

**RIMROCK
ENGINEERING, INC.**

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

BOC Property
6014 South Billings Boulevard
Billings, Montana

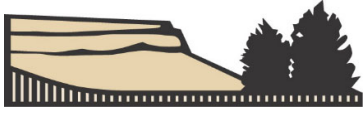
October 30, 2020
Project No. G20138

Prepared for:

City of Billings Facilities Division
4848 Midland Road
Billings, Montana 59101

Prepared by:

Rimrock Engineering, Inc.
5440 Holiday Avenue
Billings, Montana 59101



**RIMROCK
ENGINEERING, INC.**

5440 Holiday Avenue · Billings, Montana 59101 · Phone: 406.294.8400 · www.rimrock.biz

October 30, 2020

Ms. Jessica Iverson
City of Billings Facilities Division
4848 Midland Road
Billings, Montana 59101

Re: Preliminary Geotechnical Engineering Report
BOC Property
6014 South Billings Boulevard
Billings, Montana

Dear Ms. Iverson:

Rimrock Engineering, Inc. has completed the preliminary geotechnical engineering services for the referenced project. The attached report presents the results of our findings. Our work consisted of subsurface exploration, laboratory testing, engineering analyses, and preparation of this report.

We appreciate this opportunity to be of service to you and are prepared to provide design level geotechnical engineering and construction materials testing services during the construction phase of the project. If you have any questions regarding this report or need additional information or services, please contact us.

Sincerely,
RIMROCK ENGINEERING, INC.



Matt Geering, P.E.
Principal/Vice President

Wade Reynolds
Principal/President

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- Appendix B Laboratory Test Results

GEOTECHNICAL ENGINEERING REPORT

BOC Property
6014 South Billings Boulevard
Billings, Montana

1.0 INTRODUCTION AND SCOPE

1.1 Project Description

We understand the City of Billings is considering purchasing the parcel of land at 6014 South Billings Boulevard in Billings, Montana. Future buildings and layout are unknown at this time. Preliminarily, single story PEMB storage/workshop/garage type buildings and 2 story office buildings are being considered at this time.

1.2 Purpose and Scope of Work

The purpose of these studies will be to perform a limited geotechnical investigation and provide preliminary geotechnical information for due diligence considerations and to provide information, opinions, and geotechnical engineering recommendations relative to:

- General soil and groundwater conditions
- Possible foundation alternatives and limitations

Our scope of services consisted of background review, site reconnaissance, field exploration, laboratory testing, engineering analyses, and preparation of this report.

2.0 INVESTIGATION

2.1 Field Exploration

The subsurface exploration consisted of drilling three (3) boring on October 15, 2020 to approximately 15 feet below existing grades. The borings were drilled using our truck mounted drill rig equipped with hollow stem and solid flight augers. Groundwater levels were measured during drilling operations, if encountered. Upon completion of drilling and/or groundwater measurements, the borings were backfilled with drill cuttings and compacted with the equipment at hand.

Logs of the borings along with a Vicinity/Site Map are included in Appendix A. The borings were located in the field by Rimrock Engineering based on a site plan provided. Ground surface elevations were set at 100 for purposes of this investigation. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

Rimrock Engineering personnel logged the soil conditions encountered in the borings. At selected intervals, samples of the subsurface materials were taken by driving split-spoon samplers, pushing Shelby tube samplers, and collecting auger cuttings. Penetration resistance measurements were obtained by driving the samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the relative density, or consistency, of the materials encountered. The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification.

2.2 Laboratory Testing

The purpose of the laboratory testing is to assess the physical and engineering properties of the soil samples collected in the field to be used in our geotechnical evaluations and analyses. Laboratory testing was performed on selected soil samples to assess the following:

- Visual classification (USCS)
- Atterberg limits
- Moisture content
- Sieve analysis

The soil descriptions presented on the boring log are in accordance with the Unified Soil Classification System (USCS) and Key. Individual laboratory test results can be found in Appendix B at the end of this report.

3.0 SITE & SUBSURFACE CONDITIONS

3.1 Site Conditions

The site consists of undeveloped agricultural property located between South Billings Boulevard and Songbird Drive in Billings, Montana. The site consists of tilled topsoil. An irrigation ditch runs through the property to the east. The site is relatively flat with slight drainage to the east.

