



# Integrating Historical and Realtime Monitoring Data into an Internet Based Watershed Information System for the Bear River Basin

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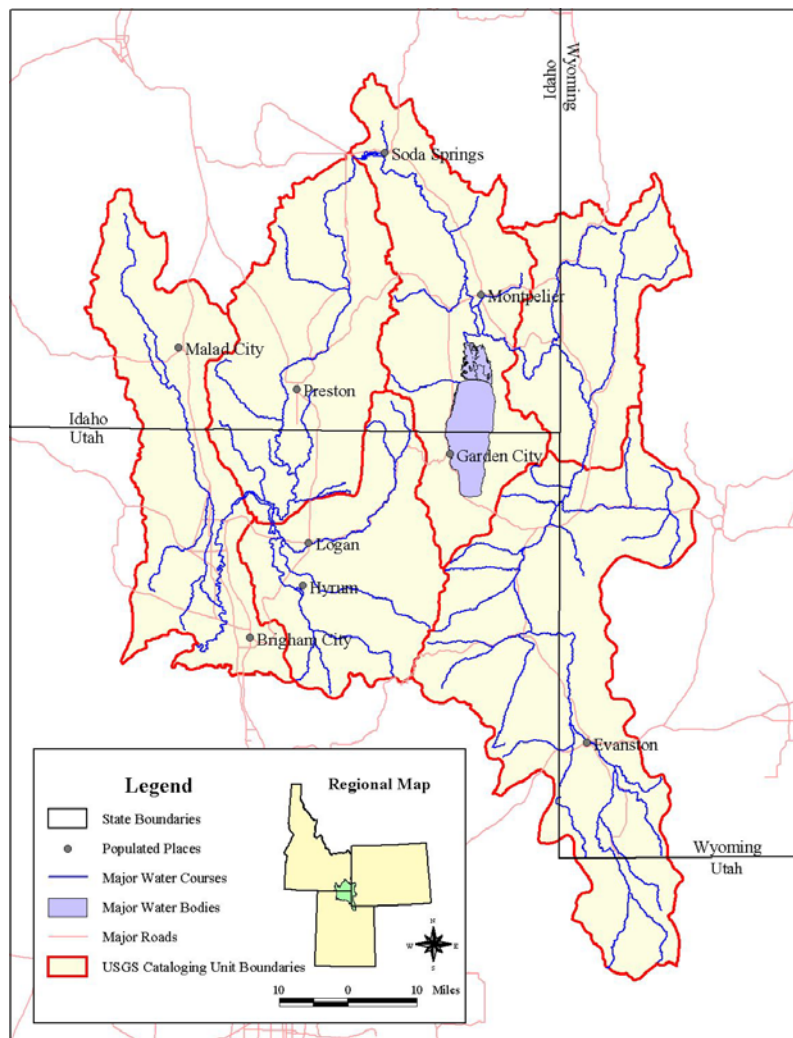
# EPA Targeted Watersheds Grant

- 1. Develop an integrated, Internet-based Watershed Information System (WIS)**
2. Investigate the feasibility of a water quality trading program
3. Develop a water quality model to support the water quality trading program





