Sanitary Sewer Overflow (SSO) Control and Wastewater Facilities Program

Geotechnical Investigation Requirements

City of Baton Rouge/Parish of East Baton Rouge Department of Public Works

Submitted by

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1.1 Introduction

This document presents general requirements and technical criteria for performing geotechnical investigations for projects associated with the City of Baton Rouge/Parish of the East Baton Rouge (C-P) Sanitary Sewer Overflow (SSO) Control and Wastewater Facilities Program (Program). The term engineer is defined as an engineering design firm under contract with the C-P and producing engineering design work on the Program. These requirements are provided to encourage consistency in the design approach used by various engineers.

While the purpose of these requirements is to assure uniformity, it is not intended to stifle the Engineer's creativity, design innovation, and ingenuity. Engineers shall review these requirements and adopt them for design of the facilities for which they are responsible. Engineers are ultimately responsible for the design, and this responsibility is in no way diluted or absolved by these requirements.

It may be necessary for the Engineer to deviate from these requirements. In such cases, the Engineer shall immediately bring this matter to the attention of the Program Manager (PM) by completing and submitting the form included in the Program's *Requirements for Engineers*. The PM reserves the right to allow or disallow the deviation from the requirements. If the deviation will impact design contract terms, then a Supplemental Agreement will be negotiated between the Engineer, the PM, and the C-P.

The Geotechnical Engineering firm is a specialty firm contracted to the Engineer. The Engineer is selected by and under contract to the C-P. The PM and C-P reserve the right to visit the offices of the Geotechnical Engineer, the laboratory, and field site and to engage in discussions, as deemed necessary by the PM.

1.2 Planning the Geotechnical Investigation

The requirements envision that the geotechnical investigation is planned during the course of proposal preparation. Planning in this context means that all reasonably anticipated conditions that could affect the scope of investigation and geotechnical design for the subject project are considered and accommodated. The following sections develop this intent in further detail.

1.2.1 Project Description

The subject of the investigation, the project, is described by the PM as part of the project definition. The project could be a segment of sewer, a force main, any or several of the components of a wastewater treatment plant, or one or more pumping stations. In each case, the PM will at least describe the project with regard to alignment or location, size and shape, design or construction restrictions, relationship to other facilities, available geotechnical information, schedule of design and construction, and any restrictions on the geotechnical investigation.

1.2.2 Site Reconnaissance

It is assumed that the Geotechnical Engineer will perform a reconnaissance of the project site early in the planning effort. The objective is twofold: (1) Recognize conditions affecting the conduct of the investigation, and (2) recognize conditions that could affect design and construction of the project. Where adverse impacts are discerned, the Geotechnical Engineer shall so indicate in the proposal.

1.2.3 Initial Desk Study

In addition to information provided by the PM and Engineer, it is expected that the Geotechnical Engineer will review any geotechnical information publicly available or in his files that is descriptive of the project area. Since some of this information could be confidential, it is not expected that overt reference will be made or copies provided. Rather, the intent is that planning of the investigation is benefited. The proposal will include a brief characterization of the geotechnical conditions anticipated.

1.2.4 Design and Construction Issues

The geotechnical investigation will be planned to provide information useful in addressing the design and construction issues anticipated for the subject project. Such planning requires a tentative statement of those issues. The proposal will include explicit statements toward the design and construction issues followed by a description of the investigation components proposed to address them. The narrative will also present the scope of the geotechnical analysis required.

Of interest at this point in the project is the prospect of alternative means to achieve the final installation. For example, storage tanks could be constructed in various ways. These include pile support and at grade support methods achieved by preloading, stage loading, or mats. Alternatives of similar nature envisioned by the Geotechnical Engineer will be presented in the proposal with brief narrative explaining the viability and benefits attributable.

