City of Denton Watershed Mapping and Public Information Website

By Rodney Smith

Abstract-
The City of Denton has developed a watershed monitoring system of its three main basins and its seventy-one sub basins consisting of sampling stations reporting data back in continuous real time. These data are collected and processed monthly to be presented in a public information campaign designed to raise awareness of damage caused by runoff pollutants. The objective of this project is to utilize ArcIMS and ArcSDE products to allow the citizens to easily find: their watershed and sub basin, real time live data of pollutant levels and water contents, and other historical data all via an interactive mapping system.

Introduction
The City of Denton, in accordance with National Pollution Discharge Elimination System (NPDES) Storm Water Phase II rule, has created a watershed monitoring system designed to increase public knowledge of runoff pollutants and how they affect our drinking water by allowing public access to the data collected. The City has taken this campaign a step further by presenting these data in an ArcIMS interactive web mapping format, encouraging public interest in maintaining and protecting the watershed.

Objective
To utilize ArcIMS and ArcSDE products to allow the public to easily find: their watershed and sub basin, real time live data of pollutant levels and water contents, and other historical watershed data all via an interactive mapping system.

History

What is a Watershed?
A watershed is the area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or groundwater and eventually even to the ocean. Any area that experiences precipitation of some sort is a watershed. Watersheds can be subdivided into smaller watersheds or sub basins, which collectively flow together to form larger watersheds and basins. Some watersheds extend across county, state, and even international borders. Watersheds come in all shapes and sizes. Some are millions of square miles; others are just a few acres. Just as creeks drain into rivers, watersheds are nearly always part of a larger watershed.

Why is it Important?
Watersheds are a dynamic part of the hydrological cycle. Surface and Groundwater resources are tied directly to all watersheds. There are also diverse and dynamic ecosystems that rely on the continuity of watershed to survive. Anything that can be picked up with rainfall runoff or any other drainage can end up in the watershed. This includes trash and pollutants that can upset the ecosystem and threaten our resources for water supply and recreation.
What pollutants do we look for in the watershed?
There are a number of types of pollutants that can be found in runoff. Usually these are what are known as non-point sources of pollution. Non-point source pollution is water pollution that originates from surprisingly common sources such as our homes, yards, cars and even our pets. It is generated by a variety of everyday activities and is the country’s leading cause of water quality degradation. What may initially appear as harmless behaviors such as fertilizing, mowing, taking out the trash and walking the dog can clog or pollute a storm drain which drains to Lake Lewisville, the drinking water source for the City of Denton. As a result, the City has a vested interest in protecting this water source and the water that feeds into it from the watershed.

Examples of areas of concern:
Each associated stream basin’s measurement level of pH, Turbidity, Conductivity, Total dissolved solids information (determining mineralization), and Salinity. High levels of Conductivity, Salinity and Total Dissolved Solids are often associated with increased development and/or construction. Pesticides and herbicides measured include- Chlordane, Diazinon, and Atrazine. Pesticides and /or herbicides can be bioaccumulated in organisms and absorbed by plants. Other parameters measured include Total Phosphorus (TP), Total Nitrogen (TN), Bacteria, Zinc, Copper, Lead, Oil and Grease, Arsenic, Cadmium, and Chromium. Unusually high measurements for any of these parameters can upset aquatic ecosystems and may pose a threat to human health.

Methodology
City of Denton Watershed Protection Approach
To accomplish the dual goals of Phase II Storm Water compliance and source water protection, the City of Denton developed the Watershed Protection Program Plan (WPPP). One of the advantages of this program is the incorporation of the infrastructure established by the USEPA EMPACT grant that was awarded to the City of Denton and the University of North Texas in 1999. Monitoring results from the “Real Time” EMPACT system and additional watershed monitors were used during the first year of the Watershed Protection Program to establish preliminary baseline conditions for the physical, chemical, and biological components of the City’s surface water resources. Results from this monitoring program are used to support the requirements of the Phase II storm water program, assess water quality for the purposes of source water protection, and to establish baseline conditions that can be used to evaluate any future changes in water quality. Using ArcView and our base map topographical information, 71 sub-basins were delineated within the City of Denton. Sampling stations were established within these 71 sub-basins at locations that would likely represent the water quality of the sub-basins. Monitoring of these 71 sub-basins during base-flow conditions was initiated in January 2001 and continues on a monthly basis, including “Real Time” monitoring of the Lake Lewisville sub basin.

