ICWater: Incident Command Tool for Protecting Drinking Water

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Abstract

The primary purpose of the Incident Command Tool for Protecting Drinking Water (ICWater) is to make critical information rapidly available to incident commanders who would direct first responders protecting the public during a chemical, biological, or radiological (CBR) attack on a drinking water source. The tool is designed to enable incident commanders to quickly evaluate the threat posed to the public and take action to reduce the threat. Second, the tool also offers forensics capability to track down the sources of contamination and thus applies to law enforcement and forensics operations as well. 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 both upstream and downstream tracing.

Background

The United States Department of Agriculture (USDA) Forest Service, Environmental Protection Agency (EPA), 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 key information rapidly 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. ICWater is a component of the Integrated Water Quality Security System (IWQSS) and is based on the RiverSpill (Samuels, 2003) model (see figure 1).

Figure 1. Integrated Water Quality Security System (IWQSS)

Development

The development of ICWater has taken place in three phases: (1) requirements, (2) pilot and (3) operational. A user requirements workshop was held during the requirements phase. The product of the pilot phase was an ICWater prototype that was subjected to user testing. During the operational phase, feedback from user testing was integrated to produce an operational ICWater system.

Requirements Phase

The purpose of the requirements phase was to identify user needs, translate these needs into a system specification, and develop a project implementation plan for building the ICWater. A review of ICWater requirements is also necessary to ensure that the development team and the users have a common vision of the proposed outcome of the effort in terms of capability and usability.

The user requirements workshop for ICWater was held on October 15, 2003 in McLean, VA (SAIC, 2003). The workshop consisted of 43 attendees representing Federal, State, Local (water utilities) government, water utility organizations, and private industry. The morning plenary session consisted of presentation about the project goals, plan for implementation and technical details about the RiverSpill model. In the afternoon, the attendees broke up into three groups: on-the-scene response, strategic response and technical. Each group discussed a series of questions related to two major topics: (1) What information would it be most important for ICWater to provide to Incident Commanders and/or Strategic Decision Makers to help them respond to a real-time terrorist attack or accidental HAZMAT release, and (2) how can we most effectively introduce this new Tool to the user community? The key ICWater requirements identified by workshop attendees were:

- Provide for keeping all databases current
- Include capability for users to add their own databases
- Determine uncertainties of time-of-travel and concentration
- Apply to real places and events, including past events
- Incorporate tutorials
- Enable user to specify sites to obtain time-of-travel and concentration
- Enable user to reinitialize model if model and observations deviate
- Create graphics and maps for the press and other public outreach
- A more specific identification of the effected population is needed
- ICWATER to support and be compatible with water utility operational plans
- Need capability for time phased releases at same or different locations
- Develop standardized warnings and advisories
- Links to operators of dams that control river flows

Pilot Phase

The purpose of the Pilot Phase was to develop a working ICWater prototype based on user requirements (SAIC 2004a, SAIC, 2004b). The ICWater prototype enables decision makers to evaluate and take actions against terrorism attacks on public drinking water sources in real time. This tool integrates multiple sources of information to give decision makers concise summaries of current conditions and forecasts of future consequences of terrorist acts on public water supply safety. The system is GIS-based and the output is compatible with the Defense Threat Reduction Agency's (DTRA) Consequences Assessment Tool Set (CATS), the Federal Emergency Management Agency's HAZUS system, Chemical and Biological Response Aid (CoBRA), and the Environmental Protection Agency's Emergency Response Analyzer (see figure 2). The core components of ICWater include many of the components found in the RiverSpill model. Alpha and Beta versions of the system were developed and tested by over 40 users at two separate

workshops (SAIC 2005a, SAIC 2005b, SAIC, 2005c). Prototype development included the integration of databases that represented potential spill sites such as highway bridges (figure 3), petroleum pipelines (figure 4) and toxic chemical release sites (figure 5).