3.2 Subsurface Soil Conditions

The subsurface profile generally consists of soft to stiff lean clay soils overlying dense poorly graded gravels. Silty sand lenses are present as well. The depth to the gravel stratum generally decreases from west to east. Gravel soils were encountered in Borings B-2 and B-3 at depths of about 12 and 8.5, respectively. For a more detailed description of the subsurface conditions, please refer to the logs provided in Appendix A.

3.3 Groundwater Conditions

The borings were observed while drilling and after completion for the presence and level of groundwater. Groundwater was encountered at approximately 16 feet while drilling or for the short duration the borings were allowed to remain open. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other

locations. Groundwater can be expected to fluctuate with varying seasonal, weather and irrigation conditions. Evaluation of the factors that affect groundwater fluctuations is beyond the scope of this report.

3.4 Laboratory Test Results

The site soils were tested for grain size distribution (sieve analysis) and Atterberg Limits. Atterberg limits are a basic measure of the critical water contents of a fine-grained soils. The fine grained soils encountered in the borings generally have low to medium plasticity. Results are summarized below:

Location	Depth (ft)	USCS	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Gravel (%)	Sand (%)	Clay/Silt (%)
B-1	5.0	CL	25	17	8	0.0	35.7	64.3
B-2	7.5	SM	NP	NP	NP	0.0	62.2	37.8
B-3	5.0	CL	37	24	13	0.1	14.5	85.4

4.0 PRELIMINARY FINDINGS AND RECOMMENDATIONS

Excavations across the site will generally encounter soft to stiff, low to medium plasticity lean clay soils. Loose to very loose silty sand soils may be encountered as well. Depending on excavation depths, groundwater and dense gravels may be encountered. It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment such as tractor mounted backhoes and tracked excavators.

As previously stated, lean clay soils were encountered at or near anticipated footing and slab elevations across the site. The site clay soils are expected to be highly compressible. Due to these conditions, deep foundations such as helical piers extending to more competent soils or rammed aggregate piers are potential options for structures on this site.

Another common foundation alternative based on the conditions described above is to utilize shallow spread footing foundations bearing on a zone of geotextile reinforced structural fill. Depth of structural fill varies with anticipated structural loading and subsurface conditions. An allowable bearing capacity for foundations bearing on structural fill generally ranges from 1,500 to 3,500 psf, depending on site specific subsurface conditions, foundation loading, and thickness of the structural fill zone. Regardless of the subsurface conditions, good surface drainage is important and should be maintained throughout the life of the structures.

It is anticipated that pavement subgrade soils will consist of clay soils which are typically considered poor materials for pavement support. Depending on anticipated traffic loads and subgrade strength parameters, subgrade stabilization may be required for pavement construction at the site.

A site specific design level geotechnical investigation should be performed once specific project design information has been established.

5.0 LIMITATIONS

Recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The study was performed using a mutually agreed upon scope of work. It is our opinion that this study was a cost-effective method to evaluate the subject site and evaluate some of the potential geotechnical concerns. More detailed, focused, and/or thorough investigations can be conducted. Further studies will tend to increase the level of assurance; however, such efforts will result in increased costs. If the Client wishes to reduce the uncertainties beyond the level associated with this study, Rimrock Engineering should be contacted for additional consultation.

The soils data used in the preparation of this report were obtained from borings made for this investigation. It is possible that variations in soils exist between the points explored. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at this site which is different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to our recommendations. In addition, if the scope of the proposed project changes, our firm should be notified. This report has been prepared for design purposes for specific application to this project in accordance with the generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors including advances in man's understanding of applied science may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 36 months from its issue. Rimrock Engineering should be notified if the project is delayed by more than 24 months from the date of this report so that a review of site conditions can be made, and recommendations revised if appropriate.

It is the Client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk. Any party other than the Client who wishes to use this report shall notify Rimrock Engineering of such intended use. Based on the intended use of the report, Rimrock Engineering may require that additional work be performed and that an updated report be issued. Non-

compliance with any of these requirements by the Client or anyone else will release Rimrock Engineering from any liability resulting from the use of this report by any unauthorized party.

