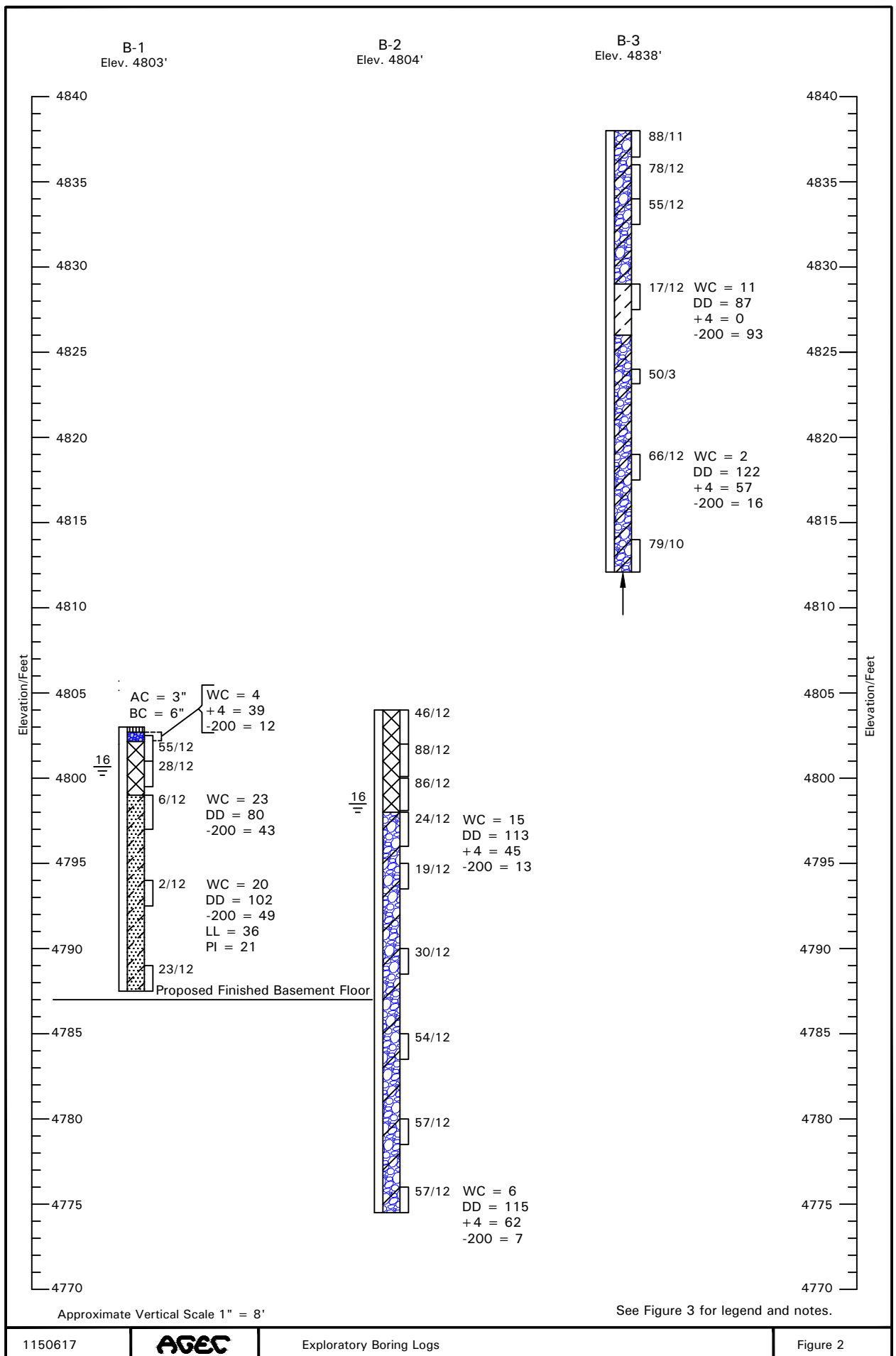
SPRING COLLECTION GALLERY AND BOOSTER STATION
2900 EAST CANYON ROAD
SPRINGVILLE, UTAH