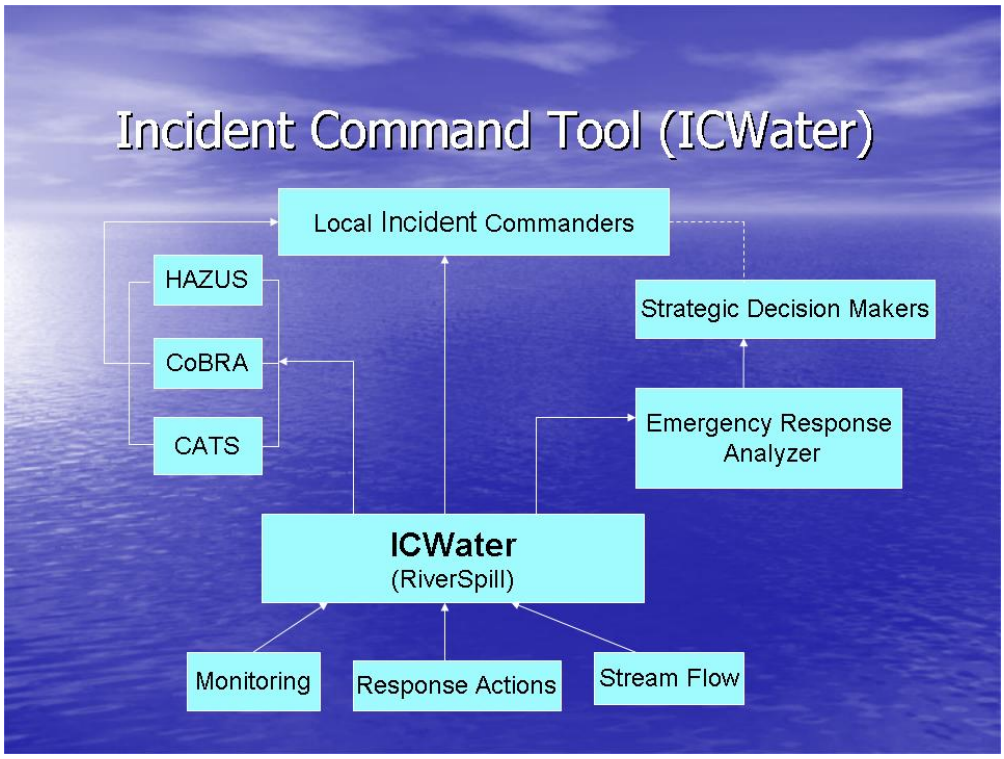

Figure 2. ICWater schematic diagram.

