

**Streamlined Watershed Modeling  
with the  
Kentucky Watershed Modeling Information Portal  
(KWMIP)**

**JSEM 2007  
Geospatial Technical Session  
Columbus, Ohio  
May 23, 2007**

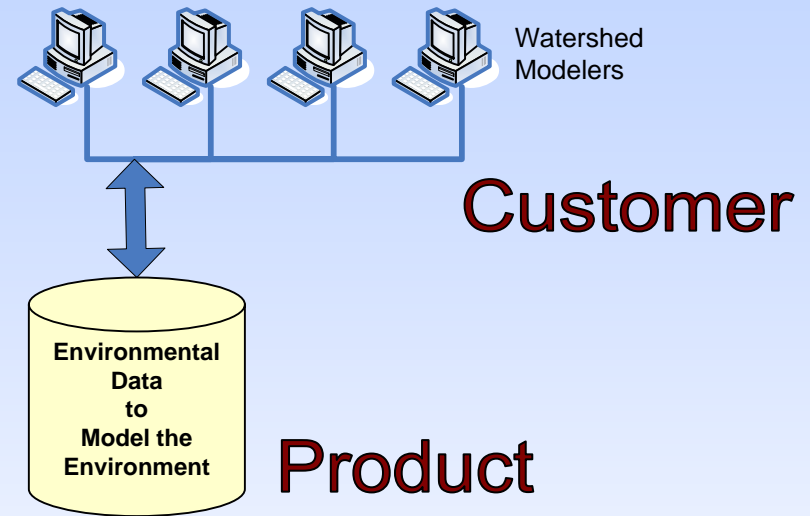
**Ray Rush, PE  
Information Solutions Manager  
FMSM Engineers  
Louisville, Kentucky**



# *KWMIP Project Vision*

Enable better environmental decisions

- Improve ease of analyses
- Increase the value of existing datasets
- Make it easy to get that data to the people who need it
- Apply open standards to allow future expansion—no stovepipe!



# *KWMIP Project Goals & Objectives*

## ➤ Increase Model Use

- ❑ TMDLs needed for 2,000 impaired pollutant/waterbodies in KY

## ➤ Improve Modeling Efficiency

- ❑ KWMIP requests and packages many model datasets

## ➤ Improve Model Consistency

- ❑ Model precipitation and temperature statewide

## ➤ Train Water Resource Managers

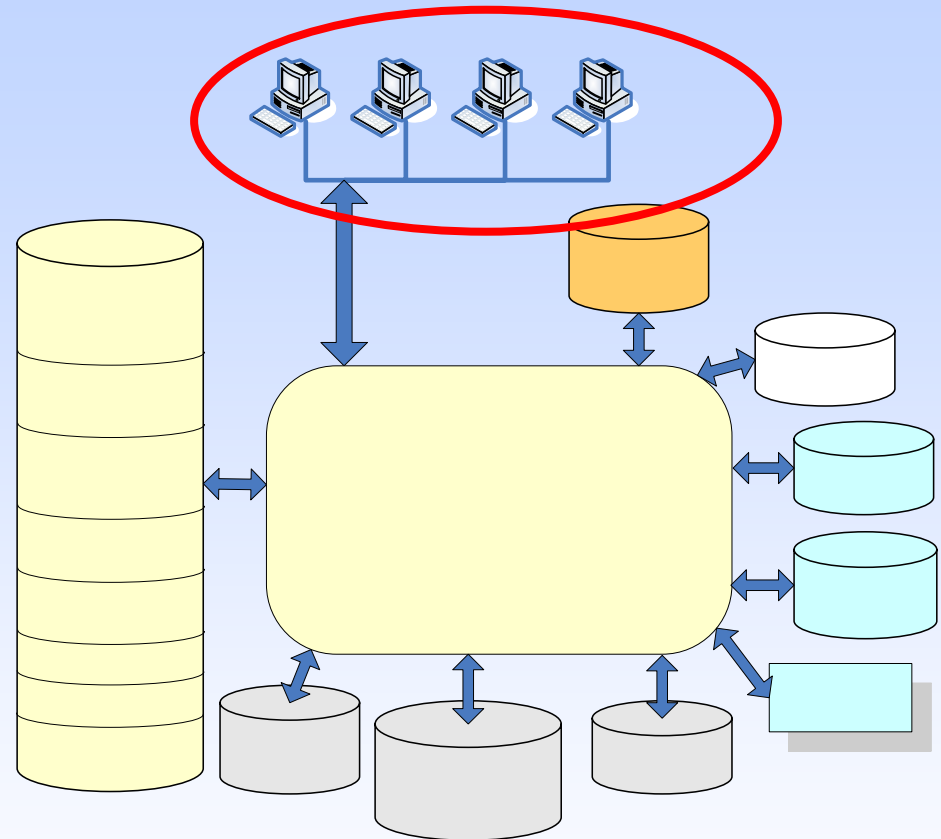
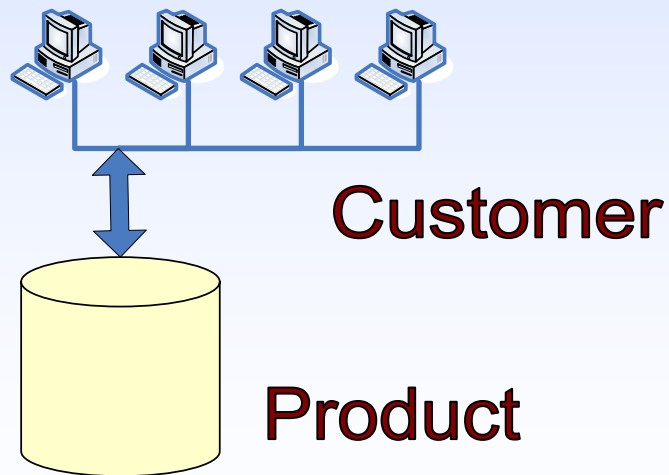
- ❑ Models as Decision Support Tools

