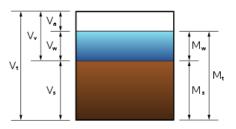
Lorenzen Soil Mechanics, Inc.



Riverfront Trails Geotechnical Engineering Report Missoula, Montana

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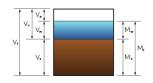
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> March 8, 2021 *Amended July 12, 2022*

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1 Introduction

This report has been amended to reflect that there are no basement level recommendations and to update groundwater depth elevations.

Through Tollefson Construction, Woith Engineering requested Lorenzen Soil Mechanics, Inc. (LSM) to complete a geotechnical/materials investigation for the proposed Riverfront Trails development located within the Linda Vista neighborhood. Lorenzen Soil Mechanics, Inc. (LSM) has completed a geotechnical evaluation for the proposed streets that will serve the development.

The primary purpose of the evaluation was to assess the street, bicycle trail, and underground utility subgrade materials, measure the infiltration rates at depth for potential dry well sumps, and to provide typical sections for the proposed streets and trails. LSM has also provided general recommendations for the residential building foundations based on the soils encountered during the street subsurface investigation. The soils may differ at each of the lot locations and the general recommendations provided may not be applicable.

2 SITE EVALUATION

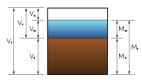
The site has been used primarily for agricultural grazing and haying purposes. It is currently undeveloped. The development will be on the north and south sides of Old Bitterroot Road. A Google Earth image from 2007 indicates the site had produced alfalfa hay. A drainage ditch travels along the southern portion of the property's west border, crosses beneath Old Bitterroot Road, and then angles to the northwest toward the Bitterroot River away from the northern portion of the property's west border.

Geologically, this area is mapped on the MBMG Open File Report 373 - Missoula West 30' x 60' Quadrangle Geologic Map as Quaternary period Alluvium of Modern Channels and Flood Plains (Qal). These deposits are characterized as well-rounded gravel and sand with lesser amounts of clay.

Two nearby water wells associated with the recently constructed Jeanette Rankine Elementary School and data-based at the Montana Bureau of Mines and Geology, indicate groundwater table depths of 19 and 35 feet. The two water wells were drilled to depths of 120 and 178 feet, respectively. The water well lithologies were somewhat varied. The shallower well was logged as 15 feet of silty sand and gravel overlying an 8-foot thick moist clay layer, then moving into saturated sand with clay seams. Bedrock was encountered in the shallower well at a depth of 114 feet. The deeper of the two wells was logged as 35 feet of sand and gravel overlying saturated sand with clay seams. Bedrock was logged in the deeper well at a depth of 105 feet.

The proposed Riverfront Trails Development streets will be carrying primarily residential traffic but must be able to carry heavier truck traffic for garbage collection, emergency fire trucks, freight deliveries, and at their onset, construction traffic that will include concrete trucks, and

Lorenzen Soil Mechanics, Inc.



building materials delivery trucks. It is LSM's opinion that it is the construction traffic that will be delivering the highest concentrated traffic loadings to the streets. If possible, LSM recommends keeping the asphalt from being placed as long as possible, then re-dressing the base course and placing the asphalt plant mix.

LSM conducted a subsurface investigation on September 9th and 10th, 2020. Boland Drilling of Great Falls drilled a total of ten boreholes with their truck-mounted Mobile B59 drill rig. Figure 2 depicts the borehole locations. Horizontal coordinates were obtained using a Garmin eTrex Vista® HCx GPS unit. The boreholes were advanced and sampled to depths ranging from 9.5 to 20 feet. The four shallower 9.5-foot deep boreholes received a 4-inch diameter PVC pipe for infiltration testing. The five 16.5-foot deep boreholes received a 1-inch diameter slotted PVC pipe that was used as a piezometer to measure the depth to the static groundwater water table. BH-01 was drilled to 20 feet and experienced 18 inches of sand heave when lowering the Standard Penetration Test (SPT) steel split spoon sampler to the 20-foot depth. Sand heave usually occurs in granular soils under a hydrostatic head pressure that carries sand up inside the hollow stem augers and limits the SPT sampling. The SPT sampler was driven through the sand at the 18.5-foot depth. 'Washed' sand was what was returned in the sampler. The SPT blow counts were taken but should not be relied upon to bear any relation to the relative density of the soil below 20 feet.

In general, silty sand and sandy silt overlie high quality sand and gravel aggregates. The underlying aggregates will allow for rapid stormwater infiltration collected in dry well sumps that extend into the gravel layer. The finer-grained soils overlying the gravels are considered somewhat problematic for the construction of roadways but can be addressed with separation/stabilization geotextile and a subbase layer as part of the typical section or by removing the upper 1 foot of topsoil, likely exposing the aggregate subgrade.

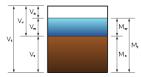
The groundwater table was encountered in each of the boreholes that were drilled to 15 feet and deeper. BH-06 was logged as encountering the groundwater table at 12 feet during the drilling operations. It was read as 'dry' nine days later at 15.2 feet. It was recorded at 14.25 feet several months later in January 2021.

Logs of the boreholes and of the two water wells, soil testing and water infiltration testing results, and seismic spectral accelerations are provided in Appendix A. Photographs of the drilling operations and the soil samples are included in Appendix B.

3 STREET RECOMMENDATIONS

3.1 Subgrade Soils

Sandy loam topsoil was logged as 1 foot across the site. The topsoil overlies primarily cohesionless soils that varied from poorly graded gravel with silt and sand (GP) [A-1-a], poorly graded sand (SP) [A-3], silty sand (SM) [A-4], and in one borehole (BH-10), silt (ML) [A-4].



The Missoula County Public Works Department classifies A-1-a soils as a 'good' subgrade and A-4 soils as an 'average' subgrade. LSM cautions that an A-4 soil subgrade is susceptible to frost heave during the winter months and frost boils during the thawing periods.

3.2 Street Typical Sections

LSM recommends removing the upper 1 foot of topsoil and constructing the street typical section on the granular subgrades. The A-1-a to A-4 range of AASHTO subgrade classification soils can be expected to have California Bearing Ratio (CBR) values of 45 for the poorly graded gravel and 10 for the silty sand/sandy silt soils.

Using the CBR value of 10 as a conservative design, LSM recommends a street typical section of:

Asphalt Concrete: 4 inches Plant Mix.

Crushed Granular Base: 6 inches Crushed 1 1/2-inch minus. Crushed Subbase: 8 inches Crushed 3-inch minus.

Scarified Subgrade: 6 inches.

LSM recommends preparing the subgrade and constructing the typical section aggregates by:

- 1. Removing the upper 1 foot of topsoil across the street alignment. Extend the street excavation horizontally to include 1 foot beyond the back of the street curbing.
- 2. Scarifying to a depth of at least 6 inches and wetting the surface to, or up to 2 percent over, its optimum moisture content.
- 3. Compacting the wetted subgrade to a modified relative compaction (ASTM D1557) of at least 95 percent.
- 4. Providing a crushed 3-inch minus crushed subbase course meeting the gradation presented in Table 1. Recycled asphalt and/or concrete are acceptable, provided they meet the gradation bands in Table 1.

TABLE 1: 3" Minus Crushed Subbase Course

Sieve Size	Percent Passing
3"	90 -100
2 1/2"	85 - 95
1 1/2"	75 - 95
3/4"	65 - 85
No. 4	25 - 60
No. 200	3 - 10

- 5. Placing the crushed 3-inch minus subbase in 8-inch (maximum) loose lift thicknesses and compacting each lift to a modified relative compaction of at least 95 percent.
- 6. Providing a crushed 1 1/2-inch minus base course meeting the gradation presented in Table 2. Recycled asphalt and/or concrete are acceptable, provided they meet the gradation bands in Table 2.

TABLE 2: 1 1/2" Minus Crushed Base Course

Sieve Size	Percent Passing
1 1/2"	100
3/4"	90 - 100
3/8"	70 - 90
No. 4	40 - 70
No. 10	25 - 55
No. 200	2 - 8

7. Placing the crushed 1 1/2-inch minus base and compacting it to a modified relative compaction of at least 95 percent and within 2 percent of its optimum moisture content.

LSM suggests using a vibratory pad roller compactor having an operating weight of at least 25,000 pounds and a centrifugal force of at least 45,000 pounds to compact the subgrade and the aggregate courses.

Plant Mix Surfacing

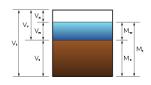
For the asphalt concrete, LSM recommends using PG 64-22 for the binder and for the plant mix surfacing aggregate meeting the Montana Public Work's gradation presented in Table 3. The gradation bands represent the job mix target limits, which determine the suitability of aggregate. Provide the final job 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 3: 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 - 97	+/- 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 3, 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.

Compact the asphalt concrete plant mix surfacing in one lift to an average relative compaction (ASTM D2041) of at least 93 percent, and no individual sample being less than 92 percent.



3.3 Off-Street Bike Trails Typical Section

Off Street bike trails are proposed for this development. Though the loadings are much lighter than the streets, the subgrade and base course preparation must receive the same level of attention as given for the streets. For drainage purposes, LSM suggests the grading for the bicycle trail be kept above the existing grade. LSM recommends shoulders are included with the trail surface width to provide lateral stability for the plant mix surfacing. LSM recommends keeping the vegetation mat in place. The root mat acts similar to a stabilization geotextile but will still need a separation geotextile to limit the migration of base aggregate into the subgrade and vice-versa.

LSM recommends a typical section for the Off-street Bike Trails of:

Asphalt Concrete: 1 1/2 inches Plant Mix.

Crushed Granular Base: 8 inches Crushed 1 1/2-inch minus.

Woven Geotextile: Propex® 200ST.

LSM recommends preparing the subgrade and constructing the bicycle typical section aggregates by:

- 1. Compacting the existing ground surface to a standard relative compaction (ASTM D698) of at least 95 percent.
- 2. Providing a woven geotextile meeting the engineering characteristics of Propex® 200ST.
- 3. Placing the woven geotextile across the compacted surface, overlapping the joints by at least 1 foot.
- 4. Providing 8 inches of 1 1/2-inch crushed base course meeting the gradation presented in Table 2.
- 5. Placing the base course over the woven geotextile and compacting it to a modified relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.
- 6. Placing the 1 1/2-inch thick plant mix asphalt across the base course and compact to an average relative compaction (ASTM D2041) of at least 93 percent, and no individual sample being less than 92 percent.

3.4 Street Subsurface Drainage

With the exception of BH-01, the boreholes received either a slotted 1 1/2-inch diameter PVC as a piezometer or a 4-inch diameter PVC pipe slotted across the bottom 2 feet that was used for infiltration testing. Holman Consulting Engineers conducted the infiltration testing on January 28 and 29, 2021. The infiltration testing rates are presented in Table 4.

TABLE 4: Infiltration Rates

Borehole	Infiltration Rates (inches/hour)
BH-03	345
BH-05	238
BH-07	94
BH-10	144

The groundwater table was encountered in each of the piezometers. LSM recorded piezometer readings on September 19, 2020. Holman Consulting Engineers read the piezometers the same dates they conducted the infiltration testing in January, 2021. The shallowest readings are presented in Table 5.

