



GEOTECHNICAL SUBMISSION GUIDELINES

July 20, 2018

Geotechnical Bulletin GB5 was developed by the Office of Geotechnical Engineering. The first edition of GB5 was dated August 13, 2007. This edition supersedes all previous editions.

This Geotechnical Bulletin is a guideline, detailing geotechnical submissions for all projects that are being delivered through ODOT's Project Development Process (PDP).

The PDP Manual provides guidance on the determination of a project classification, as well as a description of the various phases to be followed in developing the project. Projects will generally fall into one of five paths, Path 1 to Path 5, based on the complexity of the project work. Section 1400 of the Location and Design Manual focuses on the design involvement in the PDP, with an emphasis on design review submittals. It provides a general overview of plan development and identifies the information which is to be included in each design review submission. However, the submission information presented in these documents is of a general nature, and the listing of the information to be submitted for a specific task is meant to be all inclusive, covering all the disciplines within ODOT. Specific, detailed information on the submission requirements for a given discipline is not provided.

The purpose of this document is to provide a more detailed explanation of the requirements for the nine PDP tasks and the appropriate submissions in the area of Geotechnical Engineering. It should be understood that the geotechnical information listed in this document would be included as a part of the complete review package required for submittal at that specific PDP task. Avoiding the submission of unnecessary information, but more importantly, avoiding insufficient or incomplete submissions, are the primary objectives of these guidelines. It is imperative that the submitting agency be aware of the expectations of the reviewing party, so that complete, correct, and consistent submittals are provided.

The Specification for Geotechnical Exploration (SGE) presents details on the content of various geotechnical studies and reports. Section 700 covers five geotechnical report types. The specific content of these five reports: Preliminary Geotechnical Exploration, Subgrade Exploration, Roadway Exploration, Structure Foundation Exploration, and Geohazard Exploration are described so that these reports will provide the necessary

information and are consistent from project to project. Many of these reports and geotechnical plans are part of the geotechnical deliverables for specific PDP task submissions, and are referenced in these guidelines at the appropriate tasks. Refer to Section 700 of the SGE for information regarding the electronic submission of geotechnical information and the role of the District Geotechnical Engineer.

Although guidelines are presented for the required geotechnical submissions in specific PDP tasks, it is understood that not all projects will have all geotechnical tasks. As well, in some projects, additional submissions may be desired throughout the plan development process. Meetings and additional correspondence between the appropriate parties may be beneficial. Subsurface explorations may be conducted in phases or for individual design concerns. Geotechnical reports and data should be submitted to the appropriate agency whenever this information will benefit the design process. Submissions for specific design features or compliance reviews may also be necessary as the project becomes more defined.

These guidelines are intended to provide guidance as to the typical content of the various geotechnical documentation and submissions that are part of the PDP. It is understood that the size and complexity of these documents are directly related to the specific requirements of the project. What would be a two page submission for one project may be a thirty page bound report with appendices for another project. The type of reports, amount of design calculations, and complexity of plan detailing, are just some examples of the things that will differ from project to project.

This Bulletin may be obtained from the Office of Geotechnical Engineering's web site (www.dot.state.oh.us/Divisions/Engineering/Geotechnical). This web site contains other ODOT geotechnical documents, bulletins, and an online copy of the Geotechnical Engineering Design Checklists and SGE, some of which are referenced in this document.

A. 1.2 Project Initiation Package

Task 1.2.C.B Identify Geotechnical Issues

Task Summary

The Project Initiation Package (PIP) is intended to provide a snapshot of potential issues and concerns that could require major scope, schedule, or cost issues during project development. Knowing about and avoiding problematic issues will save time and money. The PIP is produced early in the Planning Phase by the ODOT District Staff and is required for projects following Paths 2-5.

Geotechnical Deliverables and Geotechnical Review Submissions

The deliverables for this task will vary in detail based on the project size and complexity. Both an office and field review of the geotechnical aspects of the proposed project should be performed by the District Geotechnical Engineer (DGE). The geotechnical portion of the PIP form should be completed. In general, a description of the site geology, subsurface conditions, field observations, and any potential geotechnical issues are to be included in the project PIP. The required information should also be indicated on the proper study area basemap.

- As the geotechnical work for the PIP is performed solely by the DGE within the District, there are no submission requirements. The end product will be the geotechnical information being supplied on the PIP form and the project basemaps.

