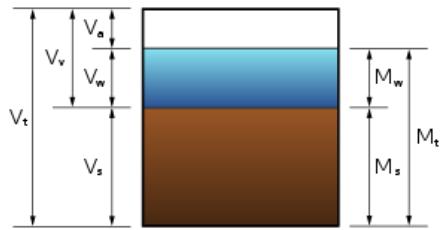


Lorenzen Soil Mechanics, Inc.



Hillview Subdivision

Missoula, Montana

Geotechnical Engineering Report – Phase 2

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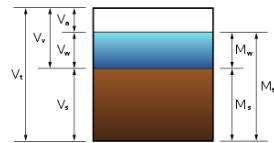
September 13, 2022

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1 INTRODUCTION

On behalf of Hillview, LLC, Cushing Terrell requested Lorenzen Soil Mechanics, Inc. (LSM) to complete a general geotechnical/materials investigation for a subdivision within the southern portion of Missoula, Montana. The purpose of the subsurface investigation was to evaluate the subgrade materials and provide general recommendations for street typical sections, underground utilities, building foundations, slabs-on-grade, retaining walls, water infiltration, and slope stability for roughly 105 acres. Due to scheduling conflicts, the geotechnical investigation was conducted in two phases. The first stage primarily addressed the commercial and multi-family portions of the subdivision and is located within the southwestern portion of the Development. Its streets line up directly with Clearview Way and with Village View Way, each intersecting with Hillview Way. The geotechnical report for the Phase 1 portion was completed March 20, 2022.

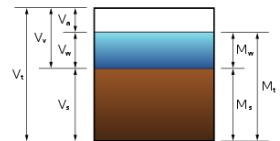
This geotechnical report represents the Phase 2 portion of the project and is mostly east and north of the Phase 1 portion. LSM understands this area will primarily be residential with single-family homes serviced by an array of city streets.

2 SITE EVALUATION

LSM understands the overall site has primarily been used for pasture grazing. A portion of the Development addressed in Phase 1 had been mined for gravel. Grading operations for Phase 1 were underway at the time of LSM's Phase 2 geotechnical investigation which occurred June 30 and July 1, 2022.

Geologically, this area is mapped on the Missoula West 30' x 60' Quadrangle Geologic Map (MBMG Open File Report 373). The geologic map depicts the site primarily as Miocene through Pliocene epochs Alluvial Fan Deposits (Taf) and to a lesser amount, as Eocene through Miocene epochs Gravel and Clay Deposits (Tgc). The Taf materials are characterized in the Open File Report as locally derived, poorly sorted (well-graded), angular to rounded boulders, cobbles, gravel, sand, and silt. It is likely equivalent to the Sixmile Formation of southwest Montana. The Tgc materials are characterized as channel and flood plain deposits of the ancestral Clark Fork River. They include well-sorted (poorly graded) and well-rounded cobbles, gravel, sand, silt, clay, and volcanic ash deposits. The clasts are not locally derived. The Open File Report notes that a marked angular unconformity at the top of the unit near Missoula is overlain by the Taf unit. Its coarser material intervals are permeable, but clay-rich zones are not. They are likely equivalent to the Renova Formation of southwest Montana. A portion of the geologic map is included as Figure 1. The map also notes nearby Belt Supergroup Snowslip Formation (Ysn) from the Middle Proterozoic Period. The Ysn materials are characterized as green and red argillite and siltite in the lower and middle part of the unit and reddish quartzite in the uppermost portion of the unit.

Three nearby water well logs data-based at the Montana Bureau of Mines and Geology were reviewed. The water wells appear to be associated with the three private residences to the



northeast of the Development. The logs indicate depths to the groundwater table ranged from 200 to 340 feet. The water well drilling depths extended from 360 to 440. Bedrock was noted in only one of the water well logs and that was logged as shale at a depth of 410 feet.

LSM conducted its subsurface investigation on June 30 and July 1, 2022. A Caterpillar 308CR mini-excavator, owned and operated by Grant Creek Excavating, was used to dig a total of thirteen test pits (TP). Figure 2 depicts the test pit locations for each of the two geotechnical phases. Horizontal coordinates were obtained using a Garmin eTrex® 10 GPS unit. The elevations were estimated from Google Earth. Figure 2 also includes the general locations for the three water wells.

The materials encountered in the Phase 2 test pits tended to agree with the MBMG Open File Report for the Taf and the Tgc materials in that there were gravel and sand with varying amounts of clayey fines and frequent to occasional cobble-sized particles. TP-11 featured fractured rock clasts with clayey infilling, indicating possible bedrock. Based on the water well logs and the materials encountered during LSM's investigation, the seismic site class is recommended as 'C – Very Dense Soils and Soft Rock'.

The groundwater table was not encountered in any of the test pits, the deepest depth of which extended to 8.5 feet. The moisture conditions of the subgrade materials were generally regarded as being 'damp' or 'moist'. Logs of the test pits and the testing results are provided in Appendix A. The three MBMG water well logs and the seismic spectral acceleration design values are included in Appendix A. Photographs of the test pitting operations and soil samples are included in Appendix B.

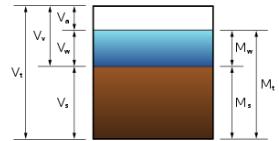
3 RECOMMENDATIONS

In general, LSM believes the gravelly soils encountered during the subgrade investigation are considered excellent for street and building construction. For residential structures, the excavated soils can be stockpiled and re-used on site as backfill, provided the cobble-sized (>3") particles and debris are removed. The recommendations that follow are generic to the test pit investigations completed thus far. LSM recommends including a more in-depth geotechnical for individual structures, or at the very least, a geotechnical review during the residential foundation excavations to verify the soils are consistent with what is provided in this general report. Some locations can expect to encounter perched groundwater zones that may develop into springs upon excavation. French drains and sumps may be necessary in some locations.

3.1 Street Typical Sections

LSM has evaluated a typical section for standard duty street traffic for this site using the Montana Department of Transportation (MDT) and American Association of State Highway and Transportation Officials (AASHTO) methods.

The A-1-a, A-1-b, and A-2-6 soils are considered acceptable as street subgrade soils. The A-1 soils in particular are considered excellent subgrade soils. Missoula County ranks the A-1 soils as 'good' and the A-2-6 soils as 'average'. Using Table 14.2-A in the MDT Geotechnical

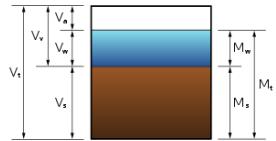


Manual, the soil classifications correlate to an R-value ranging from 46 to greater than 70. LSM has conservatively based the typical section design on an R-value of 50, which correlates to a Resilient Modulus (M_R) of 20,000 psi. A California Bearing Ratio (CBR) range of 20 to 80 can be expected for the A-1 soils. A CBR range of 9 to 30 can be expected for the A-2 soils.

The M_R is used to calculate the design structural number for a flexible pavement. The R-value was correlated to a table provided in MDT's Geotechnical Manual. Other variables include the 18-kip equivalent single axle loadings (ESALs), initial serviceability, terminal serviceability, design serviceability loss, reliability level, and the overall standard deviation. Their values and description are provided below.

- Resistance Value, R-value = 50 - a material property used by MDT to characterize the support characteristics of the roadbed soil in flexible pavement design. It measures the response of a compacted sample of soil or aggregate to a vertically applied pressure.
- Roadbed Soil Resilient Modulus, M_R = 20,000 psi - a material property used by AASHTO to characterize the support characteristics of the roadbed soil in flexible pavement design. In general terms, it is a measure of the soil's deformation in response to repeated applications of load much smaller than a failure load.
- Equivalent Single Axle Loadings, ESALs = 1,000,000. This is an assumed value and is intended to take into account residential structure construction.
- Initial Serviceability, p_o = 4.2 - a measure of the pavement's smoothness or rideability immediately after construction. Serviceability is rated on a scale of 0 to 5, with 5 being a perfectly smooth pavement and 0 being a very rough or impassable pavement.
- Terminal Serviceability, p_t = 2.2 - the minimum tolerable serviceability of a pavement, on the same 0 to 5 scale as described in Initial Serviceability.
- Design Serviceability Loss, ΔPSI , = 2.0 – the difference between p_o and p_t .
- Reliability Level, R = 90 percent - the probability that a pavement structure will survive the design period traffic. Generally, as traffic volumes become larger, the consequences of premature pavement failure increases dramatically; therefore, high-volume roadways must be constructed with a much higher level of reliability than low-volume roadways.
- Overall Standard Deviation, S_o = 0.49 - accounts for all variability associated with design and construction inputs, including variability in material properties, roadbed soil properties, traffic estimates, climatic conditions, and quality of construction.

Based on the above criteria, a required Structural Number (SN) of 2.50 was calculated using a nomograph developed by AASHTO. The nomograph is included in Appendix A.



The SN represents the ability of a flexible pavement to withstand structural loadings. Using the required SN, the thicknesses of the different material layers within the typical section can be determined as:

$$SN = a_1 D_1 m_1 + a_2 D_2 m_2 + a_n D_n m_n$$

The 'a' values represent structural coefficients, the 'D' values represent the layer thicknesses, and the 'm' values represent the drainage coefficients. A value of 0.41 was used for the asphalt cement structural coefficient, a_1 . A value of 0.14 for virgin crushed base course was used for its structural coefficient, a_2 . The structural coefficients are recommended values from a May 11, 2006 MDT memorandum for 'Revised Surfacing Structural Coefficients and Layer Thicknesses'. The drainage coefficient, m , is a function of the time required for the pavement to drain and the amount of time during the year that the pavement structure is exposed to moisture levels approaching saturation. MDT recommends a conservative drainage coefficient value of 1.0 for the plant mix surfacing and for the base course.

To match or exceed the required SN of 2.50, LSM proposes a typical section of:

Asphalt Plant Mix	4 inches – in two 2-inch thick lifts
3/4-inch Crushed Base	8 inches
Scarified and Wetted Subgrade	6 inches

This typical section produces a design SN of 2.76. LSM believes this to be an appropriate value, given the actual ESAL loadings are unknown at this time but may likely be less than the assumed value of 1,000,000 over a 20-year period in a residential neighborhood.

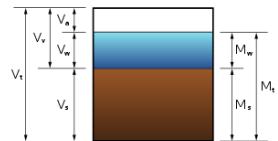
The gradation for the 3/4-inch crushed base course is provided in Table 1.

TABLE 1: 3/4" Crushed Base Course

Sieve Size	Percent Passing
3/4"	90 - 100
3/8"	70 - 90
No. 4	40 - 70
No. 10	25 - 55
No. 200	2 - 8

LSM recommends preparing the new street typical sections by:

1. Grading to the subgrade depth, extending the typical section to at least 1 horizontal foot beyond any curb and gutter section.
2. Scarifying to a depth of at least 6 inches and wetting the scarified surface.
3. Compacting the wetted, scarified surface to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content. The subgrade may be too coarse to have a relevant Proctor moisture density curve and, similar to the perimeter footing and slab-on-graded subgrades, the maximum dry density may need to be established in the field. LSM recommends using a roller compactor having an



operating weight of at least 25,000 pounds and a centrifugal force of at least 50,000 pounds.

4. Providing an 8-inch compacted thickness of 3/4-inch crushed aggregate base course meeting the gradation in Table 1. Recycled concrete can be blended with the base course, provided the end result meets the gradation recommendation.
5. Grading the final surface to drain stormwater to dry well sumps or other City-approved stormwater detention area.

LSM recommends a performance graded PG 58-28 binder for the asphalt concrete and the plant mix surfacing aggregate meeting the Montana Public Work's gradation presented in Table 2. The gradation bands in Table 2 represent the job mix target limits, which determine the suitability of aggregate. Provide the final job mix target gradation within the specified bands and uniformly graded from coarse to fine, not to vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice-versa. For example, using the 3/8" and No. 4 sieves, a gradation of 73 percent and 48 percent passing their respective sieves is acceptable, 73 percent and 62 percent passing their respective sieves is not.

TABLE 2: Plant Mix Surfacing Gradation

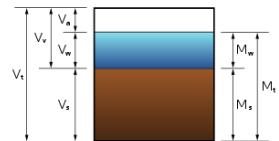
Sieve Size	% Passing Job Mix Target Bands	Job Mix Tolerances
3/4"	100	---
1/2"	83 - 93	+/- 7
3/8"	73 - 87	+/- 7
No. 4	47 - 63	+/- 6
No. 10	32 - 43	+/- 6
No. 40	15 - 25	+/- 5
No. 200	5 - 7	+/- 2

The job mix formula establishes target values. During mix production, the gradations are to fall within the job mix limits presented in Table 2, i.e. if a QA job mix target of 6 has been selected for the No. 200 sieve and since the tolerance is +/-2, the job mix gradation for production would be 4 - 8.

Place the asphalt concrete plant mix surfacing in a two 2-inch thick lifts and compacting each lift to an average relative compaction (ASTM D2041) of at least 93 percent, and no individual sample being less than 92 percent.

3.2 Residential Foundations

The recommendations that follow are very general and are meant to provide preliminary information regarding the construction of home foundations, stem and basement walls, and slabs-on-grade. A total of only thirteen test pits were excavated over a rather wide area that likely exceeds 60 acres. Groundwater studies were outside the scope of the geotechnical report. Perched groundwater zones are known to exist in the general area around the periphery of this development. Moisture conditions during the subsurface investigation indicate water is moving across the site. The clay layers likely act as an aquitard that may cause the groundwater to build



up in localized area. LSM recommends that during residential construction, a site investigation be completed that includes the installation of 1-inch diameter piezometers that can be periodically read to determine if groundwater is moving close to the surface and if it could affect the foundation excavations and lower levels of home sites.

3.2.1 Building Foundations

Continuous and isolated spread footings can be used to support normal building loads. LSM recommends setting the foundation footing elevations at least 3 feet below the final grading.

LSM recommends preparing the continuous foundation subgrades by:

1. Excavating to the subgrade elevation.
2. Scarifying to a depth of at least 6 inches. The scarifying can be completed with the excavator bucket. Remove cobble-sized particles larger than 3 inches that are brought to the subgrade surface and replace with stockpiled smaller granular spoils or imported structural backfill meeting the gradation in Table 3.

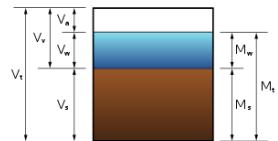
TABLE 3: Structural Backfill

Sieve Size	Percent Passing
3"	100
1"	80 - 100
1/2"	60 - 75
No. 4	35 - 55
No. 40	5 - 30
No. 200	0 - 8

3. Wetting the scarified surface to a moisture content within 2 percent of its optimum moisture content.
4. Compacting the wetted surface to a standard relative compaction (ASTM D698) of at least 98 percent. LSM recommends using a trench roller having an operating weight of at least 3,000 pounds and a centrifugal force of at least 15,000 pounds. The subgrade soils may be too coarse to receive a relevant Proctor moisture/density relationship curve. If so, the maximum dry density for the relative compaction can be established by making repeated passes with the trench roller and checking the dry density values with a nuclear densometer until they no longer increase. That value would then be used as the maximum dry density.
5. Setting the concrete formwork and tying the reinforcement steel.
6. Providing adequate dobies and chairs to support the reinforcement steel to keep it from settling toward the bottom of the footing.

Interior isolated footings can be set directly below the slab-on-grade elevations. They are to receive a subgrade preparation treatment similar to the continuous footings. LSM recommends preparing the isolated footing subgrades by:

1. Excavating to the subgrade elevation and scarifying to a depth of at least 9 inches.
2. Removing cobbles at the subgrade surface larger than 3 inches.



3. Wetting the scarified surface to a moisture content within 2 percent of its optimum moisture content.
4. Compacting the wetted surface to a standard relative compaction (ASTM D698) of at least 98 percent. If the excavated space does not allow room for the trench roller used for the continuous footings, LSM recommends using a plate compactor having an impact force of at least 3,800 pounds.
5. Setting the concrete formwork and tying the reinforcement steel.
6. Providing adequate dobies and chairs to support the reinforcement steel to keep it from settling toward the bottom of the footing.

The scarified and compacted gravels are considered an excellent bearing surface and will offer an allowable soil bearing capacity of 4,000 pounds per square foot (psf). A coefficient of friction, μ , of 0.45 can be used for either the continuous footing or the isolated footing sliding resistance designs.

LSM believes a perimeter drain tile system is prudent for these sites. LSM recommends that after stripping the foundation forms,

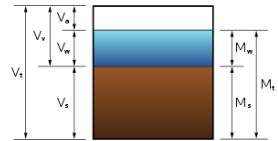
1. Excavating a separate, narrow (~12 inches wide) trench that is graded to drain to daylight on a slope of at least 0.5 percent along the outer edge of the foundation trench.
2. Providing a 4-inch diameter slotted PVC drain tile, geotextile filter sock meeting the engineering characteristics of Geotex® 111F, a 6-inch cover of 3/4-inch drain rock, and a non-woven geotextile meeting the engineering characteristics of Geotex 401 to burrito-wrap the drain tile and drain rock.
3. Installing the perimeter drain tile system along the outer perimeter of the drainage trench.
4. Providing a rodent guard at the drain's outlet and riprap rock to act as a landmark and to control possible erosion.