TABLE 5: Groundwater Table at its Shallowest Depth

Borehole	Groundwater Table Depth		
BH-01	16'-0" (09/09/20)	Not Measured – Borehole Filled	
BH-02	12'-1" (09/09/20)	6' – 10" (06/2021)	
BH-04	13'-2" (09/19/20)	8' - 2" (06/2021)	
BH-06	12'-0" (09/10/20)	10' - 8" (06/2021)	
BH-08	14'-6" (09/19/20	12' – 2'''' (06/2021)	
BH-09	13'-0" (09/10/20)	10' – 10" (06/2021)	

3.5 Compaction and Fresh Concrete Testing Frequency

LSM suggests a testing frequency presented in Table 5 for subgrade and backfill compaction and for fresh concrete for the streets' curbs and gutters and their sidewalks.

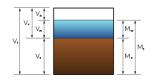
TABLE 6: Compaction and Fresh Concrete Testing Frequency

Tibel of compaction und from concrete forms from the			
Compaction Testing			
Street Subgrade and Aggregates	1 Test per 5,000 Square Feet per Lift		
Concrete Testing			
Curb/Sidewalk Concrete	1 Test per 50 Cubic Yards per Day		

4 GENERAL RESIDENTIAL RECOMMENDATIONS

Based on the soils encountered during the street drilling operations, LSM is making general recommendations for the residential foundations, foundation walls, and slabs-on-grade. If fine-grained soils are encountered that differ from what LSM encountered during the street excavations, contact LSM to evaluate the subgrade soils and to provide additional design recommendations.

Basement levels are not recommend at this site due to the possibility of cyclical groundwater fluctuations that may lead to basement flooding. The shallowest groundwater depth was measured at 12 feet but this was in the month of September, 2020. The piezometers are still intact and LSM understands the groundwater table has indeed risen.



4.1 Foundations

Footing over-excavations to the gravels or sands are recommended for crawl spaces and for slabs on grades. Interior footings can be placed directly below the slabs-on-grade but are also to be supported on the underlying gravels or sands. Compact the footing subgrades to a standard relative compaction (ASTM D698) of at least 98 percent and at a moisture content within 2 percent of the subgrade's optimum moisture content.

Provided the foundation subgrades have been prepared and compacted as noted, an allowable soil bearing pressure up to 3,000 pounds per square foot (psf) is recommended for the foundation subgrades on the native gravel and sand soils.

LSM believes the gravel subgrade at depth is porous and will adequately pass infiltrated surface water that arrives at the foundation elevation. With the presence of gravel soils at the foundation depth, LSM does not believe perimeter foundation drains are necessary. The BH-10 location did have sandy silt down to the 7-foot depth and will not rapidly transmit infiltrated water. If these soils are encountered at the foundation elevation, LSM recommends extending the excavation further until gravels are encountered or installing a perimeter drain system that carries the infiltrated water to a dry well.

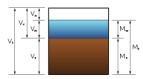
4.2 Foundation Walls

LSM recommends foundation walls associated with the exterior footings be cast-in-place reinforced concrete, damp proofed, and to include water stops at the foundation wall/footing keyway.

The sandy silt and granular soils can be re-used as backfill against the foundation walls provided the cobble-sized (>3") particles are either removed entirely or be at least 1 foot away from the walls. Compacting these materials as backfill will offer an internal angle of friction (ϕ) of 34°, and a moist unit weight (γ_m) of at least 135 pcf. For the on-site soils being used as backfill, LSM recommends using an at-rest equivalent fluid unit weight (γ_f) of 59.5 pounds per cubic foot (pcf) for foundation wall design where the tops of the walls are not allowed to rotate. LSM recommends using an active equivalent fluid unit weight (γ_f) of 38.2 pounds per cubic foot (pcf) for retaining wall design where the tops of the walls are allowed to rotate. 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):

Active Pressure, P_a : 19.1 x H^2 Passive Pressure, P_p : 238.8 x H^2 At-rest Pressure, P_0 : 29.8 x H^2 Seismic Pressure, P_E : 10.1 x H^2 Seismic Active Pressure, $P_{(E+a)}$: 29.2 x H^2

LSM recommends walls associated with the foundation footings or columns be cast-in-place reinforced concrete. At least 2 inches of rigid EPS insulation is suggested for use along the exterior sides of the perimeter walls. In addition to providing insulation benefits, the rigid



insulation board will offer some cushion and protection to the wall waterproofing during the backfilling operations.

4.3 Slabs-on-Grade

For crawl spaces on the silty soils that may have a slab-on-grade and for the garage slabs, LSM recommends including a 9-inch thick gravel layer meeting the gradation in Table 2 and a 3-inch thick leveling course of 3/4-inch sandy gravel beneath the slab. LSM suggests the placement of the aggregates even if there is no slab in the crawl spaces.

Varying amounts of curling within the slabs are likely to occur due to differences in the moisture content or to temperature 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. In addition to being a vapor barrier, the Stego® vapor barrier has a radon diffusion coefficient of 8.8 x 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.

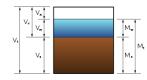
LSM recommends including isolation and control (contraction) joints within the slab-on-grade. Joint geometries should include:

- 1. Placing isolation joints at all interior column locations.
- 2. Spacing saw-cut or forming control joints from 24 to 36 times the thickness of the slab in each direction and extending the control joints to one-quarter the thickness of the slab.
- 3. Terminating reinforcing bars within 2 inches of both sides of control joints to limit the transfer of shrinkage and contraction restraints.
- 4. If sawing, cut 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. 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 designs.

4.4 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 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.

Soil compaction in utility trenches deeper than 5 feet should be performed using a remote trench compactor and observed by an inspector. When the backfill has been brought back to within 5 feet of the surface, perform compaction testing. Compact the trench soils to a standard relative compaction of at least 95 percent.

4.5 Groundwater Table and Surface Water

The groundwater table was encountered during the drilling operations which extended to 20 feet at its deepest depth. Piezometers were inserted in five of the boreholes and the shallowest reading was 12 feet. One of the piezometers, BH-06, noted a groundwater table at 12 feet when it was drilled on September 10. A second reading was taken on September 19, at which time it was dry to its bottom at 15.2 feet. A third reading was taken on January 29, 2021, at the time of the groundwater infiltration testing for nearby sites and the groundwater table was measured at 14.25 feet.

Infiltration rates were presented in Table 4 and they ranged from 94 to 345 inches per hour at the 8-foot depths in BH-07 and BH-03, respectively. LSM understands the City of Missoula recommends a safety factor of 3.0, making the design rates 31 to 115 inches per hour.

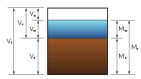
LSM notes that the groundwater is likely under a hydrostatic head pressure (BH-01) which may lead to the groundwater table rising after the overburden soils are removed for deep basements. LSM does not recommend basement level elevations at this development.

LSM recommends berming all open excavations during construction to prevent surface water from entering.

4.6 Seismic Considerations

The Missoula area is within the Northern Intermountain Seismic Belt seismotectonic province. The ASCE/SEI 7-16 Hazards Report was used to develop the spectral response values for a seismic site class 'C', "Very Dense Soils 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. The spectral response acceleration parameters are presented in Table 7.

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 10.1 x H^2 , making the active pressure against the wall during an earthquake equal to 29.2x H^2 and was presented in Section



4.2. 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 7: Seismic Coefficients

ASCE/SEI 7/16, Earthquake Loads		
Site Class Definition	С	
Mapped Spectral Response Acceleration Parameter, S _S for 0.2 second	0.392g	
Mapped Spectral Response Acceleration Parameter, S ₁ for 1.0 second	0.132g	
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S _{MS}	0.510g	
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S _{M1}	0.199g	
Design Spectral Response Acceleration Parameter, S _{DS}	0.340g	
Design Spectral Response Acceleration Parameter, S _{D1}	0.132g	

Due to the groundwater table being less than 15 feet and the nature of the granular soils encountered in the test pits, liquefaction during a seismic event is considered a moderate concern at this site during a significant seismic event of a moment magnitude greater than 6.0.

4.7 Shrink/Swell Characteristics

The volume change potential of the on-site granular soils encountered during the street drilling is expected to be low. The presence of the silty subgrades at the upper portion of the soil profile will present issues regarding frost heaving during the colder winter months and frost boils during the thaw periods beneath sidewalks and patios. To mitigate the effects of frost heave, LSM recommends including at least 9 inches of a base course meeting the gradation in Table 2 beneath exterior flatwork.

The building designs should include eaves and roof gutters with downspouts that will carry roof runoff water at least 7 feet horizontally away from the buildings. Provide positive drainage around the entire building on a 2 percent grade extending at least 10 feet horizontally away from the building.

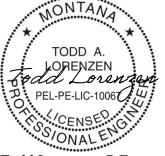
5 Basis of Recommendations

The analyses and recommendations submitted in this report are based upon the subsurface investigation. Often, variations occur within the subgrade, the nature and extent of which do not become evident until additional exploration or construction is conducted.

This report is for the exclusive use of Tollefson Construction, Woith Engineering, 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. Again, general recommendations made for the residential sites were based on the soils encountered during the street test pitting operations. If the structure foundation soils differ, contact LSM for additional foundation recommendation guidance. Parties contemplating structures or purposes other than what this report was written are directed to contact LSM.

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.



March 8, 2021

Amended July 12, 2022

Todd Lorenzen, P.E. Geotechnical Engineer

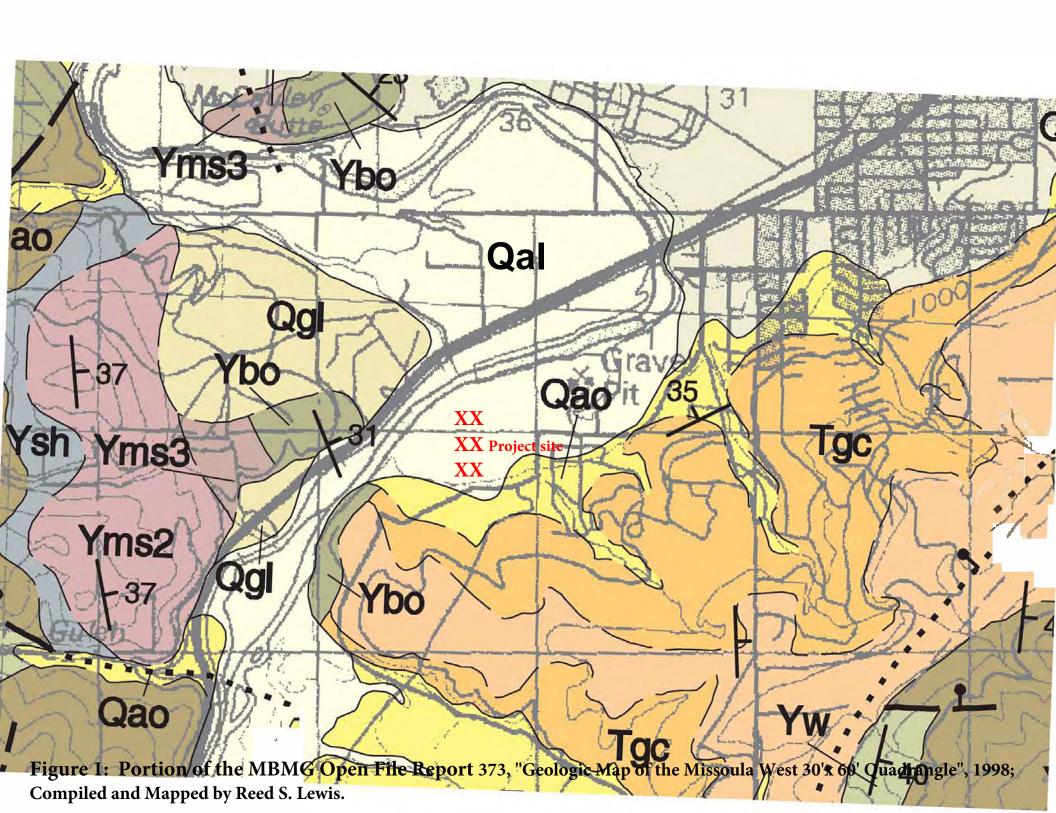
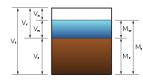




Figure 2: Borehole Locations

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APPENDIX A. LOGS OF BOREHOLES 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

CA: Casing Advancer

Da: Drill Auger

CB: California Sampler - 2" I.D., 2.5" O.D., unless otherwise noted

Diamond Bit Coring - 4", NX, unless otherwise noted

BS: Bulk Sample or Auger Sample

CA: Casing Advancer

Drill 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
WCl:	Wet Cave-In	WD: $\overline{\Sigma}$	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.