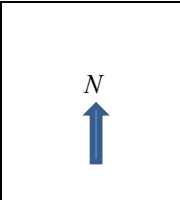
APPENDIX A

Field Exploration




Rimrock Engineering, Inc.
 5440 Holiday Avenue
 Billings, MT 59101 Tel. (406) 294-8400
PROJECT NO. G20138

VICINITY/SITE MAP
BOC PROPERTY
South Billings Boulevard
Billings, Montana





Rimrock Engineering, Inc.

CLIENT City of Billings
PROJECT NUMBER G20138
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
DRILLING CONTRACTOR Rimrock Engineering, Inc.
DRILLING METHOD Hollow Stem Auger
LOGGED BY W.R. **CHECKED BY** M.G.
NOTES West Boring

PROJECT NAME BOC Property
PROJECT LOCATION South Billings Boulevard
GROUND ELEVATION 100 ft **HOLE SIZE** 5 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING --
AT END OF DRILLING --
AFTER DRILLING --

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL										
5		(CL) SANDY LEAN CLAY Brown, soft to stiff, low to medium plasticity, fine sand, silty sand lenses.	SPT	100	4-3-4 (7)			15	25	17	8	64
10												
15												

Bottom of borehole at 15.0 feet.

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Rimrock Engineering, Inc.

CLIENT City of Billings
PROJECT NUMBER G20138
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
DRILLING CONTRACTOR Rimrock Engineering, Inc.
DRILLING METHOD Hollow Stem Auger
LOGGED BY W.R. **CHECKED BY** M.G.
NOTES Middle Boring

PROJECT NAME BOC Property
PROJECT LOCATION South Billings Boulevard
GROUND ELEVATION 100 ft **HOLE SIZE** 5 inches
GROUND WATER LEVELS:
 ∇ **AT TIME OF DRILLING** 16.00 ft / Elev 84.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL										
		(CL) SANDY LEAN CLAY Brown, soft to stiff, low to medium plasticity, fine sand.	SPT	100	2-1-1 (2)			21				
5		(SM) SILTY SAND Brown, loose to very loose, fine sand.	SPT	100	2-3-5 (8)			25				
		(GP-GM) POORLY GRADED GRAVEL with SILT and SAND Gray/brown, dense, subrounded.	SPT	100	3-2-3 (5)			10	NP	NP	NP	38
10			SPT	100	1-2-1 (3)			17				
15			SPT	100	19-18-21 (39)			5				

Bottom of borehole at 16.5 feet.



Rimrock Engineering, Inc.

CLIENT City of Billings
PROJECT NUMBER G20138
DATE STARTED 10/15/20 **COMPLETED** 10/15/20
DRILLING CONTRACTOR Rimrock Engineering, Inc.
DRILLING METHOD Hollow Stem Auger
LOGGED BY W.R. **CHECKED BY** M.G.
NOTES East Boring

PROJECT NAME BOC Property
PROJECT LOCATION South Billings Boulevard
GROUND ELEVATION 100 ft **HOLE SIZE** 5 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING --
AT END OF DRILLING --
AFTER DRILLING --

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL										
		(CL) LEAN CLAY Brown, stiff, medium plasticity.										
5			SPT	100	4-4-8 (12)			20	37	24	13	85
		(GP-GM) POORLY GRADED GRAVEL with SILT and SAND Gray/brown, dense, subrounded.										
10												
15												

Bottom of borehole at 15.0 feet.

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KEY TO SYMBOLS



Rimrock Engineering, Inc.

CLIENT City of Billings

PROJECT NAME BOC Property

PROJECT NUMBER G20138

PROJECT LOCATION South Billings Boulevard

LITHOLOGIC SYMBOLS (Unified Soil Classification System)



CL: USCS Low Plasticity Clay



CLS: USCS Low Plasticity Sandy Clay



GP-GM: USCS Poorly-graded Gravel with Silt



SM: USCS Silty Sand



TOPSOIL: Topsoil

SAMPLER SYMBOLS



Standard Penetration Test

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▽ Water Level After 24 Hours, or as Shown

APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION



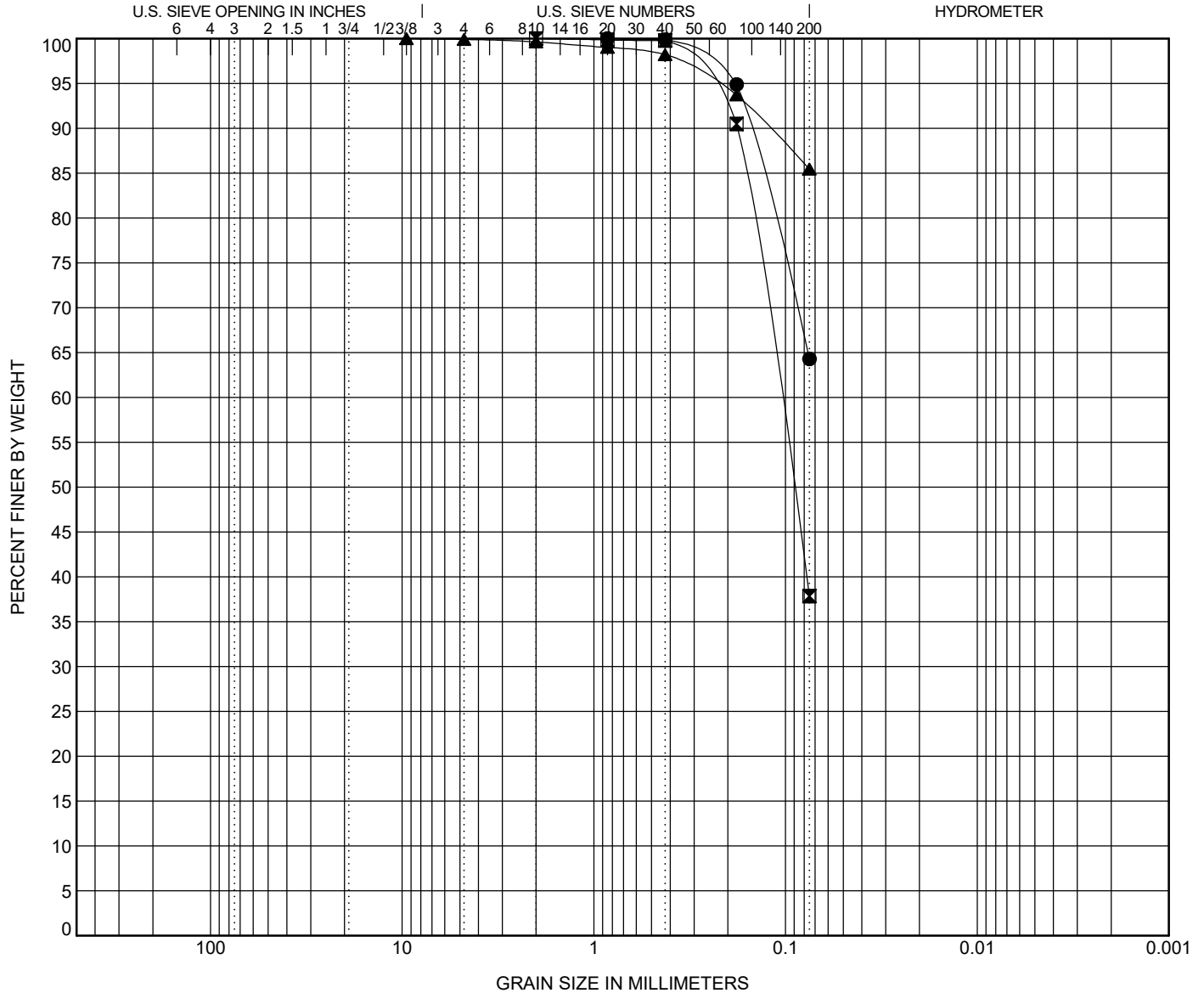
Rimrock Engineering, Inc.

CLIENT City of Billings

PROJECT NAME BOC Property

PROJECT NUMBER G20138

PROJECT LOCATION South Billings Boulevard



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● B-1	5.0	SANDY LEAN CLAY(CL)	25	17	8		
☒ B-2	7.5	SILTY SAND(SM)	NP	NP	NP		
▲ B-3	5.0	LEAN CLAY(CL)	37	24	13		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	5.0	0.85				0.0	35.7		64.3
☒ B-2	7.5	2	0.108			0.0	62.2		37.8
▲ B-3	5.0	9.5				0.1	14.5		85.4

GRAIN SIZE - GINT STD US LAB.GDT - 10/30/20 10:06 - G:\PROJECTS\2020\G20138.GPJ

