Status Report from the Subcommittee on Ground Water

Presentation to the Advisory Committee on Water Information
on the
National Ground Water Monitoring Network
July 13, 2011

Robert P. Schreiber, Co-Chair, (ASCE), CDM
William L. Cunningham, Co-Chair, USGS
H. Allen Wehrmann, ISWS
Nathaniel L. Booth, USGS

Representing products of the SOGW
and
SOGW Work Groups

Agenda

- Framework Overview
  - Bob Schreiber, SOGW/CDM
- Pilot Projects Summary
  - Bill Cunningham, SOGW/USGS
- A Pilot Example: Illinois-Indiana
  - Al Wehrmann, Pilot Leader, IL State Water Survey
- Web Data Portal
  - Nate Booth, USGS
- Next Steps and Resolution
  - Bob Schreiber, SOGW/CDM
- Q&A

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Why a National GW Network?

- 2003 GAO Report
  - 36 States expect water shortages
- 2005 NGWA/AASG Survey
  - GW shortages expected in 43 states
  - Calls for cooperative monitoring
- 2006 Heinz Report
  - GW data inadequate for national reporting

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Support for Network

- 2005 - NGWA facilitates development of concepts for national network
- 2007 - SWAQ report calls for water census
- 2007 – Formation of SOGW
- 2009 – SECURE Water Act calls for a national gw network

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Charge to SOGW

The **overall goal** of the SOGW is to **develop and encourage implementation of a nationwide, long-term ground-water quantity and quality monitoring framework** that would provide information necessary for the planning, management, and development of ground-water supplies to meet current and future water needs, and ecosystem requirements.

Scope: This national framework for ground-water monitoring and collaboration will be developed to assist in assessments of the **quantity of U.S. ground-water reserves, as constrained by ground-water quality**.

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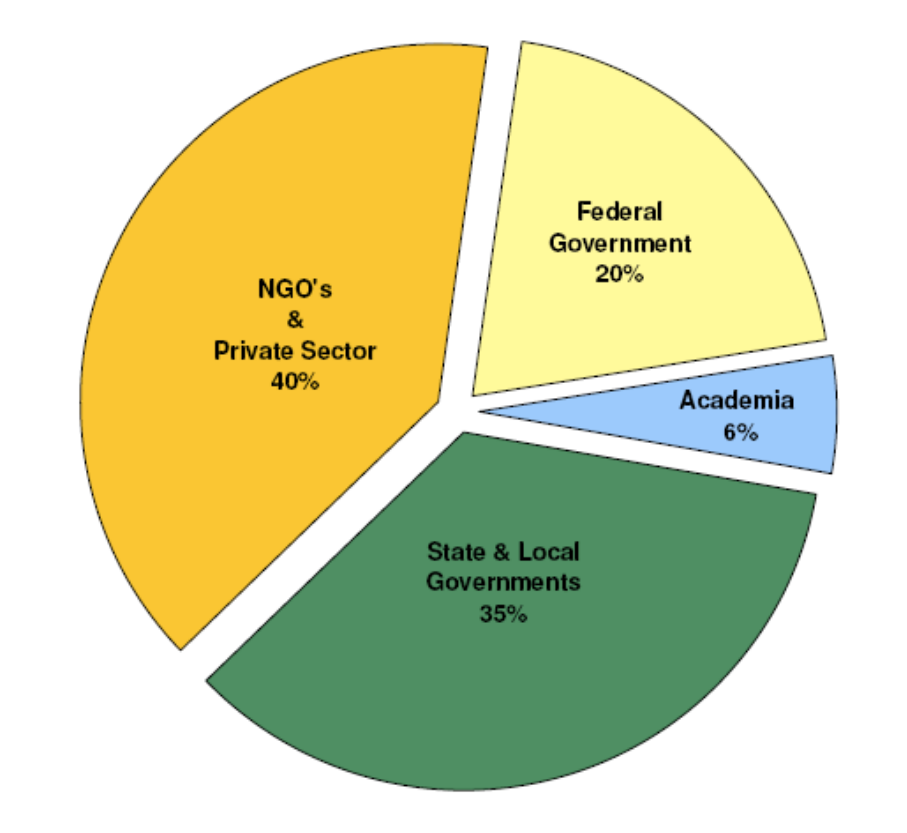
SOGW Members & Supporters

- *American Society of Civil Engineers*
- *Ground Water Protection Council*
- *Interstate Council on Water Policy*
- *Association of American State Geologists*
- *National Ground Water Association*
- *Texas Commission on Environmental Quality*
- *US Geological Survey*
- *USEPA Headquarters and Region 8*
- *Association of State Drinking Water Administrators*
- *Water Environment Federation*
- *USDA Forest Service*
- *Association of State and Interstate Water Pollution Control Administrators*
- *ASTM*

Subcommittee & Work Groups: 70 people from 54 organizations



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SOGW Guiding Principles

- “Walk before running”
- Reach consensus
- Retain flexibility
- Strive for inclusion
- Leverage “local knowledge”
- Encourage cross-border cooperation

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SOGW Approach

- Determine “current picture” of ground-water monitoring
- Consensus network design principles
- Consensus field methods and data standards
- Determine approach for compiling data
- Consensus implementation plan

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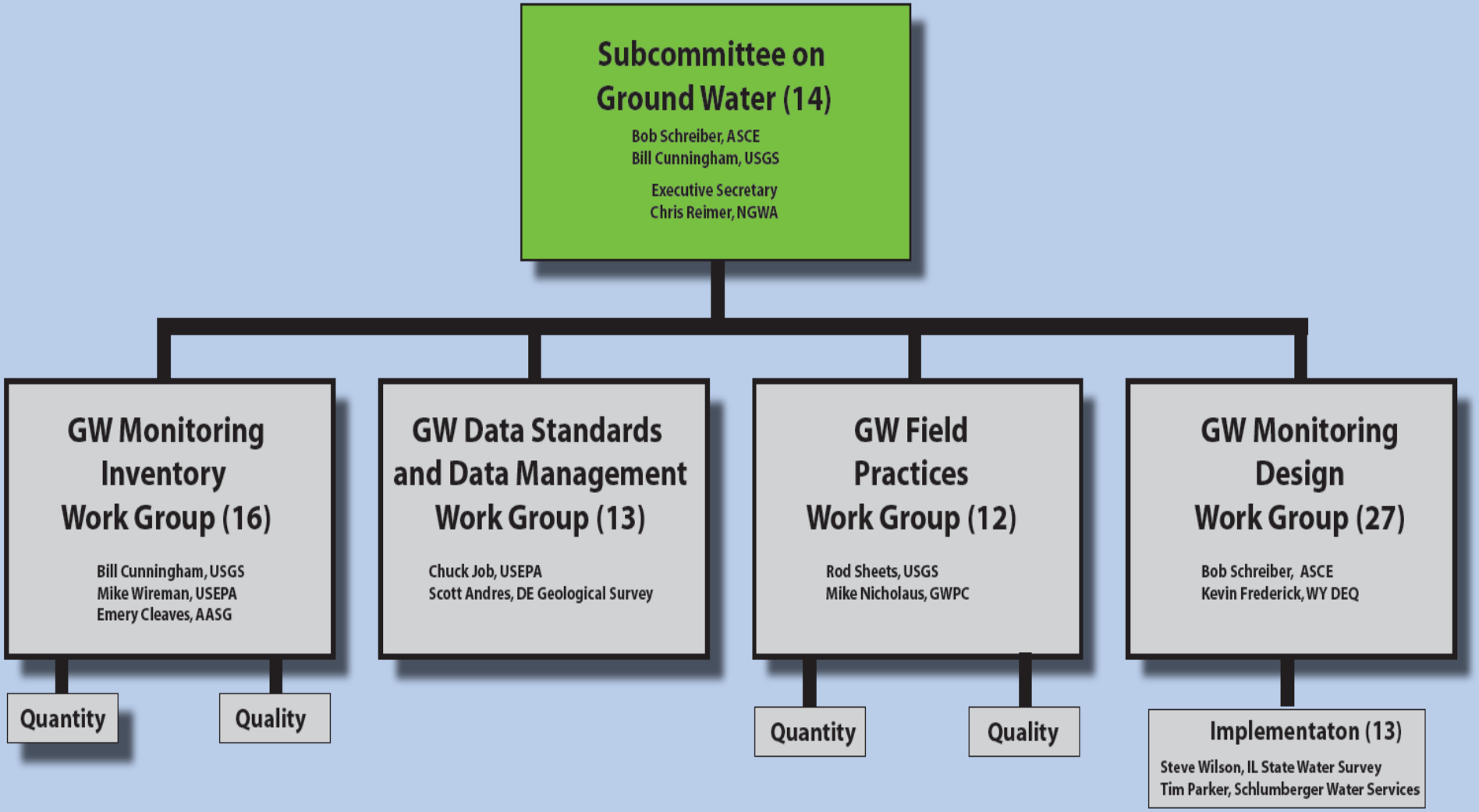
SOGW Work Groups



Inventory Work Group – Results

- Many networks already exist
- Multiple agencies involved, sometimes multiple agencies within a state
- Ambient level networks more prevalent than quality networks
- National gaps in both
- Gap analysis work to be done

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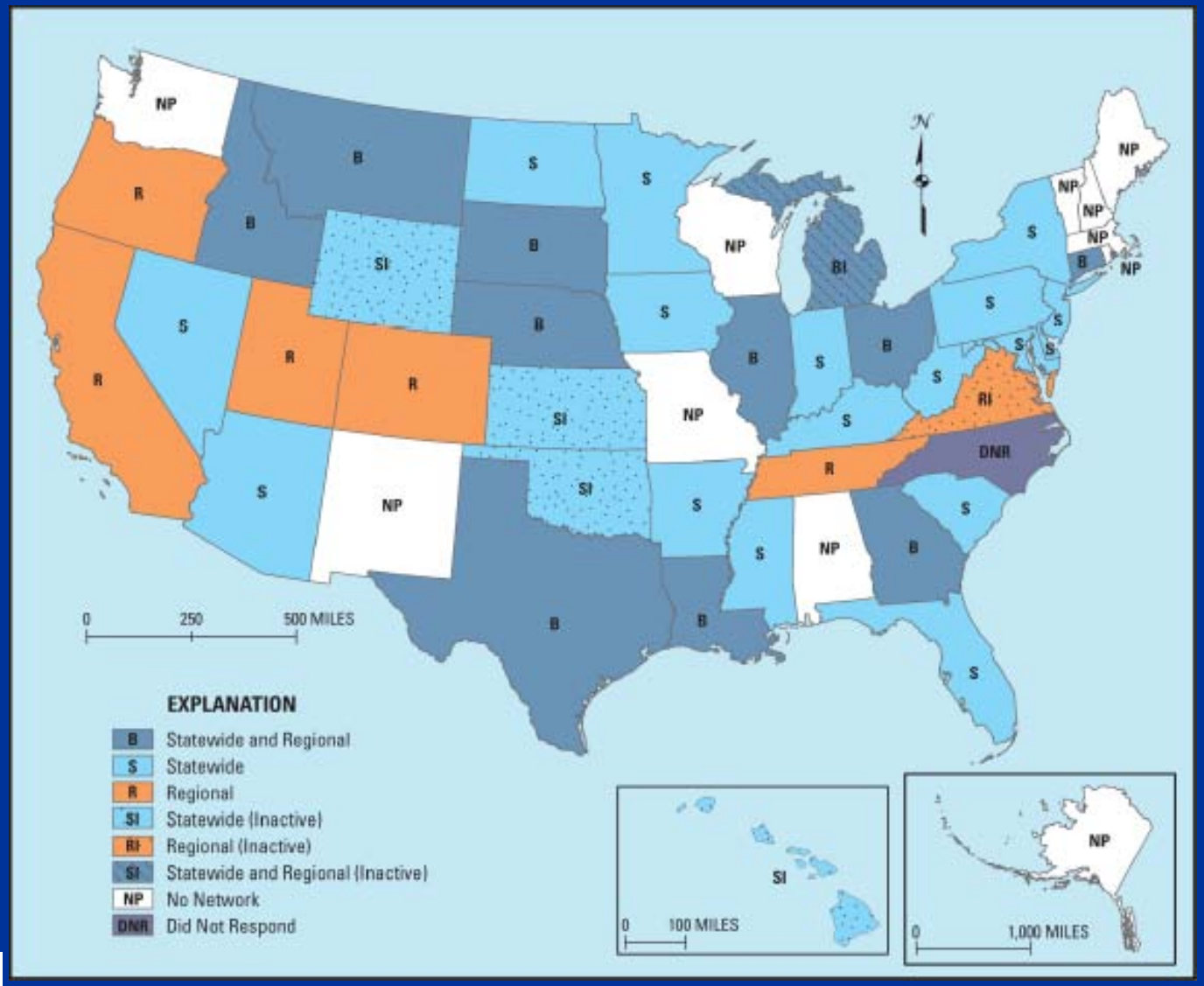
Inventory Workgroup - Quality



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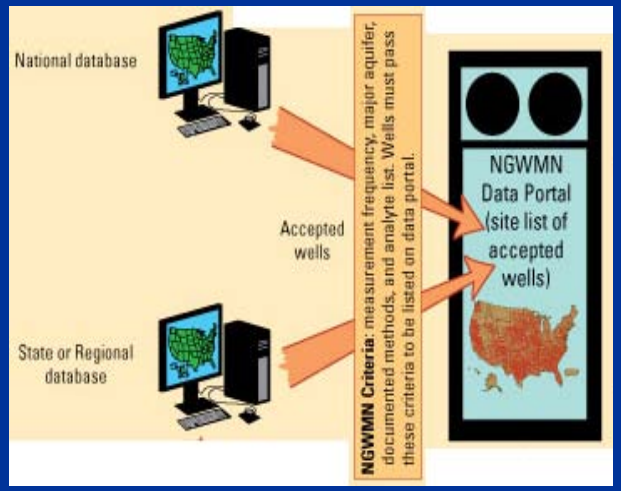
SOGW (2009) – final framework document – page 22

Data Standards & Mgt Work Group
→ *Comparable - Acceptable*

- **Minimum Data Elements for wells and measurements are provided***
- **A Data Portal is the most critical component, and needed early in the process**



*** Methods Board**

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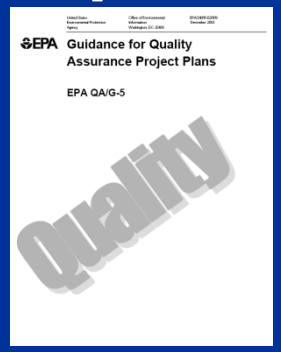
Field Practices Work Group
→*Comparable - Acceptable*

- Few strict requirements--flexible and adaptable.
- Requires documentation of techniques to ensure comparability and assure quality in ground-water measurement and sampling activities.
- New technologies will be incorporated into the NGWMN as appropriate.



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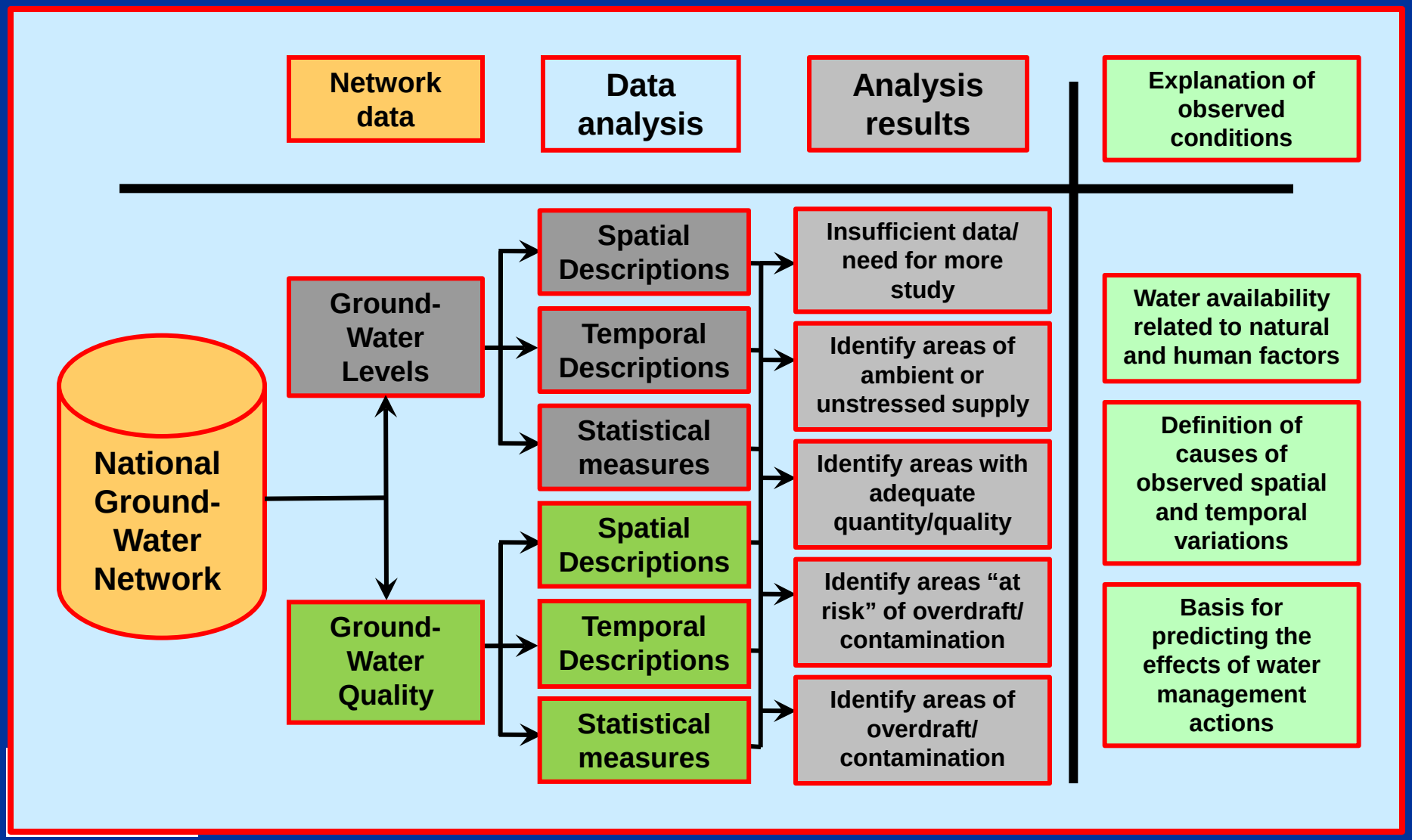
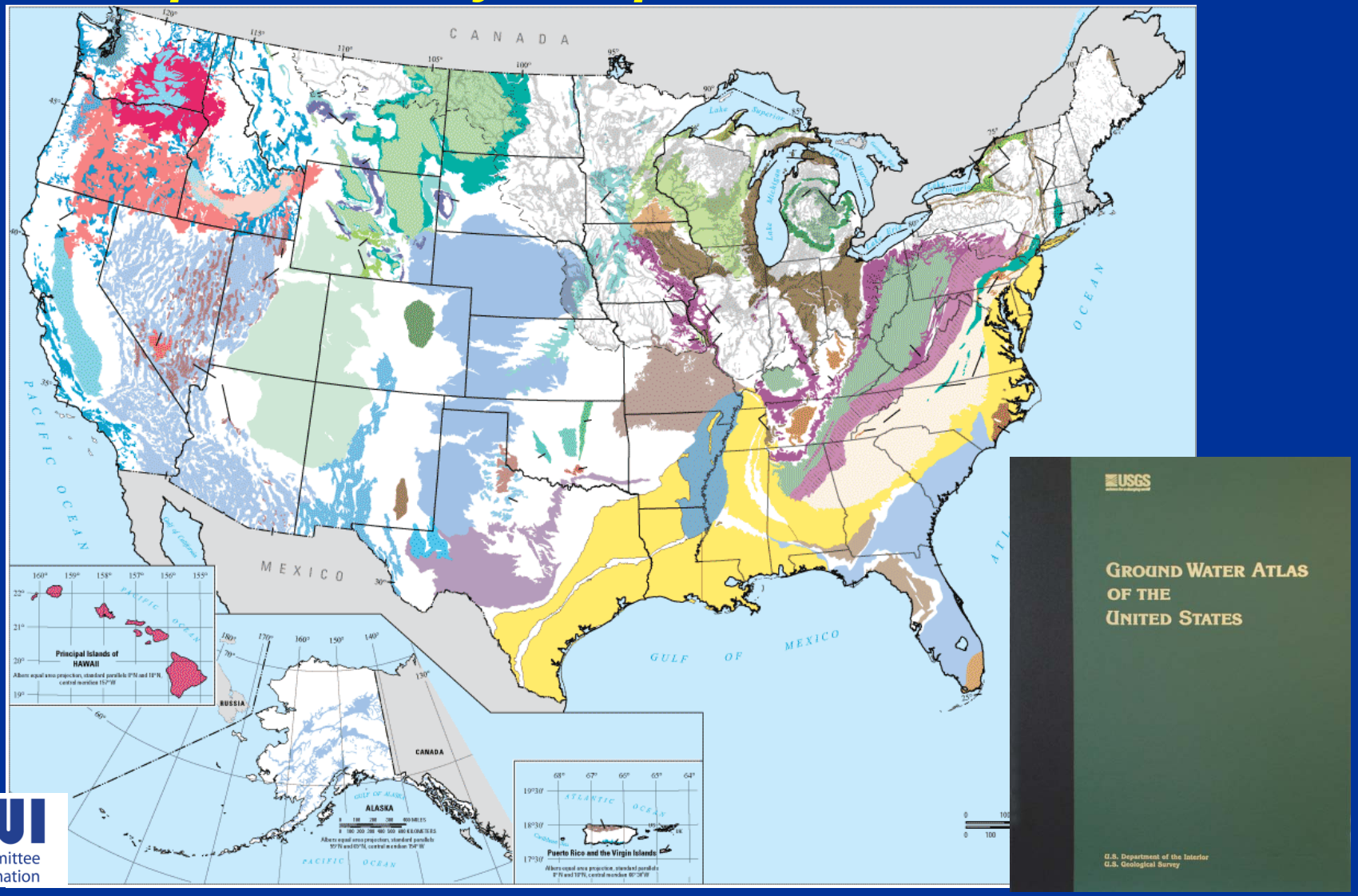
Network Design Work Group