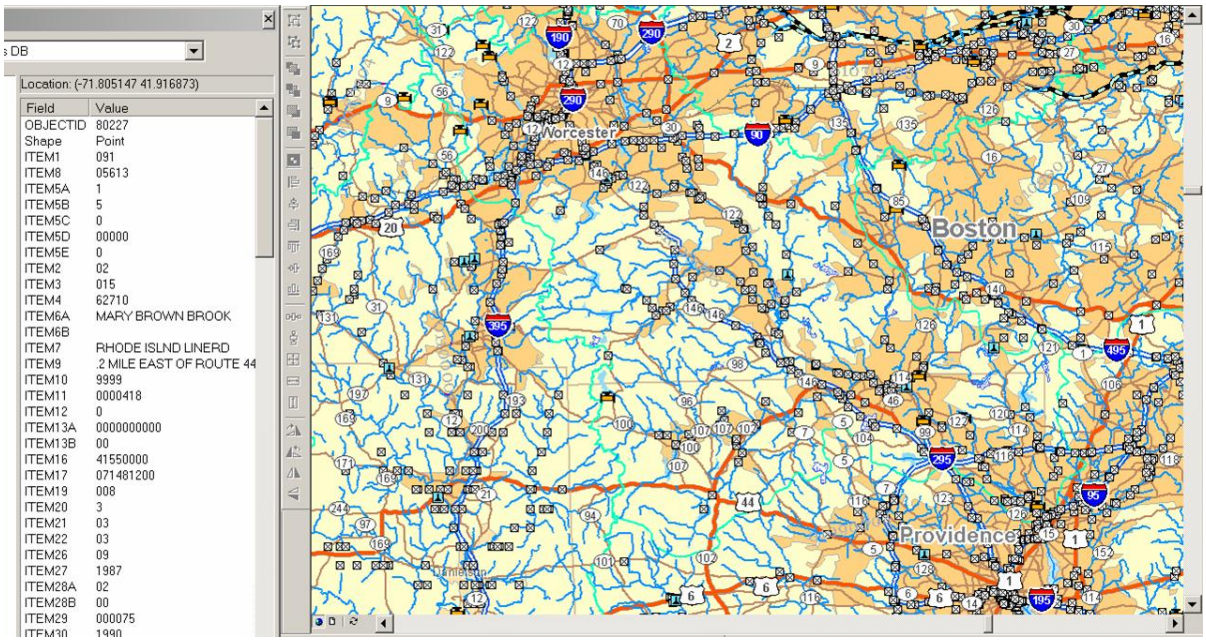

Figure 3. Highway bridge locations.

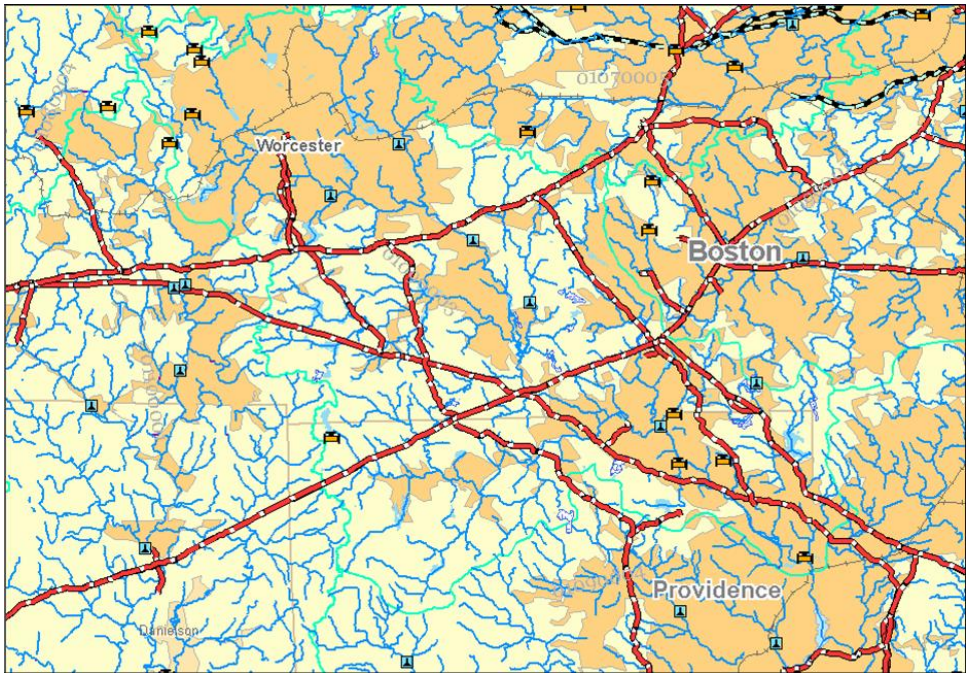

Figure 4. Petroleum pipeline locations.

Figure 5. Toxic Chemical Release Inventory data.

Operational Phase

In the operational phase, the aforementioned databases as well as other databases (e.g., gages, intakes, sewage treatment plants, etc) were organized into categories and assets that could be displayed on the ICWater map (figure 6) User feedback from the alpha and beta testing workshops was incorporated into ICWater so that the final product reflected users reactions form the pilot phase. Three versions of ICWater have been developed: (1) stand-alone desktop version using ARCGIS, (2) web-based system using ARCGIS Server and (3) ICWater web-service.

