

The Penn State Approach to Watershed Conditional Assessment

at

Upper Delaware Scenic and Recreational River

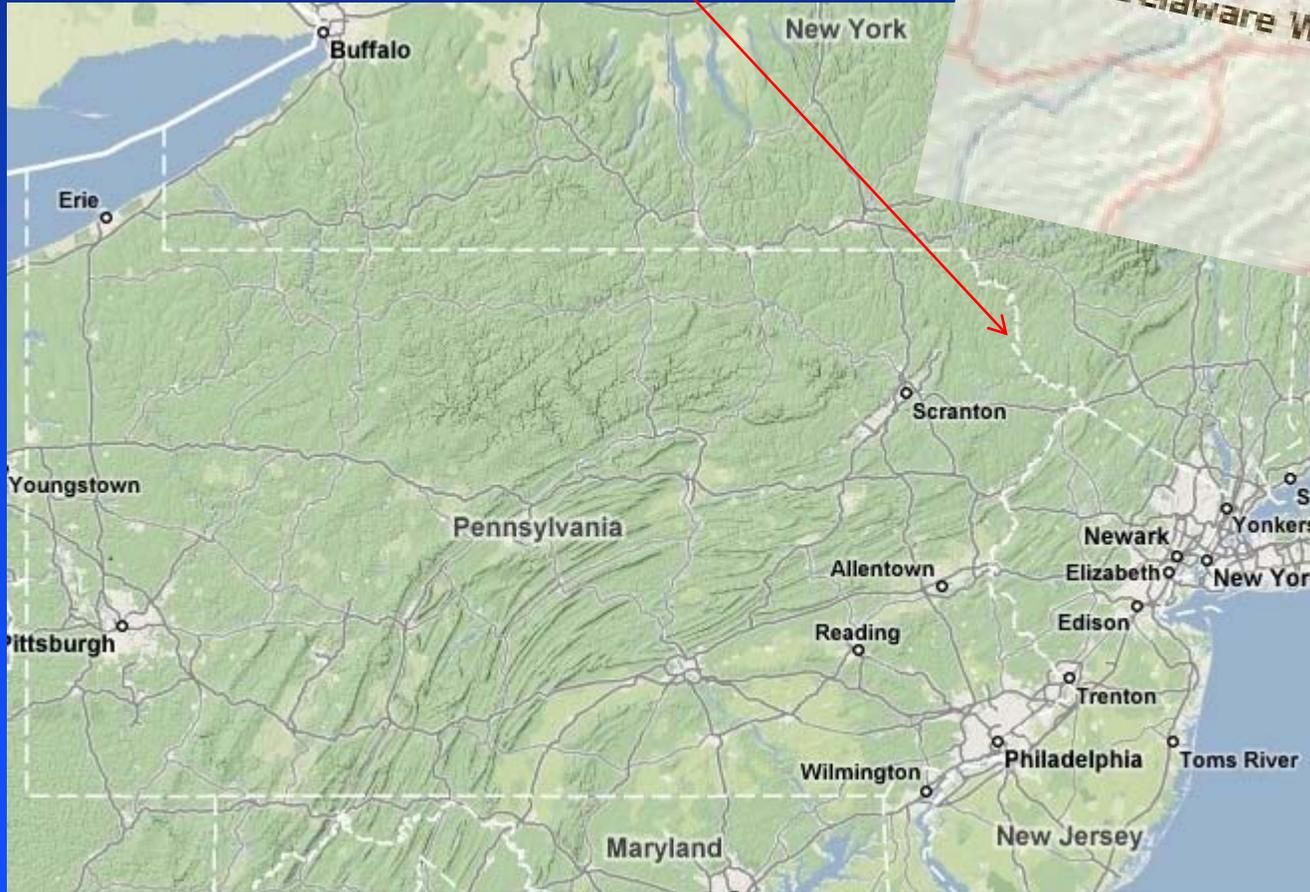
and

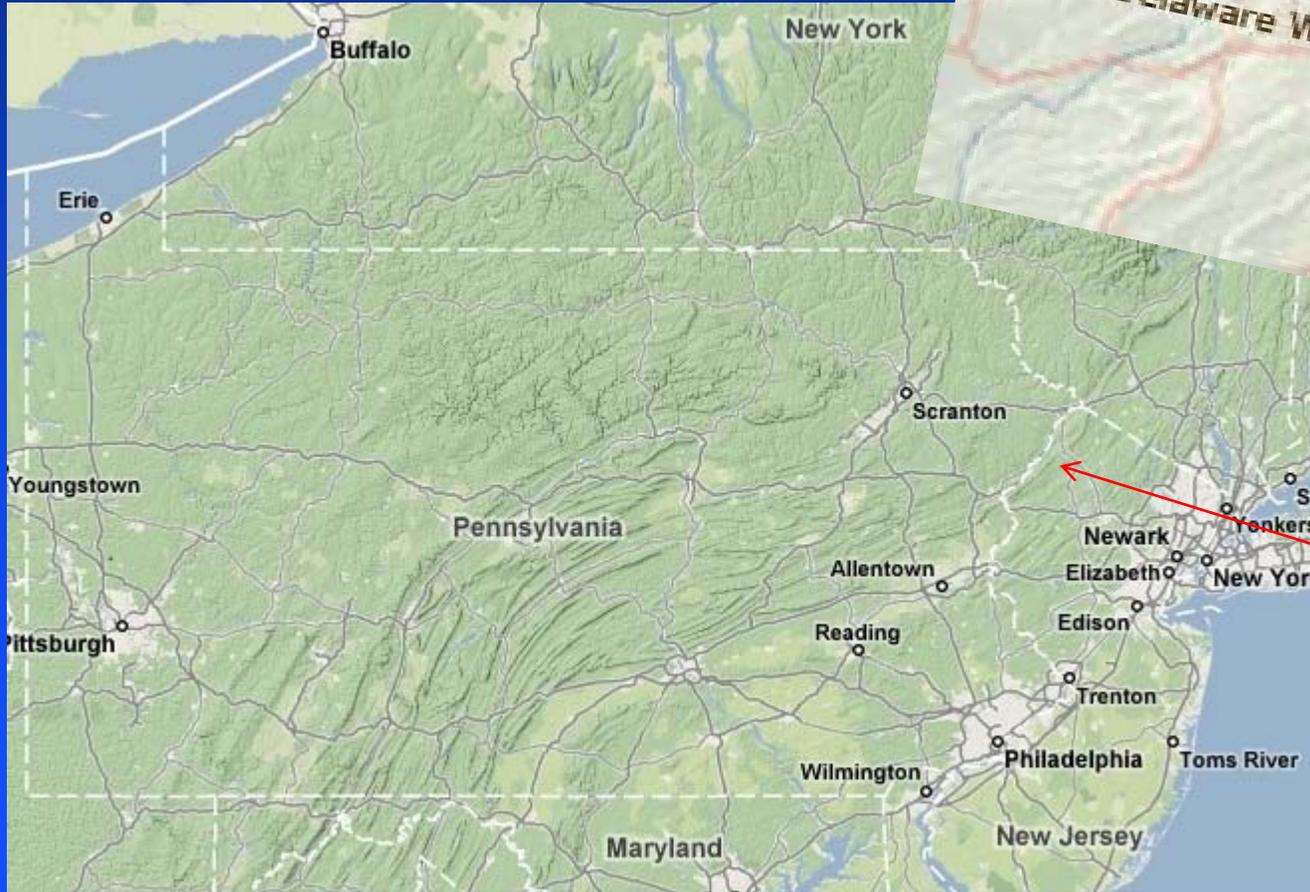
Delaware Water Gap National Recreational Area

