Protecting Watershed Resources and Quality through Utilization of GIS Tools and Models

Authors:
Tara A. Bongiorni Ajello, CH2M HILL
Ronald A. Etzel, Anne Arundel County DPW
Mary L. Searing, Anne Arundel County OECR
William H. Frost, KCI Technologies, Inc
Laurens van der Tak, CH2M HILL

May 6, 2004
Anne Arundel County, MD is developing a comprehensive Watershed Management Master Plan for the Severn River.

Project Team: CH2M HILL and KCI Technologies, Inc.

Two Main Parts to project:
- traditional watershed management plan activities
- development of Watershed Management Tool (WMT)

Focus of this presentation is on the WMT
Anne Arundel County, MD is feeling development pressures

Severn River Watershed:
- includes Annapolis, USNA
- drains to Chesapeake Bay
- heavy reliance of community on water resources:
  - tourist industry
  - water recreation / sailing
  - fisheries
Additional Benefits of the Watershed Master Plan

- Balance environment and healthy economy
- Maintain Anne Arundel County’s quality of life
- Analyze the land and watershed environments together
- Identify and protect environmentally sensitive areas
Vision

The Watershed Master Plan will provide a blueprint and tools to facilitate land use and infrastructure decisions by County Staff and Stakeholders to protect the resources of the Severn River.
Summary and Overview of Watershed Management Tool

Utilized for:

- Watershed-Based Land Management
- Land Use Planning
- Development Review
- NPDES Compliance and Reporting

Components include:

- Comprehensive watershed database of GIS layers and field data
- Visualization tool
- Different models to assess the condition of the watershed in terms of water quality, flow regime, and habitat assessment
Overview of Functional Components of WMT

Modeling Component
Models and Interfaces

- Interfaces/Analysts
  - Input Retrieval and Output Storage
  - Import and Export Functions
  - Model Run Control
  - Result Presentation/Interpretation/Analysis

- Models
  - Pollutant Loading Tool
  - Stream Assessment Tool
  - Hydrology Models/Analysis Tool
  - Hydraulic Models/Analysis Tool
  - Soil Erosion Model/Analysis Tool
  - Estuary Model/Analysis Tool
  - Groundwater and Surface Water Interactions

Data Warehouse Component
Spatial and Non-spatial Databases

- Database Administrators
  - Planning & Zoning
  - Inspections & Permitting
  - Public Works

Watershed Management Tool

Management Component
Interfaces and Administration

- Data Integration
  - Data Availability/Establishment
  - Data Update/Monitoring

- Workflow Management
  - Modeling Requests
  - Project Tracking and Fulfillment

Internal Viewing Component
Intranet MapOptix

- Intranet MapOptix
  - With New Watershed Data View/Query/Report Modules

CH2M HILL
Components of the Anne Arundel County Watershed Management Tool

- **Comprehensive watershed database**
  - GIS layers
  - field inventory data
  - monitoring data

- **Visualization Tool**
  - graphical presentation of watershed info

- **Modeling Tool**
  - allows for qualitative and quantitative analyses
  - allows the reviewer to perform what-if scenarios
Model Categories within WMT

- **Water Quality Modeling - Pollutant Loading**
  - models pollutants coming off land - runoff quality
  - PLOAD and GWLF (Generalized Watershed Loading Function)

- **Hydrologic & Hydraulic Modeling**
  - addresses flooding and changes in flow regime
  - TR-20 and HEC-RAS
Model Categories within WMT

- **Stream Assessment**
  - predicts future stream habitat conditions
  - based on regression analyses
  - WISE (Watershed Improvements through Statistical Evaluation)
  - data visualization tool - allows querying, categorizing
  - Stream Assessment Tool

- **Groundwater / Surface Water Interactions**
  - GWLF

- **Septic System Discharges**
  - GWLF
Stream Assessment Tool

- data visualization tool
- querying and categorizing functionality for County to use in their analyses of stream assessment and bioassessment data
- contains baseline 2002 conditions
- original version developed in ArcView 3.2 and Access 2000
- now has been migrated to ArcGIS 8.2
Stream Assessment Tool: Watershed Management - Data Visualization

- Assessed streams
- Classification of stream reaches by MPHI category
- Ranking of County stream reaches
- Development requirements (e.g. floodplains)
- BMP locations
- Infrastructure locations - including illicit discharges
Stream Assessment Tool: Development Review
Pollutant Loading Model: PLOAD

- Developed by CH2M HILL in 1999
- Now included in the EPA BASINS package - linked to ArcView 3.2
- Has been migrated to ArcGIS 8.3
- New version includes a scenario wizard and personal geodatabase to better manage the input and output data associated with a model run scenario
Pollutant Loading Model: PLOAD

- Models runoff quality using Simple Method
- Event Mean Concentration literature review performed, MDE and NURP data used among others
- BMP point coverage developed during this project from County database
- Point source coverage developed with County and utilized EPA Permit Compliance System data
- Current conditions modeled to date, future conditions in process, then additional scenarios coordinated with County
Modeling Tool: Pollutant Load Modeling

Land use + Subwatersheds + BMPs

Severn River Watershed
Pollutant: Nitrate-Nitrites (NOx)
Units: lbs/ac/yr

Subwatershed - Pollutant Load
- 0 - 1.3
- 1.3 - 2.6
- 2.6 - 3.9
- 3.9 - 5.2
- 5.2 - 6.5
In conclusion:

General Advantages of the WMT

- Better access and use of existing mapping and related data throughout the County
- Ability to make more informed decisions
- More consistent review and analysis
- Supports existing business practices and software (MapOptix)
- Provides an overall watershed perspective
- Dynamic tool
- Win-win situation for the environment and the economy
Protecting Watershed Resources and Quality through Utilization of GIS Tools and Models

Tara A. Bongiorni Ajello
May 6, 2004