LSM recommends good building practices by including either wide eaves or rain gutters with downspouts that carry roof runoff water at least 7 horizontal feet away from the buildings and to provide positive drainage on at least a 2 percent slope extending at least 10 feet around the entire perimeter of each of the buildings.

3.3 Foundation Stem Walls/Retaining Walls

The stockpiled gravel soils can be re-used as backfill against the walls, provided all the 3-inch plus sized particles are removed. Prepare the foundation walls for backfilling by:

1. Ensuring there is a water stop at the wall and footing interface.
2. Providing damp proofing or water proofing as per the Architect or Structural Engineer's recommendations. Water proofing is required for living quarters that are below the ground surface.
3. Providing rigid expanded polystyrene (EPS) insulation along the exterior perimeter of the building foundation walls. In addition to insulation, the EPS insulation will provide a cushion to help protect the damp proofing or water proofing on the foundation walls during the backfilling operations.



4. Placing each of the backfill lifts in 8-inch (maximum) thick, loose lifts and compacting each lift to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.

Compacting these materials as backfill will offer an internal angle of friction (ϕ) of 40° , and a moist unit weight (γ_m) of at least 140 pcf. For the on-site soils being used as backfill, LSM recommends using an active equivalent fluid unit weight (γ_{fa}) of 30.4 pounds per cubic foot (pcf) for wall design where the tops of the walls are allowed to rotate, such as for retaining walls. Where the walls are rigid, such as for foundation walls, LSM recommends an at-rest equivalent fluid unit weight (γ_{fr}) of 50.0 pcf. With a level backfill, the following equations can be used to obtain a resultant lateral force (pounds per lineal foot) acting at the lower one-third of the wall heights (H in feet):

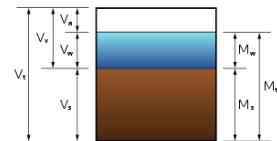
$$\begin{aligned} \text{Active Pressure, } P_a: & \quad 15.2 \times H^2 \\ \text{Passive Pressure, } P_p: & \quad 321.9 \times H^2 \\ \text{At-rest Pressure, } P_0: & \quad 25.0 \times H^2 \\ \text{Seismic Pressure, } P_E: & \quad 9.5 \times H^2 \\ \text{Seismic Active Pressure, } P_{(E+a)}: & \quad 24.7 \times H^2 \end{aligned}$$

Retaining walls can be designed using the lateral earth pressures provided in this section. The allowable soil bearing capacity for the retaining walls is recommended to be 3,500 psf. The lower value is due to the likelihood the retaining wall base will be buried only 1 foot below the final grade. A 4-inch diameter slotted drain system is recommended directly behind the retaining walls. The drain system includes a PVC drain tile graded to drain to daylight and a 1-foot wide layer of 3/4-inch drain rock that extends from the base of the wall to its full height. The drain rock and drain tile are to be burrito-wrapped in a filter fabric meeting the engineering characteristics of Geotex 111F.

3.4 Slabs-on Grade

It is LSM's belief and opinion that the most important preparations for a slab-on-grade's subgrade include the surfaces being properly compacted and being level. LSM recommends the interior slab-on-grade subgrades be prepared by:

1. Excavating to the subgrade depth + 3 inches and scarifying the excavated surface by at least 6 inches. This can be accomplished with the excavator bucket's teeth or a disc.
2. Removing all cobble-sized particles in excess of 3 inches.
3. Moisture conditioning the scarified surface by wetting the subgrade to within 2 percent of its optimum moisture content.
4. Compacting the moisture conditioned subgrade to a standard relative compaction of at least 98 percent. Similar to the continuous and isolated footing subgrades, the slab subgrade may be too coarse to have a relevant Proctor moisture/density curve and will need to have its maximum dry density established in the field. LSM recommends using a roller compactor having an operating weight of at least 20,000 pounds and a centrifugal force of at least 40,000 pounds.



5. Providing a 3-inch thick leveling course of 3/4-inch minus cushion material meeting the gradation in Table 4. Alternatively, 3/4-inch drain rock can be used as the leveling course. A compacted, level surface prior to placing fresh concrete will help minimize concrete cracking.

TABLE 4: Leveling Course/Base Course

Sieve Size	Percent Passing
3/4"	100
3/8"	70 - 90
No. 4	40 - 70
No. 10	25 - 55
No. 200	0 - 8

6. Ensuring there are no visible rises or depressions across the compacted surface. Grade and compact the surface if it is uneven to make it level prior to placing fresh concrete.
7. Including temperature steel within the slab-on-grade at, or just above, its mid-depth.
8. Including sufficient dobies and chairs to provide support for the temperature steel, thereby preventing the steel from moving toward the bottom portion of the slab. LSM suggests a grid of 18-inch to 24-inch centers using No. 5 rebar or greater to provide room for the concrete flatworkers to step over the rebar during placement and finishing.

For slabs placed on the properly compacted and prepared subgrades as described, a modulus of subgrade reaction, k , of 300 pounds per square inch per inch of deflection (pci) can be used for the slab thickness design. Use a coefficient of friction, μ , of 0.45 for sliding resistance design.

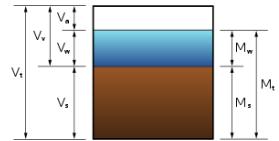
Varying amounts of curling within the slabs are likely to occur due to differences in the moisture content or to temperatures variations between the top and the bottom of the slab. To help mitigate potential slab curling, LSM recommends the following options:

1. Putting a chloride-free retardant additive into the fresh concrete mix;
2. Maintaining a minimum of 1.5 inches clearance on all rebar; and,
3. Placing a 15-mil thick polyolefin vapor barrier across the prepared subgrade surface prior to placing the fresh concrete. If the roof system and walls are in place prior to the slab pour, place the vapor barrier below the leveling course to mitigate edge curling. In addition to being a vapor barrier, the Stego® vapor barrier has a radon diffusion coefficient of 8.8×10^{-12} square meters per second.

The purpose of the retardant in the first option is to slow the set at the surface of the slab. No chlorides are allowed in any of the admixtures for the slabs-on-grade. The concrete at the slab surface will generally harden quicker than the concrete at the bottom of the slab. This is particularly true of concrete placed during hot weather conditions. The use of a retardant can also reduce cold joints, allow smaller crews to finish flat work, and permit later joint sawing.

For joint designs, LSM suggests:

1. Including isolation joints at all interior column locations.



2. Spacing control joints from 24 to 36 times the thickness of the slab in each direction.
3. Terminating reinforcing bars within 2 inches of both sides of control joints to limit the transfer of shrinkage and contraction restraints.
4. Cutting the joints with a conventional saw within 4 to 12 hours after the concrete is finished, or with a dry-cut early entry saw within 1 to 4 hours after the concrete is finished. Extend the saw cuts to one-quarter the thickness of the slab. If fiber reinforcing is used, increase the saw cut to one-third the thickness of the slab. If added correctly, fiber reinforcement can limit the growth of shrinkage cracking.

LSM yields to the Structural Engineer for the joint and steel reinforcement designs.

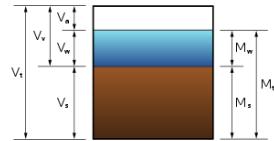
3.5 Exterior Flatwork

Exterior flatwork slabs such as utility and trash container pads, patios, lanais, and sidewalks are not anticipated to be supporting any loads other than the traffic intended for their use. LSM recommends preparing the flatwork subgrades by:

1. Excavating to the exterior flatwork subgrade.
2. Scarifying the excavation to a depth of at least 6 inches and removing all cobble-sized particles in excess of 3 inches that come to the surface.
3. Moisture-conditioning the scarified surface by wetting the subgrade to within 2 percent of its optimum moisture content.
4. Compacting the moisture-conditioned subgrade to a standard relative compaction of at least 95 percent.
5. Providing at least 6 inches of a compacted granular base course meeting the gradation presented in Table 4.
6. Compacting the base course to a relative compaction of at least 95 percent.
7. Ensuring there are no visible rises or depressions across the compacted surface and if needed, grading and further compacting the surface to make it level prior to placing fresh concrete.
8. Forming sidewalk slabs to be at least 4 inches in thickness. Where the sidewalks cross a driveway, form the sidewalk to be at least 8 inches thick.
9. Spacing the contraction joints a maximum of 8 feet apart and providing a maximum width of 1/4-inch, cut at least one-quarter of the depth of the concrete.
10. Installing expansion joints between slabs no more than 40 feet apart and at sidewalk/doorway entry interfaces. At these locations, provide a minimum width of 3/4-inch.
11. Filling all expansion joints with a field-molded sealant to prevent the infiltration of water into the underlying soils.
12. LSM suggests including steel or synthetic fibers with any tensile reinforcement to help prevent widening or horizontal separation of concrete cracks that may form.

3.6 Fresh Concrete

LSM recommends Type I/II cement for the footings and foundation walls. LSM suggests a concrete mix design have a 4-inch maximum slump before any water reducer (plasticizer)



admixture is added or up to 8 inches after it is added. The air content range should range from 5 to 8 percent for footings, foundation walls, and exterior flatwork. The inclusion of entrained air in the footings is a safeguard against concrete being placed and exposed during cold temperatures and if the frost depth extends below the footing elevation.

For the interior slab and exterior flatwork concrete, LSM recommends Type II cement *or* including a shrinkage reducing admixture and/or a hydration control admixture to Type I/II cement. The admixture are to be chloride-free. LSM understands Type II cement is no longer readily available in this region. The purpose of the cement type recommendation is to limit shrinkage cracking. LSM understands Type I/II cement meets the strength requirements for Type I cement and the composition requirements for Type II cement. Type I and Type III cements usually give higher early strengths than Type II cement but all else being equal, will also have higher concrete shrinkage than Type II cement. LSM recommends the maximum aggregate size be 1 1/2 inches for the slab mix designs. LSM suggests the mix design have a 3-inch maximum slump before any water reducer (plasticizer) admixture is added or up to 8 inches after it is added. If fiber reinforced concrete is used, give consideration to providing a slump value associated with the fibers. Erect windbreaks and sunshades to limit rapid surface drying. Avoid curing with water that is more than 20°F cooler than the concrete. These recommendations are intended to limit the amount of shrinkage cracking in the slabs.

If the concrete will be freshly cast during cold temperatures, protect the fresh concrete from freezing. Do not cast fresh concrete on frozen ground. LSM recommends the Contractor provide an approved plan for protecting concrete being placed during cold weather.

LSM yields to the Structural Engineer in each of the concrete mix designs for footings, foundation walls, slabs-on-grade, and exterior flatwork.

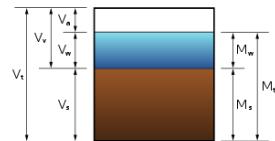
3.7 Slope Stability

It does appear that the current slope geometry is stable. The slopes can be assessed for the individual lots that encroach near the crest or the toe. Following the International Residential Code (IRC) R403.1.7, footings are to be located no closer than one-third the slope height or 4-feet, whichever is less, from a descending slope. The face of the structure is to be no closer than one-half the slope height or 15 feet, whichever is less, from an ascending slope. A geotechnical review is needed to determine if the structures can be closer to the slope surface.

3.8 Groundwater Table and Surface Water

The groundwater table was not encountered during the subsurface investigation, though none of the test pits extended beyond 8.5 feet of depth. Of the three nearby water well logs that were reviewed, the shallowest depth to the groundwater table was 317 feet.

LSM understands the City of Missoula is concerned with stormwater migrating down-gradient to the west and beyond Hillview Way, perhaps expressing itself as a spring or seep downslope. Without conducting extensive groundwater studies, LSM is not prepared to offer design guidelines other than to note the existing ground likely allows a rapid infiltration rate downward.



With hard surfacing and rooftops, plus added irrigation water that has not yet been seen across this property, surface water will likely become localized. LSM is aware there are springs nearby, likely fed by perched groundwater. If a spring is encountered, it is to be developed and routed away from the building sites. LSM can provide recommendations for developing the springs if necessary. Regardless, the residential sites must be graded during construction to limit ponding. LSM recommends berming all open excavations to prevent surface water from entering into them.

3.9 *Underground Utilities*

For utility trench excavations, the trench materials are expected to meet OSHA's requirements for a Type C soil. The steepest unsupported slope within a Type C soil trench is a 1 1/2H: 1V.

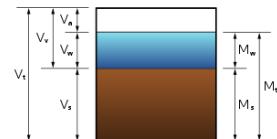
Use bedding soils that are minus 3/4-inch granular materials and are non-corrosive. A non-corrosive soil has a resistivity value greater than 3,000 ohm-centimeters. LSM recommends extending the bedding soil from the bottom of the utility trench to 6 inches above the top of the utility conduits. The native materials can be re-used as trench backfill over the bedding, provided the 3-inch and greater materials are removed. If the excavated cobble-sized materials are placed back in the utility trench, there will likely be uneven settlement due to the confined space in which to get an adequately sized piece of compaction equipment on the over-sized materials.

Soil compaction in utility trenches deeper than 5 feet should be performed using a remote trench compactor and observed by an inspector. The loose lift thickness are not to exceed 8 inches. When the backfill has been brought back to within 5 feet of the surface, perform compaction testing. Compact the trench backfill soils in 8-inch (maximum) thick, loose lifts to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.

3.10 *Seismic Considerations*

The Missoula area is within the Northern Intermountain Seismic Belt. The ASCE/SEI 7-22 Hazards Report was used to develop the spectral response values for a seismic site class 'C', "Very Dense Soil and Soft Rock". LSM recommends the maximum credible spectral response accelerations at short 0.2-second periods, S_{MS} , and at 1-second periods, S_{M1} , to determine the seismic design base shear. A risk category of II was used for residential housing. The spectral response acceleration parameters are presented in Table 5.

The seismic backfill pressures against the buried portion of the foundation walls can be determined by adding a seismic event component, P_E , based on Seed and Whitman (1970) to the coefficient of active pressure P_a . The P_E was calculated to be $9.5 \times H^2$, making the active pressure against the wall during an earthquake equal to $24.7 \times H^2$ and was presented in Section 3.2. A factor of safety of 1.1 can be used for earthquake design lateral earth pressures and the allowable bearing capacity can be increased by one-third for seismic design.

**TABLE 5: Seismic Coefficients**

ASCE/SEI 7-22, Earthquake Loads	
Site Class Definition	C
Mapped Spectral Response Acceleration Parameter, S_s for 0.2 second	0.42g
Mapped Spectral Response Acceleration Parameter, S_1 for 1.0 second	0.12g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{MS}	0.46g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{M1}	0.18g
Design Spectral Response Acceleration Parameter, S_{DS}	0.31g
Design Spectral Response Acceleration Parameter, S_{DI}	0.12g
Mean Peak Ground Acceleration, PGA_M	0.19g

Due to the expected groundwater depth being greater than 15 feet, liquefaction is considered to be a low concern at this site during a major earthquake.

3.11 Shrink/Swell Characteristics

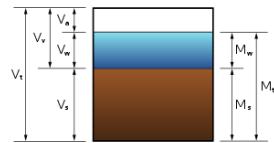
The volume change potential for the coarse grained soils is considered low during seasonal moisture fluctuations for this particular site. The fine-grained soils that may be encountered within the foundation and slab-on-grade subgrades should be considered to have a medium to high volume change potential. These sites should be modified to limit its volume change potential. Though the fine-grained soils were not prevalent in the thirteen test pits, the test pit density is light compared to the number of lots across the sites. LSM does recommend that individual lots receive a geotechnical investigation specific to their site prior to design.

The frost heave potential is considered high if the subgrades are on fine-grained soils. Every effort must be made to direct surface water away from building foundation and flatwork subgrades. LSM recommends positive drainage away from the building's exterior perimeters be in place by providing at least 2 percent grades extending at least 10 horizontal feet away from the building's perimeters.

The collapse potential of the on-site soils is considered low due to the age of the soil profile.

3.12 Compaction and Fresh Concrete Testing Frequency

LSM recommends a compaction testing frequency presented in Table 6 for the foundation, slab-on-grade, and street subgrades, wall backfill, and utility trench backfill. LSM recommends concrete sampling and testing for fresh concrete. In addition to the compaction and fresh concrete testing, LSM recommends including applicable special inspections as per the International Building Code, Chapter 17.

**TABLE 6: Testing Frequency**

Compaction Testing	
Beneath Column Footings	1 Test per Footing
Beneath Wall Footings	1 Test per 75 Lineal Feet of Wall
Foundation Wall/Column Backfill	1 Test per 100 Lineal Feet of Wall per Lift
Slabs-on-Grade Subgrade	1 Test per 2,000 Square Feet
Exterior Flatwork Subgrade	1 Test per 1,000 Square Feet
Roadway & Parking Subgrade and Aggregates	1 Test per 4,000 Square Feet
Utility Trench Backfill	1 Test per 200 Lineal Feet per Lift
Concrete Testing	
Structural Concrete ¹	1 Test per 50 Cubic Yards per Day
Non-Structural Concrete	1 Test per Day

¹. Structural concrete includes all footings, foundation walls, slabs, and other load bearing elements.