1.2.5 Proposed Fieldwork

Boring locations, depths, sampling intervals, and piezometers are chosen to collect geotechnical information relevant to the design and construction issues believed to exist. For example, a pump station project having a large and deep wet well poses the problem of buoyancy during construction and at times during operation. For this aspect of the project, borings, sampling, and testing would be planned to investigate water bearing strata and aquitards to characterize the hydraulic characteristics of the strata. This investigation could include one or more piezometers with a program of water level observations indicate the range of head conditions in these strata. Comparable illustrations focused on issues of settlement, bearing capacity, and lateral earth pressure can also be made. The proposal will include drawings or sketches of boring and piezometer locations and depths. A description of the sampling program will also be provided.

Refer to the SSO Program's *Pump Station Design Requirements* and *Conveyance Design Requirements* for minimum requirements for fieldwork.

1.2.6 Proposed Laboratory Work

The approach presented in Section 1.2.5 is extended to the laboratory testing program. Continuing the example posed therein, a particular collection of tests would be focused on hydraulic characteristics of the soils while other collections would address consolidation and strength aspects. Expectations of the subsurface environment and project requirements framing the testing program will be briefly presented in the proposal.

1.2.7 Personnel and Equipment

The proposal shall identify the individuals assigned to perform the work. This can be accomplished by listing or by an organization chart, either showing the lines of reporting and assigned roles. The proposal shall name the individual serving as Supervising Professional for the geotechnical firm in keeping with LAC 46:505. In addition, the proposal shall also name the Geotechnical Engineer (the registrant in responsible charge) assigned to sign and seal the report as defined in LAC 46:LXI.101.J and as required in LAC 46:LXI.1701. This person shall serve as the technical point of contact for the geotechnical investigation.

Members of the field crew that will physically perform the borings, sampling, and other installations shall be named in the proposal. Likewise, personnel in the laboratory that will physically manage the disposition of samples, particularly preparation and testing, shall be named. In both cases, describe the level of experience of key individuals, such as drillers, loggers, and individuals performing complex testing (for example, consolidation, triaxial strength, or permeability).

The type of field or laboratory equipment planned for any particular task shall also be indicated and described in the proposal. The description will note any limitations of the equipment for the tasks planned.

1.2.8 Deviations

The proposal shall list and explain any deviations from nationally recognized drilling, sampling, and testing practices. If additional deviations are determined to be necessary during the performance of the geotechnical investigation, the Geotechnical Engineer shall notify the Engineer and the PM.

1.2.9 Work Schedule

The proposal will present the planned schedule of work in a final report. A Gantt chart is preferred for this presentation. Any contingencies affecting the prospect of meeting the date of report issue will be identified and explained.

1.2.10 Presenting the Investigation Plan

Proposal Document

The points developed in Sections 1.2.1 through 1.2.9 are compiled in a narrative proposal. The following are the principal parts of a proposal:

- Scope of Geotechnical Work
- Schedule of Work

- Commercial Terms of Work
- Work Plan

The first three parts are expected to be relatively brief. The Work Plan will be detailed and incorporate responses to points developed in Sections 1.2.1 through 1.2.9.

Alternatives

The request to present alternatives stated in Section 1.2.4 will be presented in the Scope of Geotechnical Work. Corresponding modifications to the Work Plan will also be detailed in the Work Plan.

Review and Comment

The Engineer responsible for the project is the primary recipient of the Geotechnical Investigation proposal. It is expected that a copy will be forwarded to the PM in a timely manner. The PM shall review the proposal within the week following receipt of the copy. At that point a meeting shall be scheduled to communicate comments, ask for clarifications, and, if needed, request revision and re-submittal. Once agreement on the proposal is attained, the PM will recommend that the work proceed as contained in the proposal, and the Geotechnical Engineer can proceed (presuming commercial terms are agreed between the Engineer and the Geotechnical Engineer).

1.3 Performing the Field Investigation

The following expectations of the PM with regard to Fieldwork are communicated to the Geotechnical Engineer.

