Lecture Notes, Environmental Geology Laboratory GEOS 3110, Summer, 2005[1]

Dr. T. Brikowski, Geosciences Dept., U. Texas-Dallas

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[1]see this document online at http://www.utdallas.edu/~brikowi/Teaching/Field_Methods/

Chapter 6

Hydrogeologic Mapping

In this exercise, we will learn how to make a preliminary evaluation of the hydrogeology of a site. We will map the location and elevation of important hydrogeologic features, then produce a hydrogeologic map of the site, including a water profile and estimated flow paths for groundwater. This type of map is crucial for evaluating potential sources of groundwater, as well as potential sources of groundwater contamination. Perhaps some day you'll need to know if the septic system for your mansion in Aspen, Colorado, is likely to impact Kevin Costner's drinking water well. The approach used in today's lab can give you a preliminary answer.

We will convene class at 2 pm in FO 2.604, departing from there by van for the Heard Museum. Students are encouraged to take personal vehicles if they do not wish to return to campus, or if a conflict with evening classes is possible. We should return to campus at around 5:30 pm, depending on traffic. See the Heard Museum webpage ("About the Museum" section)[1] or the location map[2] for information about the Heard Museum in McKinney. Bring appropriate clothing, a snack and beverage, since we will be far from any buildings for the entire Museum visit. We will park in the upper parking lot of the Science Center (at the eastern end of the Heard Museum road).

6.1 Lab-5 Activities

We will make use of a topographic base map (Fig. 6.1) to map an approximation of the water table at the Heard Museum. In order to do this, we will collect water elevation data, by measuring the height of surface and groundwater occurrences relative to known elevation benchmarks. The method is summarized in Fig. 6.2 and a form for field notes is provided in Table 6.1. Given these point elevations, and assuming that the water table roughly parallels the ground surface, we will construct a contour map of the water table.

[0]See this file online at `http://www.utdallas.edu/~brikowi/Teaching/Field_Methods`
[1]http://www.heardmuseum.org/
[2]`http://www.heardmuseum.org/go/map.html`

