



Littlehorn Engineering & Surveying, LLC

P. O. Box 776390
Steamboat Springs, CO 80477
Fairplay Office: (719) 836-7120
Steamboat Office: (970) 879-5112

"Peace of mind through comprehensive design"

Preliminary SOILS ENGINEERING REPORT & DESIGN RECOMMENDATIONS FOR

6306/6270 Highway 9
Blue River, CO 80424

Technical Report for:

Katie Miller
5432 Thornbush Rd
Fort Worth, TX 76179

To Construct a Single Family Residence
January 08, 2018



Our Project No.
2017-410

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1.0 INTRODUCTION

- 1.1 The owners are proposing to construct a new single family residence on a two parcels to be combined into one single parcel through a lot consolidation process. As requested, we have prepared this report to present the methodology and results of a subsoil study to develop guidelines for designing the residence foundation and any associated deck piers or house piers. Upon use of this report for construction, it is understood that you are familiar with this report in its entirety and have agreed to the terms in our contract for professional services. This contract is on file with our office; for a small fee, a copy is available upon request.
- 1.2 The property is located at the addresses of 6306 & 6270 Highway 9, near Blue River, Colorado, at an approximate Google elevation of 10,094 feet. The Town of Blue River has adopted the 2012 International Building Codes. The applicable codes and Town of Blue River Building, Planning, and Zoning, and The State of Colorado and the Corps of Engineers shall govern construction. The State of Colorado typically governs such items as well construction, graded areas larger than 1 acre, etc. The Corps of Engineers governs wetlands. Wetlands shall not be disturbed without county and Corps approval.
- 1.3 This report is being prepared as a general site specific guide only. To date, we have not been provided complete building plans for the residence including foundation plans. We have received a preliminary architectural floor plan schematic which is shown in the attached site plan drawing.
- 1.4 For information regarding adoptions and amendments of the Town of Blue River Building Code, please visit:
https://www.colorado.gov/pacific/sites/default/files/015_CHAPTER%2018%20Building%20Regulations.pdf
- 1.5 If there is an active Home Owners Association (HOA), the Town of Blue River will require a written letter from the HOA stating that they are aware of the project, that proposed plans are approved, and that colors and types of construction materials are approved.
- 1.6 Town of Blue River design criteria is as follows: Design snow loads are site specific and are based upon subdivision. Design wind speed is 90 miles per hour. Frost line depth, as measured from the finish grade to the bottom of the concrete footing, is required to be at least 40 inches. The applicable snow load is 100 pounds per square foot and 125 pounds per square foot for exterior decks.

- 1.7 For this project, we were requested to provide soils testing as associated with the design of a single family residence and to prepare a report summarizing our findings. For the purposes of this report, we have not included construction related details. Prior to construction, our office should either be permitted to provide such details or be allowed to review complete construction plans.
- 1.8 Prior to construction, our office shall be contacted for an “open hole” inspection of the home and any other excavations used to support buildings over 120 square feet in basal area. During construction, the owner may desire to have an engineering firm perform routine backfill inspections to verify compaction of backfill.
- 1.9 We presume that the proposed project will consist of improvements where site cuts will range from 2 feet to a maximum of 8 feet in depth. If deeper cuts are proposed, our office shall be permitted to revisit the site and perform further testing.
- 1.10 It is the owner’s and contractor’s responsibility to ensure that all foundation, walls, house, and any proposed deck piers (1) are constructed in the area where the soil samples were collected, (2) will meet all setback requirements, and (3) are installed and designed per this report, county guidelines, state guidelines, and manufacturer’s specifications.

2.0 GEOLOGY AND SOILS TESTING

As requested, we visited the referenced site on September 19, 2017 to examine septic profile holes and foundation profile holes. At the time of our inspection and collection of soil samples, the weather was warm and the skies were sunny. We visited the site to perform density tests and examine the underlying soils for classification. Based upon the data developed during our field investigation, laboratory testing, engineering analyses and experience with similar conditions, this report presents our opinions and recommendations for design criteria and construction details for foundations, slab-on-grade floor systems, lateral earth loads, drainage recommendations, underslab utilities, and radon control recommendations.

- 2.1 **Substratum Geology.** Soils in the general area consist of gravelly sandy loam with cobbles & boulders. To evaluate underlying soil geology in the area of the site a mini excavator was used to excavate two (2) soil profile holes. All test pits have been assigned a letter and respective locations are shown in the accompanying drawing soils exhibit. Samples were obtained from one (1) of the excavation pits and laboratory testing was performed. These samples were collected from the gravelly matrix below the surface. Sampling methods were used to collect relatively undisturbed and disturbed soils for soils testing per ASTM guidelines. The soils in the excavation test

pits generally consisted of:

Soil Profile Hole A (90-inch depth)

	HOLE	DEPTHS	DESCRIPTION	COLORS
ROCK	35%	0 – 12”	OTS with fine to medium roots.	DK Brown
SLOPE SHAPE	LL	12 – 36”	Sandy gravelly loam with cobbles & fine roots.	LT Brown
STRUCTURE SHAPE	BL			
STRUCTURE GRADE	WE	36 – 60”	Gravelly sand with loam.	LT Brown
SOIL TYPE	2A	60 – 90”	Gravelly sandy loam with silt, cobbles & boulders.	LT Brown

Notes: Pooling ground water not present. Possible water table at 48” depth.

