WATER RESOURCES
IMPACT

NHD, RIVERSPILL, AND THE DEVELOPMENT OF THE INCIDENT COMMAND TOOL FOR DRINKING WATER PROTECTION

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INTRODUCTION

This project involved the development of an information tool that gives Incident Commanders the critical information they need to make informed decisions regarding the consequences of threats to public water supply intakes.

The U.S. Department of Agriculture (USDA) Forest Service, Environmental Protection Agency (USEPA), Federal Emergency Management Agency (FEMA), Technical Support Working Group (TSWG), and Defense Threat Reduction Agency (DTRA) have identified as a high priority, the need for protecting drinking water sources from terrorist attacks. Making early detection of contamination and other key information available to incident commanders will better enable them to evaluate the risks posed to the public and to direct the actions of first responders to effectively reduce those risks.

The objective of this project was to develop an incident command tool that:

- Integrates critical data needed to evaluate and respond to an incident into a GIS referenced system.

- Predicts dispersion of waterborne contaminants by integrating the RiverSpill system with the National Hydrography Dataset (NHD).

- Incorporate interfaces between field sensors and RiverSpill.

- Contains GIS layers and databases to display water threats in relation to surface water contamination sensor locations; sensor outputs; the location of dams, reservoirs, and locks; the location of surface water bodies; public drinking water intakes; roads and other terrestrial transportation networks; topography; and population.

- Provides secure web-based access to local incident commanders, and to a centralized, regional, or national command center.

- Provides the capability of tracking human pathogens, toxic chemicals, and radioactive substances that pose significant threats to public safety in case they were used to attack water sources.

SPONSORS AND PARTNERS

The development and implementation of the Incident Command Tool for Drinking Water Protection (ICWater) is a collaboration of government agencies, a regional river basin commission, and private industry. The main sponsoring organization is the USDA Forest Service and its desire to provide spill response tools to their Incident Commanders. The TSWG is managing the ICWater contract. The TSWG is the U.S. national forum that identifies, prioritizes, and coordinates interagency and international research and development (R&D) requirements for combating terrorism. The TSWG rapidly develops technologies and equipment to meet the high priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with major allies.

The Defense Threat Reduction Agency has signed a Memorandum of Understanding with the Forest Service to provide training on ICWater to first responders. The USEPA has supported the development of the RiverSpill model which is the core component of ICWater. The USEPA and the U.S. Geological Survey (USGS) are providing value added attributes (VAAs) to the NHD such as mean flow volume and velocity. This product is called NHDPlus (Simley, 2005). Finally, through funding from USEPA Region 3, a version of RiverSpill is being calibrated for the Potomac River Basin with the participation of the Interstate Commission on the Potomac River Basin (ICPRB).

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RIVERSPILL AND ICWATER

The ICWater project has resulted in significant changes to the current RiverSpill application. These changes include: (1) the replacement of the Enhanced Reach File (ERF1-2) with the National Hydrography Dataset, (2) replacement of Arcview 3.x with ARCGIS version 9, and (3) the inclusion of a web-based version of ICWater. ICWater's core component, RiverSpill, is a GIS-based system used to track and model the flow and

concentration of contaminants in source water supplies. With RiverSpill, personnel can calculate, locate, and map the population that could be at risk from the contamination of a public water supply, by providing data through a variety of modules. In addition, the model calculates the travel time of a contaminant based upon stream flow, decay, and dispersion of the constituent introduced in surface waters.

ICWater is being developed using the 1:100,000-scale (medium resolution) NHD which is available for all hydrologic units in the continental United States. The data was downloaded from the USGS NHD Server in pre-staged personal geodatabases by subregion. The VAAs are being made available by USEPA and the USGS for individual hydrologic regions with Hydro Region 5 (Ohio River Basin) and 17 (Pacific Northwest states) being used for development purposes. As part of the initial development, the USGS also provided mean flow volume and velocity on NHD reaches for Hydro Region 1 (New England) through the Sparrow Program (Moore and Johnston, 2004).