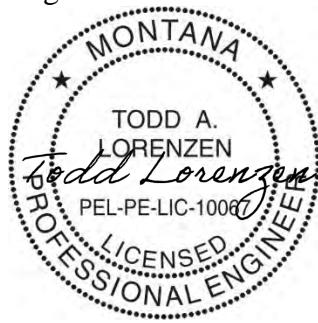
4 BASIS OF RECOMMENDATIONS

The analyses and recommendations submitted in this general report are based upon the subsurface investigation that was used to provide generic instructions for the subgrade preparations. Often, variations occur within the subgrade, the nature and extent of which do not become evident until additional exploration or construction is conducted. The test pits completed thus far are widely spaced but do provide an initial understanding as to the local geology.

This report is for the exclusive use of Hillview, LLC, Cushing Terrell and their design team. In the absence of LSM's written approval, LSM makes no representation and assumes no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes.

Professional Certification

I hereby certify that this report was prepared by me and that I am a duly Licensed Professional Engineer under the laws of the State of Montana.



September 13, 2022

Todd Lorenzen, P.E.
Geotechnical Engineer

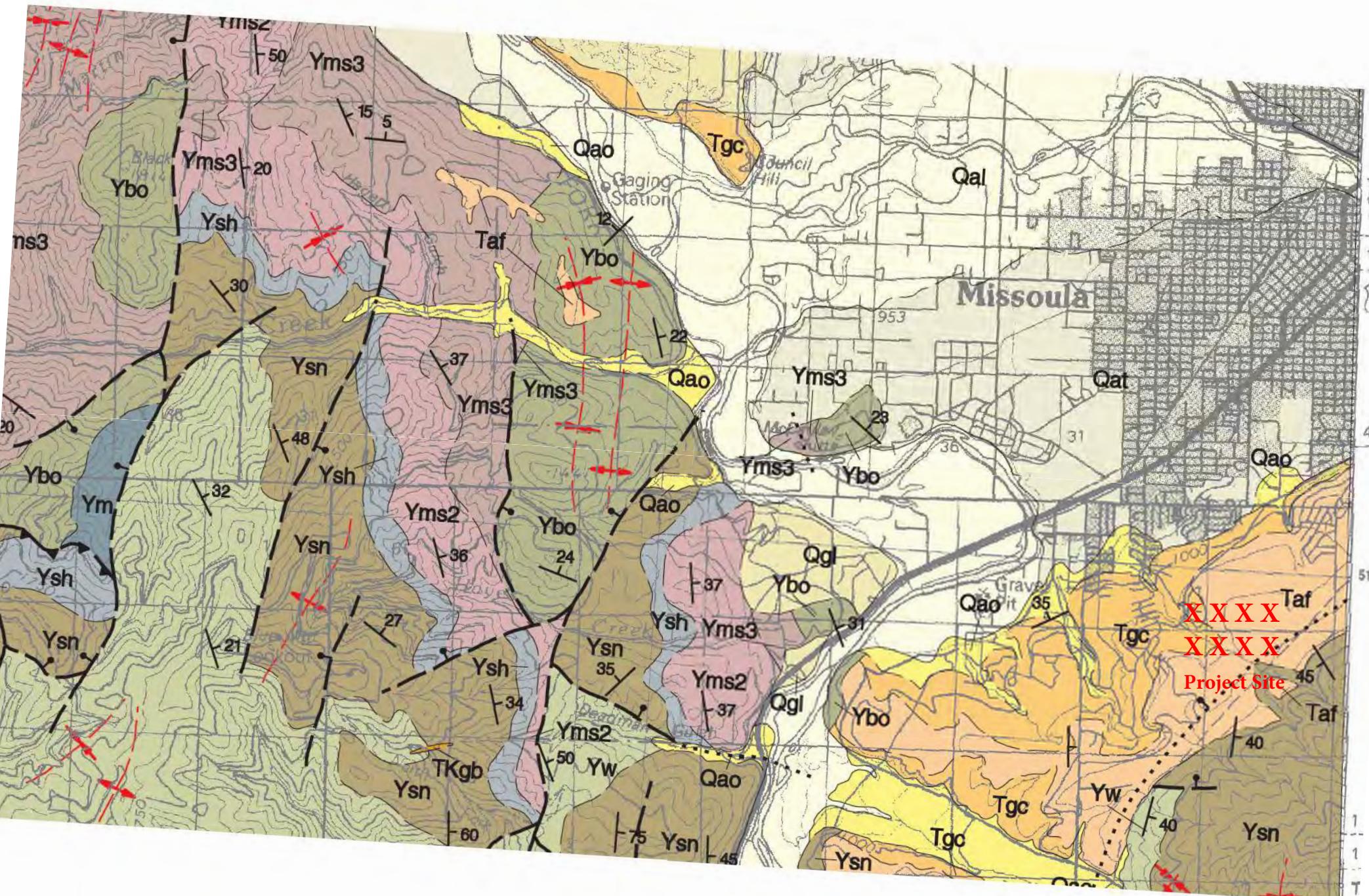
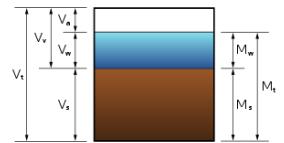


Figure 1: Portion of Montana Bureau of Mines and Geology Open File Report 373, Geologic Map of Missoula-West 30' x 60' Quadrangle; 1998 Reed S. Lewis.



Figure 2: Test Pit Locations - Phase 1 (yellow pin), Phase 2 (red pin) and Water Well Locations (blue balloons)



APPENDIX A. LOGS OF TEST PITS AND TESTING INFORMATION

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:		Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted
ST:		Thin-Walled Tube - 2" O.D., unless otherwise noted
CB:		California Sampler - 2" I.D., 2.5" O.D., unless otherwise noted
DB:		Diamond Bit Coring - 4", NX, unless otherwise noted
BS:		Bulk Sample or Auger Sample

CA:		Casing Advancer
DA:		Drill Auger
HA:		Hand Auger
RB:		Rock Bit
GS:		Grab Sample

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". The field blow counts are reported for each 6-inch interval, or portion thereof if greater than 50 blows are required to advance the full 6-inch interval. For over-sized split spoon samplers, non-standard hammers, or non-standard drop heights, the field penetration values are reported on the bore log. The values must be corrected to obtain the N-value.

WL:	Water Level	WS:	While Sampling	NE:	Not Encountered
WCI:	Wet Cave-In	WD:		While Drilling	
DCI:	Dry Cave-In	BCR:		Before Casing Removal	
AB:	After Boring	ACR:		After Casing Removal	

Groundwater table levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater table levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater table levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: gravel or sand. Cobbles and boulders are not part of the USCS system but are included, when present, as percentages. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; depending on their plasticity, they are described as clay or silt. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils are defined on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

<u>Unconfined Compressive Strength, Ou, psf</u>	<u>Standard Penetration or N-value (SS)</u>		<u>Consistency</u>
	<u>Blows/Ft.</u>	<u>N-value (SS)</u>	
< 500	0 - 1		Very Soft
500 - 1,000	2 - 4		Soft
1,001 - 2,000	5 - 8		Medium Stiff
2,001 - 4,000	9 - 15		Stiff
4,001 - 8,000	16 - 30		Very Stiff
8,000 +	30 +		Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

<u>Standard Penetration or N-value (SS)</u>	<u>California Barrel (CB) Blows/Ft.</u>	<u>Relative Density</u>
<u>Blows/Ft.</u>	<u>(CB) Blows/Ft.</u>	
0 - 4	0 - 6	Very Loose
5 - 10	7 - 18	Loose
11 - 30	19 - 58	Medium Dense
31 - 50	59 - 98	Dense
50 +	99 +	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of Other Constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 30
Modifier	> 30

USCS* GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

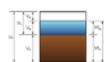
*For AASHTO grain size the #4 sieve is replaced with the #10 sieve

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of Other Constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifiers	> 12

PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-Plastic	0
Slightly	1 - 5
Low	6 - 10
Medium	11 - 20
Highly	21 - 40
Very Highly	> 40



GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very Slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately Severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Highly	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very Highly	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete/Residual Soil	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

FIELD HARDNESS (for engineering description of rock not to be confused with Moh's scale for minerals)

Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with knife or pick. Gouges or grooves to 1/4 in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very Soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock ^a

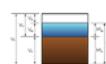
Spacing	Joint	Bedding/Foliation
Less than 2 in.	Very Close	Very Thin
2 in. - 1 ft.	Close	Thin
1 ft. - 3 ft.	Moderately Close	Medium
3 ft.-10 ft.	Wide	Thick
More than 10 ft.	Very Wide	Very thick

Rock Quality Designation (RQD) ^b		Joint Openness Descriptors	
ROD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 - 75	Good	Less than 1/32 in.	Slightly Open
74 - 50	Fair	1/32 to 1/8 in.	Moderately Open
49 - 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	1/2 in. to 1 1/4 in.	Moderately Wide
		Greater than 1 1/4 in.	Wide

a. Spacing refers to the distance normal to the planes of the described feature, which are parallel to each other or nearly so.

b. RQD (given as a percentage) = $(\Sigma \text{ of core 4 in. and longer}) / (\text{length of run})$.

References: American Society of Civil Engineers Manuals and Reports on Engineering Practice - No. 56, American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual. AASHTO M145, 2010.



Lorenzen Soil Mechanics, Inc.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A

			Soil Classification			
			Group Symbol	Group Name ^B		
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels	Cu \geq 4 and $1 \leq Cc \leq 3$	GW		
		Less than 5% fines	Cu $<$ 4 and/or $1 > Cc > 3$	GP		
		Gravels with Fines	Fines classify as ML or MH	GM		
		More than 12% fines	Fines classify as CL or CH	GC		
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands	Cu \geq 6 and $1 \leq Cc \leq 3$	SW		
		Less than 5% fines	Cu $<$ 6 and/or $1 > Cc > 3$	SP		
		Sands with Fines	Fines classify as ML or MH	SM		
		More than 12% fines	Fines classify as CL or CH	SC		
Fine-Grained Soils 50% or more passes the No. 200 sieve	Sils and Clays Liquid limit less than 50	inorganic	PI $>$ 7 and plots on or above "A" line	CL		
			PI $<$ 4 or plots below "A" line	ML		
		organic	Liquid limit - oven dried $<$ 0.75	OL		
			Liquid limit - not dried	OL		
			PI plots on or above "A" Line	CH		
	Sils and Clays Liquid Limit 50 or more	inorganic	PI plots below "A" line	MH		
			Liquid limit - oven dried $<$ 0.75	OH		
		organic	Liquid limit - not dried	OH		
			PI plots on or above "A" line	CH		
			PI plots below "A" line	MH		
Highly organic soils			Primarily organic matter, dark in color, and organic odor	PT		
			Peat			

^ABased on the material passing the 3-in. (75-mm) sieve

^BIf field sample contains cobbles and/or boulders, add "with cobbles or boulders, or both" as necessary to group name.

^CGravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^DSands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$Cu = D_{60} / D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^EIf soil contains \geq 15% sand, add "with sand" to group name.

^FIf fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^HIf fines are organic, add "with organic fines" to group name.

^IIf soil contains \geq 15% gravel, add "with gravel" to group name.

^JIf Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^KIf soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^LIf soil contains \geq 30% plus No. 200, predominantly sand, add "sandy" to group name.

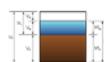
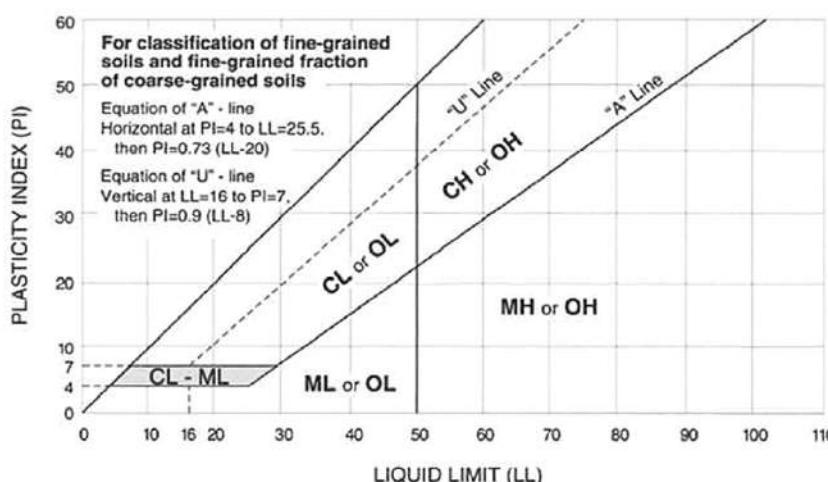
^MIf soil contains \geq 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

^NPI \geq 4 and plots on or above "A" line.

^OPI $<$ 4 or plots below "A" line.

^PPI plots on or above "A" line.

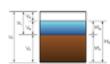
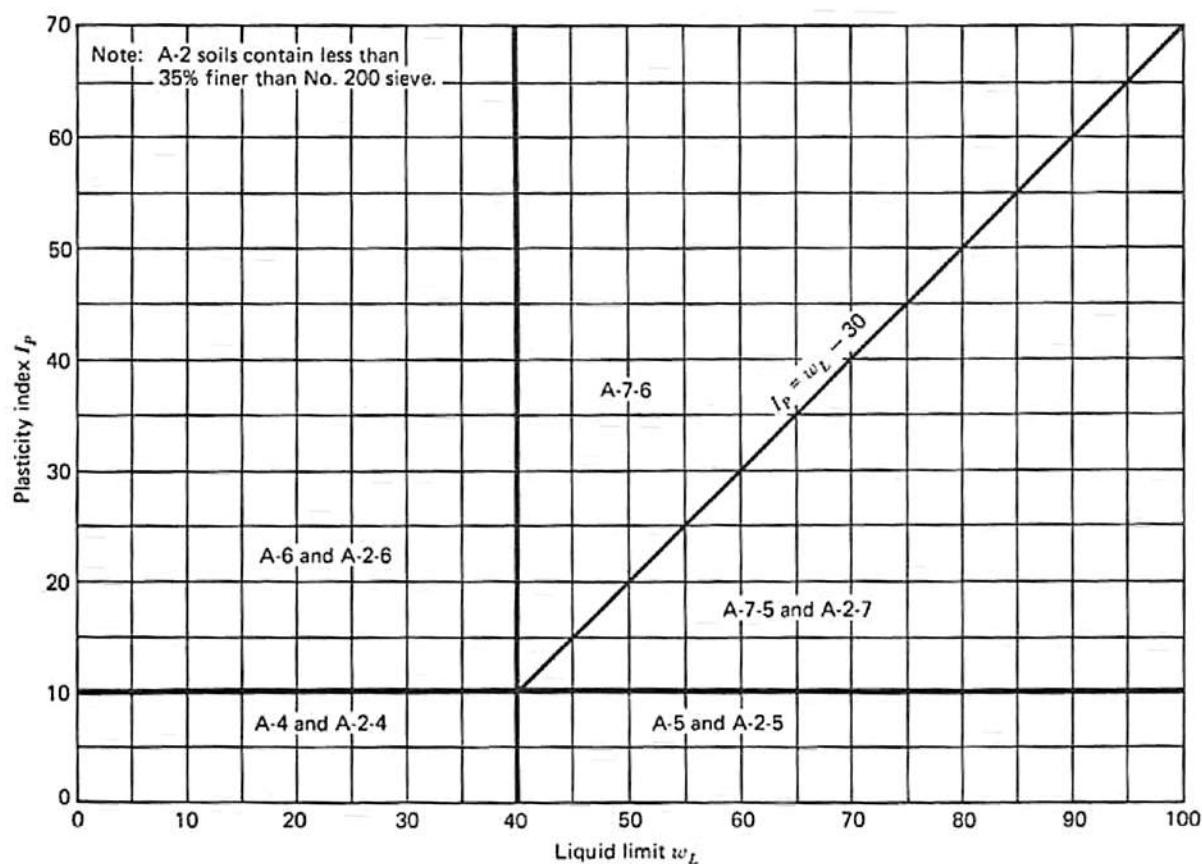
^QPI plots below "A" line.



AASHTO SOIL CLASSIFICATION SYSTEM

General classification	Granular materials (35 percent or less of total sample passing No. 200)							Silt-clay material (More than 35 percent of total sample passing No. 200)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7 ¹
Group classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve analysis percent passing No. 10 No. 40 No. 200	50 max 30 max 15 max	50 max 25 max	51 max 10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 Liquid limit, w_L Plastic Index, I_p			NP	40 max 10 max	41 min 10 max	40 max 11 min	41 min 11 min	40 max 10 max	41 min 10 max	40 max 11 min	41 min 11 min
Significant constituent materials	gravel and sand	fine sand		silty and clayey gravel and sand				silty soils		clayey soils	

¹ Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.