Bruce J. Miller – Penn State University

Alan C. Ellsworth – National Park Service

UPDE

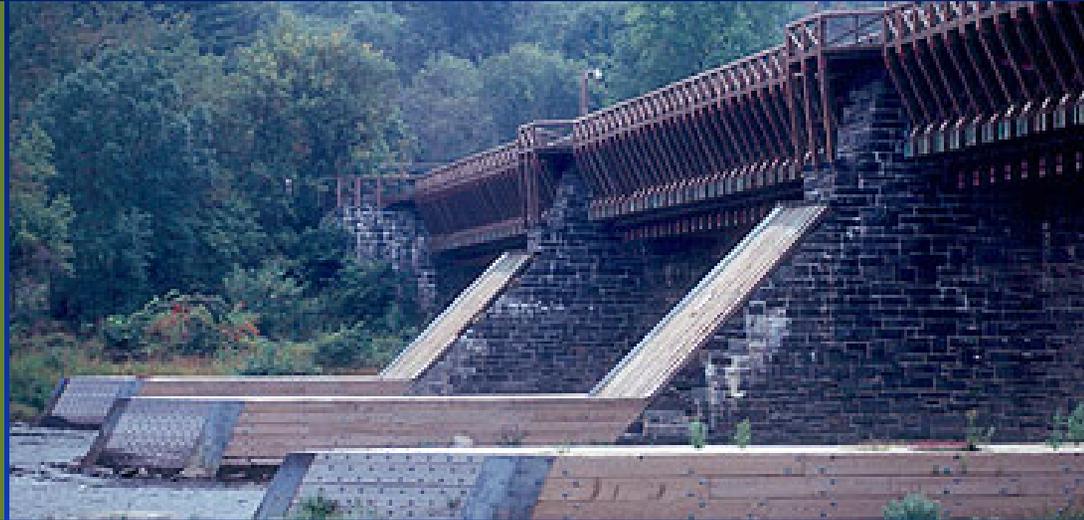




DEWA

Upper Delaware

Scenic and Recreational River
New York, Pennsylvania

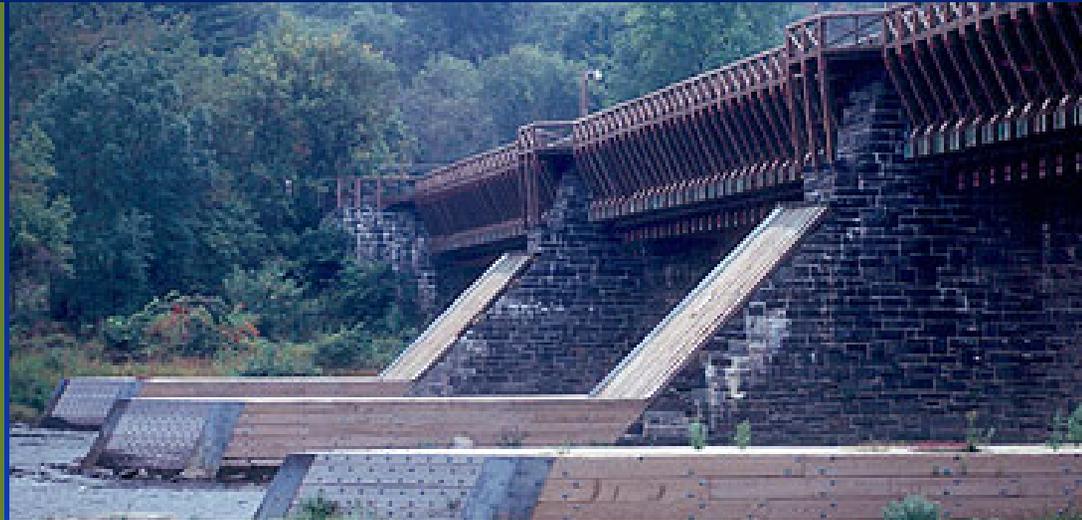


- Wild and Scenic River System
- 73 Miles of Mainstem Delaware River
- Bisects Southeast New York and Northeast Pennsylvania
- Supports boating, swimming, fishing, and hiking



Upper Delaware

Scenic and Recreational River
New York, Pennsylvania



- One of cleanest free-flowing rivers in eastern US
- World class trout fishery
- T&E species – Dwarf Wedge Mussel & Am Bald Eagle
- Very little land area – subject to land use decisions in surrounding watersheds



Delaware Water Gap
National Recreation Area
and
Middle Delaware
National Scenic River

Pennsylvania, New Jersey



- 40 Miles of Mainstem Delaware River
- Bounds New Jersey and Pennsylvania
- 67,000 acres of mountain ridge, forest, and floodplain
- Supports boating, swimming, fishing, and hiking



Delaware Water Gap
National Recreation Area
and
Middle Delaware
National Scenic River

Pennsylvania, New Jersey



- Black bear, timber rattlesnakes, bald eagles, nesting peregrine falcons
- Hemlock ravines, trout streams, lakes, ponds, some of highest waterfalls of either state
- Exceptional Water Quality

UPDEWA



- Share a common river with exceptional water quality
- Neither park has much land area
- Only a small percentage of watersheds within parks
- Water quality influenced by forces outside the parks
- Each spans two states, many counties and municipalities

Why WCA is important to UPDEWA?