B. 2.1 Develop Preliminary Alternatives

Task Summary

The development of preliminary alternatives in the Preliminary Engineering Phase involves Feasibility Studies (FS), Environmental Field Studies, and the creation of the Alternative Evaluation Report (AER). Of concern in the geotechnical arena is the FS and the AER. The FS is designed to analyze alternatives in order to identify a preferred alternative, or multiple alternatives, through the PDP. An FS is not required for Path 1 projects, will typically lead to the preferred alternative in Paths 2 and 3, and produces a limited number of alternatives for further study in Paths 4 and 5. The AER is designed for concurrent processing of preliminary engineering and environmental work, and the recommendation of the preferred alternative. An AER will not be compiled for Path 1 and 2 projects, and is unlikely for Path 3 projects. The AER is primarily used on Path 4 and 5 projects.

Geotechnical Deliverables

The geotechnical deliverables for this task would typically be the geotechnical input into the FS and AER, but may also include a Preliminary Geotechnical Exploration Report and/or a Subgrade Exploration Report.

For the FS, each proposed alternative should be analyzed to ascertain the impact of the geotechnical conditions present. The work consists of a thorough review of all existing geotechnical information, including that provided in the PIP. The location and extent of the geotechnical concerns for all alternatives is developed. A summary of the existing geotechnical conditions and possible construction and long term geotechnical issues with

each of the proposed alternatives would become part of the Feasibility Study.

In the AER, typically 2 to 3 alternatives are compared, with the end result being a recommendation for the preferred alternative. There may be several aspects of each alternative being studied that require geotechnical evaluation, such as:

- The horizontal/vertical alignment may be affected by soft foundations, mines, rock cuts, or slope stability issues
- The need for retaining walls, compared to steeper slopes or alignment changes
- Types of bridges or culverts are influenced by the foundation material at the alternative location
- Remediation or special construction techniques to alleviate harmful geotechnical features

All of these items influence the cost of a proposed alternative. In evaluating these areas, all existing geotechnical information should be utilized, and when necessary, reasonable design assumptions should be made. By using sound engineering judgment, reasonable evaluations and cost estimates can be developed for the alternatives without performing new borings. These evaluations and associated costs for each of the proposed alternatives would become part of the AER.

Although it should be a rare occurrence, there are times when a Preliminary Geotechnical Exploration (PGE) is necessary to adequately perform the alternative evaluations for the AER. This exploration should only be performed when major design facets of an alternative require exploration to reasonably estimate project impacts because the existing geotechnical information does not allow for reasonable assumptions to be made. This exploration work must be approved by the DGE prior to beginning the work. Therefore a cost proposal and boring plan should be submitted to District as early as possible. The report issued as a result of the PGE should cover all the geotechnical alternatives considered, any design and remedial measures necessary to complete the project, and a cost summary for the geotechnical aspects of the proposed alternatives. A preferred alternative from the geotechnical perspective should be provided. The borings should be plotted on a plan and profile view. Either a summary of the PGE report or the entire report should be included in the AER.

Sometimes, pavement design is requested at this early phase. However, rarely is a Subgrade Exploration necessary or prudent as alignments and profiles change and assuming average design parameters is usually sufficient. If performed, this exploration work must be approved by the DGE prior to beginning the work. Therefore a cost proposal and boring plan should be submitted to District as early as possible. The report issued as a result of the Subgrade Exploration should include a Geotechnical Bulletin 1 analysis, specific subgrade treatment recommendations, subgrade support values with the pavement design, and a cost summary for all the proposed alternatives. The borings should be plotted on a plan and profile view. Either a summary of the Subgrade

Exploration report or the entire report should be included in the AER.

The geotechnical deliverables for this step are as follows:

- Documentation summarizing existing conditions and possible construction and long-term geologic and geotechnical issues for each alternative, to be included as part of the Feasibility Study.
- Documentation of the geotechnical evaluations and cost estimates for the proposed alternatives, and a recommendation of a geotechnically based preferred alternative, to be included as part of the AER.
- Preliminary and/or subgrade borings (if any) plotted in plan and profile view.
- Draft /Final versions of the Preliminary Geotechnical Exploration Report (if preliminary borings were taken).
- Draft/Final versions of the Subgrade Exploration Report (if borings were taken).

Geotechnical Review Submissions

The general submission requirements for this step are presented in Section 1400 of the L&D Manual. The deliverables above will probably be presented in two different submittals, the Feasibility Study and the AER, with the latter occurring under Task 2.5 AER Submittal and Other Studies.