Component

CONSISTENCY OF FINE-GRAINED SOILS

	<u>Standard</u>	
Unconfined	Penetration or	
Compressive	N-value (SS)	
Strength, Qu, psf	Blows/Ft.	Consistency
< 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

Standard		
Penetration or		
N-value (SS)	California Barrel	
Blows/Ft.	(CB) Blows/Ft.	Relative Density
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

USCS* GRAIN SIZE TERMINOLOGY

RELATIVE PROPORTIONS OF SAND AND GRAVEL

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

of Sample	<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)
E A A CLUTTO	

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

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of Other	Percent of
Constituents	Dry Weight
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



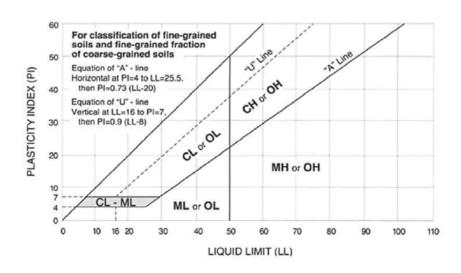
UNIFIED SOIL CLASSIFICATION SYSTEM

Coarse Grained Soils More than 50% of coarse fraction retained on No. 4 sieve Sands 50% or more of coarse fraction passes No. 4 sieve Gravels with Fine More than 12% fi			Jsing Laboratory Tests ^A	So	l Classification						
				Group Symbol	Group Name ^B						
	C 1	Clean Gravels	$Cu \ge 4$ and $1 \le Cc \le 3$	GW	Well-graded Gravel F						
		Less than 5% fines	Cu < and/or 1 > Cc > 3	GP	Poorly graded gravel F						
		Gravels with Fines	Fines classify as ML or MH	GM	Silty Gravel F,G,H						
	No. 4 sieve	More than 12% fines	Fines classify as CL or CH	GC	Clayey Gravel F,G,H						
	Canda	Clean Sands	$Cu \ge 6$ and $1 \le Cc \le 3$	SW	Well-graded Sand ^I						
		Less than 5% fines	Cu < 6 and/or 1 > Cc > 3	SP	Poorly graded Sand I						
					Silty Sand G,H,I						
	No. 4 sieve	More than 12% fines	Fines classify as CL or CH	SC	Clayey Sand G,H,I						
			PI > 7 and plots on or above "A" line	CL	Lean Clay K,L,M						
	Silts and Clays	inorganic	PI < 4 or plots below "A" line	ML	Silt K,L,M						
	Liquid limit less than 50		<u>Liquid limit - oven dried</u> < 0.75	OI	Organic Clay K,L,M,N						
		Liquid limit - not dried		Liquid limit - not dried		organic Liquid limit - not dried		Liquid limit - not dried		OL	Organic Silt K,L,M,Q
			PI plots on or above "A" Line	СН	Fat Clay K,L,M						
	Silts and Clays	morganic	PI plots below "A" line	MH	Elastic Silt K,L,M						
	Liquid Limit 50 or more		<u>Liquid limit - oven dried</u> < 0.75	OH	Organic Clay K,L,M,P						
	organic Liquid limit - over dried < 0.73		ОН	Organic Silt K,L,M,Q							
Highly organic soils	Primarily organic matter, d	PT	Peat								

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

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

QPI plots below "A" line.



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

^C Gravels 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.

^D Sands 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.

^F If soil contains ≥ 15% sand, add "with sand" to group name.

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

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

 $^{^{\}rm I}$ If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

¹ If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

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

 $^{^{\}rm L}$ If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

 $^{^{}M}If$ soil contains \geq 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

 $^{{}^{\}rm N}{\rm PI} \ge 4$ and plots on or above "A" line.

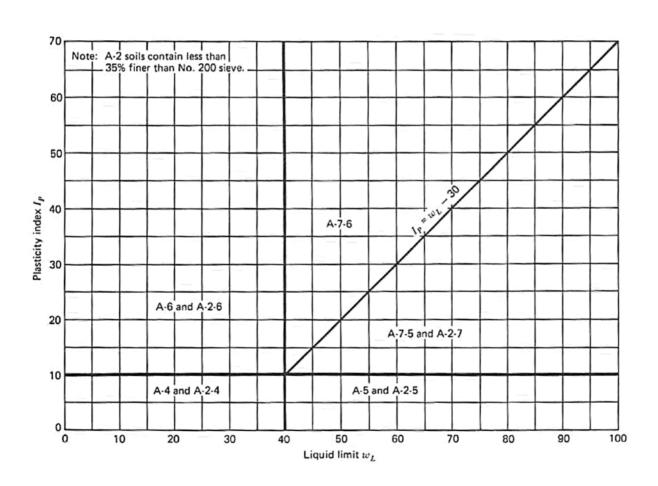
 $^{^{\}mathrm{O}}$ PI < 4 or plots below "A" line.

P PI plots on or above "A" line.

AASHTO SOIL CLASSIFICATION SYSTEM

General classification		(35 perce	Gran	nular mate of total samp		No. 200)			Silt-clay re than 35 pmple passing	ercent of to	
	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. 20 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		,	ND	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plastic Index, l _P	6 n	nax	NP	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Significant constituent materials	gravel a	and sand	fine sand		•	d clayey 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.



BORING NUMBER BH-01 PAGE 1 OF 1

GPJ	CLIE	NT _T	olleffson Construction P	ROJEC	T NAME	Rive	rfront Trails	;						
AIL.G	PROJ	ECT	NUMBER_BT2020 P	ROJEC	T LOCA	TION	Missoula							
	DATE	STA	RTED 9/9/20 COMPLETED 9/9/20 G	ROUNE	ELEVA	TION			HOLE	SIZE	_6 inc	ches		
J F	DRILI	ING	CONTRACTOR Boland Drilling G	ROUNE	WATE	R LEV	ELS:							
IVER	DRILI	ING	METHOD Mobile B59	$\overline{igspace}$ at	TIME O	F DRII	LING 16.0	00 ft						
ES/R	LOGO	SED E	SY Lorenzen CHECKED BY Lorenzen	▼ AT	END OF	DRIL	LING_16.0	0 ft						
RABL	NOTE	S _N	46° 49' 12.1"; W114° 04' 15.7"	AF.	TER DRI	LLING	3							
ILIVE					Ш	%		<u>.</u>			AT	TERBE		누
GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 377/21 14:12 - C.\USERS\TODD LORENZEN\DOCUMENTS\LORENZEN\SOLL MECHANICS\WOITH ENGINEERING\RIVER\TRAILS SUBDIVISION\S.0 DELIVERABLES\RIVER	O DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYP NUMBER	RECOVERY 9 (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC MI LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
VER TRAILS	-	70 7 7 77 7 7 7 7	(SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry (10YR 5/1); no reaction to 10% HCl solution - it beaded on t sample. [A-4].	; gray he										
EERING/RI	-		(GP-GM) Poorly Graded GRAVEL with Silt and Sand, traces Mica; rounded to subangular; dry; very pale brown (10YR 7/matrix; medium dense; no reaction to 10% HCl solution. Fir	s of (3) nes are				_			-			
OTH ENGIN	_		slightly plastic. [A-1-a]. Drill rate from 0 to 2.5 feet = 180 ft/hr.		SPT	67	3-5-6 (11)			1				
S/WC		[0,0]	Drill rate from 2.5 to 5 feet = 180 ft/hr.											
OIL MECHANIC	5 -		(CD) Dearly Creded CDAVEL with Cond traces of Missy re-	ınded no	SPT	72	4-13-19 (32)	_		1				
LORENZEN SC	_		Drill rate from 5 to 7.5 feet = 165 ft/hr.											
DOCUMENTS\	-		Drill rate from 7.5 to 10 feet = 130 ft/hr.		SPT	67	8-21-19 (40)	_		2				
DD LORENZEN	_				SPT	78	13-23-23 (46)	_		2				
14:12 - C:\USERS\TC	-		Drill rate from 10 to 15 feet = 75 ft/hr.											
- 3/7/21 1	15													
US LAB.GDT	_		(ML) SILT, traces of Mica; moist to wet; brown (10YR 4/3) to (10YR 6/1); loose; no reaction to 10% HCl solution; non-plas low dry strength, powdery; rapid dilatency - 'Bull's Liver'. [A-	stic,	SPT	78	2-4-5 (9)	_		30	NP	NP	NP	97
GINT ST	-		(SP) Poorly Graded SAND; wet.											
NNS	-		Drill rate from 15 to 20 feet = 385 ft/hr.											
CH BH COLUN	- 20		There was 18 inches of 'sand heave' inside the casing prior attempting the SPT at the 20-foot depth. The collected sam considered 'washed material'.		SPT	100	2-9-18 (27)			24				
OTEC			Bottom of borehole at 20.0 feet.											
B B														

BORING NUMBER BH-02 PAGE 1 OF 1

띩드		olleffson Construction			PROJEC	TNAME	Rive	rfront Trails	3						
∄ PRC	JECT	NUMBER BT2020			PROJEC	T LOCA	TION_	Missoula							
Ë DA1	E STA	RTED 9/9/20	COI	MPLETED 9/9/20	GROUNI	D ELEVA	TION			HOLE	SIZE	<u>6 inc</u>	hes		
္က် DRI	LLING	CONTRACTOR_BC	oland Drilling		GROUNI	WATE	R LEV	ELS:							
ا ال DRI	LLING	METHOD Mobile B	359			TIME O	F DRIL	LING 12.	10 ft						
[LOG		·		ECKED BY Lorenzen				LING 12.1							
		46° 49' 12.1"; W114						RILLING_1							
	123 _1	1 49 12.1 , 1111	4 04 13.7			ZIIIS AI	I LIX DI	NILLING_	J.00 II	·	1				
VISION/5.0 DELIN DEPTH (#)	GRAPHIC		MATERIA	AL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)		PLASTIC HIMIT LIMIT		S CONTENT (%)
o suggin						SAN	REC	02	PO	DR	ΣŌ	55	P.L	PLAS	FINES
IVER TRAIL:	- 777 17 741	·	reaction to 1	am with Vegetation Org 10% HCl solution - it be = 180 ft/hr	anics; dry; gray eaded on the										
EKING/K		(SM) Silty SAN	ID, traces of	Mica; dry ; light gray (1 ution. Fines are slightly	10YR 7/2); loose; y plastic. [A-4].										
H ENGINE	-14	Drill rate from 2	2.5 to 5 feet :	= 215 ft/hr.		SPT	72	4-3-2 (5)			2				
- 5 5		(GP) Poorly Gr to subangular;	raded GRAV dry to moist;	EL with Sand, traces of light gray (10YR 7/2) thense; no reaction to 10	to light brownish										
OIL MECHAN		[A-1-a].	-,			SPT	78	4-15-16 (31)			2				
ATS/LORENZEN S		Drill rate from \$	5 to 10 feet =	= 140 ft/hr.											
- 10 - 10						V		12-15-16							
		Groundwater to	abla maasur	ed at 12.2 feet 9/19/20.		SPT	78	(31)			4				
12 - C:\USERS\10		(GP) Poorly Gr	raded GRAV wet; grayish	EL with Sand, traces of brown (10YR 5/2) mat	f Mica; rounded										
75 – 15 15		Drill rate from	10 to 15 feet	= 85 ft/hr.											
LAB.GDI -						SPT	50	2-4-5 (9)			17				
SEOTECH BH COLUMNS - GINT STD US LAB.GDT - 377/21 14:12 - C.USERS/TODD LORENZENDOCUMENT SLORENZEND SOLUMENT TRAILGRUMS - GINT STD US LAB.GDT - 377/21 14:12 - C.USERS/TODD LORENZENDOCUMENT SLORENZEND SOLUMENT TRAILGRUMS - GINT STD US LAB.GDT - 377/21 14:12 - C.USERS/TODD LORENZEND LORENZEND SULUM SOLUMIN SOLUM			Bottom of	borehole at 16.5 feet.											