## ➤ Train Modelers

- ❑ KWMIP and new datasets

# KWMIP Project Background

- EPA Environmental Information Exchange Network Challenge Grant
- Interface with Federal and State level spatial and spatially-related tabular data sources
- Support watershed modeling and watershed-based assessments



# KWMIP Partners

U.S. EPA Grantor



**Demetrio Zourarakis, PhD (DGI) Principal Investigator**



**Mark Ayers, USGS  
Co-awardee**  
Precipitation &  
temperature modeling



**Sam Bacharach, Open  
GeoSpatial Consortium  
(OGC) Co-awardee**

User Needs Assessment,  
Portal Development,  
Testing, Installation



**Bill Caldwell  
Lee Colten  
(KY DEP) Co-awardee**  
Project input and  
review

## Technical Advisory Group (TAG)

~80 representatives from  
academia, government,  
agencies, consultants

## OGC Sub-Contractors

**Karen Schaffer, FMSM**

Project Coordination

**Andrew Brenner, Sanborn Solutions**

Web-Enable EPA GeoBook

**Portal Build Team**





# TAG (Technical Advisory Group)

- American Public Works Association
- CDP Engineers
- City of Bowling Green
- Cumberland Environmental Group
- Eastern Kentucky University
- EPA – various units
- FEMA
- FMSM Engineers
- GRW
- Kentucky Department of Environmental Protection
- Kentucky Division of Water
- Kentucky Geological Survey
- Kentucky Pride
- Kentucky Society of Professional Engineers
- Kentucky Waterways Alliance
- Khafra Engineering Consultants
- Lexington Fayette County Urban Government
- Limno-Tech
- Louisville Metro Sewer District
- Morehead State University
- Murray State University
- National Weather Service Ohio River Forecast Center
- Northern Kentucky University
- ORSANCO
- PlanGraphics
- Tennessee Valley Authority
- Tetra Tech
- The Nature Conservancy
- Third Rock
- University of Kentucky - various units
- University of Louisville - Stream Restoration Institute
- USACE
- USDA-NRCS
- USGS – various disciplines/regions
- Western Kentucky University



# Use Case: *KWMIP Models & Tools*

## ➤ Surface Water Quality Models

- ❑ Load Duration Curves

- ❑ **QUAL2K**

- ❑ **LSPC**

- ❑ HSPF

- ❑ **SWMM**

- ❑ **WASP**

## ➤ Groundwater Model

- ❑ MODFLOW

## ➤ Hydrologic Models

- ❑ **EFDC**

- ❑ HEC

## ➤ Tools (Leverage)

- ❑ BASINS

- ❑ **WCS**

- ❑ **MetAdapt**

\* Included in USEPA Region IV Modeling Toolbox

# Use Case: Major KWMIP Data Layers

## Geospatial Data

- ❑ Digital Ortho Quads
- ❑ Geology
- ❑ Land Cover
- ❑ Elevation
- ❑ Hydrography
- ❑ Karst features
- ❑ Water & Wastewater Infrastructure
- ❑ Population
- ❑ Soils

## Tabular Data (spatially related)

- ❑ Stream Water Quality (STORET, NWIS, COMPASS)
- ❑ Stream Flow (NWIS)
- ❑ Groundwater & Spring Quality
- ❑ Effluent Flow & Quality (PCS)
- ❑ Impoundment Stage
- ❑ KY Climate Data Generator

*KY GeoNet already provides access to many of these data layers!* <http://kygeonet.ky.gov/>



