

Creation of an Internet Based Indiana Water Quality Atlas  
(IWQA)

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IUPUI

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## Indiana Water Quality Atlas

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### ABSTRACT

Geographic information systems (GIS) have proved valuable as decision-making tools to plan and manage human activities that impact water quality. However, the benefits of utilizing GIS are frequently unrealized at the local level. County staff, watershed coordinators, environmental and conservation professionals, and the informed public are often not empowered to address water quality problems due to lack of access to data (data in too many places, undocumented, unknown), and lack of physical access to analysis applications / functions.

The Indiana Water Quality Atlas (IWQA) <http://www.in.gov/idem/iwqa/> is a collaborative project to create a Web-based interactive atlas of water quality related GIS data. It aims to spur water quality and watershed management, land use planning, and data exploration by facilitating access to a wide variety of spatially and temporally referenced data through a common interface. By drawing on existing data through the use of distributed databases and Internet GIS technology, IWQA seeks to provide this resource at no cost to the end user. This paper discusses the distributed GIS architecture and the custom capabilities provided by the system.

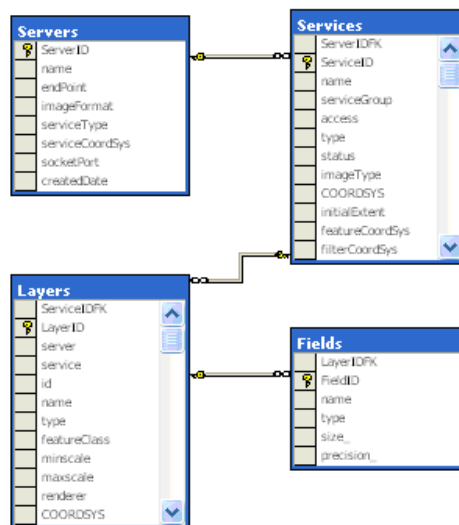
### Strategy

Under a contract with the Indiana Department of Environmental Management (IDEM), The Polis Center at Indiana University Purdue University Indianapolis (Polis) has developed the Indiana Water Quality Atlas (IWQA), which includes orthoimagery, hydrology (NHD), and many other framework layers for the entire State. In addition, the Indiana Geological Survey (IGS) compiled more than 170 critical data layers, including framework layers, with the appropriate metadata for the Indiana Department of Transportation (INDOT). Both of these efforts provide statewide GIS data to the public through ESRI ArcIMS Web Sites. These sites provide user friendly viewers, the capabilities to download data (at no charge to the user) and query information from the themes.

To take advantage of these existing data, the IWQA uses distributed ESRI ArcIMS capabilities to query data which resides on multiple servers in different locations. Many important objectives are achieved with the integration of the IGS and Polis efforts. Most significantly, needless duplication of effort, specifically gathering and authoring data is minimized creating savings for IDEM the maintainer of the IWQA. Implementing the IWQA as a distributed model allows the users to access multiple data sets from other data servers and allow data providers the ability to share their data while remaining the primary custodians of its storage, maintenance, and security.

## IWQA GIS Data Services Map Registry

The Polis Center has developed a map registry that pulls together ESRI Mapping services. The map registry service both integrates and exposes map services. As new data become available to add to the IWQA, the GIS administrator adds the specific service layers and defines the attributes to be queried. The tables depicting the map registry are included below.



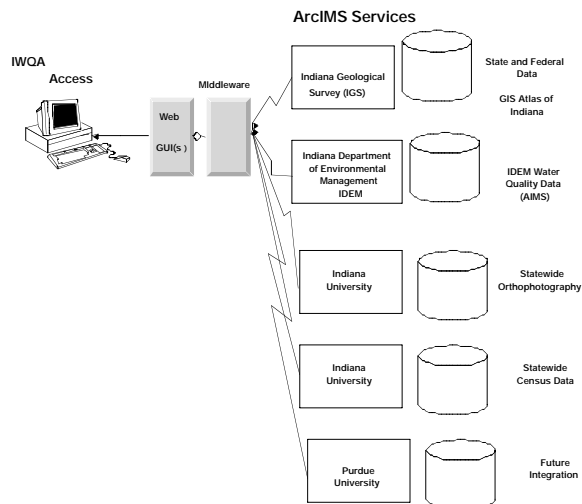
## IWQA Middleware

IWQA uses middleware to address the limitations of available Internet mapping service (IMS) software when integrating multiple, distributed ArcIMS services. The critical capabilities included in IWQA are not available from out-of-the-box software. These solutions include:

