

Redesigned EnviroMapper

A Services-Based Web Mapping Application of EPA Office of Water

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U.S. Environmental Protection Agency

Legacy EnviroMapper

- Developed using MapObjects 2.1
- Not easily integrated with web services
- Not designed to display multiple map resources
- Usage \approx 870,000 hits/month
 \approx 29,000 hits/day
- Some difficulties with maintenance & stability
- Costly to add enhancements



EnviroMapper for Water

- **EPA Office of Water environmental management and geospatial analysis tool**
- **Integrated platform for generating maps and exchanging data with program web services**
- **Supports cross-program analysis**
- **Helps assess progress against Office of Water strategic goals and performance measures**
- **Publicly accessible**



EnviroMapper for Water

- **Web-based mapping application in ArcGIS Server 9.2**
- **Displays Office of Water & other geospatial data**
 - National Hydrography Dataset
 - Watersheds, Catchments, Surface Water
 - EPA Office of Water program data
 - Water Quality Standards, Assessed Waters, Impaired Waters, Fish Consumption Advisories, etc.
 - EPA Regulated Facilities
 - Water Monitoring Stations
 - EPA STORET, USGS Surface & Ground Water



Redesigned EnviroMapper

The screenshot shows the 'EnviroMapper for Water' web application. The interface includes a top navigation bar with the EPA logo and the text 'U.S. Environmental Protection Agency'. Below this is a search bar and a 'Home' link. The main content area is divided into several panels:

- Map Controls:** A vertical sidebar on the left containing a list of map layers such as 'Facility Register', 'Superfund Sites', 'Water Dischargers', 'Water Quality', 'EPA Water Monitoring Stations', 'Transportation', 'Political Boundaries', 'ZIP Codes', 'Congressional Districts', 'Federal Lands', 'Tribal Lands', 'Counties', 'States', 'USGS Water Monitoring Stations', 'Watersheds', 'Surface Water', 'Dam', 'Flow Lines', 'Water Bodies', 'Catchments', 'Major Water', 'Biological Boundaries', 'Thematic Maps', and 'Base Imagery'.
- Map:** A central map showing a geographic area with various colored overlays representing the selected layers. A red outline indicates the current geographic area.
- Right Panel:** Contains interactive controls for selecting a geographic area, including a 'Select an Area: State' dropdown (set to '22 Louisiana'), a 'Watershed' dropdown (set to '0907004 Lake Maumee, Lorain'), and a 'Zoom to Watershed' button. Below this is a 'Report Query Builder' section with fields for 'Report Type' (set to 'EPA Water Monitoring Stations'), 'Report Name', 'Filter by State' (set to '22 Louisiana'), and 'Watershed HUC' (set to '0907004 Lake Maumee, Lorain'). A 'View Results' button is at the bottom of this section.
- Bottom Panel:** Displays 'Identification Results' and 'Query Results'. The 'Query Results' section shows a table of data for the selected area.

| Organization ID: | 22LAGWTR - Louisiana Dept of Environmental Quality |
|------------------|--|
| EP001 AN-267 | 12/14/1993-12/14/1993 |
| | 15-Metal, 4-Nutrient, 106-Other, 6-PCB, 39-Pesticide, 11-Physical, |
| EP001 LA-85 | 12/13/1993-12/13/1993 |
| | 15-Metal, 4-Nutrient, 106-Other, 6-PCB, 39-Pesticide, 9-Physical, |
| EP001 AN-216 | 04/11/1994-04/11/1994 |

- Look and feel of a Portal Application
- Interactive panels
- Dynamic callbacks to web services
- Seamless mapping functions
- Enhancement friendly architecture