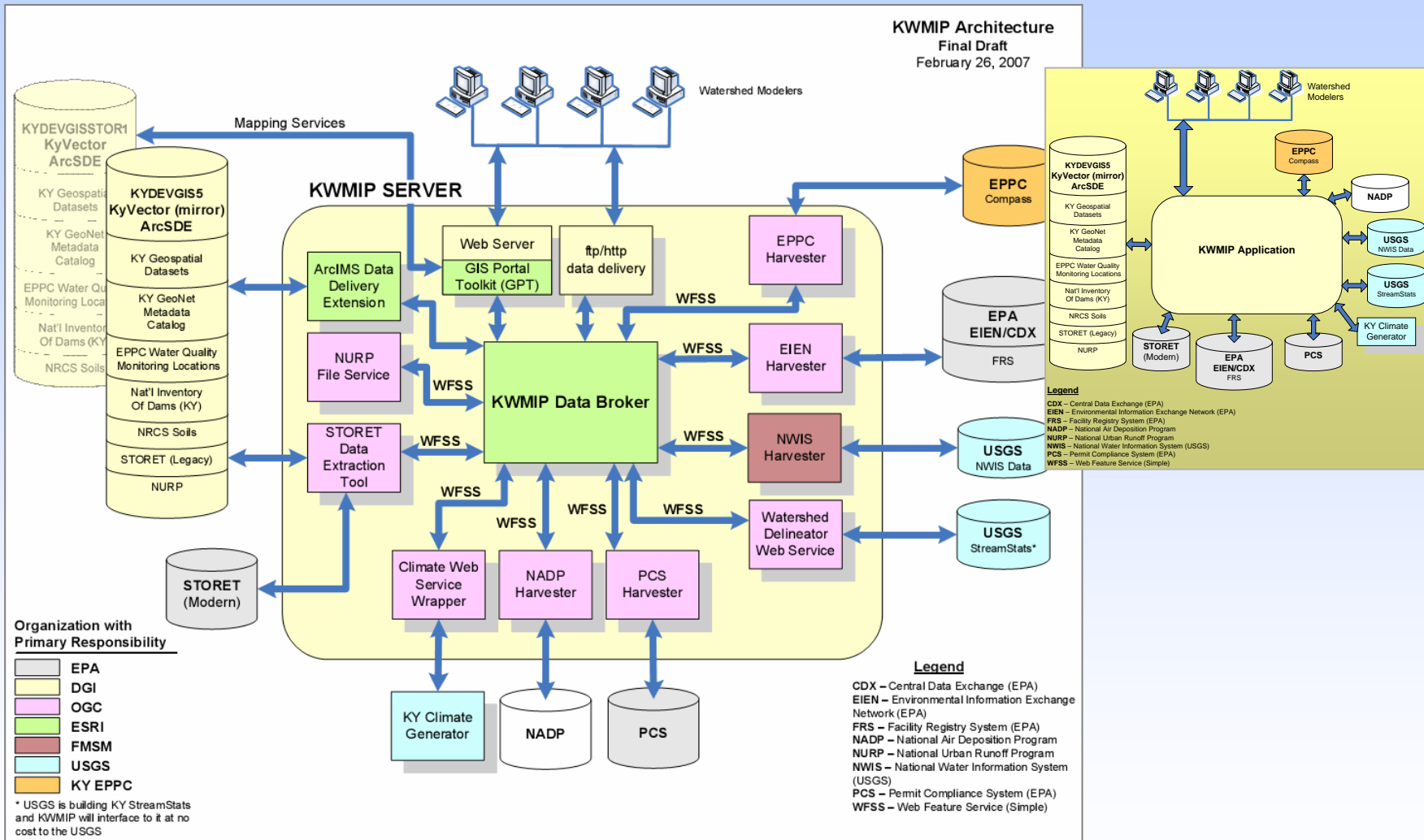
# *Building KWMIP – Key Concepts*

- Datasets from State and Federal systems retrieved from one interface
- Build upon what exists—minimize new software and systems
  - ❑ Apply standards-based COTS software for the interface
  - ❑ Proxy requests for data through existing web-enabled interfaces using an open-standard service protocol
- Defining what is now called the Web Feature Service Simple (WFSS) protocol