BORING NUMBER BH-03 PAGE 1 OF 1

2	CLIEN	NT _Tc	olleffson Construction		PROJEC	T NAME	Rive	front Trails	3						
AIL.G	PROJ	IECT N	NUMBER BT2020		PROJEC	T LOCA	TION_	Missoula							
T TR	DATE	STAF	RTED 9/10/20	COMPLETED 9/10/20	GROUN	D ELEVA	TION			HOLE	SIZE	_6 inc	ches		
RON	DRILI	LING (CONTRACTOR Boland	d Drilling	GROUN	D WATE	R LEV	ELS:							
VERF	DRILI	LING N	METHOD Mobile B59		A1	TIME O	F DRIL	LING (GW tab	ole wa	s not e	encour	ntered		
SIRI	LOGO	SED B	Y Lorenzen	CHECKED BY Lorenzen	A1	END OF	DRIL	LING G	W tab	le was	not e	ncoun	tered.		
ABLE	NOTE	S N4	46° 49' 12.1"; W114° 04	4' 15.7"	AF	TER DR	ILLING	}							
IVER												ATT	TERBE	RG	—
GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 37/21 14:12 - C. UJSERSYTODD LORENZENDOCUMENTS/LORENZEN SOIL MECHANICS/WOITH ENGINEERING/RIVER TRAILS SUBDIV/SION/S.0 DELIVERABLES/RIVERFRONT TRAIL. GPJ	O DEPTH (ft)	GRAPHIC LOG	ı	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC MIT LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
R TRAILS		7 77		andy Loam with Vegetation Orgar ction to 10% HCl solution - it bear											
RIVE		70.7	Drill rate from 0 to	2.5 feet = 210 ft/hr.											
RING	-		(SP) Poorly Grade	d SAND, traces of Mica; dry; fine- (10YR 7/2); loose; no reaction to	to medium										
INEE			solution. [A-3].	(101111/2), 10000, 110 10000101110	,	V						-			
ENG						SPT	61	5-5-3 (8)			2				
/OITH			Drill rate from 2.5 t	o 5 feet = 145 ft/hr.					-						
CS/W	5	٥٥٥	(OB) B	d GRAVEL with Sand, traces of M	Mica; rounded	-									
HAN			to subangular; dry;	light gray (10YR 7/2) to light brows; dense; no reaction to 10% HC	wnish gray Lsolution	V		5 40 00	1						
. MEC	L -	000	[A-1-a].	o, donoo, no rodonom to 1070 mo	i colution.	SPT	72	5-16-20 (36)			1				
SOIL									-						
NZEN	-		Drill rate from 5 to	8 feet = 80 ft/hr.											
ORE															
NTS/L						SPT	78	11-19-18			2				
CUME	-					A SPT	/ 6	(37)			3				
N/DO		h.O.(.)		48 ft/min = 346 in/hr					-						-
ENZE			ŀ	Bottom of borehole at 9.5 feet.											
LORE															
JODD I															
3S/T															
\USE															
2 - C:															
14:1															
3/7/21															
DT - (
AB.G															
USL															
ГSTD															
GIN															
MNS-															
COLUIN															
BHC															
TECH															
GEO.															

BORING NUMBER BH-04 PAGE 1 OF 1

DATE DRILL DRILL LOGG	START ING CO ING ME SED BY	FED_9/10/20 COMPLETED_9/10/20 GRO DNTRACTOR_Boland Drilling GRO ETHOD_Mobile B59 CHECKED BY Lorenzen	DUND ELEVA DUND WATE AT TIME O AT END O 142hrs AF	ATION R LEV F DRIL F DRIL	ELS: _LING (LING (GW tab	e was	s not e	encour ncoun	ntered.	RG	L
DRILL DRILL LOGG NOTE	CRAPHIC CRAPHIC LOG	CHECKED BY Lorenzen CHECKED BY Lorenzen CHECKED BY Lorenzen 49' 12.1"; W114° 04' 15.7" MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	AT TIME O AT END O	R LEV F DRIL F DRIL TER DI	ELS: _LING (LING (RILLING_1	GW tab	e was	s not e	encour ncoun	tered.	RG	LV
DRILL LOGG NOTE (t)	GEAPHIC CRAPHIC COG	CHECKED BY Lorenzen "49' 12.1"; W114" 04' 15.7" MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	AT TIME OF	F DRIL F DRIL TER DI	LING (LING (RILLING_1	3.80 ft	e was	not e	ncoun	tered.	RG	L
NOTE (t)	GRAPHIC CRAPHIC LOG	CHECKED BY Lorenzen ° 49' 12.1"; W114° 04' 15.7" MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	AT END O	F DRIL	LING G	3.80 ft	e was	not e	ncoun	tered.	RG	L
DEPTH (ft)	GRAPHIC LOG LOG	MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	142hrs AF	TER DI	RILLING_1	3.80 ft			ATT	TERBE	RG	L N
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the		%				(%)			3	L N
	1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1	(SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	SAMPLE TYPE NUMBER	OVERY %	OW INTS ALUE)	PEN.	WT.	щ (%)			3	L
	1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1	(SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gr (10YR 5/1); no reaction to 10% HCl solution - it beaded on the	SAMPLE TYPE NUMBER	OVERY %	OW INTS ALUE)	PEN (M	Щ <u></u>		LIMITS	3	<u> </u>
	1/ 1/1/	(10YR 5/1); no reaction to 10% HCl solution - it beaded on the		REC	BL COL (N V/	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
		Drill rate from 0 to 2.5 feet = 225 ft/hr.										
	니라다	loose; no reaction to 10% HCl solution, the acid beaded on the);									
			SPT	33	2-2-4 (6)			2				
_		Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica: round	2d									
_ 5 _		to subangular; dry; light gray (10YR 7/2) matrix; medium dense no reaction to 10% HCl solution. [A-1-a].	;	67	6-12-14 (26)			2				
		Drill rate from 5 to 10 feet = 35 ft/hr.										
10	200				44.40.44							
			SPT	67	11-12-11 (23)			2				
		to subangular; moist; light gray (10YR 7/2) matrix; medium den to loose (inferred); no reaction to 10% HCl solution. [A-1-a]. Drill rate from 10 to 15 feet = 140 ft/hr.				_						
		Groundwater table measured at 13.2 feet 9/19/20.										
15		very dark grayish brown (10YR 3/2); loose; no reaction to 10% solution; non-plastic; low dry strength, powdery; rapid dilatency	HCI			-						
			SPT	72	2-5-4 (9)			28	NP	NP	NP	73
	<u>. 1 -1 -1 -1 -</u>	Bottom of borehole at 16.5 feet.								<u> </u>		\vdash
	-	10 10 10 10 10 10 10 10 10 10 10 10 10 1	(SM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2) loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; round to subangular; dry; light gray (10YR 7/2) matrix; medium dense no reaction to 10% HCl solution. [A-1-a]. Drill rate from 5 to 10 feet = 35 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; round to subangular; moist; light gray (10YR 7/2) matrix; medium dent to loose (inferred); no reaction to 10% HCl solution. [A-1-a]. Drill rate from 10 to 15 feet = 140 ft/hr. Groundwater table measured at 13.2 feet 9/19/20. (ML) SILT with Sand, traces of Mica; wet; gray (10YR 5/1) and very dark grayish brown (10YR 3/2); loose; no reaction to 10% solution; non-plastic; low dry strength, powdery; rapid dilatency -'Bull's Liver'. [A-4].	(SM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. Drill rate from 5 to 10 feet = 35 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; moist; light gray (10YR 7/2) matrix; medium dense to loose (inferred); no reaction to 10% HCl solution. [A-1-a]. Drill rate from 10 to 15 feet = 140 ft/hr. Groundwater table measured at 13.2 feet 9/19/20. (ML) SILT with Sand, traces of Mica; wet; gray (10YR 5/1) and very dark grayish brown (10YR 3/2); loose; no reaction to 10% HCl solution; non-plastic; low dry strength, powdery; rapid dilatency -Bull's Liver'. [A-4].	(SM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr.	(SM) Sitty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. SPT 33 2-2-4 (6) Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry: light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. Drill rate from 5 to 10 feet = 35 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; moist; light gray (10YR 7/2) matrix; medium dense; no subangular; moist; light gray (10YR 7/2) matrix; medium dense to loose (inferred); no reaction to 10% HCl solution. [A-1-a]. Drill rate from 10 to 15 feet = 140 ft/hr. Groundwater table measured at 13.2 feet 9/19/20. (ML) SILT with Sand, traces of Mica; wet; gray (10YR 5/1) and very dark grayish brown (10YR 3/2); loose; no reaction to 10% HCl solution; non-plastic; low dry strength, powdery; rapid dilatency -Bull's Liver'. [A-4].	(SM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr.	(SM) Silty SAND, traces of Mica; dry: grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr.	(SM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light gray (10VR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. Drill rate from 5 to 10 feet = 35 ft/hr.	(GM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. Drill rate from 5 to 10 feet = 35 ft/hr. SPT 67 6-12-14 (26) Drill rate from 5 to 10 feet = 35 ft/hr. SPT 67 11-12-11 (23) SPT 67 11-12-11 (23)	(GM) Silty SAND, traces of Mica; dry; grayish brown (10YR 5/2); loose; no reaction to 10% HCl solution, the acid beaded on the sample. [A-4]. SPT 33 2-2-4 (6) SPT 37 3-2-2-4 (6) SPT 38 3-2-2-4 (6) SPT 38 3-2-2-4 (6) SPT 38 3-2-2-4 (6) SPT 39 3-2-2-4 (6) SPT 39 3-2-2-4 (6) SPT 39 3-2-2-4 (6) SPT 67 6-12-14 (26) SPT 67 6-12-14 (26) SPT 67 6-12-14 (26) SPT 67 6-12-11 (23) SPT 67 6-12-11 (23) SPT 67 6-12-11 (23) SPT 67 11-12-11 (23) SPT 72 2-5-4 (9) SPT 72 2-5-4 (9)	(GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; moist light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light gray (10YR 7/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a]. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; moist; light gray (10YR 7/2) matrix; medium dense to loose (interred); no reaction to 10% HCl solution. [A-1-a]. Groundwater table measured at 13.2 feet 9/19/20. (ML) SILT with Sand, traces of Mica; wet; gray (10YR 5/1) and very dark gray/sh brown (10YR 3/2); loose; no reaction to 10% HCl solution; no-plastic; low dry strength, powdery; rapid dilatency -Bull's Liver. [A-4].

