

SECTION 6 GEOTECHNICAL SITE CHARACTERIZATION

6.1 Introduction.

This Section does not apply to the construction of single family homes or duplexes unless the project's stormwater design includes an infiltration system and the project creates greater than 5,000 square feet of new impervious area. This Section outlines the minimum requirements for a geotechnical site characterization (GSC), which is used in developing recommendations for stormwater disposal and determining the feasibility of constructing sub-level structures in potentially high groundwater areas. A qualified geotechnical engineer (a professional engineer currently licensed in the State of Montana with geotechnical engineering as a specialty) is required to perform the GSC. Hydrogeologists, engineering geologists, and civil engineers may prepare sections of the geotechnical site characterization study, excluding structural, and foundation design.

The following geotechnical studies, if required, can be performed at the same time as the GSC:

- Geohazard analysis;
- Pavement subgrade evaluation;
- Down-gradient analysis;
- Embankment recommendations for proposed disposal facilities that would impound stormwater; and
- Recommendations for all cut and fill slopes.

Contact the City Engineer for specific requirements with regard to geohazardous areas and road surfacing. The requirements of this Section are in addition to any field or laboratory testing that may be required, or recommended by the project engineer, with regard to footings, foundations, utility work, etc.

In known drainage problem areas, the geotechnical engineer may make recommendations on the feasibility of sub-level structures based on the information available from the initial site investigation.

6.2 Applicability.

The scope and geographic extent of the investigation may vary depending on the general location and setting of the site, the characteristics of the target soil layer, and whether there are known or anticipated drainage problems in the vicinity of the site.

A GSC is required for:

- Projects proposing infiltration (infiltration facilities, detention facilities receiving credit for pond bottom infiltration, etc.), drywells, or non-standard drainage systems that also

create greater than 5,000 square feet of new impervious area; or

- Projects located within or draining to a drainage problem area as recognized by the City Engineer or within an area mapped by the City as having the potential for high groundwater.

6.3 Geotechnical Site Characterization Report.

The following are minimum requirements for the GSC:

- The Study shall include:
 - A surface reconnaissance of the site and adjacent properties to assess potential impacts from the proposed stormwater system and to verify that the conditions are consistent with the mapped information. Typically, the evaluation should extend a quarter of a mile down gradient. Where access to adjacent properties is unavailable, the project owner shall rely upon the best known information for the area, supplemented with information available from the City Engineer, including any existing geotechnical engineering reports or studies for sites in the vicinity;
 - A review of available geologic, topographic, and soils, and identify any site conditions that could impact the use of storm drainage systems or the construction of sub-level structures. This review shall include all available previous geotechnical engineering reports or studies for sites in the vicinity; and,
 - An evaluation of the potential impacts of groundwater on the proposed storm drainage facilities, roadways and proposed underground structures, when a seasonally high groundwater table is suspected.
- The Report Narrative shall include:
 - A brief project description including size, number of lots proposed, project location (section, township and range), and background information relevant for drainage design;
 - A discussion of the study investigations;
 - A description of the soil units on the site and in the vicinity of the site;
 - A description of the site including surface, soil, and groundwater conditions, etc; and,
 - Conclusions and recommendations.
- The Site Plan shall include:
 - Project boundaries (including all existing and proposed property lines);
 - Labeled topographic contours, extending beyond the project and drainage basin. Projects in an urban area shall use a maximum contour spacing of 1 foot;
 - Location of the soil units identified;
 - Location of significant structures, properties or geologic features on site and in the project vicinity;
 - Location of existing natural or constructed drainage features on site and in the project vicinity; and,

- Location of proposed site infrastructure including roadways and drainage features such as ponds, drywells, etc.
- Test Method Documentation shall include:
 - A map with the location of all subsurface field explorations and any in-place field tests;
 - A description of any difficulties encountered during excavation and testing;
 - A description of the equipment used to perform the field explorations or tests. When applicable, describe the type of fabric lining and gravel backfill used;
 - Logs of subsurface explorations which shall identify the depth to groundwater, the presence of any limiting layers and the target soil layer; include test pit or excavation dimensions, with photographs, where applicable;
 - Report test data in a format that includes time of day, flow meter readings, incremental flow rates, observed head levels, water depths and total flow volumes in the test pit or infiltrometer; and,
 - A description of the condition of any existing facilities being tested, noting any silt build-up, water level, connections to other structures (including distance to inverts of any interconnecting pipes), measured depths and dimensions, etc.
- Results of field and laboratory testing conducted, including the grain size analysis represented both graphically and in tabular format;
- A report on the actual and proposed design outflow rates for test pits;
- Results of the sub-level structure feasibility study and a summary of the down-gradient analysis as applicable; and,
- A geologic cross-section of the stormwater disposal area drawn to scale, with the proposed stormwater disposal facilities superimposed on the cross-section. All relevant geologic units shall be clearly identified including the target disposal layer and limiting layers.