→ *Data Flow for Analysis & Mgt Purposes*



Network Design Work Group

→ *Principal and Major Aquifers*



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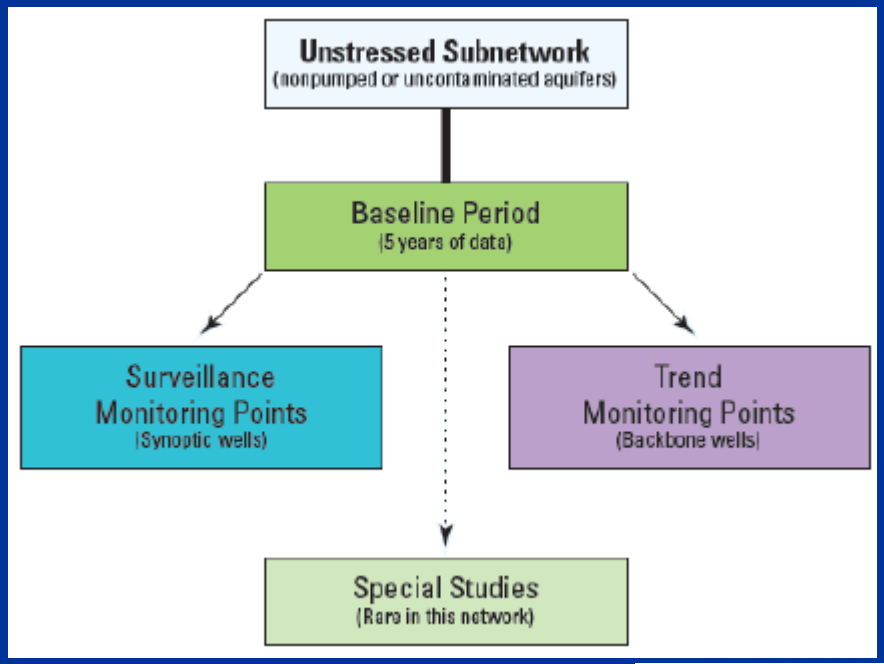
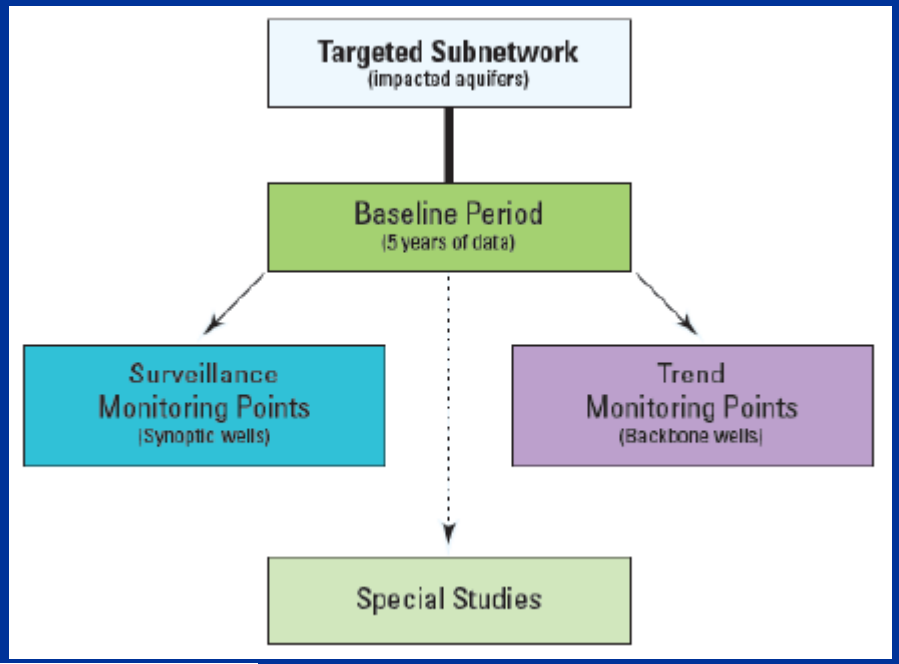
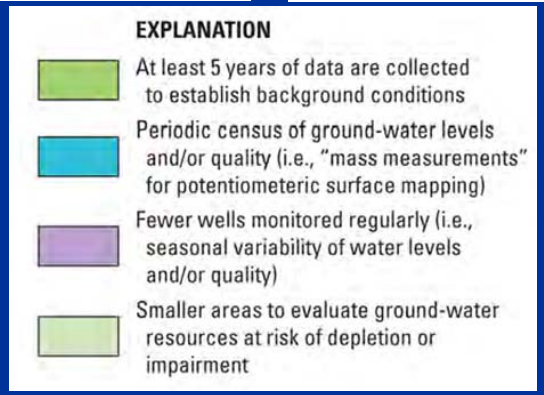
Network Design Work Group

→*Types of Networks & Sub-Networks*







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Implementation Sub-Group

→ *Stepwise Approach*

- Initiate Pilot Programs
- Develop Portal System
- Establish Management Structure
- Provide foundation for federal funding
- Facilitate participation by data providers

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Implementation Sub-Group

→*Pilot Program Strategy*

- Conduct gap analysis – cost estimate
- Evaluate water-level, WQ, and combo networks
- Assess "robustness"
- Establish ground-water data portal
  - → Data flows through portal
  - → But not stored in central database
- Improve Framework Document
- Leverage significant state expertise

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Implementation Sub-Group

→*Recommended Management Structure*

Management of the National Ground-Water Monitoring Network (NGWMN)

Data Providers

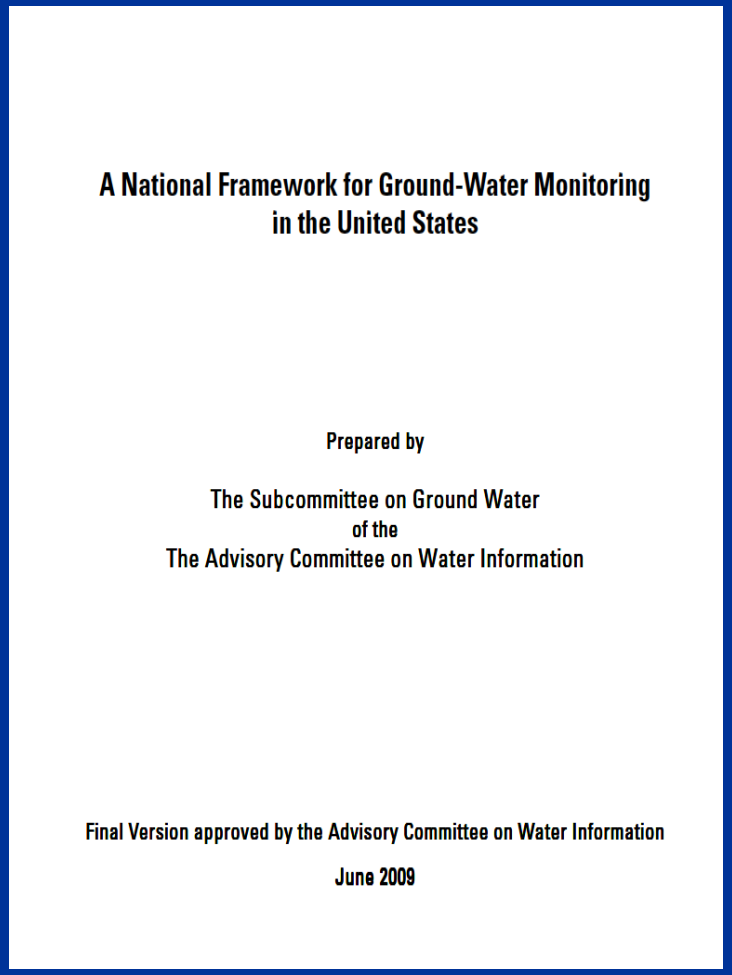
[Networks and Individual Sites That Meet NGWMN Criteria]

- Federal
- State
- Tribal
- Regional
- Local
- Other

Advisory Committee on Water Information Subcommittee on Ground Water [Federal Interface]	U.S. Geological Survey Management and Operations Group [Day-to-day operations]	NGWMN Program Board [Representatives from Data Providers] [Guidance and Direction]

Framework Report to ACWI

- Available to NWQMC in Jan 2009
- Report approved by the ACWI in February 2009
- Available at http://acwi.gov/sogw/pubs



A National Framework for Ground-Water Monitoring in the United States

Prepared by

The Subcommittee on Ground Water
of the
The Advisory Committee on Water Information

Final Version approved by the Advisory Committee on Water Information

June 2009

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ACWI Resolution, Feb 2009

Now Therefore Be it Resolved that……..

- **ACWI accepts the Framework Document,**
- **ACWI adopts the conceptual implementation plan for the National Ground Water Monitoring Network, and**
- **ACWI charges SOGW to move forward with development and initiation of pilot testing, patterned after the preceding efforts related to the National Water Quality Monitoring Network for U.S. Coastal Waters and Their Tributaries.**

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Schedule

- Pilot-Testing RFP → Fall 2009
- Evaluation and Selection → same
- Pilot-Testing → FY10
- Reporting → FY11
  - Recommended Updates
  - Suggested "Next Steps"
- Full-Scale Implementation → FY12?

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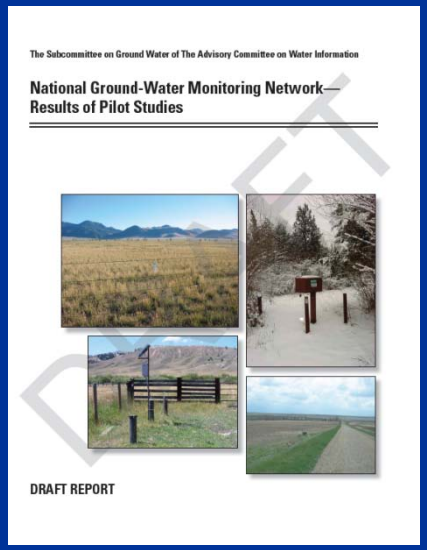
Pilot Projects Summary

National Ground Water Monitoring Network

Bill Cunningham
Co-Chair, Subcommittee on Ground Water
U.S. Geological Survey



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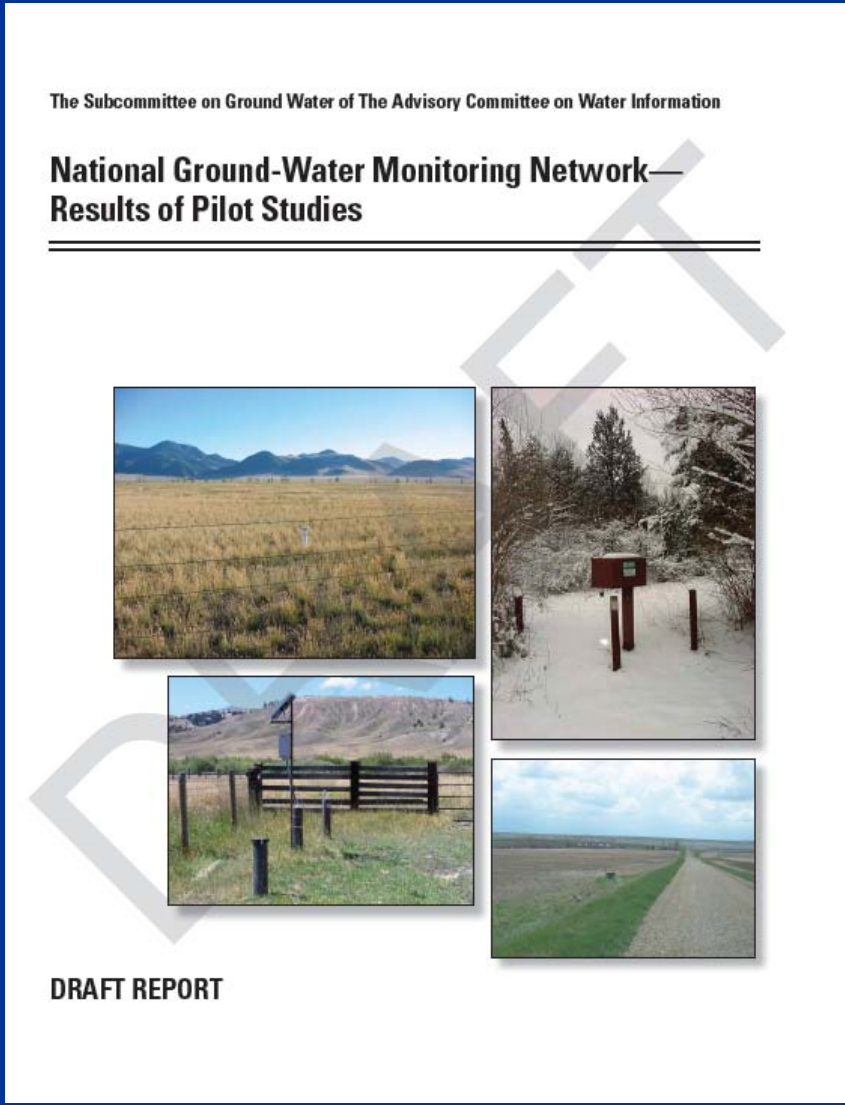
NGWMN Pilot Studies

- Pilot phase followed Framework approval.
- Solicitation yielded 9 statements of interest
- Evaluation team selected 5 pilots to represent different scope/scale/IT
- Volunteer effort with 1-year timeline.


The Subcommittee on Ground Water of The Advisory Committee on Water Information

National Ground-Water Monitoring Network—
Results of Pilot Studies

DRAFT REPORT

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Why Pilot Projects?

- Test the concepts and produce information to evaluate the costs and technical feasibility of the NGWMN
- Improve the "Framework Document" of the NGWMN
- Use this information in the Implementation Phase of the National Ground Water Monitoring Network

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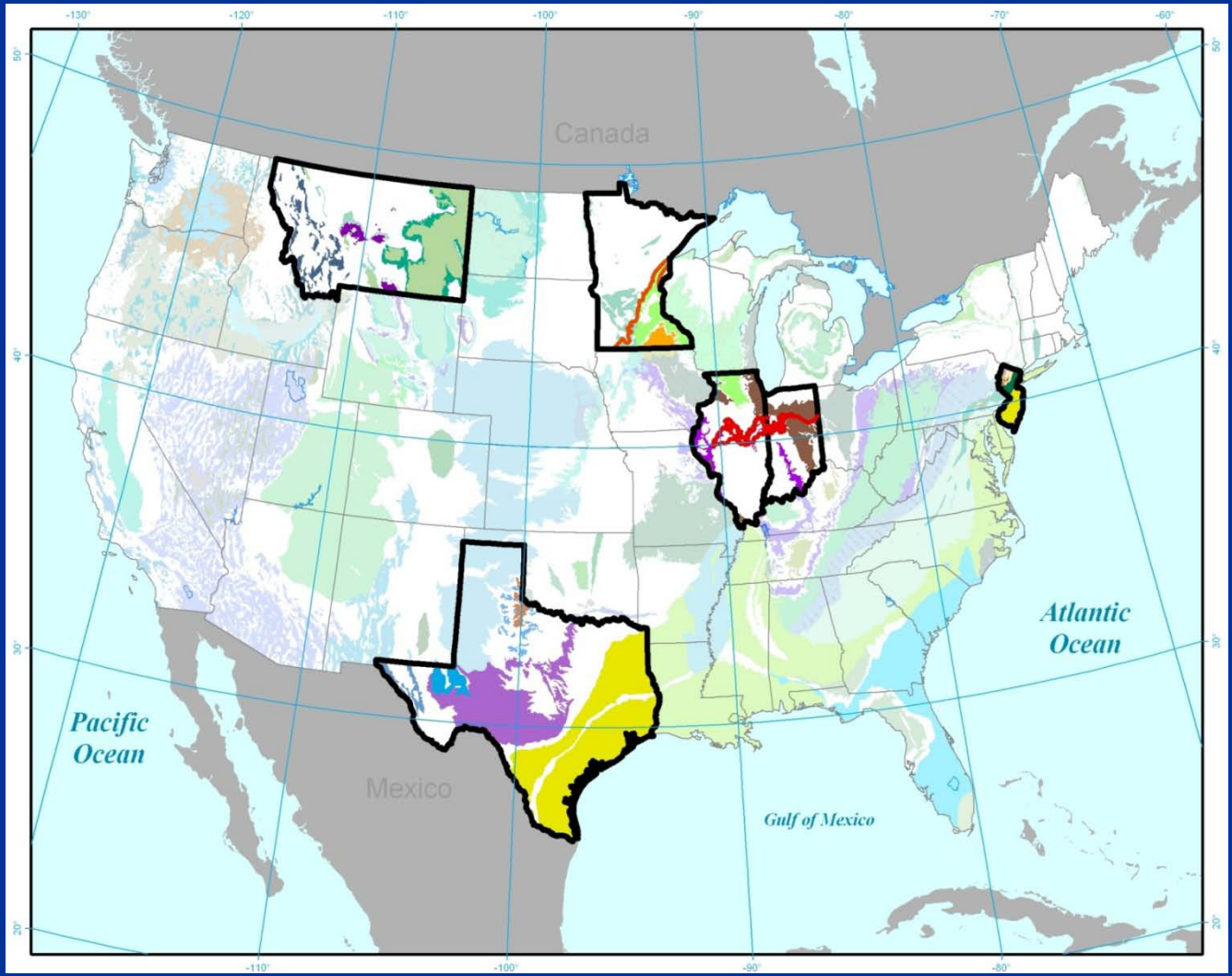
National Ground Water Monitoring Network Pilot Projects



