Working on GIS projects

Learning objectives

- Learn project management methods for GIS
- Learn how to structure GIS projects
- Study a solved project

Introduction

To prepare you for independent project work, this document begins by surveying the basics of project management in the context of GIS. You will learn about project life cycles and project components. After you’ve learned basic project structure and management, you will review a simple and short, but complete, project.

Project management

Projects are challenging. You must define the problem, decide which factors to ignore and which are important, deal with uncertainties (including whether the project outcome will be valuable or not), and carry out the work. Fortunately, the field of project management brings structure to GIS project work. There are entire textbooks and courses devoted to project management, but the few concepts we introduce here will give you a good start on managing GIS projects.
Project life cycle

Projects have phases that can be organized in a systems development life cycle. The most widely used model is called the waterfall model because it assumes that a project flows from one phase to the next, like water going over a series of waterfalls. Ideally, project phases like water that does not reverse direction and flow upstream are sequential. Once a phase is completed, it is not revisited. However, in reality most projects cycle back, repeating parts of the earlier phases, with steps being reexamined and modified as one learns or as conditions change. Nevertheless, the waterfall model is a good starting place for getting organized.

The major phases of any project are as follows (Kendall and Kendall 1995, 7–11). Each project phase is described in terms of what you must do. While the material presented next covers the major phases of a project, ultimately this document has you follow an abbreviated, simpler life cycle suited to a small student project.

- **Problem identification phase**: Parts are: (1) state the problem, opportunity, issue, or objective; (2) provide an approach for a solution, and (3) define the scope of the project that is, what it will and will not attempt to solve. It’s important to restrict a project to only a few issues and to state them clearly. Include background on the problem area and a few references for general information. Generally, it is also a good idea to provide a rationale for why the parts studied are important. The **deliverable**, or product of this phase, is a short report that is the project
proposal. A client (or your instructor) must comment on and approve the proposal, and you should expect some helpful suggestions.

- **Analysis phase**: Determine the specifics of a solution, collect data, and envision the solution. You should identify data sources and collect the data, determine specific attributes (variables) that represent underlying performance or behavioral measures, and provide a verbal or schematic representation of the finished system that can be discussed and easily modified before proceeding to building the solution.

- **Design phase**: While both the problem identification and analysis phases focus on thought processes and the feasibility of carrying out the project, most of the computer and other hands-on work occurs in the design phase. Process the data and build the system or models that provide a solution. The deliverable for this phase is a working GIS, ready for use.

- **Implementation phase**: Provide access to the solution as a GIS and a report.

**GIS project components**

Student GIS projects are limited in scope, so this section presents a corresponding, abbreviated systems development life cycle. The project phases are combined and streamlined into three components:

- **Project proposal**: This project phase’s deliverable combines the phases for problem identification and analysis. The proposal states the problem or issue, limits the scope of the project to a geographic area and specific
purposes, and lists map layers and data to be downloaded or otherwise obtained. The project proposal is a Word document that can be evaluated and commented upon by an instructor. Some of the text and other material of the proposal can be reused in the project’s report.

- **Process log:** The deliverable for this project component lists each major step you’ve taken to build the analytical GIS. We have a well-developed and structured approach for building a GIS, so you already know how to design and build much of the solution. Thus, you can just list major steps. (A detailed log is useful to you if you may have to revise parts of the project, so that you do not have to reinvent steps.) Include the process log as an appendix in your report. A process log is especially valuable for student projects so instructors can assess and diagnose student work and provide feedback. Otherwise, many of the processing steps could remain hidden, and students would not get credit for their hard work.

- **GIS and report:** The folders and files of your GIS and a report are the major deliverables of the project. Map layouts are key parts of the report and need to be included in the report document. The report structure follows the lines of the systems development life cycle: problem identification, analysis, solution, and results. Also, include a paragraph on future work stating suggestions and implications for additional study. There is always more that can be done on a project, and it is important to summarize your ideas about additional work that might be done if time and resources are available. **Special note:** Be sure to cite references for ideas, facts, and data.
Next, let’s look at a project and its solution.