Feasibility Study

- Documentation summarizing existing conditions and possible construction and long-term geologic and geotechnical issues for each alternative,
- Mapping showing the areas of geotechnical and geological concerns.

Alternative Evaluation Report

- The second bulleted geotechnical deliverable item above
- The third, fourth, and/or fifth bulleted geotechnical deliverable item above, if any of the explorations are performed
- Preliminary plan and profiles for each alternative
- Other geotechnical related items, Structure Type Studies and Retaining Wall Justifications, may be performed and included in the AER. See Section C for information.

C. 2.5 Alternative Evaluation Report Submittals and Other Studies

Task 2.5.D.A Structure Type Study

Task 2.5.E Retaining Wall Justification

Task Summary

The analysis of preliminary alternatives is near completion as the AER is finished and the preferred alternative is chosen for full design and plan development. In addition to the AER, this analysis of alternatives may include the geotechnically related structural items Structure Type Studies and Retaining Wall Justifications. A Structure Type Study (STS) examines the project site in detail and evaluates conditions to determine the best structure alternative. Path 1 projects would not have an STS, but Path 4 and 5 projects, and often Path 2 and 3 projects, will have structure work that requires an STS. A Retaining Wall justification (RWJ) compares the impacts and costs (both right of way and construction) of the preferred alternative with and without retaining walls. RWJ would not be performed for Path 1 projects, but typically would be for Path 4 and 5 projects. Rarely would Path 2 and 3 projects have a need for RWJ.

Geotechnical Deliverables

The geotechnical deliverables for these tasks would typically be the STS and RWJ reports, but may also include a Structure Foundation Exploration (SFE) report for developing recommendations in the STS. The geotechnical deliverables for the AER are discussed in Section B above, but are referred to here as the AER submittal is prepared under Task 2.5, and the STS and RWJ may be part of that submittal.

Any time a culvert or bridge is being replaced, or a new over structure is being added, an STS is needed to determine the appropriate structure type at each location. The work involved in an STS, including the geotechnical requirements, is prescribed in the Bridge Design Manual (BDM). Estimated resistances, a recommended foundation type, and associated costs, comprise the geotechnical work. All existing geotechnical information should be utilized, and reasonable design assumptions should be made to provide the needed recommendations without requiring new borings. The STS may be a separate report, but is often included as part of the AER.

There are times when a Structure Foundation Exploration will be necessary to adequately develop the required foundation recommendations for the STS. This exploration should only be performed when the existing information at a critical structure location does not allow for reasonable foundation estimates to be developed. This exploration work must be approved by the DGE prior to beginning the work. Therefore a cost proposal and boring plan should be submitted to District as early as possible. The report issued as a result of the SFE should cover all the geotechnical requirements of the STS provided in the BDM

for the structure location being evaluated. The borings should be plotted on a plan and profile at the structure location. Either a summary of the SFE report, or preferably, the entire report, should be included in the STS report.

A RWJ compares the impacts and costs of the project with and without retaining walls. Specific information on RWJ studies is found in the BDM and the Location & Design Manual. One finds that many areas of the project work affect the RWJ. Horizontal and vertical geometry, right of way acquisition, environmental and geotechnical concerns, types of usable wall systems, and associated costs of all these items, all need to be evaluated in an RWJ study. Making use of existing geotechnical information should be sufficient to perform the geotechnical evaluation in a RWJ study, so no further explorations should be necessary. The RWJ may be a separate report, but is often included as part of the AER.

The geotechnical deliverables for these tasks are as follows:

- Geotechnical aspects of the Structure Type Study, as required by the BDM, and included as part of the STS report.
- Existing soil information presented on a plan and profile for any structure location being analyzed.
- Preliminary borings (if any) plotted in plan and profile view for the structure location being analyzed for an STS.
- Draft/Final versions of the SFE report (if borings were taken).
- Geotechnical aspects of the Retaining Wall Justification study, as prescribed in the BDM and L&D manuals, and included as part of the RWJ report.
- Existing soil information presented on a plan and profile for any wall location being analyzed.

Geotechnical Review Submissions

The general submission requirements for this step are presented in Section 1400 of the L&D Manual. When the STS or RWJ are provided as separate submissions, the following items are needed for a complete geotechnical review:

Structure Type Study

- The STS documentation, including the first and second bulleted geotechnical deliverable item above
- The third and fourth bulleted geotechnical deliverable items above, if the exploration is performed. The SFE report may be part of the STS report.

