

CHAPTER 12 GEOTECHNICAL

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12.1 PREPARATION OF FULL PLANS AND SPECIFICATION SOLICITATION PACKAGES

- a) The purpose of this Section 12.1 is to outline Louisville District (LRL) geotechnical requirements for Design Bid Build (DBB) military construction projects to assist the A/E in (1) preparing full plans/specifications (specifically Section 31 00 00.00 06 Earthwork, other geotechnically-related specifications, and the geotechnical components of plans) and (2) providing geotechnical direction to the contractor.

12.1.1 GEOTECHNICAL INVESTIGATIONS

12.1.1.1 General

- a) A geotechnical exploration is performed to obtain site-specific subsurface data and to provide foundation and earthwork requirements for each project. Perform the geotechnical exploration under the direction of a licensed professional engineer (registered in the state of the project) specializing in geotechnical engineering with a minimum of 10 years of experience. Include the depth, thickness, extent, and composition of each surface and subsurface stratum and the groundwater conditions encountered with the geotechnical data.
- b) Conduct quality control checks on all geotechnical deliverables. An ITR member with a background specializing in geotechnical engineering is required to conduct Quality Control.
- c) If practicable, submit the geotechnical reports at the 30% design but prior to completion of the 65% interim stage of design. The purpose of completing the geotechnical reports at the 30% design and prior to the 65% interim is to assist in locating structures, to identify potential site development problems, and to determine the foundation system prior to the design team proceeding with the design of the project to accommodate time constraints. The objective being to allow the design team the opportunity to make an informed decision regarding the preferred cost-effective design.

12.1.1.2 Submission of Drilling Program

- a) Outline the proposed scope of the geotechnical exploration and return it as an attachment to the fee proposal before negotiation of the original contract. Design the character and extent of the exploration based on the importance of the structure to be constructed. Develop or modify the final program as project information becomes available to prepare an effective plan in an efficient and budget conscious manner.

12.1.1.3 Method of Exploration

- a) The field investigation consists of a series of soil test borings (or other appropriate exploratory methods). Select the number and spacing commensurate with the size and complexity of the structure as determined by the geotechnical Designer of Record.
- b) Penetrate all soil strata that could shear or consolidate materially under the proposed structural loads. Extend a minimum of one boring to refusal, or 100 feet for the purpose of establishing site seismic parameters. Extend borings to refusal or to bedrock for very heavy or sensitive structures. Obtain core samples to verify the character and continuity of the refusal material if design or subsurface conditions warrant. Extend borings in pavement areas to a minimum of 15 feet below ground surface or design grade plus 5 feet, whichever is deeper.
- c) In conjunction with the soil test borings, perform the standard penetration test to obtain disturbed soil samples for classification testing and to obtain an indication of the density of cohesionless soils and the strength of cohesive soils.
- d) Cone penetration testing can be performed to complement soil test borings.
- e) If quantitative laboratory testing is anticipated, collect the appropriate samples for testing. For example, obtain undisturbed thin-walled tube samples (minimum 3 inches diameter); and collect bag samples of auger cuttings from pavement and borrow areas to investigate the compaction characteristics of the soil.
- f) Obtain groundwater readings upon completion of drilling and 24 hours after drilling is completed. In unusual circumstances (e.g., where deep excavations are anticipated in areas of high groundwater), install observation wells to monitor the groundwater level.

- g) Retain all soil and rock samples taken during the exploration until the Geotechnical Evaluation & Recommendations Report (GERR) is approved. See Section 12.1.2 for more information on the GERR.
- h) Conduct geophysical surveys for all sites unless specified otherwise.

12.1.1.4 Laboratory Testing of Soils Samples

- a) Design the laboratory testing program to facilitate analysis of the subsurface conditions based on factual data, including classification tests to identify the soils within the Unified Soil Classification System (USCS), measure their physical properties, and enable an estimation of the behavior of the soils based on empirical correlations. Include visual examination, moisture content, Atterberg Limits, and grain size analyses.
- b) Calculate the allowable soil bearing pressure and the expected settlement of the structure. Perform quantitative laboratory tests, such as the unconfined compression, consolidation, and swell pressure tests, on undisturbed soil samples to assist in these analyses.
- c) Perform the California Bearing Ratio (CBR) test to quantify the subgrade strength for pavement design. Prepare remolded test specimens for CBR testing in accordance with the modified Proctor compaction test procedure, unless otherwise justified in advance by the Designer of Record.
- d) Perform more sophisticated field and laboratory studies if warranted by the complexity of the project. More sophisticated field studies may include, but are not limited to, pressuremeter measurements, plate bearing tests, inclinometer installation and monitoring, and advanced geophysical explorations. More sophisticated laboratory tests may include, but are not limited to, triaxial, direct shear, and permeability tests.

12.1.1.5 Background Information

- a) For projects within and outside the LRL traditional military boundaries, such as many of the Reserves Projects, contact the project's nearest Military Corps of Engineer (COE) District (known as the Servicing Corps Geographic-District) Geotechnical Engineering Section and the engineering authority at the facility where the construction will be performed (such as the Base Civil Engineer (BCE) or Department of Public Works (DPW)) and inquire about standard construction techniques relative to foundations, pavements and earthwork in the area and incorporate applicable requirements into the specifications.
- b) Obtain pavement minimums for projects outside the Louisville District boundaries from the project's Servicing Corps Geographic-District.
- c) Obtain background information relative to experience within the area from the Servicing Corps Geographic-District and the BCE or DPW contact, such as understanding complex soil conditions (such as swelling/collapsing soils) where traditional shallow spread footings may not be feasible, where lime stabilization is typically used beneath pavements, if known seismic conditions requiring remediation are encountered, or if any other geotechnical anomaly typically can be encountered.
- d) Include the name of the COE Servicing Corps-Geographic-District contact and BCE or DPW contact, their phone number and a summary of what was discussed in the Design Analysis.