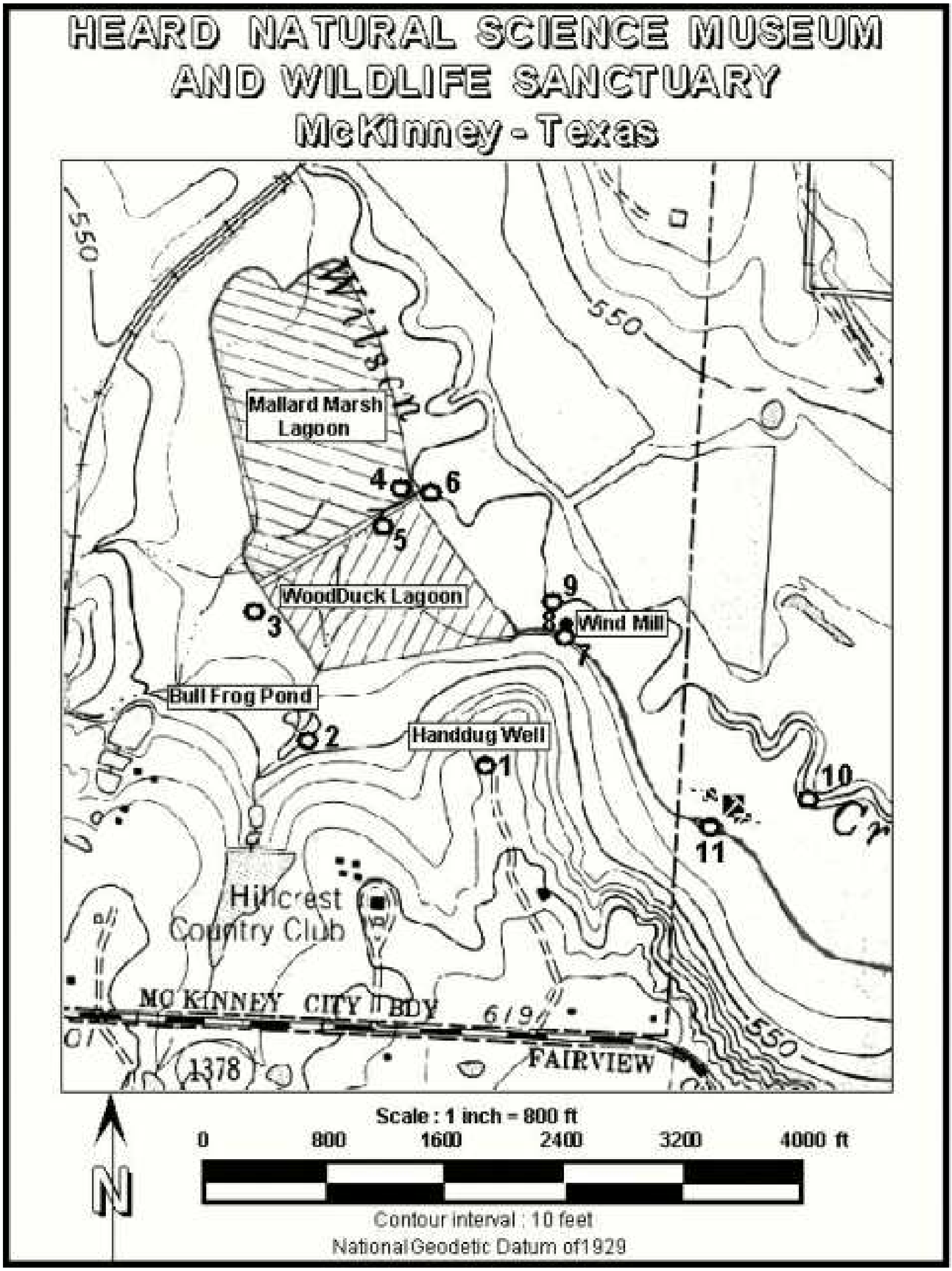

Figure 6.1: Heard Museum topographic map. Sample points are labeled by number and name (see Table 6.1).

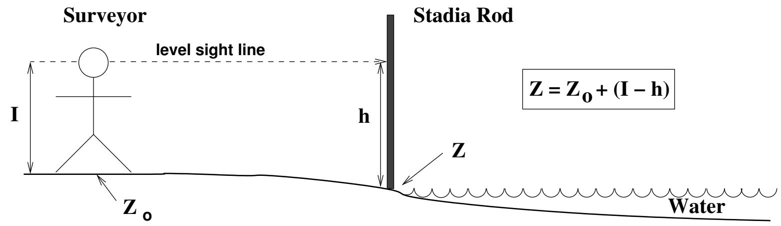

Figure 6.2: Field procedure for measuring elevation difference from a known point using a sighting level. Note our feet will stay dry, so $Z_o > Z$ and therefore $h > I$.

6.1.1 Lab-5 Leveling Procedure

To carry out a leveling survey (see Fig. 6.2 for meaning of symbols):

1. select an instrument man (person doing the sighting)
2. measure eye-height I using stadia rod held close to the instrument man
3. instrument man stands on a benchmark (point of known elevation Z_o)
4. rod man places base of stadia rod at location where ground elevation Z is sought
5. instrument man reads elevation on stadia rod, holding sight level so that level bubble is centered on line in viewfinder, h is the position of the viewfinder line on the stadia rod
6. For elevation differences greater than height of rod, or distances too far to read stadia rod with hand level
   (a) surveyor determines Z at an intermendiate location
   (b) then moves to that location and repeats these steps as needed.
   (c) In this case the formula for elevation Z becomes: $Z = Z_o + (I-h)_1 + (I-h)_2 + ...$
   (d) Remember to record I and h for each of these "turnaround" points (see extra lines in Table 6.1)

6.1.2 Lab-5 Well Measurement Procedure

When wells are available, the water table elevation is measured by determining the elevation of the ground at the well ("collar elevation"), and subtracting the depth to water measured by beeper tape.

1. determine the elevation of the ground adjacent to the well (Z_o)
2. if a well housing is present, measure the height of this (H)
3. measure the depth to water from the top of the well housing (D)

Table 6.1: Field data form for leveling survey. All values in feet, water elevation $Z = Z_o + (I - h)$.

Station #	Station Name	Benchmark Elev (Z_o)	Eye Height (I)	Rod Reading (h)	Water Elev. (Z)
1	Hand-dug Well	593			
2	Bullfrog Pond	548			
3	Stagnant Pond	533			
4	Mallard Marsh Lagoon	528			
5	Woodduck Lagoon	528			
6	Upper Wilson Creek	528			
7	Canoe Trail	525			
8	Windmill	525			
9	Lower Wilson Creek	525			

4. water table elevation $Z = Z_0 + H - D$

Proceed through the points in numerical order, see Fig. 6.3 for help in navigating the route.

6.1.3 Lab-5 Field Procedures

1. Gather at site of new Science Center (north of Heard Museum Visitor Center). In the center of the traffic circle is Point 1 (Fig. 6.1).
2. Assemble your team and make a site reconnaissance using the material handed to you
3. First observation will be done at the hand-dug well (Point 1, Fig. 6.1), in the parking lot. Use the Well Measurement procedure (section 6.1.2).
4. Go to next points (2, 3, 4, . . . on the map) and evaluate the surface water level using the hand-leveling technique shown in Fig. 6.2
5. Record all the values in the data table Table 6.1.
6. Measure the groundwater level at the point Wind Mill well using the beeper tape.
   (a) Determine the elevation of the base of the concrete housing of the well using the leveling technique
   (b) Determine water table elevation using the Well Measurement procedure (section 6.1.2)

6.2 Lab-5 Tasks

Your lab report will consist of the following items:

1. Water Table Map
   (a) Draw ground water table contours on Fig. 6.1 in colored pencil using a 10 foot contour interval. Where data is absent, follow the topography. Water table contours should meet topographic contours only where water is at the surface! Save a pristine copy of Fig. 6.1 in case of errors.
   (b) Draw representative ground water flowlines (4-5, perpendicular to the contour lines). The flowlines show the probable path of groundwater.
   (c) In red, draw the most likely path that a groundwater nitrate plume coming from the Golf Course feeding Bullfrog Pond would follow. Also draw the most likely path for a chemical spill from the location of Point 1.
2. Hydrogeologic Cross-Section
   (a) Draw a topographic cross section which passes through the hand-dug well (Point 1), the canoe trail (Point 7), the Wind Mill (Point 8) and Wilson Creek (Point9))