BORING NUMBER BH-05

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

CLIENT Tolleffson Construction PROJECT NAME Riverfront Trails

PROJECT NUMBER BT2020 PROJECT LOCATION Missoula

DATE STARTED 9/10/20 COMPLETED 9/10/20 GROUND ELEVATION HOLE SIZE 6 inches

DRILLING CONTRACTOR Boland Drilling GROUND WATER LEVELS:

DRILLING METHOD Mobile B59 AT TIME OF DRILLING --- GW table was not encountered.

LOGGED BY Lorenzen CHECKED BY Lorenzen AT END OF DRILLING --- GW table was not encountered.

NOTES N46° 49' 12.1"; W114° 04' 15.7" AFTER DRILLING ---

2		7										
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RCOVERY % (RQD)	BLOW COUNTS (N VALUE)	KET PEN. (tsf)	DRY UNIT WT. (pcf)	ISTURE TENT (%)		LASTIC LIMIT		CONTENT (%)
	95		SAMI	REC.	"ÖZ	POCKET (tsf)	DRY	MOIS- CONTE	NI TIN	PLA	PLAS' IND	FINES
IVEK INAILS	7 77 7	(SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gray (10YR 5/1); no reaction to 10% HCl solution - it beaded on the sample. [A-4]. Drill rate from 0 to 2.5 feet = 95 ft/hr.										
교 일 	0 0	(GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded										
		to subangular; dry; light brownish gray (10YR 6/2) matrix; medium dense; no reaction to 10% HCl solution. [A-1-a].	SPT	61	7-10-9 (19)			0				
5	000	Drill rate from 2.5 to 5 feet = 165 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded										
OCI MECHANI		to subangular; dry; yellowish brown (10YR 5/4) to pale brown (10YR 6/3) matrices; dense to medium dense; no reaction to 10% HCl solution. [A-1-a].	SPT	67	6-19-17 (36)			1				
		Drill rate from 5 to 8 feet = 65 ft/hr.										
			SPT	61	7-10-17 (27)			3				

Infiltration rate = 0.33 ft/min = 238 in/hr
Bottom of borehole at 9.5 feet.

SCHOMINS - GINT STD US LAB GDT - 377/21 14:12 - C.USERSITODD LORENZENDOCUMENTS/LORENZEN SOIL MECHANICS/WOITH ENGINEERING/RIVER TRAILS SUBDIVISIONIS. DELIVERABLES/RIVERFRONT TRAIL GPJ

BORING NUMBER BH-06

PAGE 1 OF 1

≂ ໄ CL	JEN	IT To	lleffson Construction	PROJEC	TNAME	Rive	rfront Trails							
ااً PF							Missoula							
∐ DA			RTED 9/10/20 COMPLETED 9/10/20	GROUN	D ELEVA	TION			HOLE	SIZE	6 inc	hes		
Ö DF					D WATER									
삙 D F	RILL	ING N	METHOD Mobile B59	$ar{oxtsymbol{oxed}}$ at	TIME OI	F DRIL	LING 12.0	00 ft						
S LC	GG	ED B	Y Lorenzen CHECKED BY Lorenzen				LING_12.0							
NO BEE			6° 49' 12.1"; W114° 04' 15.7"	▼ 14	2hrs AFT	ER DI	RILLING_1							
						. 0				_	ATT	ERBE		5
SUBDIVISION/5.0 DE DEPTH	(#)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC WILIMIT	PLASTICITY INDEX	FINES CONTENT (%)
ER TRAILS	-		(SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry (10YR 5/1); no reaction to 10% HCl solution - it beaded on sample. [A-4].											
- KING/RIV	-		Drill rate from 0 to 2.5 feet =255 ft/hr. (SP) Poorly Graded SAND, traces of Mica; dry; fine- to mergrained; light brownish gray (10YR 6/2); loose; no reaction											
TH ENGINE	-		HCl solution. [A-3].		SPT	61	1-1-2 (3)			1				
ō N	-		Drill rate from 2.5 to 5 feet = 195 ft/hr.											
SOIL MECHANICS	5 -		(GP) Poorly Graded GRAVEL with Sand, traces of Mica; roto subangular; dry to damp; yellowish brown (10YR 6/2) to gray (10YR 7/1) matrices; medium dense to dense; no read 10% HCl solution. [A-1-a].	light	SPT	61	5-12-12 (24)			2				
WDOCUMENTS/LORENZEN	- - 0		Drill rate from 5 to 10 feet = 100 ft/hr.											
LORENZE	_				SPT	72	10-21-18 (39)			2				
			▼ Drill rate from 10 to 15 feet = 125 ft/hr.								-			
/21 14:12 - C:\USERS	-		(SP) Poorly Graded SAND with Gravel, traces of Mica; wet (10YR 5/3) matrix; loose; no reaction to 10% HCl solution. Gravels are rounded to subangular. [A-1-a].	, brown										
S LAB.GDT - 3/7/	5_		Groundwater table measured as dry 9/19/20.		SPT	67	2-2-2 (4)			28				
			Bottom of borehole at 16.5 feet.					I				l		
OTECH BH COLUMNS - GINT STD US LAB.GDT - 37/21 14:12 - C. USERSTODD LORENZEN SOL MECHANICS/WORTH ENGNEERINGRIVER TRAILS SUBDIVISIONS. DELIVERABLES/RIVER FRONT TRAILS PUBLICAD. A 13														

BORING NUMBER BH-07

PAGE 1 OF 1

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

CLIENT Tolleffson Construction **PROJECT NAME** Riverfront Trails PROJECT NUMBER BT2020 PROJECT LOCATION Missoula GROUND ELEVATION DATE STARTED 9/10/20 ___ COMPLETED 9/10/20 HOLE SIZE 6 inches **DRILLING CONTRACTOR** Boland Drilling **GROUND WATER LEVELS:** DRILLING METHOD Mobile B59 AT TIME OF DRILLING --- GW table was not encountered. LOGGED BY Lorenzen CHECKED BY Lorenzen AT END OF DRILLING --- GW table was not encountered. NOTES N46° 49' 12.1"; W114° 04' 15.7" AFTER DRILLING ---FINES CONTENT (%) SAMPLE TYPE NUMBER DRY UNIT WT. (pcf) MOISTURE CONTENT (%) POCKET PEN. (tsf) LIMITS GRAPHIC LOG RECOVERY (RQD) BLOW COUNTS (N VALUE) PLASTICITY INDEX DEPTH (ft) PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION (SM) TOPSOIL, Sandy Loam with Vegetation Organics; dry; gray (10YR 5/1); no reaction to 10% HCl solution - it beaded on the sample. [A-4]. Drill rate from 0 to 2.5 feet = 250 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded to subangular; dry; light yellowish brown (10YR 6/4) to light gray (10YR 7/1) matrices; medium dense; no reaction to 10% HCI solution. [A-1-a]. 5-6-8 1 (14)Drill rate from 2.5 to 5 feet = 95 ft/hr. 5-9-16 72 2 (25)Drill rate from 5 to 8 feet = 290 ft/hr. (GP) Poorly Graded GRAVEL with Sand, traces of Mica; rounded 00 to subangular; damp; pale brown (10YR 6/3) matrix; no reaction to 10% HCl solution. [A-1-a]. 5-7-10 2 (17)

Infiltration rate = 0.13 ft/min = 94 in/hr Bottom of borehole at 9.5 feet.

GEOTECH BH COLUMNS - GINT STD US LAB, GDT - 377/21 14:12 - C.USERS/TODD LORENZEN/DOCUMENTS/LORENZEN SOIL MECHANICS/WOITH ENGINEERING/RIVER TRAIL, SUBDIV/SION/S.0 DELIVERABLES/RIVERFRONT TRAIL, GPJ

BORING NUMBER BH-08 PAGE 1 OF 1

PROJECT NUMBER BIT2020	9		-	effson Construction				rfront Trails	S						
DRILLING METHOD Mobile B59 DRILLING METHOD Mobile B59 NOTES N46° 49' 12.1"; W114° 04' 15.7" THE GOOD MATERIAL DESCRIPTION MATER	ا∖ۃ				-		_			UOI 5	CIZE	C inc			
DRILLING METHOD Mobile B59 LOGGED BY Lorenzen CHECKED BY Lorenzen ATTERBERG CLIMITS ATTERBERG CLIMITS ATTERBERG CLIMITS CHECKED BY Lorenzen ATTERBERG CLIMITS	ŻΙ									HOLE	SIZE	<u> 6 inc</u>	nes		
COGED BY Lorenzen CHECKED BY Lorenzen Table Lorenzen Lorenzen Table Lorenzen Lor	₩								50 ft						
NOTES N46° 49' 12.1"; W114° 04' 15.7" 1 142hrs AFTER DRILLING 15.00 ft 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	£Ι														
MATERIAL DESCRIPTION ATTERBERG LIMITS A STAND A S	<u>ال</u> ا														
	VER/		<u> </u>									ΔΤ	ΓERΒΕ	RG	
	SUBDIVISION\5.0 DELI		GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	LIMITS	3	FINES CONTENT (%)
	TRAILS			(10YR 5/1); no reaction to 10% HCl solution - it beaded	dry; gray on the	∰ GB					2				
	RIVER	_	71.7		_										
	NG-	-		(SP) Poorly Graded SAND, traces of Mica; dry; fine- to r	nedium										
	RER			loose; no reaction to 10% HCl solution. [A-3].	K 5/3),				1			1			
	ENGI	_				SPT	50				1				
	F -	-		Drill rote from 0.5 to 5 foot 205 ft/lon				()	-			-			
	CS\W	_	6 U		rounded										
	N N N		$R \cap A$	to subangular; dry; light brownish gray (10YR 6/2) to yel	lowish				_			1			
	MEC	_		HCl solution. [A-1-a].	10 10 / 0	SPT	33				1				
	SOIL							, ,	1						
	ZEN-	-	0 C	Drill rate from 5 to 10 feet = 295 ft/hr.											
	ORE		RO 4												
	ZTS/L	_													
	OME!	-													
	NDOC	10													
	NZEN	10	1) - 1						1			1			
	-ORE	_				SPT	61				3				
GCL) Lean CLAY with Sand; wet; brown (7.5YR 4/3); soft (inferred); no reaction to 10% HCl solution; medium plastic; medium dry strength, brittle; no dilatency. [A-6(8)]. Groundwater table measured at 14.6 feet 9/19/20. GSM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.				Drill rate from 5 to 10 feet - 240 ft/hr								-			
(inferred); no reaction to 10% HCl solution; medium plastic; medium dry strength, brittle; no dilatency. [A-6(8)]. Groundwater table measured at 14.6 feet 9/19/20. SPT 78 1-1-4 (5) (SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.	RS/T(-	b	(CL) Lean CLAY with Sand; wet; brown (7.5YR 4/3); sof											
Groundwater table measured at 14.6 feet 9/19/20. SPT 78 1-1-4 (5) (SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.	2 - C:\USE	-			tic;										
Groundwater table measured at 14.6 feet 9/19/20. SPT 78 1-1-4 (5) (SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.	7/21 14:1:	· -													
SPT 78 1-1-4 (5) 33 35 20 15 (SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.)T - 3,	15		Groundwater table measured at 14.6 feet 9/19/20					-						-
(SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1); loose (inferred); no reaction with 10% HCl solution. Fines have low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.	^B.G⊑		7	<u></u>		SPT	78				33	35	20	15	85
low plasticity. Gravels are subrounded. [A-2-4]. Bottom of borehole at 16.5 feet.	USL	_		(SM) Silty SAND with Gravel, traces of Mica; wet; gray (10YR 6/1);			(5)			14				
Bottom of borehole at 16.5 feet.	STD			low plasticity. Gravels are subrounded. [A-2-4].	STIAVE										
3H COLUMNS.	GINT			Bottom of borehole at 16.5 feet.											
	ANS -														
	ÖLUN														
	ВНС														
<u> </u>	HECH														
OB COLUMN TO THE	GEO.														