12.1.1.6 Specific Information Relative to Frost Penetration and use of the UFC:

- a) Determine the frost line depth in accordance with latest edition of UFC 3-301-01. UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), states "Frost line depth for foundation construction must be specified by the project geotechnical engineer."

12.1.1.7 Specific Information Relative to Required Spectral Accelerations:

- a) Base spectral accelerations on the latest edition of UFC 3-301-01. UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), requires the use of ASCE Hazard Tool (<https://ascehazardtool.org>). Where seismic parameters are not provided by the ASCE Hazard Tool, consult the authority having jurisdiction.

12.1.2 GEOTECHNICAL REPORTING

12.1.2.1 General

- a) The typical geotechnical exploration can be divided into 3 major components: the fieldwork/laboratory testing, the findings, and the evaluation/calculations/recommendations. Provide the findings, including the site history, geology, subsurface conditions, and laboratory results in a Geotechnical Data Report (GDR). Include only factual project data in the GDR, such as site observations, site photos, site history, borings, sample photos, geophysical findings, and laboratory data. Do not include any evaluation, interpretation, calculations, or recommendations in the GDR.
- b) Provide all geotechnical evaluation, interpretation, calculations, conclusions, and recommendations in the Design Analysis (DA) or provide them under separate cover from the GDR in a Geotechnical Evaluation & Recommendations Report (GERR).
- c) The purpose for this bifurcation of a typical geotechnical report into the GDR and GERR is so that if a contractor requests the “geotechnical report” or all the geotechnical data to which they are entitled, they can be provided the data easily without providing the calculations and recommendations. Inclusion of the interpretation, calculations, conclusions, and recommendations has contributed to confusion and elevated risk to the Government since these components of a typical geotechnical exploration are for design purposes, not construction purposes. Therefore, the Government wishes to separate the factual data from the recommendations and calculations.
- d) Conduct a foundation design analysis to demonstrate that the type of foundation system selected can support the structure(s) given the site conditions. Include a narrative describing the design approach and all estimates and assumptions made, as well as soil bearing and settlement calculations in accordance with the guidelines and general requirements of UFC 3-220-01 entitled “Geotechnical Engineering.”
- e) Upload boring logs and laboratory testing to USACE’s OpenGround Cloud in accordance with the directions provided in Section 12.4..

12.1.2.2 Specific Requirements

- a) Submit the GDR and GERR no later than the 65% interim stage of the design (ideally, prior to the 30% design stage). Prepare the written reports after the project information has been reviewed and the collective subsurface information has been analyzed. Support all conclusions and recommendations with appropriate calculations and/or discussion.
- b) Include the following in the GDR at a minimum:
 1. A review of information on existing structures in the area.
 2. A review of site history and prior construction.
 3. A review of the area geologic conditions and site topographic features.
 4. a review of the subsurface stratigraphy with the results of all testing conducted.
- c) Include the following in the GERR at a minimum:
 1. A general evaluation of the site considering the proposed project and the estimated subsurface conditions including an evaluation of any geotechnical concerns that were identified.
 2. Comprehensive foundation and earthwork recommendations including recommendations to address any geotechnical concerns identified, bearing capacity and settlement calculations, and discussions to support the recommended foundation system.
 3. Backup documentation (sources) for any design parameters such as shear strength, earth pressure coefficients, friction factors, subgrade modulus, CBR, etc.
 4. Seismic design criteria (Ss, S1, and site class).

5. Pavement design calculations.

Pavements: Include flexible and rigid pavement design(s) including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades in the GERR. Provide information on the types of base course materials available in the area and design strengths. Pavement typically should have a design life of 20 years using appropriate traffic loading. Design pavements using the PCASE software and in accordance with UFC 3-250-01, latest version.

Provide a minimum flexible pavement section of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Provide a minimum rigid pavement section of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30. **[Note to Preparer: The stated minimums are for the Louisville District traditional military boundaries only. Pavement minimums in other parts of the country need to be obtained from the Servicing Corps Geographic-District, BCE, DPW, or an experienced pavement designer in the area.]**

Design subsurface drainage associated with pavements in accordance with the latest edition of UFC 3-250-01.

Specify in the plans and specifications all specific aggregates proposed in the pavement design per state DOT or Transportation Cabinet designations and gradations, including the aggregate to be used to choke off drainage layer aggregates to accommodate paving equipment.

Specify a binder grade appropriate for the intended use and readily available in the project locale. The local DOT-specified binder grades are a good reference.

6. Topsoil depths: If the topsoil depth exceeds 8 inches, obtain at least 3 representative samples of the topsoil (from three different boring locations) for organic content testing. In addition, obtain at least 3 representative samples of the soil 6 inches below the material visually described as topsoil for organic content testing. Representative for these purposes means “most typical of the site.” Obtain samples in manner so that they represent the full depth increment. As an example, if topsoil is 12 inches thick, obtain a sample from 0 inches to 12 inches and a sample from 12 to 18 inches. Determine the organic content in accordance with ASTM D2974 (latest edition).
 7. Percolation rates, resistivity readings, corrosion potential, and shear wave velocities of the subsurface materials, if requested, in the GERR.
 8. Soils information obtained from field logs and laboratory tests.
- d) Present logs on the contract drawings in the form of boring plans, final boring logs and explanatory notes. Include complete subsurface information such as dates, elevations, depths to rock, depths to groundwater, drilling equipment used, and the presence of unsatisfactory materials.
 - e) Do not include the GERR in the bid/contract documents and do not incorporate earthwork and other recommendations (such as undercutting of soft materials, etc.) by direct reference to the GERR. The GERR is NOT part of the bid/contract documents. To be contractually binding, incorporate the desired information or requirement directly into the plans and specifications.
 - f) The Government’s preference is not to include the GDR in the bid/contract documents. Instead, incorporate relevant information from the GDR, such as the Boring Location Plan, borings logs and geophysical findings, into the project plans. However, if the GDR must be made available, obtain approval from the Contracting Officer’s Representative (COR) and mark the document for information only (FIO) and repeat the FIO limitation in the earthwork specification.