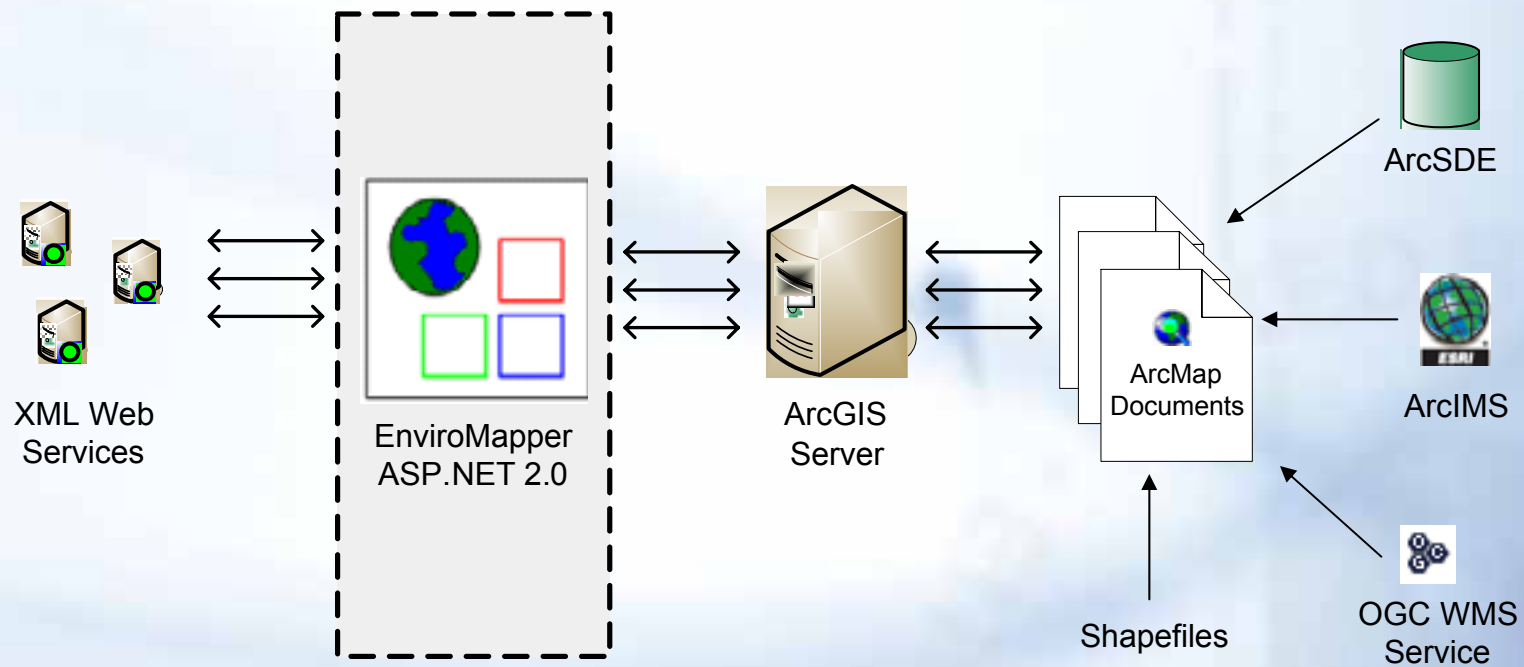


Redesigned EnviroMapper

- **Geospatial Query & Analysis Tools**
 - Feature Selection by Point, Rectangle, or Polygon
 - Feature Identification with Complete Attribute Data
- **Other Useful Tools**
 - Return to Previous Extent
 - Download Map Image, Print Map
- **Full Metadata Records for Each Layer**
- **Integration with XML Web Services**



High-Level System Architecture



Data Sources

Spatial Feature Sources:

| Features & Layers | Data Source |
|--|----------------------------|
| EPA Program System Data (RAD) | RAD/ArcSDE |
| National Hydrography Dataset (NHD) | RAD/ArcSDE |
| EPA Facility Registry System (FRS) | FRS ArcIMS Service |
| FWS National Wetlands Inventory (NWI) | OGC WMS Service |
| GlobeXplorer Satellite Imagery | OGC WMS Service |
| EPA Water Monitoring Stations (STORET) | RAD/ArcSDE |
| USGS Water Monitoring Stations | XML Web Service |
| Ecological Boundaries | Shapefiles |
| Transportation & Political Boundaries | NAVTEQ & Census Shapefiles |



Data Sources (contd.)