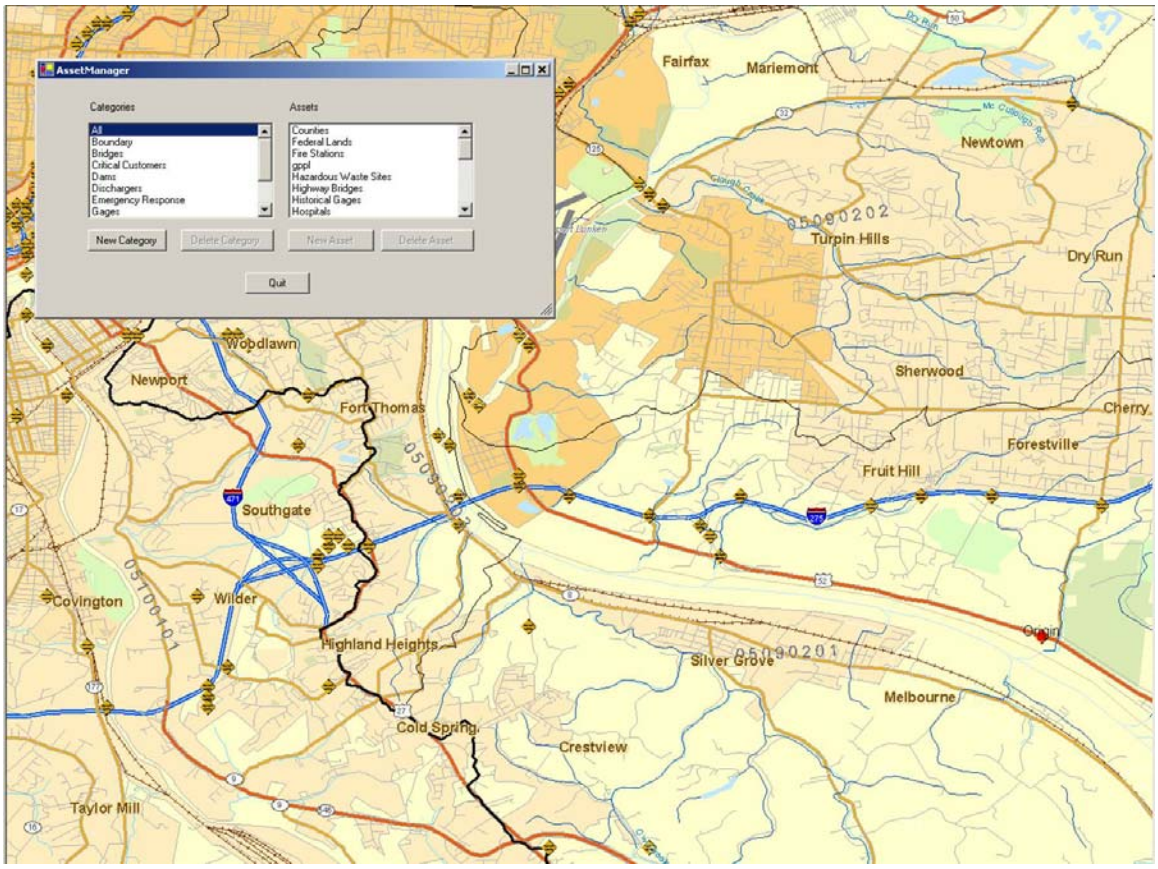

Figure 6. ICWater categories and assets.

ICWater performs downstream tracing (figure 7) based on user inputs such as spill location, mass or concentration spilled, type of release (instantaneous or continuous), type of agent (chemical, biological, radiological), agent properties (half-life, level of concern) and stream flow. A breakthrough curve can be generated at any point on the trace to show the concentration as a function of time (figure 8). An upstream trace can also be generated from any point on a stream (figure 9). The upstream distance can be a function of distance or time (based on flow). Formatted reports (html) can be generated for both the downstream and upstream trace functions. Each report consists of a map and list of facilities encountered.