Significant Findings
Land use analyses were conducted on a monthly basis for all parameters collected during base-flow screening activities. Total Housing and Planned Development land uses were consistently associated
with elevated conductivity and total dissolved solids concentrations. High turbidity values were consistently associated with Planned Development, and likely indicate land surface disturbances caused by construction activities in these areas. Total Housing, Total Business, and Planned development land uses were consistently associated with high levels of both Diazinon and Chlorpyrifos, although there is a definite seasonal component to applications. High triazine concentrations were most strongly associated with Planned Development land uses, although Agricultural and Total Business land uses also occasionally exhibited high triazine concentrations. It is likely that in many cases land that is zoned as Planned Development” is currently being developed or has been developed in the recent past. Therefore, high pesticide and herbicide concentrations are likely due to chemical management of residential and / or commercial lawns. The seasonal associations between triazines and Agricultural land uses are likely due to targeted applications for weed control.

Can we fix the problems?
For many surface water problems, technological methods exist to correct water quality impacts. However, technological methods are inherently expensive, particularly when the problems are large scale. For many water quality impairments, a much less expensive alternative is to provide education to citizens on the extent of the problems and ways in which impacts may be minimized. However, this approach requires active citizen participation and a strong sense of commitment. If the local community does not have a strong desire to maintain and improve the surface water resources of Denton, then the information provided by the Watershed Protection Program will not be used to its full capacity.

Solution - Public Information Campaign

ArcIMS Approach
Using simple customization of a standard HTML viewer created in Designer, we created a Find Your Watershed Mapping and Information Site. The site is intended to be informative, fun and easy to understand. Using ArcIMS Author Tool, we began by creating an ArcXML Map service from the monthly collected water data and base map layers on our SDE, and published this map service from our GISWEB server in ArcIMS Administrator. With the map service running, a basic viewer was generated from Designer and then customized to conform to the city web design. Graphs and Maps, created with ArcView, were exhibited in Javascript slideshows demonstrating pollutant activity over the past two years and linked to the mapping sites main tool bar. Once the mapping site was completed, an information page was created to act as a launch page for the mapping site and answer the three basic watershed questions: What Is A Watershed? Why Is It Important? What We Can Do About It? Bringing all of the data together in this information page, we linked to our joint UNT/City of Denton EMPACT Website providing real time data, as well as linking to informational sites from the Environmental Protection Agency and United States Geological Survey.

Summary
Our Goal with the Website is to Raise Awareness by Answering Basic Questions: What Is A Watershed? Why Is It Important? What We Can Do About It? In an effort to raise awareness, we are attempting to create fun, interactive informational websites designed to encourage public interest and participation in the health and maintenance of our watershed and drinking water resource. These
websites will be part of an aggressive campaign to inform the citizens of the problems and sources of pollution in our local watershed.

Conclusions
Based on the number of visitors to the site, The City of Denton’s Watershed Mapping and Information Website has proven to be effective in generating interest in the Watershed Protection Program. This tool has provided easy access to the data collected by the city as well as presented the data in an easy to understand format. Our hope is that this site combined with an aggressive advertising campaign can alert our citizens to existing problems and raise awareness of the importance of public participation in protecting the City’s water supply. It is important to recognize that without local community involvement, and a strong desire to maintain and improve the surface water resources of Denton, the City of Denton will bear the cost of future water quality impairment, and citizens will bear the cost of the negative impact to local human health and environment caused by pollutants.

Future Goals
Some future goals include the creation of an interactive watershed game for kids to play (giving graphic examples of what chemicals are in runoff), and the development of an ODBC live data link into the UNT water quality database. The link would extract data to provide a continuously updated live data graph of water quality within our sites pages.

Sources

USEPA Website: http://www.epa.gov/OWOW/NPS/facts/point1.htm
USEPA Website: http://www.epa.gov/owow/nps/qa.html
UNT Website: http://ecoplex.unt.edu
USGS Website: http://tx.waterdata.usgs.gov/nwis/

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