12.1.2.3 Soil Compaction and Foundation Excavation

- a) Require that soil compaction be achieved by equipment approved by a professional geotechnical engineer.
- b) Specify material be moistened or aerated as necessary to provide the moisture content to readily facilitate obtaining the compaction specified with the equipment used.

- c) Limit each layer of fill placement to no greater than 8-inch loose lifts compacted to not less than the percent of maximum density specified in Table 12-1 as determined in accordance with ASTM D1557.

Foundations	[95%]
Concrete Work and Pavements	[90%]
Landscaping	[85%]
Retaining Wall Backfill	[85 – 90%]

- d) Confirm the appropriateness of the compaction requirements above with the geotechnical designer of record and recommend modifications in the GERR whenever engineering, soils or climatic factors indicate the necessity. Obtain approval of any modifications to the stated compaction requirements from the COR.

12.1.3 GUIDE SPECIFICATIONS

12.1.3.1 Earthwork Specification

- a) Use the latest version of the LRL Earthwork Guide Specifications 31 00 00.00 06.
- b) Review all subsurface information and determine which soil types are satisfactory and which are unsatisfactory with respect to the project requirements and incorporate this determination into the earthwork specification.

12.1.3.2 Pavement Specification

- a) UFGS 32 12 16.16 Road-Mix Asphalt Paving is the preferred guide specification for asphalt pavement.
- b) In the guide specification, there are pay factors that set the requirements for asphalt compaction. The pay factors are based on a specified unit price determined from current geographical area pricing. Use pay factors on both unit-price and lump-sum contracts. The guide specification includes language for both options.
- c) Obtain approval from the COR if pay factors will not be used. This approach is strongly discouraged for all projects, since it requires removal if the strict density requirements are not obtained. Specify the target specification for asphalt pavement density as 94% to 96%. Require removal and replacement of pavements not meeting this requirement at the Contractor’s expense.

12.1.4 PLANS/DRAWINGS/DESIGN ANALYSIS

12.1.4.1 Data

- a) Where applicable, provide the allowable soil or rock bearing pressure on the plans. Make it clear the pressure provided is the design (allowable) pressure used in sizing the foundations and that this pressure is not the ultimate pressure which the soil or rock can bear.

12.1.4.2 Drawings

- a) Verify that the drawing set contains a boring location plan, soils classification sheet, and boring logs with laboratory test results.
- b) Show all physical surface features of the site such as rock outcrops, wet areas (swamps, marshy areas), sanitary landfills, existing pavement condition, that can influence the design and construction of the project.

12.1.4.3 Drawing Notes

- a) Verify that the plans require that “during construction, all foundation excavations shall be judged suitable by the Contractor’s Geotechnical Engineer and judged suitable by the Contractor Officer’s Representative prior to placing concrete.” Typically, this statement is on the “Structural Notes” Plan Sheet under “Foundation Notes” and in the earthwork specification.

12.1.4.4 Design Analysis

- a) Verify the allowable bearing capacity recommended by the geotechnical engineer is used in the structural calculations.

- b) Verify that floor slab calculations have been performed in accordance with UFC 3-301-01 “Structural Engineering,” UFC 3-320-06A “Concrete Floor Slabs on Grade Subjected to Heavy Loads,” and the recommendations in the GERR.
- c) Verify footing depths are below frost depths recommended in the GERR.
- d) Verify the pavement design in the GERR is used in the pavement detail.
- e) Verify the pavement detail designates specific aggregates and includes underdrain details if underdrains are required.

12.1.4.5 Certification

- a) Certify in writing that the design of the project has been designed consistent with the final geotechnical report. Provide certification from the professional geotechnical engineer with the first design submission. If revisions are made to the initial design submission, provide a new certification with the final design submission.

12.2 PREPARATION OF DESIGN/BUILD SOLICITATION PACKAGES (RFPs)

- a) The purpose of Section 12.2 is to outline the geotechnical requirements for the preparation of Design Build (D/B) solicitation packages for Louisville District's (LRL) military construction projects. This document is to assist the A/E with preparation of the geotechnical portion of the Guide Specification and to provide direction to its geotechnical specialist/subcontractor.

12.2.1 APPLICABILITY

- a) Use the requirements herein for preparation of D/B solicitation packages (Requests for Proposals, or RFPs) for military construction projects for LRL.
- b) There are multiple RFP templates being used and most templates contain dated language with respect to geotechnical (soils) requirements. Therefore, regardless of the RFP template or guide specification being used, update it with the geotechnical language using the requirements herein.
- c) In general, this guidance is applicable in its entirety to traditional military projects within LRL traditional military boundaries. In the case of MILCON Transformation and Army/Air Force Reserves Projects, exceptions to the requirements herein typically include requirements to use UFC 3-250- 01 for Pavement Design.
- d) With the most used templates, the language presented herein can be found in Section 01 02 00.00 48 (Statement of Work) under Part 3 – Site Civil Engineering and Part 7 – Design - Structural. This template may also include conflicting or redundant language in Section 01 03 00.00 48 (Design After Award). Verify that the most current language as presented in this document is being used, and that any redundant or conflicting language be removed.
- e) Obtain approval for any deviations from the requirements presented herein through the LRL COE A/E manager for all Louisville District Projects.
- f) The guidance herein is changed on a regular basis (based on lessons learned), therefore, verify that you access the Louisville Military Design Guide website for each job to assure you are using the most up to date requirements.