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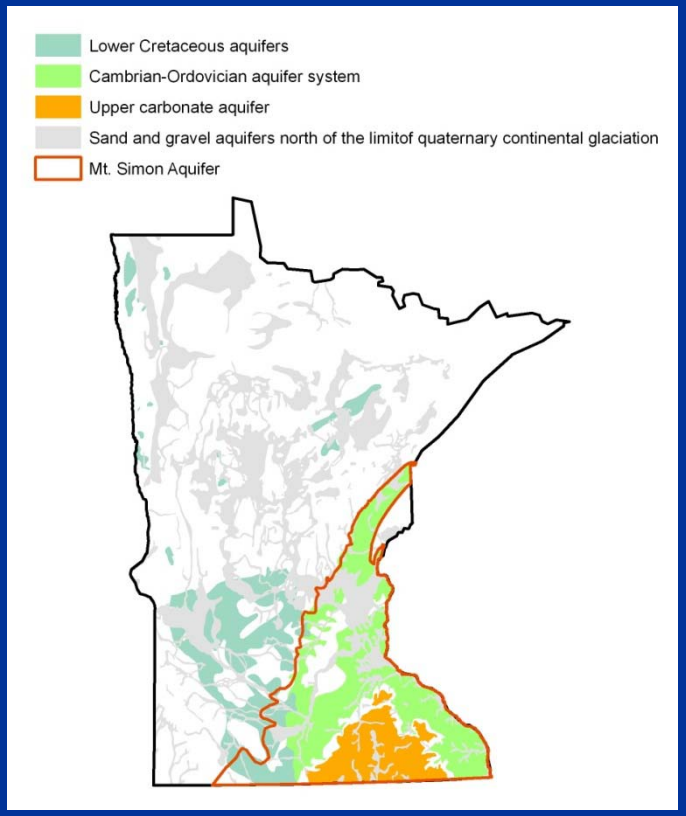
Minnesota



- **Principal/Major Aquifers**
  - Cambrian-Ordovician aquifer system
    - Upper Ordovician aquifers
    - Prarie du Chien-Jordan aquifers
    - Tunnel City/Wonewoc aquifers
    - Mt. Simon aquifer
- **Primary Agencies**
  - Minnesota DNR
  - Minnesota Pollution Control Agency
- **Pilot Authors**
  - Michael MacDonald (DNR) and Sharon Kroening (PCA)
- **NGWMN Wells**
  - Selected 52 of the 157 wells in the Cambrian-Ordovician aquifer system

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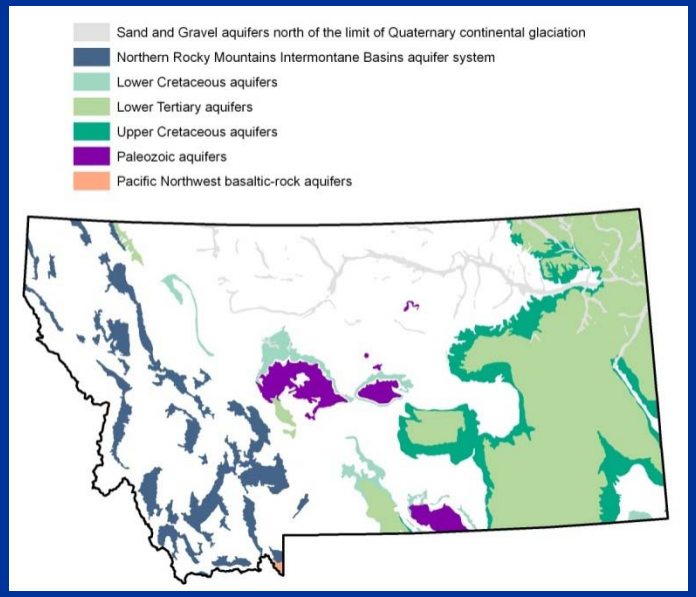
Montana



- **Statewide Principal Aquifers**
  - Alluvial aquifers
  - Glacial aquifers
  - Lower Tertiary,
  - Northern Rocky Mountains Intermontane Basins
  - Paleozoic aquifer systems
- **Primary Agency**
  - Montana Bureau of Mines and Geology
- **Pilot Authors**
  - Thomas Patton and Luke Buckley
- **NGWMN Wells**
  - Selected 271 of more than 940 wells in the statewide network.

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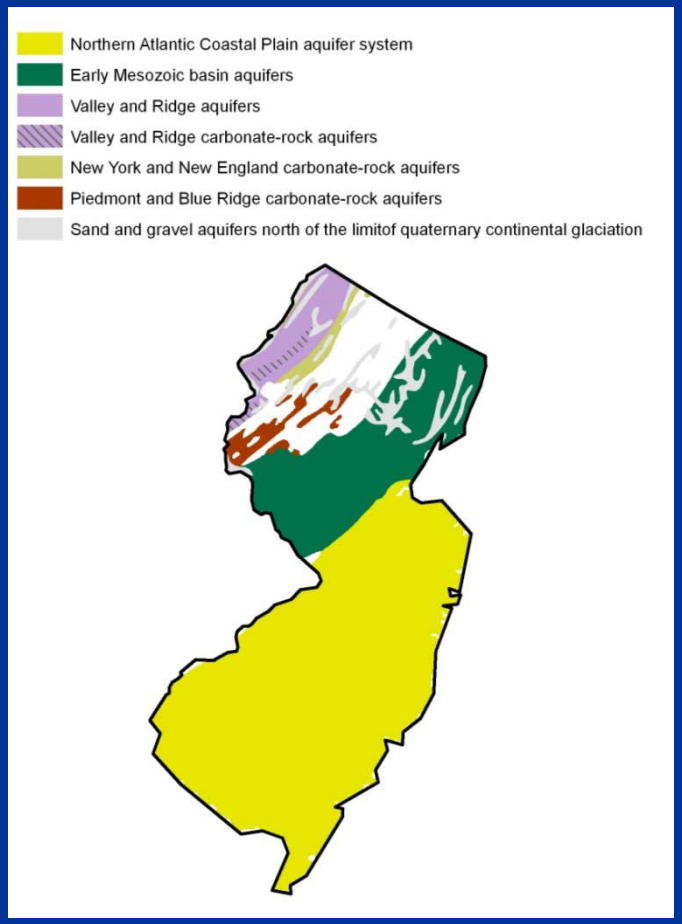
New Jersey



- **Statewide Principal/Major Aquifers**
  - Northern Atlantic Coastal Plain
    - 10 major subunits
  - Early Mesozoic Basin
  - Piedmont and Blue Ridge crystalline rock
  - Piedmont and Blue Ridge carbonate rock
  - Valley and Ridge aquifers
  - NY and NE carbonate rock aquifers
- **Primary Agencies**
  - New Jersey Geological Survey
  - USGS NJ Water Science Center
- **Pilot Authors**
  - Steven Domber, Raymond Bousenberry, and Karl Meussig (NJGS); Daryll Pope and Anthony Navoy (USGS)
- **NGWMN Wells**
  - Selected 982 of 19,000 wells

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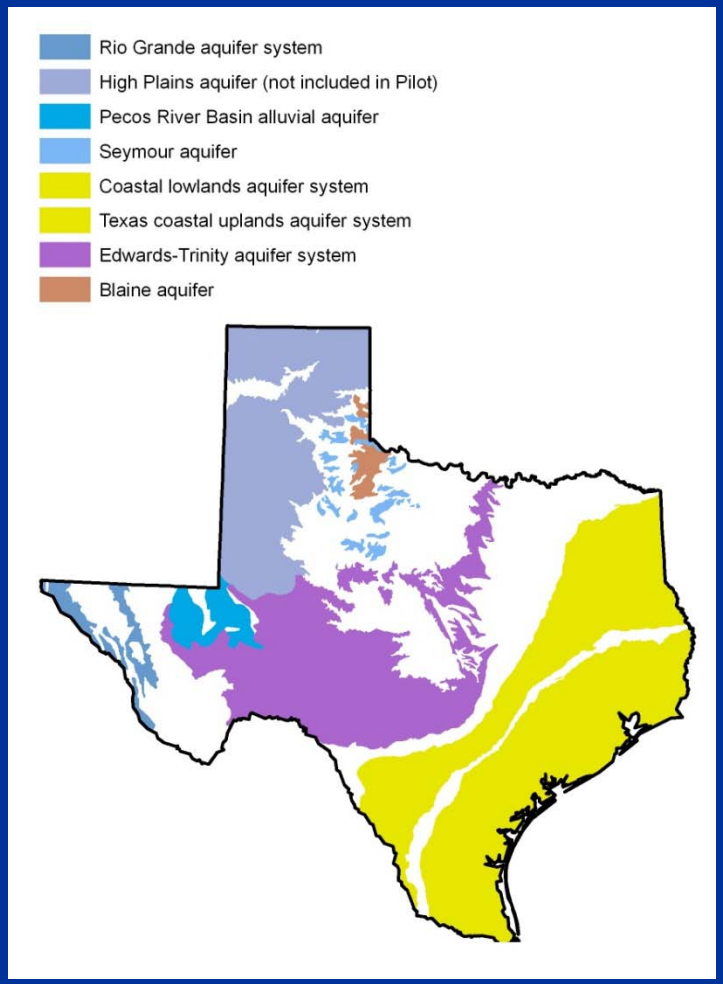
Texas



- **Principal/Major Aquifers**
  - Edwards-Trinity aquifer system,
    - 3 major subunits
  - Seymour aquifer,
  - Pecos River Basin alluvial aquifer,
  - Coastal lowlands aquifer system,
  - Texas coastal uplands aquifer system,
- **Primary Agencies**
  - Texas Water Development Board (TWDB)
- **Pilot Authors**
  - Janie Hopkins, Radu Boghici, and Bryan Anderson
- **NGWMN Wells**
  - Selected 425 of the 2,250 available wells

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Summary of Pilot Tasks

- Evaluate the network within the concepts in “Framework for a Nationwide Ground Water Monitoring Network”
  - Select aquifers, well characteristics, frequency, analytes, “flagging”, spatial distribution
- Evaluate field practices, data elements stored in the GW database, and data management procedures and their documentation,
- Evaluate ability to transmit data to the data portal
- Identify all costs of potential participation in the NGWMN
- Identify network gaps

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Network Gaps

- **Spatial gaps**: additional monitoring points identified to provide an adequate areal and depth distribution of wells or springs.
- **Temporal gaps**: an increase in the frequency of water-level or water-quality measurements.
- **Field practice gaps**: changes in water-level or water-quality measurement techniques.
- **Data management gaps**: missing data elements, or other data-handling issues.

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WL Network Gaps

Gap	IL-IN	Minnesota	Montana	New Jersey	Texas
Spatial	12 wells	98 wells	245 wells	3 wells	32 wells
Temporal	Additional data loggers and/or telemetry	None	Additional 2,400 site visits needed	Increase frequency from 1 per 5 yrs to 1 per year on 844 wells	Additional 2,200 site visits needed
Field Practice ★	None reported	8 minor differences	Minimal differences reported.	4 minor differences	Minimal differences reported.
Data Management ★	Missing some MDE's; Surveyed elevations	Database is missing 75% of MDE's, though most available	None (addressed during pilot)	Minimal gaps reported.	Missing some MDE's, including screened interval and completion data

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WQ Network Gaps

Gap	IL-IN	Minnesota	Montana	New Jersey	Texas
Spatial	Greater density needed	130 wells	245 wells	6-8 wells	In progress
Temporal	None reported	Many wells do not meet baseline criteria	940 samples to close baseline gap; 60-80 samples annually	No wells meet baseline criteria	Gaps exist, but undefined
Field Practice ★	No major differences	8 minor differences	Minimal differences reported.	4 minor differences	Minimal differences reported.
Data Management ★	Working on web services	Database is missing 75% of MDE's, though most available	Establish web services	Minimal gaps reported.	Database missing some MDE's and web services

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Pilot Network Costs

- The SOGW provided no specific guidance on the number of wells in any subnetwork.
- Pilots selected wells from among their existing networks and identified spatial and temporal gaps using their interpretation of the goals of the NGWMN as provided in the Framework Document.
- The Pilot's network design drives each cost estimates for network implementation.
- Cost estimates are provided for:
    - NGWMN pilot participation
    - Monitoring Network
    - Field Practices
    - Data Management

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One-Time/Capital Costs ($1K)

Category	IL/IN	MN	MT	NJ	TX	Avg
Initial Participation (Existing wells only)	$32 ($32)	$27 ($27)	$32 ($32)	$38 ($38)	$36 ($36)	$33 ($33)
Monitoring Network (includes gaps) (Existing wells only)	$200 ($66)	$3,525 ($0)	$1,604 ($0)	$1,516 ($0)	$132 ($132)	$1,395 ($40)
Field Practice changes (Existing wells only)	0 ($0)	$17 ($17)	0 ($0)	0 ($0)	0 ($0)	3 ($3)
Data Management improvements (Existing wells only)	$13 ($13)	$17 ($0)	$8 ($3)	$0 ($0)	$22 ($22)	$12 ($32)
Monitoring Program improvements (Existing wells only)	$0 ($0)	$15 ($15)	$553 ($310)	$121 ($121)	$0 ($0)	$138 ($65)

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O&M Costs ($1K)

Category	IL/IN	MN	MT	NJ	TX	Avg
Monitoring Network (includes gaps) (Existing wells only)	$34 ($0)	$13 ($13)	$160 ($160)	$546 ($0)	$0 ($0)	$151 ($35)
Field Practice (Existing wells only)	0 ($0)	$0 ($0)	0 ($0)	$33 ($33)	$.1 ($.1)	$7 ($7) ★
Data Management (Existing wells only)	$34 ($0)	$0 ($0)	$0 ($0)	$0 ($0)	$0 ($0)	$7 ($0) ★
Monitoring Program (Existing wells only)	0 ($0)	$123 ($123)	$147 ($147)	$4,702 ($1313)	$78 ($78)	$1,010 ($332)

Pilot Benefits

- Single, consistent dataset can be used for decisions about shared interstate GW resources.
- Opportunity to share data among state agencies.
- Impetus for a critical review of field procedures and data management procedures.
- Public education: opportunity to raise awareness for GW monitoring.
- Opportunity to learn from other states.
- Opportunity to improve consistency among states.
- New way of getting data to the public (critical mission).

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Pilot Summary

- GW monitoring is done by many federal, tribal, state, and local agencies for many purposes.
- A collaborative NGWMN is feasible.
- Pilot states record data differently and use different database platforms, but most “minimum data elements” are available.
- Incremental costs of using existing state monitoring systems are low. Existing monitoring will not fill all gaps.
- The NGWMN Internet data portal is a key element to the success of a NGWMN
- A convergence of IT improvements, increased information needs, and interest in collaboration have come together to make this the ideal time to pursue a NGWMN.

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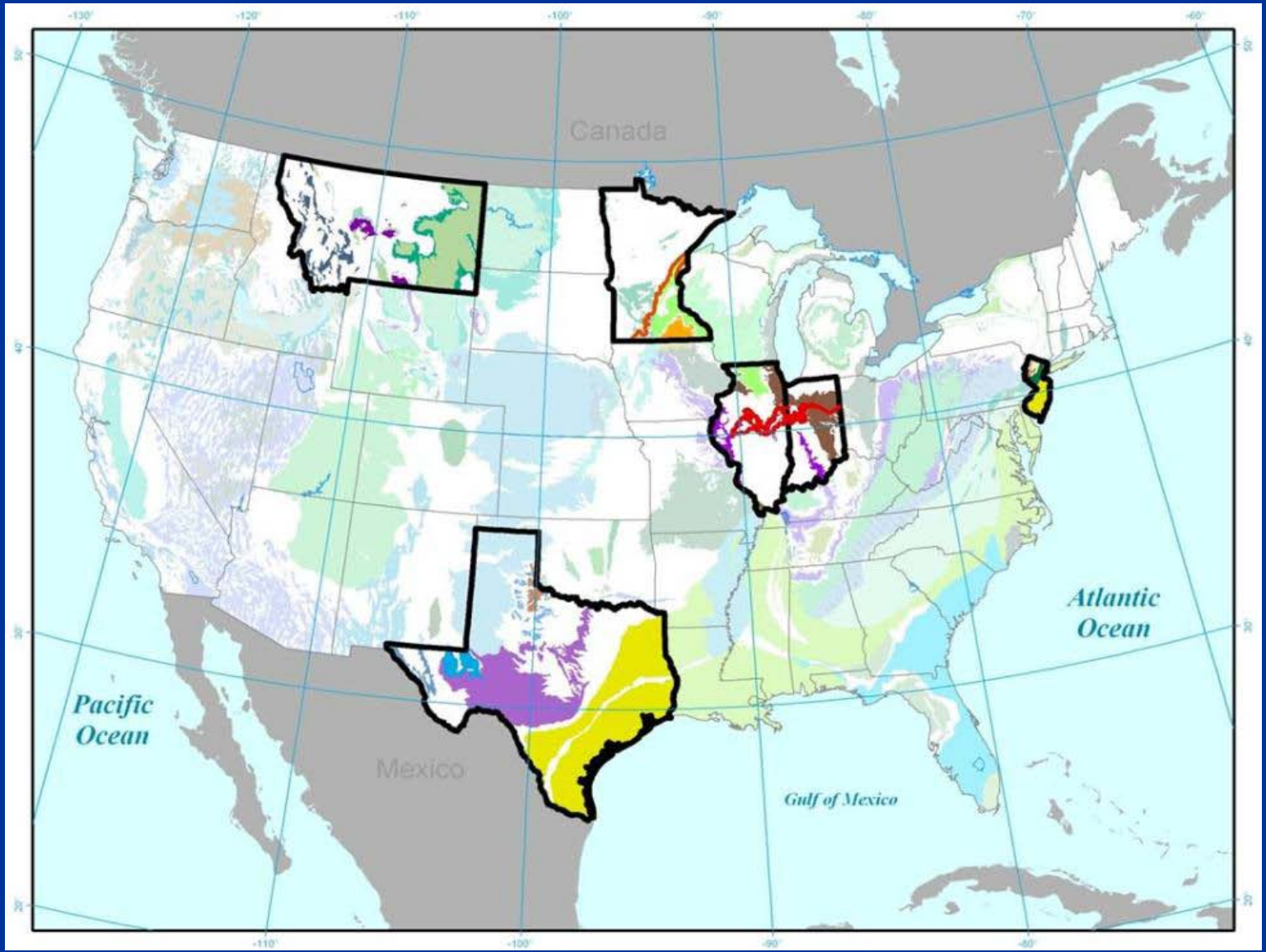
Results of the Illinois-Indiana Pilot Study for the National Ground Water Monitoring Network

Allen Wehrmann (ISWS), Jerry Unterreiner (InDNR), George Roadcap (ISWS), Jim Sullivan (InDEM), Rick Cobb (IEPA), Dave Larson (ISGS), Greg Rogers (ISWS), and Robert Schmidt (InDNR)



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Pilot Tasks

- Evaluate monitoring points within each important aquifer for potential inclusion in the NGWMN
- “Flag” all or a subset of proposed monitoring points as “stressed” or “unstressed”
- Identify data gaps
- Assess field practices against NGWMN criteria
- Assess data management practices and ability to interface with the NGWMN data portal
- Estimate costs