# Why the Bear River Basin?

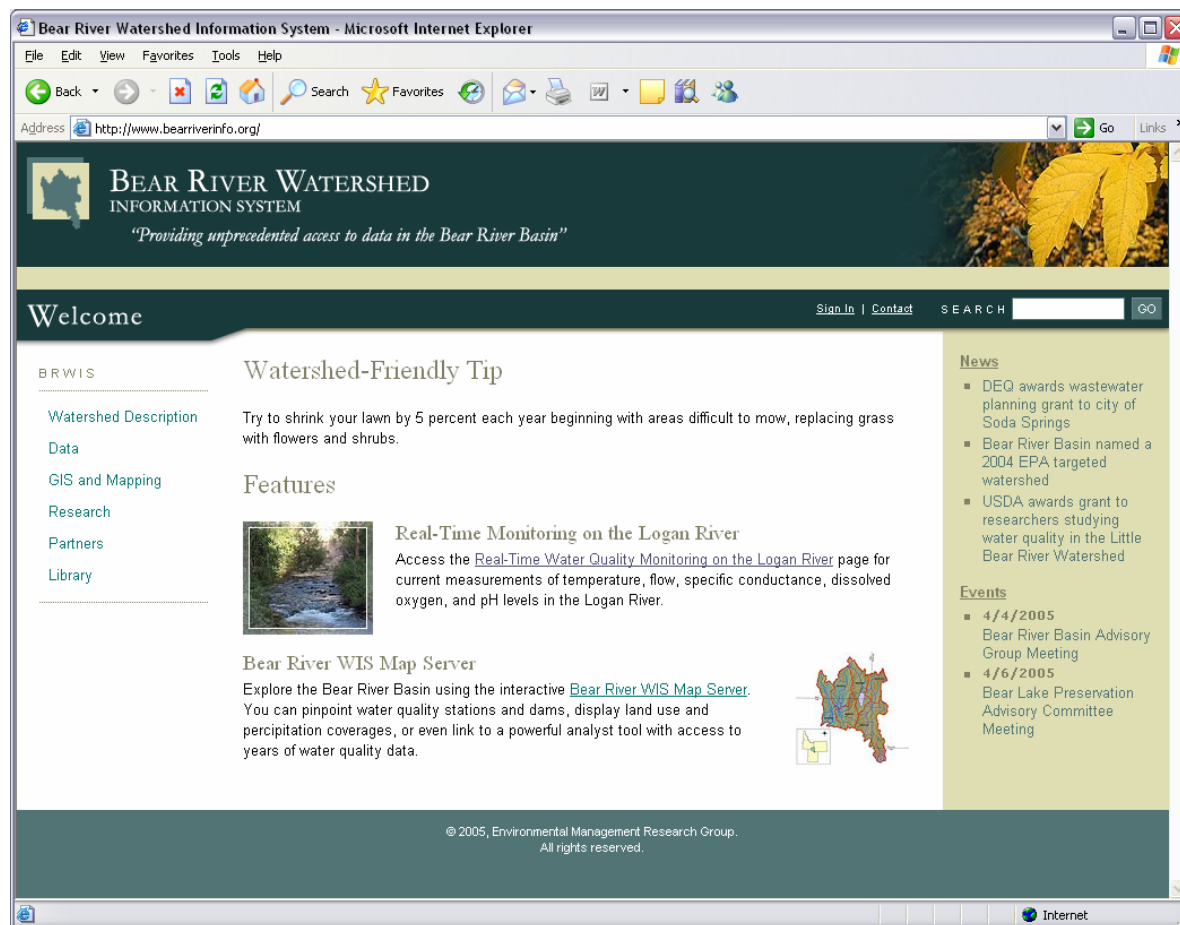


- The Bear River crosses state lines 5 times!
- Multiple organizations generating data within the watershed
- An identified need for a common site for data and information



# Bear River WIS Website

## <http://www.bearriverinfo.org>





# Bear River WIS Features

- **Watershed wide coordination web pages**
  - Digital library
  - Resource guide
  - Calendar and news events
- **Comprehensive data warehouse**
  - GIS data
  - Historical monitoring data
  - Realtime monitoring data
- **Data visualization and statistical tools**