12.2.2 DISCUSSION OF GEOTECHNICAL STUDIES (GENERAL)

- a) For D/B RFPs, in general, redact any recommendations in the geotechnical report in the RFP package. Instead, provide only factual data, such as the site description, appropriate background/site history information, boring logs, and laboratory testing. The purpose of this requirement is so the D/B Contractor's Designer of Record (DOR) is responsible for the extraction of design parameters from the data given and thus is responsible for the design. In addition, this approach typically requires the D/B Contractor to have a geotechnical team member involved early.
- b) Defining the subsurface conditions at a site is most complete if the RFP package includes a "Full Geotechnical Characterization Report" (enough boring and laboratory information to get complete coverage and representation of the site conditions). A Full Site Characterization Report is most appropriate to avoid differing site conditions and thus claims. Sometimes the RFP will only contain a Preliminary Site Characterization Report (fewer borings). In this case, LRL requires the D/B Contractors to base their bid on the preliminary information and then to verify that the data is representative by performing additional investigation after award and prior to their design. Coordinate with the LRL COE A/E manager to discuss the approach they wish to take on each individual project.
- c) In addition to other data collection described herein, if the topsoil depth exceeds 8 inches, obtain at least 3 representative samples of the topsoil (from three different boring locations) for organic content testing. In addition, obtain at least 3 representative samples of the soil 6 inches below the material visually described as topsoil for organic content testing. Representative for these purposes means "most typical of the site." Obtain samples in manner so that they represent the full depth increment. As an example, if topsoil is 12 inches thick, obtain a sample from 0 inches to 12 inches and a sample from 12 to 18 inches. Determine the organic content in accordance with ASTM D2974 (latest edition).
- d) The standard language provided herein is guidance. It is primarily applicable when problems are not anticipated with foundation and pavement support conditions or unknowns such as large quantities of unexpected rock

removal. If the geotechnical data obtained for the D/B RFP solicitation package indicates problem conditions such as soft soils, uncontrolled fills, shallow or unpredictable quantities of bedrock removal, seismic issues, etc., it may be necessary to modify the D/B RFP solicitation package in an attempt to proactively avoid potential issues that may be encountered after award (such as modifications due to differing site conditions). As an example, if it is known that the soils are not suitable for shallow foundations based on the borings, it may be prudent to specify a foundation type in the D/B solicitation package or at least state shallow foundations will not be suitable; therefore, the expectation is that the A/E should not simply use the language verbatim as given herein without considering the geotechnical ramifications. The requirement is that the geotechnical borings be done in a timely manner so if there are indications of problems, the A/E can notify the LRL COE A/E Manager that there may be issues and seek our input to the solution. Sometimes, it may be desirable to direct bidders to design the foundation system or pavements, or other geotechnical features specifically requested, based on customer preference or other reasons. This is acceptable provided the language makes it clear in the RFP package. Communication with the LRL COE A/E manager is key.

- e) Pavements: It is important that expected traffic loading criteria for the design of proposed roads and parking lots is gathered by the preparer of the solicitation package so potential design-build contractors have the correct parameters on which to base their bid. Include the exact vehicle types and the number of passes for each vehicle over the design life of the pavement in traffic loading. The basis for this information must be obtained from the customer by an experienced pavement designer who can make sound judgments to interpret the customer information and translate it into a reasonable traffic loading criteria on which the D/B contractor can base their bid. In addition, the desired design life of the pavement (generally 20 years) must be obtained from the customer and specified in the D/B RFP. It is also important that data be obtained and presented in the RFP solicitation package relative to the subgrade stiffness (typically given in terms of CBR for flexible pavements and modulus of subgrade reaction, k, for rigid pavements). If it is not practical to perform CBR testing for whatever reason, a sound judgment must be made based on the other geotechnical data obtained as to appropriate CBR and k values to give the D/B contractor as a basis for bid in the RFP.
- f) Background information: For projects within and outside the Louisville Districts traditional military boundaries, such as many of the Reserves Projects, contact the project's nearest Military Corps of Engineer District (known as the Servicing Corps Geographic-District) Geotechnical Engineering Section and the engineering authority at the facility where the construction will be performed (such as the Base Civil Engineer (BCE) or Department of Public Works (DPW)) and inquire about standard construction techniques relative to foundations, pavements and earthwork in the area and incorporate applicable requirements into the D/B specifications. In addition, obtain pavement minimums for projects outside LRL from the project's Servicing Corps Geographic-District. Obtain background information relative to experience within the area, such as known swelling soil potential where drilled piers or mat foundations are typically used instead of shallow spread footings, where lime stabilization is typically used beneath paving, or if known seismic conditions requiring remediation are encountered, etc. Include the name of the COE Servicing District Contact and BC or DPW contact, their phone number, and a summary of what was discussed in the Design Analysis.
- g) Specific Information Relative to Frost Penetration and use of the UFC: Determine the frost line depth in accordance with UFC 3-301-01 (latest edition). UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), states "Frost line depth for foundation construction must be specified by the project geotechnical engineer."

12.2.3 A/E SUBMISSION OF DRILLING PROGRAM

- a) Require the proposed scope of exploration be outlined and returned as an attachment to the fee proposal before negotiation of the original contract. Require the character and extent of the exploration be designed in consideration of the importance of the structure to be constructed. Require the submission contain enough information such that the A/E demonstrates an understanding of the guidance and requirements presented herein. Require the final program be developed as information accumulates to obtain the greatest amount of useful information in the most cost-effective manner.

12.2.4 GUIDE SPECIFICATIONS (TYPICALLY SECTION 01 02 00.00 48)

- a) Specific language associated with Geotechnical Studies within Guide Specification 01 02 00.00 48 is presented below (**notes to the preparer are bolded**).

12.2.5 GEOTECHNICAL STUDIES

12.2.5.1 Subsurface Characterization Report

- a) **NOTE TO THE PREPARER:** Use the 1st paragraph below (Example 1) as a guide if a “Full Site Characterization Report” as described in Section 12.2.2 is being provided in the solicitation package and use the 2nd paragraph below (Example 2) if a “Preliminary Site Characterization Report” as described in Section 12.2.2 is being provided in the solicitation package. Appropriately modify the language below if other than a “Full Site Characterization Report” or “Preliminary Site Characterization Report” is being provided in the solicitation package.

- b) Example 1 (Full Site Characterization Report).