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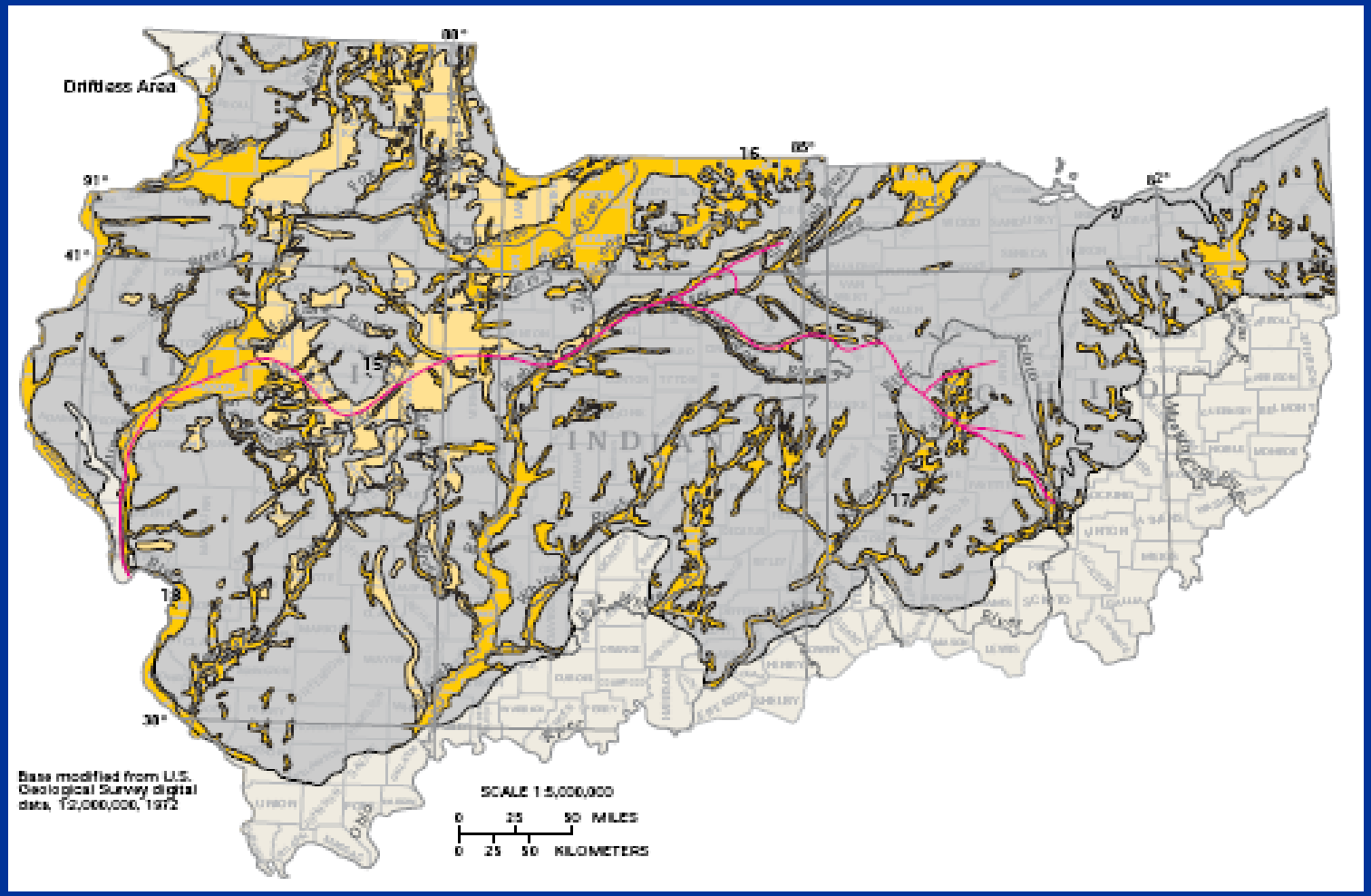
The Mahomet-Teays Bedrock Valley



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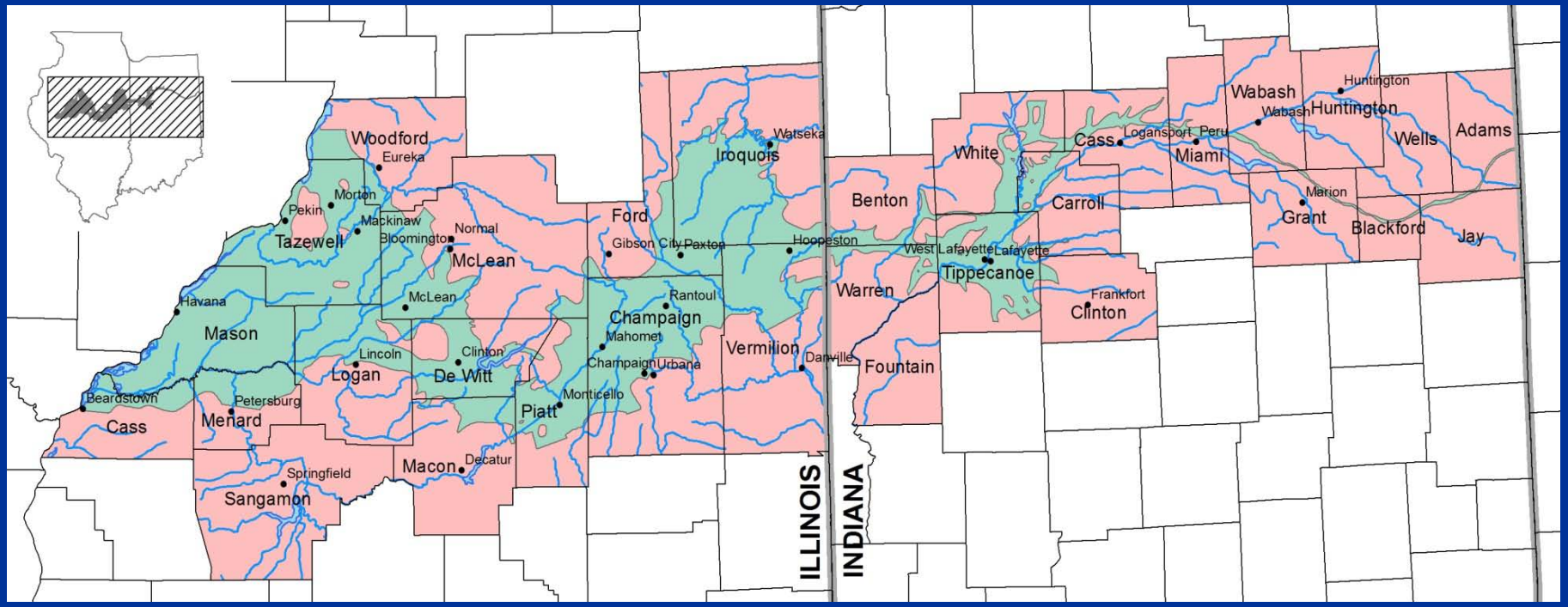
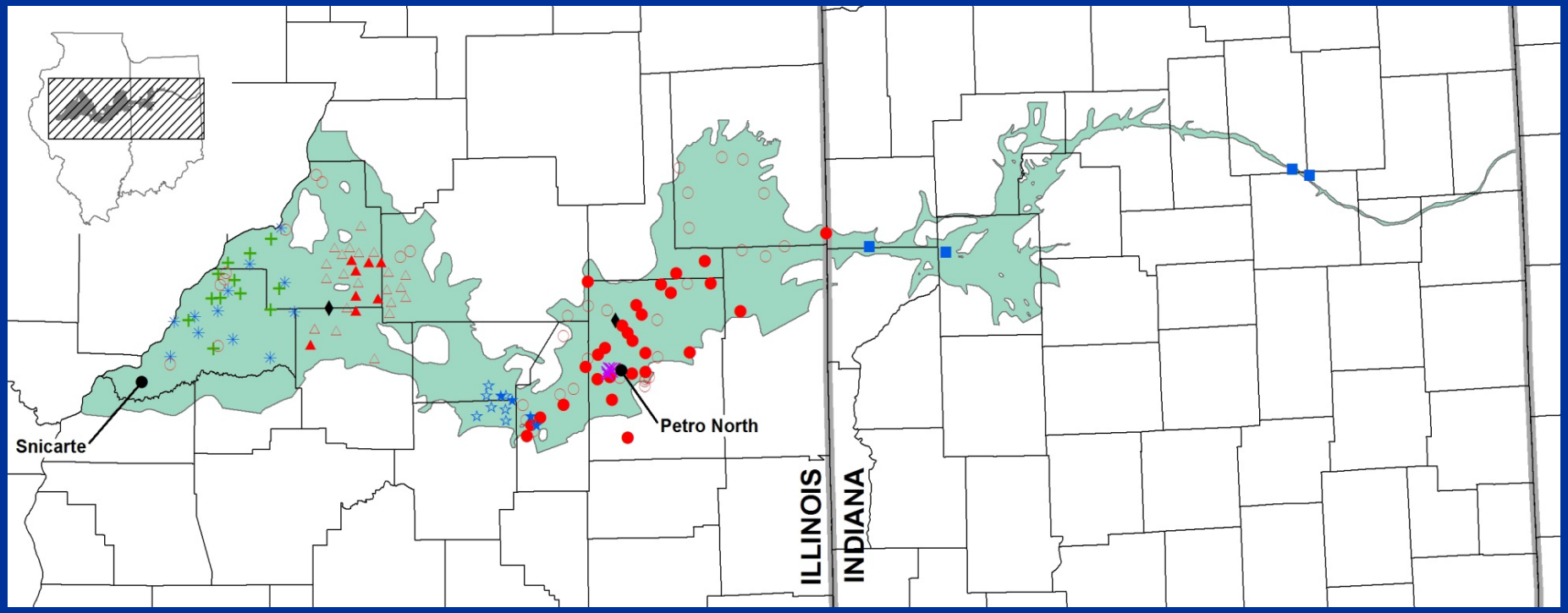
The Mahomet-Teays Aquifer
Illinois/Indiana Pilot



Existing Water Level Ob-Wells in Illinois and Indiana



Open symbols are individual wells; closed symbols are nested well sites

◆ **USGS Real-time Instrumentation of ISWS/ISGS Wells**

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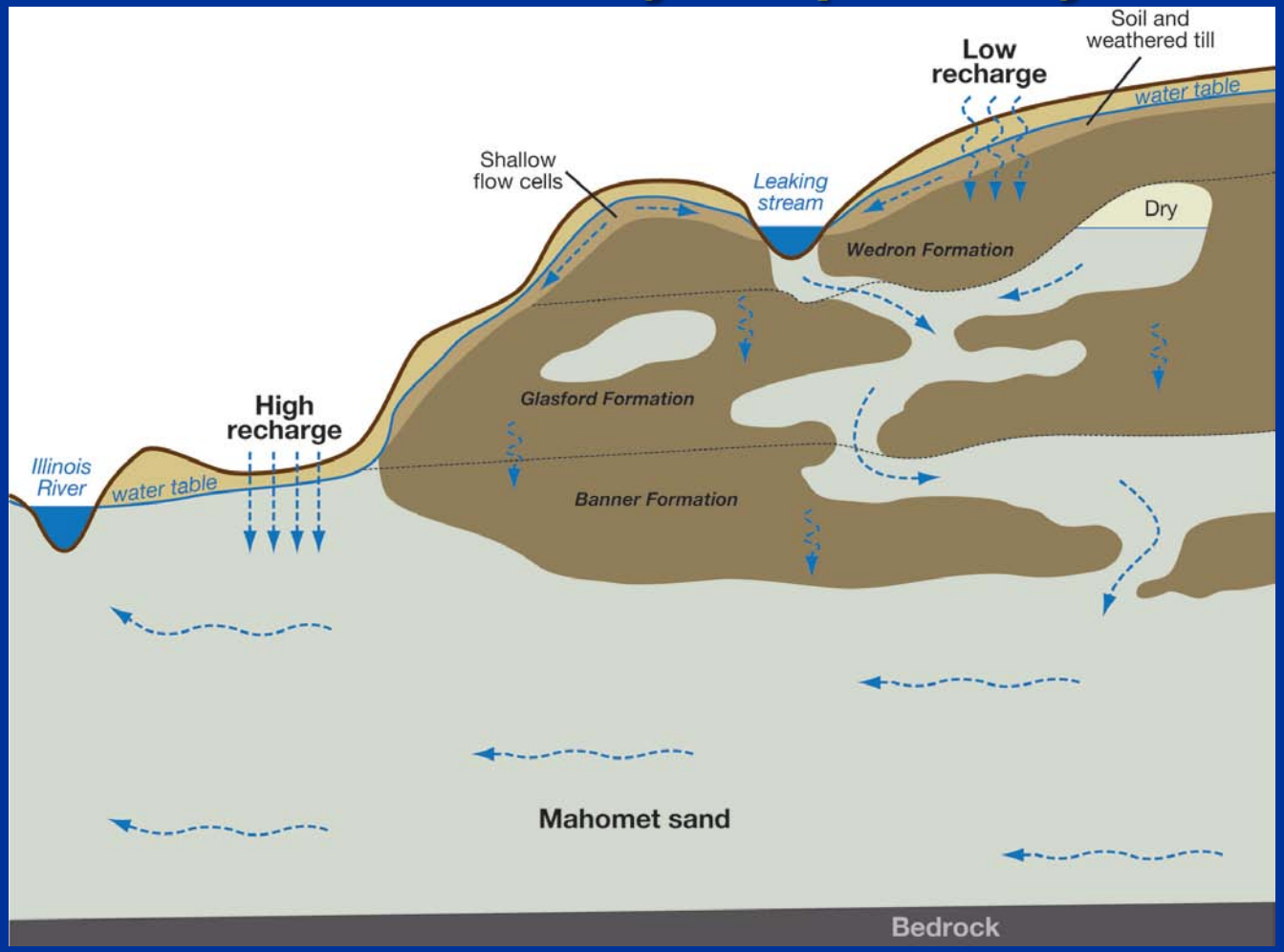
Conceptualizing Water Movement into and within the Mahomet-Teays Aquifer System



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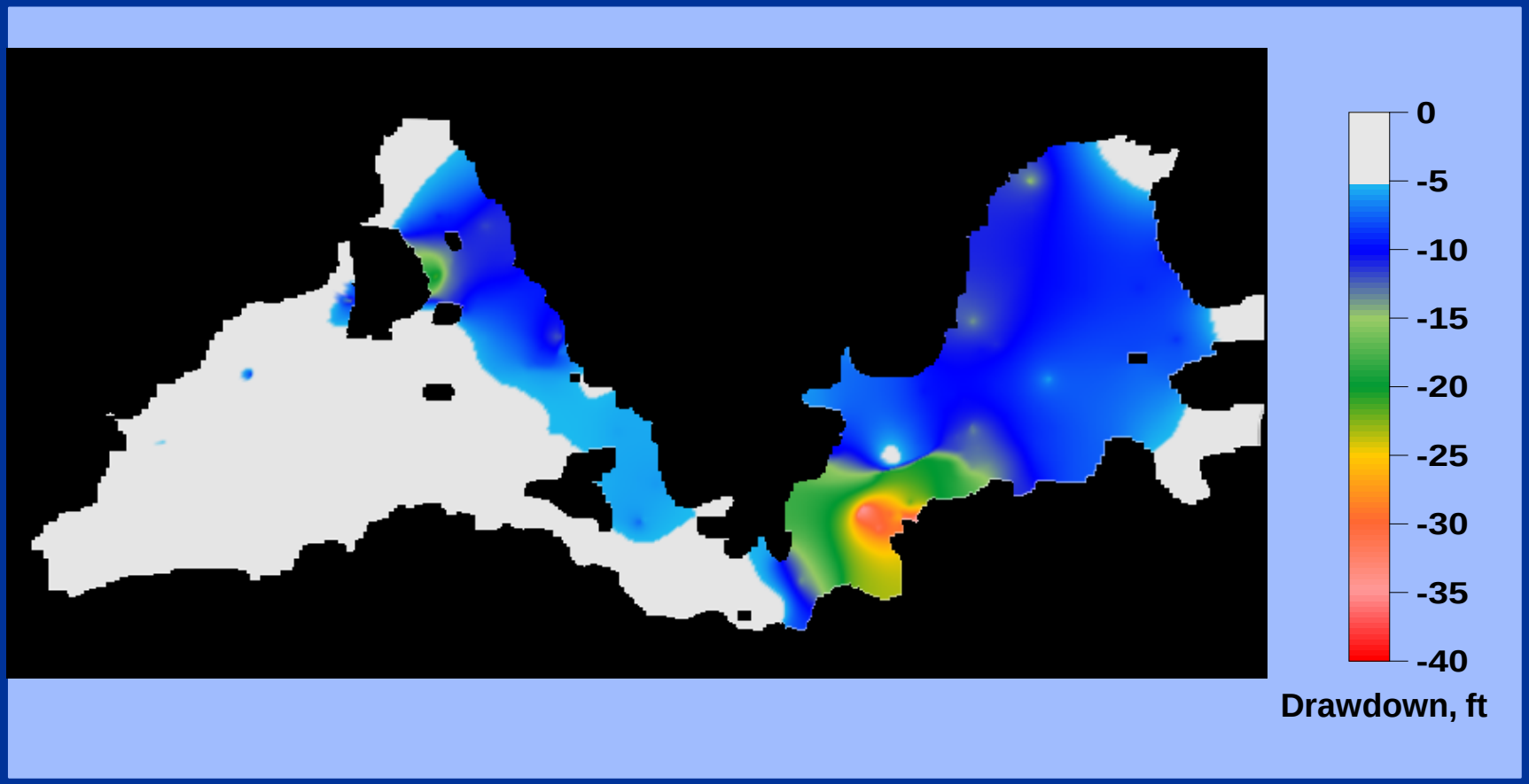
Simulated drawdown 2005 – 2050 across Illinois portion of the Mahomet-Teays Aquifer



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Well Selection Process for IL/IN

- Plot well hydrographs
- Assess hydrographs for:
  - Length of record
  - Similarities/differences among wells within locales
  - Exclude wells with odd behavior
  - Prefer wells exhibiting long-term trends or natural fluctuations
  - Include wells representative of SW/GW interaction
- Prefer wells with good logs & construction details
- Assess spatial distribution
- Classify as “unstressed” or “targeted” after selection

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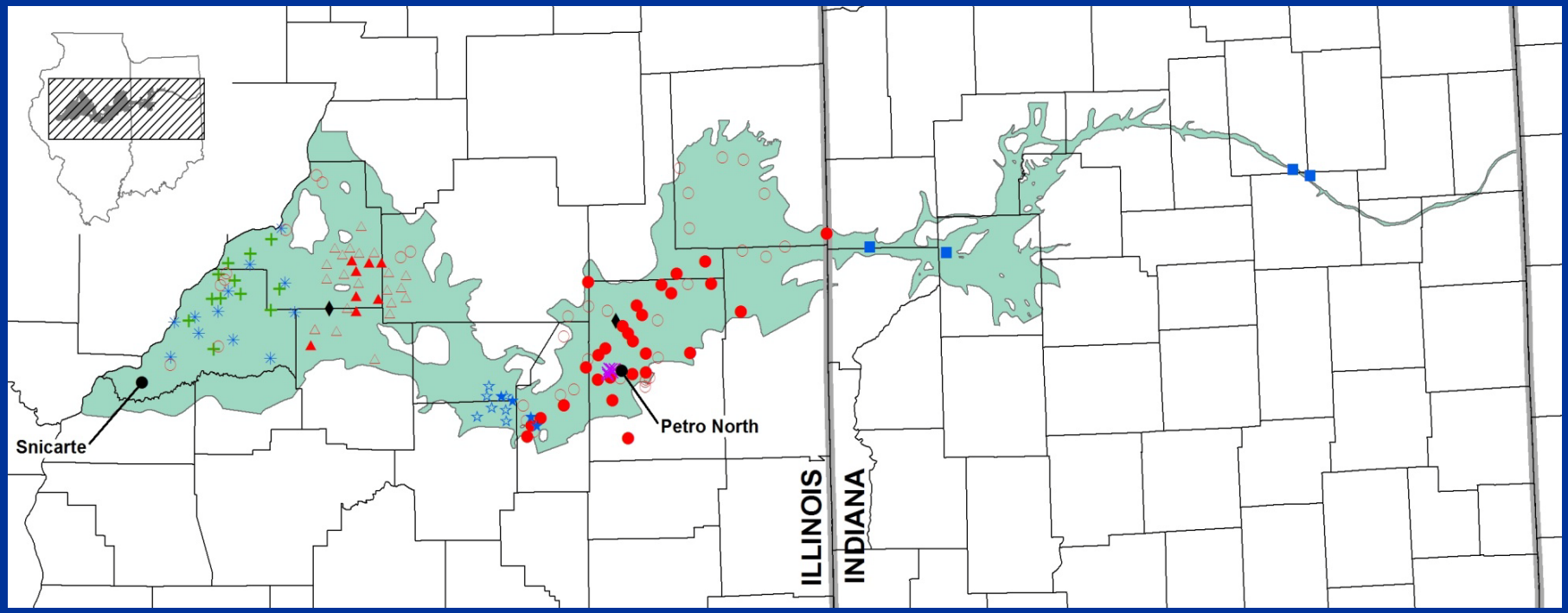
Existing Water Level Ob-Wells in Illinois and Indiana