# Comprehensive Data Warehouse

## Sources of Monitoring Data

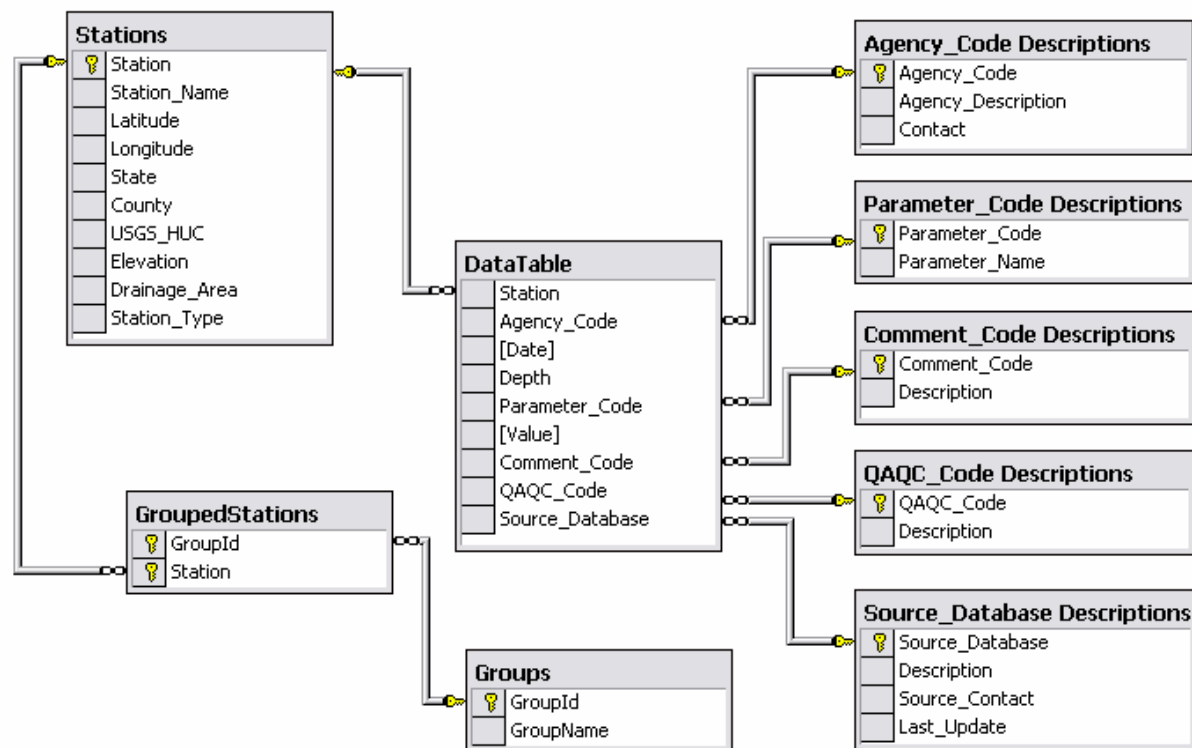
- **Historical data**
  - Streamflow - USGS NWIS
  - Water Quality - EPA STORET
  - Climate – NRCS SNOTEL, NCDC, etc.
  - Local data sources
- **Realtime monitoring data**
  - Streamflow - USGS NWIS
  - Water Quality - Utah State University
  - Diversion Flows - Utah Division of Water Rights
  - Reservoir Releases - PacifiCorp
  - Local canal companies and water users



# How Do We Store and Serve Disparate Monitoring Data?

## Original WIS Relational Database

- Robust
- Interactive
- Simple...
- Core Tables
  - Stations
  - Parameters
  - Data

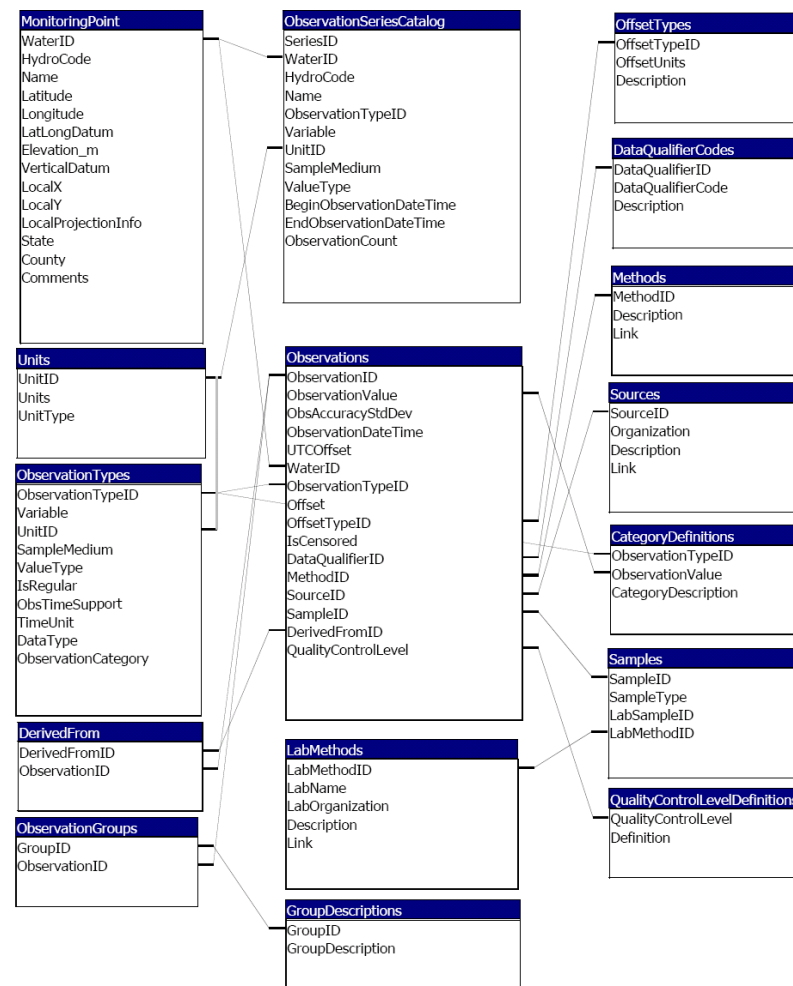




# Storing Disparate Monitoring Data

## HODM - A More Robust Schema

- One database schema to store all observational data
- **CUAHSI Hydrologic Observations Data Model (HODM)**