DOWNSTREAM AND UPSTREAM TRACING USING NHD

The NHD flowlines and their associated mean flow and velocity data are used in conjunction with USGS real time stream flow gauging stations to navigate downstream (Figure 1). For downstream tracing, a graphical user interface allows for input of the spill location, size, type (instantaneous or continuous), agent type (chemical, biological, or radiological) and choice of flow data (automated location of nearest real-time gage, user selected gage, mean flow, or user specified flow). Once the trace is completed, a breakthrough curve (concentration versus time) can be generated for any location on the trace (Figure 2).

The NHD can also be navigated in the upstream direction (Figure 3) based either on distance or time. If time is chosen, the travel time upstream can be based on flow from real-time gages, mean flow, or user specified flow. The total distance or time upstream of a location can be subdivided into zones and assets such as HazMat sites, municipal and industrial dischargers, dams, etc., can be overlain. A report in html format can also be generated which shows the location of the upstream assets and a table of asset attributes.

SUMMARY

The RiverSpill time-of-travel spill model has been updated to use the NHD in geodatabase format. Mean flow volume and velocity attributes are linked to the NHD flowlines. USGS real time stream flow gages have been

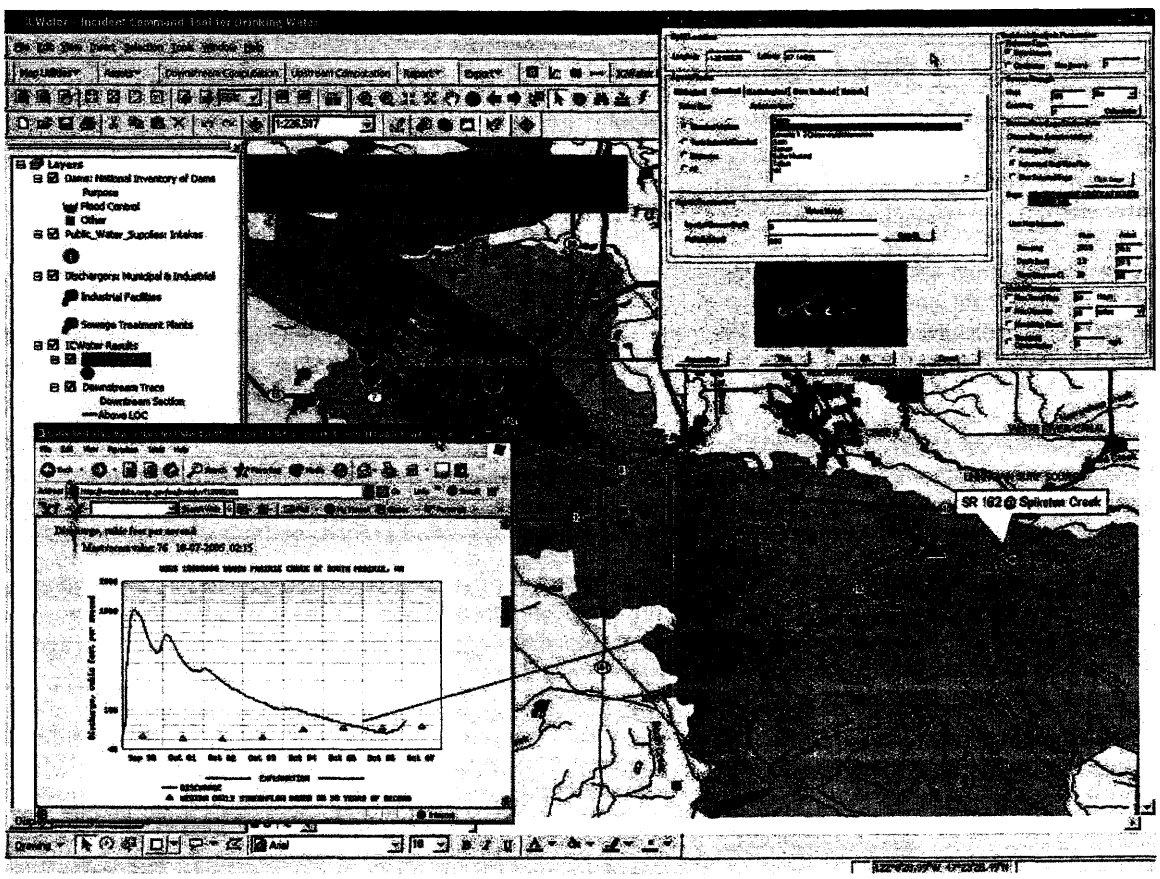

Figure 1. ICWater Downstream Trace Using USGS Real-Time Stream Flow.