Soil Profile Hole B (84-inch depth)

	HOLE	DEPTHS	DESCRIPTION	COLORS
ROCK	35%	0 – 12”	OTS with fine to medium roots.	DK Brown
SLOPE SHAPE	LL	12 – 36”	Sandy gravelly loam with cobbles & fine roots.	LT Brown
STRUCTURE SHAPE	BL			
STRUCTURE GRADE	WE	36 – 60”	Gravelly sand with loam & fine roots.	LT Brown
SOIL TYPE	2A	60 – 84”	Gravelly sandy loam with silt, cobbles & boulders.	LT Brown

Notes: Pooling ground water not present. Possible water table at 48” depth.

2.2 Density testing, Index testing, consolidation, and sieve testing was performed in the relatively undisturbed soils per ASTM guidelines.

Sample Location Tested (Hole A)

Soils Description: GW-GM (Well Graded Gravel with Silt);

Percent of Fines: 8.06%;

Percent of Sand: 27.68%;

Percent of Gravel: 64.26%

Liquid Limit: 22; Plastic Limit: 3; Group Index A-1-A(0)

Sediment Ratio: 1.0; Degree of Swelling: None

3.0 WATER

- 3.1 A seasonal standing ground water table was not observed in the test pits; however, a seasonal water table is believed to be present during spring runoff and especially in a heavy snow year at approximately 48 inches below the surface. The supply of moisture can make the prediction of soil behavior difficult. A foundation drain tile system shall be installed around the foundation to mitigate water away from the foundation. Keep in mind that the general development of the area, heavy rainfall, flooding, snow melt, new springs, or surrounding development can contribute to a rise of the perched water table and greatly affect the foundation's performance. Roof drainage, landscaping, impervious soils coverings such as concrete and pavement must be considered and designed to mitigate water away from the structure
- 3.2 When practical, retaining walls should be designed with wall drains on the uphill side. Drains should consist of a sock drain or rigid perforated PVC pipe (4-inch diameter) bedded in a gravel envelope and sloped to daylight at a minimum of 0.5%. Gravel should be isolated from soil with fabric.
- 3.3 All excavated areas must drain via a foundation drain and the area shall be properly graded at the surface to drain well. All foundation drains and graded swales must daylight away from all wells, wastewater components, and must not create a problem for a neighboring property.
- 3.4 The site lies near Blue River. This river can flood in a significant storm. All foundation openings shall be placed at least 12 inches above the 100 year flood stage.

4.0 BEARING CAPACITY AND DESIGN RECOMMENDATIONS

For the proposed house foundation, the following criteria should be used as a guide:

- 4.1. Footings. Footings shall be comprised of continuous concrete. Wood or stone is not permitted without written approval and a complete review by this office.
 - a. Eight-(8) inch-thick by sixteen-(16) inch-wide footers shall be considered as a minimum and reinforced per code. If piers are used, 12-inch diameter piers shall be considered as a minimum and reinforced per code
 - b. Footings shall bear on undisturbed soil or may bear on 1 to 3 inches of imported ¾-inch angular screened gravel.
 - c. Make sure to remove all disturbed soil and keep the foundation area where

slabs and footings will bear free of debris, ice, snow, and organic material. Do not place footings on wet or soft soils.

- d. Use an allowable soil bearing value of 2,500 PSF for all foundation spread footings that bear on undisturbed soil.
- e. When concrete bears on undisturbed native soil, a friction coefficient of 0.4 may be used.
- f. Piers: All piers shall bear on native, gravelly-type soil. Use an allowable soil bearing value of 2,500 PSF for piers (see below). The bottom of all piers must be placed at least 40 inches below the surface.
- g. When foundation steps are required, all footings should be connected via a continuous footing using continuous-type footings and rebar through foundation steps.
- h. All footings should be reinforced and verified by a structural engineer to support both vertical and horizontal loads. All footings should be reinforced for temperature, shrinkage, hydraulic, shear, and surcharge loads.
- i. An on-site inspection is required when the foundation excavation has been completed (prior to concrete placement) and again when the gravel for any slabs is installed (prior to concrete placement). Please contact this office at (719) 836-7120 for these inspections and provide at least 5 days' notice for each inspection.

4.2. Frost Mitigation. Town of Blue River soils are unique due to the environment and varying snow cover throughout the county. The county requires footings to be placed at least 40 inches below the surface. This is measured from finish grade to the bottom of the footing

4.3. Structural Floor Slabs. Buildings are permitted to have a concrete slab on grade or crawl space-type foundation. If slabs are used, the following is a guide:

- a. Structural floor slabs should be isolated from perimeter footings, walls, and other interior-type load bearing walls and footings with a slip joint that allows free vertical movement of the slabs. An exception to this is at door locations where a thickened concrete slab may overlay the constructed foundation wall. All slip joints must remain post construction and be maintained as slip joints through the life of the project.