COTS – commercial off-the-shelf software

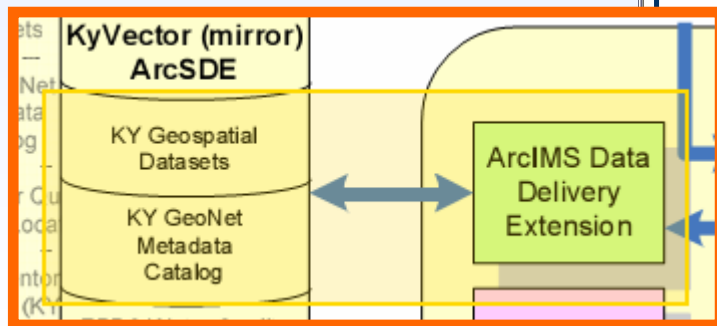
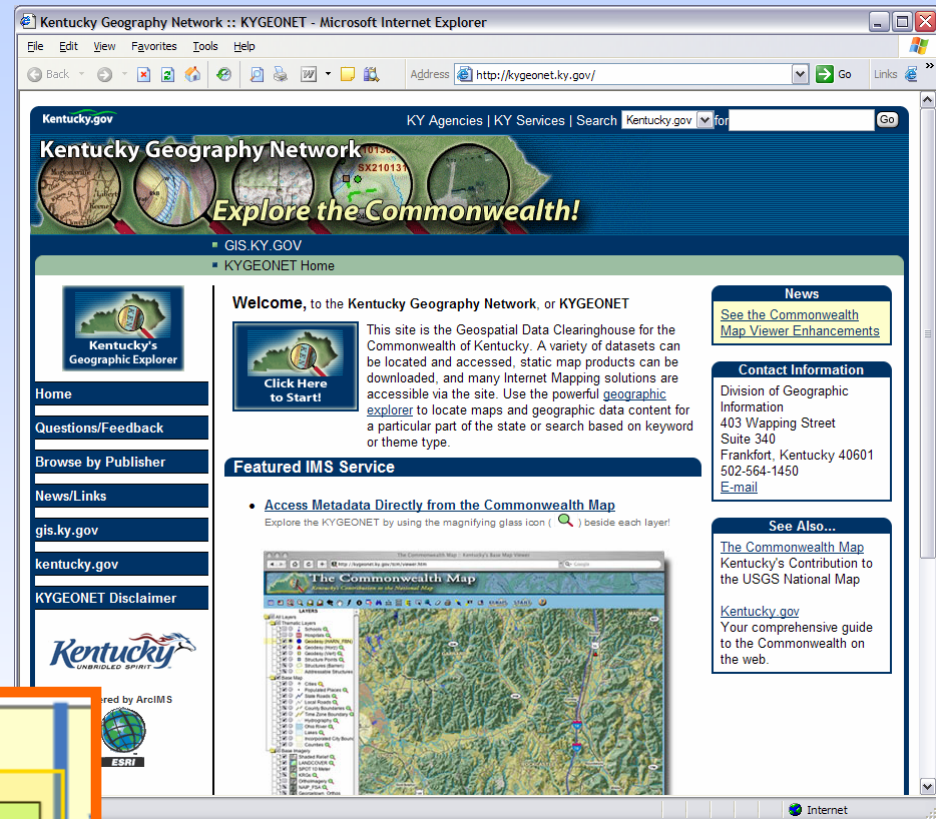
# KWMIP Architecture

KWMIP Architecture  
Final Draft  
February 26, 2007



# Kentucky Geography Network

- KYGEONET
- Started in 2002
- 150+ spatial datasets
- Day-to-day resource for the public and private sector
- 7.56 million hits in August 2006
- Data provider to the USGS National Map



# Kentucky Climate Data Generator

Watershed based access

- Precipitation
- Temperature

Raw Data Source: National Climatic Data Center, Asheville, NC

# KWMIP - Main Page

Home - Metadata Portal - - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://kygnet.ky.gov/Portal/ptk> Go Links

Kentucky.gov [About](#) | [Feedback](#) | [Help](#)

## Kentucky Geography Network

Explore the Commonwealth!

**Metadata Portal**

- Home
- Launch Map Viewer
- Advanced Search
- Log Out (rrush)

**My Functions**

- Manage my Profile
- Change Password
- Manage my Searches
- Manage my Maps
- Download Portal Toolbar
- Download ArcGIS Explorer Search Task

**Home**

[Advanced Search](#)

**My Maps**  
No Saved Maps available

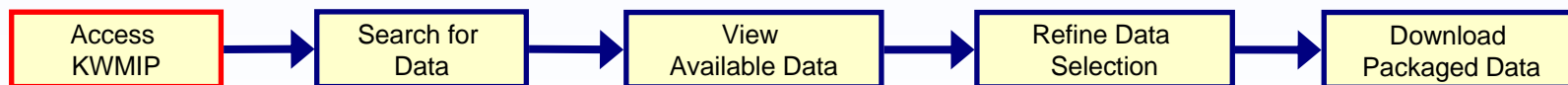
**My Searches**  
No Saved Searches available

**Data Categories**

- Applications Areas
- Current Events
- Watershed Models
  - HEC-HMS
  - EFDC
  - WASP

This is a GIS Portal Toolkit Computer System. Please read the [Disclaimer](#) and [Privacy](#).

Done Internet



# Model (info) Channel Page

Channel - Metadata Portal - Microsoft Internet Explorer

Address: http://kygnet.ky.gov/Portal/ptk?command=openchannel&channe

Kentucky.gov | About | Feedback | Help

## Kentucky Geography Network

Explore the

**Metadata Portal**

- Home
- Launch Map Viewer
- Advanced Search
- Login

Username:

Password:

Login

[Create a new account!](#)

[Forgot Password?](#)

[Forgot Username?](#)

Channel: WASP

- WASP Model Information
- Data Sources for WASP
- Imagery
- About this Channel

Show selected data sources for download

### Introduction

The Water Quality Analysis Simulation Program (WASP7) is a model that helps users interpret and predict water quality responses to natural phenomena and manmade pollution for various pollution management decisions. WASP is a dynamic compartment-modeling program for aquatic systems, including both the water column and the

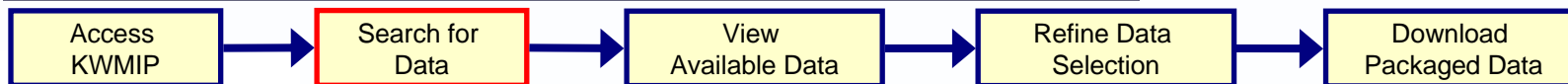
**Water Quality Analysis Simulation Program**

[WASP Homepage](#)

**Content Summary:**

Link to the WASP Homepage on the website of the Ecosystems Research Division of the United States Environmental Protection Agency

[Go To Website](#)



# Model-Based Search Criteria

Where?