BORING NUMBER BH-09 PAGE 1 OF 1

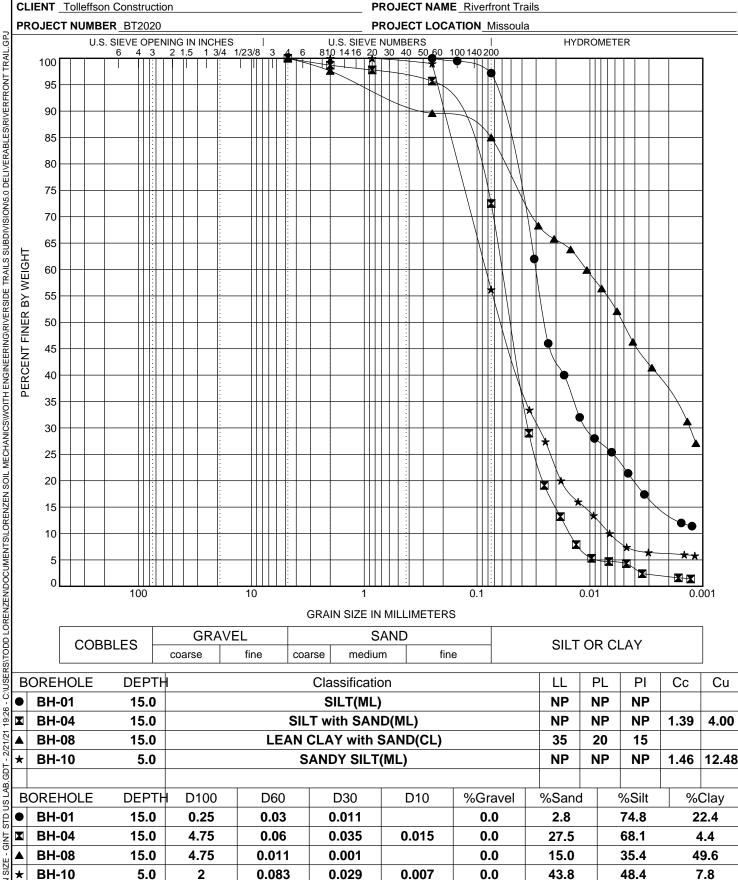
즲	CLIE	NT _To	olleffson Construct	ion			PROJEC	T NAME	Rive	front Trails	3						
AIL.C	PROJ	ECT I	NUMBER BT2020)			PROJEC	T LOCA	TION_	Missoula							
TTR	DATE	STAF	RTED 9/10/20	C	OMPLETED 9/	10/20	GROUN	D ELEVA	TION			HOLE	SIZE	_6 inc	hes		
RON	DRILI	_ING (CONTRACTOR_B	oland Drillin	ng		GROUN	D WATE	R LEV	ELS:							
ÆRF			METHOD Mobile I					TIME O	F DRIL	.LING_13.0	00 ft						
S/RI/			Y Lorenzen		HECKED BY Lo	orenzen				LING 13.0							
ABLE			46° 49' 12.1"; W11				₹			RILLING_1							G LNH
NER.			,											ΔΤΊ	ERBE	RG	
SUBDIVISION/5.0 DELI	O DEPTH (ft)	GRAPHIC LOG		MATEF	RIAL DESCRIPT	ION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC WIT	PLASTICITY NO INDEX	FINES CONTENT (%)
TH ENGINEERING\RIVER TRAILS	- 	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(10ÝR 5/1); no sample. [A-4] Drill rate from (SP) Poorly G grained; light y 10% HCl solui	o reaction to 0 to 2.5 fee raded SANI yellowish br tion. [A-3].	D, traces of Mica rown (10YR 6/4);	on - it beaded on a; dry; fine- to m ; loose; weak re	nedium eaction to	SPT	56	2-3-2 (5)			1				
SOIL MECHANICS\WOI	5 _		to subangular; matrices; med [A-1-a].	; dry; light g lium dense;	AVEL with Sand, gray (10YR 7/1) to no reaction to 1 et = 255 ft/hr.	o pale brown (1	0YR 6/3)	SPT	56	4-6-9 (15)	-		1				
OCUMENTS/LORENZEN	. –		This borehole changed wher prior to installi	was intend n the hole c ng the 4-ind	= 250 ft/hr. ed to be an infiltrollapse upon retch diameter hole a piezometer was	rieving the auge . The borehole	ers and	SPT	44	3-8-10 (18)	-		2				
21 14:12 - C:\USERS\TODD LORENZEN\C	10 -		Drill rate from (GP) Poorly G to subangular reaction to 10	raded GRA ; wet; yellov	VEL with Sand, vish brown (10Yl												
JS LAB.GDT - 3/7,	15_		▼ Groundwater	table meası	ured at 15.2 feet	9/19/20.		SPT	44	4-5-5 (10)	_		12				
GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 37/21 14:12 - C.USERSYTODD LORENZEN/DOCUMENTS/LORENZEN SOIL MECHANICS/WOITH ENGINEERING/RIVER TRAILS SUBDIVISIONIS.0 DELIVERABLES/RIVERFRONT TRAIL.GPJ		<u>6. ∽</u> .√		Bottom	of borehole at 16	3.5 feet.		_			1						

BORING NUMBER BH-10 PAGE 1 OF 1

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

GPJ	CLIE	NT _Tc	elleffson Construction	PROJEC	CT NAME	Rive	rfront Trails							
'RAIL.			NUMBER BT2020			_	Missoula							
T L			RTED_9/10/20						HOLE	SIZE	6 inc	ches		
:RFR(CONTRACTOR Boland Drilling					NA/ 4-1				. 4		
NRIVE.			METHOD _Mobile B59 Y _Lorenzen CHECKED BY _Lorenzen				_LING (LING ()							
BLES			6° 49' 12.1"; W114° 04' 15.7"		TER DRI			vv tab	ie was	i iiot e	ilcour	itereu.		
VERA			0 10 12.1 , 10 11 01 10.1				1 				ΔΤ	ΓERBE	RG	
LORENZENIDOCUMENTSILORENZEN SOIL MECHANICS\WOITH ENGINEERING\RIVER TRAILS SUBDIVISIONI5.0 DELIVERAB	(#) OEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID	PLASTIC LIMIT	S 	FINES CONTENT (%)
ER TRAILS		777	(ML) TOPSOIL, Silty Loam with Vegetation Organics; da grayish brown (10YR 4/2); no reaction to 10% HCl solution beaded on the sample. [A-4].	mp; dark on - it	∰ GB					5	_			
ERING\RIV			(ML) SILT; damp; gray (10YR 6/1) and brown (10YR 4/3 strong reaction to 10% HCl solution; slightly plastic; low of strength, powdery. [A-4].); loose; dry										
VOITH ENGINEI		-	cuongui, ponicoly. [c. 1]		SPT	61	4-2-3 (5)			7				
ICS/W	5		(ML) Sandy SILT; damp; yellowish brown (10YR 5/6); loc	ose;										
SOIL MECHAN		-	medium reaction to 10% HCl solution; non-plastic; mediustrength, brittle. [A-4(0)].	ım dry	SPT	67	2-3-4 (7)			12	NP	NP	NP	56
%LORENZEN 8			(GP) Poorly Graded GRAVEL with Sand, traces of Mica; to subangular; wet; brown (10YR 5/3) matrix; dense; stroreaction to 10% HCl solution. [A-1-a].	rounded										
COMENTS			Low percent recovery was due to gravel clast stuck in the spoon shoe.	e split	SPT	39	11-18-16 (34)			1				
ENZEN/DC			Infiltration rate = 0.20 ft/min = 144 in/hr Bottom of borehole at 9.5 feet.											
GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/7/21 14:12 - C:USERS\TODD LOR														
GEOTECH BH COLUMNS - C														

GRAIN SIZE DISTRIBUTION



ATTERBERG LIMITS' RESULTS

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

Telephone: 406-830-0633 CLIENT Tolleffson Construction PROJECT NAME Riverfront Trails MECHANICS/WOITH ENGINEERING/RIVERSIDE TRAILS SUBDIVISION/5.0 DELIVERABLES/RIVERFRONT TRAIL. PROJECT NUMBER BT2020 **PROJECT LOCATION** Missoula 60 (CL) (CH) 50 L A S T I 40 C T Y 30 ١ N D E X 20 10 CL-ML (ML)(MH) 20 40 60 80 100 LIQUID LIMIT **BOREHOLE DEPTH** LL PL PI Fines Classification ● BH-01 15.0 NP SILT(ML) NP NP 97 ATTERBERG LIMITS - GINT STD US LAB.GDT - 2/21/21 19:29 - C:\USERS\TODD LORENZEN\DOCUMENTS\LORENZEN SOIL **■** BH-04 15.0 NP NP NP 73 SILT with SAND(ML) **BH-08** 15.0 85 LEAN CLAY with SAND(CL) 35 20 15 ★ BH-10 5.0 NP NP NP 56 SANDY SILT(ML)

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu Plot this site in State Library Digital Atlas Plot this site in Google Maps View scanned well log_(2/13/2019 1:46:14 PM)

Site Name: MISSOULA COUNTY PUBLIC SCHOOLS -

JEANETTE RANKIN SCHOOL

GWIC Id: 300055

DNRC Water Right: 30121478

Section 1: Well Owner(s)

1) MISSOULA COUNTY PUBLIC SCHOOLS - JEANETTE RANKIN Air Test *

SCHOOL (MAIL) 915 SOUTH AVE

MISSOULA MT 59801 [09/25/2018]

2) MISSOULA COUNTY PUBLIC SCHOOLS - JEANETTE RANKIN Recovery water level 19 feet.

SCHOOL (WELL) 5150 BIGFORK RD

MISSOULA MT 59803 [09/25/2018]

Section 2: Location

Township Range Section **Quarter Sections** 12N 20W 11 NE1/4 Gencode

County **MISSOULA** 04209211101150000

Latitude Geomethod Datum Longitude 46.81735 -114.07065 **NAV-GPS** NAD27

Ground Surface Altitude Ground Surface Method Datum Date

9/25/2018 Unassigned 3138

Addition Block Lot

1

Section 3: Proposed Use of Water

IRRIGATION (1)

Section 4: Type of Work

Drilling Method: ROTARY Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Tuesday, September 25, 2018

Section 6: Well Construction Details

Borehole dimensions

From To Diameter 0 120

Casing

From	То		 Pressure Rating	Joint	Туре
-2	118	6		WELDED	STEEL

Completion (Perf/Screen)

From	То			Size of Openings	Description
100	110	6	240	,	HOLTE PERFORATOR SLOTS

Annular Space (Seal/Grout/Packer)

			Cont.
From	То	Description	Fed?
0	45	BENTONITE	Υ

Section 7: Well Test Data

Total Depth: 120 Static Water Level: 19 Water Temperature:

100 gpm with drill stem set at 110 feet for 2 hours.

Time of recovery <u>0.02</u> hours. Pumping water level _ feet.

* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casina.