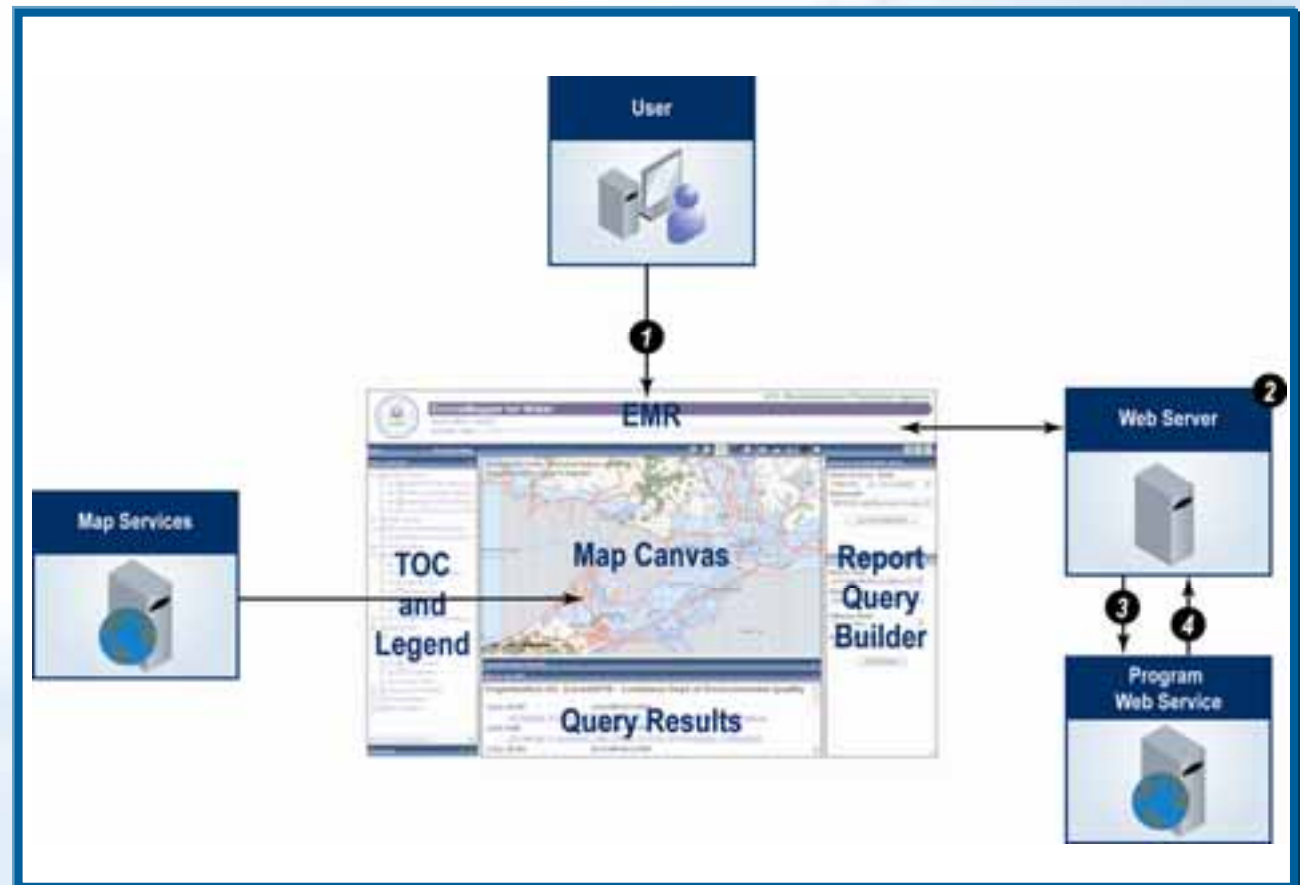
Query Result Sources:

| Feature Queries | Data Source |
|--|------------------------|
| EPA Water Monitoring Stations (STORET) | STORET XML Web Service |
| USGS Water Monitoring Stations | USGS XML Web Service |