Lorenzen Soil Mechanics, Inc.
2720 Palmer Street, Unit C
Missoula, MT 59808
Telephone: 406-830-0633

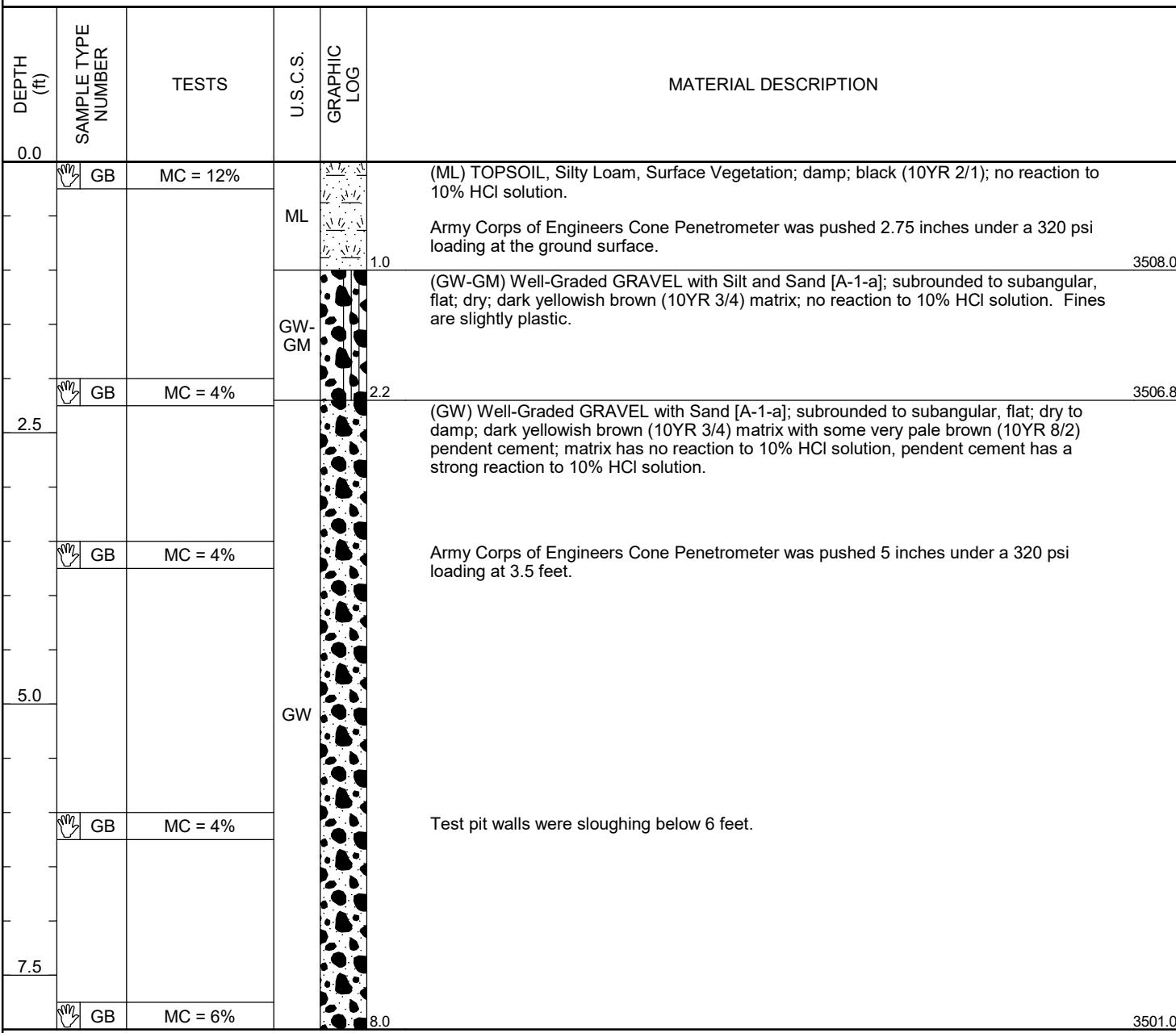
TEST PIT NUMBER TP-10

PAGE 1 OF 1

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CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 7/1/22 **COMPLETED** 7/1/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.259'; W 114° 01.496'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3509 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---



Lorenzen Soil Mechanics, Inc.
2720 Palmer Street, Unit C
Missoula, MT 59808
Telephone: 406-830-0633

TEST PIT NUMBER TP-11

PAGE 1 OF 1

CLIENT Hillview, LLC

PROJECT NUMBER E22

DATE STARTED 6/30/22 COMPLETED 6/30/22

EXCAVATION CONTRACTOR Grant Creek Excavating

EXCAVATION METHOD CAT 308CR

LOGGED BY Lorenzen CHECKED BY Lorenzen

NOTES N46° 49.246'; W 114° 01.371'

PROJECT NAME Hillview Subdivision

PROJECT LOCATION Missoula

GROUND ELEVATION 3599 ft TEST PIT SIZE 36 inches

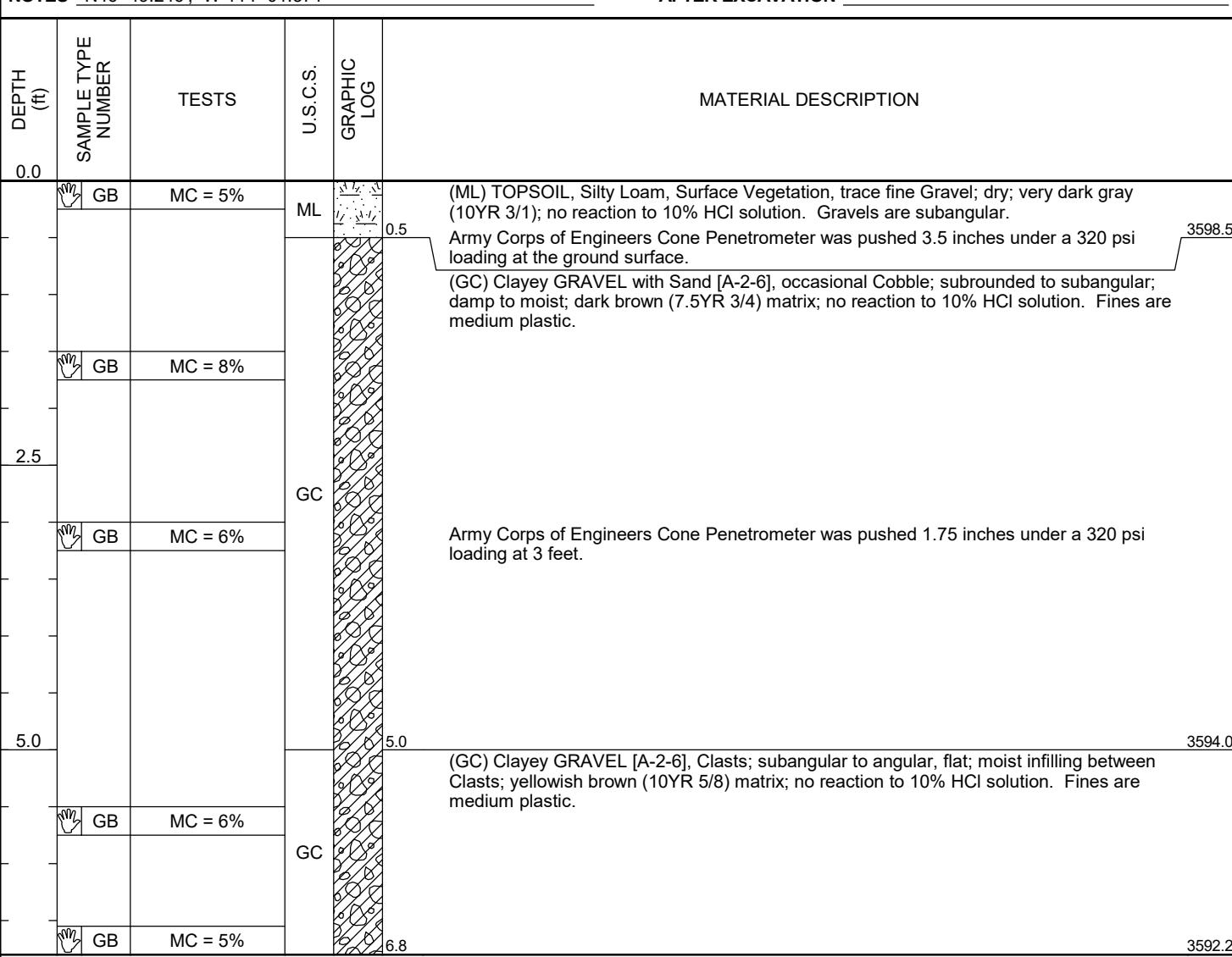
GROUND WATER LEVELS:

AT TIME OF EXCAVATION --- GW table was not encountered.

AT END OF EXCAVATION --- GW table was not encountered.

AFTER EXCAVATION ---

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2720 Palmer Street, Unit C
Missoula, MT 59808
Telephone: 406-830-0633

TEST PIT NUMBER TP-12

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.301'; W 114° 01.668'

PROJECT NAME Hillview Subdivision

PROJECT LOCATION Missoula

GROUND ELEVATION 3626 ft **TEST PIT SIZE** 36 inches

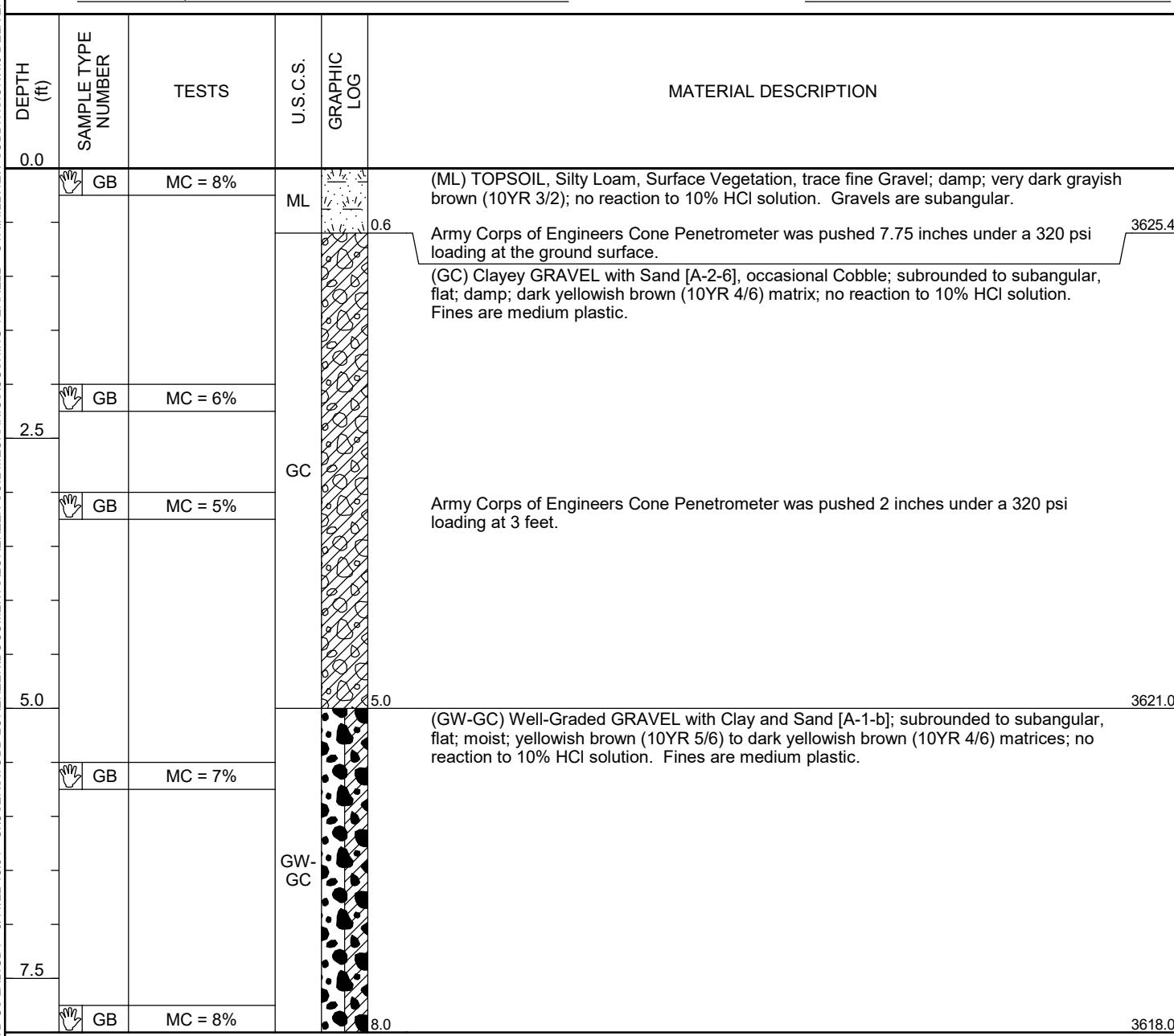
GROUND WATER LEVELS:

AT TIME OF EXCAVATION --- GW table was not encountered.

AT END OF EXCAVATION --- GW table was not encountered.

AFTER EXCAVATION ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/11/22 15:54 - C:\USERS\TODD LORENZEN\DOCUMENTS\LORENZEN SOIL MECHANICS\HILLVIEW SUBDIVISION4.0 DELIVERABLES\HILLVIEW.GPJ



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Missoula, MT 59808
Telephone: 406-830-0633

TEST PIT NUMBER TP-13

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.312'; W 114° 01.406'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3587 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---

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DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	GB	MC = 5%	ML	0.9	(ML) TOPSOIL, Silty Loam, Surface Vegetation, trace fine Gravel; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution. Gravels are subangular. Army Corps of Engineers Cone Penetrometer was pushed 4.75 inches under a 320 psi loading at the ground surface. 3586.1
2.5	GB	MC = 5%	GC		(GC) Clayey GRAVEL with Sand [A-2-6], occasional Cobble; subrounded to subangular, flat; damp to moist; dark yellowish brown (10YR 3/4) to brown (7.5YR 4/4) matrices; no reaction to 10% HCl solution. Fines are medium plastic.
5.0	GB	MC = 13%		4.5	Army Corps of Engineers Cone Penetrometer was pushed 3.5 inches under a 320 psi loading at 3.2 feet.
7.5	GB	MC = 5%	GP-GC	8.0	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1-b], occasional Cobble; subrounded to subangular, flat; damp; dark yellowish brown (10YR 4/6) matrix; no reaction to 10% HCl solution. Fines are medium plastic. 3582.5
	GB	MC = 6%			Bottom of test pit at 8.0 feet. 3579.0

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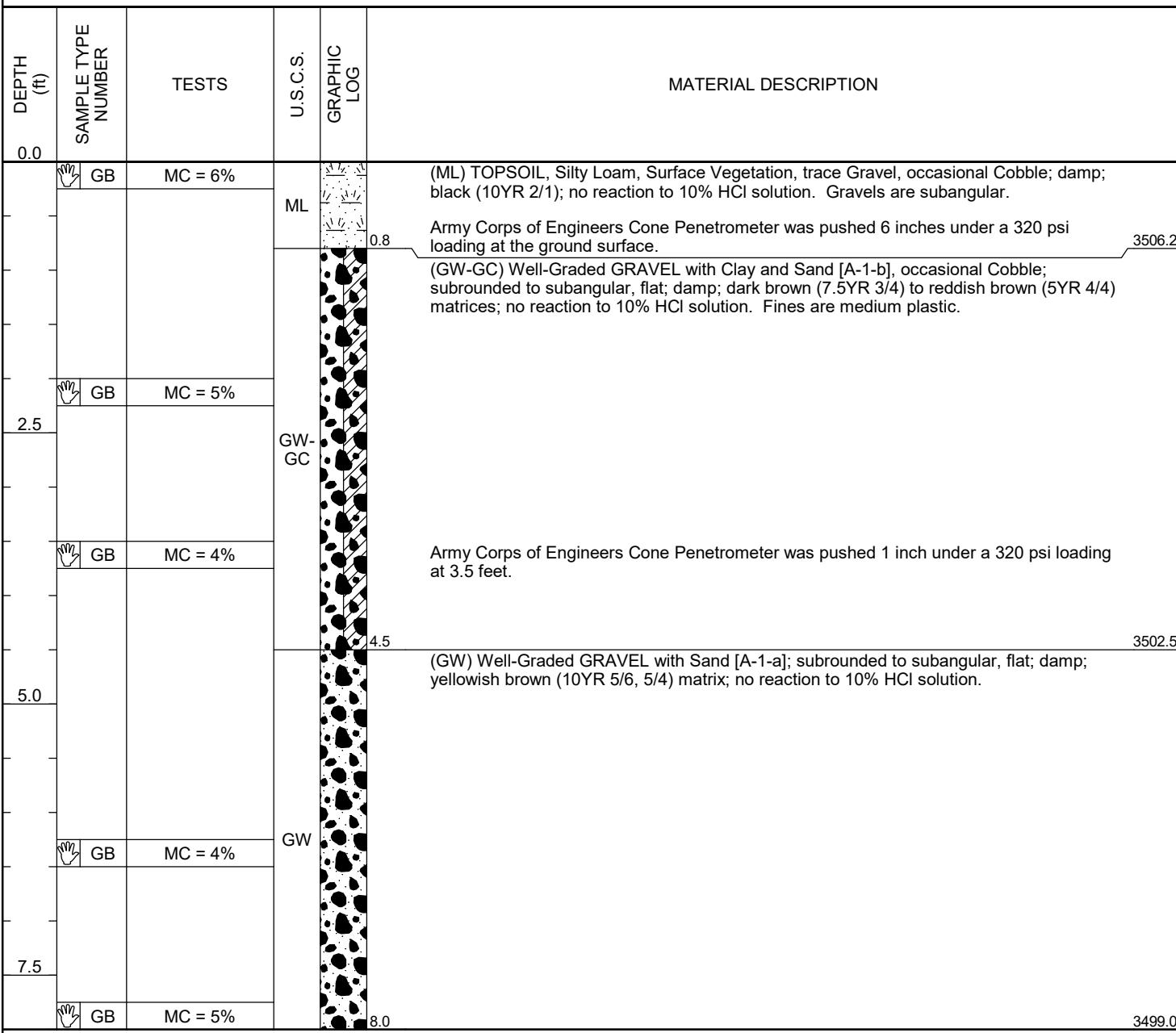
TEST PIT NUMBER TP-14

PAGE 1 OF 1

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CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 7/1/22 **COMPLETED** 7/1/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.107'; W 114° 01.520'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3507 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---



Bottom of test pit at 8.0 feet.

