ArcIMS Internet Mapping Application for Recreation, i-Map DelBasin (Delaware River Basin)

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Abstract: The Delaware River Basin Commission's (DRBC) Information Management Advisory Committee (IMAC) has developed i-Map Delaware River Basin, an interactive mapping application that provides answers to basic questions about recreational activities in the Delaware River Basin area. Presented in an easy to use interface, the i-MapDelBasin application enables users to view and perform basic GIS analyses and queries. Utilizing ESRI's ArcIMS, i-Map DelBasin can display reference data from New Jersey, Pennsylvania, Delaware, and New York map services as well as and provide numerous links to various state, federal, and recreational websites.

Background: The Delaware River Basin Commission embarked on a project that brings together the complexities of GIS in a simple intuitive map that meets the needs of the public. The result of this is a project called i-Map DelBasin. The project encompasses parts of four states: Delaware, New Jersey, New York and Pennsylvania, and involved representatives of each of those states in addition to the Federal government (EPA & USGS), and Academia.

To accomplish this task the DRBC formed the IMAC (Information Management Advisory Committee). This committee brought together the representatives and worked to determine if there was a way to gather data in different formats into one comprehensive program while determining what would capture the public's interest. The committee determined that they should seek advice from a consultant to see if this type of project was feasible and whether it could be served to the public as a user friendly web page. The consultant, CyberTech, Inc had already completed the groundwork for this type of web page for the New Jersey Department of Environmental Protection (NJDEP). Using the NJDEP i-Map NJ as a template, the consultant was sure that accessing data from various state and other party's servers was achievable. A major issue was data; what files were available and from whom; what framework layers were needed; should some be stored locally and could others be integrated from other states' servers. The latter was considered to be most significant because one of the goals of the project was to let the owners of the data be the stewards, rather than the DRBC. The consultant, CyberTech Inc., determined that it was indeed possible.

With this study framework established, the committee sought funding through the DRBC and others. Funds for the total cost of the project became available through different programs at the DRBC, in addition to the State of Pennsylvania and the Delaware Estuary Program. With funding in place the consultant began work on the project.

The committee then had to come up with a theme for the project and all agreed that recreation was important. Then they created a series of questions that an Internet user might ask:

- Find a location of Interest
- Find Recreational Facilities
- Find Boat Launching Sites
- Find Fish Advisories
- Indicate Ground Water Protected Areas

Development: The project was developed using ESRI's suite of products including ArcInfo, ArcMap, and ArcIMS. Additionally the project was programmed in java while using ArcSDE to store the data layers.

The Application: i-Map DelBasin is launched from a splash page. Information that can be accessed from the splash page includes About Us, Tutorials, and About i-Map. The interface has a large map window (see Figure 1) a list of data layers on the left column, and tools along the top (in yellow buttons). The right hand column shows the questions that the Internet user may want to ask. Also notice the tabs above the data layers and the questions that can be switched to change their focus. Above the data layers is a tab showing the legend for each data layer that is active.
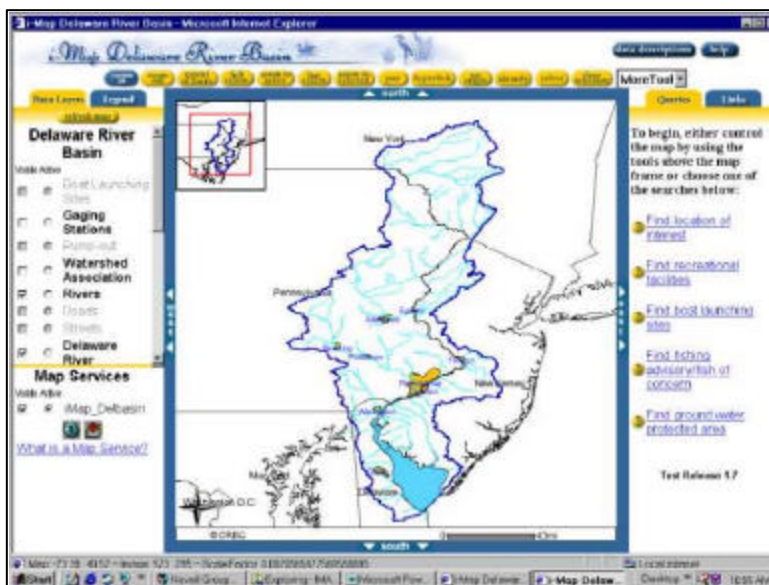