- Use of registry services for identification of available web data services and connection to identified ArcIMS data and mapping servers
- Identification and selection of desired data and mapping services and selection of individual raster and vector layers for display
- Re-projection on-the-fly of both vector and raster layers
- Individually reordering of the overlay of vector and raster layers
- Geo-coding through dynamic integration of multiple street address sources
- Querying of distributed vector layers
- Rendering capabilities to change of symbology, colors, and scale-dependent rendering

The middleware application utilizes the registry entries to construct ESRI ArcXML requests to send to distributed ArcIMS servers. Using internet transport protocols the application sends these ArcXML constructs to receive a response from ArcIMS servers. Prior to the construction of these ArcXML fragments it uses a clustering algorithm to group GIS layers according to the layer ordering based on users choice. The application then sends these groups as batch requests to appropriate ArcIMS servers in multiple threads. Each map image response from these batch requests is overlaid according to the layer ordering and fused to create a single seamless integrated map image which is dispatched to the clients.

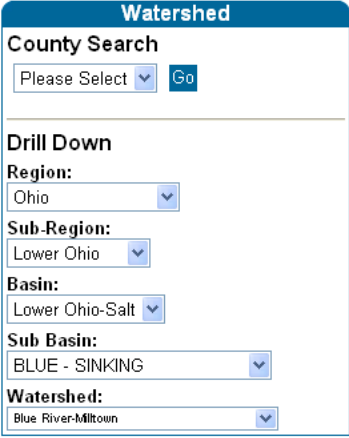
## IWQA ESRI ArcIMS Services



### IWQA Capabilities

The initial task involved developing detailed requirements. The interviews and workshops identified five (5) key custom capabilities, listed below, for inclusion in IWQA. In addition to the five capabilities, IWQA includes educational information. The educational information allows the user to access watershed information as well as other related terms by exploring colorful illustrations and reading informative explanations describing how the watershed works with its surroundings. The custom capabilities include:

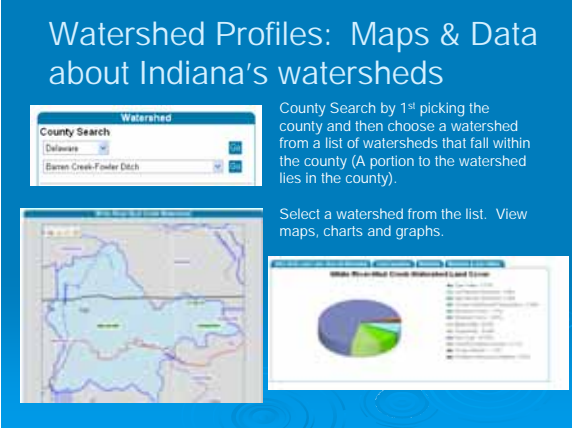
1. The **profiles** capability allows users to find a wealth of information about a single watershed by working down to it through a map-based tool showing the geographic hierarchy of Region, Sub-Region, Basin, Sub Basin, and Watershed. The focus is on watersheds, providing specific information about a chosen watershed such as land cover breakdown, population per square mile, proportion of wetlands to upland, and relative size and location within Indiana.



### Watershed Profiles: Maps & Data about Indiana's watersheds

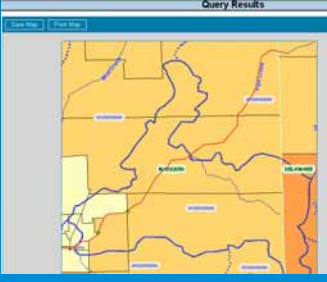
County Search by 1<sup>st</sup> picking the county and then choose a watershed from a list of watersheds that fall within the county (A portion to the watershed lies in the county).

Select a watershed from the list. View maps, charts and graphs.