# HODM Features

- **Generic schema**
  - Can be implemented in any relational database system
- **Store metadata**
  - Enough info to unambiguously interpret each observation
- **Data levels and versioning**
  - Level 0: Raw sensor data
  - Level 1: Processed or QAQC checked data
  - Level 2: Derived Data
  - Level 3: Interpreted Products
- **Trace source** and provenance of data
- **General and Robust enough** to store all types of observations
  - Hydrologic
  - Environmental
  - Climatic



# Acquiring Monitoring Data - Historical

- **Sources**

- Download data from internet sources
  - EPA STORET data
  - USGS NWIS data
- Local agencies or organizations
  - Primarily word of mouth

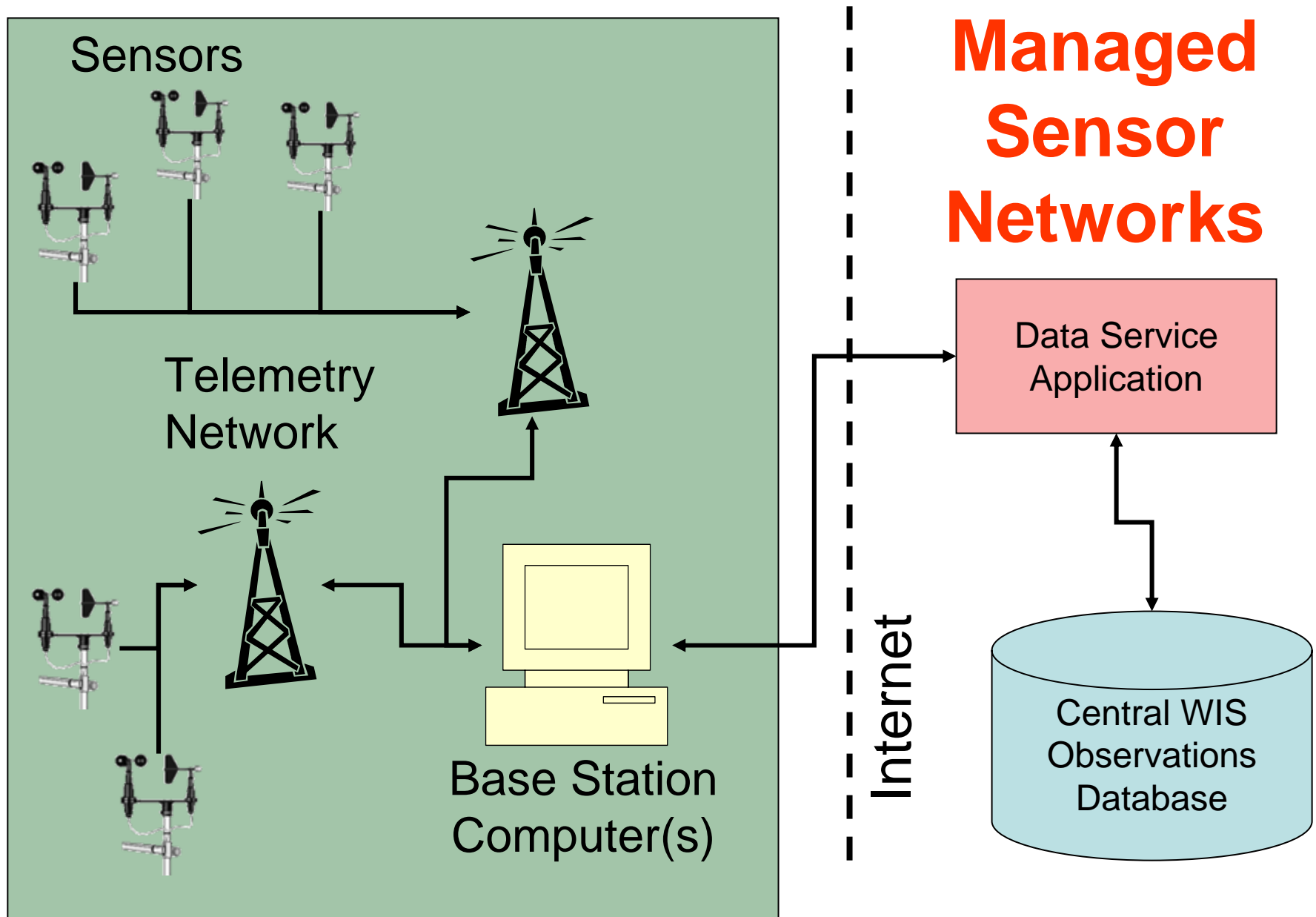
- **Challenges**

- Each source has their own data format
- Database must be periodically updated
- Can build automated filters to parse data into the observations database