Figure 1. The iMap DelBasin interface.

Above the questions there is a tab that shows appropriate links to each of the questions. Below the data layers is a section called Map Services which will be discussed later.

The questions allow users not familiar with internet mapping to use i-Map DelBasin without any previous knowledge of ArcIMS (Specific mapping and GIS knowledge were not a pre-requisite for the public to use this application).

The data layers are on the left margin are bold when they are capable of being visible. Conversely if the data layers are gray then they are not available at the current scale. As users zoom in, more data becomes available.

The yellow buttons at the top of the view window include, zoom in, zoom out, extent of basin, full extent, last extent, zoom to selected, pan, set origin, and clear selection tools.

Additional tools were added to a drop down list and include: measure, overview map (on or off), print map, query, set units, selected data. At the top right is a button for accessing Data Descriptions, which is a really the meta data related to the data layers presented in a pop up window (Figure 2). The descriptions define the GIS data in layman terms.
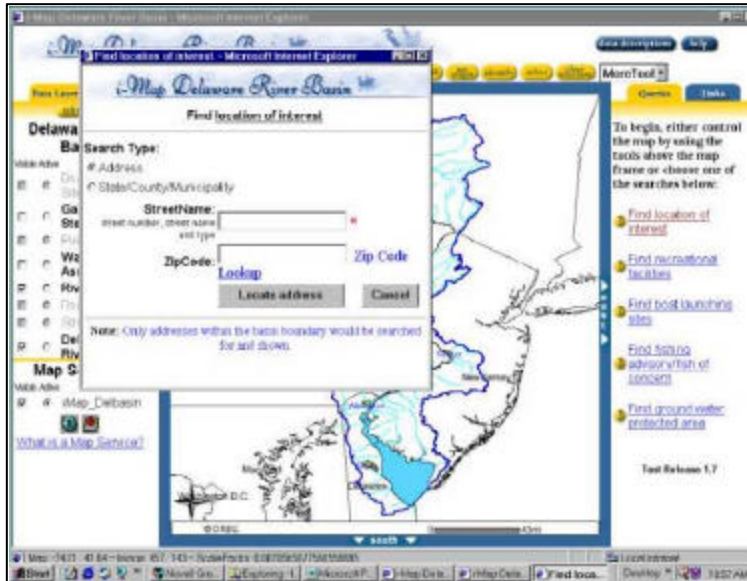

The Help button, just to the right of Data Descriptions button, explains how to use the application. Included in the help file is a New User Tutorial that presents detail about how to run the application with detailed instructions with images representing what the user should see on the screen at each step.

Users may interactively use the tools and GIS data on the left column or use the questions on the right column to query the data.

Figure 2. Data Description

Each question on the right opens a new window for putting in information. Much of the information is delivered to the user by pull down lists.