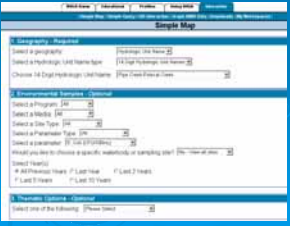


- The Interactive section provides a simple query capability. The capability is demonstrated through the **simple map** and **simple query** applications. With "simple" map, the user can create a map for a specific watershed or county using a large variety of available layers. This interface allows a novice access to a wide variety of data and creates a map of the watersheds and datasets in question. "Simple query," like "simple map" is an interface that creates a map specific to a watershed or county using a variety of layers. With simple query, however, the user can query the layers by a specific field of information in the layer to generate a specific map.

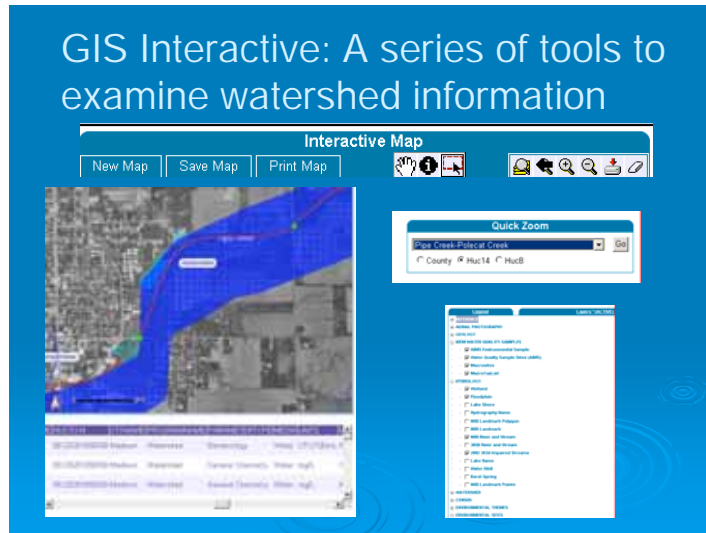
### SimpleMap: Map selected information about your county or watershed



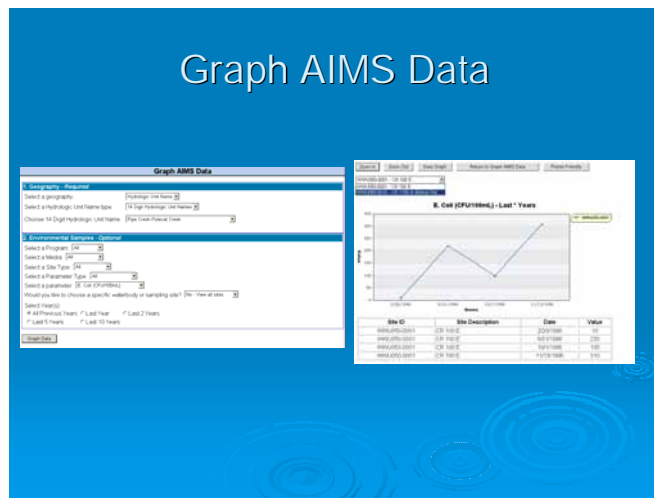
For the Pipe Creek-Polecat Creek watershed we have chosen to query Ecoli sampling sites as well as Census total blockgroup population and 303D Impaired Streams



- The Interactive section has an **interactive** mapping capability. The capability includes allowing the user to create custom maps with data from all over the state of Indiana. The focus is on watersheds, but the flexibility of this website allows the user to edit and focus maps for a specific purpose. The interactive mapping capability includes an application that allows the user to save and later access maps that they have created.



4. The interactive section has a custom **charting** capability. The Assessment Information Management System (AIMS) database is a comprehensive water quality dataset maintained by the Indiana Department of Environmental Management. The graphing capability allows the user to graph the IDEM sampling sites by selected parameters and also view the results in a table.



5. The data **download** application provides the capability to download all of the datasets and metadata. The user may also query the AIMS database and select a dataset to download.