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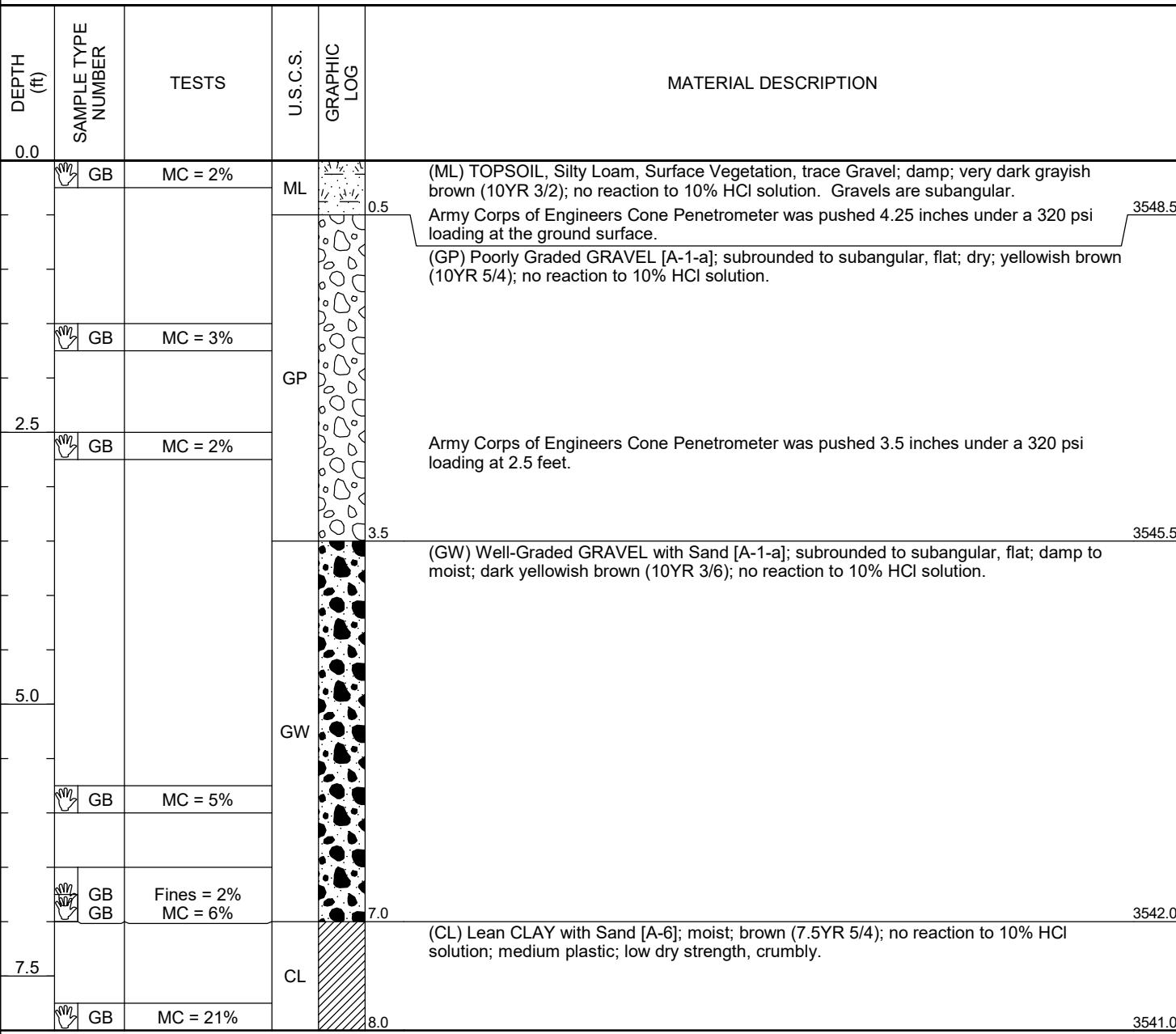
TEST PIT NUMBER TP-15

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 7/1/22 **COMPLETED** 7/1/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.381'; W 114° 01.516'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3549 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---

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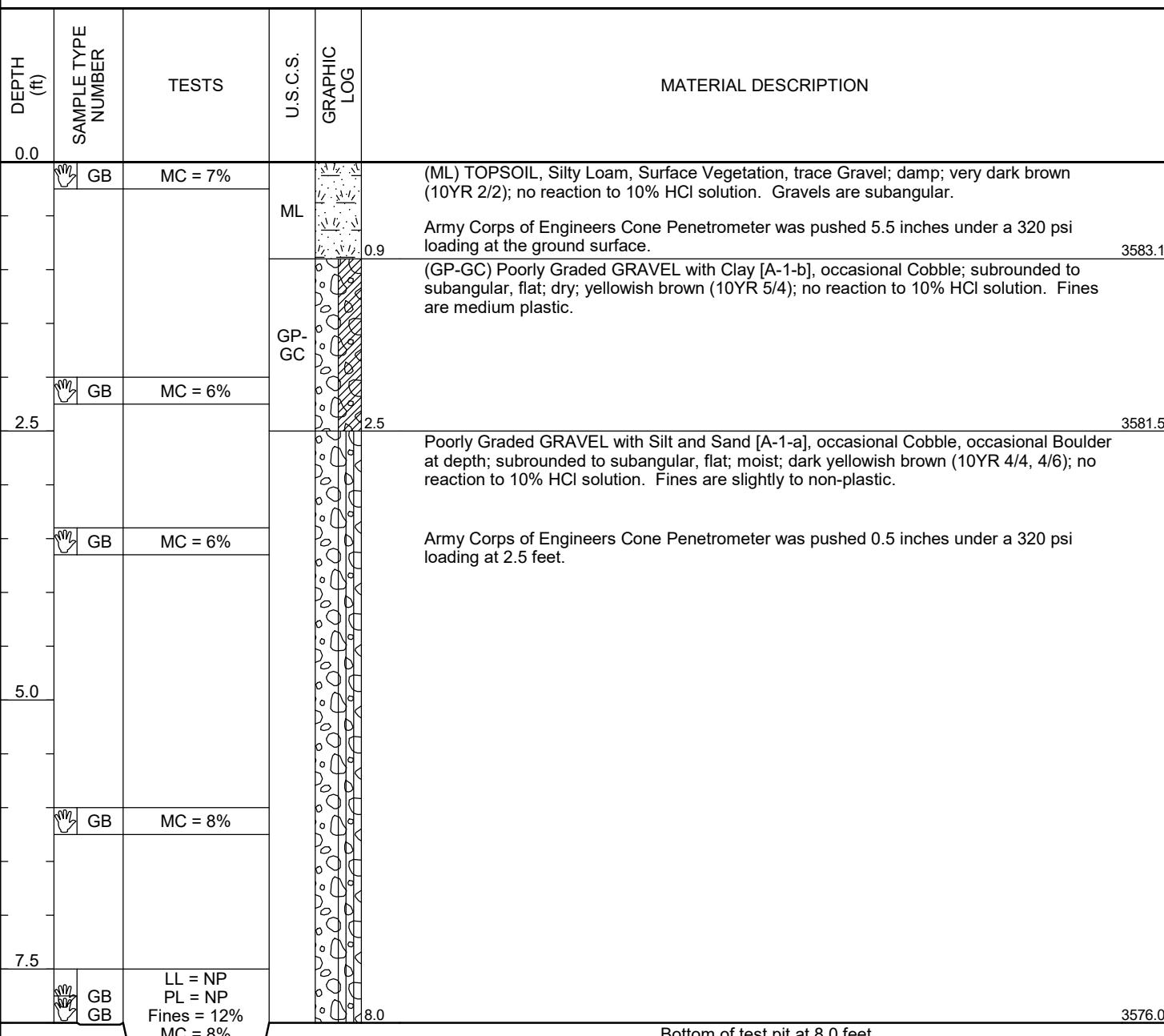
TEST PIT NUMBER TP-16

PAGE 1 OF 1

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CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.385'; W 114° 01.397'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3584 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---



Bottom of test pit at 8.0 feet.

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TEST PIT NUMBER TP-17

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.390"; W 114° 01.243'

PROJECT NAME Hillview Subdivision

PROJECT LOCATION Missoula

GROUND ELEVATION 3606 ft **TEST PIT SIZE** 36 inches

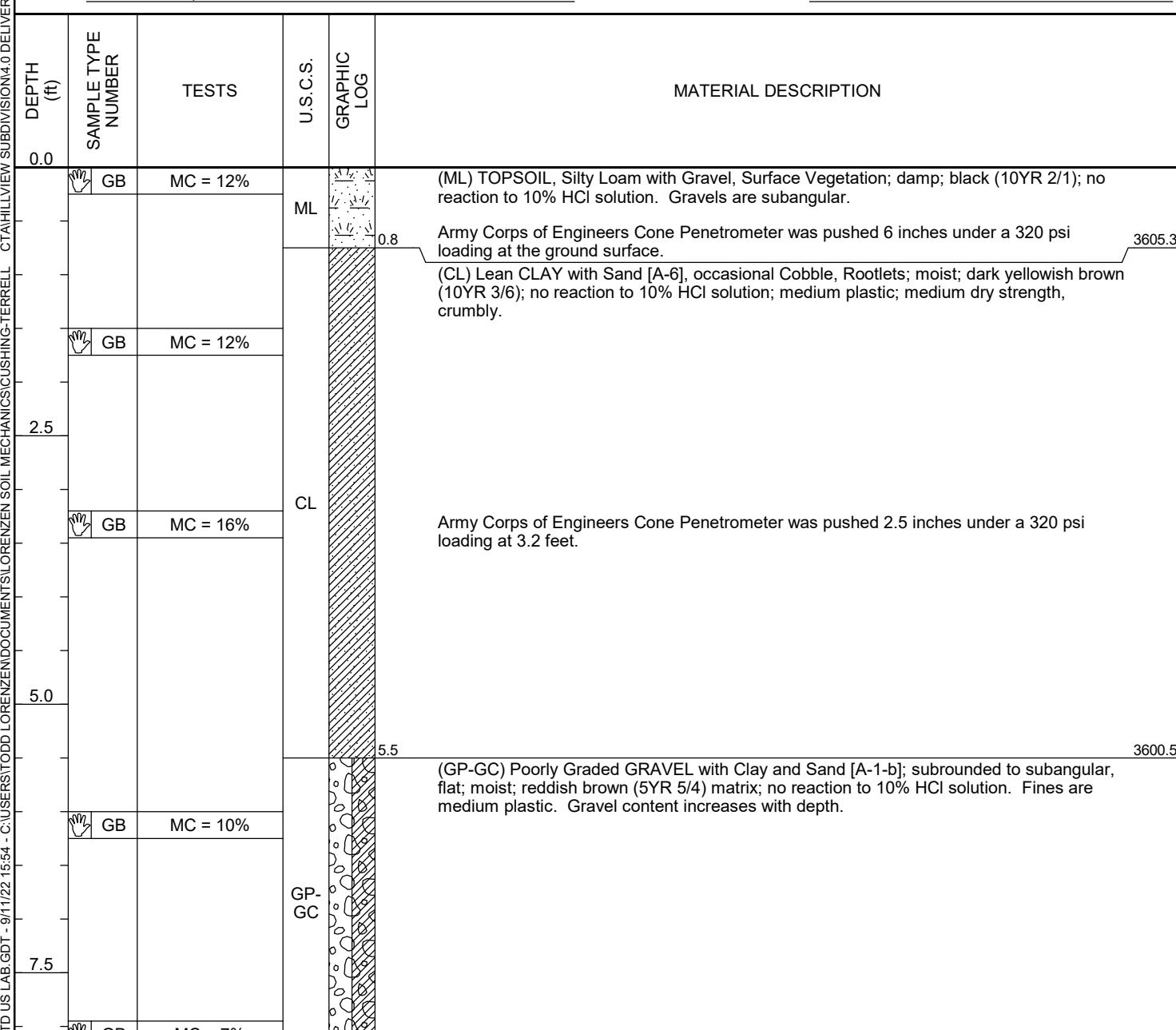
GROUND WATER LEVELS:

AT TIME OF EXCAVATION --- GW table was not encountered.

AT END OF EXCAVATION --- GW table was not encountered.

AFTER EXCAVATION ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/11/22 15:54 - C:\USERS\TODD LORENZEN\DOCUMENTS\LORENZEN SOIL MECHANICS\HILLVIEW SUBDIVISION4.0 DELIVERABLES\HILLVIEW.GPJ



3597.8

3600.5

3605.3

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TEST PIT NUMBER TP-18

PAGE 1 OF 1

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CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.476'; W 114° 01.267'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3576 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	GB	MC = 8%	ML	1.0	(ML) TOPSOIL, Sandy Loam with Gravel, Surface Vegetation; damp; very dark brown (10YR 2/2); no reaction to 10% HCl solution. Gravels are subangular. Army Corps of Engineers Cone Penetrometer was pushed 3.5 inches under a 320 psi loading at the ground surface.
2.5	GB	MC = 3%	GP	3.0	(GP) Well-Graded GRAVEL with Sand [A-1-a], occasional Cobble; subrounded to subangular, flat; dry to damp; dark yellowish brown (10YR 4/4, 4/6) matrix; no reaction to 10% HCl solution.
5.0	GB	MC = 6%	GP	5.0	Army Corps of Engineers Cone Penetrometer was pushed 1 inch under a 320 psi loading at 3 feet.
7.5	GB	Fines = 2%	GW-GC	7.5	(GW-GC) Well-Graded GRAVEL with Clay and Sand [A-1-b], occasional Cobble; subrounded to subangular, flat; damp to moist; strong brown (7.5YR 5/6, 4/6) matrix; no reaction to 10% HCl solution. Fines are medium plastic.
	GB	MC = 9%		8.3	Bottom of test pit at 8.3 feet.

3567.8

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Telephone: 406-830-0633

TEST PIT NUMBER TP-19

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.472'; W 114° 01.385'

PROJECT NAME Hillview Subdivision

PROJECT LOCATION Missoula

GROUND ELEVATION 3565 ft **TEST PIT SIZE** 36 inches

GROUND WATER LEVELS:

AT TIME OF EXCAVATION --- GW table was not encountered.

AT END OF EXCAVATION --- GW table was not encountered.