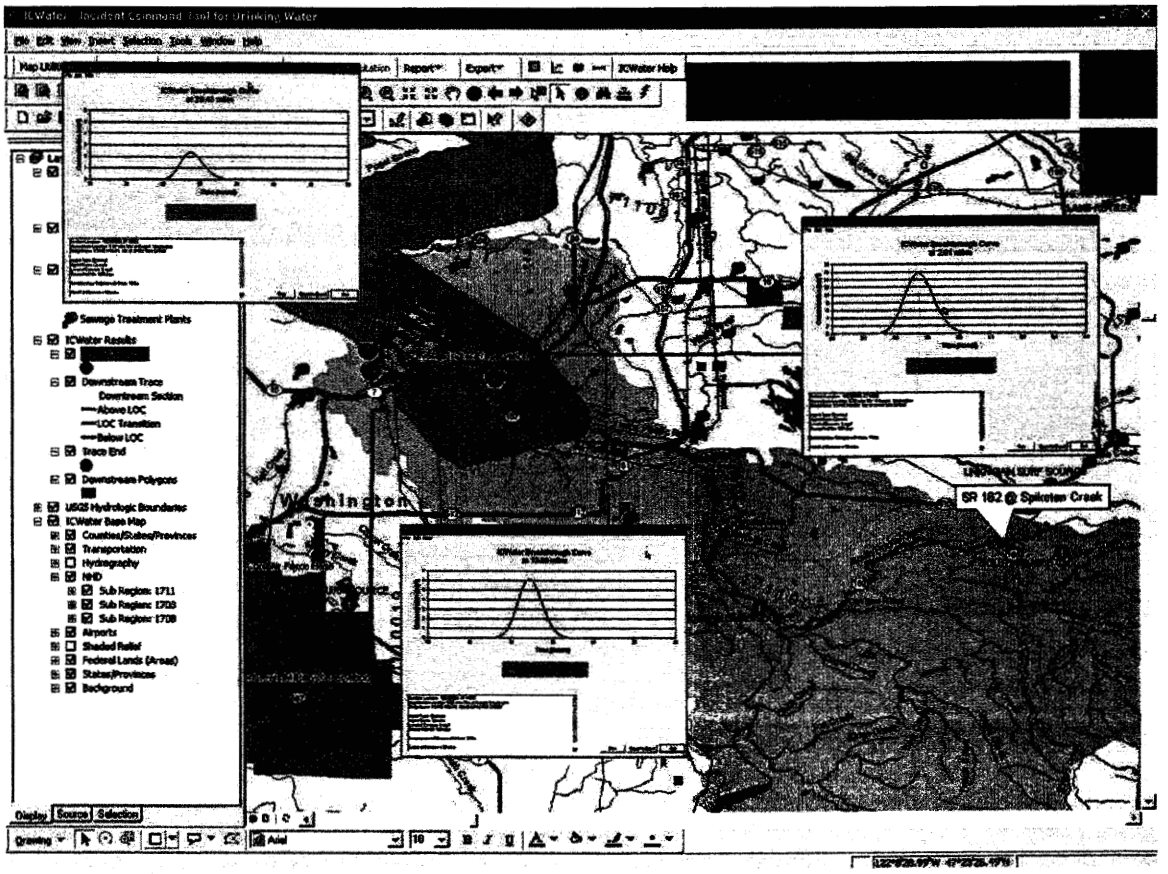

Figure 2. ICWater Downstream Trace Showing Breakthrough Curves.

indexed to NHD so that travel time and concentration is based on flow conditions at the time of the spill event. This model forms the basis of the transport module of ICWater. Public water supply intakes, HazMat sites, dams, pipelines, bridges, and railroads are also included as part of ICWater. Both stand-alone and web-based versions have been developed.