Open symbols are individual wells; closed symbols are nested well sites

◆ **USGS Real-time Instrumentation of ISWS/ISGS Wells**

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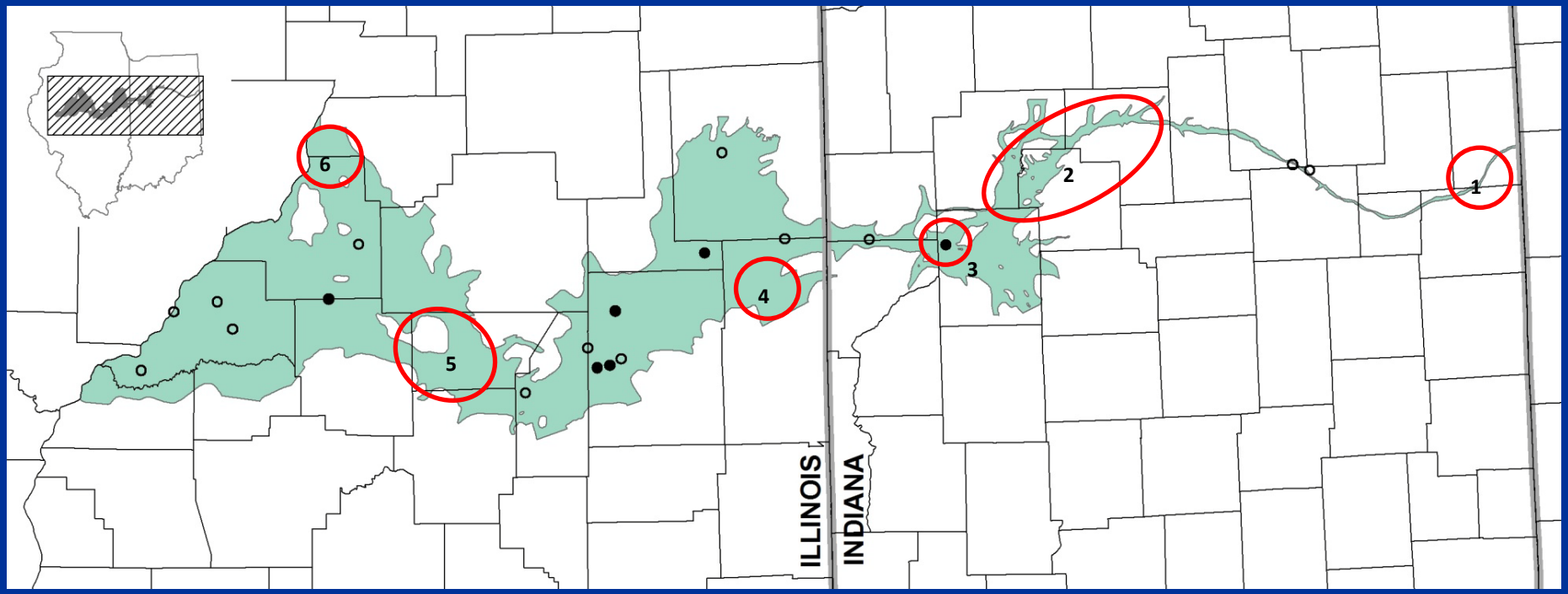
Spatial Data Gaps in the IL-IN Water-Level Subnetwork



Open symbols are individual wells; closed symbols are nested well sites

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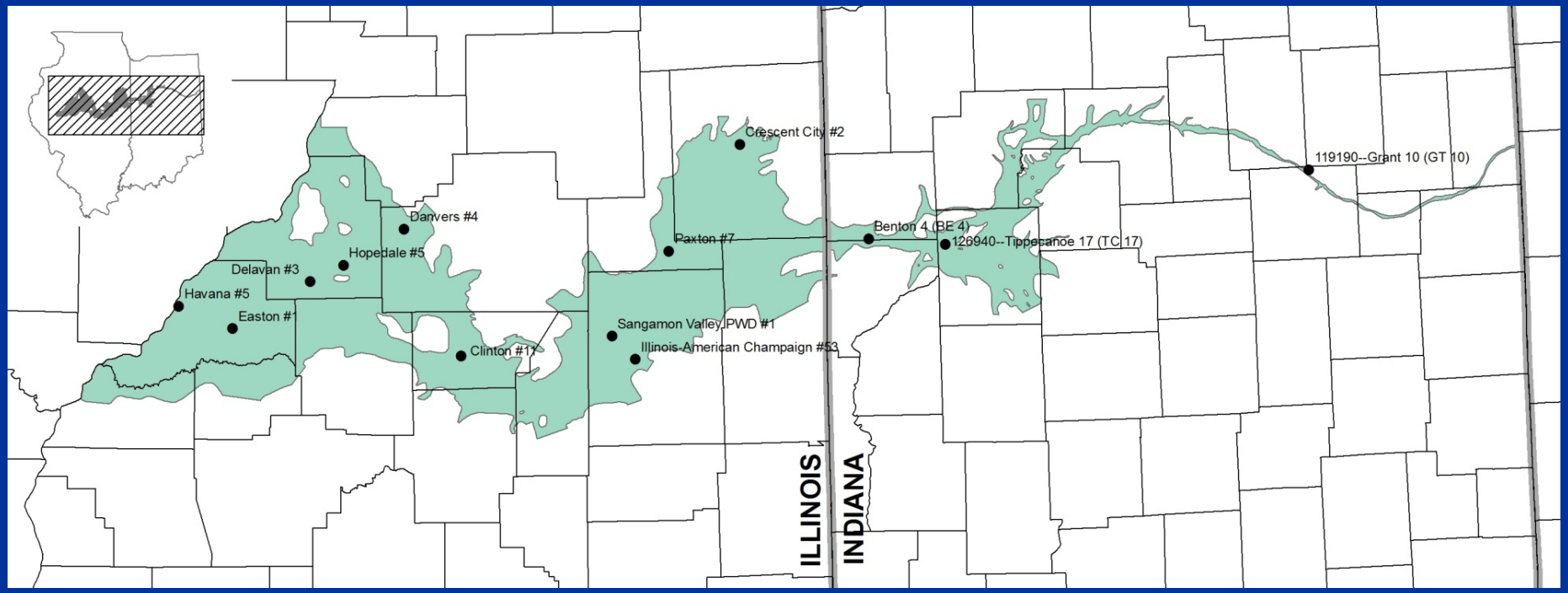
IL-IN Water-Quality Subnetwork



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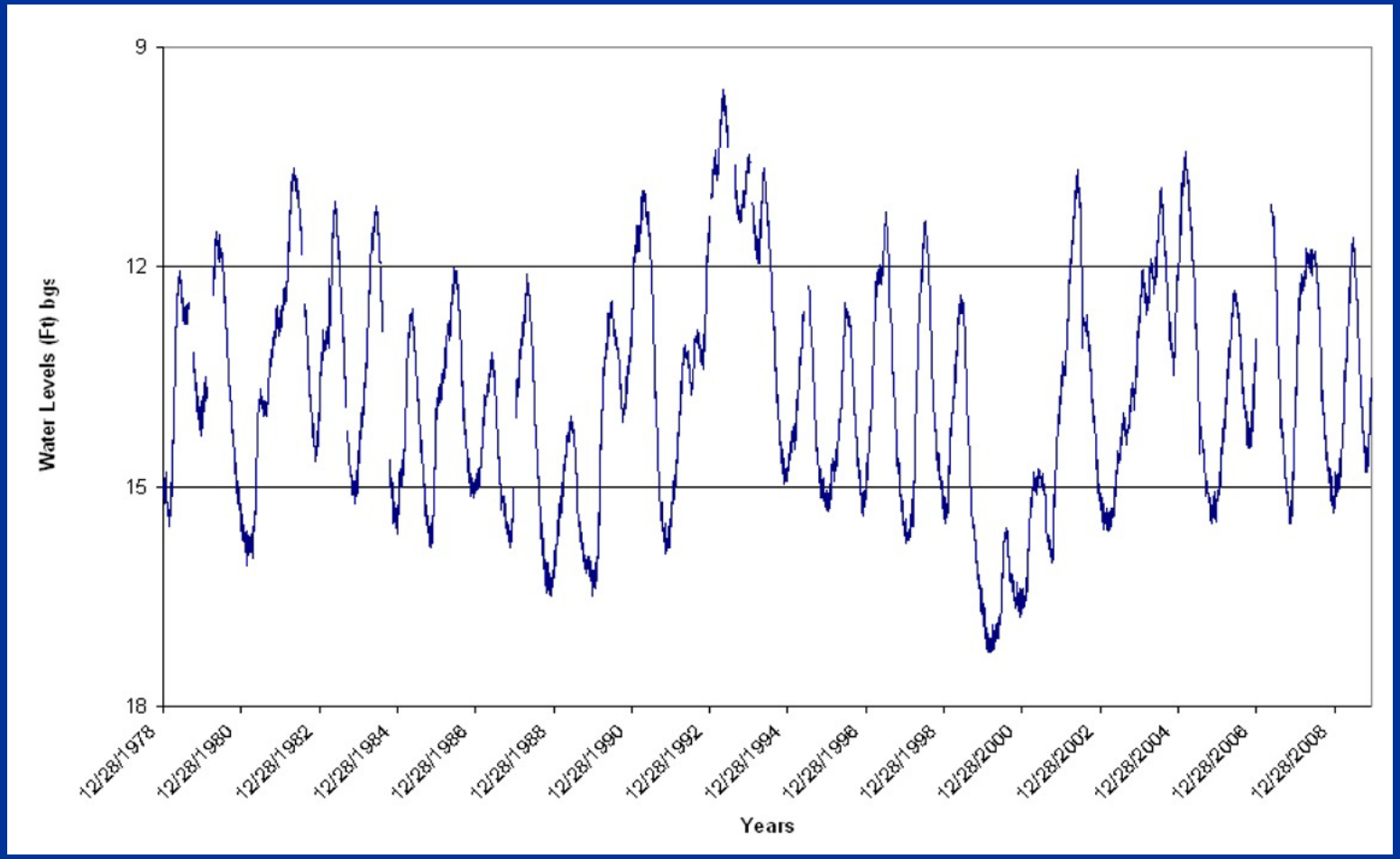
Benton 4 (IN) Hydrograph

Unstressed Aquifer 1



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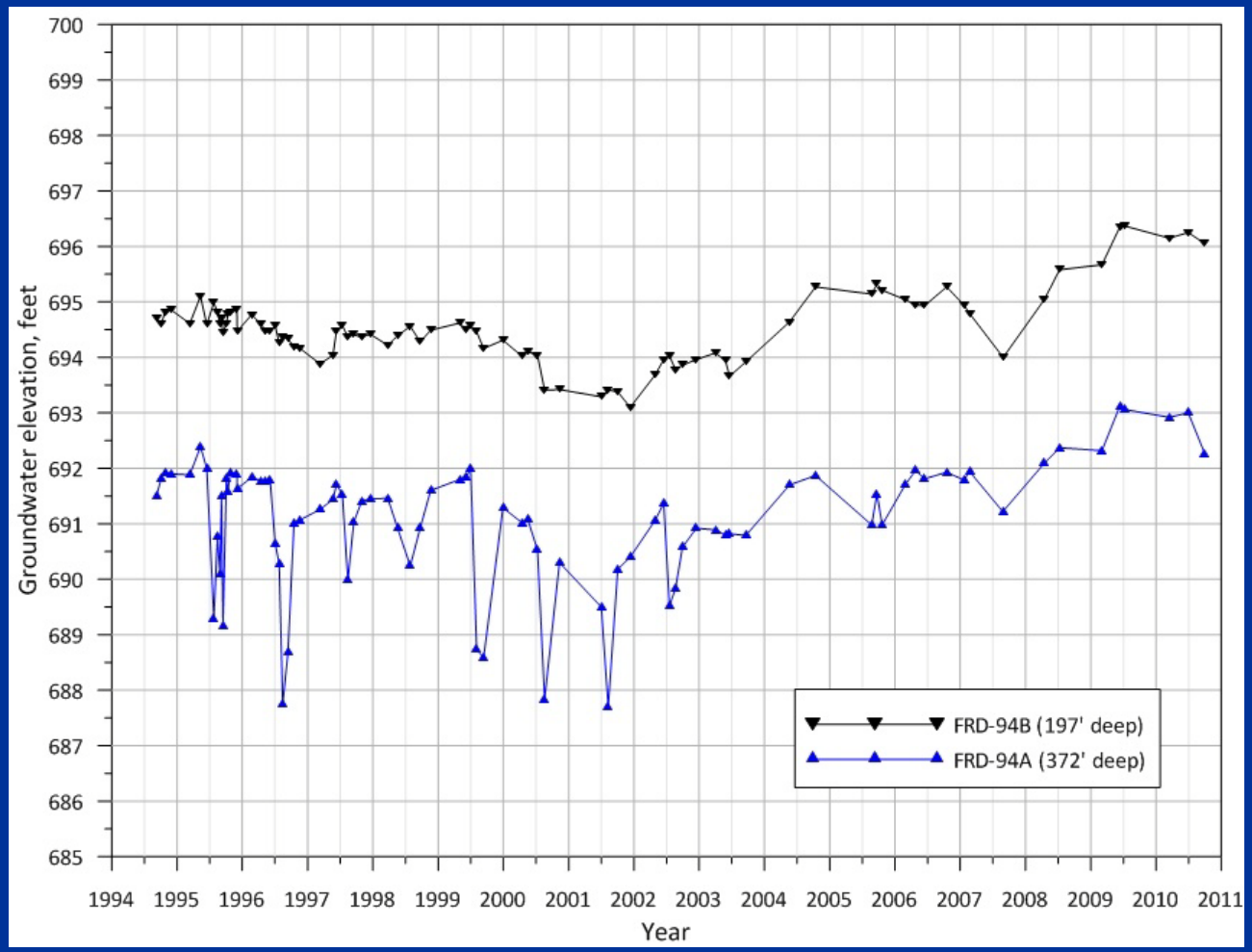
FRD-94 (IL) Hydrographs

Unstressed Aquifer 1 and Aquifer 2



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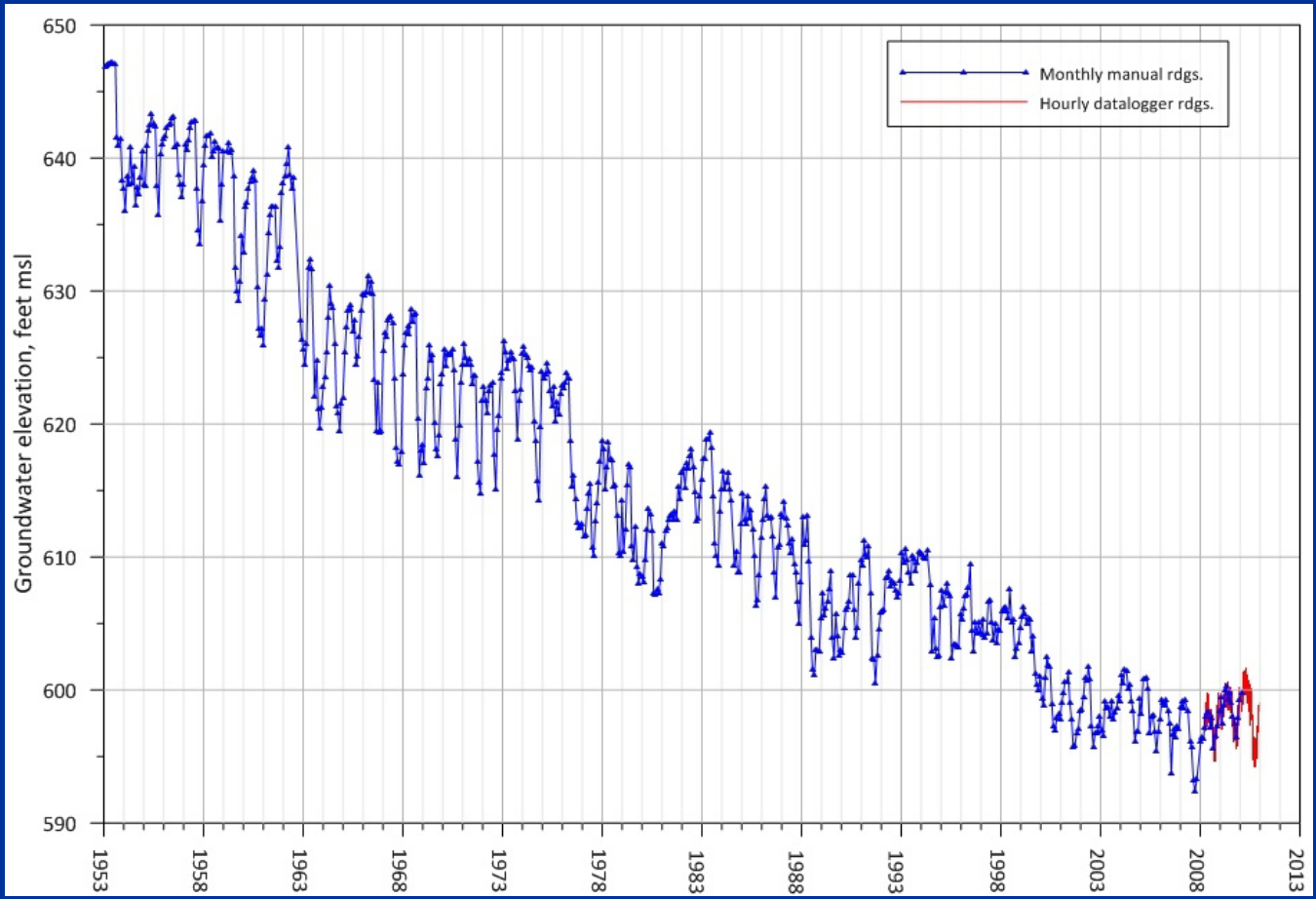
Petro North (IL) Hydrograph

Targeted Aquifer 1



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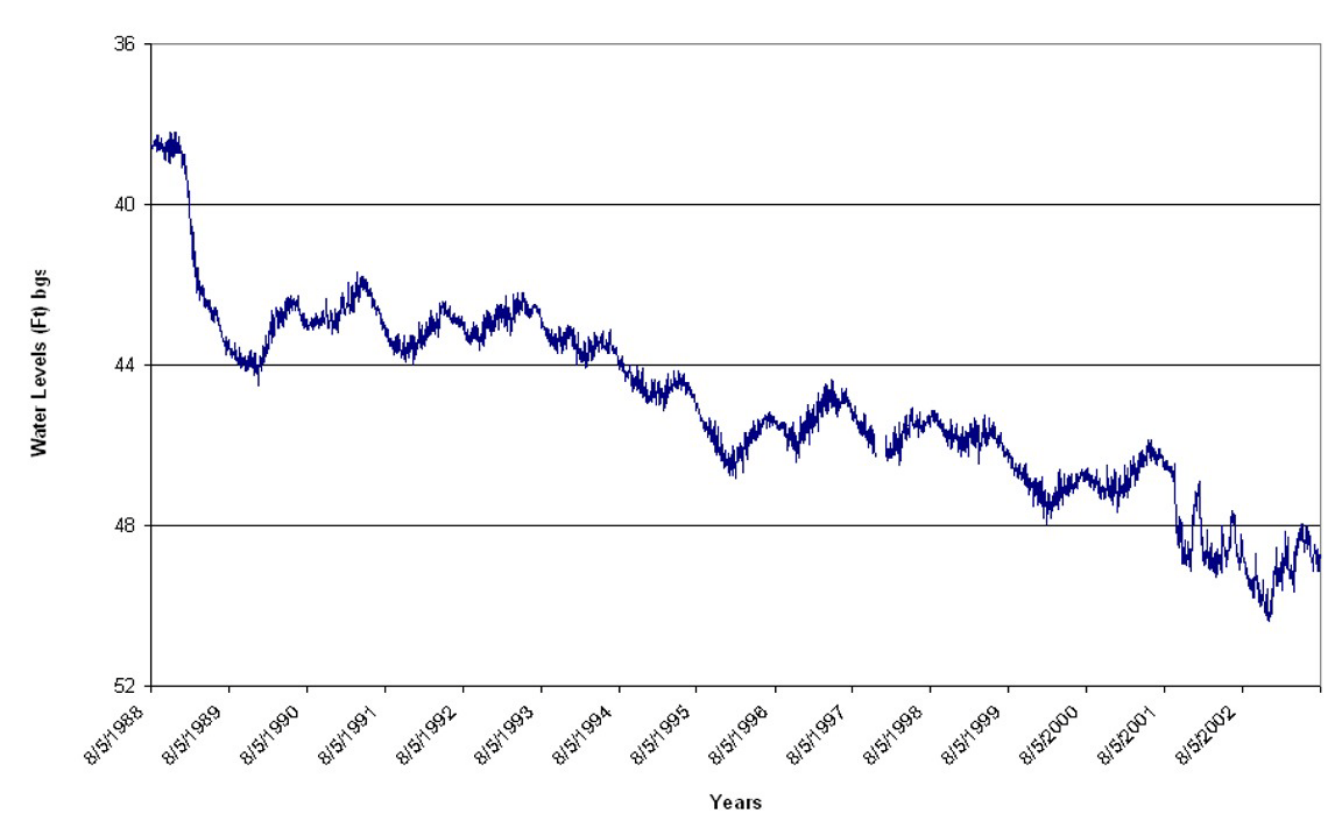
Wabash 4 (IN) Hydrograph

Targeted Aquifer 1



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Benefits

- Interstate communication – “crossing the state line”
  - Aquifer does not recognize political boundaries
  - Different importance to each state (i.e., size, yield)
  - Understanding, & possible management, of the aquifer needs to transcend political boundaries
- Interagency communication – “crossing agency boundaries”
  - Data sharing and collection coordination across agencies (states)
  - Data “wealth” and local knowledge can be shared nationally
- Critical review of methods & data management
- Public education (also, a certain “pride” factor in being part of the NGWMN)

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Web Data Portal

National Ground Water Monitoring Network

Nate Booth
Center for Integrated Data Analytics
U.S. Geological Survey

USGS

Web Data Portal

Goal

A web-accessible data portal to automatically relay National GW Monitoring Network groundwater levels, groundwater-quality data and associated metadata from distributed state databases through a map-based interface.