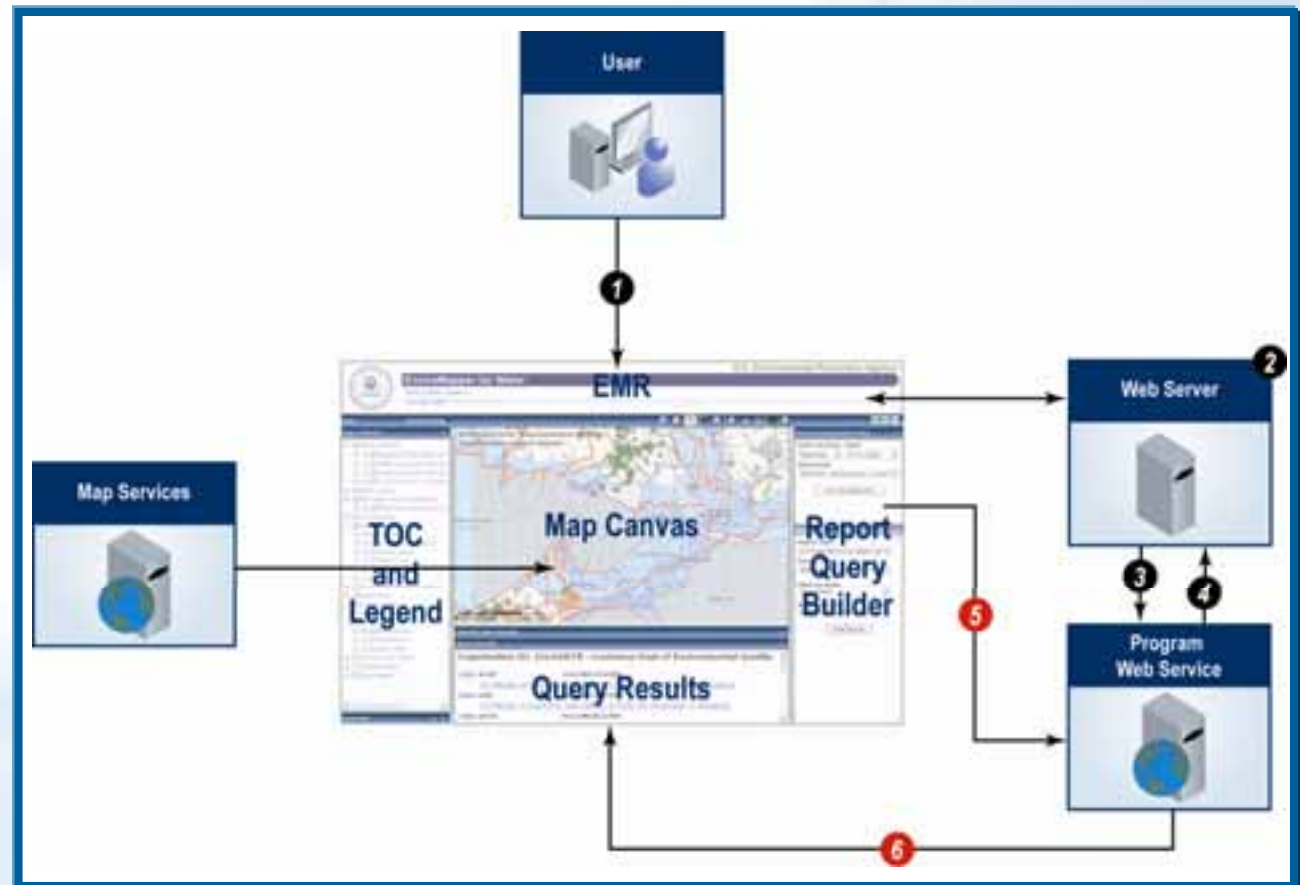
Detailed System Architecture

- 1 HTTP user launches EMR
- 2 EMR web server specifies available web services
- 3 EMR sends request to each web service to know their list of available methods
- 4 XML response from the web services on their available methods



