Applied Geophysics

Lab 2: Bac-Ho

Due: Digital Drop Box 10am, Friday, March 2nd

Some useful references:

Exploration Geophysics of the Shallow Subsurface, Burger, Chapter 5: Prentice Hall Publishing.

Geotechnical and Environmental Geophysics, Ward, editor: Society of Exploration Geophysicists Publishing, Investigations in Geophysics No. 5.

Your Textbook

Overview

This objective of this lab is to have you think as much about sampling and survey design as the EM and GPR methods. For now, you want to think about our discussions in class, and also draw on your own experiences and logic. Your goal of will be to design a survey—using each technique—based on the fictitious objectives and constraints I outline for you (Parts I & II). For Part III of this lab, you will present your data and interpretations, and then create a revised plan based on your experiences in the field.

Note: You will submit one report per group for Parts II & III.

Part I – The Request (whole class)

You have been asked to aid the Baker Associates Construction & Housing Organization (BAC-HO) by conducting a preliminary geophysical investigation to locate buried utilities/sewers in a space in Sequoyah Hills (Figure 1). The BAC-HO group plans on building some multi-family housing units in that location, and want to get a preliminary "feel" for existing utilities or utilities that may have to be moved prior to excavation (old records are unreliable). You are given the following information through discussions with BAC-HO:

1. Determination of Objective

Locate all utility access tunnels and/or drainage sewers within the boundaries shown on Figure 1 & 2 within the agreed time allotment.

2. Determination of Constraint(s)

Time: You have 2 hours to complete this survey.

Cost: You have enough "money" to hire several field assistants (i.e., other students in class) and cover field expenses, and will be given credit for your time.

Logistics: Acquisition must be completed in the required time. Field area is located very close to the equipment and personnel. See "additional comments," below.

Resolution: Utilities access tunnels and/or drainage sewers are presumed to be no less than 1 meter in diameter (including supporting construction) and linear. The data points should be surveyed with tape measures, as this degree of accuracy will be sufficient.

Noise: Ponder and discuss.

Target-to-Background Contrasts: Conductivity and dielectric permittivity contrasts should be sufficient to generate signal, but not know for sure.

3. Method(s) Selection:

a. Geonics EM-31 Mark II Gound Conductivity Meter

b. Sensors & Software PulseEKKo Pro Ground Penetrating Radar

Additional comments:

Your main constraining factor will be time (BAC-HO wants to start construction early on Monday March 5th, so you must finish the final report on Friday March 2nd. You should consider that it may take some time to survey your optimum survey design in the field; thus, you should think ahead of time about dividing duties. The instruments are fast (no more than 1 sec per reading), but you will need to "survey in" the stations of each reading/line with tape measures (flagging will be provided if you want).

Because of the time constraints, a uniform station spacing over the whole area may not be feasible (unless it's very course—but then perhaps in the realm of aliasing).