Find Location of Interest

For Find Location of Interest (Figure 3) a new window opens where the user can input an address or scale down to a specific state, county, or municipality. A point of interest can also be added interactively using the Set Origin tool. The tool is selected and then the user clicks on a desired area on the map. The origin is then represented by a star on the map. Afterwards, the user may buffer an area around the star to find a location of interest.
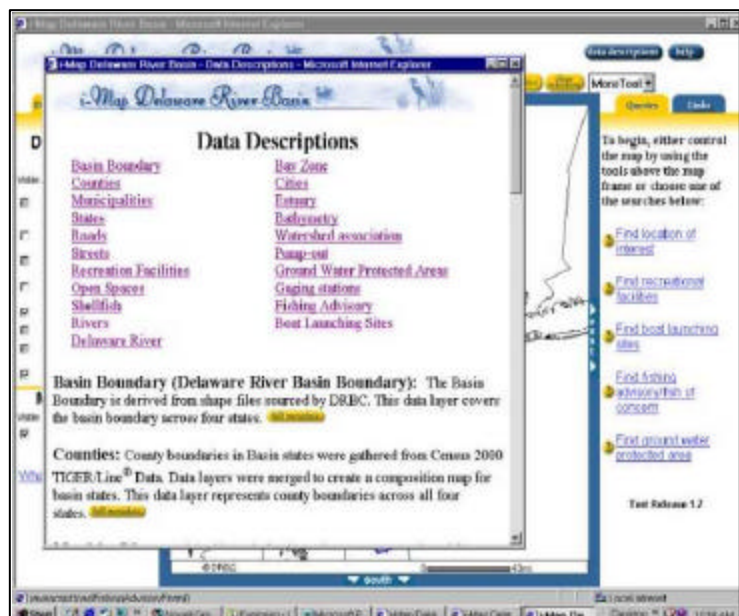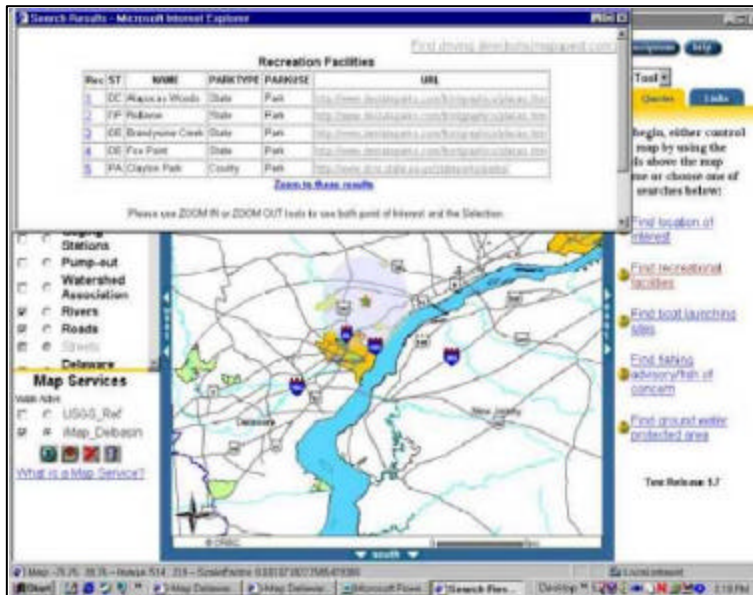

Figure 3: Find location of interest using a drop down list of State, County and Municipality

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Figure 4. Buffered area in the background with a new window (foreground) showing recreational information.

Find Recreational Facilities

Finding recreational facilities is the second topic. After the location of interest is set by one of the methods described above, the user sets a buffer distance (the units for the buffer is in miles). Each recreational area selected in the buffer is listed in a new window (Figure 4) with a table listing the results. This table is made up of attributes such as PARKTYPE, which describes the level of jurisdiction that each park falls under, as well as PARKUSE, which specifies the type of facility selected.

By clicking on the URL in the table the user is pointed to a web site where more information is available about that particular facility.

Figure 5 lists all the services available at Fox Point State Park on the Delaware River north of Wilmington, Delaware.

Users can find driving directions, information about the recreational area and in many cases services offered at the area. Some of these services include bike trails, picnic areas, playgrounds, refreshments, and restrooms. Visitors can use this type of information to properly plan a trip to that particular recreational area. The data provided under this query is in an easy-to-use database format, whereby the user can quickly decipher the specific amenities that each park provides.