A report has been prepared to characterize the subsurface conditions at the project site and is appended to these specifications. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. Include a licensed geotechnical engineer in the project state with at least 10 years of experience specializing in geotechnical engineering on the Contractor’s team to interpret the report and develop earthwork and foundation requirements and design parameters on which to base their proposal. Present the foundation type, pavement, and earthwork requirements on which the Contractor’s bid is based in the proposal, along with the resume of the geotechnical engineer.

If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, it will be performed after the award under the direction of a licensed geotechnical engineer and will be the full responsibility of the Contractor. After award, perform and provide a complete geotechnical report of the proposed site to develop the final design.

- c) Example 2 (Preliminary Site Characterization Report).

A preliminary report has been prepared to characterize the subsurface conditions at the project site and is appended to these specifications. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. Include a licensed geotechnical engineer in the project state with at least 10 years of experience specializing in geotechnical engineering on the Contractor’s team to interpret the report and develop earthwork and foundation requirements and design parameters on which to base their proposal. Present the foundation type, pavement, and earthwork requirements on which the Contractor’s bid is based in the proposal, along with the resume of the geotechnical engineer.

After award, perform a complete geotechnical exploration of the proposed site to develop the final design and prepare a geotechnical report. This exploration is the full responsibility of the Contractor. Detailed requirements are outlined herein. It is possible that site specific subsurface conditions encountered by the Contractor will differ from those appended herein. Therefore, it is the responsibility of the Contractor to establish a meeting with the Contracting Officer’s Representative (COR) after completion and evaluation of the site-specific geotechnical exploration to outline any differences encountered that are not consistent with the information provided herein. Clearly outline in the meeting any differences that require changes resulting in cost increases in the foundation type, pavement and earthwork requirements proposed with the bid that result.

12.2.5.2 Application and Usage of the Contractor’s Geotechnical Report

- a) The Contractor will prepare a final geotechnical report per these specifications. This report must provide all recommendations as detailed in subsequent sections. The applicable recommendations from the geotechnical report must be incorporated into the plans and specifications. The geotechnical report is not a contractually binding document and must not be used as a component of the contractual documents. The geotechnical report may be provided but must be marked “For Information Only.”

12.2.5.3 Contractor’s Geotechnical Report

- a) Prepare a final geotechnical report and submit it along with the first foundation design submittal [**NOTE TO THE PREPARER: add the following statement to the end of this sentence if a full characterization report is performed: “using the data in RFP package”**]. Summarize the subsurface conditions and provide requirements for the design of appropriate foundations, floor slabs, retaining walls, embankments, and pavements. Specify the type of foundation system to be used, lateral load resistance capacities for foundation systems, allowable bearing elevations for footings, grade beams, slabs, etc. Provide an assessment of post-

construction settlement potential, including total and differential. Provide requirements regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the required spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and requirements for mitigation, if necessary. Base spectral accelerations on the latest edition of UFC 3-301-01. UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), requires the use of ASCE Hazard Tool (<https://ascehazardtool.org>). Where seismic parameters are not provided by the ASCE Hazard Tool, consult the authority having jurisdiction.

- b) Include calculations to support the requirements for bearing capacity, settlement, and pavement sections. Include supporting documentation for all required design parameters such as site class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. In addition, provide earthwork requirements, expected frost penetration depth, expected groundwater levels, requirements for dewatering and groundwater control, possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Provide the original field data. Design all corrosion control and grounding systems required for the project. Determine project dewatering requirements. If temporary construction dewatering is required due to a high water table, prepare and present a dewatering plan. Secure all the required information necessary for the design of the dewatering system.
- c) Upload boring logs and laboratory testing to USACE's OpenGround Cloud in accordance with the directions provided in Section 12.4.

12.2.5.4 Additional Borings

- a) Sample any additional borings with a split spoon sampler in accordance with ASTM D1586, with all samples visually classified (unless specified otherwise) in accordance with the Unified Soil Classification System (ASTM D2487). Record the depth to water. Record Standard Penetration blow counts. Provide a dated drilling log for each boring drilled. Present soils information obtained from field logs and laboratory tests on the contract drawings in the form of a boring location plan, final boring logs, and explanatory notes.

12.2.5.5 Pavements

- a) Include flexible and rigid pavement design(s) in the geotechnical report, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades. Provide information on the types and strengths of base course materials available. Provide a design life of **[typically 20]** years using the traffic loading requirements presented herein.
- b) Conduct pavement designs in accordance with the latest edition of UFC 3-250-01, which requires the use of PCASE software. Regardless of the pavement design, provide a minimum flexible pavement section of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Regardless of the pavement design, provide a minimum rigid pavement section of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30. **[NOTE TO THE PREPARER: The above minimums are for the Louisville District traditional military boundaries only. Pavement minimums in other parts of the country need to be obtained from the Servicing Corps Geographic-District, BCE, DPW, or an experienced pavement designer in the area.]**
- c) Design subsurface drainage associated with pavements in accordance with the latest edition of UFC 3-250-01.
- d) Specify in plans and specifications all the specific aggregates proposed in the pavement design per local state DOT designations and gradations including the aggregate used to choke off drainage layer aggregates to accommodate paving equipment.
- e) Specify a binder grade appropriate for the intended use and readily available in the project locale. The local DOT-specified binder grades are a good reference.
- f) For bidding purposes, perform the design of the pavement under the provisions of this RFP (as the basis for his bid) using a subgrade CBR of **[typically 3 unless laboratory or experience suggest otherwise]** and the following traffic loading for a design service life of **[typically 20]** years: **[provide assumed traffic type,**

loading, and frequency]. Should this design result in a pavement section less than the minimums required above, base the bid on the minimum pavement sections.

[NOTE TO THE PREPARER: Provide a site-specific CBR. The laboratory CBR is not always used as the design CBR. An experienced designer in the area should determine the CBR to be placed here for design. Do not only depend on the laboratory test results, as laboratory results are commonly reduced or design purposes. Include the exact vehicle types and the number of passes for each vehicle over the design life of the pavement in traffic loading criteria. Obtain traffic loading information from the customer by an experienced pavement designer who can make sound judgments to interpret the customer information and translate it into a reasonable traffic loading criteria in which the DB contractors can base their bids.]