- Centralized Data Repository
- Information Synthesis
- Access to current conditions and current data
- Informs water and other NR management planning

The Penn State Team

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- Carolyn Mahan, PhD – Penn State University

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Penn State Approach

- “Living Document”
- Continuous Assessment VS Snapshot Assessment
- Infrastructure VS Report

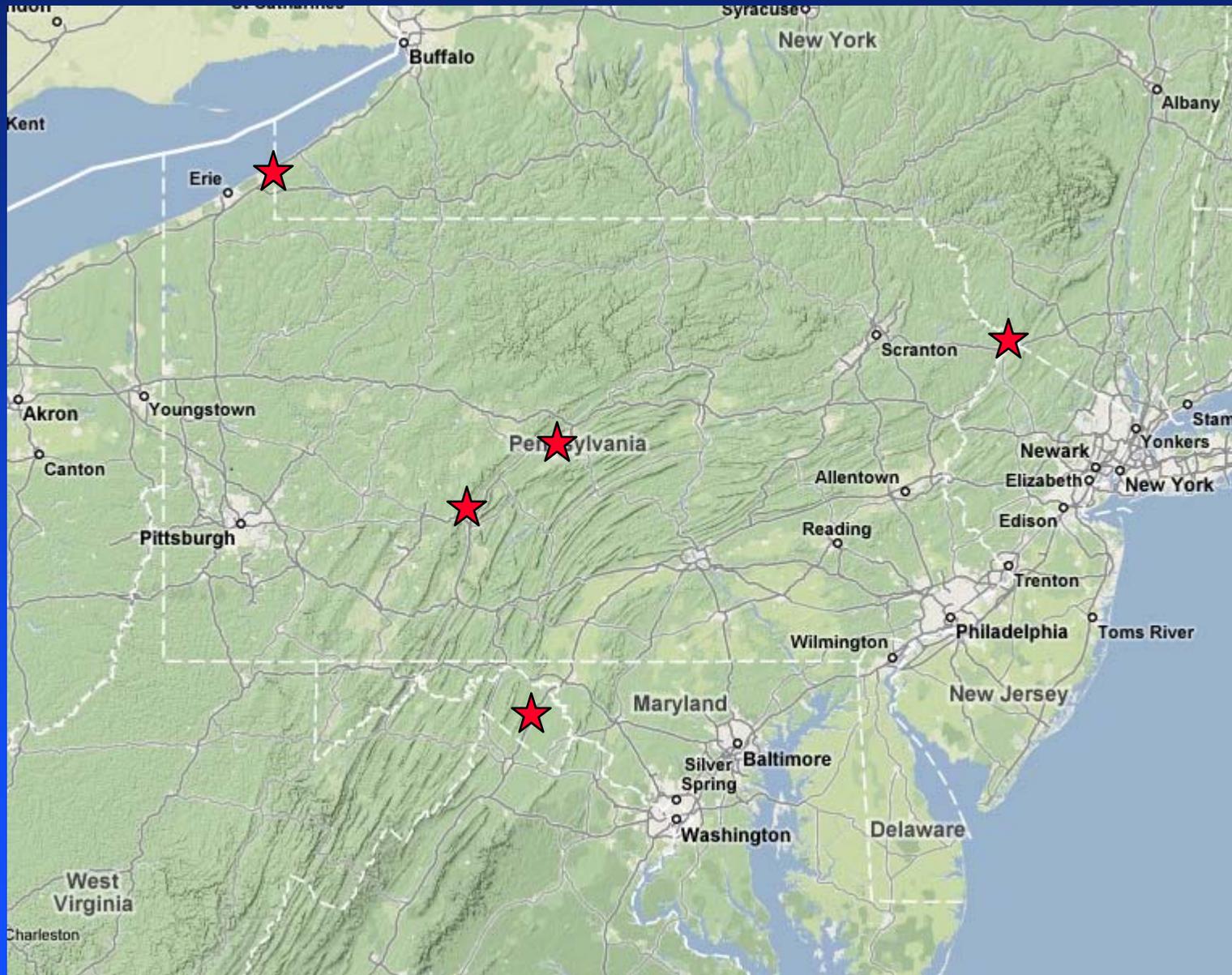
Methodology

- Collaboration
- Data Collection/Entry
- Data Aggregation
- Data Assessment
- Results Synthesis
- Results Presentation

Collaboration



Collaboration





Delaware Water Gap - Wikipedia, the free encyclopedia - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://en.wikipedia.org/wiki/Delaware_Water_Gap

Sign in / create account

article discussion edit this page history

Delaware Water Gap

From Wikipedia, the free encyclopedia Coordinates: 40°58′11.58″N, 75°07′19.14″W﻿ / ﻿40.9700000°N 75.1219833°W﻿ / 40.97; -75.122

Delaware Water Gap, Pennsylvania is also a town located near the gap.

The **Delaware Water Gap** is on the border of **New Jersey** and **Pennsylvania** where the **Delaware River** traverses a large ridge of the **Appalachian Mountains**. A **water gap** is a geological formation where a river cuts through a mountain ridge.

The Delaware Water Gap is the site of the **Delaware Water Gap National Recreation Area**, which is used primarily for recreational purposes, such as **rafting**, **canoeing**, **swimming**, **fishing**, **hiking** and **rock climbing**. With a fishing license, one can fish in the Delaware for **carp**, **shad** and other fish.

Delaware Water Gap	
Elevation	
Location	 New Jersey/Pennsylvania, United States
Range	 Blue Mountains/Kittatinny Ridge
Traversed by	 Interstate 80

Geography and boundaries [edit]



The ridge of the Appalachians that the Delaware crosses is called the **Blue Mountains** in Pennsylvania and the **Kittatinny Ridge** in New Jersey. The New Jersey mountain is **Mt. Tammany** (located in Worthington State Forest); the Pennsylvania mountain is **Mount Minsi**. The summit of Tammany is 1200 ft (360 m) above the river. The **Appalachian Trail** threads the gap, and climbs the Kittatinies alongside **Dunnfield Creek**.

