

Geotechnical Site Investigation and Recommendations Specifications, City of Greeley, Colorado

Updated: 3/18/2025

Introduction

The City of Greeley (City), to ensure uniformity and performance on infrastructure development within the City is requiring geotechnical consultants to provide services at a minimum in accordance with the following specifications. These specifications are intended as a guide to geotechnical consultants in preparing a scope of services for work as requested. These are the minimum requirements; the geotechnical consultant should review the proposed work and include any additional effort as needed to provide design recommendations. To improve pavement performance, reduce maintenance needs and better asset management planning, the City proposes to start recommending a layer of modified subbase with a minimum thickness of 6 inches underlain by at least 12 inches of prepared or chemically treated subgrade below the pavement section. A layer of geogrid separating the modified subbase and the prepared subgrade can be considered in lieu of reducing the thickness of the subgrade to 9 inches. The City also recommends that the amount of sheet flow along the streets be kept to a minimum and eliminate crosspans across street intersections by replacing them with innovative drainage solutions.

Site Investigation Plan

The goal of the site investigation plan is to obtain all applicable information needed to develop geotechnical recommendations for the proposed work. The geotechnical consultant should familiarize themselves with the project requirements by reviewing the site plan, the proposed grading, the intended site use, locations of major drainage (defined as any pipe or culvert more than 3 feet in diameter or any box culvert) and bridges. The geotechnical consultant should review available topographic maps, soil survey maps and any as-built information if available when developing the site investigation plan.

The overall purpose of the site investigation plan is to provide sufficient geotechnical design recommendations for the following:

- Overall geotechnical design for the final roadway location, both horizontal and vertical, including pavement section.
- Suitability of materials obtained from cuts, borrow, or channel changes for use in embankments.
- Final geotechnical design of the roadway section, foreslopes, and backslopes, including possible geotechnical remediations, etc.
- Identification of required subgrade treatment and determination of type of subgrade treatment.

- Identification of areas where geotechnical features such as subsurface drains are needed and associated final design of such features.
- Final geotechnical design of embankments in the vicinity of structures (including around bridges, when used in conjunction with the bridge borings), based on adequate determination of strength and consolidation characteristics of the subsoils from tests on soil samples obtained with the borings.
- Geotechnical design recommendations for open trench excavation support, as needed for utilities.

The site investigation plan shall include and address the following items:

- Work performed in single or phased exploration.
- Traffic Control plan, if needed
- Right-of-Way Permits, Damage to Property. *It is the geotechnical consultant's responsibility to obtain all necessary permits and take all precautions necessary against injury to any public or private property. The consultant will be responsible for promptly repairing or payment for any such repairs to the satisfaction of the City and applicable property owners.*
- Utility Clearances
- Groundwater monitoring plan
- Hole Abandonment and Backfilling
- Environmental and Other Concerns. *If items are discovered which are potentially of environmental, archeological or similar concern, the Consultant shall immediately stop drilling and notify the City.*
- Proposed schedule of completing the work and delivering the report to the City.

The site investigation plan shall include a boring location plan showing the location, the anticipated depth and type of exploration (soil boring, CPT, etc) for all locations. The suggested minimum number of borings and depth of borings is provided in table below. The borings are not cumulative (i.e. the boring layout shall be prepared to obtain sufficient information from a minimum number of borings needed).

Purpose	Number of Borings	Minimum Depth of Boring
Arterials and Collector Roadway	One every 500 ft staggered along centerline	At least 5 feet below maximum depth of any structure proposed along the alignment. Minimum depth: 10 feet below proposed roadway grade.
Local Streets	One every 1000 feet, staggered along centerline	At least 5 feet below maximum depth of any structure proposed along the alignment. Minimum

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		depth: 10 feet below proposed street grade.
Major Drainage Structures	At least one along centerline of proposed structure	Minimum 10 feet below flowline of proposed structure.
Bridges	One every abutment and pier	Depths in accordance with CDOT Geotechnical Manual.
Fills greater than 10 feet	At least one at the maximum fill height	Minimum depth equal to 1.5 times maximum height of fill
Cuts greater than 10 feet	At least one at the maximum cut location	Minimum depth at least 10 feet below bottom of cut.
Spread Foundations	At consultant discretion across the site	Minimum depth shall be 4 times the width of the foundation or 15 feet whichever is more.
Retaining Walls retaining fill greater than 10 feet	One at start and end, and one every 100 ft	Minimum 5 feet below bottom of wall and to soils with N>10bpf
Stormwater Detention Facilities	One boring near proposed pond outlet between May 1 and October 1 to evaluate depth to groundwater, subgrade soils, and structural design recommendations, including but not limited to infiltration capacity, pH, sulfate and resistivity testing.	At least 10 feet below bottom of lowest proposed grade of pond.

Note: These are minimum requirements. Consultant should evaluate the project needs to determine actual number of soil borings needed.

The borings shall be drilled per following:

1. The borings shall be staked in the field by the geotechnical drilling consultant or if by others, the presence of the drilling subconsultant is recommended to determine accessibility and any potential offsets during the staking operation. The borings will be staked a minimum of 2 weeks before anticipated start of soil drilling activities to allow sufficient time for utility locates.
2. Any offset from the staked location shall be clearly noted on the logs.
3. The drilling consultant should have qualified staff performing field logging.

