	Ohio Department of Transportation **Division of Production Management** **Office of Geotechnical Engineering** **Geotechnical Bulletin**	**GB 5**

GEOTECHNICAL SUBMISSION GUIDELINES

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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) in the Major or Minor classification.

The PDP Manual provides guidance on the determination of a project classification, as well as a description of the various steps to be followed in developing the project. A Minor Project has 10 steps, while a Major Project has 14 steps. 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 step 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 PDP step 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 each of the PDP steps. 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 200 covers the geotechnical Red Flag Summary, while 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 step submissions, and are referenced in these guidelines at the appropriate steps. 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 each of the PDP steps, it is understood that additional submissions may be desired throughout the entire 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 (http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical/Pages/default.aspx). 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. Red Flag Summary

Major Project – Step 2
Minor Project – Step 1

Step Summary

This step is to identify locations of concern within the study area, including environmental, Right of Way, utility and engineering issues. Red flags may require additional study. Site visits, existing plan information, and other secondary sources are utilized to locate the red flags. A Red Flag Summary (RFS) is required per the PDP, and for Major projects, red flags must be identified on a study area base map.

Geotechnical Deliverables and Geotechnical Review Submissions

The deliverables for this step will vary in detail based on the project size and complexity. The geotechnical portion of the RFS should be completed. This portion of the RFS is considered a Geotechnical Red Flag Summary. In general, a description of the site geology, subsurface conditions, field observations, and any red flags noted, are to be included in the project RFS. The required information should also be indicated on the proper study area base map.

As mentioned, the geotechnical deliverables for this step are contained within the overall project RFS. However, when required in the scope of services, an independent report titled 'Geotechnical Red Flag Study' will also be prepared, detailing the findings of the Geotechnical Red Flag Summary. For more detail on the geotechnical requirements of the RFS, and the Geotechnical Red Flag Study, refer to Section 200 of the SGE.

The general submission requirements for the Red Flag Summary are presented in Section 1400 of the L&D Manual. In order for a complete geotechnical review to be performed, the following items are needed:

- Red Flag Summary Report
- Geotechnical Red Flag Study, if required
- All required mapping, with red flag areas indicated

B. Identify and Evaluate Conceptual Alternative Solutions

Major Project – Step 3

Step Summary

The purpose of this step is to identify all reasonable alternative solutions to a transportation problem. Cost estimates are generated for all alternatives. An evaluation matrix is developed to compare alternatives, and the reasons for eliminating or advancing specific alternatives are documented.

Geotechnical Deliverables and Geotechnical Review Submissions

No geotechnical deliverables are required in this step, and a geotechnical evaluation of the Step 3 information is performed on an as-needed basis.

C. Conceptual Alternatives Study (CAS)

Major Project – Step 5

Step Summary

By the end of Step 5, preliminary corridors and horizontal alignments are selected for further study. Depending on the size of the study area, the corridors are typically 1000 feet to 2000 feet wide and are established in order to avoid or minimize impact to environmental and design red flag areas. The advantages and disadvantages of each alternative are presented in a matrix configuration, and a discussion of alternative selection for further development is completed. Mapping with environmental and design red flags are further developed, and a preliminary geotechnical analysis of existing data is performed. All of this information is presented in a Conceptual Alternatives Study (CAS) document.

Geotechnical Deliverables

The geotechnical deliverables for Step 5 will consist of the geotechnical related material utilized in the development of the CAS document. The location and extent of geotechnical and geologic concerns are determined, utilizing any existing geotechnical data available. The need for a preliminary exploration for alternative evaluation is considered at this time.

The geotechnical deliverables for this step are as follows:

- Location and extent of geologic and geotechnical concerns for all alternatives (to be included as part of the CAS mapping)
- Documentation summarizing existing conditions and possible construction and long-term geotechnical and geologic issues with the proposed alternatives. If there is a need for a preliminary exploration for alternative evaluation, an explanation should be included. This information should be included as part of the CAS document.