The **Worthington State Forest** is to the immediate northeast of the gap.

navigation

- Main Page
- Contents
- Featured content
- Current events
- Random article

interaction

- About Wikipedia
- Community portal
- Recent changes
- Contact Wikipedia
- Donate to Wikipedia
- Help

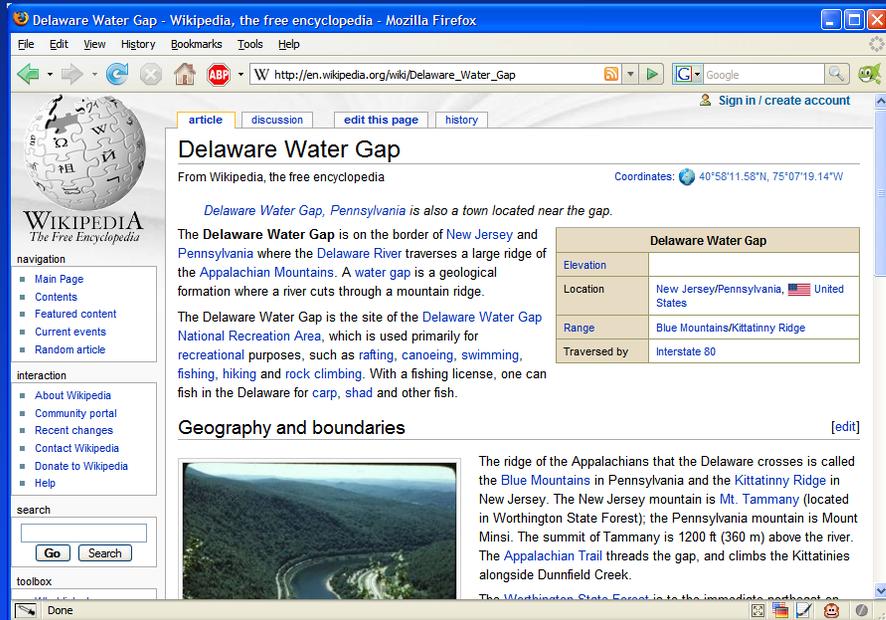
search

Go Search

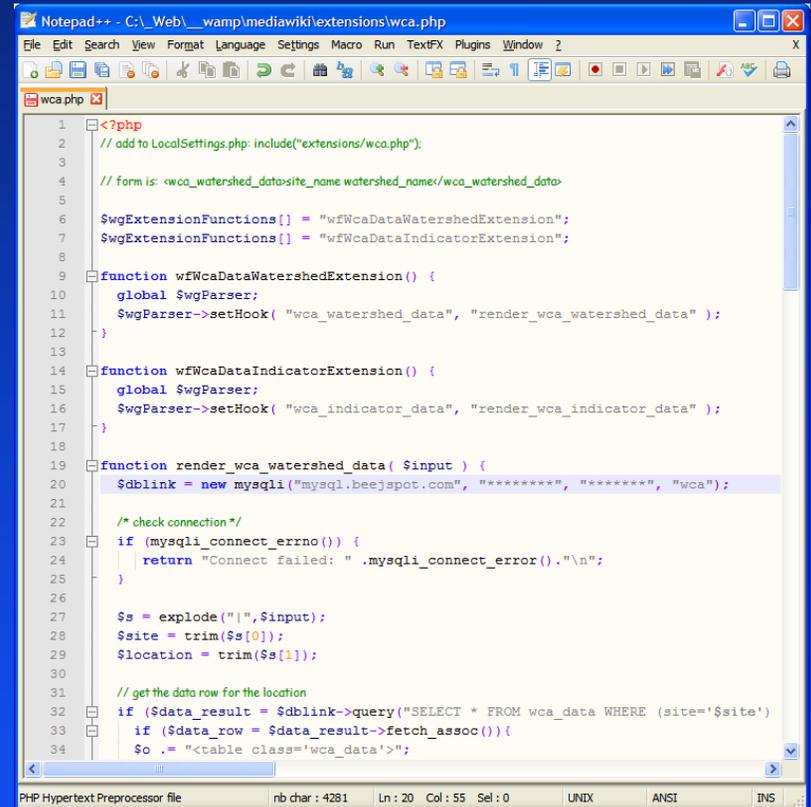
toolbox

Done

MediaWiki Software



MediaWiki Software



Custom Data Display Extensions

WCA Wiki

The screenshot shows a Mozilla Firefox browser window displaying the Main Page of WcaWiki. The browser's address bar shows the URL http://wca.beejspot.com.local/wiki/Main_Page. The page title is "Main Page - WcaWiki".

The page content includes:

- A navigation menu with links: Home, Indicators, Watersheds, Current events, Recent changes, Help.
- A search box with "Go" and "Search" buttons.
- A toolbox with links: What links here, Related changes, Upload file, Special pages, Printable version, Permanent link.
- A main heading "Main Page" with a sub-heading "Welcome to the Watershed Condition Assessment private collaboration wiki."
- A "New" section with a link to "Info for new users".
- A central message: "Access to this wiki by invitation only. (Contact Bruce Miller for an account.)"
- A blue link "Enter the Wiki".
- A footer with information: "This page was last modified 15:00, 16 October 2006.", "This page has been accessed 103 times.", "Privacy policy", "About WcaWiki", and "Powered By MediaWiki".