When?

What?

Advanced Search - Metadata Portal - - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://kygnet.ky.gov/Portal/ptk> Go Links

**Metadata Portal**

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**My Functions**

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- Download Toolbar
- Download Explorer

**Advanced Search** [Save]

[Search]  Exact text search  
 Any word  
 All words

**Where**

Anywhere  
 Use geographic extent  
[Find A Place]

Data must fall completely inside area

[Launch Map Viewer to Draw Box]  
[Get Box already drawn on Viewer]

**What**

Data Category: Any

Type/Format: Data Sources

Watershed Models: HSPF

**When (use 'YYYY-MM-DD' format)**

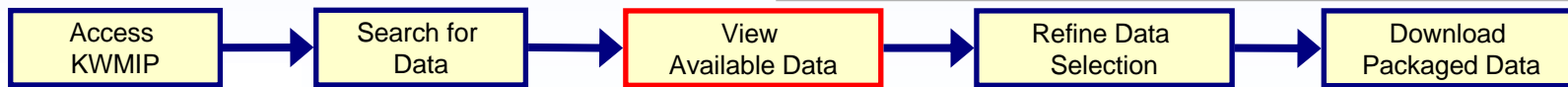
Anytime  
 Time Period: From: 1999-04-91 To: 2003-09-30  
 Date Posted: After:

**Who**

Access KWMIP → Search for Data → View Available Data → Refine Data Selection → Download Packaged Data

# Model-Based Search Results

The screenshot shows a Microsoft Internet Explorer browser window titled "Search Results - Metadata Portal". The address bar shows the URL "http://kygnet.ky.gov/Portal/DiscoveryServlet". The page content includes a navigation menu on the left with sections like "Metadata Portal" and "My Functions". The main area displays search results for "Search for: HSPF Base Imagery Geology Cl... Quality Ambient Water Quality". It shows 17 records found and lists several metadata results, including "KYVECTOR Data Layers" and "National Atmospheric Deposition Program". A large, semi-transparent overlay window is positioned over the search results, providing a detailed view of the selected record, "KYVECTOR Data Layers", with fields for Content Title, Publisher, Content Type, and a "Select for Download" checkbox. Other records are also visible in the background.





# Review Metadata

Details - Metadata Portal - - Microsoft Internet Explorer

Address: <http://kygnet.ky.gov/Portal/DiscoveryServlet>

**Metadata Portal**

- Home
- Launch Map Viewer
- Advanced Search
- Log Out (rrush)

**My Functions**

- Manage my Profile
- Change Password
- Manage my Searches
- Manage my Maps
- Download Portal Toolbar
- Download ArcGIS Explorer Search Task

**Details** [Back](#)

**Content Citation**

**Content Title:** [STORET Database Access](#)

**Content Type:** WFSS Data Sources

**Publisher:** Environmental Protection Agency(EPA)

**Publication Date:** 2006

**Content Description**

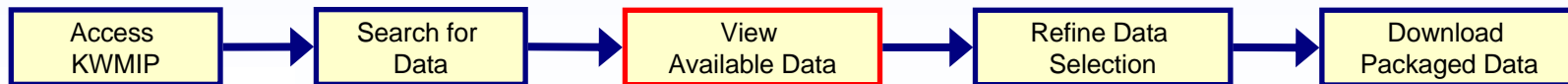
**Content Summary:** Data supplied to EPA before 1999 were all placed in Legacy STORET. This system, designed in the 1960s, was a pioneer in the long term archival of field water monitoring results. The Legacy Data Center (LDC) contains data of undocumented quality. Further, these data are static. The Legacy Data Center does not permit updates, and data here will not change over time. All new data are being entered into Modernized STORET. Because the data do not change over time, it is never necessary to repeat a specific download.

**Content Purpose:** The Legacy Data Center (LDC) contains historical water quality data dating back to the early part of the 20th century and collected up to the end of 1998. Modern STORET contains data collected beginning in 1999, along with older data that has been properly documented and migrated from the LDC. Both systems contain raw biological, chemical, and physical data on surface and ground water collected by federal, state and local agencies, Indian Tribes, volunteer groups, academics, and others. All 50 States, territories, and jurisdictions of the U.S. are represented in these systems.