4. The borings shall be advanced using hollow stem auger and mud rotary below groundwater levels if heave is anticipated.
5. Split spoon sampling shall be performed at 2.5 feet interval over the top 10 feet, and at intervals of 5 feet below 10 feet. The SPT (N-value) shall be recorded for all split spoon samples.
6. Shelby tube samples shall be taken in each cohesive layer immediately succeeding or preceding a SPT spoon sample. The Shelby tube sample shall be sealed and stored vertically for transport to the laboratory.
7. The boring logs shall record the recovery from each sample and pocket penetrometer readings for cohesive samples.
8. Photos shall be taken of the pavement cores, if any with measurements and provided to as part of the report.
9. Groundwater information (during drilling, at end of drilling) shall be measured and recorded on the logs in accordance with the groundwater monitoring plan.
10. No boring shall be terminated in a layer with a SPT N-value less than 10bpf. The boring shall be advanced another 5 feet and another sample obtained. The intent is to clearly delineate the extent of any soft soils. The geotechnical consultant shall coordinate with the field staff to determine if additional sampling is warranted based upon the information needed to prepare geotechnical recommendations.
11. Borings shall be terminated upon auger refusal or when there are two consecutive SPT samples with 50+ blow counts for less than 6-inch penetration of the split spoon sampler.
12. The geotechnical consultant shall evaluate need for rock coring for bridge foundations. If rock coring is warranted, the logs shall include detailed description of the rock type, weathering, jointing, etc. The recovery and RQD for each core run shall be recorded on the logs. Photos of the rock cores appropriately numbered shall be taken and included in the report.
13. All borings shall be backfilled in accordance with the abandonment plan.
14. Any excessive soil cuttings and fluid shall be disposed by the contractor.

Laboratory Testing:

Laboratory testing will comprise of the following tests. The number and type of tests is an estimate and should be based on the type of soils encountered. All tests shall be performed in accordance with applicable ASTM, AASHTO or other standards.

1. Natural Moisture Content, at least 1 for every 10 feet drilled or one in each layer encountered.
2. Atterberg Limits, at least 1 every 10 feet drilled or one in each layer encountered.
3. Sieve Analyses, at least one for every 1000 feet in sandy soils.
4. Unit Weight, at least one in each Shelby Tube sample
5. Strength Tests such as CU, CD, UU Triaxial Tests (3-points), Direct Shear Test, Unconfined Compression tests, if needed as determined by project type and

- requirements, except one UC test on rock samples every 5 feet of core at a minimum.
6. 1-Dimensional Consolidation Test with one load-unload-reload cycle and coefficient of consolidation graphs for each load, Method B, if needed as determined by project type and requirements.
 7. Standard or Modified Proctor Test, as needed to determine compaction/remediation requirements.
 8. Swelling potential in areas of potentially expansive soils.
 9. CBR tests, as needed to determine subgrade suitability/remediation requirements.
 10. Sulfate, resistivity and corrosivity tests to ensure adequate protection for subsurface utilities.
 11. Other tests as applicable for project requirements.

Geotechnical Report and Recommendations

The consultant will provide a geotechnical report and recommendations. The report shall include the following at a minimum.

- The location of the project beginning and ending by station, township and range, or by streets.
- A general description of the proposed improvement, including surface type and width, number of traffic lanes, median, intersections, or grade separations, etc., and any other information which may be of value in the proper interpretation of the survey data.
- A detailed description of the investigation consisting of:
 - Date (month and year) when the field soils survey and investigation was made.
 - Climatic conditions during the investigation and for a period prior to the investigation as may be necessary to document dry vs. wet conditions.
 - General description of terrain with special emphasis on springs and drainage and erosion patterns. Any conditions of high water, flooding, etc., which may have been noted and which might be of value in the design of bridges or culverts.
- A map showing the location of each boring.
- Boring logs providing field descriptions (i.e., geologic origin if identifiable, the best estimation/interpretation of Unified classification and/or USDA Textural Classification), the elevation or depth of all samples obtained, in-place moisture conditions, measured water table elevations, and drilling data.
- Laboratory results and a spreadsheet comprising a summary of all laboratory results.
- Photographs of pavement and rock cores, if any.
- Data (Including a summary of recommended geotechnical parameters for use in design), analyses, calculations, background information, etc., leading up to the Consultant's recommendations relative to the design and construction of

embankments, subgrade treatment requirements, availability and use of select soils, placement or disposal of unsuitable soils, placement or disposal of unsuitable soils, drainage installations, subgrade removal and replacement, the use of channel change materials, the special handling of unusual soil types or conditions, foundation design (shallow and deep foundations), retaining wall design, geotechnical remediations, and/or other pertinent factors affecting the design or construction of the project.

- Settlement estimates for all design structures, including concrete pipes 36 inches in diameter and larger. Also, time vs. settlement curves shall be plotted for all areas where total settlements are estimated to be 12 inches or greater.
- Full information on all analysis performed, including all computer-generated information.
- Recommendations on pavement type and thicknesses, subgrade, thickness of modified subbase, longitudinal and backslope subdrains.

Construction Support

If requested by the City, the Geotechnical consultant shall be available to provide information during the project development process and be available during the construction period to visit the site to observe the work, take samples as needed and provide testing for quality assurance. The consultant may be required to develop a quality control/quality assurance plan if not provided for in the bid specifications.

END OF SPECIFICATION