Creating and Teaching Case Studies in a Web Design Project

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Purpose

In this exercise, students create case studies that examine hydrologic issues in a way that incorporates both the societal significance of these problems and the science involved in trying to solve them. Such an approach reinforces the utility and necessity of hydrologic study.

By presenting individual case studies, students learn hydrology by explaining and teaching it. Compiling and presenting data in a variety of forms encourages students to think critically about how to make data accessible. By using a web-based approach, students make connections among the data and the scientific and social issues of their cases. The data collection process pushes students to consider how they access data. In creating structured lab exercises, students consider how to work with and understand the various types of information that hydrologists work with on a regular basis . Students can model their sites after such exemplary case study sites as Gregg Eckhardt's Edwards Aquifer home page (http://www.edwardsaquifer.net/).

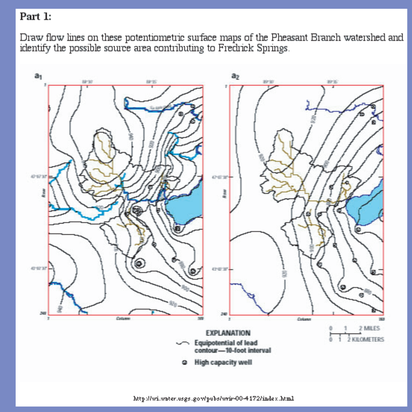
Example of title page presenting background information and links to relevant figures (Drummond).

The Process[1]

1) Select a newsworthy site or problem.
2) Determine if sufficient information to write a case study is available.
3) Collect and connect data (published maps and papers, USGS records, GIS data, news stories, etc.)
4) Determine hydrologic principles that can be demonstrated in case study.
5) Create and present a case study lab exercise that integrates diverse data.
6) Use web capabilities to compile and link data with student writing (final products were copied to CD, not posted to the Web).

The Product

Case studies compiled by hydrology students can be used in a variety of other classes, including introductory and environmental geology. Subsequent classes can review, update, and improve earlier case studies. One student's 2002 case study on hydrologic implications of coal-bed methane extraction proved valuable to the lead author in reviewing a grant proposal in 2003. Finally, the model outlined here can be used for many other topics, both within earth sciences and beyond. One such application is in connecting teaching resources with pedagogical techniques and educational research.



Example of lab exercise that uses simple mapping techniques to understand groundwater flow (Hunzicker).

Lessons Learned

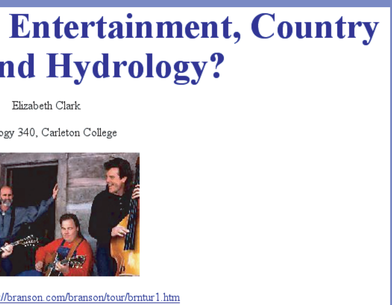
This project emphasizes two ways in which the web is an important educational resource:

1) *Connectivity*

Framing a case study in the web-design format emphasizes the connections between types of data, data collection and analysis, and the relevancy of this analysis. Web pages can easily link newspaper articles about the economic issues of a case with a groundwater flow model and geochemical data of the area in question. Information regarding the collection methods of data can easily be included with the data itself.

2) *Learning how to find data*

Many types of available data are relevant to hydrologic study; however, locating these data is often complicated. The process of data compilation required students to search for web resources, books, articles, maps and government reports. Students must determine what types of data are necessary for understanding the case at hand. For example, most students were able to locate either well data or potentiometric surface maps from USGS Water Investigations Reports or USGS on-line water data. They learned how to locate and use library resources as well as how to search effectively for on-line data. They also learned how to write metadata for end-users of the case studies.



This title page outlines web site structure and includes links to all sections. Most student case studies included similar sections, and many had additional links to data pages (Clark).

"A good case tells a story, is set in the past five years, creates empathy with the central characters, includes quotations, is relevant to the reader, serves a pedagogical function, requires that dilemmas be solved, has generality, and is short." (ref. 1)