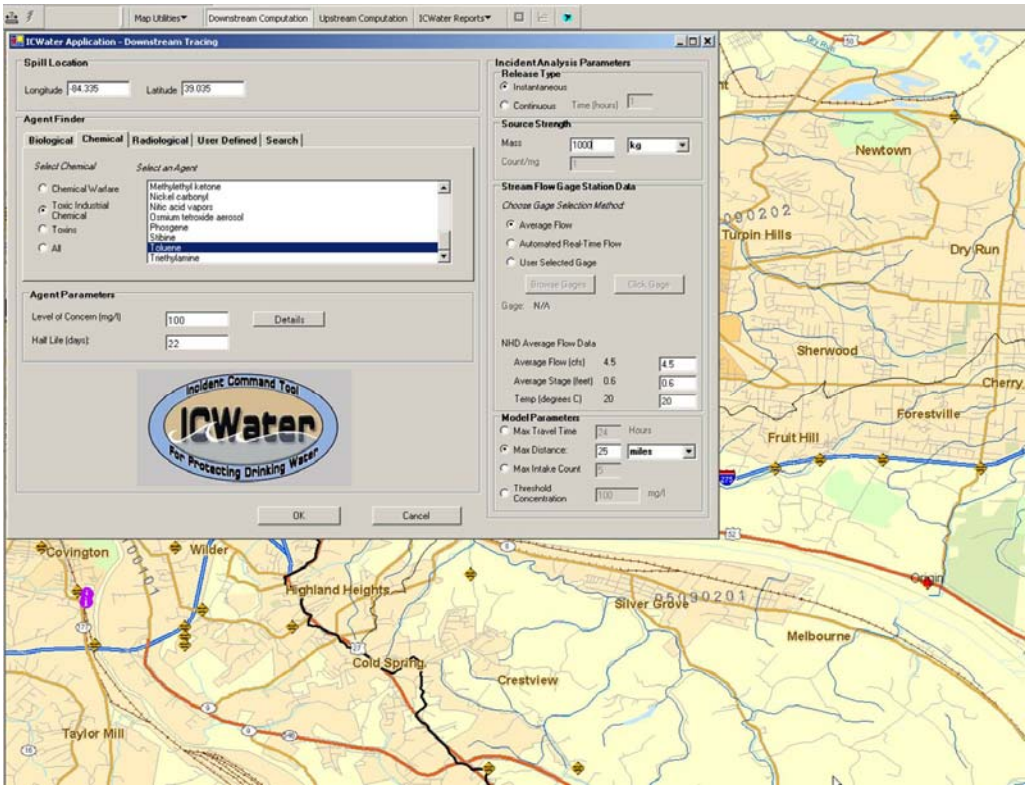

Figure 7. ICWater downstream interface.