Section 8: Remarks

Section 9: Well Log **Geologic Source**

From	То	Description
0	4	SOIL, AND SILTY SAND
4	15	SILTY SAND AND GRAVEL
15		RED AND BROWN MOIST CLAY
23	70	SAND WITH WATER, TAN CLAY, SEAMS, VERY LITTLE SEAMS OF PEA GRAVEL
70	92	SAND AND GRAVEL WITH WATER, VERY SANDY LAYERS
92	94	BROWN CLAY
94	114	GRAVEL WITH WATER
114	120	RED ROCK
	·	

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: JON NORCROSS

Company: CAMP WELL DRILLING AND PUMP SERVICE

License No: WWC-7 Date Completed: 9/25/2018

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu Plot this site in State Library Digital Atlas Plot this site in Google Maps View scanned well log_(1/7/2019 10:27:39 AM)

NOTICE >>

This well has been marked as ABANDONED in the GWIC database.

<< NOTICE

Site Name: MISSOULA COUNTY PUBLIC SCHOOLS -

JEANETTE RANKIN SCHOOL

GWIC Id: 299902

Section 1: Well Owner(s)

1) MISSOULA COUNTY PUBLIC SCHOOLS - JEANETTE RANKIN

SCHOOL (MAIL) 915 SOUTH AVENUE

MISSOULA MT 59801 [09/05/2018]

2) MISSOULA COUNTY PUBLIC SCHOOLS - JEANETTE RANKIN

SCHOOL (WELL) 5150 BIGFORK ROAD

MISSOULA MT 59803 [09/05/2018]

Section 7: Well Test Data

Total Depth: 178 Static Water Level: 35 Water Temperature:

Air Test *

gpm with drill stem set at 105 feet for 2 hours.

Time of recovery <u>0.02</u> hours. Recovery water level 19 feet. Pumping water level _ feet.

Section 2: Location

Township Quarter Sections Range Section 12N 20W 11 NF1/4 County Geocode **MISSOULA** 04209211101150000

Latitude Longitude Geomethod Datum 46.817016666667 -114.069316666667 **NAV-GPS** NAD27

Datum Date **Ground Surface Altitude Ground Surface Method**

Block

* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.

Section 8: Remarks

NO USABLE WATER ENCOUNTERED - (9/5/18); WELL WAS ABANDONED BY JON NORCROSS WWC/7 OF CAMP WELL DRILLING AND PUMP. WELL WAS FILLED WITH BENTONITE. - (10/10/18)

Section 3: Proposed Use of Water IRRIGATION (1)

Addition

Section 4: Type of Work

Drilling Method: ROTARY Status: ABANDONED

Section 5: Well Completion Date

Date well completed: Wednesday, September 5, 2018

Section 6: Well Construction Details

Rorehole dimensions

Borenole dimensions					
From	То	Diameter			
0	180	6			

Casing

			Wall	Pressure		
From	То	Diameter	Thickness	Rating	Joint	Туре
-2	178	6			WELDED	STEEL

Completion (Perf/Screen)

				Size of	
From	То	Diameter	Openings	Openings	Description
99	101	6	104	1-1/4 X 1/4	HOLTE PERFORATOR SLOTS

Annular Space (Seal/Grout/Packer)

	From	То		Cont. Fed?
Ì	0	45	BENTONITE SURFACE SEAL	Υ

Section 9: Well Log **Geologic Source**

Unassigned

Lot

From	То	Description
(3	FILL
3	35	SAND AND GRAVEL
35	67	SAND WITH WATER, CLAY SEAMS
67	99	BROWN CLAY, CLAY AND GRAVEL, FINE SAND LAYERS WITH WATER
99	101	FINE SAND AND SOME GRAVEL WITH WATER
101	105	BROWN CLAY
105	180	HARD RED AND GRAY CLAY, FRACTURES RED AND GRAY ROCK LAYERS
, 📖		

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: JON NORCROSS

Company: CAMP WELL DRILLING & PUMP SUPPLY

License No: WWC-7 Date Completed: 9/5/2018

DAILY FIELD REPORT



Service Date 1/28 - 1/29/2021

Report Date 2/1/2021 Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics Project Riverside Trails

Todd Lorenzen Missoula, Montana

Missoula, Montana Office Project No.: HCE: 21-8008 Client: NA

Work Performed by Contractor

Soil borings for soil classification, piezometer installation, and infiltration testing.

Comments

All piezometer readings were collected using a graduated water level. Infiltration testing was performed using a Hudson float valve attached to a graduated hose and a submersible pump in a 150 gallon reservoir. The float valve was placed one foot from the bottom of the 4" pipe. One foot of water was maintained for one hour. The float valve was raised to six feet from the bottom of the pipe and filled until the valve shut off. The valve was immediately lowered two feet (four feet from the bottom of the pipe) and a timer was started. The timer was stopped when the valve activated. This is the time for two feet of water drop in the pipe. Process was repeated until the difference between the last four readings did not vary by more than 10%.

Arrived at 11:30 AM on 1/28/2021. Piezometer in BH-6 is broken at the surface. Ice and snow have plugged pipe. Will return and attempt re-test. Collected readings for piezometers BH-8 and BH-9. Conducted infiltration testing on BH-7.

Returned 1/29/2021 at 8:00 AM. Cleaned BH-6 piezometer with wire. Collected piezometer readings for BH-2, BH-4, and BH-6. Conducted infiltration testing on BH-3, BH-5, and BH-10.

See included reports for piezometer readings and infiltration rates.

PIEZOMETER TEST REPORT



Service Date 1/28 - 1/29/2021

Report Date 2/1/2021 Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics Project Riverside Trails

Todd Lorenzen Missoula, Montana

Missoula, Montana Office Project No.: HCE: 21-8008 Client: NA

Summary

General Location: Piezometer readings (BH-2, BH-4, BH-6, BH-8, BH-9)

		Piezometer Re	ading	
ВН	Date	Time	Reading	Water Level
2	1/29	1:15 PM	17'-2"	15'-0"
4	1/29	3:45 PM	15'-10"	13'-10"
6	1/29	11:30 AM	14'-3"	14'-3"
8	1/28	3:15 PM	17'-0"	15'-0"
9	1/28	3:30 PM	17'-2"	15'-0"

IINFILTRATION TEST REPORT

MT DEQ-4, Appendix 6-F



Service Date 1/29/2021 **Report Date** 2/1/2021

Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics

Project Riverside Trails

Todd Lorenzen

Missoula, Montana

Missoula, Montana Office

Project No.: HCE: 21-8008 Client: NA

Summary

General Location: BH-3

			Testing Tim	e Intervals -	BH-3		
Water Fill		Began		End		Depth to Bottom of Pipe	
		Date	Time	Date	Time		
1 Hour Soak		1/29	1:05 PM	1/29	2:05 PM	1'	
Fill		1/29	2:05 PM	1/29	2:10 PM	6'	
2 Foot Drop		1/29	2:10 PM	1/29	3:00 PM	4'	
- ·			Infiltratio	n Testing - B	H-3		
Test #	Drop Time (min)		Drop Time (dec)		Water	Infiltration er Drop Rate (ft/min)	
1	1:37		1.62		2'		1.23
2	2:18		2.30		2'		0.87
3	2:37		2.62		2'		0.76
4	3:07		3.12		2'		0.64
5	2:51		2.85		2'		0.70
6	2:52		2.87		2'		0.70
7	3:35		3.58		2'		0.56
8	4:06		4.01		2'		0.50*
9	4:15		4.25		2'		0.47*
10	4:23		4.38		2'		0.47*
11	4:19		4.23		2'		0.46*

* <10% Difference

Infiltration Rate in Feet per Minute:

0.48 ft/min

IINFILTRATION TEST REPORT

MT DEQ-4, Appendix 6-F



Service Date 1/29/2021 **Report Date** 2/1/2021

Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics

Project Riverside Trails

Todd Lorenzen

Missoula, Montana

Missoula, Montana Office

Project No.: HCE: 21-8008 Client: NA

Summary

General Location: BH-5

1			Testing Tim	e Intervals -	BH-5		
Water Fill		Began		End		Depth to Bottom of Pipe	
		Date	Time	Date	Time		
1 Hour Soak		1/29	3:10 PM	1/29	4:10 PM	1"	
Fill		1/29	4:10 PM	1/29	4:12 PM	6'	
2 Foo	t Drop	1/29	4:12 PM	1/29	5:15 PM	4'	
			Infiltratio	n Testing - B	H-5		
Test #	Drop Ti	me (min)	Drop Tin	ne (dec)	Wate	r Drop	Infiltration Rate (ft/min)
1	4	:11	4.1	L8	2'		0.48
2	3	:21	3.3	35	2) t	0.60
3	3	:40	3.6	57	2	21	0.54
4	3	:51	3.8	35	2	2'	0.52
5	4	:05	4.0	08	2'		0.50
6	4:15		4.25		2'		0.48
7	5:17		5.28		2'		0.38
8	8 6:08		6.13		2'		0.33*
9	6	:07	6,1	12	2'		0.33*
10	6:10		6.17		2	0.32*	
11	1 6:00		6.00		2'		0.33*

* <10% Difference

Infiltration Rate in Feet per Minute:

0.33 ft/min

IINFILTRATION TEST REPORT

MT DEQ-4, Appendix 6-F



Service Date 1/28/2021 **Report Date** 2/1/2021

Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics

Project Riverside Trails

Todd Lorenzen

Missoula, Montana

Missoula, Montana Office

Project No.: HCE: 21-8008 Client: NA

Summary

General Location: BH-7

			Testing Tim	e Intervals -	BH-7		
Water Fill		Began		End		Depth to Bottom of Pipe	
		Date	Time	Date	Time		
1 Hour Soak 1/28		11:45 AM	1/28	12:45 PM		1"	
F	Fill 1/28		12:45 PM	1/28	12:46 PM	6'	
2 Foo	t Drop	1/28	12:46 PM	1/28	3:00 PM	4'	
			Infiltration	n Testing - B	3H-7		
Test#	Drop Ti	me (min)	Drop Tim	ne (dec)	Water	r Drop	Infiltration Rate (ft/min)
1	4	:56	4.9	2	2	ļ!	0.41
2	5	:02	5.0	3	2		0.40
3	5	:56	5.9	2	2	2	0.34
4	5	:39	5.6	5	2	1	0.35
5	10	0:43	10.	72	2	1	0.19
6	11:37		11.61		2'		0.17
7	13:24		13.40		2'		0.15
8	15:50		15.83		2'		0.13*
9	1.5	5:51	15.8	35	2	K.	0.13*
10	16	5:08	16.13		2	Y	0.12*
11	16	5:04	16.0	07	2	1	0.12*

* <10% Difference

Infiltration Rate in Feet per Minute:

0.13 ft/min

IINFILTRATION TEST REPORT

MT DEQ-4, Appendix 6-F



Service Date 1/29/2021 **Report Date** 2/1/2021

Observed By J. McCune - HCE

Client Lorenzen Soil Mechanics

Project Riverside Trails

Todd Lorenzen

Missoula, Montana

Missoula, Montana Office

Project No.: HCE: 21-8008 Client: NA

Summary

General Location: BH-10

			Testing Time	e Intervals -	BH-10		
Water Fill		Began		End		Depth to Bottom of Pipe	
		Date	Time	Date	Time		
1 Hou	ır Soak	1/29	8:35 AM	1/29	9:35 AM		1'
Fill		1/29	9:35 AM	1/29	9:42 AM	6'	
2 Foo	t Drop	1/29	9:42 AM	1/29	11:25 AM	4'	
			Infiltration	Testing - B	H-10		
Test#	Drop Ti	me (min)	Drop Tin	ne (dec)	Water Drop		Infiltration Rate (ft/min)
1	4	:07	4.1	.2	2'		0.49
2	.5	:45	5.7	5	2		0.35
3	6	:48	6.8	30	2		0.29
4	7	:17	7.2	.8	2'		0.27
5	8	:26	8.4	13	2'		0.24
6	9	:01	9.0)2	2'		0.22
7	9	:31	9.5	52	2'		0.21*
8	9	:54	9.9	00	2'		0.20*
9	10	0:04	10.	07	2'		0.20*
10	10:24 10.4		40	2	O.	0.19*	