WCA Wiki

- Information “Commons”
- Literature Deconstruction Repository
- Project Documentation



WCA Wiki

- Hyper-linking
- Searchable
- Change History
- Page Watch
- RSS News Feed
- Help System



WCA Wiki - Home

- News/Discussions
- Indicators
- Watersheds
- Data Sources
- Tools

The screenshot shows the Mozilla Firefox browser window displaying the WcaWiki Home page. The browser title is "Home - WcaWiki - Mozilla Firefox". The menu bar includes File, Edit, View, History, Bookmarks, Tools, and Help. The page content is organized into several sections:

- Home**: A large yellow sunflower image is on the left. Below it is a "Contents" section with a "show" link.
- News**: A section with an "[edit]" link. It contains a list of news items:
 - Page caching has been turned off because data will not update on a cached page until the page has been edited. Unfortunately this causes pages to load more slowly.
 - Individual indicators now have live data summaries across locations.
 - [Questions for Carolyn](#)
 - [Questions for Mike](#)
 - [Questions for Bruce](#)
- Assessment**: A section with an "[edit]" link. It contains a list of assessment items:
 - Indicators
 - Watersheds
 - Data Sources
 - Watersheds - not
- Tools**: A section with an "[edit]" link. It contains a list of tool items:
 - [Templates/Guidelines](#)
 - [PSU-WCA Database Manager](#)

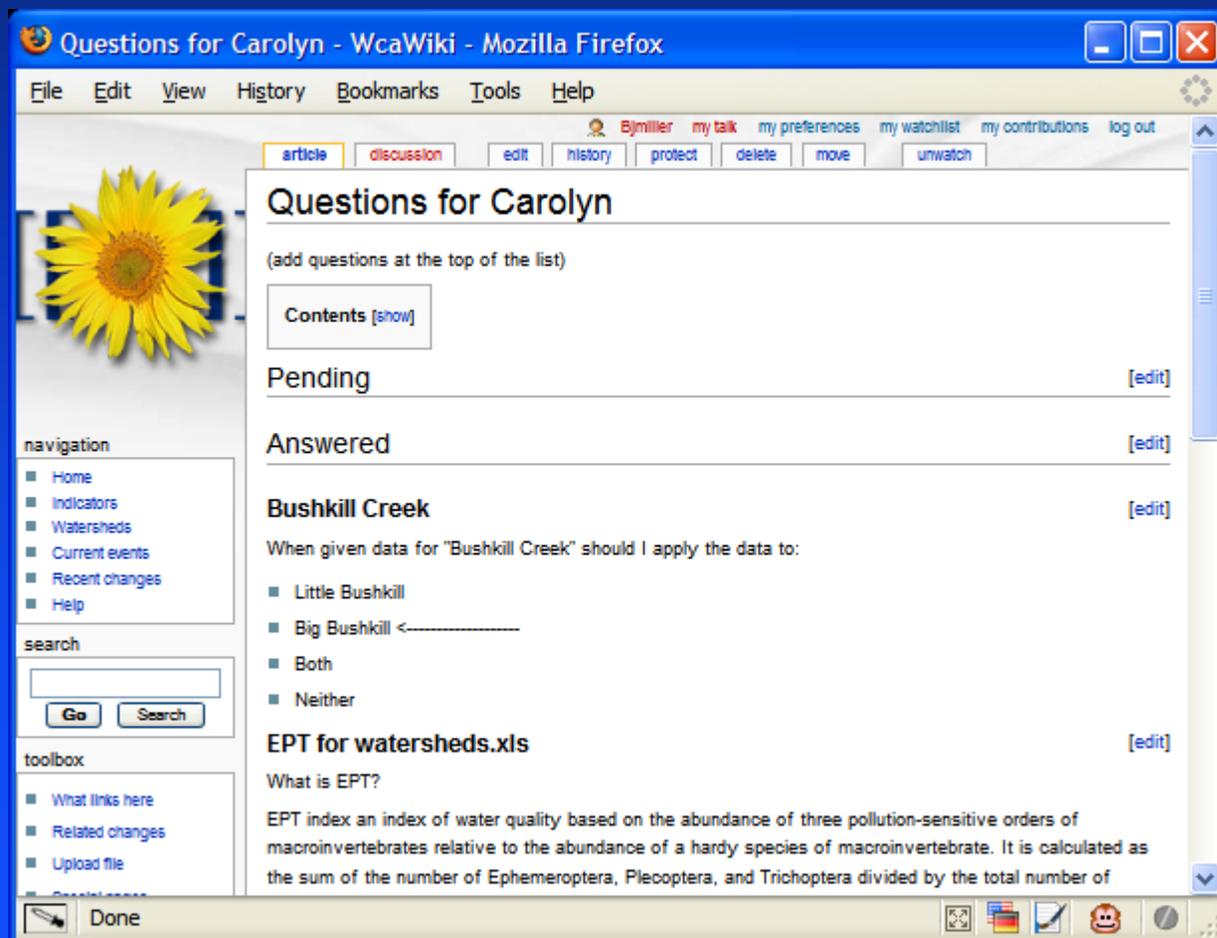
On the left side of the page, there are several utility sections:

- navigation**: A list of links including Home, Indicators, Watersheds, Current events, Recent changes, and Help.
- search**: A search box with "Go" and "Search" buttons.
- toolbox**: A list of links including What links here, Related changes, Upload file, Special pages, and Printable version.

The browser's status bar at the bottom shows "javascript:toggleToc()" and various system icons.

News/Discussions

- Announcements
- Clarifications
- To-Do's
- Comments



Questions for Carolyn - WcaWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Bjmillier my talk my preferences my watchlist my contributions log out

article discussion edit history protect delete move unwatch

Questions for Carolyn

(add questions at the top of the list)

Contents [show]

Pending [edit]

Answered [edit]

Bushkill Creek [edit]

When given data for "Bushkill Creek" should I apply the data to:

- Little Bushkill
- Big Bushkill ←-----
- Both
- Neither

EPT for watersheds.xls [edit]

What is EPT?

EPT index an index of water quality based on the abundance of three pollution-sensitive orders of macroinvertebrates relative to the abundance of a hardy species of macroinvertebrate. It is calculated as the sum of the number of Ephemeroptera, Plecoptera, and Trichoptera divided by the total number of

Done

Indicators List

The screenshot shows a Mozilla Firefox browser window titled "Indicators - WcaWiki". The address bar is empty. The menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help". The main content area displays a list of indicators under the heading "Macrobenthic Model Affinity".

- Macrobenthic Model Affinity [edit]
- Monroe County Water Quality Study 2003 [edit]
- Monroe County WQ Study Subcoregion
- Macrobenthic Score
- Habitat Score
- PA Stream Value
- CWF - Cold Water Fishes
- Warm Water Fishes
- Migratory Fishes
- Trout Stocking
- Ersbak Bioassessment Study [edit]
- Index of Biotic Integrity [edit]
- Index of Biotic Integrity - Ersbak
- Number of Intolerant Species
- Percent Individuals of Tolerant Species
- Percent Individuals of Carnivore Species
- Percent Individuals of Stenothermal Coolwater and Coldwater Species
- Percent Salmonid Individuals of Brook Trout
- Percent Individuals of Insectivores
- Percent Individuals of Pioneering Species

The status bar at the bottom shows "Done" and various system icons.