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	GB	MC = 6%	ML	1.0	(ML) TOPSOIL, Sandy Loam with Gravel, Surface Vegetation; damp; dark gray (10YR 4/1); no reaction to 10% HCl solution. Gravels are subangular. Army Corps of Engineers Cone Penetrometer was pushed 7.25 inches under a 320 psi loading at the ground surface. 3564.0
2.5	GB	MC = 8%	GP-GC	3.5	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1-b]; frequent Cobbles; subrounded to subangular, flat; moist; yellowish brown (10YR 5/4) to strong brown (7.5YR 4/6) matrices; no reaction to 10% HCl solution.
5.0	GB	MC = 7%	GP-GC	8.0	Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches under a 320 psi loading at 3 feet. 3561.5
7.5	GB	MC = 6%	GP-GC	8.0	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1-b]; frequent Cobbles, occasional Boulder; subrounded to subangular, flat; moist; pale brown (10YR 6/3) to light brownish gray (10YR 6/2) matrices; strong to weak reaction to 10% HCl solution.
	GB	MC = 8%			Difficult excavating below 4 feet.
					Bottom of test pit at 8.0 feet. 3557.0

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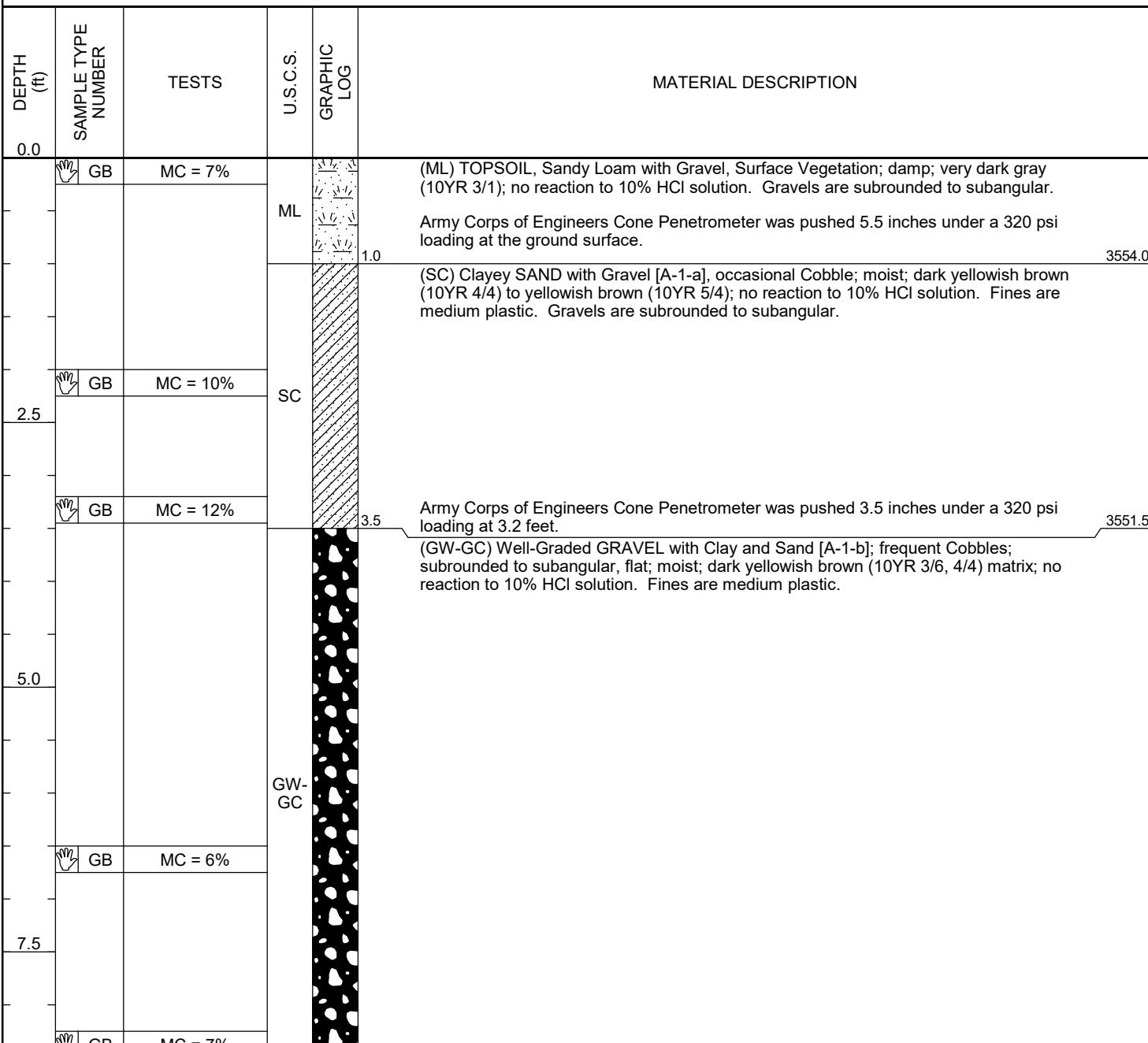
TEST PIT NUMBER TP-20

PAGE 1 OF 1

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CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 6/30/22 **COMPLETED** 6/30/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.459'; W 114°01.397'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3555 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---



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Telephone: 406-830-0633

TEST PIT NUMBER TP-21

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 7/1/22 **COMPLETED** 7/1/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
NOTES N46° 49.427'; W 114° 01.600'

PROJECT NAME Hillview Subdivision
PROJECT LOCATION Missoula
GROUND ELEVATION 3512 ft **TEST PIT SIZE** 36 inches
GROUND WATER LEVELS:
AT TIME OF EXCAVATION --- GW table was not encountered.
AT END OF EXCAVATION --- GW table was not encountered.
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			ML	0.5	(ML) TOPSOIL, Sandy Loam with Gravel, Surface Vegetation; damp; dark gray (10YR 4/1). Gravels are subrounded to subangular. 3511.5
			GW-GC	1.3	(GW-GC) Well-Graded GRAVEL with Clay and Sand [A-1-b]; subrounded to subangular, flat; moist; dark yellowish brown (10YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic. Army Corps of Engineers Cone Penetrometer was pushed 7.75 inches under a 320 psi loading at the ground surface. 3510.7
	 GB	MC = 5%	SP-SM	2.3	(SP-SM) Poorly Graded SAND with Silt [A-3]; fine-grained; moist; dark yellowish brown (10YR 4/6); no reaction to 10% HCl solution. Fines are non-plastic. 3509.7
2.5	 GB	MC = 15%	GP-GC	5.0	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1-b], occasional Cobble; subrounded to subangular, flat; moist; dark yellowish brown (10YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic. Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches under a 320 psi loading at 3.2 feet. 3507.0
5.0	 GB	MC = 7%	GP-GC	8.3	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1-b], occasional Cobble; subrounded to subangular, flat; moist; yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/6) matrices; no reaction to 10% HCl solution. Fines are medium plastic. 3503.8
7.5	 GB	MC = 9%			
	 GB	MC = 7%			

Bottom of test pit at 8.3 feet.

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Missoula, MT 59808
Telephone: 406-830-0633

TEST PIT NUMBER TP-22

PAGE 1 OF 1

CLIENT Hillview, LLC
PROJECT NUMBER E22
DATE STARTED 7/1/22 COMPLETED 7/1/22
EXCAVATION CONTRACTOR Grant Creek Excavating
EXCAVATION METHOD CAT 308CR
LOGGED BY Lorenzen CHECKED BY Lorenzen
NOTES N46° 49.399'; W 114° 01.658'

PROJECT NAME Hillview Subdivision

PROJECT LOCATION Missoula

GROUND ELEVATION 3464 ft TEST PIT SIZE 36 inches

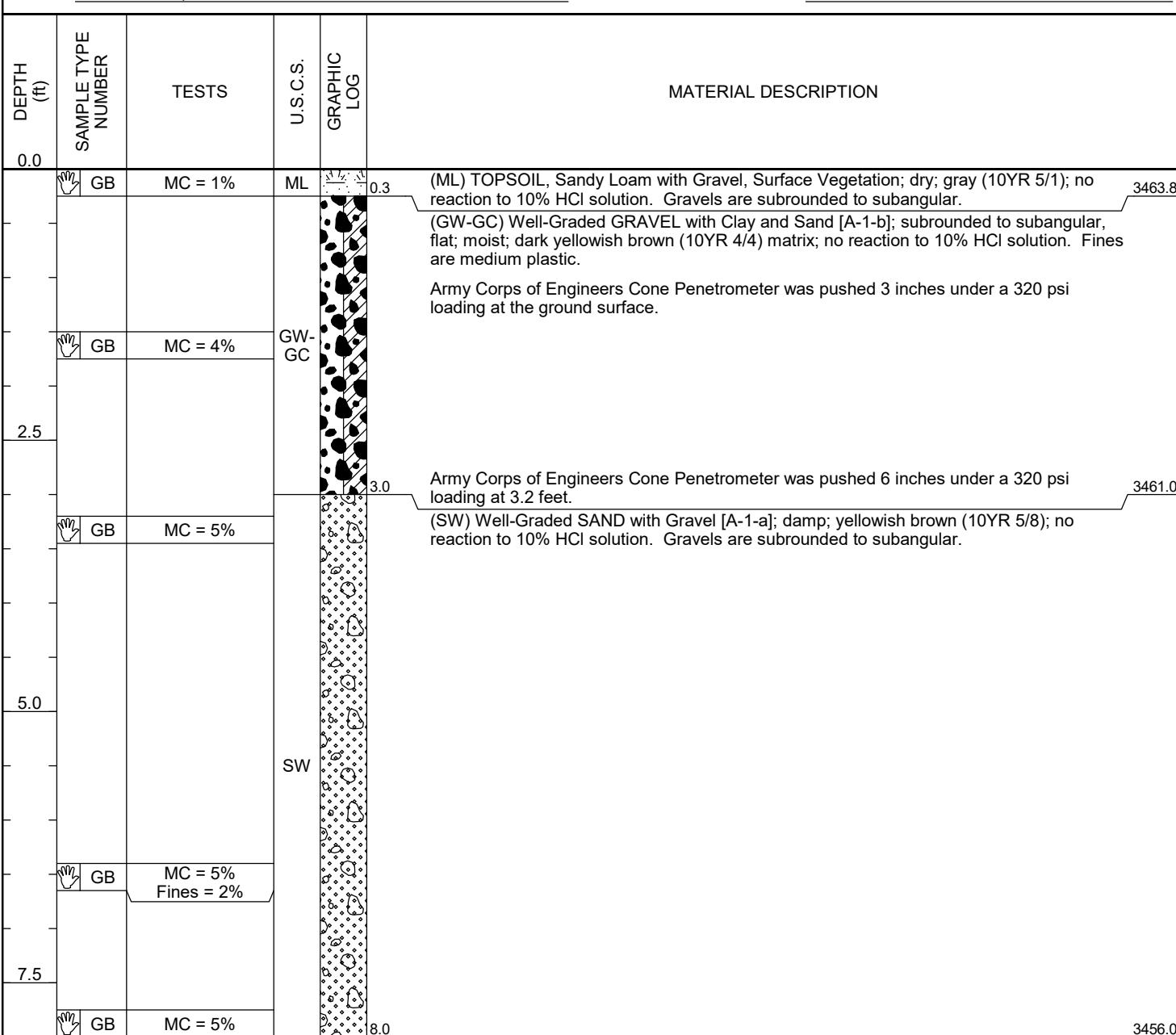
GROUND WATER LEVELS:

AT TIME OF EXCAVATION --- GW table was not encountered.

AT END OF EXCAVATION --- GW table was not encountered.

AFTER EXCAVATION ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/11/22 15:54 - C:\USERS\TODD LORENZEN\DOCUMENTS\LORENZEN SOIL MECHANICS\HILLVIEW SUBDIVISION4.0 DELIVERABLES\HILLVIEW.GPJ



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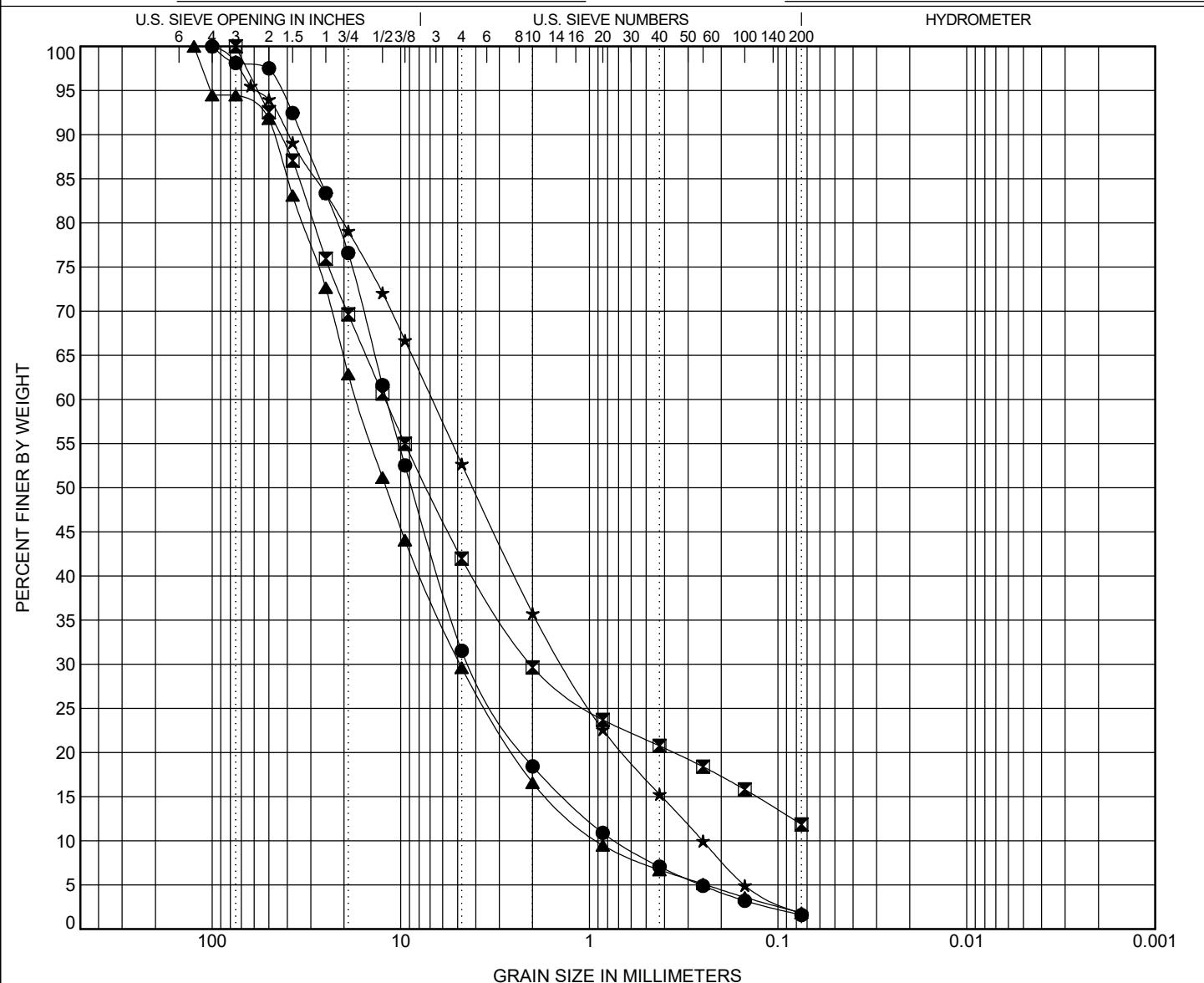
GRAIN SIZE DISTRIBUTION

CLIENT Hillview, LLC

PROJECT NAME Hillview Subdivision

PROJECT NUMBER E22

PROJECT LOCATION Missoula



COBBLES	GRAVEL		SAND			SILT OR CLAY		
	coarse	fine	coarse	medium	fine			

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● TP-15	6.5	WELL-GRADED GRAVEL with SAND(GW)								2.14	16.47
☒ TP-16	8.0	POORLY GRADED GRAVEL with SILT and SAND(GP-GM)					NP	NP	NP	6.41	223.72
▲ TP-18	4.5	WELL-GRADED GRAVEL with SAND(GW)								1.51	18.97
★ TP-22	6.4	WELL-GRADED SAND with GRAVEL(SW)								1.10	27.19

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-15	6.5	100	11.902	4.294	0.723	66.6	29.9	1.6	
☒ TP-16	8.0	75	12.109	2.05		58.0	30.1	11.9	
▲ TP-18	4.5	125	17.15	4.84	0.904	64.9	27.8	1.8	
★ TP-22	6.4	100	6.822	1.375	0.251	45.5	50.9	1.8	