- b. All concrete slabs on ground shall be placed over 6 to 12 inches of screened gravel or 6 to 12 inches CDOT class 6 or class 7 aggregate base or a 50/50 mix thereof. Gravel and fill-type soils shall be vibrated and compacted into place. This gravel or base shall be placed on undisturbed natural soil.
- c. The 2012 International Code requires a vapor retarder between the base course or subgrade soils and the bottom of the slab. A properly installed vapor retarder (minimum 6 mill's in thickness) shall be installed between the concrete slab and gravel (or under the gravel in some cases). Check with the flooring manufacturer to determine exactly where the moisture barrier should be placed, i.e., above or below the gravel base course where floors coverings are sensitive to moisture. Flooring comprised of painted floor surfaces, vinyl products, wood products, and other type products are sensitive to moisture and heat levels in concrete. Be sure to follow the general recommendations of the American Concrete Institute (ACI). Refer to the ACI302.1R-04 (77 pages) and ACI302.R-96 (67 pages). For a fee, a PDF copy can be provided upon request.
- d. We recommend a concrete floor thickness of at least 4 inches for typical residential-type loading and at least 5 inches if the slab is to contain in-floor heat tubing. For garage-type floors (i.e., carport areas, garages, etc.), we recommend a minimum floor thickness of 5 inches. Any building expected to contain commercial equipment, accommodate tractor-type loading (skid steers), should be analyzed on an individual basis.
- e. Where applicable and when slabs are heated, rigid foam insulation should be installed under the slab per Town of Blue River requirements, manufacturer' specifications and the general recommendations of the Portland Cement Association. Concrete placed directly on non-permeable surfaces may be subject to structural and architectural aesthetic issues. Be aware that with some foam manufacturers, the foam may replace the need for a separate vapor barrier if the foam edges/joints are properly sealed.
- f. When the floor level of a concrete slab is installed within 3 feet of natural grade, a drainage system is recommended but not required to be installed below the slab; however, when the floor level of a concrete slab is installed deeper than 4 feet below the surface, a drainage system shall be installed below interior concrete slabs. If installed, this drainage system shall be installed slightly below the radon piping described in item 4.5 below. Three-inch diameter or 4-inch diameter PVC pipe laid on a 10-foot or 15-foot grid system usually works

well. Make sure to daylight these pipes on property and away from any leach field or septic tank areas (use of a sump pump may be required).

- g. All concrete-type slabs shall be reinforced and verified by a structural engineer. Generally, welded wire fabric is sufficient if properly installed near the top of the slab. However, we advocate #4 (minimum grade 60) reinforcing steel placed on 18-inch centers as a minimum.
- h. Control joints should be cut into the slabs within 48 hours of slab placement to control cracking per ACI. Frequent control joints should be provided in conventional slabs-on-grade to reduce problems associated with slab curling and shrinkage cracking. Panels that are approximately square seem to perform better than rectangular areas. We advocate a control joint at the inside corners of all concrete slabs. A detailed control joint plan should be submitted to our office for review, prior to construction.

4.4 Utilities. Underslab utilities shall consist of such things as plumbing, electrical, phone, cable, gas, and other miscellaneous piped utilities located under the building slabs and on-site.

- a. Plumbing and other utilities that pass through slabs should be isolated from the slabs. Any pipes passing through the slab should be provided with flexible couplings or other means to allow for independent slab movement.
- b. Heating and air conditioning systems constructed on slabs should be provided with flexible connections capable of at least 1½ inches of vertical movement so that slab movement is not transferred to the ductwork.
- c. All plumbing that is required to be pressure tested shall be tested in accordance with the appropriate agency.
- d. All piping shall be properly bedded in a ¾-inch gravel envelope or CDOT road base or as approved by the Town of Blue River. When placed, gravel will not compact itself. Compact and vibrate all gravel prior to concrete placement.

4.5 Radon. Radon testing has not been performed at this site. For more information about radon, visit: <http://www.epa.gov/radon/pubs/devprot2.html> or go to www.epa.gov.

- a. If a concrete slab is used at the site, we recommend that radon mitigation features be built into the structure. This is not required for detached garages (garages without any living space attached or above) but recommended.

These features should include placement of a 4-inch diameter schedule 40 perforated PVC pipe placed on a 10-foot (centerline to centerline) or 15-foot (maximum) grid. Be sure to vent the collection of the pipe grids to a common area via a single pipe where a fan (if needed) can be installed to vent the air to the outside of the building.

- b. If radon piping is installed, the gravel which underlies the slab shall be increased in depth by the diameter of the radon piping and all piping shall be properly bedded. ASTM D4564 provides a sleeve method analyses for testing compacted gravel. For typical residential-type construction, we don't advocate gravel compaction testing. We do however advocate that the contractor take the time to carefully vibrate (with mechanical equipment) all gravel into place in 6-inch (preferable) or maximum 10-inch loose lifts.
- c. Post-building construction, we recommend that radon testing be performed prior to inhabiting the building and at a minimum, annually thereafter.
- d. Upon request, a detailed drawing of the under slab piping system can be reviewed or provided once we receive building plans.

4.6 Porches, Decks, Patios. Porches, patios, and decks shall consist of site-built porches, decks, and patios.

- a. Patio slabs, porch slabs, and other concrete landings and aprons should be isolated from the foundation and constructed as described above in item 4.3. Do not connect patio slabs to the house foundation.
- b. Porch slabs shall bear on 6 inches of clean gravel or CDOT class 6 structural fill. Porch slabs which do not carry load bearing columns are not required to contain a perimeter frost wall; however, we advocate installing a small, 8-inch wide x 24-inch depth, perimeter frost wall (thickened edge) around the perimeter of all porch-type slabs and using a lintel or other type ledge/haunch at the house foundation to mitigate movement and to help stabilize typical slab loading and movement.

4.7 Foundation and Retaining Walls. Footings shall be comprised of concrete. Foundation walls may consist of concrete, masonry, or wood. Retaining walls may consist of concrete, masonry, wood, or stone.

- a. All walls shall be reinforced with double rebar at the top and bottom of all walls. All reinforcing shall be by structural engineering analyses. Analyses shall

accommodate both lateral and vertical loads, temperature and shrinkage control (bar typically will not be spaced further apart than 18 inches on center) hydraulic loads, shear loads, and surcharge loads.