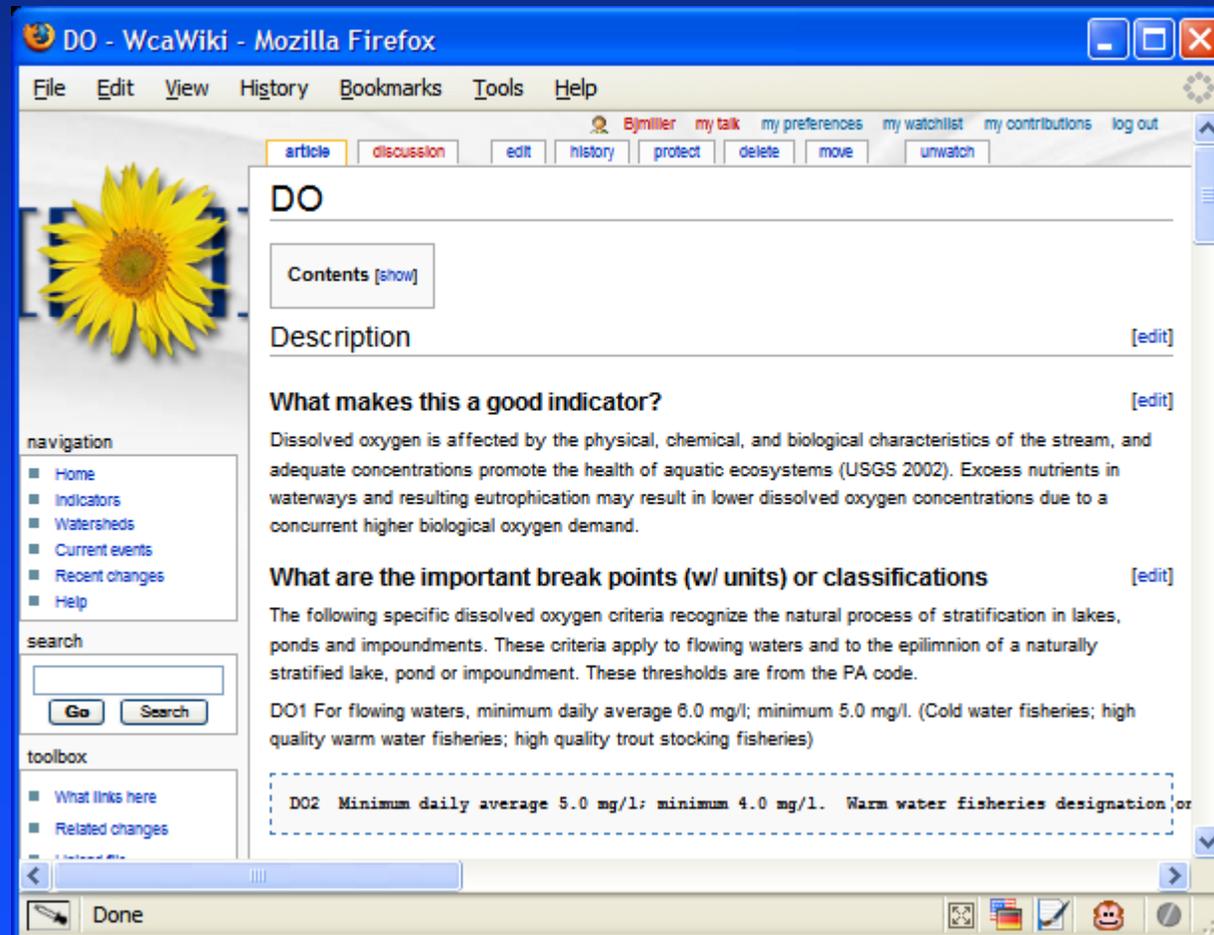
Literature Deconstruction

- Metadata
- Discussion
- Data (potential indicators)



Indicator Page

- Description / Definition
- Why Important
- Break points
- Discussion



DO - WcaWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Bjmillier my talk my preferences my watchlist my contributions log out

article discussion edit history protect delete move unwatch

DO

Contents [show]

Description [edit]

What makes this a good indicator? [edit]

Dissolved oxygen is affected by the physical, chemical, and biological characteristics of the stream, and adequate concentrations promote the health of aquatic ecosystems (USGS 2002). Excess nutrients in waterways and resulting eutrophication may result in lower dissolved oxygen concentrations due to a concurrent higher biological oxygen demand.

What are the important break points (w/ units) or classifications [edit]

The following specific dissolved oxygen criteria recognize the natural process of stratification in lakes, ponds and impoundments. These criteria apply to flowing waters and to the epilimnion of a naturally stratified lake, pond or impoundment. These thresholds are from the PA code.

DO1 For flowing waters, minimum daily average 6.0 mg/l; minimum 5.0 mg/l. (Cold water fisheries; high quality warm water fisheries; high quality trout stocking fisheries)

DO2 Minimum daily average 5.0 mg/l; minimum 4.0 mg/l. Warm water fisheries designation, or

Done

Indicator Page

- Metadata
- Data



DO - WcaWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Dissolved oxygen has been selected as a water chemistry core parameter vital sign by the Eastern Rivers and Mountain Network.

Metadata [edit]

Database Alias [edit]
 DO

Source [edit]
 Trib Chem 2000

Links [edit]

Data [edit]

