National Exams May 2005

98-Geol-B2-2, Site Investigation

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. Candidates may use one of two calculators, the Casio or Sharp approved models. This is a Closed Book exam.

3. Any FIVE QUESTIONS constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.

4. All questions are of equal value.

20 marks QUESTION 1:

Different methodologies are commonly used as screening tools in the field to provide preliminary site information on subsurface conditions *prior to* the placement of exploratory boreholes or testpits.

(5) For each of the projects listed below, identify the most suitable screening tool for obtaining relevant preliminary field data.

(15) Briefly explain your rationale for selection of the screening methodology.

a. Final route selection for a large diameter gas pipeline between two remote towns.

b. Expansion of an existing harbour facility which will include new ship loading cranes with high bearing loads.

c. Delineation of a suspected spill of chlorinated solvents into an area where the subsurface consists of shallow sandy soils overlying dense natural clays.

d. Delineation of a suspected leachate plume emanating from a municipal landfill.

e. Delineation of the probable limits of a future sand and gravel pit in an area of known granular deposits.

20 marks QUESTION 2:

A primary goal of any site investigation is to obtain information of site conditions and transfer this information to users. The "Borehole Log" is a common tool used for this purpose.

(10) Layout a Borehole Log that clearly shows the main elements for recording pertinent information from a field drilling program.

(6) Fill in the borehole log to show the information that would be recorded for a single hypothetical "hole" that intersects the following materials: fill, a granular soil, a cohesive soil, an impenetrable material. Assume that you are using power auger equipment to investigate subsurface conditions for foundation design.

(4) Show the information that would be included in the log to describe the placement of a groundwater monitoring well in the borehole.

20 marks QUESTION 3:

Imagine that an abandoned underground storage tank (UST) and contaminated soils have been identified during foundation excavations for a factory expansion project. Describe how you would investigate the extent and severity of impact by answering the following questions. Explain your reasoning with your answers.

(3) a. How would you determine the nature of 'contaminants' in the soil?

(3) b. What field methods and laboratory analyses would you specify if you determined that the contaminants consisted of organic solvents?

(4) c. How would your investigation differ in an area of deep soils overburden versus an area of shallow soils over bedrock?

(5) d. Describe how you would investigate the impact on groundwater. What is the minimum number of groundwater monitors you would install? Use a sketch to show - schematically - where you would locate groundwater monitors.

(5) e. Describe how you would install a groundwater monitor. Use a sketch and identify the components of the installation.

20 marks QUESTION 4:

The Standard Penetration Test (SPT) is a commonly used field test for soils investigations.

(10) a. Describe the test and identify the equipment components of this test. Make note of standardized weights and dimensions. Use a sketch to illustrate your description.

(5) b. To which soil types is this test best suited? To which soil types is this test NOT well suited? What soil properties can be determined by this test?

(5) c. Improper drilling and sampling procedures can effect the results of the Standard Penetration Test. List five inappropriate procedures and their potential consequences with respect to test results. How are N-values affected by each inappropriate procedure?

20 marks QUESTION 5:

Several challenging "soil conditions" occur in widespread areas across Canada. For each of the soil types and conditions listed below, briefly describe the factors which affect their engineering properties, and suggest standard tests or measurements to determine the appropriate design parameters for a simple construction project.

(5) a. Permafrost terrain

(5) b. Muskeg

(5) c. Sensitive anisotropic clays

(5) d. Heavily overconsolidated clays

20 marks QUESTION 6:

Every site investigation is unique. However, investigations commonly follow a sequence of tasks and activities in the scope of work. Likewise, site investigation reports often include a number of common elements which should be addressed in a logical sequence. A well written report is a key element of a successful site investigation.

(20) Prepare a report outline for a 'generic' site investigation (either geotechnical or geoenvironmental). Indicate the main subject headings that you would use for the report, and itemize the material addressed under each heading in point form.

20 marks QUESTION 7:

Identify four different geophysical methods used in site investigations. Answer the following questions for each method.

(12) a. Briefly describe the geophysical method and its operating principle. Use a simple sketch if this will assist your description.

(8) b. What is the general usefulness of each method for identifying:

i. Subsurface stratigraphy
ii. Buried objects and structures
iii. Organic or inorganic contaminants.

20 marks QUESTION 8:

Worker safety is a valid concern for any site investigation field work. Briefly describe the approach to worker safety and types of personal protective equipment that you would adopt if responsible for worker safety on the following projects.

(4) a. A groundwater drilling program in an active quarry operation with daily blasting activities.

(4) b. Investigation of a suspected fuel spill in a crawl space area below a warehouse floor slab.

(4) c. Surface water sampling of springs emanating form land adjacent to a municipal landfill.

(4) d. Sampling of buried drums of unknown materials in an old industrial park.

(4) e. Shallow soil drilling on the shoulder of a busy urban expressway for design of additional traffic lanes.