1.3.1 Pre-mobilization Activities

The Geotechnical Engineer's firm shall adapt their quality assurance/quality control (QA/QC) plan to accommodate the particular requirements of this project. The Geotechnical Engineer shall arrange with the Engineer means to stake in the field the location of borings and piezometers. A surveyor shall perform this task so that the geotechnical work is positioned in clear relation to the facility location or alignment. In most instances, the surveyor will also locate nearby structures and facilities that could affect or be affected by geotechnical investigation activities and project-related construction. Since elevation is important to design, the staking work will also provide a datum at or near the boring for reference. If in the course of work, the boring is located away from the location staked, then a followup survey to locate the boring is required.

The staked boring location provides a visible reference for obtaining clearance to work. Clearance is obtained from owners of adjoining property, especially if access to their property could be blocked. In all cases, the Geotechnical Engineer shall contact LA-ONE-CALL to locate buried utilities. Similar query will be made to adjoining property owners to identify service not included in the LA-ONE-CALL marking. Where investigation work is planned near levees, a permit to drill shall be obtained from the Levee Board having jurisdiction.

1.3.2 Drilling, Sampling, and Piezometer Installation

The following expectations apply to fieldwork.

1.3.3 Responsible Person in the Field

The Geotechnical Engineer shall designate an individual in each crew to serve as the foreman. It is presumed that this foreman is directly answerable to the Geotechnical Engineer or his designee. This person will be responsible for all contact with adjoining landowners, visitors to the work site, and queries received in the field. In addition, this person will direct the activities of the crew and decide changes to those activities.

1.3.4 Probing, Overhead Clearance, and Traffic Control

Notwithstanding the markings of LA-ONE-CALL, the field crew is expected to undertake probing and observation of features and conditions (manholes, instrument boxes, etc.) that indicate the presence of buried or overhead utilities. Where such installations are indicated, commencement of drilling will be delayed until confirmation of clearance is assured.

It is anticipated that setup of the drilling equipment will on occasion, otherwise unavoidable, require control of passing traffic. If so, means to accomplish traffic control for purposes of public safety and safety of the crew shall be arranged with the Engineer and in cooperation with the C-P DPW.

1.3.5 Drilling Methods

Although the Geotechnical Investigation Proposal includes drilling equipment and methods, it is acknowledged that conditions revealed in the field may require changes. These decisions are the responsibility of the Geotechnical Engineer. Even so, it is expected that the conditions prompting change of equipment or method will be documented and explained by notes on the field log and eventually on the final log presented in report. The documentation will include statement regarding effect of the change on quality of the information obtained, if any. Any significant changes in the field investigation shall be brought to the attention of the Engineer and PM, in accordance with Section 1.3.9.

1.3.6 Sampling, Sample Handling Methods, and Field Tests

The intent expressed in Drilling Methods above is also extended to this aspect of the fieldwork. In addition, it is expected that an effort will be made to obtain replacement sample at the interval immediately under that interval where a sample was not recovered. Specifically, if a sample is not recovered at the 18′ to 20′ interval, then the replacement sampling is attempted at the 20′ to 22′ interval. In course of drilling to the replacement interval, an effort to recover a disturbed sample is encouraged.

Sample handling methods are many and varied in their purpose. It is the responsibility of the Geotechnical Engineer to see that methods appropriate to the needs of the Project are used. Samples damaged or lost in the course of handling will be identified so that testing is not biased for this cause. Where the damaged/lost sample is believed essential to the proper characterization of subsurface conditions, a replacement shall be obtained.

Among the Projects comprising the SSO program, it is anticipated that some may require installation of piezometers and possibly field tests such as pumping tests (to obtain characteristics of water bearing strata). In such cases, specific work plans descriptive of the installation and test procedure shall be submitted for review and comment by the PM prior to undertaking that work. In concept, most of the issues related to planning this work can be resolved at the time of proposal. As conditions are revealed in the field, some modifications

may be considered. The PM review is intended to maintain communication on these aspects of the work.