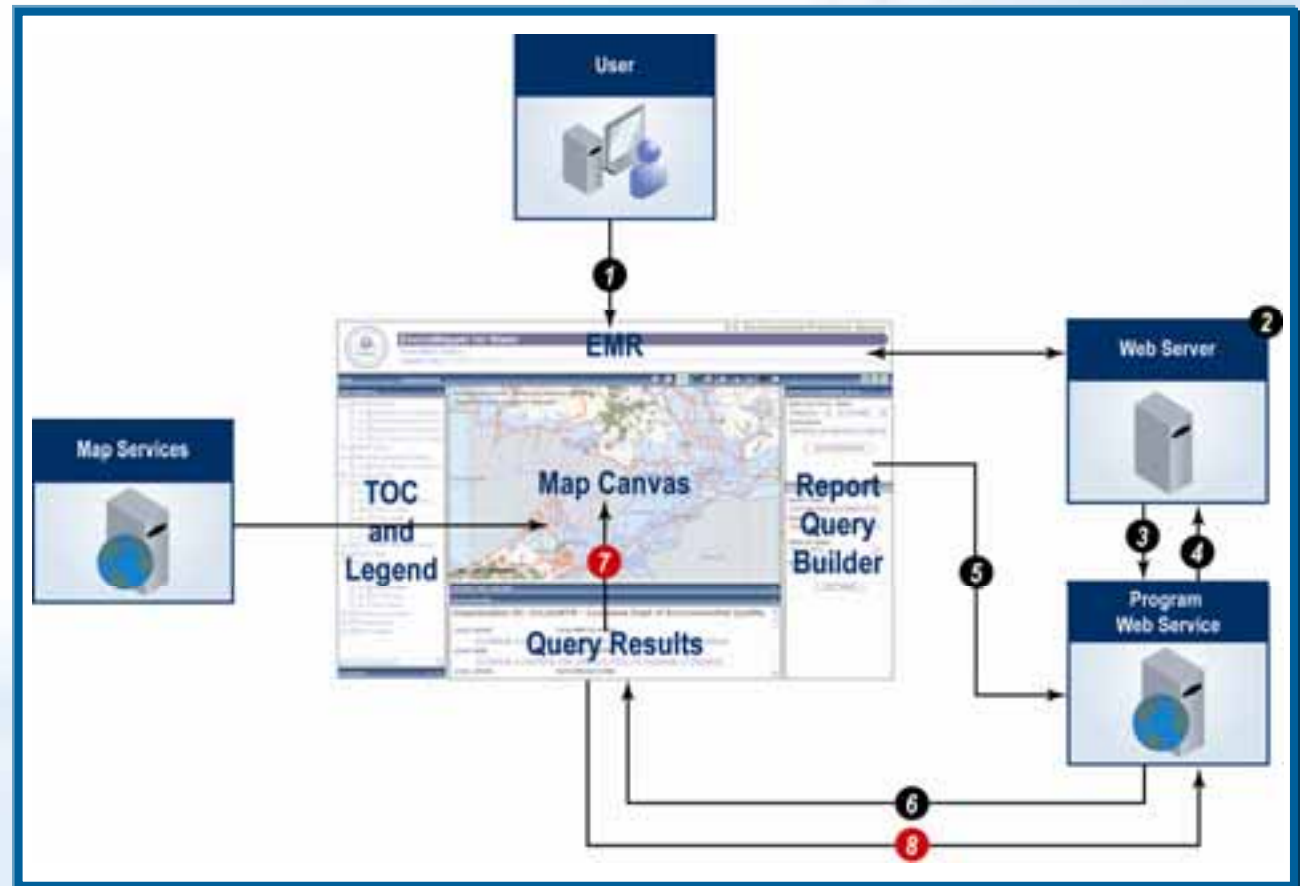
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- 6 Program Web Service method returns report query results in XML/HTML format




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- 5 HTTP/HTTPS/FTP user executes Report Query which calls specified program web service method
- 6 Program Web Service method returns report query results in XML/HTML format
- 7 Interaction between query results and maps; EMR highlights and zooms to selected features on Map Canvas (if required)
- 8 HTTP/HTTPS/FTP user clicks on link or button to filter query results, which executes another program web service method and repeats steps 6 and 7



Feature Identification

 Clicking the map displays attribute data for all features found at that point.