- b. If on-site soils are used as backfill and the backfill is NOT saturated, we recommend using an active equivalent fluid unit density (weight) of 50 pounds per cubic foot load on the wall (use a passive pressure of 250 PCF.). All earth retention structures should be designed to sustain potential surcharge loadings. Retaining walls should be constructed with free-draining backfill materials and with effective drainage systems as required. If water is allowed to pond behind the wall, the additional water pressure will dramatically increase the load on the wall and a higher Y_{eq} must be used.
- c. All crawl space-type foundation shall be sprayed with a foundation approved water resistant product/barrier. Basements for this site are permitted and if installed foundation walls shall be sprayed with waterproofed with MiraDRI 860/861 water membrane (tar is not acceptable) and then protected with Mirafi 140N filter fabric or approved equal. The waterproofing must extend from the top of the wall to the bottom of the wall and across the footing and down the footing face. Henry Blueskin or other similar-type products are also acceptable. Submit type and material to our firm for review prior to installation. Keep in mind that the area lies close to the Blue River so any foundation openings shall be located at least 12 inches above the 100 year flood level.
- d. A foundation drain is not required (but highly recommended) if a crawl space-type foundation is installed (verify with the county). If a basement-type foundation is installed then a foundation drain is required. When installed, install at the base of the wall in conjunction with a foundation composite or perimeter drain system. Sock drain is permitted to be used in or around this foundation if the backfill heights will be less than 4 feet. SDR35 perforated PVC or schedule 40 perforated PVC must be used for all backfill heights in excess of 4 feet. All pipe shall be sloped at a minimum 0.5% grade to daylight, use a stainless steel (1/4-inch mesh openings w/ stainless steel clamps is typical) insect/rodent screen at the pipe outlet and gabion-type outlet bed to mitigate erosion at the outlet. All drains should daylight (a sump pump may be required) on the property and away from leach fields, septic tank areas, and well heads. The foundation drain (3/4-inch to 1-inch clean gravel) should extend to within 12 inches of the surface. The top 12 inches of backfill around the building foundation wall should contain on-site materials that have low permeability. In lieu of full depth gravel, a drainage composite system such as a Miradrain (303-696-8960) product can be used.

- e. Upon request, our office would be happy to provide a waterproofing and drain detail or review details provided/designed by others.

4.8 Drainage. Water in the foundation area and around buildings will reduce the soil bearing capacity of the soils and have many other adverse results.

- a. The foundation system shall be installed with an adequate drain system which mitigates the water away from the foundation area. The provision for the perimeter drain system will not eliminate or prevent moist conditions in interior spaces, but will reduce the risk of moisture penetration.
- b. Moist conditions can still develop in non-basement crawl spaces, resulting in musty smells and damp/wet soils. In addition to the perimeter drain system, crawl spaces and basements must be well ventilated (refer to the code and provide accordingly). In lieu of a crawl space with openings to the exterior, a conditioned crawl space may be installed (if approved by the county). Our firm advocates properly designed and fully conditioned crawl spaces over using openings around the crawl space which allow plumbing to freeze.
- c. Landscaping and irrigation practices will affect foundation performance. Surface drainage shall be away from buildings, leach fields, well heads, neighboring properties, and other type improvements.
- d. The ground surface surrounding the exterior of any building should be sloped away from the foundation in all directions, at least 6 inches (but not more than 24 inches) in the first 5 feet. If this cannot be provided due to site constraints, please contact our office for a more specific evaluation.
- e. Window wells must be installed and constructed to code. Perimeter foundation drains must be extended up to the bottom of the interior window well so that any water which enters the window well may drain quickly and properly. Ponding or standing water in window wells should be avoided by good construction techniques.

4.9 Backfill. Backfill shall consist of all backfill for the project including utility trenching.

- a. All structural soil-type backfill should be compacted to the specifications listed below in section 6.5. Exercise care when driving equipment near any foundation wall since this could cause pressure overburden.
- b. All retaining and foundation walls should be backfilled with free draining materials.

Soils do not compact themselves - approved vibratory equipment must be used when placing all structural fill. Using a track-hoe bucket or small tamping device (like a plate compactor or “wacker”) to compact soils may not be acceptable. Larger vibratory equipment like a pad drum vibratory roller (5 ton minimum) should be considered. Exercise care when driving equipment near any foundation wall since this could cause pressure overburden and crack and move foundation walls which are not properly braced with slabs, counterforts, floors, buttresses, and shear walls.

- c. Inspect trenches, cuts, and general excavation before placing any material to ensure topsoil and debris has properly been removed and to ensure general location of said components are properly excavated and within the site constraints (requires inspection by surveyor).
- d. Backfill materials for utility trenches should be sand or other approved material in and around the utility followed by native soils compacted as described above.