**Project on environmental justice**

The material presented on this project is in the form of project deliverables: a proposal, a process log, and a report. The only deliverable not included is the GIS itself.

**Proposal**

**The problem and approach to solution**

Environmental justice is “the fair treatment and meaningful involvement of all people regardless of race, color, sex, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (US Environmental Protection Agency). The problem to be addressed concerns environmental justice in regards to the Black population and school-age children in a major metropolitan area, Minneapolis, Minnesota. Minneapolis is a progressive city, so if evidence of environmental injustice is found there, likely it will be found in other cities.

Minorities tend to live in communities with high levels of pollution. There are many reasons why this is so, but the underlying causes are economic and political. Poverty is concentrated in minority populations although, of course, not all people in minority groups are poor. The low-cost housing that poor persons can afford is often undesirable in many ways, including being in polluted environments. On the political side, poor people generally have little political clout and generally have been underrepresented in decisions impacting
pollution in their areas. The field of environmental justice is concerned with redressing such inequities. Clearly, school-age children and minorities are two groups that need increased protection from environmental pollution.

I propose to compare maps displaying major companies releasing pollutants in Minneapolis compared to locations of the Black population, youth population, and schools in that city. I will use buffers of polluters to identify populations likely at risk because of proximity to large-volume toxic air releases.

**Scope**

Generally, there are many polluters in an urban area, but for an exploratory study on environmental pollution in Minneapolis, I will restrict attention to the top 20 companies with toxic air releases in Hennepin County, Minnesota, based on how many pounds per year of pollution they emit.

**Sources of data**

The major issue on the feasibility of this project is availability of data on toxic air pollution releases. Fortunately, environmental protection laws have led to the collection and public access of detailed pollution data. The US Environmental Protection Agency (EPA), Environmental Defense Fund (a leading nonprofit organization representing more than 400,000 members), and others track and make available pollution data across the US. Data on population by race is readily available from the US Census Bureau.

Data for this project includes census layers for Hennepin County, Minnesota, which has the city of Minneapolis within its boundaries. These layers are Minor Civil Divisions and Census Tracts. Also included is census tract data. I will
download these map layers from the TIGER/Line website, www.census.gov/geo/www/tiger/.

I will download toxic release data from a website sponsored by the Environmental Defense organization, at www.scorecard.org. Established in 1967, Environmental Defense has combined approaches from science, economics, and law to create innovative, equitable, and cost-effective solutions to society’s most urgent environmental problems. Included in the data are the latitude and longitude of polluters.

Lastly, I will download latitude and longitude locations for schools in Hennepin County, Minnesota, from www.hometownlocator.com. The US HomeTownLocator website provides local information and data for US cities and states.

**Reference**


**Process log:**

This section has the list of major steps that I took to complete my project.

**Download files**

1. Open www.census.gov/geo/www/tiger and download map layers for Hennepin County, Minnesota census **tracts**, census **SF1** data, and **municipalities**.
2. Open http://www.scorecard.org and download data for top 20 polluters in Hennepin County, Minnesota.


Build an ArcMap document

1. Start ArcMap and add tgr27053trt00.shp, 227053ccd00.shp, and tgr27000sftrt.dbf.

2. Change the layer projection to state plane, 1983 NAD (feet), and Minnesota South.

3. Symbolize ccd00227053.shp with a transparent fill and dark blue outline 1.5 pixels wide. Change its name to Municipalities, and label the municipalities by name.

4. Join tgr27000sftrt.dbf to the attribute table of tgr27053trt00.shp using STFID in both tables as the join column.

5. Symbolize tgr27053trt00.shp using the field BLACK and manual break points of 500, 1,000, 1,500, 2,000, and 2,519 with a gray monochromatic scale. Change its name to Black Population.