12.2.5.6 Soil Compaction and Foundation Excavations

- a) Require that soil compaction be achieved by equipment approved by a professional geotechnical engineer.
- b) Specify material be moistened or aerated as necessary to provide the moisture content to readily facilitate obtaining the compaction specified with the equipment used.
- c) Limit each layer of fill placement to no greater than 8-inch loose lifts compacted to not less than the percent of maximum density specified in Table 12-1 as determined in accordance with ASTM D1557.

Table 12-1 Soil Compaction	
Foundations	[95%]
Concrete Work and Pavements	[90%]
Landscaping	[85%]
Retaining Wall Backfill	[85 – 90%]

- d) Confirm the appropriateness of the compaction requirements above with the geotechnical designer of record and recommend modifications in the GERR whenever engineering, soils or climatic factors indicate the necessity. Obtain approval of any modifications to the stated compaction requirements from the Contracting Officer’s Representative (COR).

12.2.6 GUIDE SPECIFICATIONS

12.2.6.1 Earthwork Specification

- a) Use the latest version of the LRL Earthwork Guide Specifications 31 00 00.00 06.
- b) Review all subsurface information and determine which soil types are satisfactory and which are unsatisfactory with respect to the project requirements and incorporate this determination into the earthwork specification.

12.2.6.2 Pavement Specifications

- a) UFGS 32 12 16.16 Road-Mix Asphalt Paving is the preferred guide specification for asphalt pavement.
- b) In the guide specification, there are pay factors that set the requirements for asphalt compaction. The pay factors are based on a specified unit price determined from current geographical area pricing. Use pay factors on both unit-price and lump-sum contracts. The guide specification includes language for both options.
- c) Obtain approval from the COR if pay factors will not be used. This approach is strongly discouraged for all projects, since it requires removal if the strict density requirements are not obtained. Specify the target specification for asphalt pavement density as 94% to 96%. Require removal and replacement of pavements not meeting this requirement at the Contractor’s expense.

12.2.7 PLANS/DRAWINGS/DESIGN ANALYSIS

12.2.7.1 Data

- a) Where applicable, provide the allowable soil or rock bearing pressure on the plans. Make it clear the pressure provided is the design (allowable) pressure used in sizing the foundations and that this pressure is not the ultimate pressure which the soil or rock can bear.

12.2.7.2 Drawings

- a) Verify the drawing set contains a boring location plan, soils classification sheet, and boring logs with laboratory test results.
- b) Show all physical surface features of the site, such as rock outcrops, wet areas (swamps, marshy areas), sanitary landfills, existing pavement condition, that can influence the design and construction of the project.

12.2.7.3 Drawing Notes

- a) Verify the plans require that “during construction, all foundation excavations be inspected and approved by the Contractor’s Geotechnical Engineer prior to placing concrete.” Typically, this statement is on the “Structural Notes” Plan Sheet under “Foundation Notes” and in the earthwork specification.

12.2.7.4 Design Analysis

- a) Verify the allowable bearing capacity recommended by the geotechnical engineer is used in the structural calculations.
- b) Verify that floor slab calculations have been performed in accordance with UFC 3-301-01 “Structural Engineering,” UFC 3-320-06A “Concrete Floor Slabs on Grade Subjected to Heavy Loads,” and the recommendations in the geotechnical report.
- c) Verify footing depths are below frost depths recommended in the geotechnical report.
- d) Verify the pavement design in the geotechnical report is used in the pavement detail.
- e) Verify the pavement detail designated specific aggregates and includes underdrain details if underdrains are required.

12.2.7.5 Certification

- a) Certify in writing that the design of the project has been designed consistent with the Contractor’s final geotechnical report. Provide certification from both the D/B contractor and the professional geotechnical engineer consultant with the first design submission. If revisions are made to the initial design submission, provide a new certification with the final design submission.

12.3 PREPARATION OF DESIGN/ BUILD DESIGN PACKAGES

- a) The purpose of Section 12.3 is to outline the geotechnical requirements for the preparation of designs for Design/Build packages Louisville District (LRL) construction projects. This document is to assist the Design/Build Contractor's designer with preparation of the geotechnical portion of the plans and specifications and to provide direction to its geotechnical specialist/subcontractor.

12.3.1 APPLICABILITY

- a) Use the requirements herein for preparation of Design/Build Designs for projects for the Louisville District Corps of Engineers (LRL).
- b) In general, this guidance is applicable in its entirety to traditional military projects within LRL traditional military boundaries. In the cases of MILCON Transformation and Army/Air Force Reserves Projects, exceptions to the requirements herein typically include requirements to use UFC 3-250- 01 for Pavement Design.
- c) Obtain approval for any deviations from the requirements presented herein through the COE LRL A/E manager for all Louisville District Projects.
- d) The guidance herein is changed on a regular basis (based on lessons learned), therefore, verify that you access the Louisville Military Design Guide website for each job to assure you are using the most up to date requirements.