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:

- CAS document, which will contain:
    - the geotechnical deliverables for this step
    - project mapping
    - alternative evaluation matrix
    - discussion of the alternatives selection

D. CAS with Constrained Study Areas

Major Project – Step 5

Step Summary

The Staged Review Process develops an increasing level of design detail as the number of alternatives is reduced. For projects that involve a constrained study area or limited number of alternatives, it is sometimes advantageous to complete detailed design work on the entire study area rather than phasing in these tasks over various review submissions. Selected tasks may move forward from the Assessment of Feasible Alternatives (Step 6) and the Preferred Alternative Verification (Step 7) into the Conceptual Alternatives Study (Step 5). Two tasks of concern for geotechnical submissions are the completion of the pavement design and the initiation or completion of the roadway exploration.

Geotechnical Deliverables and Geotechnical Review Submissions

The geotechnical deliverables and submissions will be based on project specific scheduling and requirements. The proposed boring plan and associated cost proposal for the geotechnical exploration work to be performed in this step may be submitted in an earlier step, but these items must be approved prior to doing the work.

If the pavement design is moved up to this step, the subgrade exploration information must be available. A Geotechnical Bulletin 1 (GB 1) analysis, including the spreadsheet and the subgrade exploration information, should be completed. Once the need for subgrade stabilization and the subgrade CBR are determined, the proposed pavement design can be developed. If the subgrade information will be a separate document from other geotechnical items, both the Draft and Final version of the Subgrade Exploration Report (SGE, Section 700) will be completed in this step.

If the overall project geotechnical exploration is initiated and completed in Step 5, the Draft version of the Roadway Exploration Report will be completed in this step. If the pavement design is also to be completed in this step, and there will not be a separate Subgrade Exploration Report, the subgrade portion of the Roadway Report will need to be finalized prior to the end of Step 5. The Final version of the Roadway Exploration Report may also be completed in this step, or included in a later step submission.

While preliminary borings would not be obtained solely for overall alternative assessment in a constrained study area project, specific design features in the alternatives may require a preliminary exploration. These borings should be considered part of the overall Roadway Exploration program.

The geotechnical deliverables for this step are as follows:

- Location and extent of geologic and geotechnical concerns for all alternatives (to

be included as part of the CAS mapping)
- Documentation summarizing existing conditions and possible construction and long-term geotechnical and geologic issues with the proposed alternatives. Within this documentation would be the explanation of the need for preliminary soil borings for alternative evaluation. This information would be included as part of the CAS documentation.
- Draft/Final Roadway Exploration Report from the overall project geotechnical exploration (if performed and required by the project)
- Draft/Final Subgrade Exploration Report (if pavement design is moved to this step, and subgrade recommendations are separate from the Roadway Exploration Report), including subgrade exploration information, GB 1 analysis and spreadsheet (hard copy and electronic copy on CD)
- Draft Soil Profile Sheets – Plan/profile sheets showing boring location and graphical logs (SGE 702.6), presented in as much detail as possible

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:

- CAS document, which contains:
  - the first two bulleted geotechnical deliverable items above
  - the alternative evaluation matrix
  - a discussion of the alternatives selection
- All other geotechnical deliverables for this step (the Roadway Exploration Report and Subgrade Exploration Report may be separate submissions)

E. Assessment of Feasible Alternatives (AFA)

Major Project – Step 6

Step Summary

The purpose of the AFA is to analyze two or three of the alternatives developed in the CAS at a higher level of detail. Construction limits are developed based on typical cross section criteria. The ultimate goal of the AFA is to provide the basis for recommending a preferred alternative.

Geotechnical Deliverables

The geotechnical deliverables for Step 6 mostly consist of refinements to the Step 5 deliverables. The proposed boring plan and associated cost proposal for any geotechnical exploration work to be performed in this step may be submitted in an earlier step, but these items must be approved prior to doing the work. If preliminary borings are taken, they should be plotted on a plan and profile view, and the Preliminary Geotechnical Report should be developed. The location and extent of geologic and geotechnical concerns for each alternative should be refined based on this additional

information. Preliminary cost estimates for remediation of any geotechnical or geologic issues, for each proposed alternative, are developed. A summary of the Preliminary Geotechnical Exploration will be included in the combined AFA Report.

The geotechnical deliverables for this step are as follows:

- Preliminary borings (if any) plotted in plan and profile view
- Draft and Final versions of the Preliminary Geotechnical Exploration Report (if preliminary borings were taken)
- Revised location and extent of geologic and geotechnical concerns for each alternative, to be included as part of the AFA mapping
- Documentation, to be included as part of the AFA report, summarizing existing conditions and possible construction and long-term geologic and geotechnical issues for each alternative. Preliminary cost estimates for remediations should be included.