6. Add the HennepinCountyPolluters.dbf as an XY theme using X field = LONGITUDE and Y field = LATITUDE, and symbolize it using red graduated circles sizes 4–14 with 3 manual classifications of less than 25,000, 25,000 to 50,000, and 50,000 and greater. Change its name to Hazardous Emissions (Pounds per Year).
7. Convert the **XY theme** to a **shapefile**, using the coordinate system of the data frame, by right-clicking the **XY theme** and clicking **Data…, Export**, etc. Call the new theme **TopPolluters.shp**.

8. Select the **top four polluters in Hennepin County** (those over 50,000 pounds per year of emissions) and create a **2-mile buffer** around those companies. Note: Because the polluter point layer is projected into rectangular coordinates, the buffers will be circular as desired. If left to latitude and longitude coordinates, they would be ellipses when viewed in state plane coordinates.

9. For all tracts in Hennepin County, get statistics for the population of Blacks and Whites. Then select the census tracts that have their centers within the two-mile buffer. From the selected tracts, get statistics on the number of Blacks and Whites living within two miles of the largest polluters. Then calculate the percentage of Blacks and the percentage of Whites living within two miles of the largest polluters.

**Build map layout**

1. Go to Layout view in ArcMap and create a **layout**.

2. Export a **tif** image of the layout.

**Report**

The report is included as Appendix A.

**Reference**
APPENDIX A

Report

Evidence of environmental justice:
Analysis of environmental hazards emissions compared with Black Population in
Hennepin County, Minnesota

By

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May 7, 2012
Introduction

Environmental justice is “the fair treatment and meaningful involvement of all people regardless of race, color, sex, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (US Environmental Protection Agency). The problem to be addressed concerns environmental justice in regard to the Black population in a major metropolitan county, Hennepin County, Minnesota, which contains the city of Minneapolis. Hennepin is a progressive county, so if evidence of environmental injustice is found there, likely it will be found in other areas.

Minorities tend to live in communities with high levels of pollution. There are many reasons why this is so, but the underlying causes are economic and political. Poverty is concentrated in minority populations although, of course, not all people in minority groups are poor. The low-cost housing that poor persons can afford is often undesirable in many ways, including being in polluted environments. On the political side, poor people generally have little political clout and generally have been underrepresented in decisions impacting pollution in their areas. The field of environmental justice is concerned with redressing such inequities.

In this paper, I compare maps displaying the companies releasing the most pollutants in Hennepin County compared to locations of the Black population. Buffers reveal the populations at risk because of their proximity to the hazardous releases.
Data sources

I obtained map layers for this project from the TIGER/Line 2000 website at www.census.gov/geo/www/tiger/. These consisted of two layers for Hennepin County, Minneapolis: minor civil divisions so that I could display the boundary of Minneapolis, and census tract boundaries so that I could prepare choropleth maps displaying variables representing the number of K-12 school-age children.

The second data source is the Environmental Defense agency’s website at www.scorecard.org. I downloaded data about the top 20 polluters in Hennepin County and compiled a table describing the company name, type of company, latitude and longitude location, and the amount of toxic emissions in pounds.

Results

Figure 1 presents the top 20 polluting companies in Hennepin County, Minnesota, by the amount of hazardous emissions in pounds compared with the Black population by census tract. I placed two-mile buffers around the top four polluters to identify populations most at risk. You can see that three of those buffers have significant Black populations within their borders, thus providing some evidence of environmental injustice.
Conclusion

This report has analyzed the population in close proximity to environmental hazards in Minneapolis and Hennepin County, Minnesota. For environmental hazards, I have used the top 20 polluters in Hennepin County and the amount of toxic emissions by pounds. For the population, I have used US Census variables Black population. There are clearly risks for the Black population. Three of the top four polluters are within two miles of major pockets of Blacks.
There are two major extensions possible for future work. One is to use additional measures of race and poverty compared to the toxic release sites. The second extension would be to get a map layer with disease conditions related to environmental hazards. Then it would be possible to start analyzing what the health risks are to these populations.

References

Scorecard, the Pollution Information Site, Internet URL: http://www.scorecard.org/, accessed April 26, 2007.