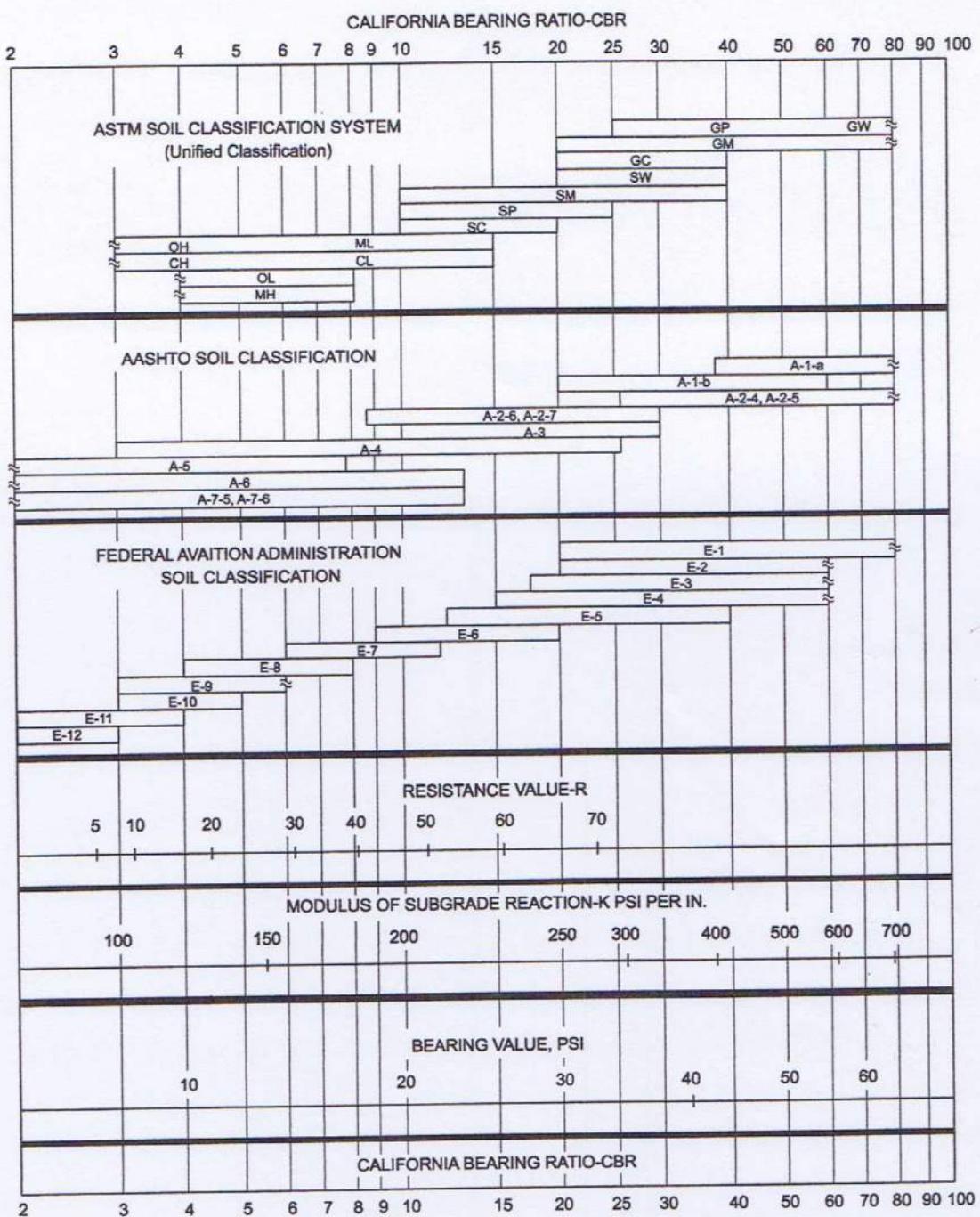


Figure 14.2-A — R-VALUE CORRELATION CHARTS

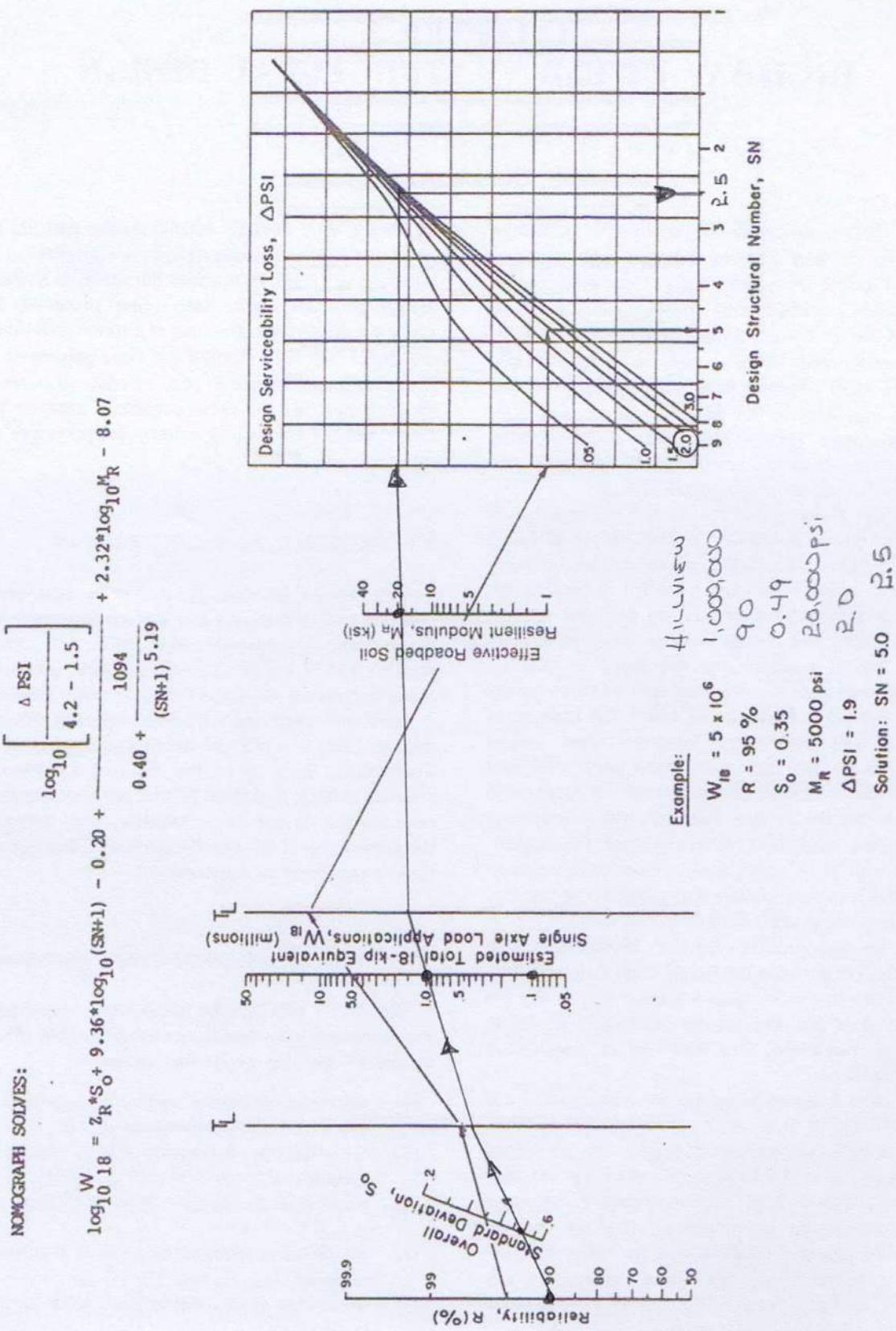


Figure 3.1. Design Chart for Flexible Pavements Based on Using Mean Values for Each Input

R403.1.7 Footings on or Adjacent to Slopes

The placement of buildings and structures on or adjacent to slopes steeper than one unit vertical in three units horizontal (33.3-percent slope) shall conform to Sections R403.1.7.1 through R403.1.7.4.

R403.1.7.1 Building Clearances From Ascending Slopes

In general, buildings below slopes shall be set a sufficient distance from the slope to provide protection from slope drainage, erosion and shallow failures. Except as provided in Section R403.1.7.4 and Figure R403.1.7.1, the following criteria will be assumed to provide this protection. Where the existing slope is steeper than one unit vertical in one unit horizontal (100-percent slope), the toe of the slope shall be assumed to be at the intersection of a horizontal plane drawn from the top of the foundation and a plane drawn tangent to the slope at an angle of 45 degrees (0.79 rad) to the horizontal. Where a retaining wall is constructed at the toe of the slope, the height of the slope shall be measured from the top of the wall to the top of the slope.

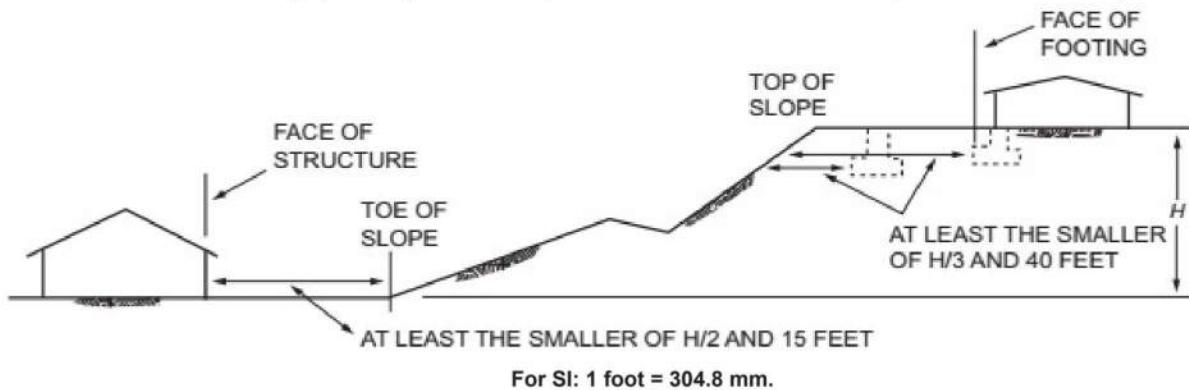


FIGURE R403.1.7.1

FOUNDATION CLEARANCE FROM SLOPES

R403.1.7.2 Footing Setback From Descending Slope Surfaces

Footings on or adjacent to slope surfaces shall be founded in material with an embedment and setback from the slope surface sufficient to provide vertical and lateral support for the footing without detrimental settlement. Except as provided for in Section R403.1.7.4 and Figure R403.1.7.1, the following setback is deemed adequate to meet the criteria. Where the slope is steeper than one unit vertical in one unit horizontal (100-percent slope), the required setback shall be measured from an imaginary plane 45 degrees (0.79 rad) to the horizontal, projected upward from the toe of the slope.

R403.1.7.3 Foundation Elevation

On graded sites, the top of any exterior foundation shall extend above the elevation of the street gutter at point of discharge or the inlet of an approved drainage device a minimum of 12 inches (305 mm) plus 2 percent. Alternate elevations are permitted subject to the approval of the building official, provided it can be demonstrated that required drainage to the point of discharge and away from the structure is provided at all locations on the site.

R403.1.7.4 Alternate Setbacks and Clearances

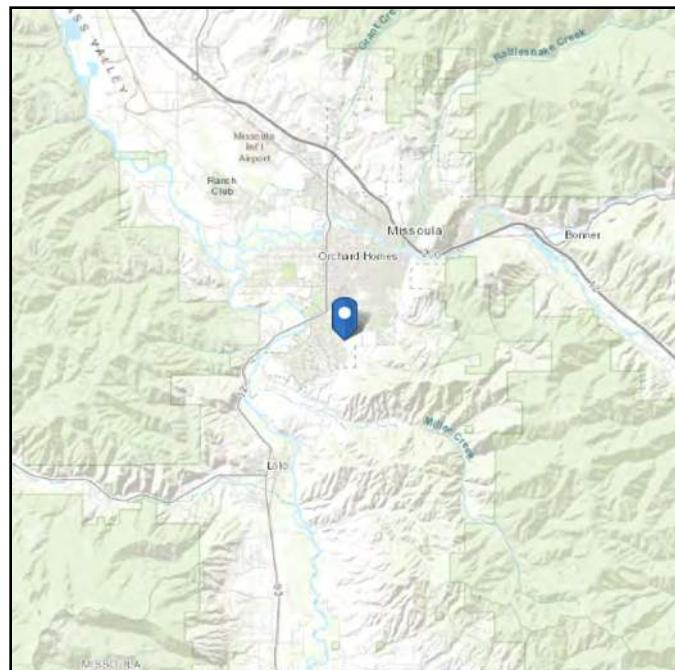
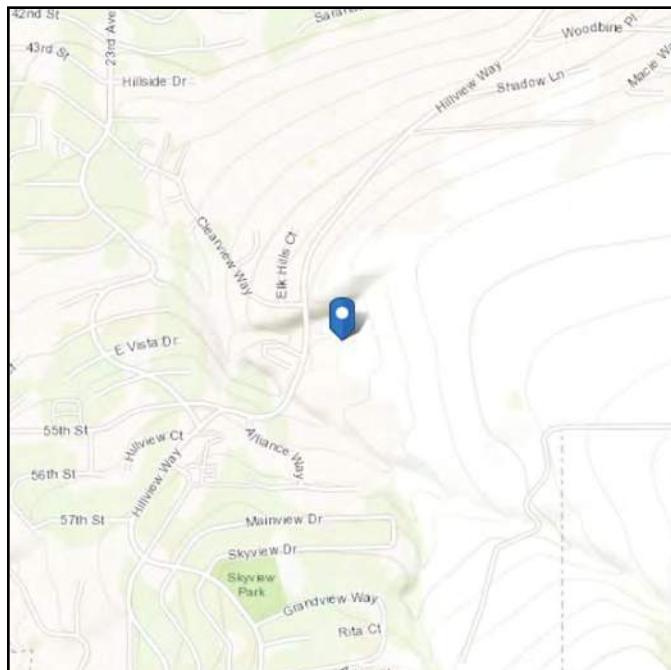
Alternate setbacks and clearances are permitted, subject to the approval of the building official. The building official is permitted to require an investigation and recommendation of a qualified engineer to demonstrate that the intent of this section has been satisfied. Such an investigation shall include consideration of material, height of slope, slope gradient, load intensity and erosion characteristics of slope material.

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: C - Very Dense
Soil and Soft Rock

Elevation: 3447.59 ft (NAVD 88)
Latitude: 46.822003
Longitude: -114.027134

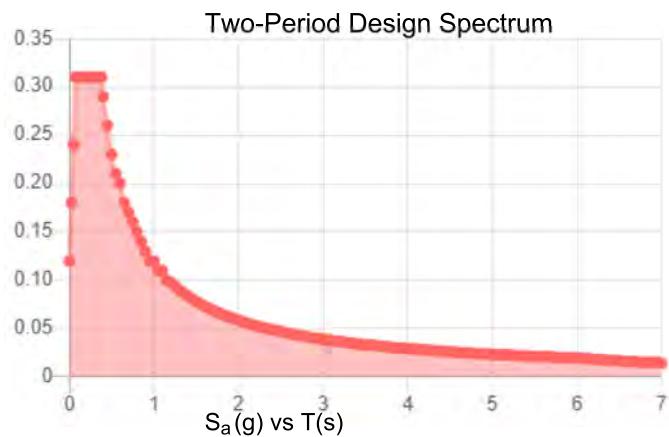
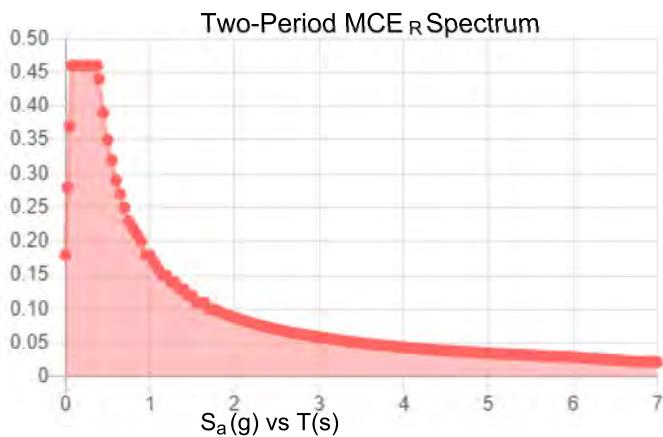
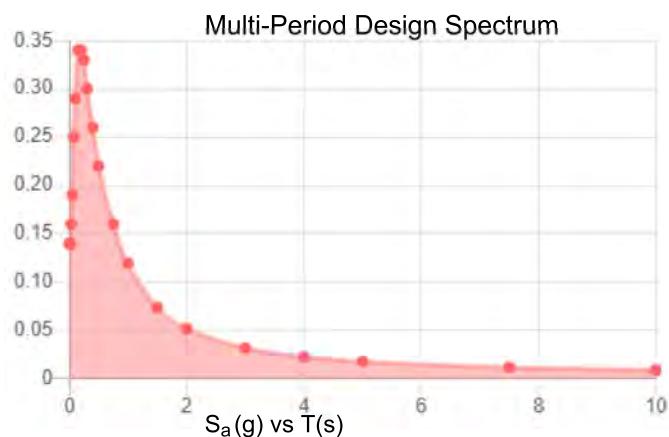
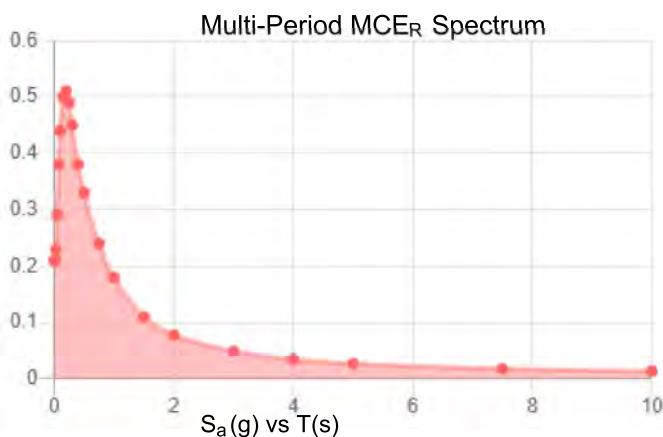


Seismic

Site Soil Class:

Results:

PGA _M :	0.19	T _L :	6
S _{MS} :	0.46	S _S :	0.42
S _{M1} :	0.18	S ₁ :	0.12
S _{DS} :	0.31	S _{DC} :	
S _{D1} :	0.12	V _{S30} :	530



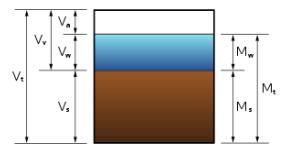
MCE_R Vertical Response Spectrum
Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum
Vertical ground motion data has not yet been made available by USGS.

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APPENDIX B. PHOTOGRAPHS

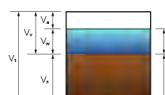


Description: TP-10 Location. View is to the southeast.



Description: TP-10 Army Corps of Engineers Cone Penetrometer was pushed 2.75 inches under a 320 psi loading. View is to the southeast.

Lorenzen Soil Mechanics, Inc.



Project: Hillview Way Phase 2 Geotechnical Investigation



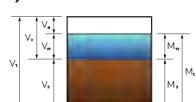
Description: TP-13 Location. View is to the west.



Description: TP-13 Location. View is to the east.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





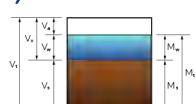
Description: TP-10 Location. View is to the northwest toward Phase 1 grading operations.



Description: TP-10 Jar sample from 2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





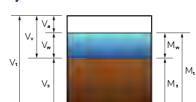
Description: TP-10 Jar sample from 3.5 feet. Cone penetrometer was pushed 5 inches under a 320 psi loading.



Description: TP-10 Jar sample from 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





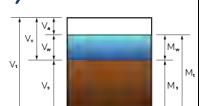
Description: TP-10 Excavated to 8 feet.



Description: TP-10 Excavated to 8 feet. Sloughing of sidewalls below 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





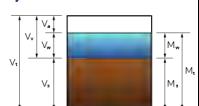
Description: TP-10 Jar sample from 8 feet.