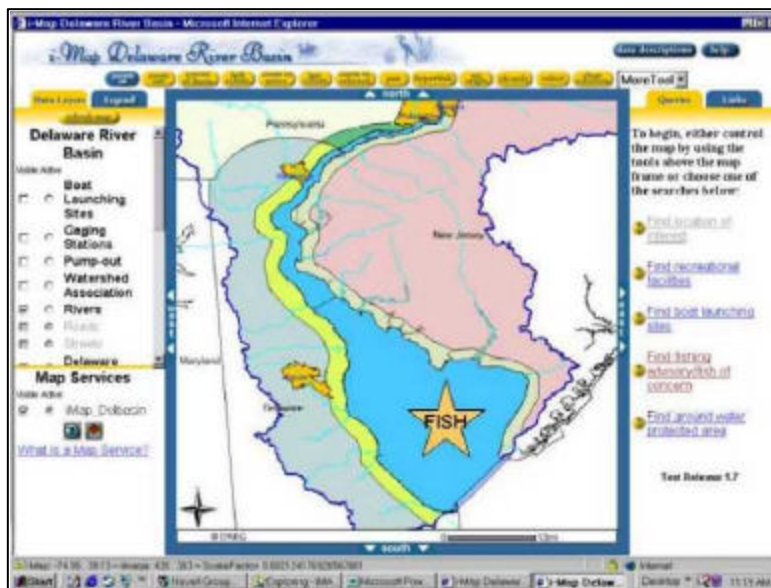**Figure 5.** Services at Fox Point State Park

Figure 6. Fish Advisories.

Find Fish Advisories

This application also has the fishing advisories for the four states and any federal advisories under the next query, Find a fish advisory (Figure 6). Suppose a party is fishing at the Star in the middle of Delaware Bay. Selecting this query in the right hand column gives the user a tutorial on how to determine fish advisories for a particular area. First the user must make the fish advisory layer visible and then click to make it active (first click the check box, then the radio dial button next to it). Hit the refresh the map button at the top of the layers list, and then use the Hyperlink tool to identify the location of your next fishing trip (a star in Figure 6). A frame with all appropriate advisories will appear. Follow the links to the advisories for the stream, lake, river or estuarine area where you expect to fish.

The advisories specifically inform users about quantities of species that can be eaten and other facts of interest. There are also advisories for Women of Childbearing Age and Pregnant Women. Advisories on special topics such as PCBs, chlordane, mercury and dioxin in fish and shellfish species are available where appropriate.

In a similar method, Find boat ramps may be identified as well as Find ground water protected areas (Pennsylvania only. When Delaware, New York and New Jersey groundwater protected areas data are available, they will be added to the application).

Users can access USGS stream information linked to the gaging stations in the i-Map DelBasin application by clicking on the gaging station layer in the Table of Contents and turn the radio button to active. Once the map is refreshed the user will see many point locations for the USGS stream gaging stations. When using the Hyperlink Tool, real time flow information is available including peak, mean and daily stream flow. If you are a boater, kayaker or canoeist this information can be very important.