5.0 DIFFERENTIAL AND REASONABLE SETTLEMENT

- 5.1 Uniform settlement seldom presents any serious problems, but differential settlement is usually a problem. The difference of settlement between two adjacent columns is commonly referred to as “differential settlement.” Generally, it is assumed that differential settlement is about one quarter of the maximum settlement. For a small building, it is not uncommon to see ½-inch to 1-inch of settlement; this is more prone to occur when footings are not located below frost depth. Owners may have the false impression that a properly designed foundation will not settle. They may be greatly alarmed when they discover that the building moves.
- 5.2 Unless we are contracted and paid to be on-site during a significant portion of the excavation process, we have very limited control over actual site conditions during and after construction.
- 5.3 With any structure it is important for the building owner to monitor the foundation for settlement cracks and contact the engineer(s) with any questions or concerns. Settlement cracks generally assume a near 45 degree angle and take place invariably over and below doors and windows. The crack is generally wider at the top than at the bottom. Temperature cracks can sometimes be mistaken for settlement cracks. Cracks in concrete floors usually assume a hairline pattern and cannot be detected without close examination. These are typical for mountain construction and usually visible in all slabs. If after construction, any cracks appear in the buildings finishes, this office should be contacted for evaluation.

6.0 GRADING AND COMPACTION

Permits are required for all grading operations in Town of Blue River prior to site disturbance. Grading, erosion, and revegetation plans must be submitted to the county for approval prior to construction. Our office shall be notified at least 5 days before beginning grading.

- 6.1 Historic Remains. When the grading operations encounter remains of prehistoric people's dwelling sites, remains, or artifacts of historical, paleontological or archaeological significance, the operations shall be temporarily discontinued. The contractor shall notify the engineer and promptly contact the proper authorities to determine the disposition thereof. If required by state or federal authorities, the contractor shall preserve the area of significance to allow authorities to excavate and recover the items of significance.
- 6.2 Clearing and grubbing. All surface objects and all trees, stumps, roots, and other vegetation over 6 inches in height, and other protruding objects, not designated to remain, shall be cleared and/or grubbed, including mowing, as required. Stump holes and other holes from which obstructions are removed (like boulders), shall be backfilled with suitable materials and compacted in accordance with this report. Materials and debris shall be disposed of in accordance with state and county regulations.
- 6.3 Topsoil. All topsoil, where physically practical, shall be salvaged. Topsoil shall consist of loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, roots, rocks, brush, weeds, or other material which would be detrimental to the proper development of vegetative growth. Materials selected for topsoil and lying within the limits of the project shall be excavated and stockpiled as required and where permissible. Topsoil shall be keyed to the underlying materials by the use of harrows, rollers, or other equipment suitable for the purpose. For sites that don't contain enough reusable top soil, approved top soil will have to be imported to the site.
- 6.4 General excavation and embankment. Excavation and embankment grading consists of excavation, disposal, shaping, or compaction of all material encountered within the limits of the grading plans including excavation for ditches and channels necessary for the construction of the project in accordance with the grading plans and in reasonably close conformity with the lines, grades, and typical cross-sections shown on the plans. The excavation and embankments shall be finished to reasonably smooth and uniform surfaces. Grading operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Where material encountered within the limits of grading is considered unsuitable for embankment foundations, streets/roads, or

structural areas by the soils engineer, such material shall be excavated and replaced with suitable material. Some examples of unsuitable material include soils which contain significant amounts of organic material or large diameter rocks, concrete, or asphalt. Excess unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed in non-structural areas as approved by this office.

6.5 Backfill. For these site soils, the moisture content of the soil at the time of compaction shall always be within +/-2% of optimum moisture. Should too much water be added to any part of the fill, all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. Fill materials shall be placed such that the thickness of loose material does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches. Rocks, broken concrete, or other solid materials more than 6 inches in greatest dimension shall be excluded from backfill material. Compaction, as specified above, shall be obtained by the use of water and sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the soils engineer. Granular fill shall be compacted using vibratory equipment and water or other equipment approved by this office. Compaction of each layer shall be continuous over the entire area. All disturbed areas should be re-seeded to mitigate erosion (a copy of the revegetation plan must be provided to this office for review prior to construction). Call engineer for inspection as required. Inspections are routinely performed during the backfill operations. If not performed, the backfill will likely settle (see item 6.7 below). Structural fill shall be properly compacted to not less than the following densities:

- a. Structural fill under concrete footings should be left undisturbed or be 100% natural density.
- b. Structural fill under parking areas and roads shall be compacted to 95% natural density.
- c. Landscape areas shall be compacted to 90% natural density.
- d. The above information is a general recommendation only. Other registered professionals shall have responsibility for the systems designed. These include but are not limited to such items as concrete foundations, retaining walls, reinforced earth sections, driveway construction, waste disposal system construction, and site utilities.

6.6 Slope standards. Cut slopes (i.e., excavated slopes) shall be no steeper than two (2) horizontal to one (1) vertical. Fill slopes shall not exceed two (2) horizontal to one (1)

vertical. All permanent cut and fill slopes shall be constructed at slopes which ensure long term slope stability and that will not cause accelerated erosion.

- a. The tops and toes of cut and fill slopes shall be set back from property boundaries as far as necessary for safety of the adjoining properties and to prevent damage resulting from water run-off or erosion of the slope.
- b. The tops and toes of cut and fill slopes shall be set back from structures as far as it is necessary for adequacy of foundation support and to prevent damage as a result of water run-off or erosion of the slopes.

6.7 Grading reports. If the owner desires, this office or any qualified soils engineer can take sufficient compaction tests to determine that the site is ready for the intended uses. If this is not done, the contractor and owner assume all responsibility for soil settlement.

6.8 Watering. Water shall be applied to the topsoil at the locations and in the amounts where required. Water shall be applied in a fine spray by nozzles or spray bars in such a manner that it will not wash or erode the topsoil area. All water used shall be free of any mineral salts or contaminating material which might result in expansion of materials after placement. Water used in landscaping shall be provided for seeding, mulching, planting, transplanting, sodding, and soil sterilization, and any other landscaping work as required.