Retaining Wall Justification

- The RWJ documentation, including the fifth and sixth bulleted geotechnical deliverable item above
- Plan sheets and cross-sections showing wall and no-wall alternatives.

When the STS and/or RWJ are submitted as part of the AER, the following items are needed for a complete geotechnical review of the AER:

- The items listed above in Section B for the AER Geotechnical Review Submissions
- The items shown here in Section C for the STS and RWJ Geotechnical Review Submissions, included as sections within the AER. If the SFE for a structure type study is produced as a separate report, a summary of this SFE report should be included in the STS section of the AER.

D. 2.7 Stage 1 Design

Task 2.7.D Geotechnical Services

Task 2.7.D.A Geotechnical Services and Report

Task Summary

Stage 1 begins after the identification of a preferred alternative. Stage 1 Design refines and builds upon the preliminary engineering design completed for the AER. It provides a level of detail necessary to begin Preliminary Right-of-Way Plans, allows for an accurate estimation of required right-of-way acquisition, and allows for a refined estimate of construction costs. Path 1 projects would not have a Stage process, but Path 4 and 5 projects, and often Path 2 and 3 projects, will go through the Stage design process.

By the end of these tasks, design plans are developed to the Stage 1 level. The geotechnical exploration, testing, and draft versions of the reports should be completed by the end of this Stage. Cross sections are nearly complete. Retaining wall and culvert plans are being developed.

Geotechnical Deliverables

The proposed boring plan and associated cost proposal for the geotechnical exploration work to be performed in these tasks may be submitted in an earlier step, but these items must be approved prior to doing the work. There are multiple geotechnical deliverables for these tasks. Draft versions of the Soil Profile drawings, Structure Foundation Exploration drawings, Roadway Exploration Report, and Structure Foundation

Exploration Report are developed in this step. Complete details on what is to be provided in these documents can be found in the SGE, Section 700. In general, the Draft Soil Profile and Structure Foundation Sheets would show subsurface exploration locations on the plan view, with standard graphic logs on the profile view. If cross-section borings were obtained, the affected sections with the graphic logs should be provided. Geotechnical information for any possible retaining wall locations is to be presented.

The Draft Roadway Exploration Report will discuss all geotechnical aspects of the roadway section of the proposed project. Geotechnical and geologic issues that will be encountered should be explained and possible solutions presented with preliminary, but specific, recommendations. Multiple options can be developed, and analyses should be included. All completed testing results should be presented. If additional borings are anticipated, the need and location for these borings should be explained.

The Draft Structure Foundation Exploration Report will discuss all geotechnical issues related to structures. Geotechnical and geological issues that will be encountered should be explained and possible solutions presented. Preliminary foundation recommendations should be included for all structural alternatives. Multiple options can be developed. All completed testing results should be presented.

Pavement design is approved and subgrade stabilization requirements are established in this task. Therefore, the Subgrade Exploration, either as a separate report or included in the Roadway Exploration Report, needs to be finalized in this Step. A GB 1 analysis is required, and a CBR determined.

The Subgrade Exploration would be presented as a distinct report in the following scenarios:

- The only geotechnical work on the project is subgrade and pavement related. Minor roadway widening, or a realignment of smaller roads, where no slope or structure work is required, would be examples. In these cases, only a Subgrade Exploration Report would be developed. No Roadway Exploration Report would be required.
- Pavement types and buildups are required earlier in the project process for the sake of plan development and pavement selection. Subgrade exploration borings may be performed well in advance of the exploration of walls and slopes. A separate Subgrade Exploration Report would be developed when analysis of the subgrade exploration borings was complete. A Roadway Exploration Report, covering walls, slopes, and other non-subgrade related geotechnical items, would be developed and submitted as scheduled.

The geotechnical deliverables for these tasks are as follows:

- Draft versions of the Soil Profile drawings, Roadway Exploration Report, Structure Foundation Exploration drawings, and Structure Foundation Exploration Reports
- Final subgrade recommendations, GB 1 analysis and spreadsheet (hard copy and electronic copy on CD), either as a Subgrade Exploration Report or included in the Roadway Exploration Report
- Filled out applicable sections of the Geotechnical Design Checklists.

Geotechnical Review Submissions

The general submission requirements for these tasks are presented in Section 1400 of the L&D Manual. In order for a complete geotechnical review to be performed at this step, the following items from the general submission package are needed:

- The geotechnical deliverables for these tasks
- Title Sheet, Typical Sections (showing subgrade stabilization if remedy is global), Plan/Profiles, and Cross Sections.