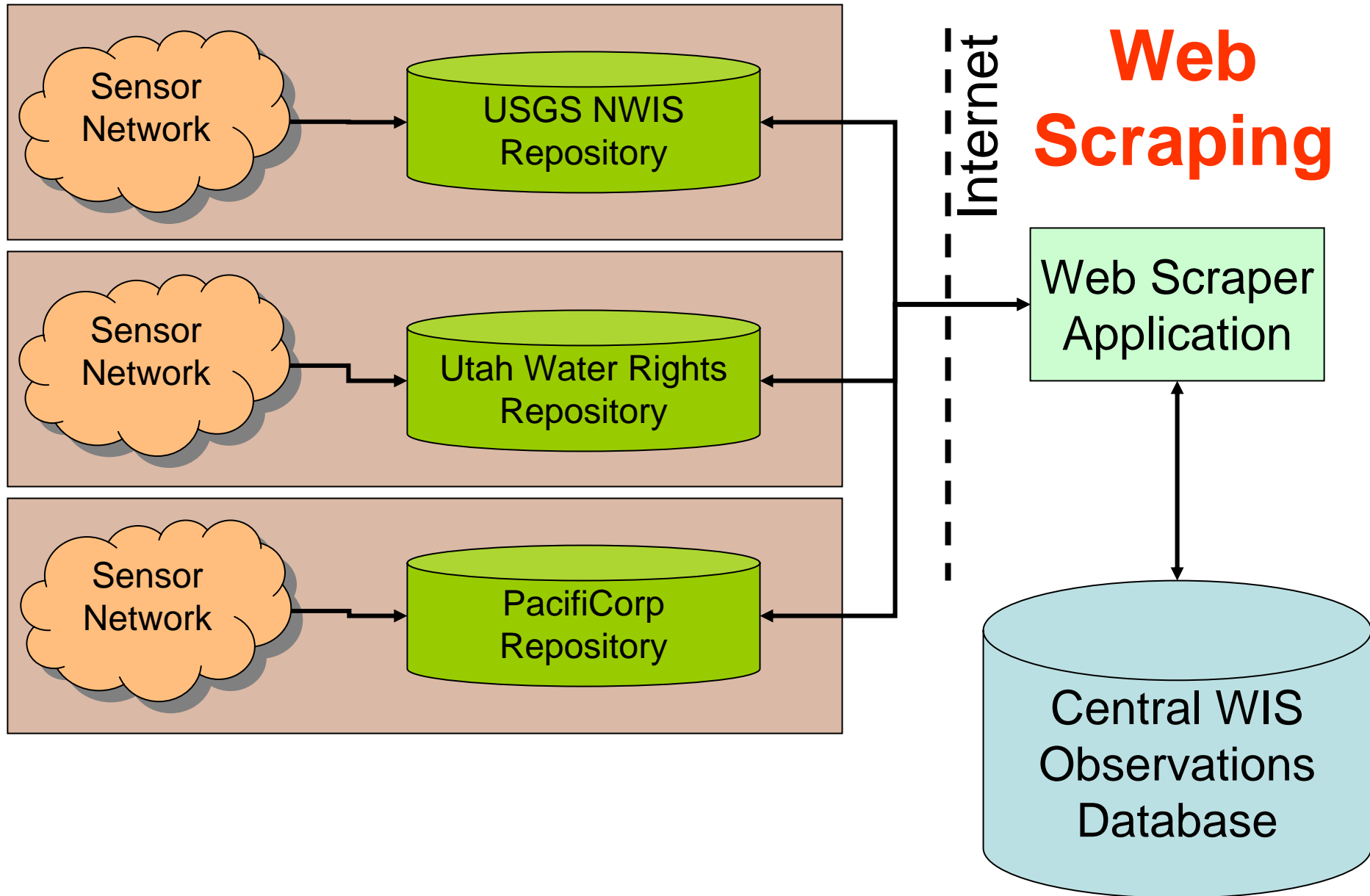
- **Value added**

- All data available in a consistent format in one place

# Automatic Ingestion of Realtime Data

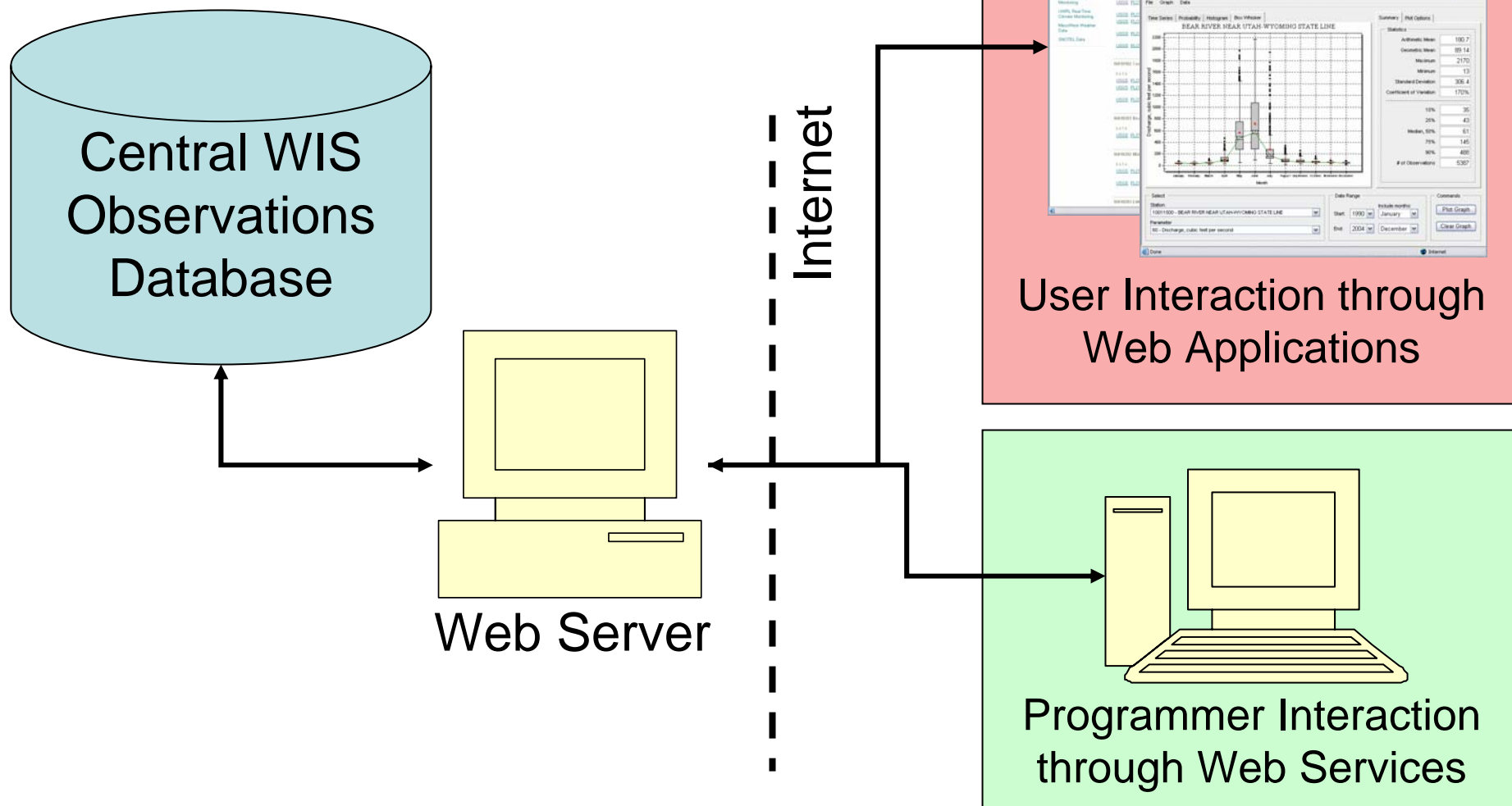


# Automatic Ingestion of Realtime Data





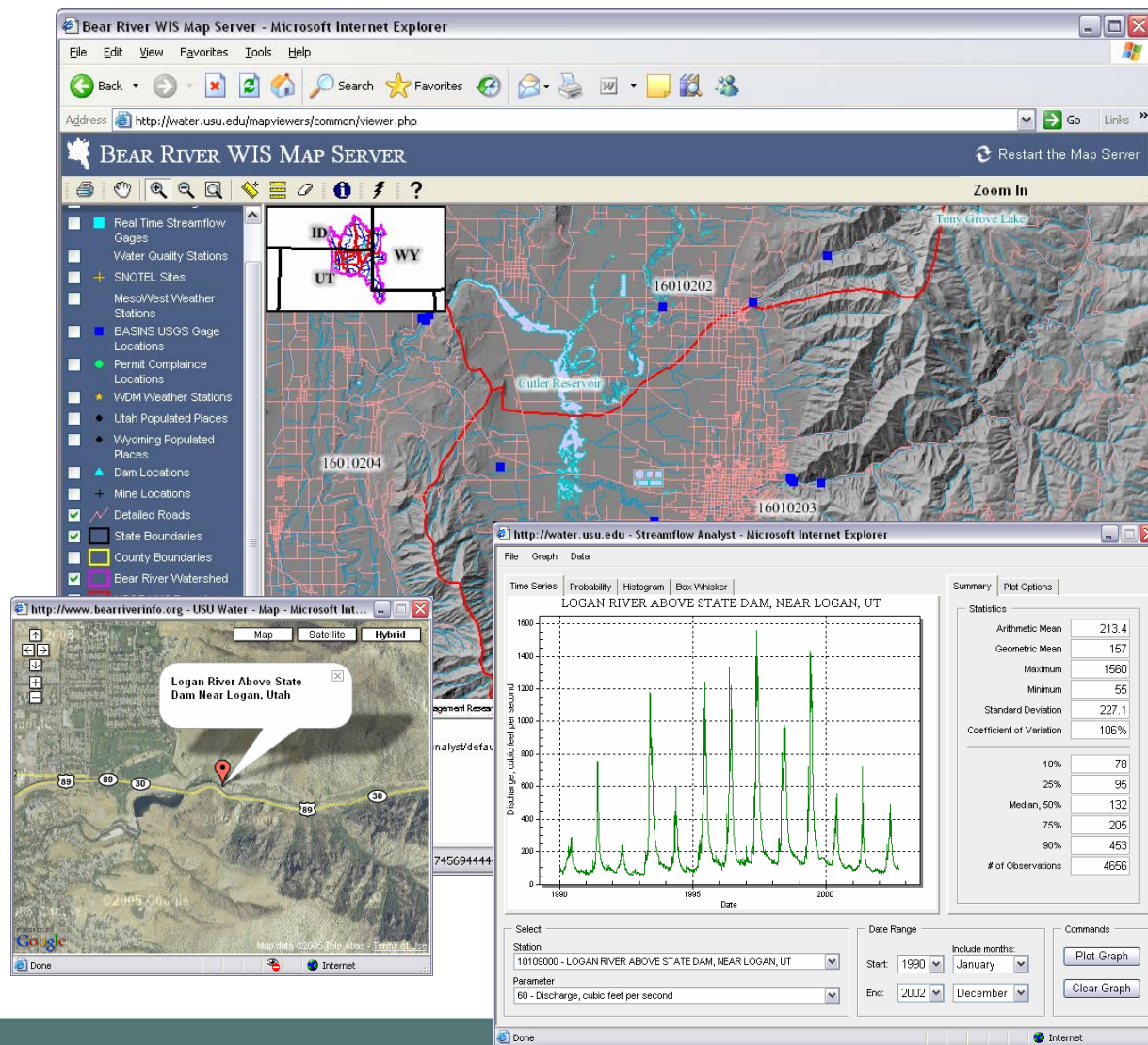
# Serving Data over the Internet

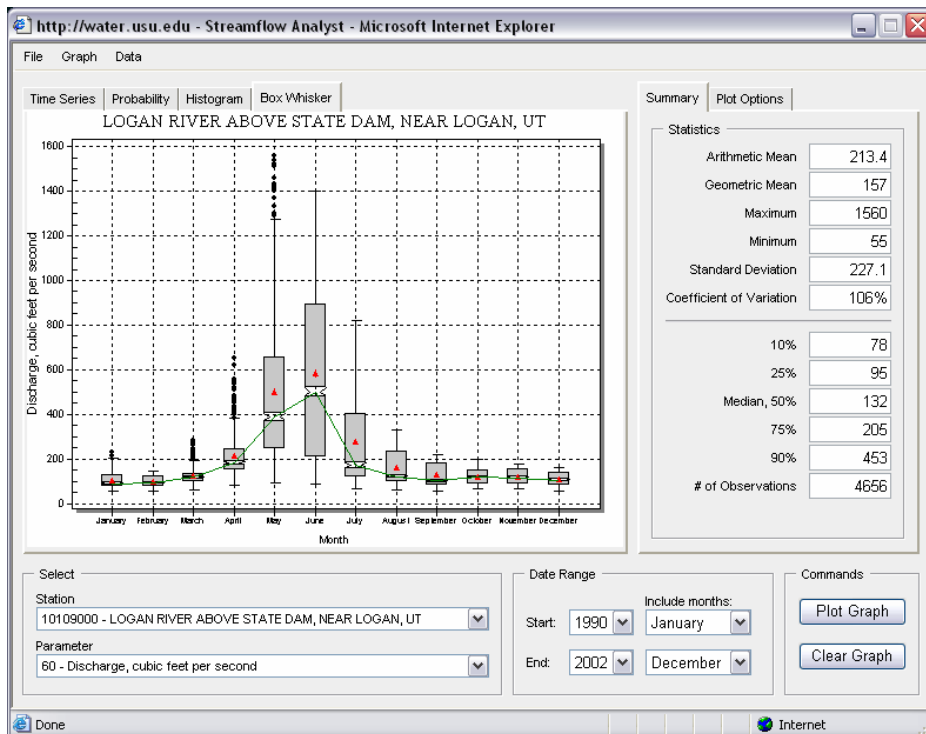




# Data Analysis and Visualization Tools

- Internet Map Server for GIS Information
- Time Series Analyst for streamflow, water quality, climate, etc.