Description: TP-10 Spoils pile from above 8 feet. View is to the north.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





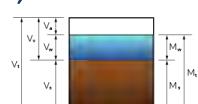
Description: TP-11 Cone penetrometer was pushed 3.5 inches under a 320 psi loading. View is to the east.



Description: TP-11 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





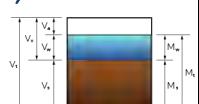
Description: TP-11 Location. View is to the southeast.



Description: TP-11 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





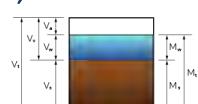
Description: TP-11 Location. View is to the northwest.



Description: TP-11 Jar sample from 1.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





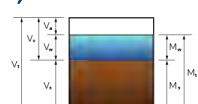
Description: TP-11 Jar sample from 3 feet. Cone penetrometer was pushed 1.75 inches under a 320 psi loading.



Description: TP-11 Jar sample from 5.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





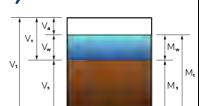
Description: TP-11 Excavated to 6.8 feet.



Description: TP-11 Excavated to 6.8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





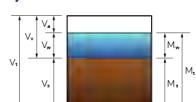
Description: TP-11 Jar sample from 8.8 feet.



Description: TP-12 Stake Location. View is to the north toward TP-17.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





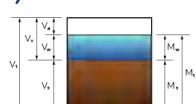
Description: TP-12 Cone penetrometer was pushed 7.75 inches under a 320 psi loading.



Description: TP-12 Location. View is to the north.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





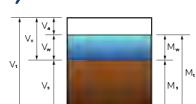
Description: TP-12 Location. View is to the south.



Description: TP-12 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





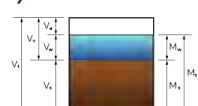
Description: TP-12 Jar sample from 2 feet.



Description: TP-12 Jar sample from 3 feet. Cone penetrometer was pushed 2 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





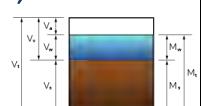
Description: TP-12 Jar sample from 5.5 feet.



Description: TP-12 jar sample from 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





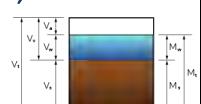
Description: TP-12 Excavated to 8 feet.



Description: TP-12 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





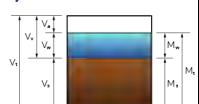
Description: TP-12 Spoils pile from above 8 feet.



Description: TP-13 Stake location. View is to the south.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-13 Location. View is to the west.



Description: TP-13 Location. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





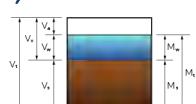
Description: TP-13 Location. View is to the southeast.



Description: TP-13 Cone penetrometer was pushed 4.75 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





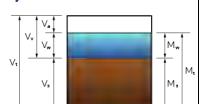
Description: TP-13 Jar sample from the ground surface.



Description: TP-13 Jar sample from 1.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





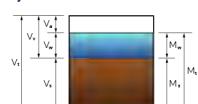
Description: TP-13 Jar sample from 3.2 feet. Cone penetrometer was pushed 3.5 inches under a 320 psi loading.



Description: TP-13 Jar sample from 6.7 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





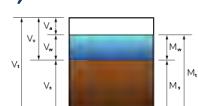
Description: TP-13 Excavated to 8 feet.



Description: TP-13 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





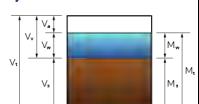
Description: TP-13 Jar sample from 8 feet.



Description: TP-13 Spoils pile from above 8 feet. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





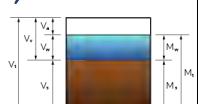
Description: TP-14 Location. View is to the southwest.



Description: TP-14 Cone penetrometer was pushed 6 inches under a 320 psi loading. View is to the east.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





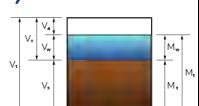
Description: TP-14 Location. View is to the north.



Description: TP-14 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





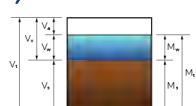
Description: TP-14 Jar sample from the ground surface.



Description: TP-14 Jar sample from 2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





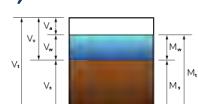
Description: TP-14 Jar sample from 3.5 feet. Cone penetrometer was pushed 1 inch under a 320 psi loading.



Description: TP-14 Jar sample from 6.25 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





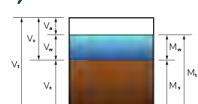
Description: TP-14 Excavated to 8 feet.



Description: TP-14 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





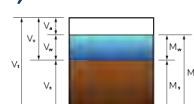
Description: TP-14 Jar sample from 8 feet.



Description: TP-14 Spoils pile from above 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





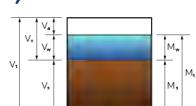
Description: TP-15 Location. View is to the southwest.



Description: TP-15 Cone penetrometer was pushed 4.25 inches under a 320 psi loading. View is to the south.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-15 Location. View is to the south.



Description: TP-15 Location. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





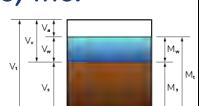
Description: TP-15 Location. View is to the northwest.



Description: TP-15 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





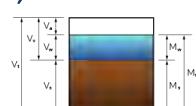
Description: TP-15 Jar sample from 2.5-foot depth. Cone penetrometer was pushed 4.25 inches under a 320 psi loading.



Description: TP-15 Jar sample from 5.75 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





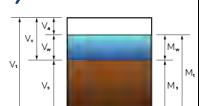
Description: TP-15 Clean gravel with very few fines.



Description: TP-15 Jar sample from 7.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





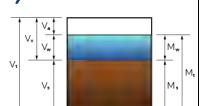
Description: TP-15 Excavated to 8 feet.



Description: TP-15 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





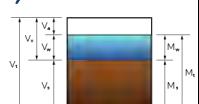
Description: TP-15 Jar sample from 8 feet.



Description: TP-15 Spoils pile from above 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





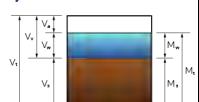
Description: TP-16 Stake location. View is to the south toward the TP-13 location.



Description: TP-16 Location. Cone penetrometer was pushed 5.5 inches under a 320 psi loading. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-16 Location. View is to the southeast.



Description: TP-16 Location. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





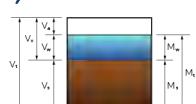
Description: TP-16 Jar sample from the ground surface.



Description: TP-16 Jar sample from 2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





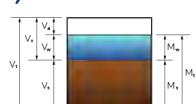
Description: TP-16 Jar sample 3.4 feet. Cone penetrometer was pushed 0.5 inches under a 320 psi loading.



Description: TP-16 Jar sample from 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-16 Excavated to 8 feet.



Description: TP-16 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





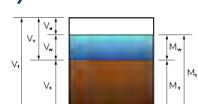
Description: TP-16 Jar sample from 8 feet



Description: TP-16 Spoils pile from above 16 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





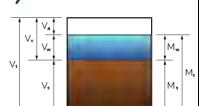
Description: TP-16 Bucket sample from 8 feet.



Description: TP-17 Stake location. View is to the north toward TP-18.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





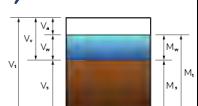
Description: TP-17 Location. View is to the east.



Description: TP-17 Location. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-17 Location. View is to the northwest.



Description: TP-17 Cone penetrometer was pushed 6 inches under a 320 psi loading. View is to the southeast.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





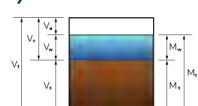
Description: TP-17 Jar sample from the ground surface.



Description: TP-17 Jar sample from 1.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





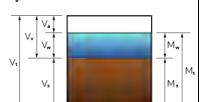
Description: TP-17 Jar sample from 3.2 feet. Cone penetrometer was pushed 2.5 inches under a 320 psi loading.



Description: TP-17 Jar sample from 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





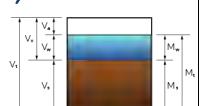
Description: TP-17 Excavated to 8.2 feet.



Description: TP-17 Excavated to 8.2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





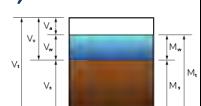
Description: TP-17 Jar sample from 8.2 feet.



Description: TP-17 Spoils pile from above 8.2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-18 Stake location. View is to the west toward TP-19 location.



Description: TP-18 Location. View is to the north.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





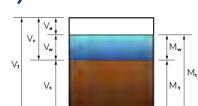
Description: TP-18 Location. View is to the east.



Description: TP-18 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





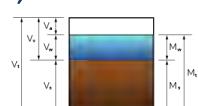
Description: TP-18 Cone penetrometer was pushed 3.5 inches under a 320 psi loading.



Description: TP-18 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





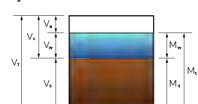
Description: TP-18 Jar sample from 1.5 feet.



Description: TP-18 Jar sample from 3 feet. Cone penetrometer was pushed 1 inch under 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





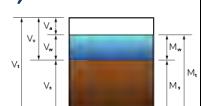
Description: TP-18 Bucket sample from 4.5 feet.



Description: TP-18 Jar sample from 5.75 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





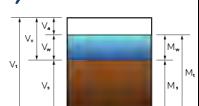
Description: TP-18 Excavated to 8.25 feet.



Description: TP-18 Excavated to 8.25 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





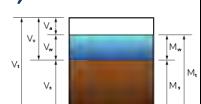
Description: TP-18 Jar sample from 8.25 feet.



Description: TP-19 Spoils pile from above 8.25 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





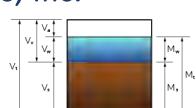
Description: TP-19 Stake location. View is to the west toward TP-20.



Description: TP-19 Location. View is to the north. Cone penetrometer was pushed 7.25 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





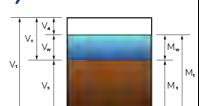
Description: TP-19 Location. View is to the east.



Description: TP-19 Location. View is to the south.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





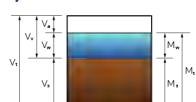
Description: TP-19 Jar sample from the ground surface.



Description: TP-19 Jar sample from 1.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





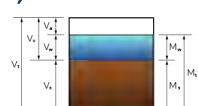
Description: TP-19 Jar sample from 3 feet. Cone penetrometer was pushed 1.75 inches under a 320 psi loading.



Description: TP-19 Jar sample from the 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





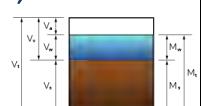
Description: TP-19 Excavated to 8 feet.



Description: TP-19 Excavated to 8 feet.

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Project: Hillview Way Phase 2 Geotechnical Investigation





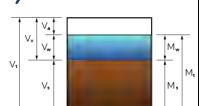
Description: TP-19 Jar sample from 8 feet.



Description: TP-19 Spoils pile from above 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





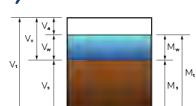
Description: TP-20 Location. View is to the northwest. Army Corps of Engineers Cone Penetrometer (not seen) was pushed 5.5 inches under a 320 psi loading.



Description: TP-20 Location. View is to the west.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





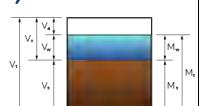
Description: TP-20 Location. View is to the southwest.



Description: TP-20 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





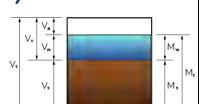
Description: TP-20 Jar sample from 2 feet.



Description: TP-20 Jar sample from 3.2 feet. Cone penetrometer was pushed 3.5 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





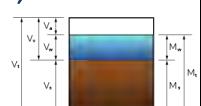
Description: TP-20 Jar sample from 6.5 feet.



Description: TP-20 Jar sample from 8.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





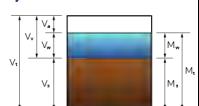
Description: TP-20 Excavated to 8.5 feet.



Description: TP-20 Excavated to 8.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





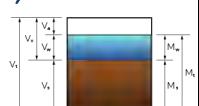
Description: TP-20 Spoils pile from above 7.5 feet.



Description: TP-21 Stake location. View is to the south as earthwork grading from Phase 1 is taking place.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





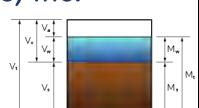
Description: TP-21 Location. View is to the southwest.



Description: TP-21 Location. View is to the east.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





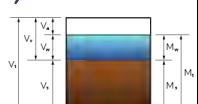
Description: TP-21 Location. View is to the west.



Description: TP-21 Cone penetrometer was pushed 7.75 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





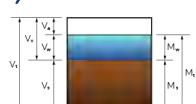
Description: TP-21 Jar sample from 1 foot.



Description: TP-21 Jar sample from 2 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





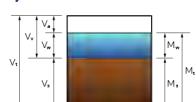
Description: TP-21 Jar sample from 3.2 feet. Cone penetrometer was pushed 1.75 inches under a 320 psi loading.



Description: TP-22 Jar sample from 6 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





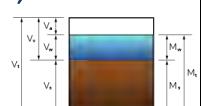
Description: TP-21 Excavated to 8.25 feet.



Description: TP-21 Excavated to 8.25 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





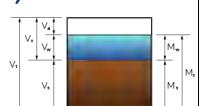
Description: TP-21 Spoils pile from above 8.25 feet.



Description: TP-22 Location. View is to the east.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





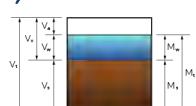
Description: TP-22 Location. View is to the south toward grading operations.



Description: TP-22 Location. View is to the south toward grading operations.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





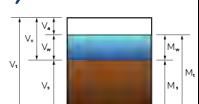
Description: TP-22 Cone penetrometer was pushed 3 inches under a 320 psi loading. View is to the west.



Description: TP-22 Jar sample from the ground surface.

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Project: Hillview Way Phase 2 Geotechnical Investigation





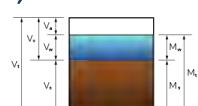
Description: TP-22 Jar sample from 1.5 feet.



Description: TP-22 Jar sample from 3.2 feet. Cone penetrometer was pushed 6 inches under a 320 psi loading.

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Project: Hillview Way Phase 2 Geotechnical Investigation





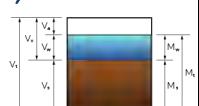
Description: TP-22 Jar sample from 6.4 feet.



Description: TP-22 Jar sample from 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





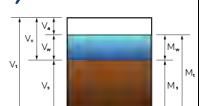
Description: TP-22 Excavated to 8 feet.



Description: TP-22 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





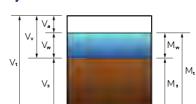
Description: TP-22 Spoils pile from above 8 feet. View is to the east.



Description: TP-22 Backfilled. View is to the northeast toward the TP-21 location near the crest of the slope.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





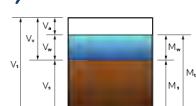
Description: TP-10 Moisture content samples prior to being placed into the drying oven.



Description: TP-10 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





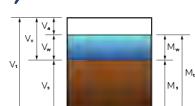
Description: TP-11 Moisture content samples prior to being placed into the drying oven.



Description: TP-11 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-12 Moisture content samples prior to being placed into the drying oven.



Description: TP-12 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





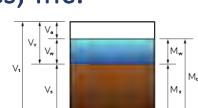
Description: TP-13 Moisture content samples prior to being placed into the drying oven.



Description: TP-13 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-14 Moisture content samples prior to being placed into the drying oven.



Description: TP-14 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





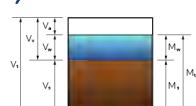
Description: TP-15 Moisture content samples prior to being placed into the drying oven.



Description: TP-15 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-16 Moisture content samples prior to being placed into the drying oven.



Description: TP-16 Moisture content samples after being taken out of the drying oven.

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Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-17 Moisture content samples prior to being placed into the drying oven.



Description: TP-17 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





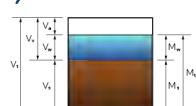
Description: TP-18 Moisture content samples after being taken out of the drying oven – the pre-drying photo was not taken.



Description: TP-18 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





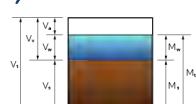
Description: TP-19 Moisture content samples prior to being placed into the drying oven.



Description: TP-19 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





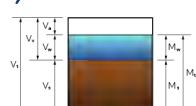
Description: TP-20 Moisture content samples prior to being placed into the drying oven.



Description: TP-20 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-21 Moisture content samples prior to being placed into the drying oven.



Description: TP-21 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-22 Moisture content samples prior to being placed into the drying oven.



Description: TP-22 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-15 Bulk sample from 6.5 feet prior to being dried, screened, and sieved.



Description: TP-15 Bulk sample from 6.5 feet after being dried, screened, and sieved.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-16 Bulk sample from 8 feet prior to being dried, screened, and sieved.



Description: TP-16 Bulk sample from 8 feet after being dried, screened, and sieved.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





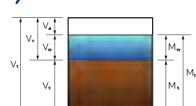
Description: TP-18 Bulk sample from 4.5 feet prior to being dried, screened, and sieved.



Description: TP-18 Bulk sample from 4.5 feet after being dried, screened, and sieved.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation





Description: TP-22 Bulk sample from 6.4 feet prior to being dried, screened, and sieved.



Description: TP-22 Bulk sample from 6.4 feet after being dried, screened, and sieved.

Lorenzen Soil Mechanics, Inc.

Project: Hillview Way Phase 2 Geotechnical Investigation