12.3.2 DISCUSSION OF GEOTECHNICAL STUDIES (GENERAL)

- a) Background information: For projects within and outside the Louisville Districts traditional military boundaries, such as many of the Reserves Projects, contact the project's nearest Military Corps of Engineer District (known as the Servicing Corps Geographic-District) Geotechnical Engineering Section and the engineering authority at the facility where the construction will be performed (such as the Base Civil Engineer (BCE) or Department of Public Works (DPW)) and inquire about standard construction techniques relative to foundations, pavements and earthwork in the area and incorporate applicable requirements into the D/B specifications. In addition, obtain pavement minimums for projects outside LRL from the project's Servicing Corps Geographic-District. Obtain background information relative to experience within the area, such as known swelling soil potential where drilled piers or mat foundations are typically used instead of shallow spread footings, where lime stabilization is typically used beneath paving, or if known seismic conditions requiring remediation are encountered, etc. Include the name of the COE Servicing District Contact and BC or DPW contact, their phone number, and a summary of what was discussed in the Design Analysis.
- b) In addition to other data collection described herein, if the topsoil depth exceeds 8 inches, obtain at least 3 representative samples of the topsoil (from three different boring locations) for organic content testing. In addition, obtain at least 3 representative samples of the soil 6 inches below the material visually described as topsoil for organic content testing. Representative for these purposes means "most typical of the site." Obtain samples in manner so that they represent the full depth increment. As an example, if topsoil is 12 inches thick, obtain a sample from 0 inches to 12 inches and a sample from 12 to 18 inches. Determine the organic content in accordance with ASTM D2974 (latest edition).
- c) Specific Information Relative to Frost Penetration and use of the UFC: Determine the frost line depth in accordance with latest edition of UFC 3-301-01. UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), states "Frost line depth for foundation construction must be specified by the project geotechnical engineer."

12.3.3 A/E SUBMISSION OF DRILLING PROGRAM

- a) Require the proposed scope of exploration be outlined and returned as an attachment to the fee proposal before negotiation of the original contract. Require the character and extent of the exploration be designed in consideration of the importance of the structure to be constructed. Require the submission contain enough information such that the A/E demonstrates an understanding of the guidance and requirements presented herein. Require the final program be developed as information accumulates to obtain the greatest amount of useful information in the most cost-effective manner.

12.3.4 GEOTECHNICAL STUDIES

12.3.4.1 Application and Usage of the Contractor's Geotechnical Report

- a) The Contractor will prepare a final geotechnical report per these specifications. This report must provide all recommendations as detailed in subsequent sections. The applicable recommendations from the geotechnical report must be incorporated into the plans and specifications. The geotechnical report is not a contractually binding document and must not be used as a component of the contractual documents. The geotechnical report may be provided but must be marked "For Information Only."

12.3.4.2 Contractor's Geotechnical Report

- a) Prepare a final geotechnical report and submit it along with the first foundation design submittal. Summarize the subsurface conditions and provide requirements for the design of appropriate foundations, floor slabs, retaining walls, embankments, and pavements. Specify the type of foundation system to be used, lateral load resistance capacities for foundation systems, allowable bearing elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential, including total and differential. Provide requirements regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the required spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and requirements for mitigation, if necessary. Base spectral accelerations on the latest edition of UFC 3-301-01. UFC 3-301-01, Change 3, dated 3 February 2025 (latest edition at the time of publication of Chapter 12), requires the use of ASCE Hazard Tool (<https://ascehazardtool.org>). Where seismic parameters are not provided by the ASCE Hazard Tool, consult the authority having jurisdiction.
- b) Include calculations to support the requirements for bearing capacity, settlement, and pavement sections. Include supporting documentation for all required design parameters such as site class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. In addition, provide earthwork requirements, expected frost penetration depth, expected groundwater levels, requirements for dewatering and groundwater control, possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Provide the original field data. Design all corrosion control and grounding systems required for the project. Determine project dewatering requirements. If temporary construction dewatering is required due to a high water table, prepare and present a dewatering plan. Secure all the required information necessary for the design of the dewatering system.
- c) Upload boring logs and laboratory testing to USACE's OpenGround Cloud in accordance with the directions provided in Section 12.4.

12.3.4.3 Additional Borings

- a) Sample any additional borings with a split spoon sampler in accordance with ASTM D1586, with all samples visually classified (unless specified otherwise) in accordance with the Unified Soil Classification System (ASTM D2487). Record the depth to water. Record Standard Penetration blow counts. Provide a dated drilling log for each boring drilled. Present soils information obtained from field logs and laboratory tests on the contract drawings in the form of a boring location plan, final boring logs, and explanatory notes.

12.3.4.4 Pavements

- a) Include flexible and rigid pavement design(s) in the geotechnical report, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades. Provide information on the types and strengths of base course materials available. Provide a design life of **typically 20** years using the traffic loading requirements presented herein.
- b) Conduct pavement designs in accordance with UFC 3-250-01 Dated 14 November 2016, which requires the use of PCASE software. Regardless of the pavement design, provide a minimum flexible pavement section of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Regardless of the pavement design, provide a minimum rigid pavement section of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30. **[NOTE: The above minimums are for the Louisville District traditional military boundaries only. Pavement minimums in other parts of the country need to be**

obtained from the Servicing Corps Geographic-District, BCE, DPW, or an experienced pavement designer in the area.]

- c) Design subsurface drainage associated with pavements in accordance with the latest edition of UFC 3-250-01.
- d) Specify in plans and specifications all the specific aggregates proposed in the pavement design per local state DOT designations and gradations including the aggregate used to choke off drainage layer aggregates to accommodate paving equipment.
- e) Specify a binder grade appropriate for the intended use and readily available in the project locale. The local DOT-specified binder grades are a good reference.

12.3.4.5 Soil Compaction and Foundation Excavations

- a) Require that soil compaction be achieved by equipment approved by a professional geotechnical engineer.
- b) Specify material be moistened or aerated as necessary to provide the moisture content to readily facilitate obtaining the compaction specified with the equipment used.
- c) Limit each layer of fill placement to no greater than 8-inch loose lifts compacted to not less than the percent of maximum density specified in Table 12-1 as determined in accordance with ASTM D1557.

Table 12-1 Soil Compaction	
Foundations	[95%]
Concrete Work and Pavements	[90%]
Landscaping	[85%]
Retaining Wall Backfill	[85 – 90%]

- d) Confirm the appropriateness of the compaction requirements above with the geotechnical designer of record and recommend modifications in the GERR whenever engineering, soils or climatic factors indicate the necessity. Obtain approval of any modifications to the stated compaction requirements from the Contracting Officer’s Representative (COR).