1150617

AGEC

Exploratory Boring Locations

Figure 1



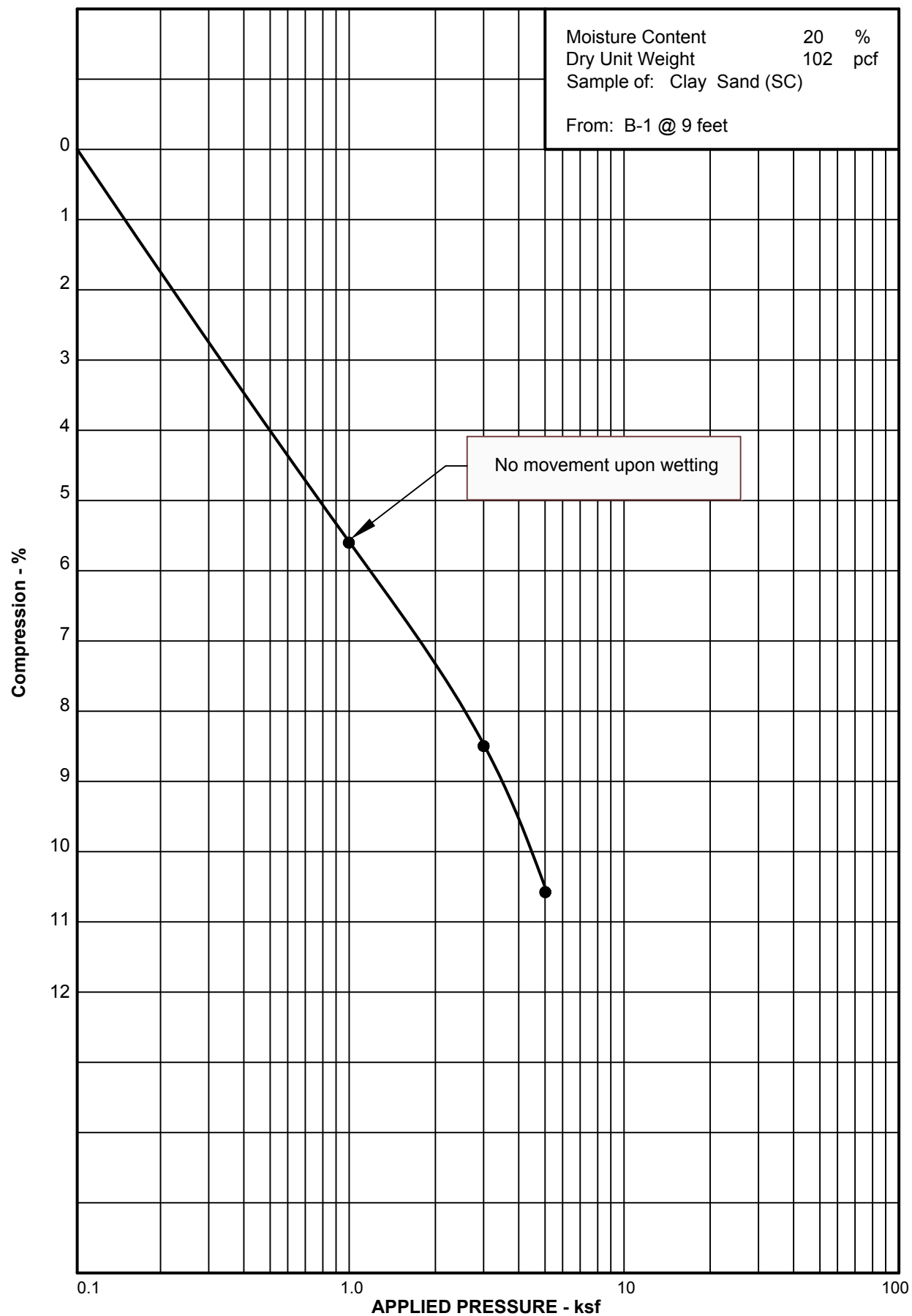
LEGEND:

	Asphaltic Concrete.
	Base Course; poorly-graded sand with silt and gravel, slightly moist, brown.
	Fill; silty and clayey gravel with sand, moist, dark brown.
	Lean Clay (CL); very stiff, slightly moist, brown.
	Clayey Sand with Gravel (SC); very loose to medium dense, wet, dark brown.
	Silty Gravel with Sand (GM); dense to very dense, slightly moist, light brown.
	Poorly-graded Gravel with Silt and Sand (GP-GM); medium dense to very dense, wet, light brown.
	10/12 California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.
	Indicates disturbed sample taken.
	Indicates slotted 1 ½ inch PVC pipe installed in the boring to the depth shown.
	Indicates the depth to free water and the number of days after drilling the measurement was taken.
	Indicates practical auger refusal.