USGS

Web Data Portal

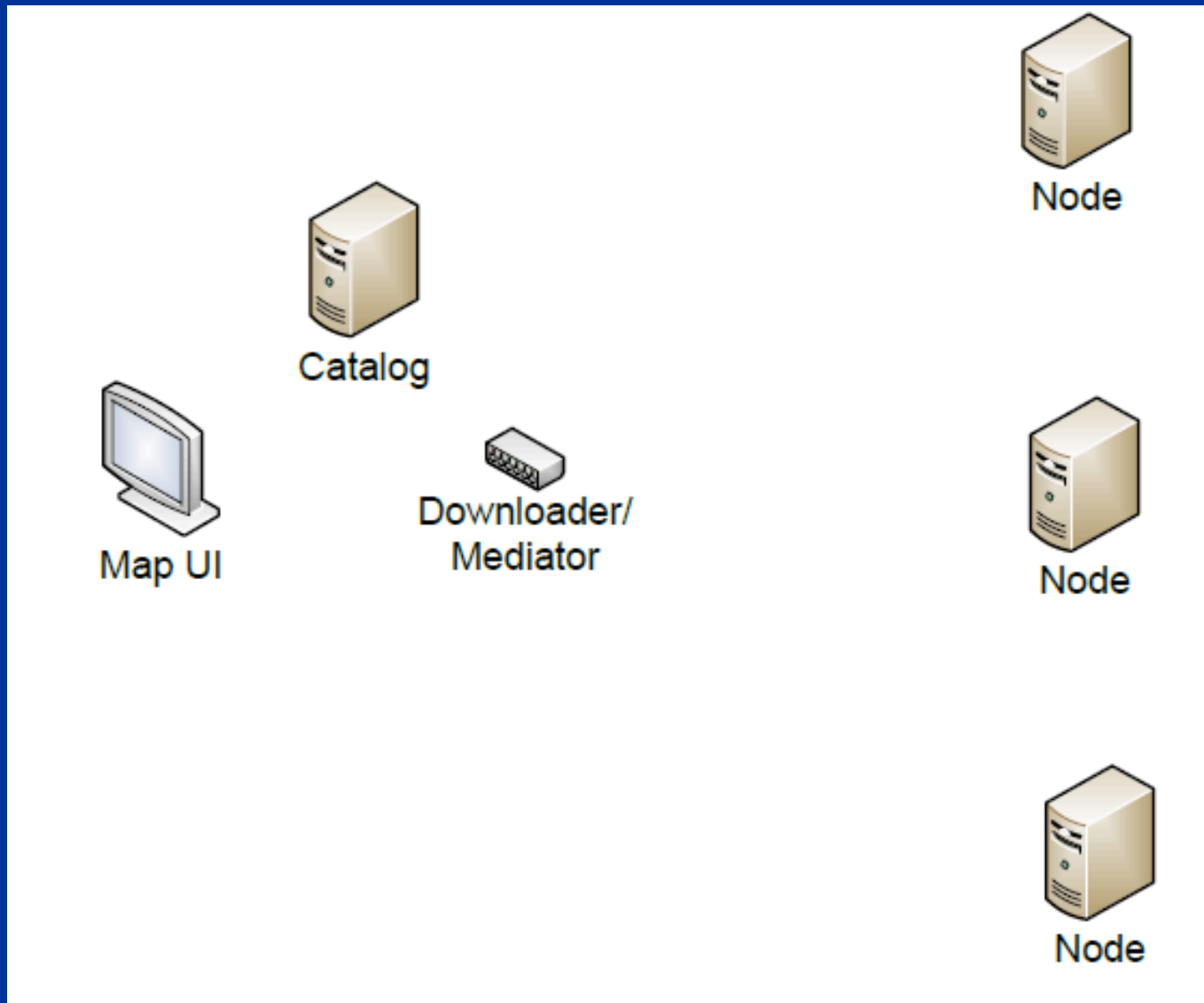
Pilot Portal Capabilities

- NGWMN well registry
- Translates heterogeneous state data formats to common standard formats
- Display real-time or nearly real-time data
  - Well characteristics (lithology, construction, aquifer)
  - Water levels
  - Water-quality
- Acceptable data download performance
- Map-based interface

USGS

Web Data Portal

Architecture



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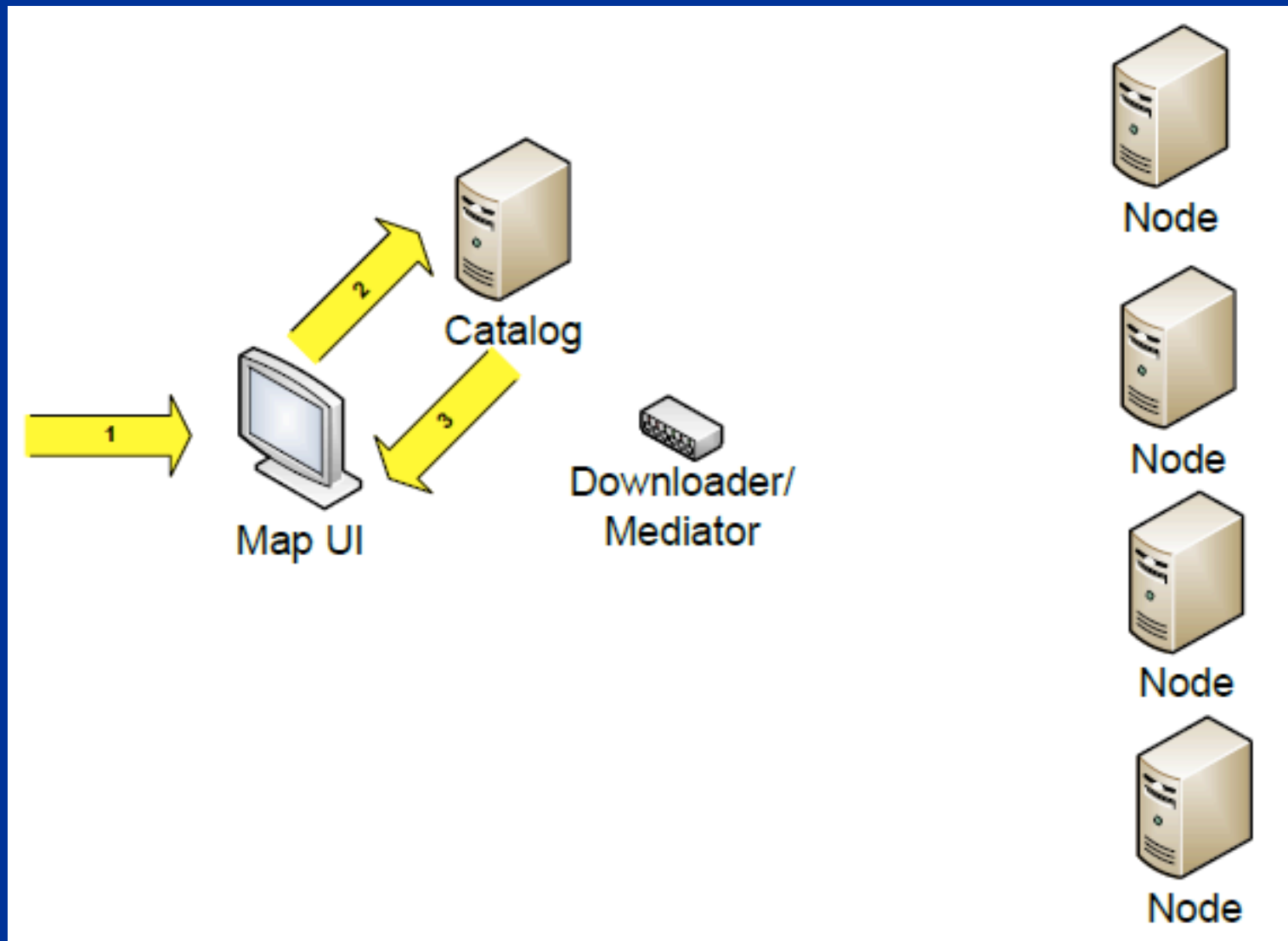
Web Data Portal

View maps and select wells



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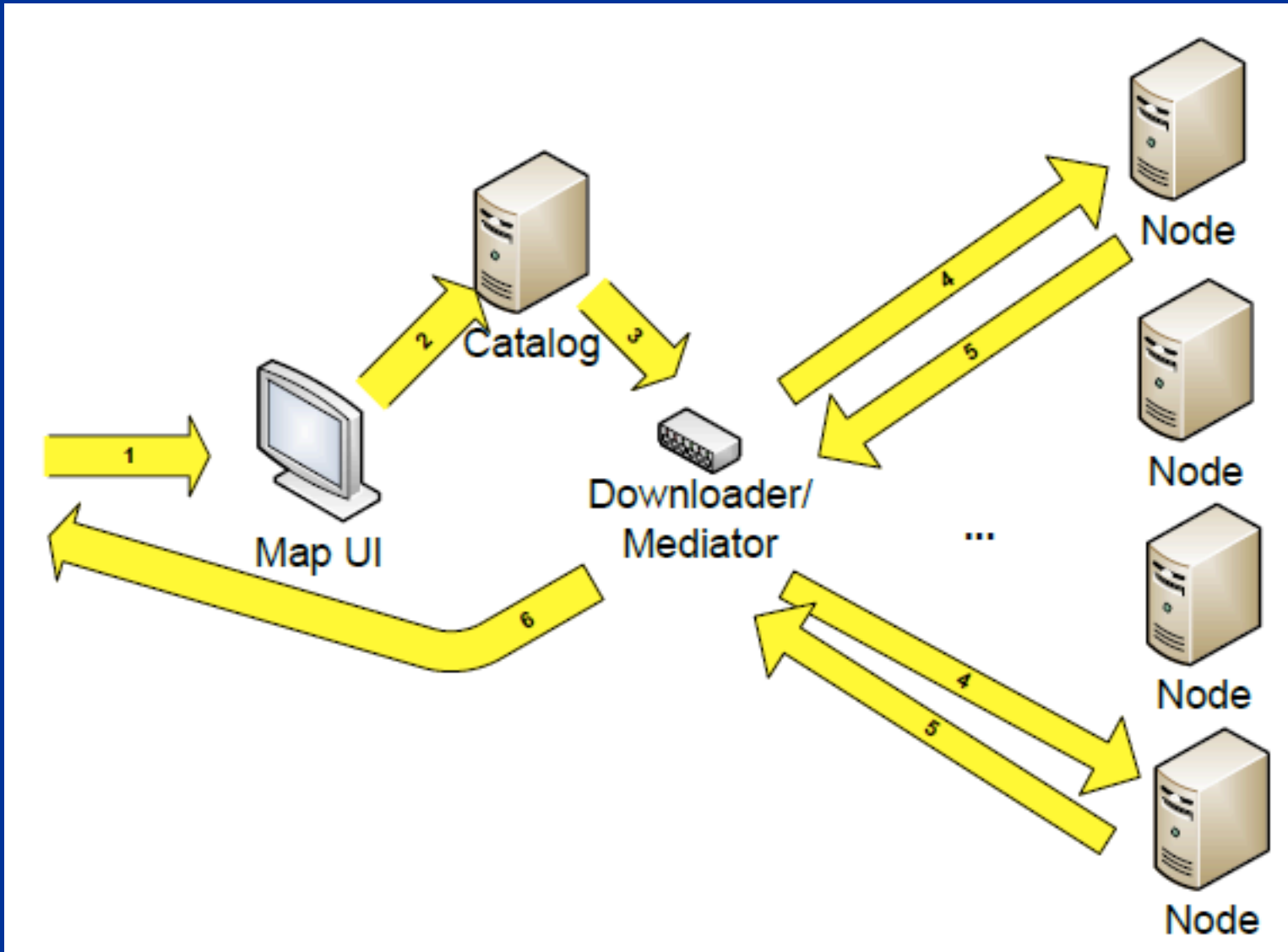
Web Data Portal

Assemble and mediate data



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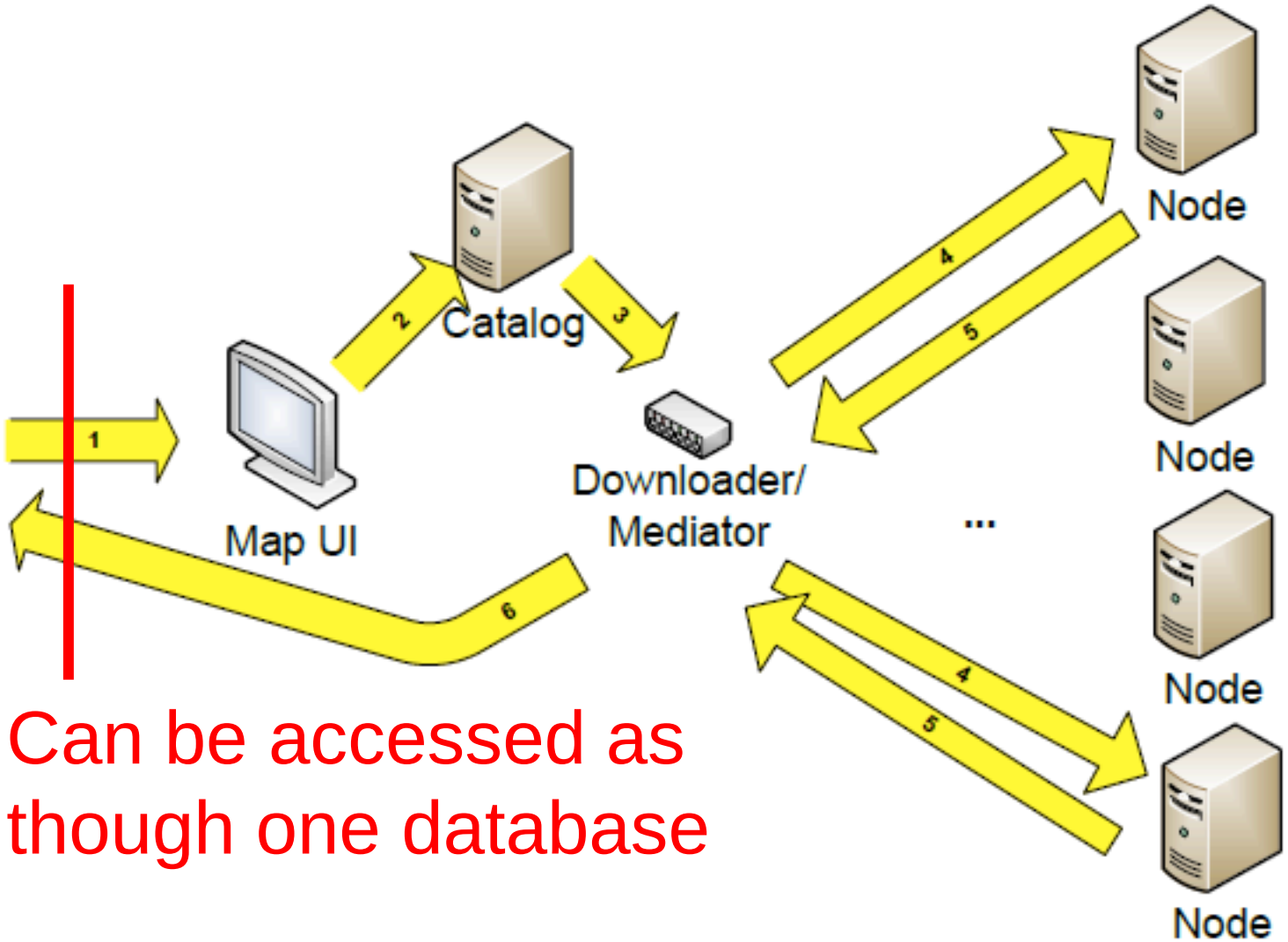
Web Data Portal

Repurposing portal services



Can be accessed as though one database

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OGC®

Jointly with World Meteorological Organization

Jump | Search

HydrologyDWG

Log In or Register

HydrologyDWG Web

Edit | Attach

You are here: OGC Public TWiki > HydrologyDWG Web > WebHome

r26 - 21 Oct 2010 - 23:34:58 -

"Welcome to the Hydrology Domain Working Group"

Work Plan

Evolving WaterML into an International Standard

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE WORLD METEOROLOGICAL ORGANIZATION
AND
THE OPEN GEOSPATIAL CONSORTIUM, INC.