1.3.7 Environmental Observations

In course of drilling, it is possible that visible or smelled evidence of subsurface contamination is discovered. If so, the drilling operation will be suspended in order to properly address the observation made. The Engineer and the PM will be immediately notified of the observation made. Following that a course of action consistent with environmental statutes and regulations will be outlined and implemented. This could include modifications to the geotechnical investigation.

1.3.8 Field Record of Observations and Conditions

The foreman described in Section 1.3.3 is also expected to keep a record of observations (such as those described in Section 1.3.7) and conditions revealed in the course of fieldwork. This record will describe the observation, the time of observation, and the action initiated.

1.3.9 Response to Observations and Conditions in the Field

Observations and conditions judged to have financial or schedule impacts on the Project or the progress of the geotechnical investigation will be brought to the attention of the Engineer and the PM as soon as they are found. One condition of interest is those that prevent the advance of the borehole, some obstruction in the ground. As with the environmental observation (Section 1.3.7), the drilling shall be suspended until the obstruction is identified and a plan to resume work is outlined. Borings at the site must be accomplished. Similar response is desired where subsurface conditions differ materially from those anticipated. For example, consider the case where the desk study indicated a thick deposit of cohesive soils at the location of a deep sump. If instead, the boring at this location penetrates a deep stratum of cohesionless materials, then it is expected that impacts to the design and construction of the sump are likely.

1.3.10 Grouting of Boreholes

All boreholes shall be grouted at completion as required under the Water Well Rules, Regulations, and Standards issued by the State of Louisiana, Department of Transportation and Development.

1.3.11 Site Restoration

Upon completion of work at any borehole location, the Geotechnical Engineer's crew shall undertake restoration of the site surface to a condition approximating that before drilling. This effort includes removal of spilled drilling fluids, mud and soil clods, litter, and reshaping of ruts to attain an even grade.

A particular component of this work is the securing of piezometers and other temporary installations. These shall be left with reasonable protections against vandalism and accidental disturbance.

1.3.12 Field QC Activities

The foreman described in Section 1.3.3 shall be responsible to accomplish the field QC activities described in the Geotechnical Engineer's QA/QC plan. These activities will be recorded as appropriate in the field records (Section 1.3.8).

1.3.13 Submittals

Sections 1.3.7 and 1.3.9 recognize the benefits of timely notification and response regarding findings that have significant impact on the Project cost or schedule. Even if such discoveries are not made, the expectation remains that the Geotechnical Engineer will inform the Engineer and the PM periodically of progress made on the investigation and the general findings. Decisions made to modify the field investigation shall be communicated to the PM by letter.

1.4 Performing the Laboratory Investigation

The following expectations apply in course of laboratory work.

1.4.1 Sample Inventory and Preservation/Storage

At the end of each day samples are obtained, they shall be delivered to the laboratory for safe storage. En route, the samples shall be secured against damage due to hazards of the road or prevailing weather. To ensure that samples are not lost, the person receiving samples will conduct inventory against the field log. At this point damaged, missing, or mislabeled samples can be identified and corrections made in collaboration with the logger. Numerous or persistent findings of damage, loss, or mislabeling will be brought to the attention of the Geotechnical Engineer for corrective action.

As the inventory proceeds, each sample shall be secured against change of moisture content or dimension. This task shall not be delayed until the next day. After preservation, the samples shall be stored in an orderly manner so that specific samples can be found without difficulty. The storage area shall be protected from the effects of weather.

1.4.2 Assigning Tests

Assignment of laboratory tests is not a rote task to be delegated without briefing by the Geotechnical Engineer. Indeed, if possible the Geotechnical Engineer will examine samples firsthand and assign tests according to his observations and the particular requirements of the Project. Where this task is delegated, the person selected will be trained and experienced in geotechnical practice and thoroughly briefed on requirements of the Project.

Assignment of testing shall be made as soon as practical after receipt of the samples from the field, at latest early the next working day. Samples not assigned for testing and remnants from testing are archived for the prospect of further testing (e.g., consolidation tests) or confirmation of test results obtained.