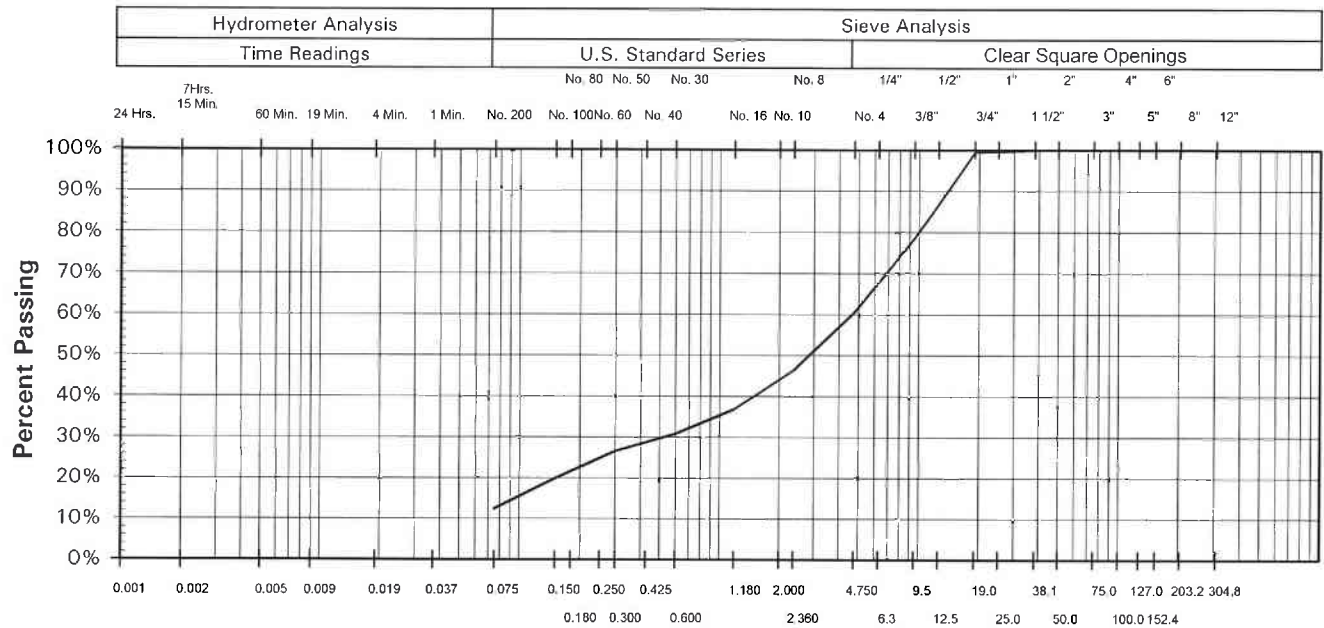
NOTES:

1. Borings were drilled on November 2 and 3, 2015 with 8-inch diameter hollowstem auger.
2. Locations of borings were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of borings were measured by automatic level and refer to the bench mark shown on Figure 1.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level will occur with time.
7. WC = Water Content (%);
DD = Dry Density (pcf);
+ 4 = Percent Retained on No. 4 Sieve;
-200 = Percent Passing No. 200 Sieve;
LL = Liquid Limit (%);
PI = Plasticity Index (%);
AC = Asphaltic Concrete Thickness;
BC = Base Course Thickness.