Map Services

All of the features up to this point are "standard" for IMS applications, however, what sets iMap DelBasin apart from other map services is its ability to bring in GIS data from other states servers, regardless of projection, and overlay it on top of the existing layers. Or the map services can be moved based on priority so that the most important layer is listed on top.
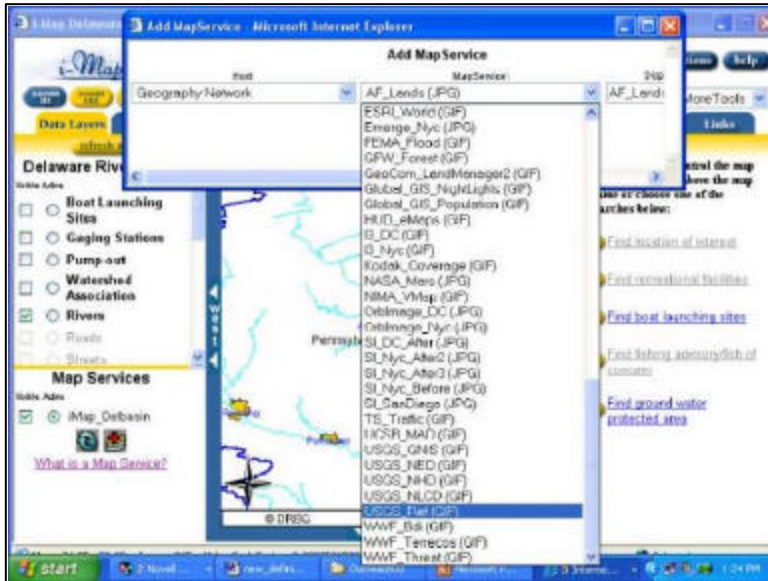
By clicking on the add layer icon in the Map Services section, a list of other data layers are available from selected servers across the basin (Figure 7). The selected hosts of data include the Delaware DataMil, Pennsylvania Spatial Data Access, New Jersey Geodata, the Geography Network, New York Spatial Data and Map Host. For each of these hosts there are a variety of data that can be added to iMap DelBasin.

Figure 7. Data Layers list changes based on active layer in the Map Services list.

If a new Map Service is made visible and active the Data Layers List changes to reflect the newly added data from that particular map service (Figure 8). These layers may be turned and off with the active button and may be made active for query. The data comes in by predefined colors, patterns, symbols and shade fills, and the user has no control over these parameters.

In addition the user may only use the identify tool to get more information about the active layer. Even with these limitations it is still exciting to identify and stream data from remote hosts into the ArcIMS session.

Figure 8. Window with List of Map Services.

In the future the IMAC will improve the data and metadata served in i-Map DelBasin. Future ArcIMS profiles include a monitoring, toxics, flood zone and water use topics. As a pilot project the Commissioners of the DRBC and the IMAC consider the interactive internet i-Map DelBasin application to be a big success and the first of many GIS services for the Commission.

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How Did We Do it?

Application Architecture: The client tier employs Microsoft Explorer 5.x as the preferred browser. The user interface uses HTML and Javascript. The middle tier is composed of ArcIMS Application Server 4.0 (ArcIMS core Spatial Server and Web Server with servlet connector) and ArcSDE 8.1.2. The database tier is supported by Microsoft SQL/Server2000.

Data Preparation: Twenty-one separate data layers were identified for this application. With the assistance of Cybertech, Inc., these layers where identified, projected, joined and finally exported to a geodatabase. These data were classified in three categories: basin, query, and project specific. Basin data are defined as primarily reference data, query data are processed when responding to a question from the Query tab, and project specific relate to layers such as rivers and cities. These data are dynamic and needed to be housed in the same location as the core application server. Many repairs had to be made to the data because of edge match problems, duplicate records, missing records, and missing arcs.

The data layers are listed by class in Table 1(below) showing the source, and the relationship between other data layers in the application and the ArcSDE table names. This working table evolved as the project matured and assisted in organizing the ongoing process.