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:

- The AFA documentation, which includes:
  - the third and fourth bulleted geotechnical deliverable items above
  - the alternatives evaluation matrix
  - discussion of the preferred alternative selection
- All other geotechnical deliverables for this step (the plotted Preliminary borings and the Draft and Final versions of the Preliminary Geotechnical Exploration Report)
- Preliminary profiles

F. AFA with Constrained Study Areas

Major Project – Step 6

Step Summary

The Staged Review Process develops an increasing level of design detail as the number of alternatives is reduced. For projects that involve a constrained study area or limited number of alternatives, it is sometimes advantageous to complete detailed design work on the entire study area rather than phasing in these tasks over various review submissions. Selected tasks may move forward from the Preferred Alternative Verification (Step 7) into the Assessment of Feasible Alternative (Step 6). Two tasks of concern for geotechnical submissions are the completion of the pavement design and the initiation or completion of the subsurface exploration.

Geotechnical Deliverables and Geotechnical Review Submissions

The geotechnical deliverables and submissions will be based on project specific scheduling and requirements. The proposed boring plan and associated cost proposal for the geotechnical exploration work to be performed in this step may be submitted in an earlier step, but these items must be approved prior to doing the work.

If the pavement design is moved up to this step, the pavement boring information must be available. A Geotechnical Bulletin 1 (GB 1) analysis, including the spreadsheet and the subgrade exploration information, should be completed. Once the need for subgrade stabilization and the subgrade CBR are determined, the proposed pavement design can be developed. If the subgrade information will be a separate document from other geotechnical items, both the Draft and Final version of the Subgrade Exploration Report (SGE, Section 700) will be completed in this step.

If the overall project geotechnical exploration is initiated and completed in Step 6, the Draft version of the Roadway Exploration Report will be completed in this step. If the pavement design is also to be completed in this step, and there will not be a separate Subgrade Exploration Report, the subgrade portion of the Roadway Report will need to be finalized prior to the end of Step 6. The Final version of the Roadway Exploration Report may also be completed in this step, or included in a later step submission.

While preliminary borings would not be obtained solely for overall alternative assessment in a constrained study area project, specific design features in the alternatives may require a preliminary exploration. These borings should be considered part of the overall Roadway Exploration program.

The geotechnical deliverables for this step are as follows:

- Location and extent of geologic and geotechnical concerns for each alternative, updated as necessary, to be included as part of the AFA mapping
- Documentation, to be included as part of the AFA report, summarizing existing conditions and possible construction and long-term geologic and geotechnical issues for each alternative. Preliminary cost estimates for remediations should be included.
- Draft/Final Roadway Exploration Report from the project geotechnical exploration (if performed and required by the project) – would also include preliminary borings obtained for specific design features
- Draft/Final Subgrade Exploration Report (if pavement design has moved to this step and subgrade recommendations are separate from the Roadway Exploration Report), including subgrade exploration information, GB 1 analysis and spreadsheet (hard copy and electronic copy on CD)
- Draft Soil Profile Sheets – Plan/profile sheets showing boring location and graphical logs (SGE 702.6), presented in as much detail as possible

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:

- The AFA documentation, which includes:
  - the first and second bulleted geotechnical deliverable items above
  - the alternatives evaluation matrix
  - discussion of the preferred alternative selection
- All other geotechnical deliverables for this step (the Roadway Exploration Report and Subgrade Exploration Report may be separate submissions)
- Preliminary profiles

G. Preferred Alternative Verification

Major Project – Step 7

Step Summary

By the end of Step 7, a final preferred alternative has been recommended. The majority, if not all, of the subsurface exploration and testing has been performed. The final horizontal and vertical profiles are determined. Cross sections are partially developed. If retaining walls are to be utilized, a justification has been performed. The geotechnical work would be approximately 70 % complete.

Geotechnical Deliverables

The information contained in this section assumes that the project was not in a constrained study area, and therefore the subsurface exploration was not performed prior to Step 7. The proposed boring plan and associated cost proposal for the geotechnical exploration work to be performed in this step may be submitted in an earlier step, but these items must be approved prior to doing the work.