## Download Data

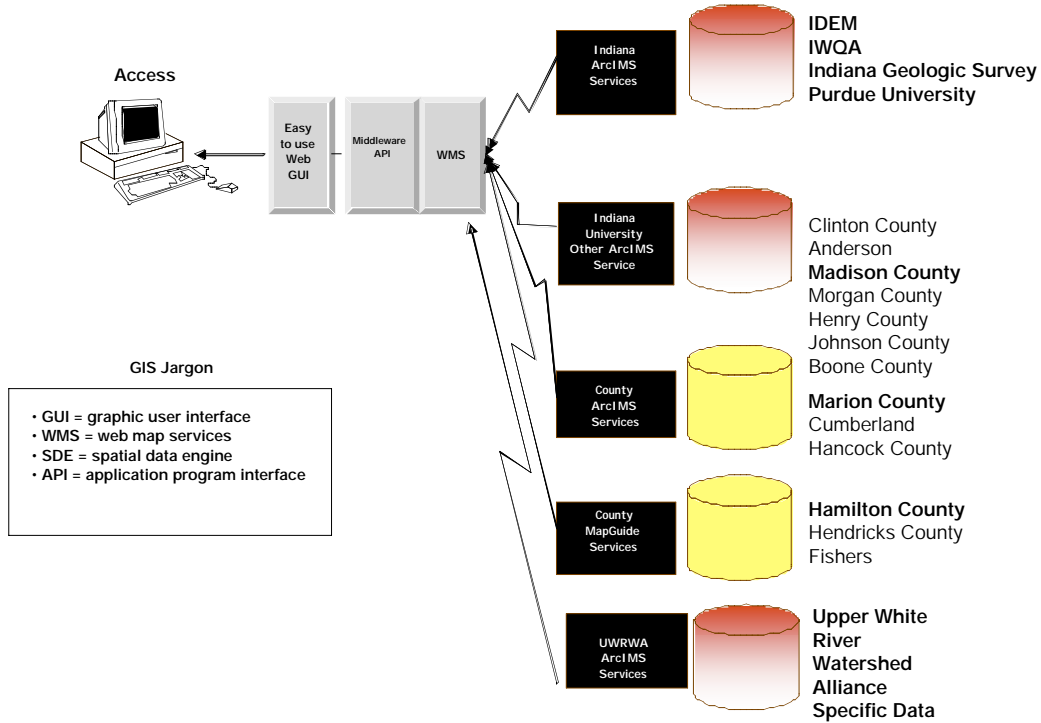
Download IDEM Water Quality Samples (AIMS Data)  
 AIMS Metadata  
 AIMS Documentation  
 Indiana Geologic Survey Statewide Data  
(Please note: The Indiana Water Quality is a distributed system. The majority of the data is served from the Indiana Geological Survey Statewide Site. Please use above to retrieve data and metadata from this site.)

The Polis Center IWQA Metadata		
DATASET	METADATA	DOWNLOAD
<b>AERIAL PHOTOGRAPHY</b>		
<b>CENSUS</b>		
<b>ENVIRONMENTAL SITES</b>		
<b>ENVIRONMENTAL THEMES</b>		
<b>GEOLOGY</b>		
<b>HYDROLOGY</b>		
2002 303d Impaired Streams	303D	SHAPEFILE
305B River and Stream	305B	SHAPEFILE
<b>IDEM WATER QUALITY SAMPLES</b>		
<b>INFRASTRUCTURE</b>		

### What's Next-Leveraging the IWQA

The Upper White River Watershed Alliance (UWRWA) is a nonprofit organization, operating within the Upper White River Watershed in Central Indiana. The organization is led by a board of eleven directors who represent various stakeholders in the watershed, such as cities, towns, counties, agriculture, industry, and citizen and environmental groups. The long-term goals of the UWRWA are to facilitate more effective water quality improvement and protection efforts within the watershed by providing a consistent forum for communication and information sharing among communities, to encourage collaborative water resource planning efforts across political jurisdictions throughout the watershed, and to develop tools, including a web based UWRWA GIS project, to support watershed-based efforts to improve and protect water quality in the watershed.

The UWRWA GIS will be rolled out in July 2005. The integrated GIS is a hybrid of ArcIMS and OGC compliant GIS Image Map Services across multiple counties and state wide base layers. The hybrid approach employs ArcIMS as the primary GIS image map service platform and OGC compliant GIS image map services as a secondary platform. A figure depicting various map services is included on the following page.



**End Notes:**

The Indiana Water Quality Atlas is a scalable application that will grow over time. Because the data for the Atlas resides with each of the data stewards, the maintenance of the data for the application is reduced and the currency of the data will be maintained.

**References**

Indiana Department of Environmental Management, 2004 Indiana Integrated Water Quality Monitoring and Assessment Report April 2004

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