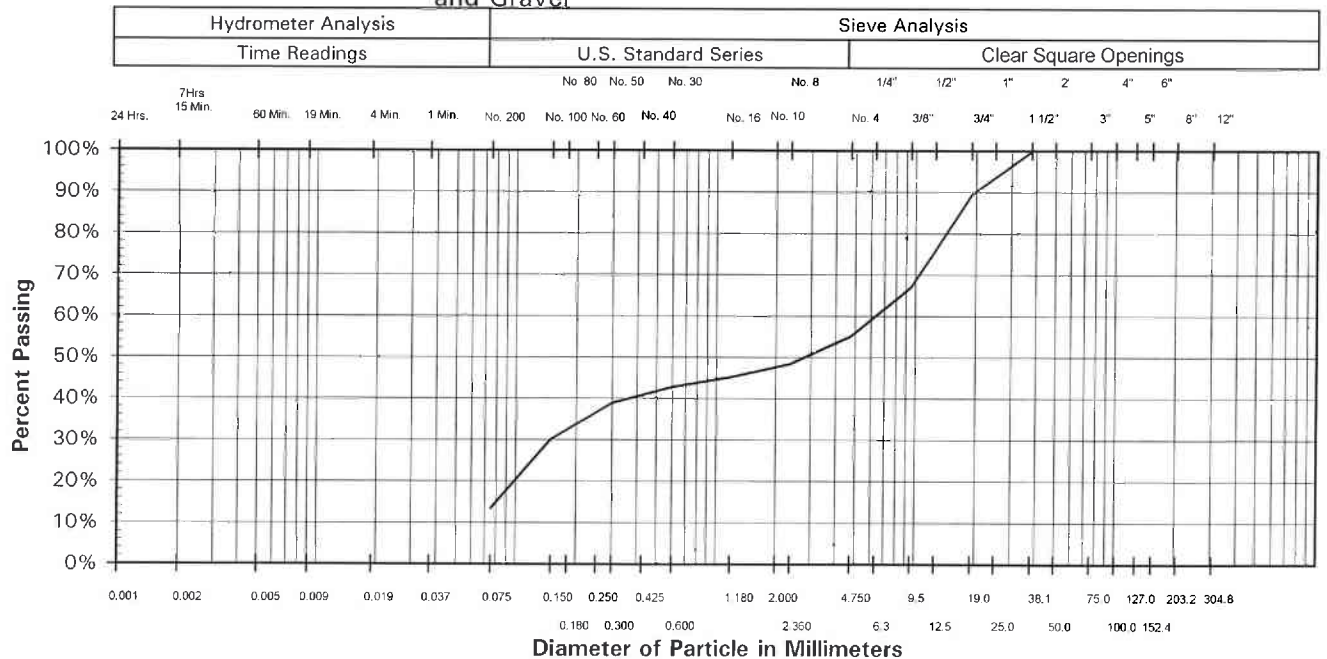
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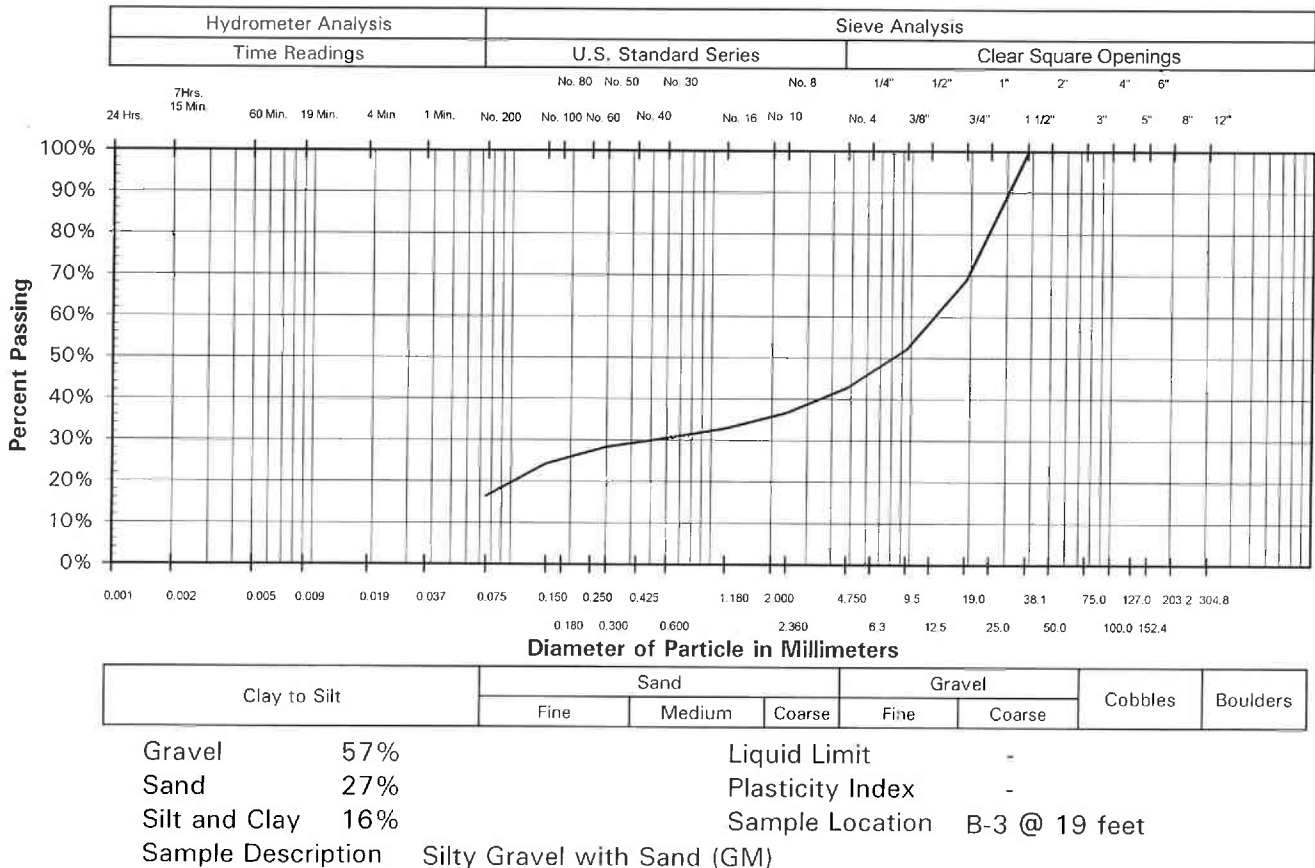
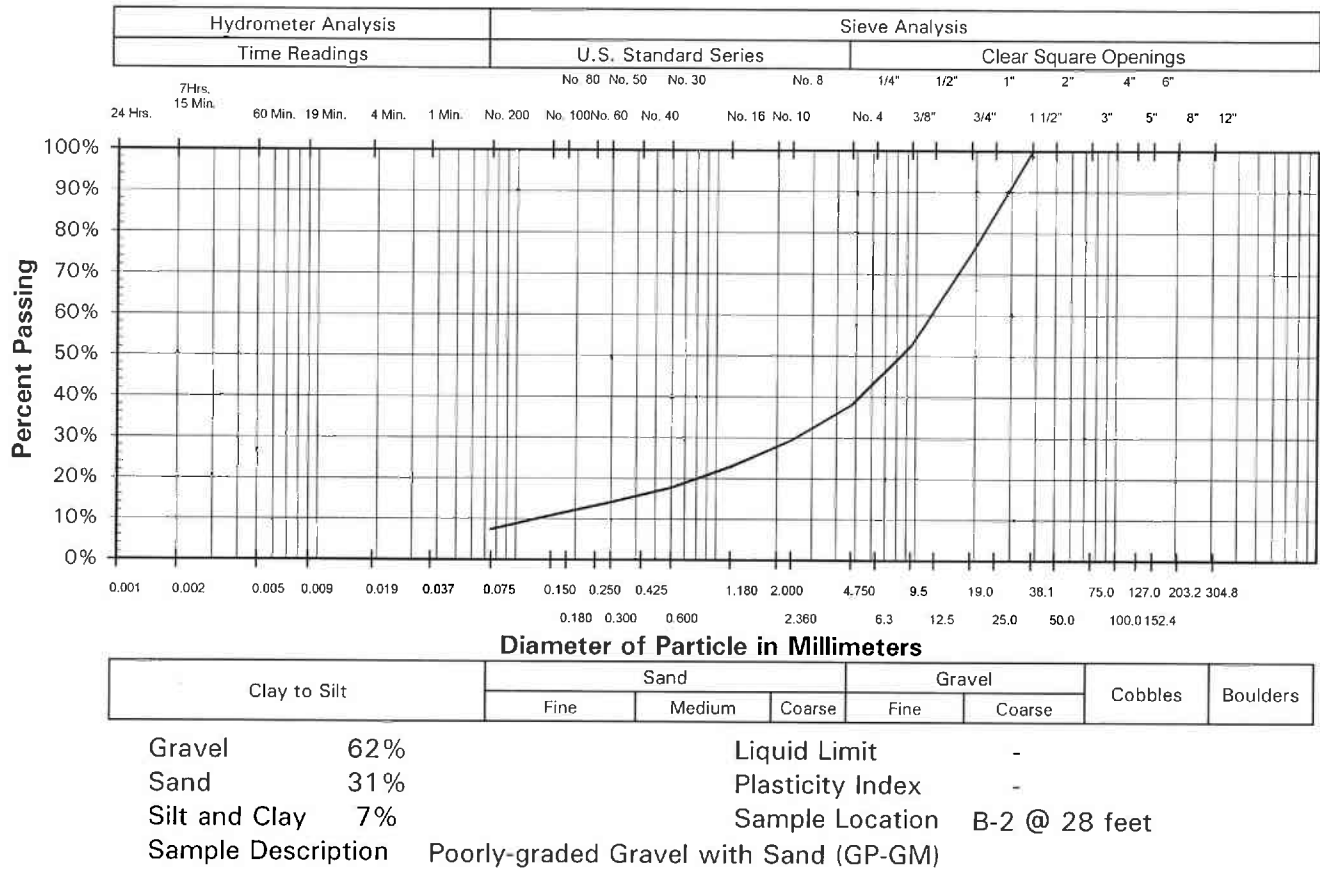


Liquid Limit -
 Plasticity Index -
 Sample Location B-1 @ 3 inches
 Sample Description Base course; Poorly-graded Sand with Silt
 and Gravel



Liquid Limit -
 Plasticity Index -
 Sample Location B-2 @ 6 feet
 Sample Description Silty Gravel with Sand (GM)

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TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1150617

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