7.0 LIMITATIONS

7.1 Our investigation, layout, design, and recommendations are based upon data submitted by the owner and contractor, data/samples observed and collected in the field, and data compiled through technical research and testing. We have not, and cannot design the system to withstand every conceivable event which might occur, as that would render the design exceptionally expensive and difficult to construct. All construction not discussed in this report shall conform to applicable county, state, and manufacturer guidelines.

7.2 Buildings should be designed by a licensed professional engineer familiar with the local climate, standards, and practices. If this is not done, problems with the foundation may occur. Our firm would be happy to assist in this process (review plans) if requested.

Thank you for the opportunity to serve your needs. If you have any questions, or if we can provide further assistance, please call us at (719) 836-7120. When you have completed the building plans for the project, please be sure to provide a copy for our review prior to placement of any concrete and preferably prior to the excavation.

Sincerely,

Littlehorn Engineering & Surveying, LLC



John J. Littlehorn, P.E.

Enclosure

- Sieve Testing Results
- Index Testing Results
- Soil Profile Location Exhibit

LITTLEHORN ENGINEERING & SURVEYING, LLC

P.O. BOX 776390 - STEAMBOAT SPRINGS, COLORADO 80477

(719) 836-7120 – FAIRPLAY (970) 879-5112 – STEAMBOAT SPRINGS

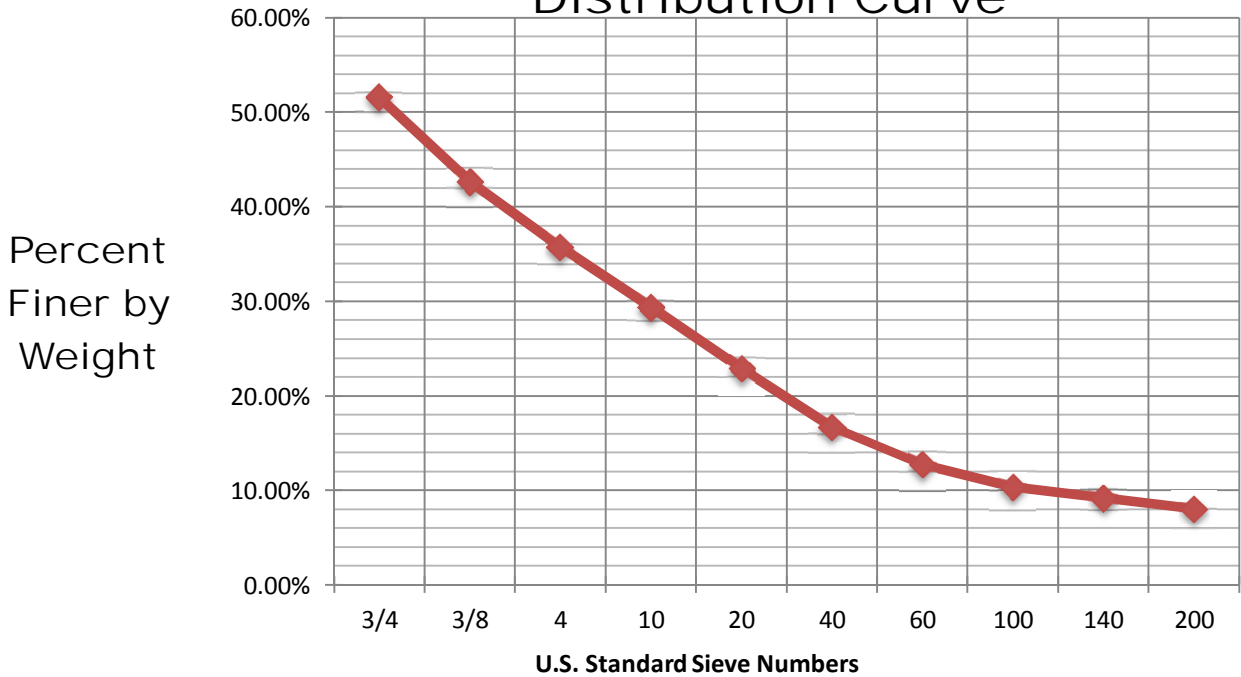
Sieve Test Results - Hole A

Project No:	2017-410	PROPERTY
Date Testing Conducted:	8-Jan-18	6306/6270 HWY 9, BLUE RIVER
Contractor or Owner:	MILLER, KATIE	SUMMIT COUNTY, CO