Data Layers	NJ	PA	NY	DE	Source File Name	Consolidated File Name	ArcSDE tables (in NJDEP naming convention)	Projection
Basin Specific data								
Basin Boundary			1		drb_bnd	basinboun	basinboun2000	GCS
Estuary			1		estuary	estuary	estuary2000	GCS
Bathymetry			1		delbay_zm.e00	bathymetry	bathymetry2002	GCS
Watershed Association Sites			1		wsassoc	watershedassociation	wsass2000	GCS
Pump-out			1		pumpout	pumpout	pumpout2000	GCS
Ground Water Protected areas	0	1	0	0	gwpa	protectedareas	pagwa2000	GCS
Query Specific								
Gaging Stations			1		drbgage	drbgage	gagest2000	GCS
Boat Launching Sites			1		boatlanding	boatlaunching	boatlaunch2000	GCS
Fishing Advisory			1		fishadvreg	fishadvisory	fishadv2000	GCS
Recreation Facilities			1		drbpark	drbpark	rec2000	GCS
Municipalities	3	3	3	3	ny_mun, nj_mun, de_mun, pa_mun	municipality	stmun2000	GCS
Counties	3	3	3	3	ny_coun, nj_coun, de_coun, pa_coun	county	stco2000	GCS
States	3	3	3	3	ny_state, nj_state, de_state, pa_state	states	st2000	GCS
Streets	3	3	3	3	ny_streets, nj_streets, de_streets, pa_streets	basin_streets	streets	GCS
Project Specific data								
Open Spaces	2	0	0	0	newstate	openspace	openspace2000	GCS
Shellfish	2	0	0	0	shellfish	shellfish	shellfish2002	GCS
Rivers			1		drb_bigriv	rivers	rivers2000	GCS
Delaware River			1		delriv	Delaware_River	drb_river	GCS
Bay Zone			1		delbayc10	bay_zone	bayzone2000	GCS
Roads			1		DRB_Roads	DRB_Roads	drb_roads	GCS
Cities			1		drb_city	big_city	drb_cities2000	GCS
Legend								
Available								
Note:	Data layer contain this type of information							
0	Not Available							
1	From DRBC							
2	From NJDEP							
3	Extracted from Tiger Files/Internet/Shapefiles							

Map Configuration Files (.AXL): .AXL files contain configuration information about each data layer in the ArcSDE table. Using ArcAuthor, the shape files were added and arranged to appear as point, line and polygon layers from top to bottom in the Table of Contents. Scale dependency, visibility and transparency were set for the appropriate layers.

Table 2 (below) summarizes these features for the i-Map DelBasin application:

#	Layer Name	Layer Style	Query	Visible at scale	Details
1	Boat Launching Sites	Triangle, 60% transparency	O	1:2,750,000	Dark green outline and light green fill, Size 10
2	Gaging Stations	Circle, 60% transparency	G	1:4,750,000	Green outline and yellow-green fill, Size 7
3	Pump -out	Square, 60% transparency	G	1:2,250,000	Dark red outline with pink fill, Size 7
4	Watershed Association	Star, 60% transparency	G	1:3,750,000	Dark blue outline with light blue fill, Size 12
5	Rivers	Solid Line	G	1:300,000	Cyan, dark blue labels at higher scale
6	Roads	Solid Line	G	1:3,500 to 1:600,000	Gray
7	Streets	Solid Line	O	1:20,000	Light gray, black labels at higher scale
8	Delaware River	Solid Fill, 60% transparency	G	NA	Blue
9	Bay Zone	Solid Fill, 80% Transparency	G	1:4,500,000	Blue
10	Cities	Solid Fill	G	NA	Orange, blue labels at same scale
11	Recreation Facilities	Solid Fill	O	NA	Yellowish Green, black labels against light red background at 1,000 : 400,000
12	Open Spaces	Solid Fill	G	1:4,000,000	Light green
13	Ground Water Protected Areas	Transparent Fill	O	NA	Red outline
15	Estuary	Light Screen Fill	G	1:3,400,000	Light blue
16	Municipality	Transparent Fill	O	1:2,000,000	Pink outline, magenta label with yellow glow background at 1: 275,000
17	County	Transparent Fill	O	1:4,500,000	Dark brown outline, black label with light blue glow at 2,000,000 : 3,750,000
18	Basin Boundary	Transparent Fill	G	NA	Dark blue border
19	Fishing Advisory	Solid Fill	O	NA	Multiple colors
20	States	Transparent Fill	G	NA	Black outline
21	Bathymetry	50% Transparency	G	NA	Image File – Shades of Gray

Application Components: A full suite of tools were necessary to assist the public and other non-GIS professionals with the application. The following lists were taken directly from the i-Map DelBasin – Technical Document.