**Time Period of Content**

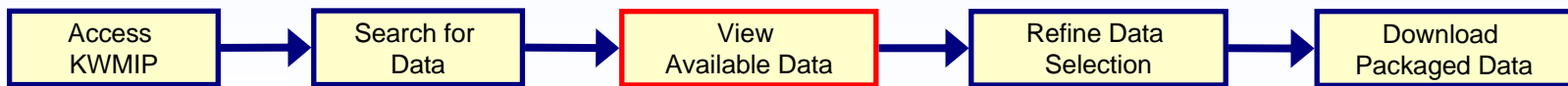
**Beginning Date:** 1965-01-01

**Ending Date:** 1998-01-01



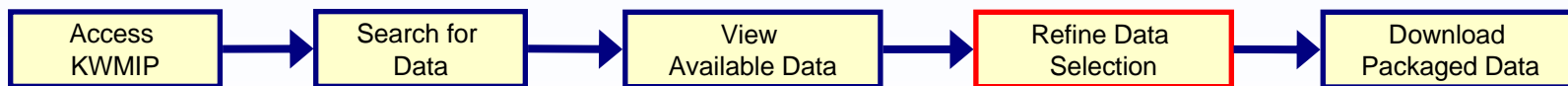
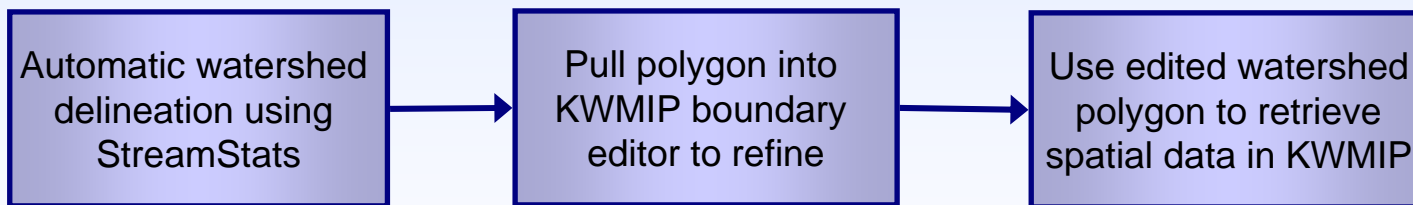
# Map Viewer

Two screenshots of the Kentucky Geography Network Mapviewer web application. The top screenshot shows the application with a legend on the left containing 'kwmp', 'Dams', and 'USGS Gaging Stations'. The bottom screenshot shows a detailed map of the Green River area with a legend on the left containing various data layers like 'Dams', 'USGS Gaging Stations (Active)', 'USGS Gaging Stations (Inactive)', 'Springs', 'Surface Sources', 'Incorporated Cities', 'County Boundary', 'State Roads', 'Local Roads', 'Wetlands (NWIP)', 'Ohio River', 'Lakes/Reservoirs', 'NHD (24k)', 'Generalized Soils', 'Generalized Geology', 'Sinkholes', 'Sinkhole Drainage Areas', and 'Incorporated City Boundary'. A small inset map of Kentucky is visible on the right side of the bottom screenshot.