6.3.1 Field And Laboratory Testing.

The subsurface exploration, testing, and associated engineering evaluations are necessary to identify permeable soils and to determine the thickness, extent, and variability of the soils. This information is necessary to properly design stormwater disposal facilities.

Field explorations and laboratory testing shall be conducted under the direct supervision of a geotechnical engineer, a hydrogeologist or an engineering geologist.

Test Methods

Soil infiltration rates shall be determined using one of the methods described in section 5.5 of these standards or an alternate test method approved by the City Engineer.

Minimum Requirements

The following minimum requirements, when applicable, shall be met for field explorations and laboratory testing when subsurface disposal is proposed:

- Test borings and/or test pits shall be located within the footprint of proposed stormwater disposal facilities;
- For each facility, a minimum of one subsurface exploration shall be performed for up to 1200 square feet of disposal area. Another subsurface exploration shall be performed for each additional 15,000 square feet, or fraction thereof, of disposal area. For a linear roadside swale, a minimum of one subsurface exploration shall be performed every 500 feet, staggered on both sides of the road, unless site conditions or test results indicate that additional explorations are necessary. Subsurface explorations and sampling shall be conducted according to applicable standards of the American Society for Testing and Materials (ASTM); and,

Post-Construction Testing

Newly constructed infiltration facility will require a full-scale successful test prior to project engineer certification. Contact the City Engineer for additional information.

6.3.2 Sub-Level Structure Feasibility.

If the project falls under the requirements of Section 6.2 to prepare a GSC and sub-level structure construction is being considered a sub-level structure feasibility study is required. The sub-level structure feasibility study shall include the following, at a minimum:

- A layout of the site showing lot lines and lot and block numbers; Identification by lot and block number of sites where sub-level structure construction is feasible. Provide recommendations with details of construction (i.e. maximum below grade floor elevations, minimum drainage system requirements, and any site specific recommendations);
- Discussion of the effects of hydrostatic pressure that may lead to basement flooding and recommendations as to the effectiveness of waterproofing;
- If infiltration is proposed as a method for stormwater disposal, discussion of any potential adverse impacts on proposed sub-level structures, taking into consideration the contribution of imported water (due to lawn watering, etc.); and,
- Identification of locations where sub-level structure construction is not feasible.

In-lieu of conducting a sub-level structure feasibility study, the owner may elect to prohibit sub-level structure construction throughout the entire plat. If a potential buyer would like to construct a sub-level structure, then a site specific geotechnical evaluation shall be performed by a geotechnical engineer for the individual lot prior to a building permit being issued. Language regarding sub-level structure restrictions, as provided by the City Engineer, shall be placed or referenced on the face of the plat.

Recommendations shall be summarized and provided electronically in Microsoft Excel, per the format found in Table 6-1.

**Table 6-1
Example Sub-level Structure Feasibility Summary**

*Refer to the Geotechnical Report for this project for further information, which may include construction details that support these recommendations.

Block 1	Lots 1-8	yes	Maximum allowable	C= 15 feet GrW=25 feet B=30 feet	Based upon the clean nature of the soils at the sub-level elevations and the depth to groundwater, footing drains are not required. However, below-grade walls shall be well reinforced to reducing cracking and thoroughly damp-proofed with a water-resistant bituminous emulsion or modified cement base coating. Backfill material shall consist of only clean granular material which is free of fine-grained soils, organic material, debris and large rocks.
Block 2	Lots 1-3	yes	4 feet	GrW=13 feet	Below-grade walls shall be well reinforced to reduce cracking and waterproofed ³ with a membrane (per IRC) which is lapped and sealed from the top of the footing to the finished grade. An under slab waterproof membrane (per IBC) which is lapped and sealed shall be integrated with the wall membrane. Backfill material shall consist of only clean granular material which is free of fine-grained soils, organic material, debris and large rocks. Walls and footings shall have a drain system with cleanouts, emptying a minimum of 15 feet in a down-slope direction away from structures. Precautions shall be taken not to excavate a closed depression over rock or clay that is intended to dispose of sump water from a foundation drain system.
Block 2	Lots 4-8	no	n/a	GrW=3 feet B=7 feet	Due to the very shallow presence of groundwater, sub-level structures are not recommended on these lots. If a crawl space is proposed, a drain system with cleanouts shall be provided that empties a minimum of 15 feet in a down-slope direction away from structures. Precautions shall be taken not to excavate a closed depression over rock or clay that is intended to dispose of sump water from foundation drain system.

1 Maximum depth measured from original pre-construction/pre-grading ground surface elevation or existing ground surface, whichever provides a greater distance between the lowest floor elevation and the limiting layer.

2 GrW=groundwater, B=bedrock or basalt, C=clayey-silty soils

3 Below grade structure waterproofing alternatives allowed by the Building and Planning Department are also acceptable.