There are multiple geotechnical deliverables for Step 7. 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 locations of explorations 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 locations 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 Step. 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 GB 1 analysis should be performed as early as possible in Step 7.

For examples, 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. Replacement or widenings of interstates, 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 (early Step 7) 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 this step 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 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:

- The geotechnical deliverables for this step
- Retaining wall justification
- Title Sheet, Schematic, Typical Sections (showing subgrade stabilization if remedy is global), Plan/Profiles, and Cross Sections.

H. Minor Project Preliminary Engineering

Minor Project – Step 3

Step Summary

The purpose of the Minor Project Preliminary Engineering Study is to perform sufficient design work to determine an accurate design scope, project schedule, construction budget, and provide construction limits. Design work should minimize impact on red flag areas. Design decisions that could increase the construction limits should be investigated in this step. The study may be performed on single or multiple feasible alternatives.

By the end of Step 3, a final preferred alternative has been recommended. The majority, if not all, of the subsurface exploration and testing has been performed. The final horizontal and vertical profiles are determined. Cross sections are partially developed. If retaining walls are to be utilized, a Retaining Wall Justification is performed.

Geotechnical Deliverables

The proposed boring plan and associated cost proposal for the geotechnical exploration work to be performed in this step may be submitted in an earlier step, but these items must be approved prior to doing the work.

There are multiple geotechnical deliverables for Step 3. 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 Step. 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 GB 1 analysis should be performed as early as possible in Step 3.

For examples, 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 (early Step 3) 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 this step 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 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:

- The geotechnical deliverables for this step
- Retaining Wall Justification
- Title Sheet, Typical Sections (showing subgrade stabilization if remedy is global), Plan/Profiles, and Cross Sections.

I. Stage 1 Review

Major Project – Step 8
Minor Project – Step 4

Step Summary

By the end of this step, design plans are developed to the Stage 1 level. Right of Way plan development begins immediately after this step, and the construction limits should be accurate. The geotechnical exploration, testing, and reports are completed. Cross sections are nearly complete. Retaining wall and culvert plans are being developed. The geotechnical work is approximately 95% complete.

Geotechnical Deliverables

The information contained in this section assumes that the project was not in a constrained study area, and therefore neither the subgrade exploration nor the roadway exploration was performed prior to Step 7.

There are multiple geotechnical deliverables for this step. 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.

The geotechnical deliverables for this step 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 draft geotechnical review performed in the prior step
- Completed applicable sections of the Geotechnical Design Checklists

Geotechnical Review Submissions

Based on the information supplied in the Final Roadway Exploration Report, Stage 1 plans can be further 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 1 submittal depends on the wall type (cast-in-place, proprietary, special). Section 204.6 of the Bridge Design Manual should be consulted for design and submission requirements.

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:

- The geotechnical deliverables for this step
- Title Sheet, Schematic, Typical Sections, Plan/Profiles, Cross sections, General Notes, and Culvert Details (if applicable)
- Retaining Wall plans and design calculations, if applicable

J. Stage 2 Review

Major Project – Step 9
Minor Project – Step 5

Step Summary

At the end of the Stage 2 Detailed Design, 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. The geotechnical work will be 100% complete.

Geotechnical Deliverables

Essentially, the geotechnical work in this step is performed in response to Stage 1 geotechnical review comments. Additional or corrective action to previous work would be completed here. A disposition of Stage 1 geotechnical comments should be developed. Do not modify the Final Roadway Report and submit the report again.

The geotechnical deliverables for this step are as follows:

- Any additional or corrective action to Stage 1 work
- Disposition of Stage 1 geotechnical comments
- Any modified or additional Geotechnical Design Checklists

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:

- The geotechnical deliverables for this step
- Title Sheet, Schematic, Typical Sections, Plan/Profiles, Cross sections, Culvert and Retaining Wall detail sheets
- General Notes (including all geotechnical and earthwork related plan notes), Bridge notes, and geotechnical specifications

K. Stage 3 Review

Major Project – Step 11
Minor Project – Step 7

Step Summary

The Stage 3 Detailed Design should complete the design and detailing of the project.

These plans must contain all details and quantities required to bid and construct the proposed work.

Geotechnical Deliverables and Geotechnical Review Submissions

No geotechnical deliverables are expected for this step, although assistance in developing a disposition of Stage 2 comments may be needed.