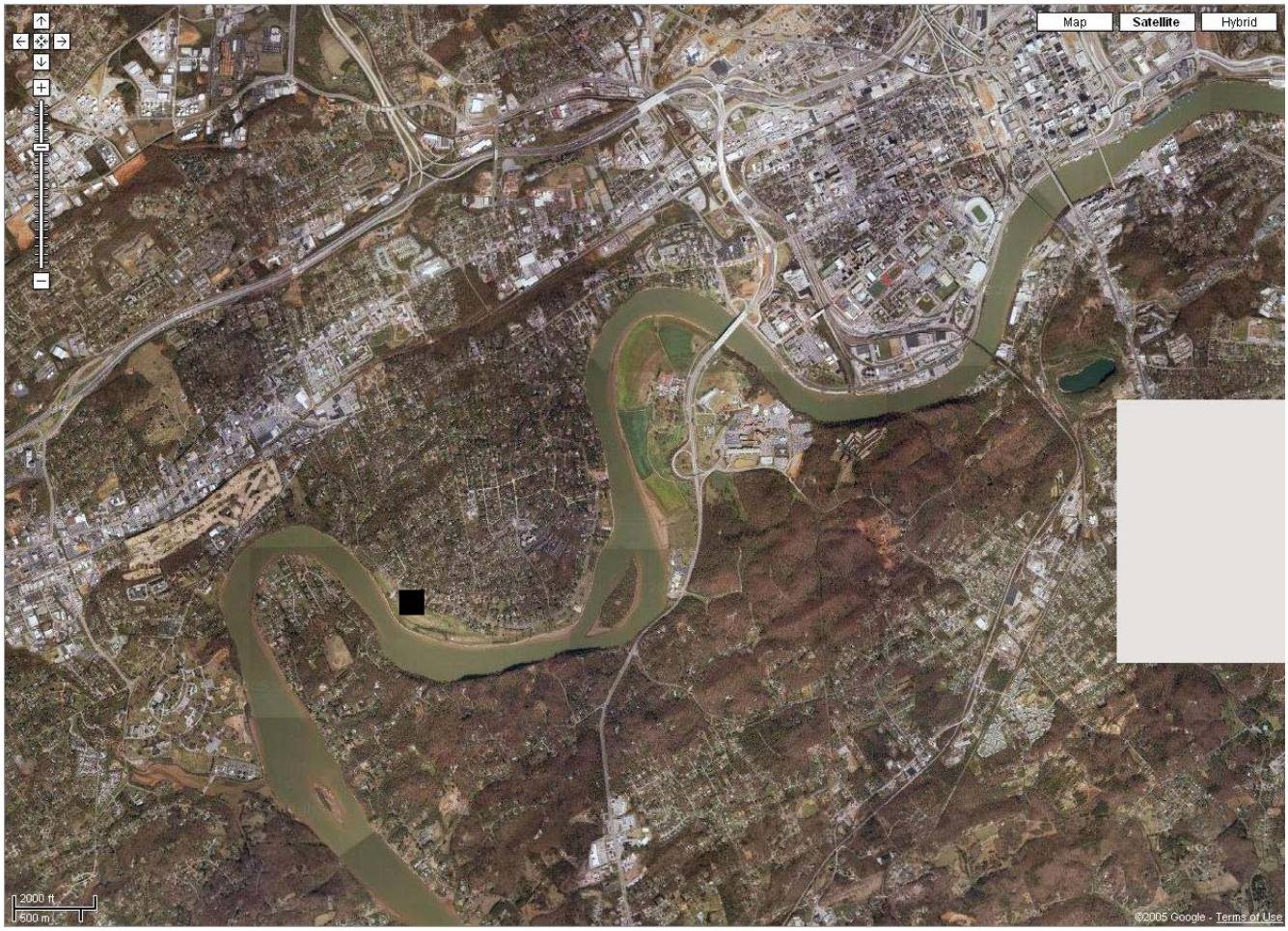

Figure 1. Aerial photo (U.S. Geological Survey) showing the Sequoyah Park region of Sequoyah Hills (left center) and Knoxville, TN, plus the UT campus (upper right). The field site is indicated with the black box.

Figure 2. Close-up view of the target area (*see* Fig. 1). The region of interest for the geophysical surveying is approximately outlined in black. The primary item of interest is the manhole cover, which should be positioned at or near the center of the survey.

Part II – The Survey (TEAMS OF 1 OR 2)

A. The requirements outlined by the BAC-HO group are that you must write a clear outline of your survey plan, and include a detailed justification for said plan. This should be typed, and about one page (single-space the report, please)—figures may be added in additional pages. Include all of the usual elements in your discussion.

B. Modify Figure 2, or create your own, with the following elements:
   1. Title
   2. Author
   3. North Arrow
   4. Scale Bar
   5. Dots or lines showing your station locations on the survey area

Part III – Post-Mortem (SAME TEAMS OF 1 OR 2)

A. Analyze your data by generating several plots in 2D or 3D in Microsoft Excel or other graphing program for the EM-31 data and plotting the GPR profiles. Write up a short (less than 1 page, single-spaced please) discussion of the results of the survey. Include the following:
   1. What would you do differently (if anything—you can reference the figure below)?
   2. Were there other time factors you didn't count on?
   3. In the future, would you use both techniques? Why (Yes or No)?

B. Modify Figure 2, or create your own, with the following elements:
   1. Title
   2. Author
   3. North Arrow (for reference, straight up on both Figures 1 & 2)
   4. Scale Bar
   5. Colored dot (.) symbols or thin dashed line showing the stations you actually collected EM/GPR data
   6. Plus (+) symbol or solid line showing your revised station locations, knowing what you know now if you repeated the experiment (it may be the same as 5.—just say so in the report).
   7. Your interpretation of the locations of various buried utilities, based on the plots shown in (A).

C. Brief (one-half page) discussion of your interpretation of the geophysical data (please reference your data figures where appropriate). If you include a larger number of stations, you should include calculations justifying the data collection feasibility in the allotted time.

Lab 02 Write-up (one report for each 1 or 2 person group)

Submit a digital version of Part II and Part III (with all required elements) to the digital drop box by 10 am on Friday, March 3rd.