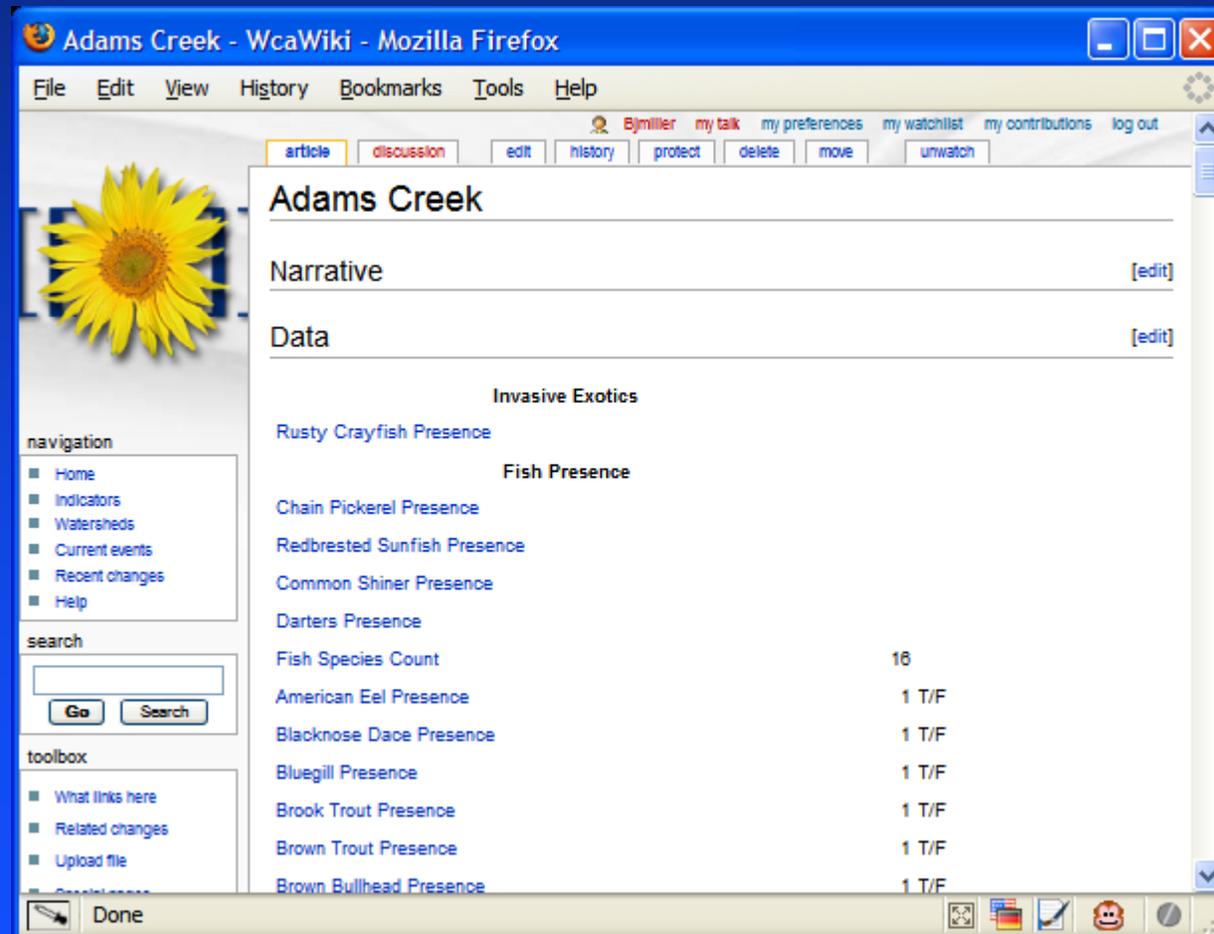
DEWA

Adams Creek	8.1
Alicias Creek	
Big Bushkill	8.5
Brodhead Creek	8.6
Caledonia Creek	
Cherry Creek	
Canebrush Creek	

Done

Watershed Page

- Discussion
- Data



Adams Creek - WcaWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Bjmillier my talk my preferences my watchlist my contributions log out

article discussion edit history protect delete move unwatch

Adams Creek

Narrative [edit]

Data [edit]

Invasive Exotics

Rusty Crayfish Presence

Fish Presence

Chain Pickerel Presence	
Redbreasted Sunfish Presence	
Common Shiner Presence	
Darters Presence	
Fish Species Count	16
American Eel Presence	1 T/F
Blacknose Dace Presence	1 T/F
Bluegill Presence	1 T/F
Brook Trout Presence	1 T/F
Brown Trout Presence	1 T/F
Brown Bullhead Presence	1 T/F