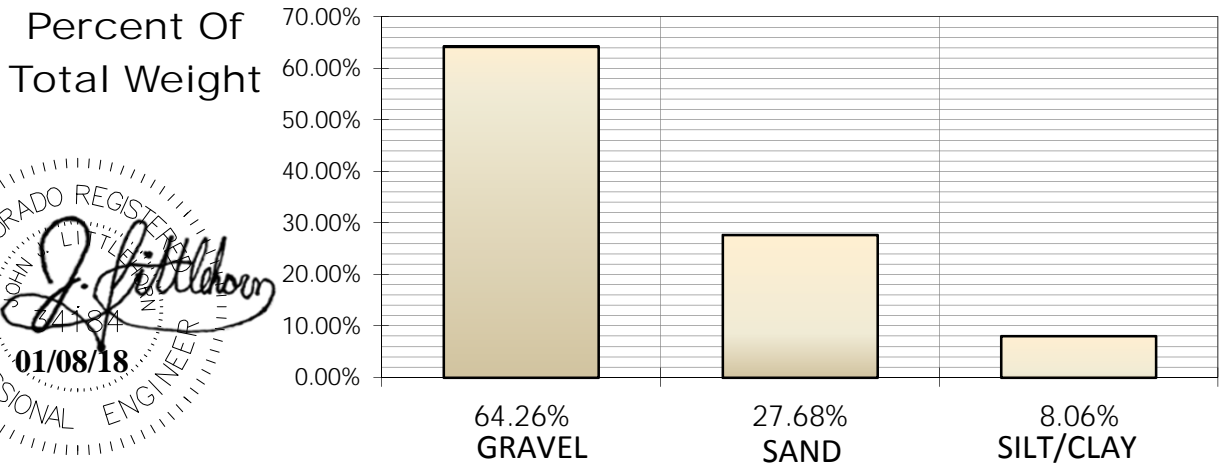
SOIL CLASSIFICATION

GW-GM (WELL GRADED GRAVEL WITH SILT)

Typical Grain Size Distribution Curve



Classification By Particle Size



Uniformity Coefficient (Cu): 198.59

Curvature Coefficient (Cc): 0.70

LITTLEHORN ENGINEERING & SURVEYING, LLC

P.O. BOX 776390 - STEAMBOAT SPRINGS, COLORADO 80477

(719) 836-7120 – FAIRPLAY (970) 879-5112 – STEAMBOAT SPRINGS

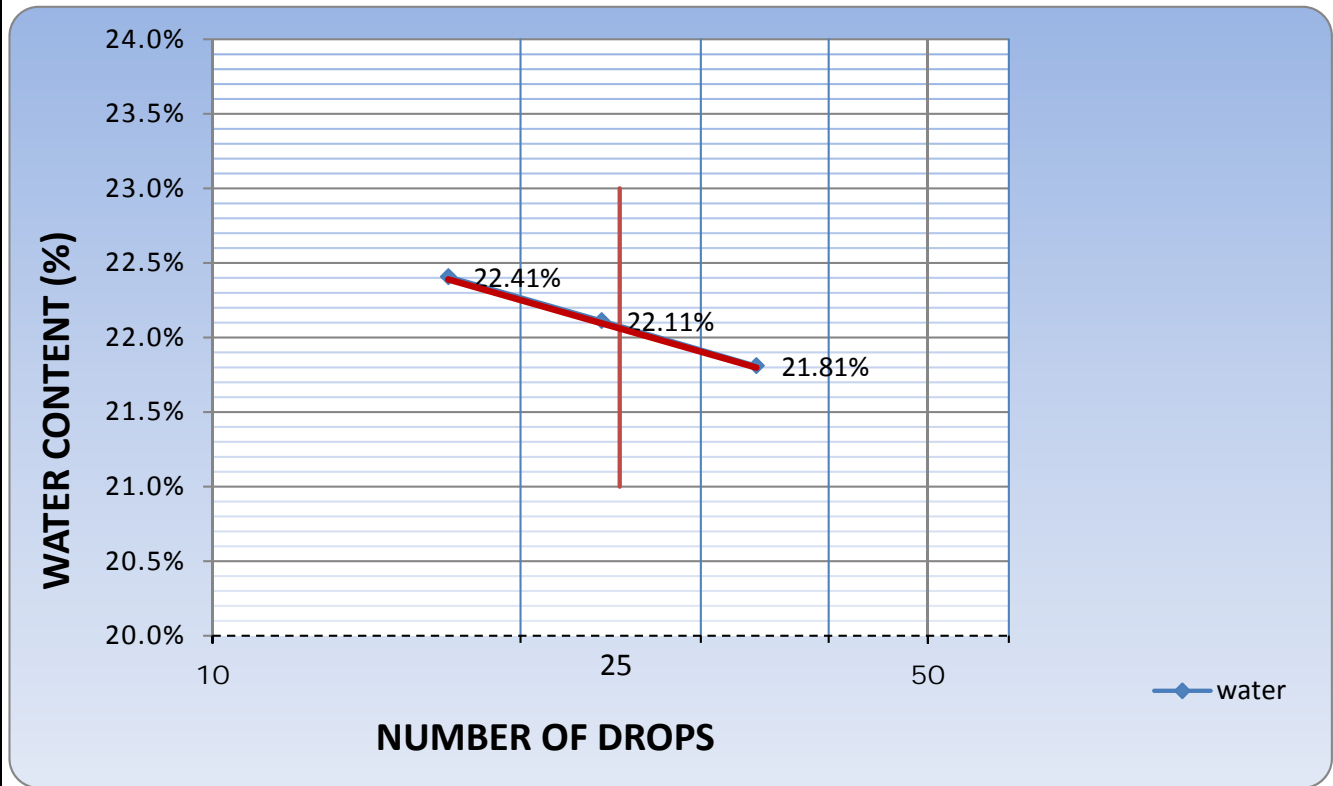
INDEX TESTING - SOIL PROFILE A

Project No:	2017-410	PROPERTY
Date Testing Conducted:	8-Jan-18	6306/6270 HWY 9, BLUE RIVER
Contractor or Owner:	MILLER, KATIE	SUMMIT COUNTY, CO

LIQUID LIMIT:	22	PLASTICITY INDEX:	3	NONPLASTIC
PLASTIC LIMIT:	19	GROUP INDEX:	A-1-A(0)	
SOIL TYPE:	GW-GM (WELL GRADED GRAVEL WITH SILT)			
SEDIMENT RATIO:	1	SWELLING DEGREE:	NONE	