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

Major Project Geotechnical Submissions

Step 2 Submission
- Red Flag Summary
- Geotechnical Red Flag Study, if required
- All required mapping

Step 3 Submission
- No geotechnical deliverables
- Geotechnical evaluation on an as-needed basis

Has the pavement design and/or the roadway exploration been moved to Step 5?
- Yes → Step 5 Pavement Design & Roadway Exploration
- No →

Step 5 Submission
- CAS Document

Has the pavement design and/or the roadway exploration been moved to Step 6?
- Yes → Step 6 Pavement Design & Roadway Exploration
- No →

Step 6 Submission
- AFA Document
- Plotted Preliminary borings, if any
- Draft and Final PGER, if any
- Preliminary Profiles

Step 7 Submission
- Geotechnical deliverables
- Retaining wall justification
- Title Sheet, Schematic, Typicals, Plan/Profiles, Cross sections

Step 8 Submission
- Geotechnical deliverables
- Retaining wall plans and design calculations
- Title Sheet, Schematic, Typicals, Plan/Profiles, Cross sections, General Notes and Culvert Details

Step 9 Submission
- Geotechnical deliverables
- Title Sheet, Schematic, Typicals, Plan/Profiles, Cross Sections, Culvert & Retaining wall details
- Geotechnical notes and specifications, bridge notes

Step 11 Submission
- Full set of Stage 3 plans
- Any Disposition of Stage 2 Comments

Step 5 Pavement Design & Roadway Exploration

Is the pavement design to be completed in this step?
- No → Is Final RER* due in this step?
  - No → **Step 5 Submission**: CAS Document; Draft RER *; Draft Soil Profile
  - Yes → **Step 5 Submission**: CAS Document; Draft & Final RER; Draft Soil Profile
- Yes → Is the roadway exploration to be completed in this step?
  - Yes → Will there be a separate SER?
    - No → Is Final RER** due in this step?
      - No → **Step 5 Submission**: CAS Document; Draft RER **; Draft Soil Profile
      - Yes → **Step 5 Submission**: CAS Document; Draft & Final RER; Draft & Final SER; Draft Soil Profile
    - Yes → Is Final RER due in this step?
      - Yes → **Step 5 Submission**: CAS Document; Draft & Final RER; Draft & Final SER; Draft Soil Profile
      - No → **Step 5 Submission**: CAS Document; Draft RER; Draft & Final SER; Draft Soil Profile
  - No → **Step 5 Submission**: CAS Document; Draft & Final SER; Draft Soil Profile

* *It is probable that the RER will contain a subgrade analysis, even though the pavement design is not finalized in Step 5*

** *The subgrade analysis within the RER must be finalized prior to the end of Step 5 so that the pavement design can be completed*

Step 6 Pavement Design & Roadway Exploration

Is the pavement design to be completed in this step?
- No → Is Final RER * due in this step?
  - No → **Step 6 Submission**: AFA Document; Draft RER *; Draft Soil Profile; Preliminary profiles
  - Yes → **Step 6 Submission**: AFA Document; Draft & Final RER; Draft Soil Profile; Preliminary profiles
- Yes → Is the roadway exploration to be completed in this step?
  - Yes → Will there be a separate SER?
    - No → Is Final RER** due in this step?
      - No → **Step 6 Submission**: AFA Document; Draft RER **; Draft Soil Profile; Preliminary profiles
      - Yes → **Step 6 Submission**: AFA Document; Draft & Final RER; Draft & Final SER; Draft Soil Profile; Preliminary profiles
    - Yes → Is Final RER due in this step?
      - Yes → **Step 6 Submission**: AFA Document; Draft & Final RER; Draft & Final SER; Draft Soil Profile; Preliminary profiles
      - No → **Step 6 Submission**: AFA Document; Draft RER; Draft & Final SER; Draft Soil Profile; Preliminary profiles
  - No → **Step 6 Submission**: AFA Document; Draft & Final SER; Draft Soil Profile; Preliminary profiles

* *It is probable that the RER will contain a subgrade analysis, even though the pavement design is not finalized in Step 6*

** *The subgrade analysis within the RER must be finalized prior to the end of Step 6 so that the pavement design can be completed*

Legend

PGER	*Preliminary Geotechnical Exploration Report*
SER	*Subgrade Exploration Report*
RER	*Roadway Exploration Report*