 User can select and zoom to each of the identified features.



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Map Contents

- Water Quality
 - Impaired Waters Point
 - Assessed Waters Point
 - Water Quality Standards
 - Beaches Point
 - Combined Sewer Overfl...
 - Fish Consumption Advic...
 - Impaired Waters Line
- Assessed Waters Line
- Water Quality Standards
- Beaches Line
- No Discharge Zone (NDZ)
- Fish Consumption Advic...
- Impaired Waters Poly
- Preferred Waters Poly

Active Layer: Water Monitoring Stations (STORET)

Identification Results

Impaired Waters Poly (1 feature)

| Source Feature ID | Event Date | Event Type | Reach Code | Cycle | Start Date |
|-------------------|------------|------------|----------------|----------|------------|
| DC_32_DCANASSE_02 | 2020 | | 02570010001365 | 4/1/2004 | 4/1/2004 |

Water Monitoring Stations (STORET) (3 features)

| Station ID | Station Name | Organization ID | Organization Name | Water Type |
|------------|-----------------------------------|-----------------|-----------------------|------------|
| NACE_HE_1 | SOUTHWEST PART OF KENLWORTH MARSH | 11NPSWRD | National Park Service | Wetland |
| NACE_KM_3 | SOUTHERN PART OF KENLWORTH MARSH | 11NPSWRD | National Park Service | Wetland |
| NACE_HE_9 | SOUTHWEST PART OF KENLWORTH MARSH | 11NPSWRD | National Park Service | Wetland |

States (1 feature)

| ST | ST FIP | NAME | GEOM | GEOM.AREA | GEOM.LEN |
|----|--------|---------------------|---------|-----------|----------|
| DC | 11 | Distrit of Columbia | Polygon | 0.01838 | 0.647419 |

Subbasin (HUIC, aka cataloging unit) (1 feature)

| HUC # | HUC# Name | RID.AREA | RID.LEN |
|----------|---|----------|----------|
| 02570010 | Middle Potomac-Anacostia-Occogan, DC, MD, VA. | 0.348972 | 3.747299 |

Query Results

Organization ID: 11NPSWRD

| Station ID | Station Name |
|------------|--------------|
| GREE_NPS_4 | ETOLL CREEK |
| GREE_NPS_5 | ETOLL CREEK |



Feature Selection by Polygon

Active Layer: Water Monitoring Stations (STORET)

Active Layer: Water Monitoring Stations (STORET)
Found 29 features in layer Water Monitoring Stations (STORET)

Identification Results

| Station ID | Station Name | Organization ID | Organization Name | Water Type |
|-----------------|--|-----------------|-----------------------|------------|
| NACE_HE_VLS | KINGMAN LAKE SOUTH | 11NPSWRD | National Park Service | Estuary |
| NACE_AN_EASTCAP | ANACOSTIA RIVER UNDER EAST CAPITAL STREET BRIDGE | 11NPSWRD | National Park Service | Estuary |
| NACE_AN_KINGN | KINGMAN LAKE AT THE GOLF COURSE | 11NPSWRD | National Park | Estuary |

STORET XML Web Service
Response



U.S. Environmental Protection Agency

Integration with XML Web Services

- **Standards-based web services are pluggable through application config**
- **Interoperability and data sharing using HTTP, AJAX, SOAP, XML Stylesheets, JavaScript Object Notation (JSON)**
- **Supports and encourages integration of data within EPA's service-oriented architecture**



Integration with XML Web Services

Selecting features on the map triggers the option to run reports.