12.3.5 GUIDE SPECIFICATION

12.3.5.1 Earthwork Specification

- a) Use the latest version of the LRL Earthwork Guide Specifications 31 00 00.00 06.
- b) Review all subsurface information and determine which soil types are satisfactory and which are unsatisfactory with respect to the project requirements and incorporate this determination into the earthwork specification.

12.3.5.2 Pavement Specifications

- a) UFGS 32 12 16.16 Road-Mix Asphalt Paving is the preferred guide specification for asphalt pavement.
- b) In the guide specification, there are pay factors that set the requirements for asphalt compaction. The pay factors are based on a specified unit price determined from current geographical area pricing. Use pay factors on both unit-price and lump-sum contracts. The guide specification includes language for both options.
- c) Obtain approval from the COR if pay factors will not be used. This approach is strongly discouraged for all projects, since it requires removal if the strict density requirements are not obtained. Specify the target specification for asphalt pavement density as 94% to 96%. Require removal and replacement of pavements not meeting this requirement at the Contractor’s expense.

12.3.6 PLANS/DRAWINGS/DESIGN ANALYSIS

12.3.6.1 Data

- a) Where applicable, provide the allowable soil or rock bearing pressure on the plans. Make it clear the pressure provided is the design (allowable) pressure used in sizing the foundations and that this pressure is not the ultimate pressure which the soil or rock can bear.

12.3.6.2 Drawings

- a) Verify the drawing set contains a boring location plan, soils classification sheet, and boring logs with laboratory test results.
- b) Show all physical surface features of the site such as rock outcrops, wet areas (swamps, marshy areas), sanitary landfills, existing pavement condition, that can influence the design and construction of the project.

12.3.6.3 Drawing Notes

- a) Verify the plans require that “during construction, all foundation excavations be inspected and judged suitable by the Contractor’s Geotechnical Engineer prior to placing concrete.” Typically, this statement is on the “Structural Notes” Plan Sheet under “Foundation Notes” and in the earthwork specification.

12.3.6.4 Design Analysis

- a) Verify the allowable bearing capacity recommended by the geotechnical engineer is used in the structural calculations.
- b) Verify that floor slab calculations have been performed in accordance with UFC 3-301-01 “Structural Engineering,” UFC 3-320-06A “Concrete Floor Slabs on Grade Subjected to Heavy Loads,” and the recommendations in the geotechnical report.
- c) Verify footing depths are below frost depths recommended in the geotechnical report.
- d) Verify the pavement design in the geotechnical report is used in the pavement detail.
- e) Verify the pavement detail shows specific aggregates and includes underdrain details if underdrains are required.

12.3.6.5 Certification

- a) Certify in writing that the design of the project has been designed consistent with the Contractor’s final geotechnical report. Provide certification from both the D/B contractor and the professional geotechnical engineer consultant with the first design submission. If revisions are made to the initial design submission, provide a new certification with the final design submission.

12.4 PREPARATION OF BORING LOGS & LAB DATA

- a) Upload boring logs and laboratory testing to USACE’s OpenGround Cloud. USACE has two Open Ground Cloud environments: one for internal use and one for contractors.
- b) All boring data (borehole, lab testing and in-situ testing) must be provided to USACE in the OpenGround Cloud Contractor Cloud.
- c) Follow the steps below to ensure the project is setup correctly and available to both USACE personnel (read only access) and the Contractor personnel who are responsible for entering/importing data into OpenGround Cloud.
 1. Follow the guide located online (https://www.dataforensics.net/updates/OGC_Virtuoso_HowTo.pdf) and/or reach out to sales@dataforensics.net regarding obtaining the appropriate OpenGround Cloud subscriptions and/or pLog subscriptions. Log in digitally and then import the digital logs into OpenGround Cloud.
 2. Email the following information shown in the two screenshots below (and in the Project.xlsx file that can be downloaded from <https://www.dataforensics.net/updates/Project.xlsx>) to Dataforensics by emailing support@dataforensics.net and cc’ing OpenGround-Cloud-Support@usace.army.mil and DLL-CELRL-OpenGroundCloud@usace.army.mil. USACE personnel will request to be added to the Contractor Cloud by emailing their first name, last name, email address, and role (View Only) to support@dataforensics.net and cc’ing OpenGround-Cloud-Support@usace.army.mil.
 3. Refer to the fields in the USACE OpenGround Cloud environment for valid values, especially for Vertical Datum, Status, Category, Office, and Location Type. The fields with **Red Boxes** are required but adding data in each field is encouraged. The metadata makes the project easier to filter on and find.

Add Project	
Details Configurations Logo	
Project ID 2022-POA Some Project ID	Client name The One, the Only Grinch
Project title The Grinch Ski Resort	Contractors name Big Dog Drillers
Location Type Latitude/Longitude	Installation Some Installation
Vertical Datum NAVD88	Project Engineer Scott Deaton
Status Archive	Office Alaska (Anchorage, AK)
Category Landslide	Project Location Latitude
Location of site Mount Crumpett	Project Location Longitude

Save Cancel

The screenshot shows a software window titled "Add Project" with a blue header bar. Below the header is a tabbed interface with three tabs: "Details", "Configurations", and "Logo". The "Configurations" tab is active. A red rectangular box highlights two dropdown menus: "Config Pack" with the value "USACE" and "Coordinate System" with the value "NAD 1983 StatePlane Alaska 1 FIPS 5001 Feet". Below these are three more dropdown menus: "Picklist Set" with "Empty", "Time Zone" with "Empty", and "Project Setup" which is an empty text input field. At the bottom right of the window are "Save" and "Cancel" buttons.

4. Request to be added to the OpenGround Contractor Cloud by emailing support@dataforensics.net and cc'ing OpenGround-Cloud-Support@usace.army.mil. Include the following information: First Name, Last Name, Email Address, and one of the following OpenGround Cloud roles - View Only, Edit (add/edit/delete data), Import (add/edit/delete data/import data), or Project Manager (full control over the project in OpenGround). Multiple people may be added.