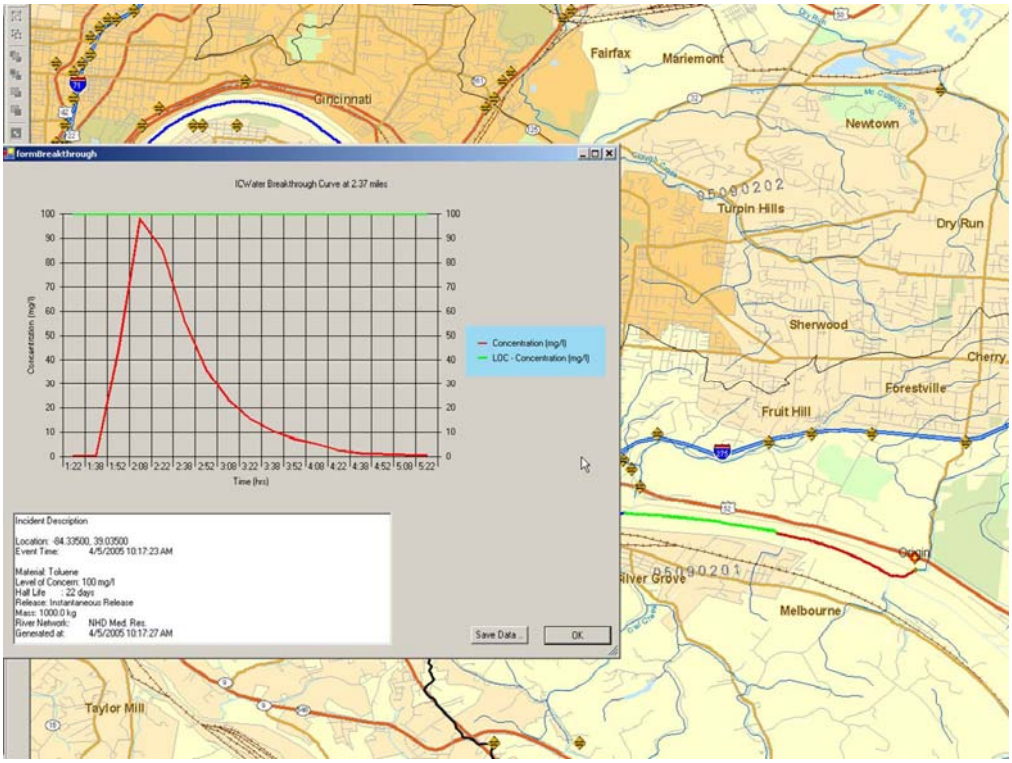

Figure 8. Display of breakthrough curve.

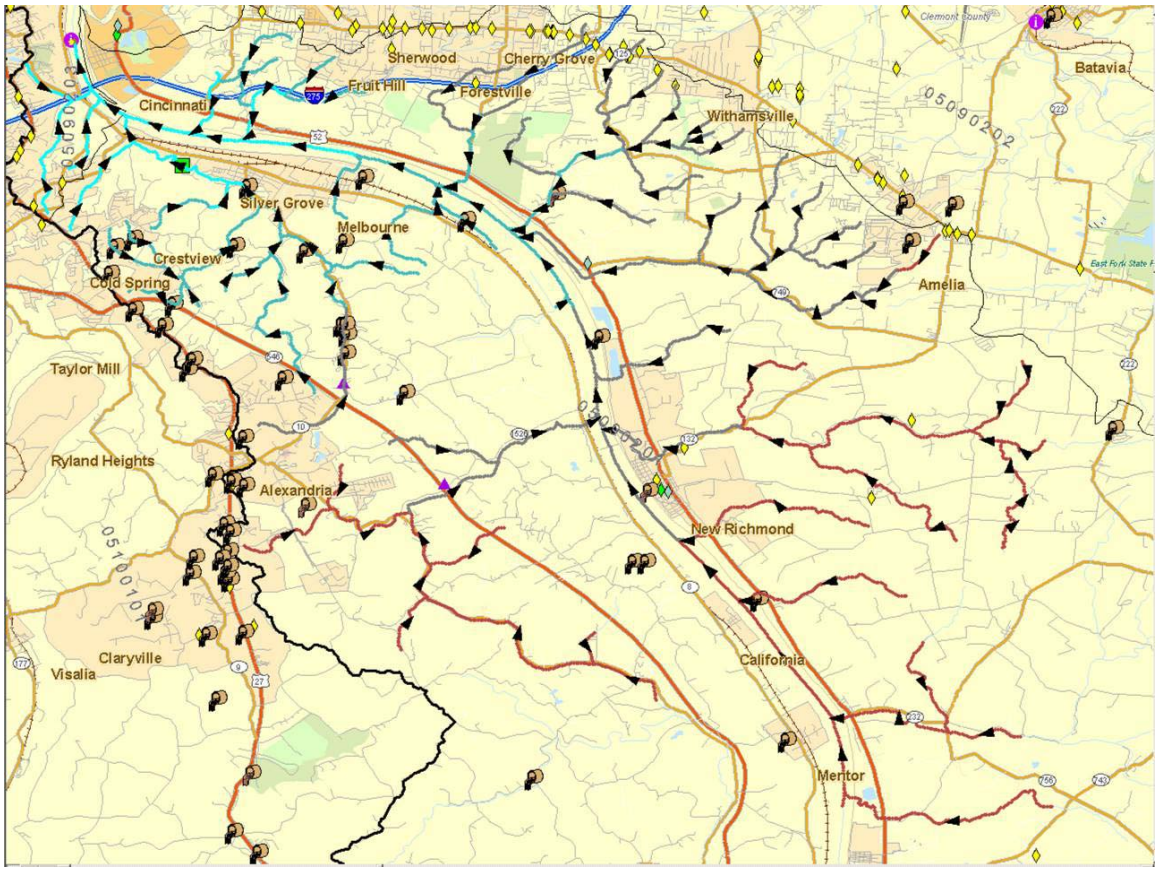

Figure 9. ICWater upstream trace showing overlay of municipal and industrial dischargers.

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