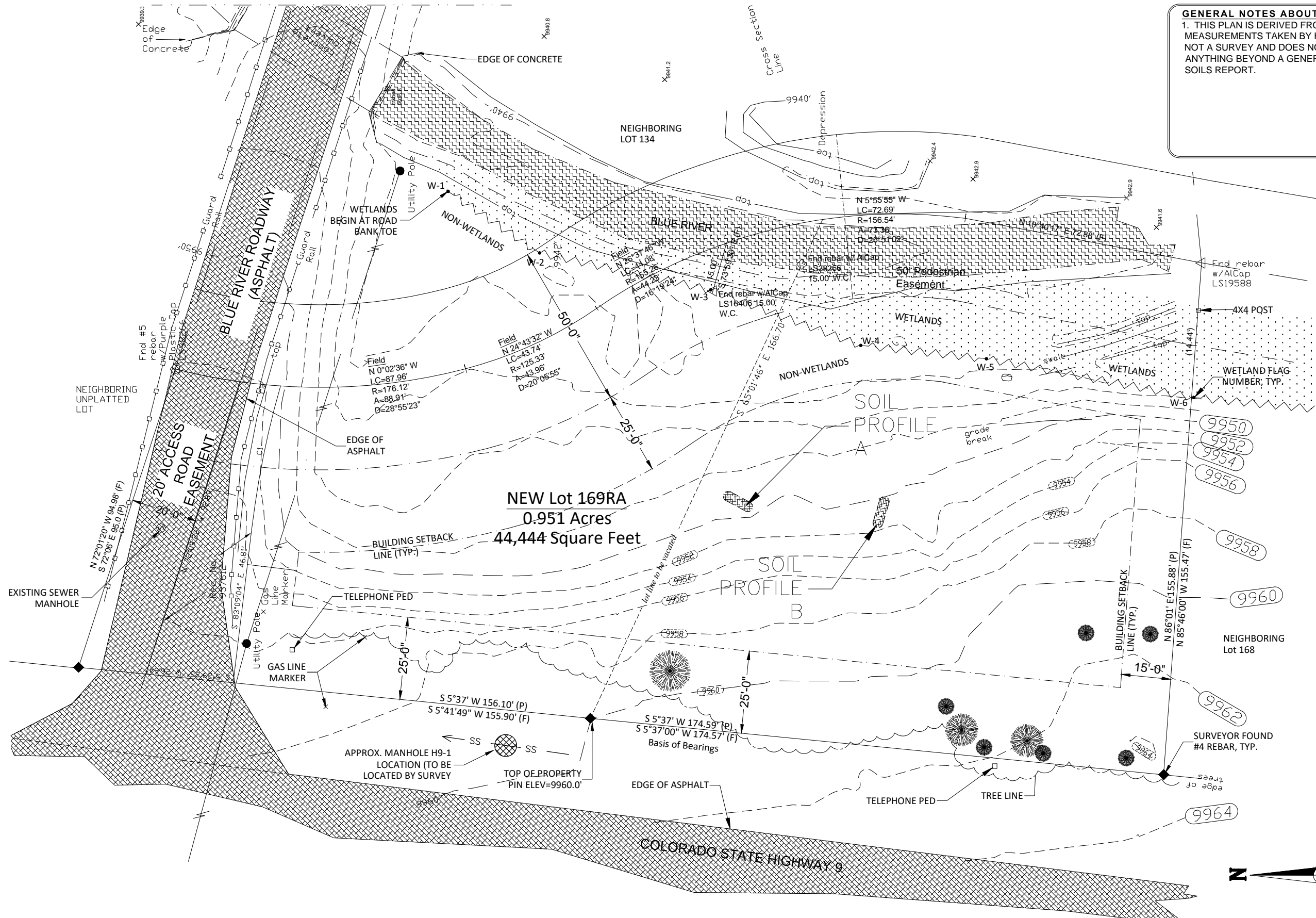
THE GRAPH AND SOIL PROPERTIES DESCRIBED HEREIN USES SOIL WHICH PASSED THE #40 SIEVE

FLOW CURVE



THIS GRAPH ACCOMPANIES A
WRITTEN SOILS REPORT





GENERAL NOTES ABOUT THIS PLAN:
 1. THIS PLAN IS DERIVED FROM FIELD MEASUREMENTS TAKEN BY HAND TAPES. IT IS NOT A SURVEY AND DOES NOT PROVIDE FOR ANYTHING BEYOND A GENERAL EXHIBIT FOR THE SOILS REPORT.

CIVIL
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SOILS EXHIBIT
 MOUNTAIN VIEW SUBDIVISION
 NEW LOT 169RA
 FORMERLY 6270/6306 HIGHWAY 9
 TOWN OF BLUE RIVER, CO

LITTLEHORN ENGINEERING & SURVEYING, LLC
 DESIGNING BEAUTIFUL HOMES AND PROPERTIES THROUGHOUT COLORADO
 P.O. BOX 776390 • STEAMBOAT SPRINGS, COLORADO 80477
 FAIRPLAY PHONE 719.836.7120 • STEAMBOAT PHONE - 970.879.5112

PROJECT NO.
 2017-410
CLIENT
 KATIE MILLER
DATE
 JAN 9, 2018
REVISION:
 △ N/A
 △ N/A
 △ N/A
1 OF 1

SOILS EXHIBIT
PLOTTED AT 1" = 30'-0"