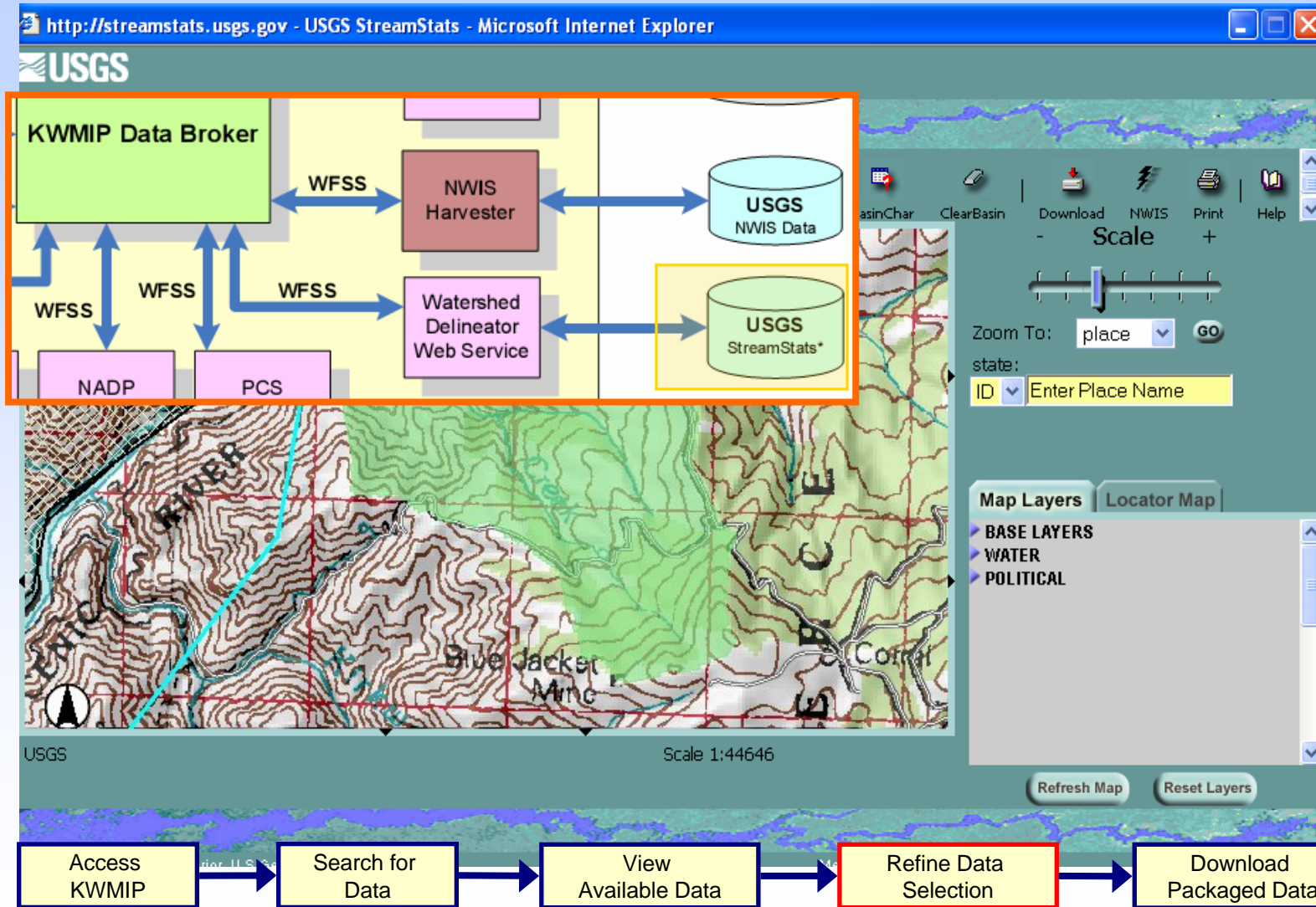


# Creating a Spatial Selection

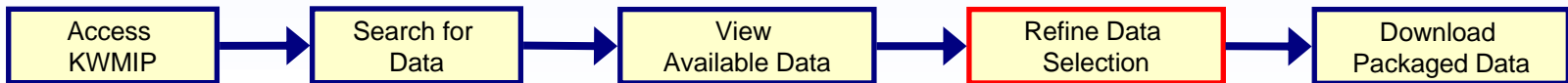
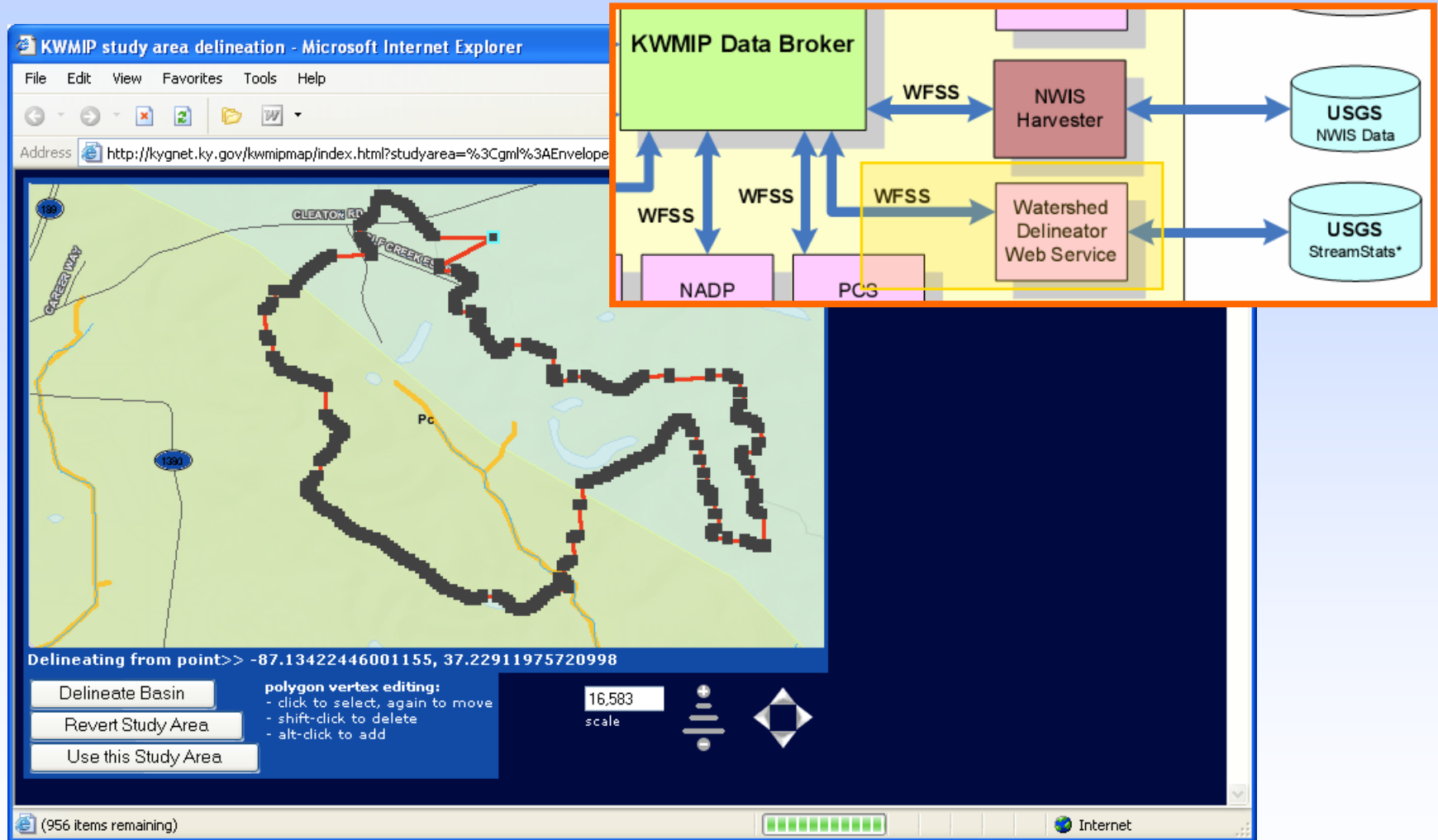
- Use existing system USGS StreamStats to automatically generate watersheds
- Provide the modeler with an interface to refine their watershed boundary polygon prior to submitting data requests
- Bounding box polygon is used to retrieve spatially-related tabular data