1.4.3 Testing

Responsible Person in the Laboratory

The responsible person in the laboratory is often called the Laboratory Manager. This person typically reports directly to the Geotechnical Engineer regarding the progress of testing on his project and on any unusual circumstances discovered in course of testing. This person also directs the testing activities and addresses any difficulties that arise.

Timely Conduct of the Tests

It is expected that the testing program will proceed without undue delay and in an orderly sequence consistent with requirements of the Project.

Testing Procedures

Testing and laboratory QA/QC procedures, and judgments incidental thereto, are amply described by organizations such as ASTM and the Louisiana DOTD. It is expected that these are followed within the framework of a laboratory QA/QC plan prepared by the Geotechnical Engineer's firm. That QA/QC plan is also expected to identify deviations from the broader practice of these public organizations. Any deviations will have been described in the proposal (Section 1.2.8).

Response to Condition of Sample as Discovered

Despite the exercise of diligence in the field and laboratory, it is possible that damaged samples are discovered only at the time of testing. In other instances, the sample can be found to consist of two materials (for example a sand layer bedded within a clay matrix). These findings will be immediately brought to the attention of the laboratory manager for direction.

Review of Test Results

Timely review of the test results obtained is expected of the Geotechnical Engineer. This expectation is intended to ensure that questionable test results are resolved and that any follow-up testing is started timely.

Additional Observations

In addition to the test, observations of the sample as part of a stratum are desirable. Observational information such as samples at depths exhibiting peculiar bedding not otherwise observable in the field is anticipated. These observations also include those characteristics affecting the test results (e.g., slickensides, inclusion of roots, bedding). Observations of this sort are written on the laboratory test sheet and communicated to the Geotechnical Engineer at report from the laboratory.

Follow-up Testing

Large laboratory testing programs often progress in stages. For example index and classification testing completed early in the program could indicate particular strata, or even particular samples, that will be tested for particular engineering properties (e.g., strength, compressibility, or permeability). This concept or similar form of approach is expected of

the geotechnical Engineer in order to arrive at a useful characterization of the strata investigated.

Follow-up testing is also performed for the purpose of resolving questions on unusual results obtained from prior tests.

Submittals

The Geotechnical Engineer will inform the Engineer and the PM regularly, for instance monthly, of progress made in the laboratory portion of the investigation and the general findings. Decisions made to modify the laboratory investigation shall be communicated to the PM by letter.

1.5 Compiling Geotechnical Information

The Geotechnical Engineer shall accumulate sufficient information to begin compiling the boring logs used for design. The compilation draws upon the desk study (possibly in greater depth than that done for the proposal), field logs, field records and observations, and the results of laboratory testing. This information is used to prepare a log for each boring that presents the characteristics of the soils relevant to the Project. Thus, the log is not simply a listing of information, but incorporates judgments and interpretations of relevance to the Project. For example, consider the case of a large storage tank to be sited atop a deep stratum of soft fat clays such as those often found in the alluvial plain of the Mississippi River. The field log could make no mention of silt and sand laminations bedded into the clay matrix because of sample smear. Then, in the laboratory, dissected samples could reveal the bedding. Detailed measurements of bedding thickness and frequency could also be made. This information reported on the compiled log would be of significance in settlement analyses for the storage tank. Likewise observations of thickness and frequency of partially decomposed plant matter layers bedded in the clay, but not sampled could also be of significance to the settlement analysis. For these reasons, it is expected that the Geotechnical Engineer will actively participate in the preparation of the boring logs used for design.

The boring logs, thus, compiled for design will be submitted to the Engineer for information and review at the time they are complete. These logs will be accompanied by a brief transmittal letter describing the work planned, work accomplished, any deviations, and a preliminary characterization of site and subsurface conditions. The latter characterization will be more than a general description of the subsurface conditions and will recognize particular aspects of the subsurface environment of significance to the Project design issues thus indicated.