November 2009

Meets every 3 months

Teleconferences most weeks

- Toulouse OGC TC Meeting - 22 September 2010
- Toulouse Hydrology DWG Workshop - 21-22 September 2010 - Agenda
- Sydney Hydrology DWG Meeting - 1 December 2010

WaterML Version 2 standard being proposed

Interoperability Experiments

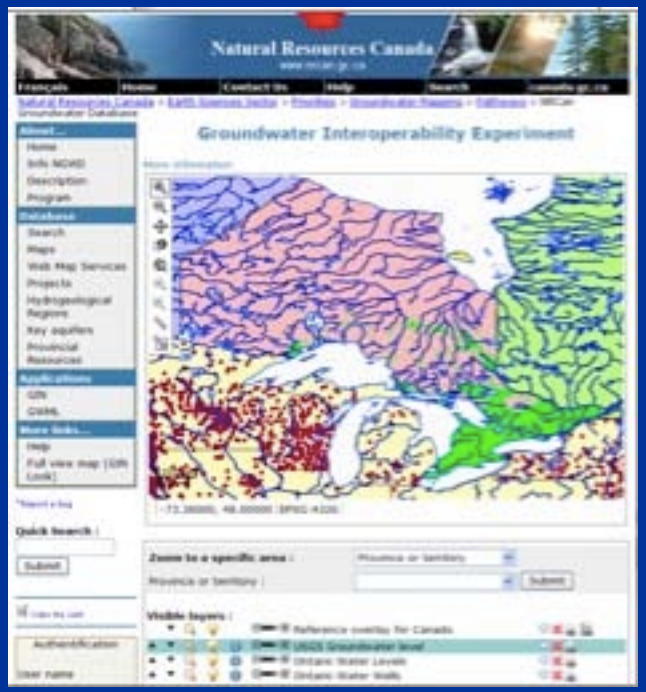
- GroundwaterInteroperabilityExperiment
- SurfacewaterInteroperabilityExperiment

Documents from Members

Helping the World to Communicate Geographically

US / Canadian Groundwater Data Exchange Experiment

- Test and enhance OGC standards for water observations
- Exchange groundwater well characteristics and water levels with Canada
- Start with Lake Superior Basin



USGS science for a changing world

Natural Resources Canada

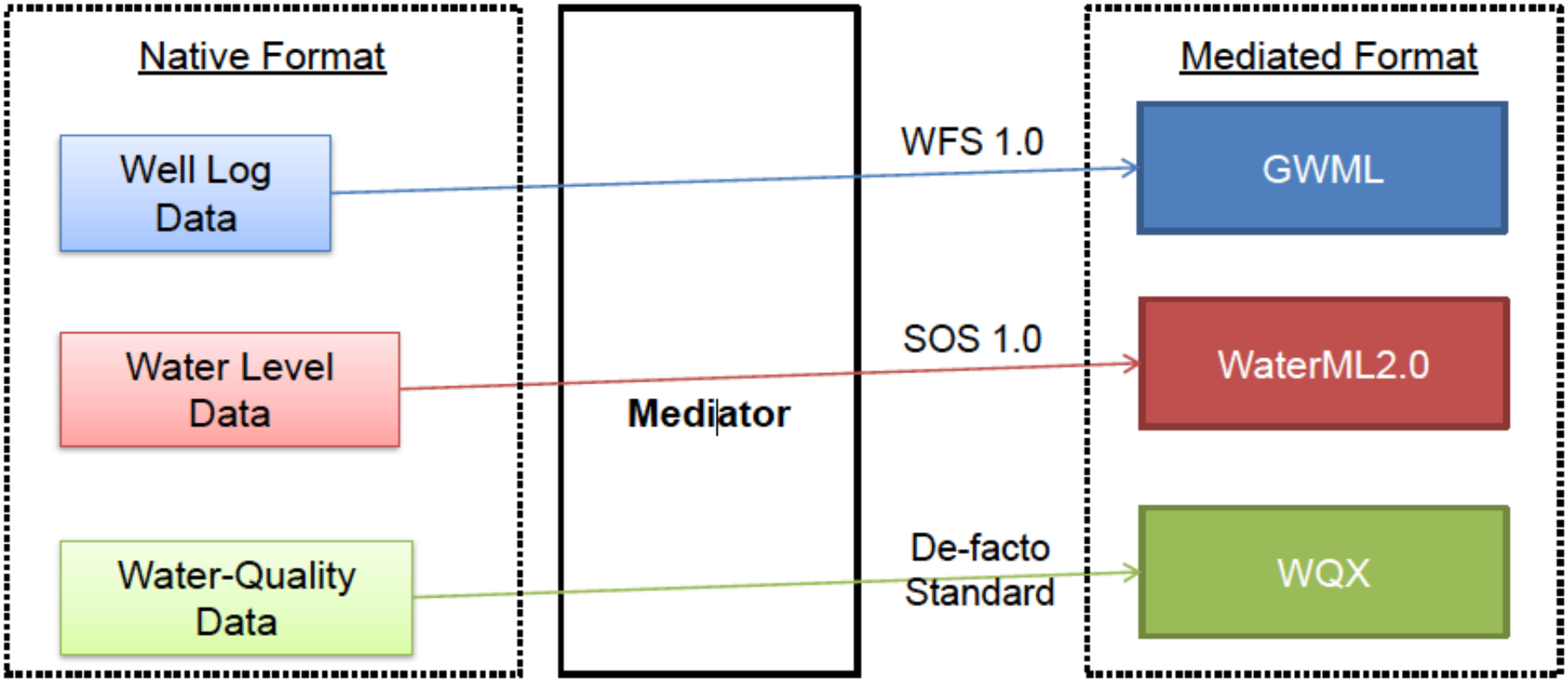
CSIRO

CUAHSI HIS Sharing hydrologic data

OGC® Open Geospatial Consortium, Inc.

Web Data Portal

Architecture



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Web Data Portal

Pilot Results

- 5 Pilots provided data (from 6 states)
- 9 Agencies provided data
- 17 Web Services created to serve data

State	Water Levels	Well Log Information				Water Quality
		General	Construction		Lithology	
			Casing	Screen		
IL	Import/WFS	NA	Import/WFS		Import/WFS	Import/WFS
IN	NWIS	NWIS				NWIS
MT	WFS	NA	WFS	WFS	WFS	NA
MN	WFS	WFS			NA	STORET
NJ	NWIS	NWIS				NWIS
TX	SOAP	SOAP	SOAP	NA	NA	NA

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Web Data Portal

Benefits of approach

- Common, inexpensive and well-supported software components for data providers
- Leverage other activities (OGC, NR Canada's Groundwater Information Network)
- Data providers can re-purpose services for other applications
- Flexibility for data providers to store and serve data in local formats

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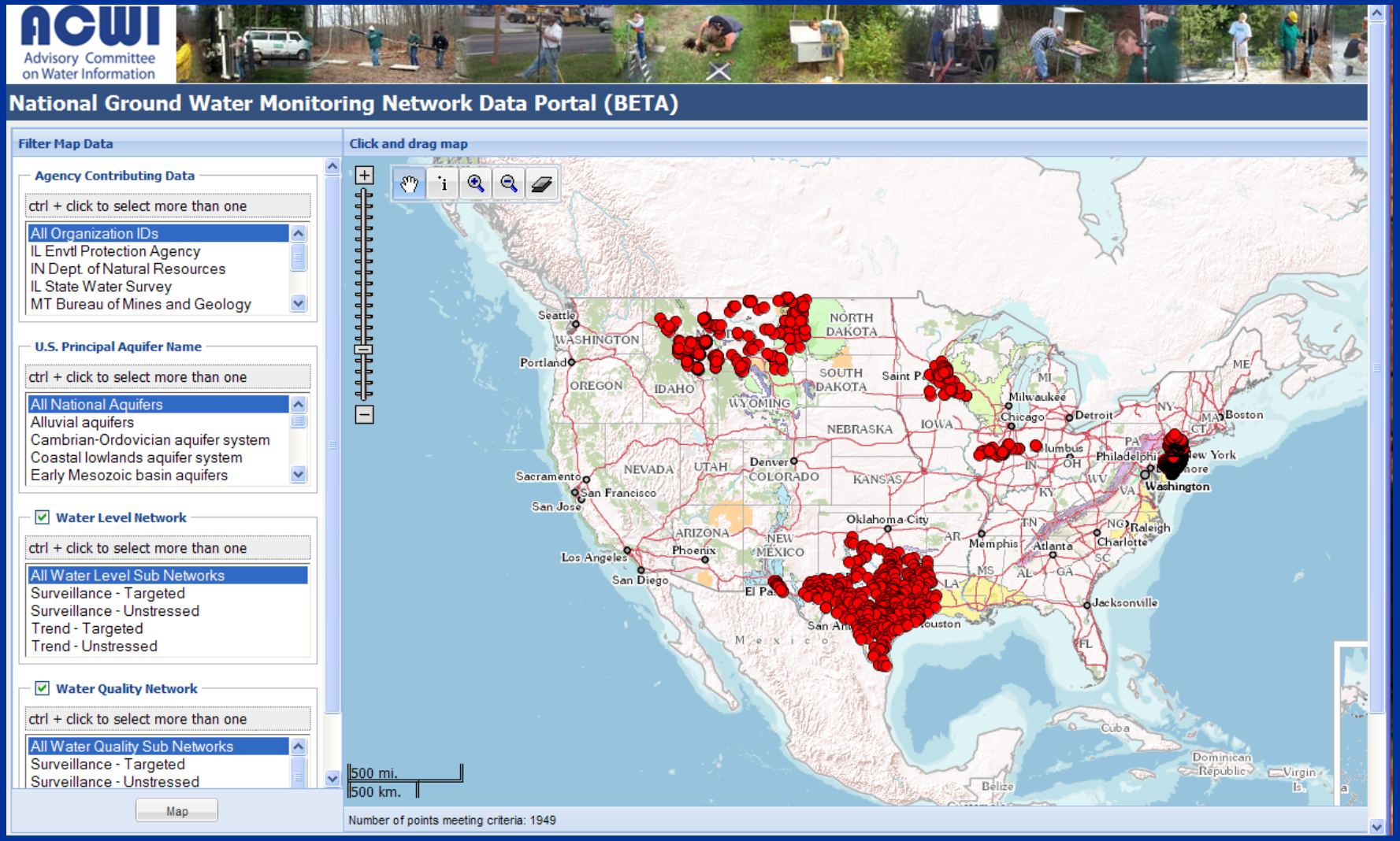
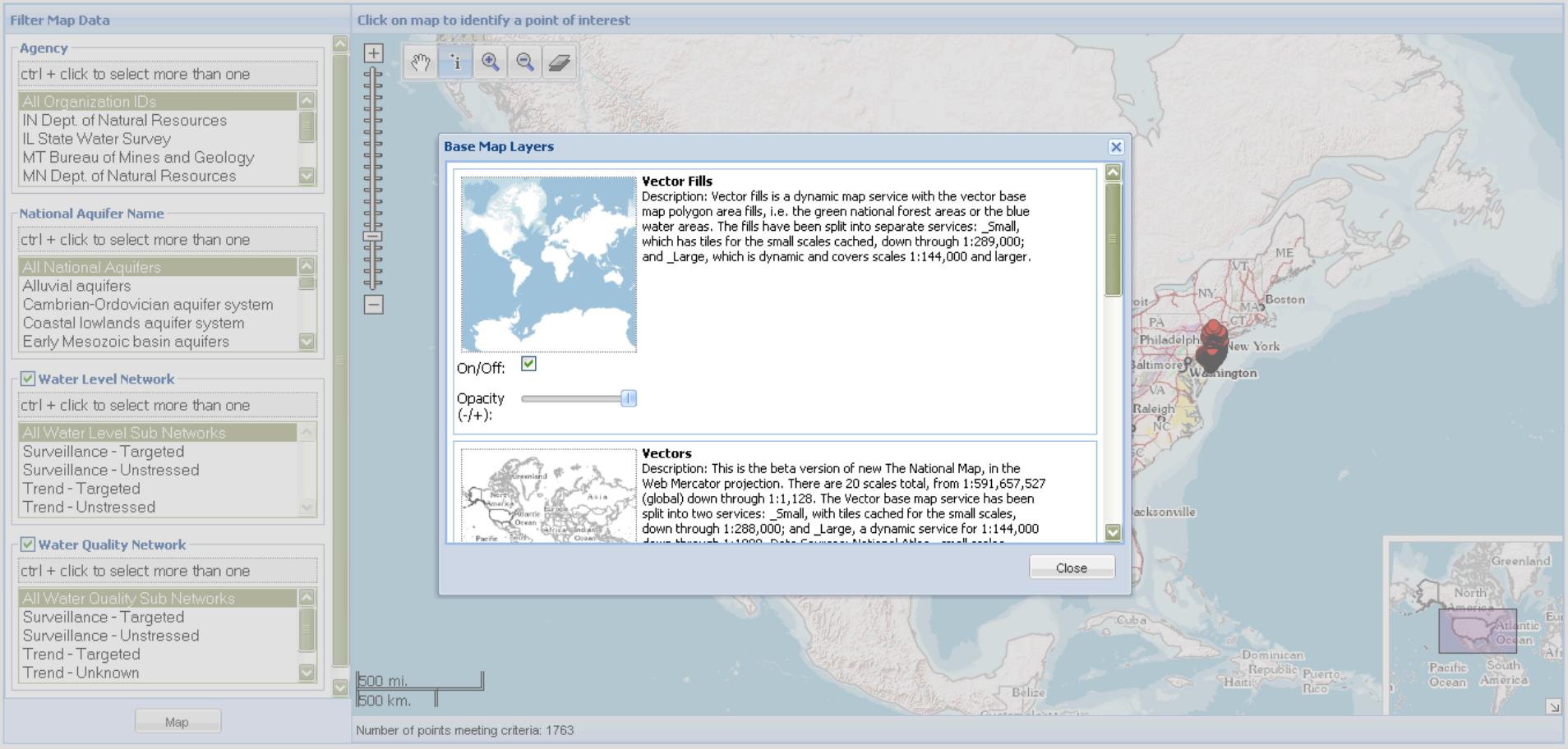
Web Data Portal Final Product

Ground-Water Data Portal Pilot States



Ground-Water Data Portal

Base Layers



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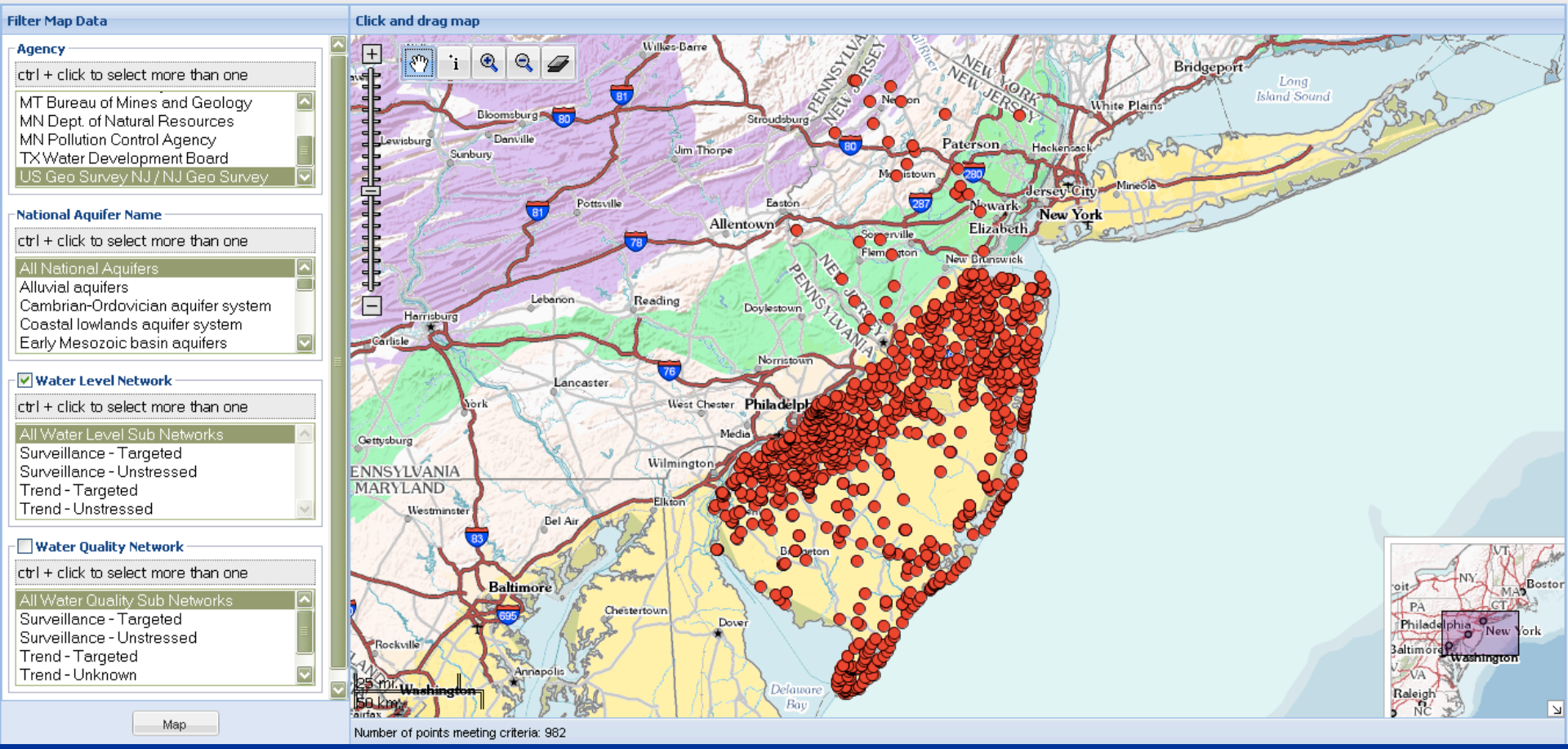
Ground-Water Data Portal

New Jersey Example



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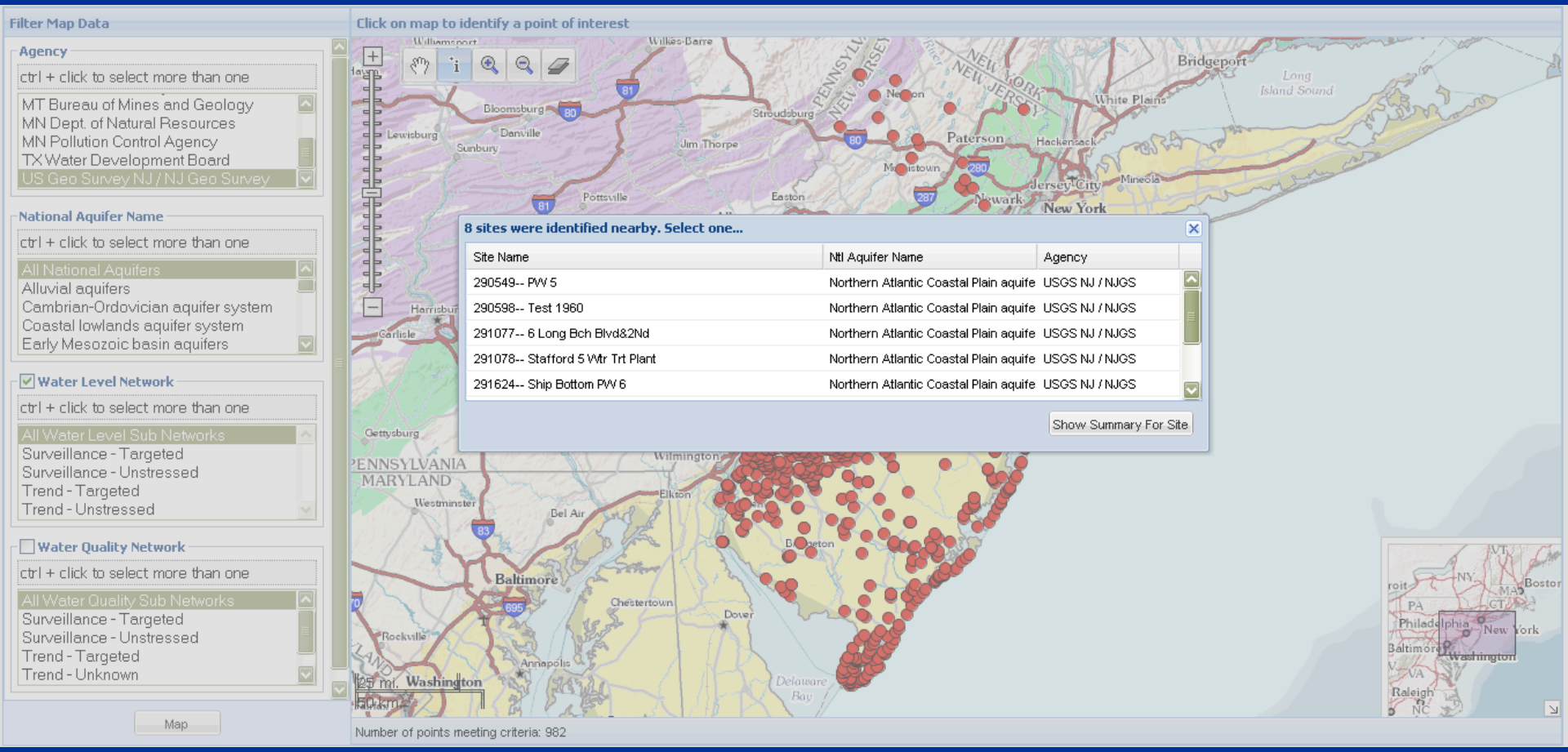
Well Selection