The tools:
- Zoom In - Zooms in on the position clicked on or the box dragged on the map.
- Zoom Out - Zooms out on the position clicked on or the box dragged on the map.
- Extent of Basin - Zooms to Basin Extents.
- Zoom to Full Extent - Zooms to the full extent of the map.
- Zoom to Active - Zooms to the extent of the active layer.
- Previous Extent - Zooms to the last previous extent. Inactive until user changes extents.
- Zoom to Selected - Zooms to the selected features.
- Pan - Pans the map as the user drags the pointer across the map.
- Hyper Link - Allows user to view Web pages related to map features.
- Set Origin - Captures X-Y coordinates of a location when a user mouse-clicks on the map. The captured point can be used as a point of origin for a radial search.
- Identify - Allows the user to click a feature from the active data layer, and view the descriptive tabular data associated with the feature.
- Select - Allows the user to click and drag a rectangle to select a group of features from the active data layer.
- Clear Selection - Clear the selected group of features from the active data layer.

More Tools :
- Overview map - Toggles display of overview map on the map frame.
- Measure - Allows a user to measure distances on the rendered map.
- Print Map - Enables the user to produce a basic map layout in an HTML page that can be printed.
- Query - Enables user to enter any spatial criteria to view results in the map.
- Set Units - Enables user to set map units in terms of feet, meters, miles or Kilometers.
- Selected Data - Allows user to view tabular data of selected features.

Other Tools :
- Data Descriptions - Brings users to a Data Descriptions page. Users can select a dataset from the listing at the top of the page or scroll down to browse all of the descriptions of the datasets. After the basic data description, a link is provided to the complete metadata.
- Metadata - Allows a user to access short abstracts on the data layers, and full metadata (how the layers were produced) if desired.
- Help - Enables access to user help topics.
- Pan North - Moves the map north.
- Pan South - Moves the map south.
- Pan East - Moves the map east.
- Pan West - Moves the map west.

Queries: As discussed previously there are five queries that the IMAC centered the application around from the perspective of text driven queries from the right side of the page. These queries are recreational in nature and are fully described in Table 3.

Development Environment: The development environment employed the following software components:

- ArcMap – To join layers, to edit features, add attributes
- ArcToolBox – To convert shapefiles to Geodatabase files
- ArcCatalog – To create metadata and to covert files to view tabular attribute data
- ArcIMS / ArcAuthor – To create the map config file (AXL)
- ArcIMS / Administrator – To create the map service
- Visual Interdev – To develop the application
- Visual FoxPro – To create index files

Metadata: Metadata for each layer can be accessed through the Data Description Button on the top frame. Most of the metadata has been edited or created with ArcCatalog and is currently being reviewed to make sure they are FGDC compliant. The data provided to this application from the states all has compliant metadata files.

Lessons Learned: During the development of the i-Map DelBasin application the IMAC knew that is was imperative to have the IT community involved because the application needed to be stewarded to the Internet and served out with the ability to hit other map services. These issues are not intuitive to the average GIS practitioner so the IMAC asked the New Jersey Office of Information Technology, Office of GIS to sit in the development meetings and advise the committee on IT issues. This cooperation provided expert advice on how to proceed to make the transition from development to internet as smooth as possible.

i-Map DelBasin can be found on the NJDEP web site (www.nj.gov/dep/gis/mapping.htm), on the DRBC web site (www.drbc.net) or on the Delaware Estuary Program (DELEP) web site (www.delep.org). Specialized GIS software is not needed to run the application.

i-Map DelBasin works best with Microsoft Internet Explorer, version 5.0 and above and uses ESRI ArcIMS technology.

References: DRBC, Delaware River, IMAC, Cybertech, ESRI, Recreation

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