# KWMIP Study Area Boundary Generator



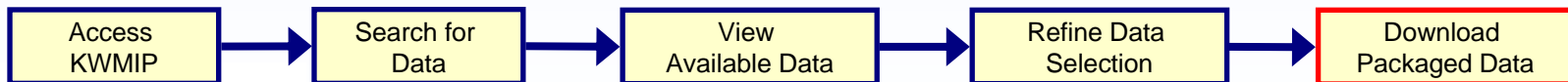
# Delineate Basins for Study Boundaries



# Prepare to Download Data

Microsoft Internet Explorer window showing the Kentucky Geography Network Metadata Portal. The browser address is <http://kygnet.ky.gov/Portal/DxServlet>. The page displays navigation links (Home, Launch Map Viewer, Advanced Search, Log Out) and a section for Data Download, including Data Sources (USGS National Water Information System, KYVECTOR Data Layers, STORET Database Access) and Data Extraction Extent (Extent: -85.551, Polygon Ring).

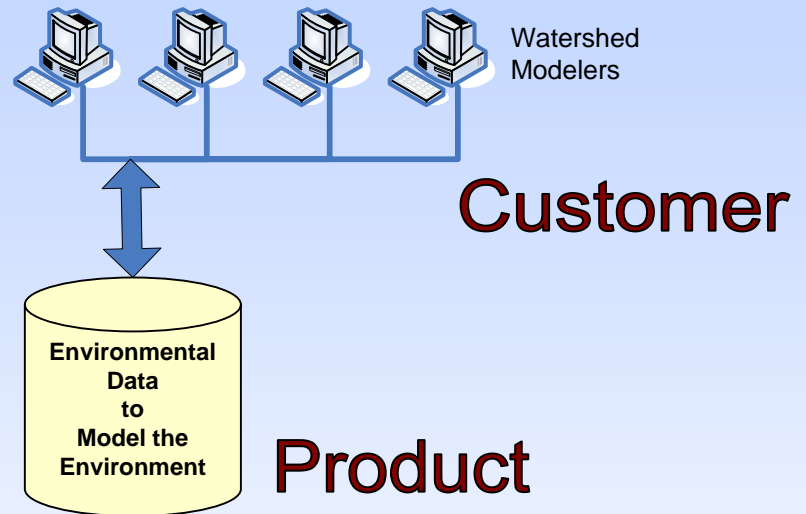
The diagram illustrates the system architecture, showing the KWMIP SERVER (Web Server, GIS Portal Toolkit (GPT), ArcIMS Data Delivery Extension, ftp/http data delivery) connected to Watershed Modelers. The KWMIP Data Broker is connected to NURP File Service and EPPC Harves, with WFSS (Web Feature Service) connections.



# Reviewing the Project Vision

## Enable better environmental decisions

- Improve ease of analyses
- Increase the value of existing datasets
- Make it easy to get that data to the people who need it
- Apply open standards to allow future expansion—no stovepipe!



# *Open Standards Make it Possible!*

- Created a platform to build upon by using a service oriented architecture (SOA) – inception of WFS Simple protocol
- Data simply shows up from one request with spatial and temporal parameters to potentially 70 spatial and spatially-related web services
- A better project by:
  - ❑ Integrating a pre-built open standard package with project specific solutions
  - ❑ Collaboration between a geographically distributed team



# Questions and Contacts

*Grant Link: <http://www.epa.gov/Networkg/>*

*Exchange Network Link: <http://www.exchangenetwork.net/index.htm>*

*KWMIP Website URL: <http://kwmip.ky.gov>*

## Build Team

Open Geospatial Consortium Technical Lead: Raj Singh, Ph.D. [rsingh@opengeospatial.org](mailto:rsingh@opengeospatial.org)

FMSM Development Lead: Ray Rush, P.E. [rrush@fmsm.com](mailto:rrush@fmsm.com)

ESRI Development Lead: Marten Hogeweg [mhogeweg@esri.com](mailto:mhogeweg@esri.com)

## Project Team

Principal Investigator: Demetrio Zourarakis, Ph.D. [demetrio.zourarakis@ky.gov](mailto:demetrio.zourarakis@ky.gov)

Project Coordinator: Karen Schaffer, FMSM Engineers, [kschaffer@fmsm.com](mailto:kschaffer@fmsm.com)

Open Geospatial Consortium Planning Lead: Sam Bacharach  
[sbacharach@opengeospatial.org](mailto:sbacharach@opengeospatial.org)