Reviews of the logs and subsurface characterization by the Engineer are not for the purpose of approval. Instead, the intent is to be aware of conditions impacting the Project progress and cost as they arise. In this regard, the Engineer may call a meeting with the PM and the Geotechnical Engineer to discuss in detail the scope of design issues posed by the subsurface conditions now characterized. An objective of this meeting will be to recognize alternatives for design and construction and possibly select the one believed most beneficial to the Project. The follow-up would be to focus analyses and design by the Geotechnical Engineer and Engineer to address these issues and develop the alternatives.

1.6 Performing Geotechnical Analyses

The analyses performed by the Geotechnical Engineer are many and varied according to the scope of the problem at hand. An intrinsic aspect of these analyses is the application of unique experiences with local geotechnical conditions accompanied by the exercise of judgment. It is not the intent of the PM to interrupt or redirect the Geotechnical Engineer in the performance of these analyses. The Geotechnical Engineer's calculations package is submitted to the Engineer and will be made available to the PM, if requested.

The package will contain the analyses, as performed. Handwritten calculations and narrative along with output of proprietary computer programs are expected. Where computer output is generated by programs, spreadsheets, or other means prepared by the Geotechnical Engineer's firm, the basic assumptions of the analysis and method employed will be described. All reference works used and other sources of information (e.g., the desk study) will be fully cited. A record of communications incidental to the analysis will also be included.

1.7 Reporting Geotechnical Findings and Recommendations

In addition to the information requested above and provided in progress, draft and final geotechnical reports shall be prepared by the Geotechnical Engineer. Each shall be issued as required under the provisions of LAC 46:LXI.1701.B. and C. Copies of the draft shall be issued to the Engineer and the PM for review and comment. The comments made and any issues indicated shall be listed by each and forwarded to the Geotechnical Engineer for his use in preparation of response. A meeting with the Geotechnical Engineer is envisioned to hear response and set direction for issue of the final report.

Format of the geotechnical Engineer's report is chosen by him. As a matter of expectation, the following components are listed:

- Transmittal
- Project Description
- Field and Laboratory program description
- Site and Subsurface Characterization
- Scope of Geotechnical Analyses
- Findings relevant to the particular facility
- Discussion of design alternatives
- Recommendations for design and construction of the particular facility including ancillary structures, buildings, utilities, etc.
- Appendices
- Qualifying texts

Much explanatory detail is desired in the discussion of alternatives for the purpose of briefing C-P representatives. This discussion would be based on the meeting described in Section 1.5 and the findings of analyses following.

Recommendations for design and construction will be comprehensive. It is envisioned that the geotechnical report will first be used by the Engineer as a reference source for design. Inputs needed for their design work will be recognized in the sequence of meetings described herein and by communications occurring during the geotechnical investigation.

It is anticipated that the geotechnical report will be available to bidders and to the selected contractor but will not be part of the Contract Documents. Therefore, proper representation of the report as information only is to be prominently stated in the report. Even so, the report will include information and parameters useful to the contractor preparing bid and planning construction activities.

1.8 Follow-on Consultation

All queries to the Geotechnical Engineer, whether small or great, shall be communicated to the Geotechnical Engineer via a single point of contact. The preferred point of contact is the person exercising responsible charge of the work as Geotechnical Engineer. In the case of queries from prospective contractors bidding a Project, the PM shall serve as the point of contact, coordinating and reviewing both the query and the response.

It is anticipated that the Engineer will work with the Geotechnical Engineer to resolve the inevitable sequence of minor questions and clarifications that arise after issue of the final report. These collaborations will be documented in writing.

The following point is made for more significant queries, those needing additional analyses or other work by the Geotechnical Engineer. Those requests requiring additional work of any sort that could be invoiced or could change the geotechnical report and impact the cost or schedule of the Project shall be brought to the attention of the Engineer and the PM before proceeding with the work. After necessary collaboration, decision shall be rendered and agreed on authorization to proceed. These communications and decisions shall be documented in writing by all three parties to the collaboration.