E. 3.3 Stage 2

Task 3.3.K Geotechnical Services

Task 3.3.K.A Final Geotechnical Investigation & Reports

Task Summary

At the end of the Stage 2, all design issues of any significance should be resolved. In general, Stage 2 plans should be developed to the point where plan preparation, design, and detailing are substantially complete.

Geotechnical Deliverables

There are multiple geotechnical deliverables for these tasks. Final Roadway Exploration and Structure Foundation Exploration Reports, and Final Soil Profile and Structure Foundation Exploration plans are completed at this time. These documents should meet all the requirements as laid out in the SGE.

As a revised version of the Draft Roadway Exploration Report, the Final Roadway Exploration Report will reflect changes issued in the Draft review comments. The Final Roadway Exploration Report must contain specific and detailed recommendations for the

chosen solution to each of the geotechnical issues anticipated on this project. Station limits, depths, specifications, notes, instrumentation, and calculations should be included. All analyses required by the Geotechnical Bulletins should be completed. A disposition of comments covering items from the Draft Soil Profile and Draft Roadway Exploration Report review should be developed and be separate from the Final Roadway Exploration Report. More detail on the information to be provided in this Final Soil Profile and Roadway Exploration Report submission can be found in the SGE.

As a revised version of the Draft Structure Foundation Exploration Report, the Final Structure Foundation Exploration Report will reflect changes issued in the Draft review comments. The Final Structure Foundation Exploration Report must contain specific and detailed recommendations for the chosen solution to all of the geotechnical issues anticipated for the structures on the project. Foundation types, size and depths of deep foundations, bearing capacities, preliminary wall designs, specifications, notes, instrumentation and calculations should be included. A separate disposition of comments covering the items from the Draft Structure Foundation Exploration Plan and Draft Structure Foundation Exploration Report review should be developed and be separate from the Final Structure Foundation Exploration Report. More detail on the information to be provided in this Final Report and Foundation Exploration plan submission can be found in the SGE and Bridge Design Manual.

The geotechnical deliverables for these tasks are as follows:

- Final versions of the Soil Profile drawings, Roadway Exploration Report, Structure Foundation Exploration drawings, and Structure Foundation Exploration Report
- All analyses required by the Geotechnical Bulletins
- Disposition of the geotechnical comments from the geotechnical review performed in Stage 1
- Completed applicable sections of the Geotechnical Design Checklists.

Geotechnical Review Submissions

Based on the information supplied in the Final Roadway Exploration Report, Stage 2 plans should be fully developed geotechnically and submitted. Plan and profile and cross section sheets will be nearly complete. Culverts, retaining walls, and pertinent geotechnical features are to be located in the plan views. Special benching and retaining walls are to be shown on the cross sections. Rock cut layouts and catchment ditches are to be provided in the cross sections (refer to GB 3 Rock Cut Slope & Catchment Design). Show any subgrade undercuts (from GB 1 analysis), embankment foundation stabilization, and any special embankment treatment on the cross sections.

Provide detail sheets and design calculations for culverts with possible bearing capacity or settlement issues. Retaining wall plans should be submitted in this step. The information to be included in the Stage 2 submittal depends on the wall type (cast-in-

place, proprietary, special). The Bridge Design Manual should be consulted for design and submission requirements.

The general submission requirements for these tasks are presented in Section 1400 of the L&D Manual. In order for a complete geotechnical review to be performed at this step, the following items from the general submission package are needed:

- The geotechnical deliverables for these tasks
- Title Sheet, Schematic, Typical Sections, Plan/Profiles, Cross sections, General Notes, and Culvert Details (if applicable)
- Retaining Wall plans and design calculations, if applicable
- General Notes (including all geotechnical and earthwork related plan notes), Bridge notes, and geotechnical specifications.

F. 4.2 Stage 3 Detailed Design Plans

Task Summary

The Stage 3 Detailed Design should complete the design of the project. These plans must contain all details and quantities required to bid and construct the proposed work.

Geotechnical Deliverables

No specific geotechnical deliverables are expected for this task, although assistance in developing a disposition of Stage 2 comments may be needed. Do not modify the Final Roadway Report and submit the report again.

Geotechnical Review Submissions

The general submission requirements for this step are presented in Section 1400 of the L&D Manual. In order for a complete geotechnical review to be performed at this step, the following items from the general submission package are needed:

- Full set of Stage 3 plans
- Disposition of Stage 2 comments