Case Studies from 2002

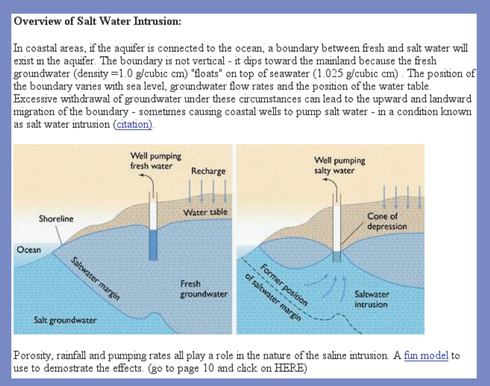
Chetel, Lauren M., Saltwater in the Mississippi River, a threat to the drinking water of New Orleans, Louisiana: A case study.
Clark, Elizabeth, Branson, Missouri: Entertainment, country music, and hydrology?
Drummond, Benjamin, Water in the San Juan Islands (Washington).
Gendaszek, Andrew, Yucca Mountain, Nevada: A hydrologic case study.
Gittings, Hilary, Saline intrusion at Hilton Head Island, SC.
Hall, Melissa, Bemidji (Minnesota)Toxics Project: USGS National Research Program in the hydrologic sciences.
Hunzicker, David, Pheasant Branch Marsh (Wisconsin): Surface water - groundwater interactions and the possible effects of urbanization.
Nemitz, Eric, Saltwater intrusion on Cape Cod (Massachusetts): Threats to a coastal aquifer.
Nickerson, David, What's the story on coal-bed methane (CBM) in Wyoming's Powder River Basin.

"...the case method involves learning by doing, the development of analytical and decision-making skills, the internalization of learning, learning how to grapple with messy real-life problems, the development of skills in oral communications, and often teamwork" (ref. 2)

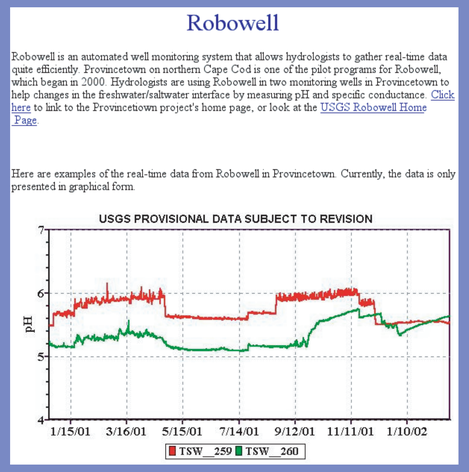
In 1983, the Minnesota district of the USGS proposed the Bemidji site for consideration as a research site for a USGS groundwater and toxic waste program began in 1982. This program is now known as the National Research Program in the Hydrologic Sciences. The Bemidji site was chosen due to a number of features. 1. The groundwater hydrology was assumed to be relatively simple. The main hydrologic unit being glacial deposits. 2. The local discharge drained into a single lake. 3 There were no wells drawing water from the aquifer, and no houses within a mile of the site of the spill. As a result, a number of institutions and agencies set up equipment to analyze the evolution of thecrude oil within the aquifer over time. This data collection has occurred from 1983 through 2001.

In 1999 new Minnesota state legislation required that further remediation take place in this area, to remove existing liquid phase crude oil contaminating the aquifer. Results of this remediation are at this point unknown, although will have serious implications for the long term research projects that were being completed in the area.

Historical photos and a narrative description of the case introduce this historical case study. This project explores the remaining effects and issues surrounding an oil pipeline accident that occurred in 1979 (Hall).

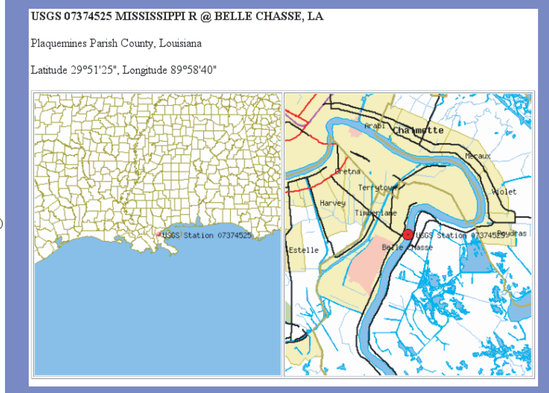


Example of background information including schematic diagram (Gittings).



Example of data presentation including explanatory prose written by student, date-specific data and links to regularly updated data sources. Real-time water data and historic water levels were commonly selected data types (Nemitz).

Example of outline for class presentation. This case study uses a quotation to frame the issues. The outline includes links to data and structured lab exercises, as well as questions for discussion (Nickerson).



An example of metadata for streamflow data at a USGS station in Louisiana. Maps of the location of the gaging station and links to further data from this station are included (Chetel).

References

1 Herreid, C.F., 2000, Cooking with Betty Crocker: A recipe for case writing, Journal of College Science Teaching: 29(3), 156-8.
2 Herreid, C.F., 1994, Case studies in science: A novel method of science education, Journal of College Science Teaching: 23(4), 221-229.