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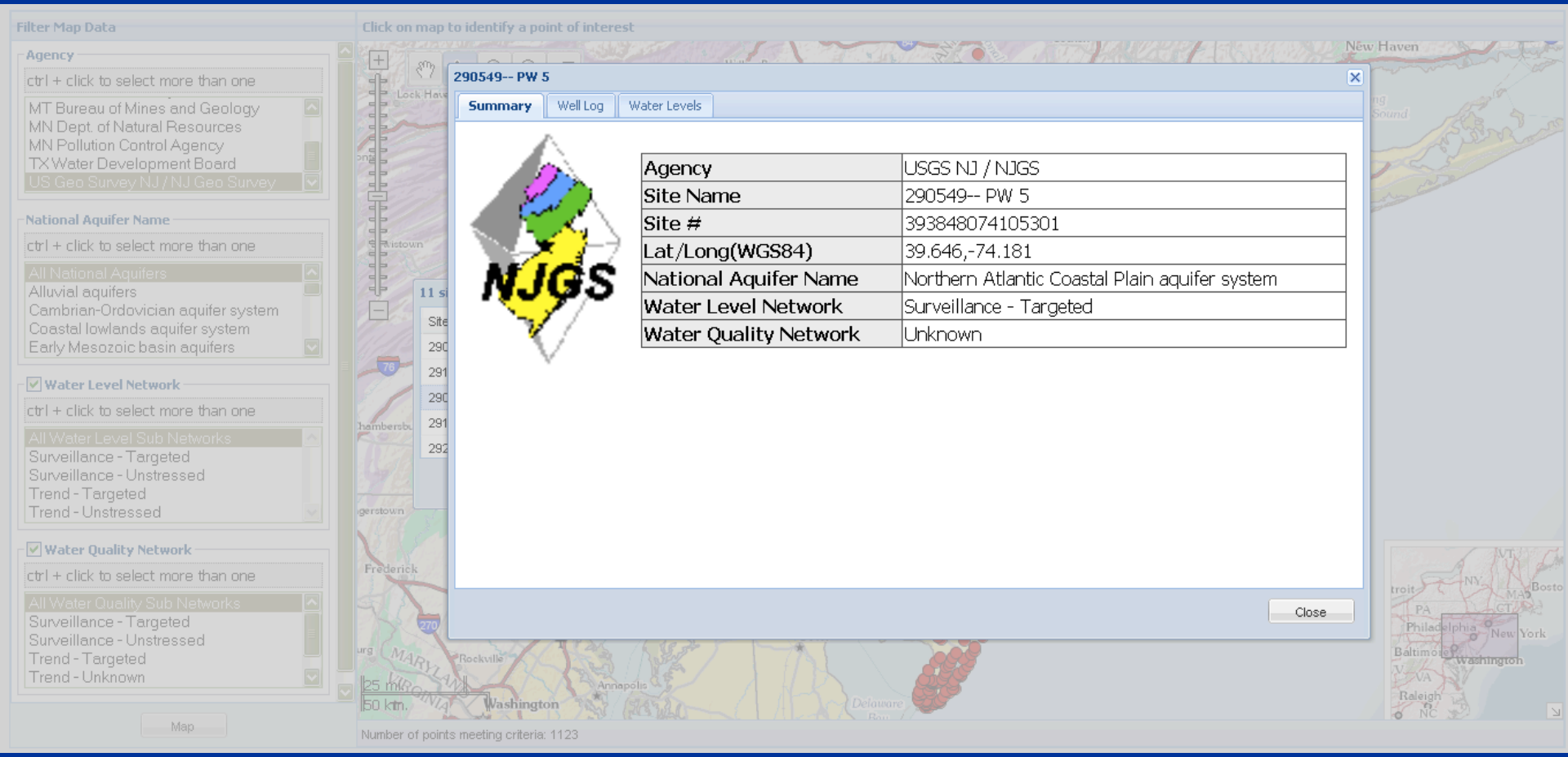
Ground-Water Data Portal

Summary Well Info



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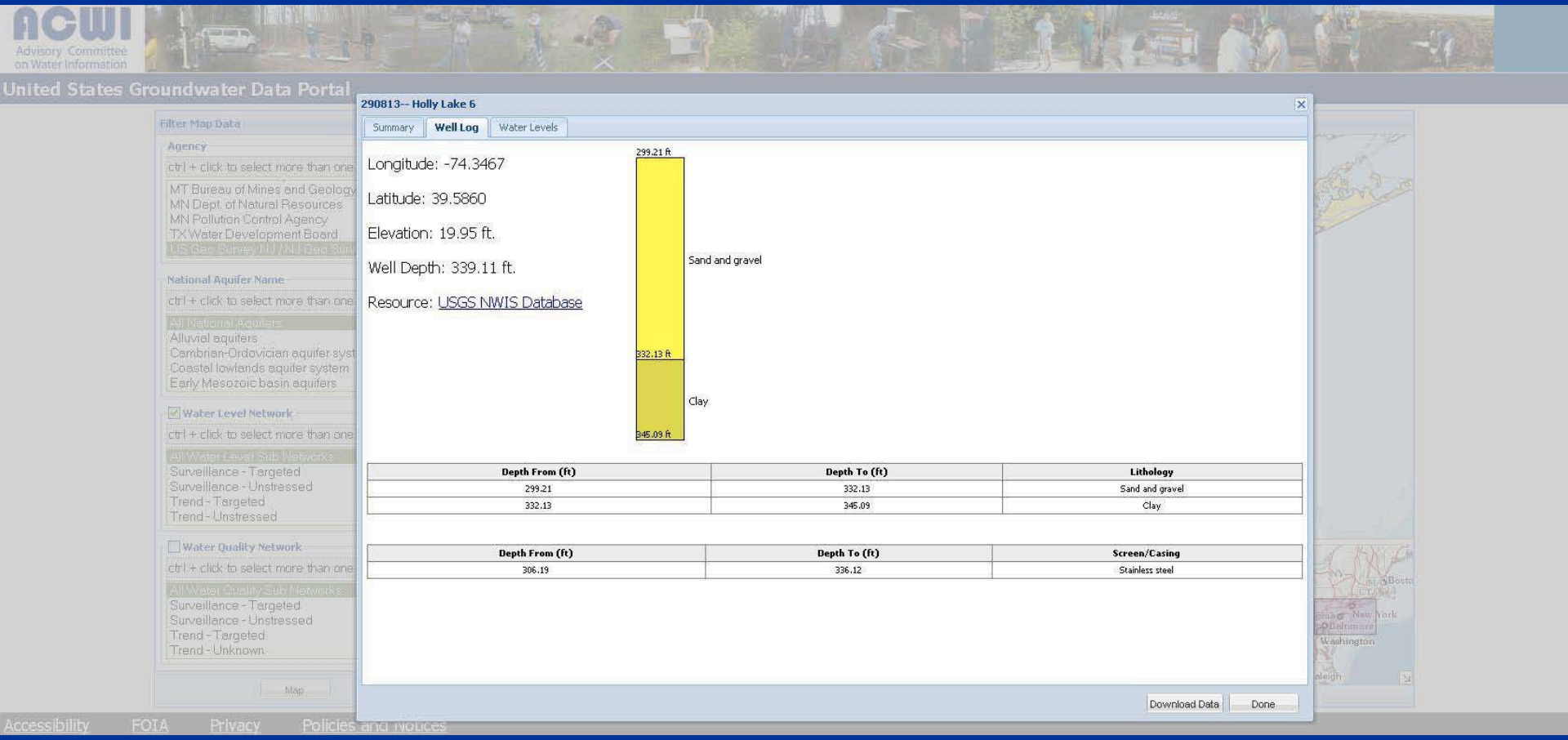
Lithology



Depth From (ft)	Depth To (ft)	Lithology
299.21	332.13	Sand and gravel
332.13	345.09	Clay

Depth From (ft)	Depth To (ft)	Screen/Casing
306.19	336.12	Stainless steel

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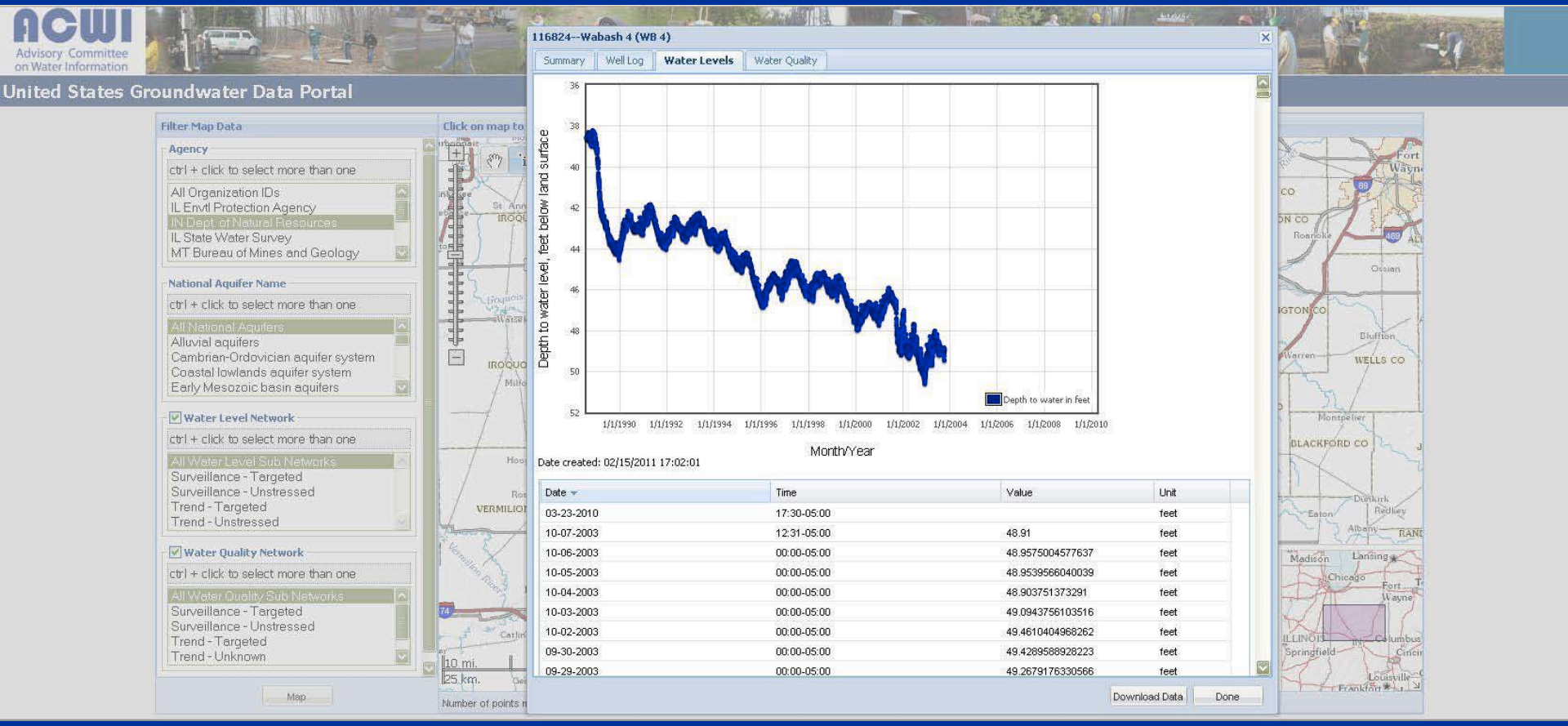
Ground-Water Data Portal

Water Levels



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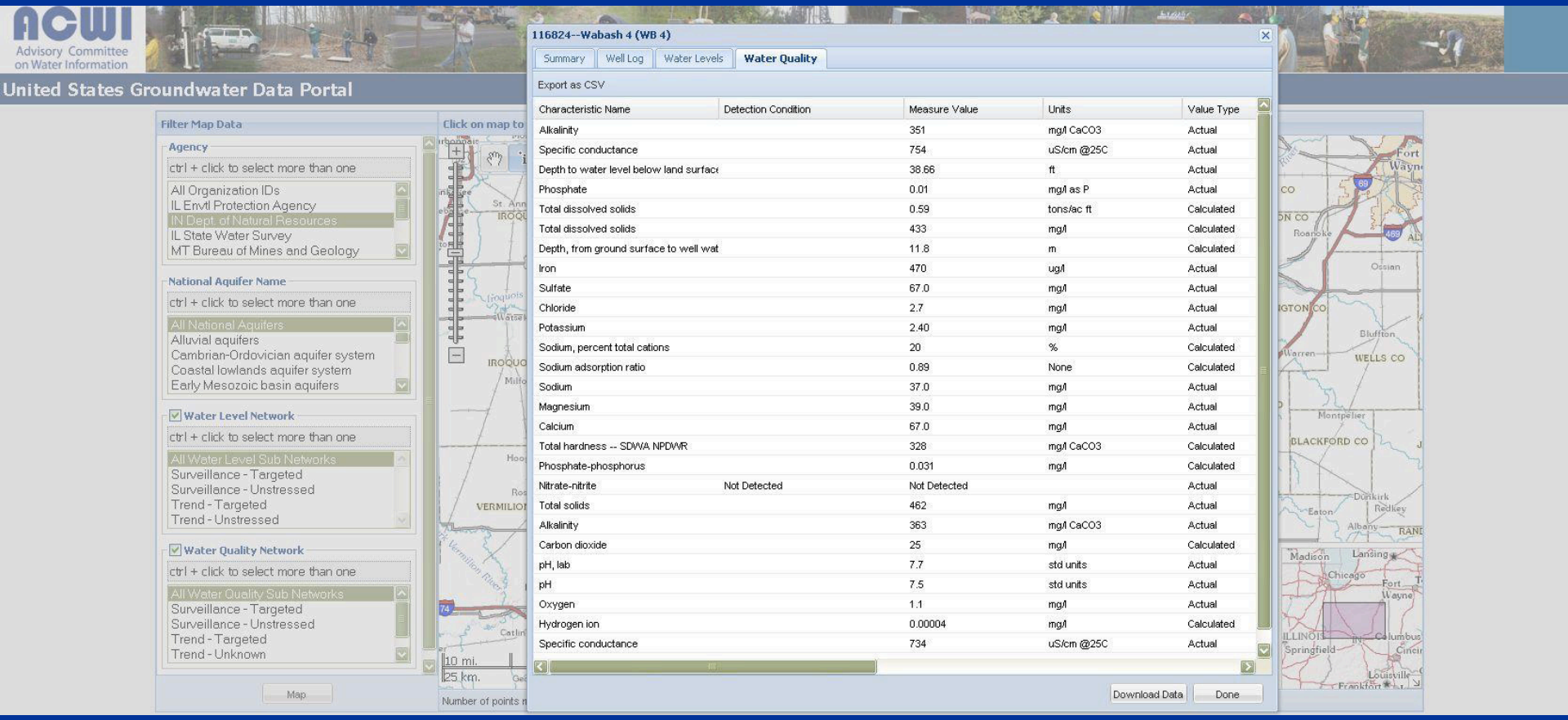
Water Quality



Characteristic Name	Detection Condition	Measure Value	Units	Value Type
Alkalinity		351	mg/l CaCO3	Actual
Specific conductance		754	uS/cm @25C	Actual
Depth to water level below land surfac		38.66	ft	Actual
Phosphate		0.01	mg/l as P	Actual
Total dissolved solids		0.59	tons/ac ft	Calculated
Total dissolved solids		433	mg/l	Calculated
Depth, from ground surface to well wat		11.8	m	Calculated
Iron		470	ug/l	Actual
Sulfate		67.0	mg/l	Actual
Chloride		2.7	mg/l	Actual
Potassium		2.40	mg/l	Actual
Sodium, percent total cations		20	%	Calculated
Sodium adsorption ratio		0.89	None	Calculated
Sodium		37.0	mg/l	Actual
Magnesium		39.0	mg/l	Actual
Calcium		67.0	mg/l	Actual
Total hardness -- SDWA NPDWR		328	mg/l CaCO3	Calculated
Phosphate-phosphorus		0.031	mg/l	Calculated
Nitrate-nitrite	Not Detected	Not Detected		Actual
Total solids		462	mg/l	Actual
Alkalinity		363	mg/l CaCO3	Actual
Carbon dioxide		25	mg/l	Calculated
pH, lab		7.7	std units	Actual
pH		7.5	std units	Actual
Oxygen		1.1	mg/l	Actual
Hydrogen ion		0.00004	mg/l	Calculated
Specific conductance		734	uS/cm @25C	Actual

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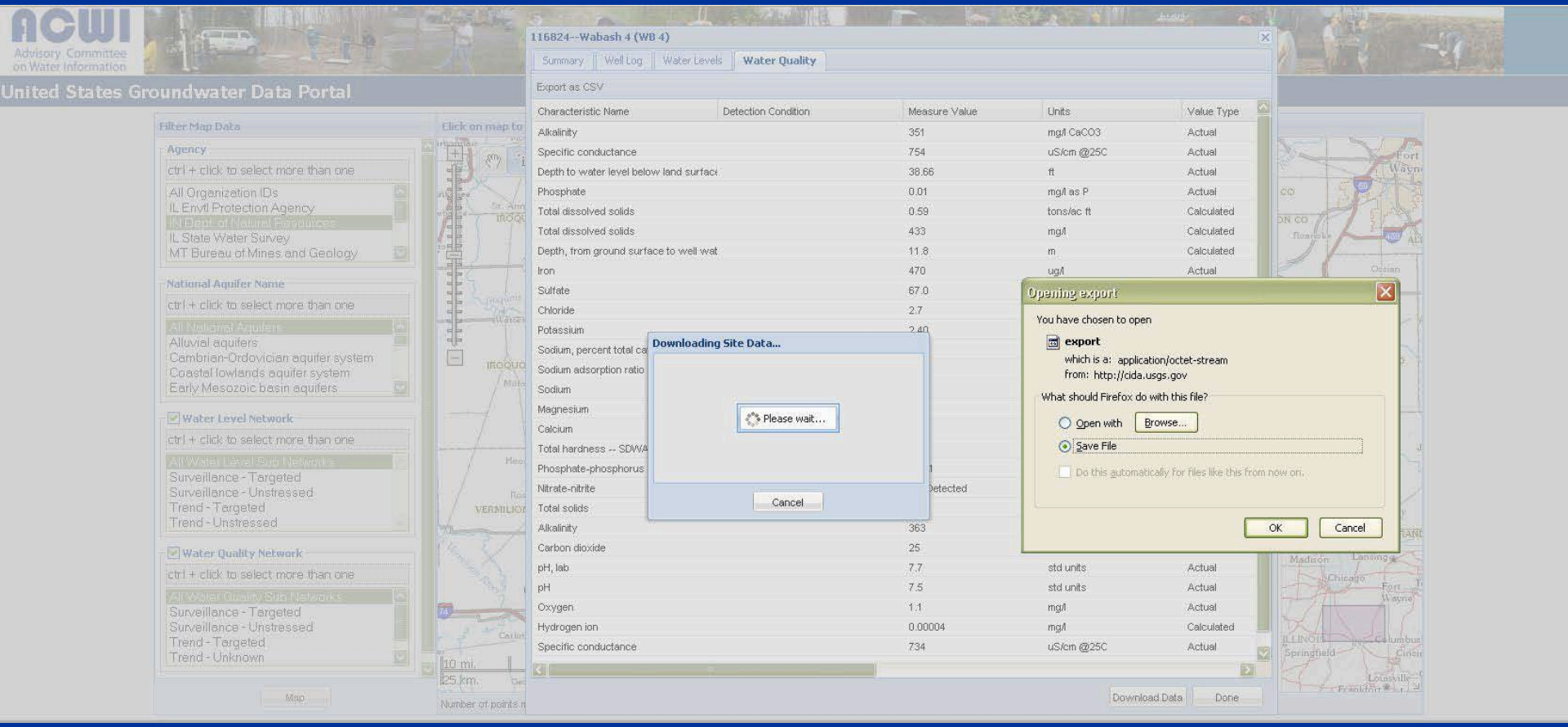
Ground-Water Data Portal

Reports/Downloads



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Acknowledgements:

Illinois Environmental Protection Agency

Illinois State Water Survey

Indiana Department of Natural Resources

Minnesota DNR

USGS science for a changing world

Texas Water Development Board

NJGS

MBMG science & service

Minnesota Pollution Control Agency

ACWI Advisory Committee on Water Information

Next Steps and Presentation of Resolution

National Ground Water Monitoring Network

.

Bob Schreiber, Non-Federal Co-Chair, SOGW
ASCE Representative to ACWI
(CDM's Groundwater Subdiscipline Leader)

ACWI
Advisory Committee on Water Information

Post-Pilot Updates to: *A National Framework for Ground-Water Monitoring in the United States* (June 2009):

Changes Needed To:

- accommodate new understandings;
- results of 5 State pilot monitoring projects
- to remove redundancy; make necessary corrections; address concerns of SOGW members

Key Areas for Revision:

- Monitoring program design
- Well classification issues
- Portal issues
- Use of output data

ACWI
Advisory Committee on Water Information

Subcommittee on Ground Water →*Next Steps*

- Present pilot-test synthesis report (July 2011)
  - Recommendations for full-scale implementation
  - Indications of pilot-state suggested improvements
- Update Framework Document (Summer 2011)
- Open pilot GW portal for public access (Summer 2011)
- Continue portal development (Summer 2011 +)
- Begin (incremental) full-scale implementation (Fall 2011)
- Incorporate new data providers (Fall 2011 +)

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ACWI Resolution

SOGW is requesting

- Approval of the Pilot summary report
- Approval of the implementation strategy
  - Update Framework Document
  - Continue Portal Development
  - Additional data providers

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Q&A and Discussion

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