The screenshot shows the 'Streamflow Analyst - Data View' web application. It displays a table of water quality data with the following columns: Date, Feature, Water Quality Point, Type, and Value.

Date	Feature	Water Quality Point	Type	Value
8/28/1973 2:25 PM	4602	02089500	2	26
8/28/1973 2:25 PM	4602	02089500	2	26
9/4/1973 3:00 PM	4602	02089500	2	26
9/10/1973 2:15 PM	4602	02089500	2	26
9/18/1973 6:30 AM	4602	02089500	2	26
9/25/1973 1:15 PM	4602	02089500	2	26
10/4/1973 3:15 PM	4602	02089500	2	26
10/9/1973 2:15 PM	4602	02089500	2	26
10/15/1973 10:00 AM	4602	02089500	2	23
10/17/1973 10:00 AM	4602	02089500	2	23
10/26/1973 14:25	4602	2089500	2	26
8/28/1973 14:25	4602	2089500	2	26
9/4/1973 15:00	4602	2089500	2	29
9/10/1973 14:30	4602	2089500	2	30
9/18/1973 6:30	4602	2089500	2	25
9/25/1973 11:30	4602	2089500	2	25
10/4/1973 15:10	4602	2089500	2	25
10/9/1973 14:15	4602	2089500	2	25
10/15/1973 10:00	4602	2089500	2	23
10/17/1973 9:30	4602	2089500	2	17
10/22/1973 11:30	4602	2089500	2	21

SQL Queries  
passed from  
Time Series  
Viewer to the  
server database

Query results can  
be exported to a  
browser window  
or directly to  
Microsoft Excel

Query results are passed  
to the ProEssentials  
plotting control

# Time Series Analyst

User Interaction  
through Web Browser

Plot image generated by  
ProEssentials is passed  
back to the Time Series  
Viewer and displayed in  
browser

ProEssentials  
Plotting Control

<http://water.usu.edu/analyst/>

Central WIS  
Observations  
Database





# Project Partners

<http://www.bearriverinfo.org>



Utah Water Research Laboratory



United States EPA



Bear River Commission



Water Quality Task Force



Idaho DEQ



Utah DEQ



Wyoming DEQ