Selected STORET features

Feature selection tool

Web service response

| Station ID | Station Name | Organization ID | Organization Name | Water Type |
|------------|--|-----------------|-----------------------|--------------|
| GREE_SS_0 | STILL RUN 3/4 MI. NORTHWEST OF LAMONT SCH. | 11NPSWRD | National Park Service | River/Stream |
| GREE_NPS_5 | STILL CREEK ON WEST SIDE OF KEPAER ROAD | 11NPSWRD | National Park Service | River/Stream |
| GREE_SS_8 | DEEP CREEK 1/2 MILE NORTH OF | 11NPSWRD | National Park Service | River/Stream |



Integration with XML Web Services

Results from XML Web Services can be identified and shown on the map.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EnviroMapper for Water

Report Address | Contact Us
EPA Home | Water | EnviroMapper for Water

Map Contents

- Water Quality
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 - Combined Sewer Overfl
 - Fish Consumption Advis
 - Impaired Waters Line
- Assessed Waters Line
- Water Quality Standards
- Beaches Line
- Combined Sewer Overfl
- No Discharge Zone (NDZ)
- Fish Consumption Advis
- Impaired Waters Poly
- Assessed Waters Poly
- Water Quality Standards
- Beaches Poly
- Combined Sewer Overfl
- No Discharge Zone (NDZ)
- Fish Consumption Advis

Active Layer: Water Monitoring Stations (STORET)
Found 9 features in layer Water Monitoring Stations (STORET)

Zoom to Geographic Area

Select an Area: State:
County: 24 Maryland
County: 033 Prince George's
Zoom to County

Report Query Builder

Report Type:
EPA Water Monitoring Stations (01)

Report Name:
Summary of STORET Project Data

Minimum Latitude:
38.9879

Maximum Latitude:
39.0019

Minimum Longitude:
-76.9925

Maximum Longitude:
-76.8073

Note: A large bounding box may return too many results.

View Results

Identification Results

Query Results

Query Result:
Organization ID: 11NPSWRD - National Park Service

| Station ID | Station Name/Summary Information | Period of Record |
|------------|---|-----------------------|
| GWEE_NPS_4 | STILL CREEK ON WHITE SIDE OF HAINVILLE ROAD (04 Becks) 01 06/20/2004, 07/19/2004 | 06/20/2004-07/19/2004 |
| GWEE_NPS_5 | BECK ON WHITE SIDE OF KETTER ROAD (04 Becks) 01 06/20/2004, 08/19/2004 | 06/20/2004-08/19/2004 |



Development Challenges

- **Caching in ArcGIS Server**

- ZoomLevel tool requires a cached service
- Time and disk space requirements are prohibitive

- **ArcIMS Services**

- ArcIMS API differs in subtle ways from ArcGIS Server API
- Scale dependencies are not displayed in TOC

- **GlobeXplorer WMS Service**

- Direct connection in ADF doesn't work, must use .mxd



Future Enhancements

- **Performance:** Monitor server load and move ArcGIS Server onto separate machine
- **Web Services:** Add more interfaces to external web services and build in tighter integration
- **Database Design:** Provide ‘generalized’ layers from highly detailed spatial features for display at lower zoom scales
- **Data Exchange:** Generate KML and pass to Google Maps with attribute data in info window



Thanks for Coming

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Zoom to Geographic Features

Latitude/Longitude

Zoom to Geographic Area

Select an Area:

Lat/Long Poin

Latitude: 38.2345 Longitude: -80.240

Zoom to Lat/Long Poin

State

Zoom to Geographic Area

Select an Area: State:

State 09: Connecticut

Zoom to State

County

Zoom to Geographic Area

Select an Area: State:

County 05: Arkansas

County: 007: Benton

Zoom to County

Additional slide for any future presentation

Watershed

Zoom to Geographic Area

Select an Area: State:

Watershed 18: Indiana

Watershed: 05120205: Flatrock-Haw. Indiana.

Zoom to Watershed

Zipcode

Zoom to Geographic Area

Select an Area: Zipcode:

Zipcode 22182

Zoom to Zipcode