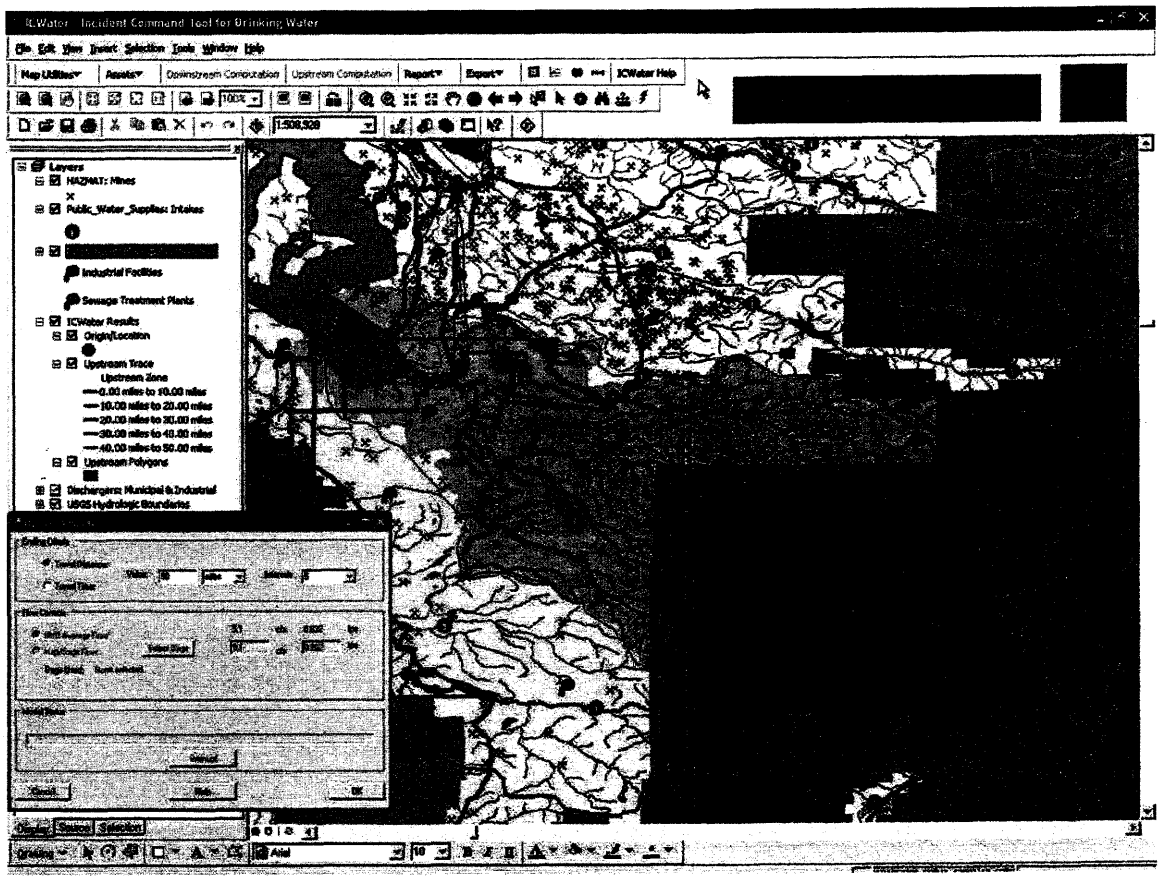

Figure 3. ICWater Upstream Trace Output.

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Imagine a map of all the surface water hydrography in the United States – all the streams and lakes and springs found on all 55,000 7.5-minute USGS topographic maps. Now imagine all of that data available to you at the tips of your fingers – for free. That is the National Hydrography Dataset (NHD). With just a few minutes of training, anyone can access this data over the web. And with just a few more minutes of training anyone with basic geographic information system skills can begin some rather complex analysis of the Nation's surface water. Availability, power and ease-of-use are the hallmarks of the NHD.

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Cover Photo: A 3D hillshade from a bare-earth Digital Elevation Model with two-foot contours and Special Flood Hazard Areas (flood plains) for the Little Cypress Creek Watershed in Harris County, Texas. The image was created by Brandon Grimm and John Grounds of Grounds Anderson, LLC.

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