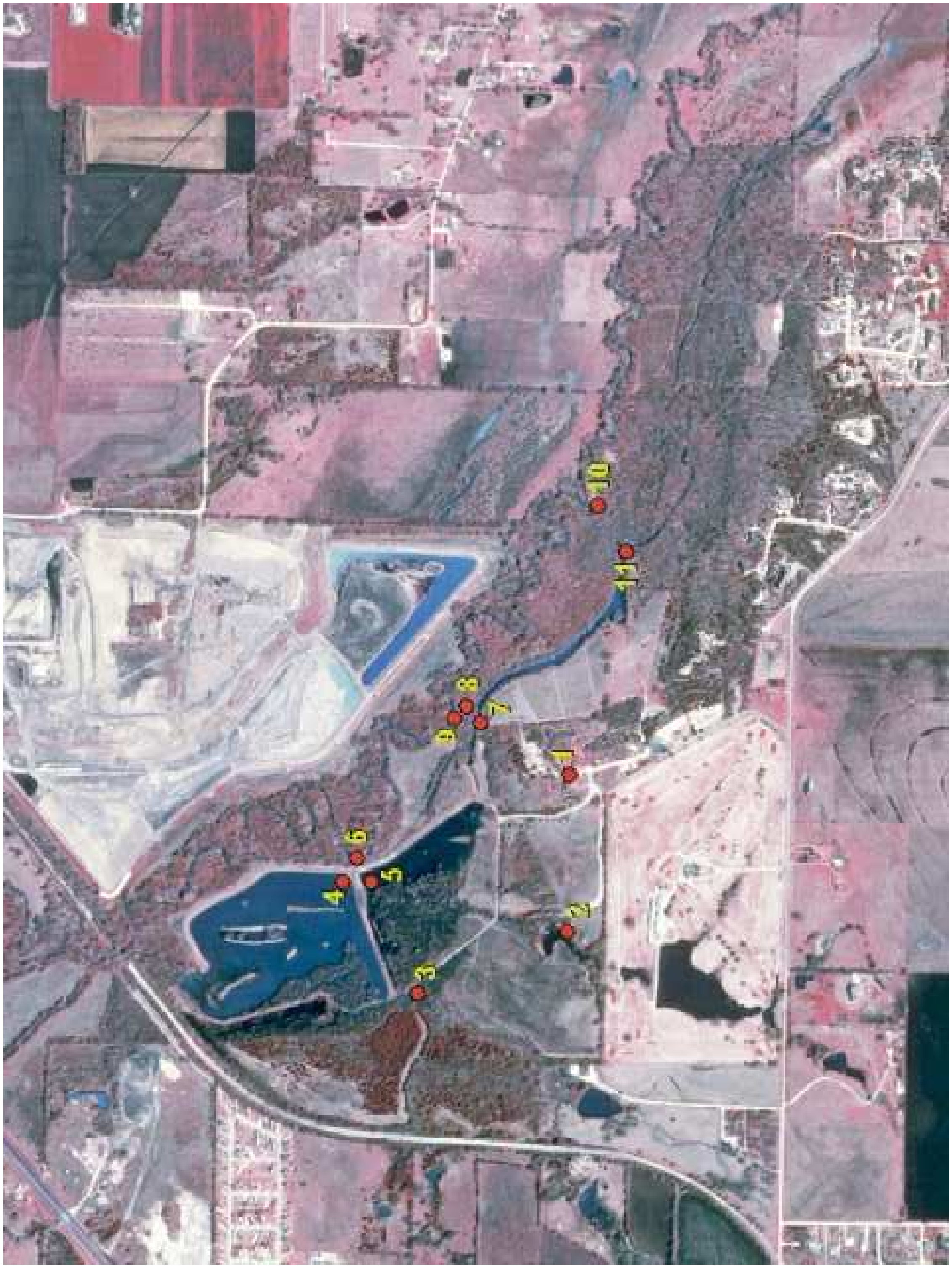

Figure 6.3: Satellite image of Heard Museum, with sample locations. Location numbers are upright when photo is oriented with north up.

(b) Draw on it the ground water table. Things like scale, horizontal distance, elevations and orientation of the cross section are mandatory.

3. Turn in your final lab report by March 30th. to the TA or Geosciences office. Other group's data need not to be reported in this lab. Your hydrogeologic map will serve as the required graphical summary. Discuss general trends in probable groundwater movement at the Museum, and how that movement differs from surface water movement and storm-related overland flow.

6.2.1 Lab-5 Comparative Data

Tables and a map of GPS data collected by class TA for:

GPS Data[3]

Water levels, Spring '05[4]

Bibliography

L. L. Sanders. *A Manual of Field Hydrogeology*. Prentice Hall, Upper Saddle River, NJ, 1998. ISBN 0-13-227927-4.