* <10% Difference

Infiltration Rate in Feet per Minute:

0.20 ft/min



Address:

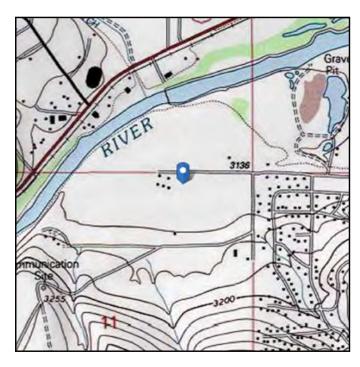
No Address at This Location

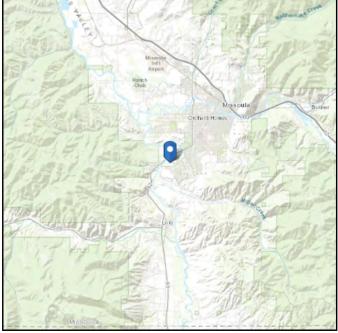
ASCE 7 Hazards Report

Standard: ASCE/SEI 7-16 Elevation: 3140.21 ft (NAVD 88)

Risk Category: II Latitude: 46.81931
Soil Class: C - Very Dense Longitude: -114.071277

Soil and Soft Rock







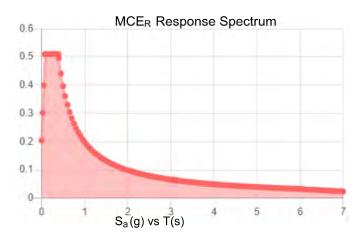
Seismic

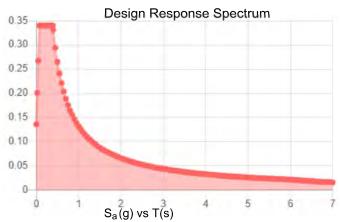
Site Soil Class: C - Very Dense Soil and Soft Rock

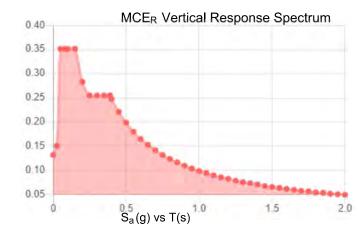
Results:

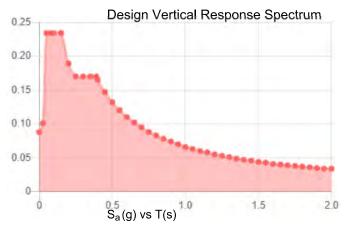
S _s :	0.392	S _{D1} :	0.132
S ₁ :	0.132	T_L :	6
F _a :	1.3	PGA :	0.173
F _v :	1.5	PGA _M :	0.212
S _{MS} :	0.51	F _{PGA} :	1.227
S _{M1} :	0.199	l _e :	1
S _{DS} :	0.34	C _v :	0.861

Seismic Design Category C









Data Accessed: Date Source:

Sun Feb 21 2021

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

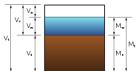


The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

Lorenzen Soil Mechanics, Inc. V.



APPENDIX B. PHOTOGRAPHS



Description: BH-01 Location. View is to the southwest.



Description: BH-01 Location. View is to the west.

Project: Riverfront Trails



Description: BH-01 Split Spoon (SS) sample from the 2.5- to 4-foot depth.



Description: BH-01 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-01 auger cuttings from above 8 feet.



Description: BH-01 SS sample from the 8- to 9.5-foot depth.

Project: Riverfront Trails



Description: BH-01 Auger cuttings from above 10 feet.



Description: BH-01 SS sample from the 10- to 11.5-foot depth.

Project: Riverfront Trails



Description: BH-01 SS sample from the 15- to 16.5-foot depth.



Description: BH-01 SS sample from the 20- foot depth – wash sample from sand heave.

Lorenzen Soil Mechanics, Inc.

v. v. v. M. M.



Description: BH-02 Location. View is to the north from BH-01 stake location.



Description: BH-02 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

V. V. M. M.



Description: BH-02 SS sample from the 2.5- to 4-foot depth.



Description: BH-02 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-02 SS sample from the 10- to 11.5-foot depth.



Description: BH-02 SS sample from the 15- to 16.5-foot depth.

Project: Riverfront Trails



Description: BH-03 Location. View is to the east from the BH-02 Piezometer.



Description: BH-03 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

V₁ V₂ M_m M_m M_s



Description: BH-03 Location. View is to the west.



Description: BH-03 SS sample from the 2.5- to 4-foot depth.

Project: Riverfront Trails



Description: BH-03 SS sample from the 5- to 6.5-foot depth.



Description: BH-03 SS sample from the 8- to 9.5-foot depth.

Project: Riverfront Trails



Description: BH-03 Location of infiltrometer test pipe. View is to the east towards BH-04 location.



Description: BH-04 Location. View is to the southeast.

Lorenzen Soil Mechanics, Inc.

V. V. M. M.



Description: BH-04 SS sample from the 2.5- to 4-foot depth.



Description: BH-04 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-04 SS sample from the 10- to 11.5-foot depth. (depth is not noted on the label)



Description: BH-04 Auger cuttings from above 15 feet.

Lorenzen Soil Mechanics, Inc.

V. V. M. M. M.



Description: BH-04 SS sample from the 15- to 16.5-foot depth. Pocket penetrometer value was 0.25 tsf.



Description: BH-04 Piezometer location. View is to the south toward BH-05.

Lorenzen Soil Mechanics, Inc.

V. V. V. M. M.



Description: BH-05 SS sample from the 2.5- to 4-foot depth.



Description: BH-05 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-05 SS sample from the 8- to 9.5-foot depth.



Description: TP-05 Infiltrometer pipe location. View is to the west.

Project: Riverfront Trails



Description: TP-05 Infiltrometer pipe location. View is to the east.



Description: TP-05 Infiltrometer pipe location. View is to the south.

Project: Riverfront Trails



Description: BH-06 Location. View is to the southwest.



Description: BH-06 Location. View is o the northeast.

Lorenzen Soil Mechanics, Inc.

v. v. v. M.



Description: BH-06 SS sample from the 2.5- to 4-foot depth.



Description: BH-06 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-06 SS sample from the 10- to 11.5-foot depth.



Description: BH-06 SS sample from the 15- to 16.5-foot depth.

Project: Riverfront Trails



Description: BH-06 Piezometer installation.



Description: BH-07 Location. View is to the southwest.

Lorenzen Soil Mechanics, Inc.

v. v. v. M. M.



Description: BH-07 Location. View is to the northeast.



Description: BH-07 SS sample from the 2.5- to 4-foot depth.

Project: Riverfront Trails



Description: BH-07 SS sample from the 5- to 6.5-foot depth.



Description: BH-07 SS sample from the 8- to 9.5-foot depth.

Project: Riverfront Trails



Description: BH-08 Location. View is to the south.



Description: BH-08 Location. View is to the northeast.

Lorenzen Soil Mechanics, Inc.

V. V. M. M. M.



Description: BH-08 SS sample from the 2.5- to 4-foot depth.



Description: BH-08 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-08 SS sample from the 10- to 11.5-foot depth.



Description: BH-08 SS sample from the 15- to 16.5-foot depth.

Project: Riverfront Trails



Description: BH-08 Piezometer location. View is to the north.



Description: BH-09 Location. View is to the south.

Lorenzen Soil Mechanics, Inc.

V. V. M.



Description: BH-09 Location. View is to the west.



Description: BH-09 Location. View is to the northeast.

Lorenzen Soil Mechanics, Inc.



Description: BH-09 SS sample from the 2.5- to 4-foot depth.



Description: BH-09 SS sample from the 5- to 6.5-foot depth.

Project: Riverfront Trails



Description: BH-09 SS sample from the 8- to 9.5-foot depth.



Description: BH-09 SS sample from the 15- to 16.5-foot depth.

Project: Riverfront Trails



Description: BH-10 Location. View is to the west.



Description: BH-10 Location. View is to the south.

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V. V. M. M.



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



Description: BH-10 SS sample from the 2.5- to 4-foot depth.

Project: Riverfront Trails



Description: BH-10 SS sample from the 5- to 6.5-foot depth.



Description: BH-10 SS sample from the 8- to 9.5-foot depth.

Project: Riverfront Trails



Description: BH-01 Moisture content samples prior to being placed into the drying oven.



Description: BH-01 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails





Description: BH-02 Moisture content samples prior to being placed into the drying oven.



Description: BH-02 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails



Description: BH-03 Moisture content samples prior to being placed into the drying oven.



Description: BH-03 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails





Description: BH-04 Moisture content samples prior to being placed into the drying oven.



Description: BH-04 Moisture content samples after being taken out of the drying oven.

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Description: BH-05 Moisture content samples prior to being placed into the drying oven.



Description: BH-05 Moisture content samples after being taken out of the drying oven.

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Description: BH-06 Moisture content samples prior to being placed into the drying oven.



Description: BH-06 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails





Description: BH-07 Moisture content samples prior to being placed into the drying oven.



Description: BH-07 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails



Description: BH-08 Moisture content samples prior to being placed into the drying oven.



Description: BH-08 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails



Description: BH-09 Moisture content samples prior to being placed into the drying oven.



Description: BH-09 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails



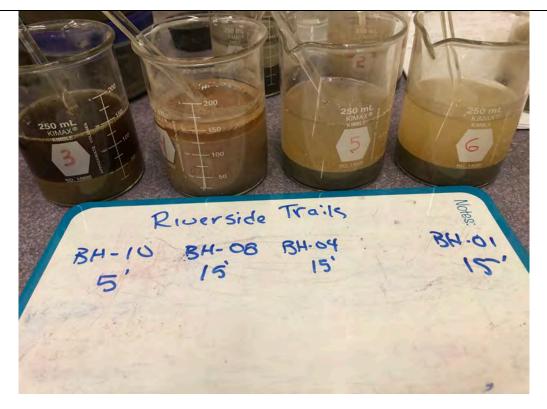


Description: BH-10 Moisture content samples prior to being placed into the drying oven.

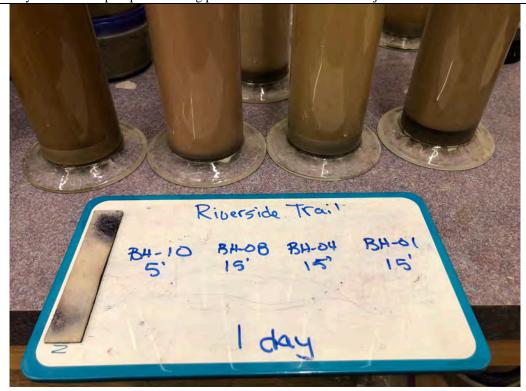


Description: BH-10 Moisture content samples after being taken out of the drying oven.

Project: Riverfront Trails



Description: Hydrometer samples prior to being placed into their sedimentation jars.



Description: Hydrometer samples after 1 day in their sedimentation jars.

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