navigation

- Home
- Indicators
- Watersheds
- Current events
- Recent changes
- Help

search

Go Search

toolbox

- What links here
- Related changes
- Upload file

Done

Watershed Page

- Data



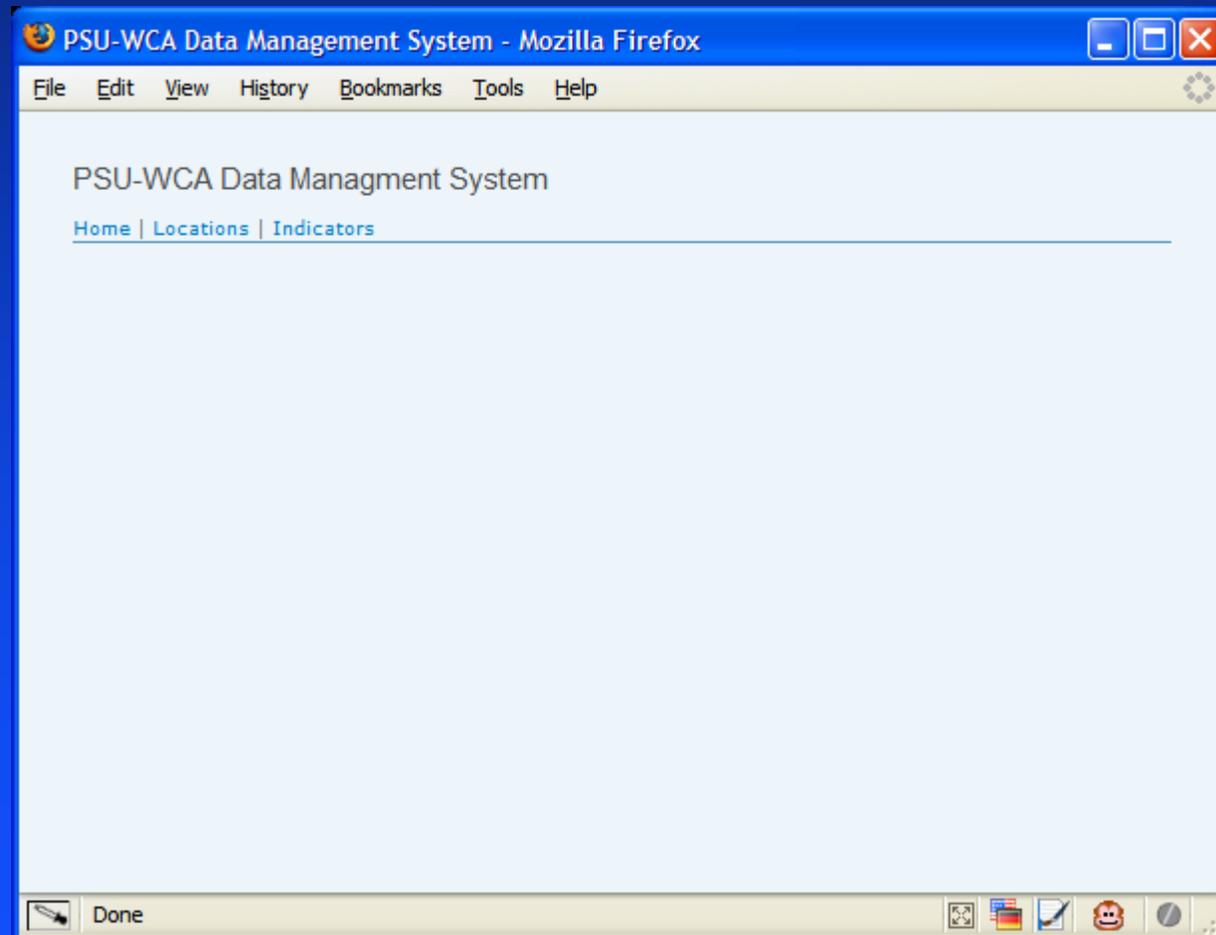
Adams Creek - WcaWiki - Mozilla Firefox

Parameter	Value
Mean July Discharge	7 cfs
Percent July Mainstem Discharge	0.2 %
Water Temperature 2	24.3 C
DO	8.1 mg/l
Conductivity 2	71.5 micromh
pH 2	6.98
NOx	0.21 mg/l
NHx	0.03 mg/l
Totkjel_N	0.39 mg/l
Orthophosphates	0.01 mg/l
Total Phosphates	0.09 mg/l
BOD 5 Day	0.74 mg/l
Fecal Coliforms	18.5 per 100ml
Turbidity	0.86 ntu
WQI	81.58
Drainage Area	42 sq km
Forested	86
Urban/Developed	9
Agricultural/Farm	0
Sewage Flow	0 kl/day

Data Entry

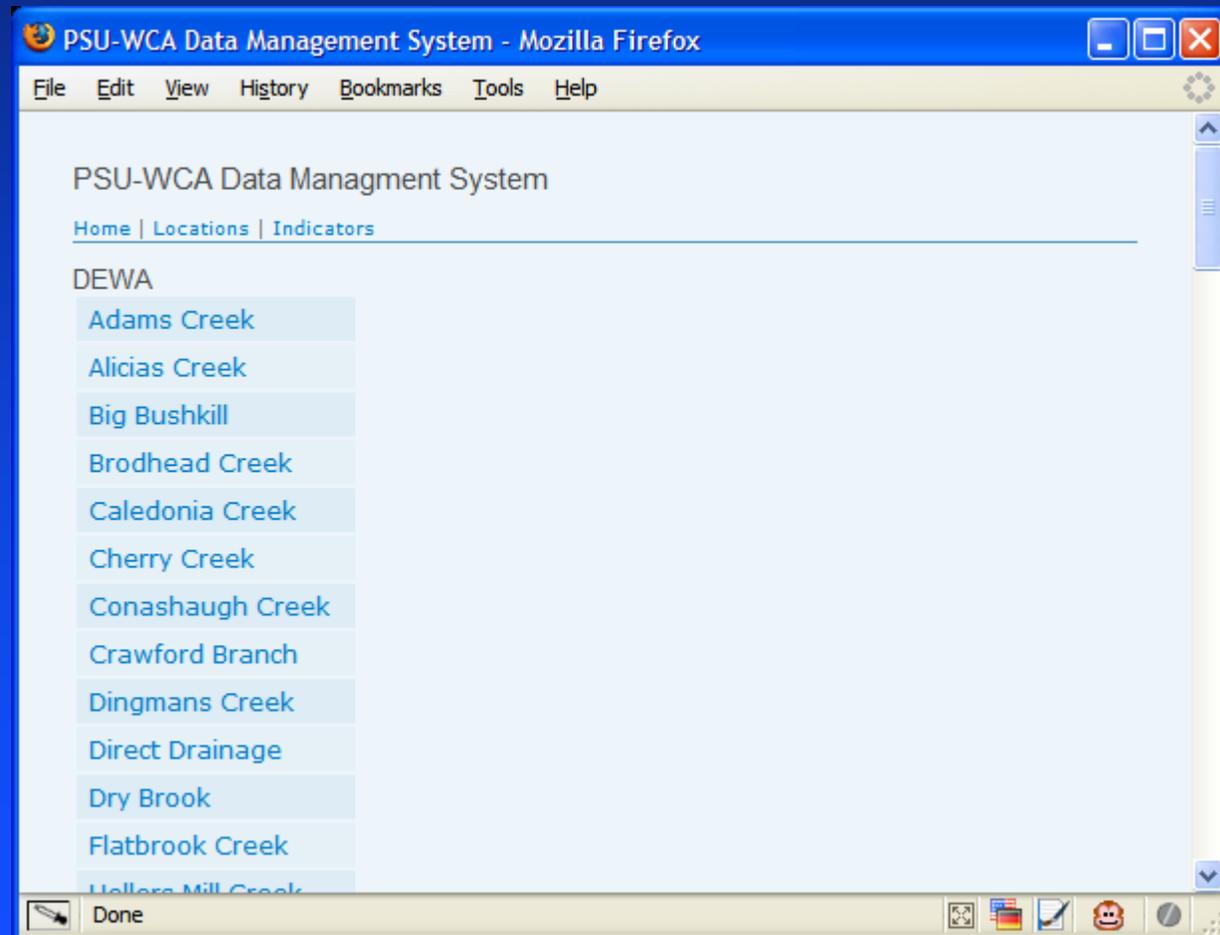
Data Entry – Home Page

- PHP script
- MySQL
- Data is integrated with the Wiki



Data Entry – Locations List

- Hyper-linked list of locations



Data Entry – Adding/Editing Data by Location

- Ordered by indicator group and indicator weight

PSU-WCA Data Management System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

PSU-WCA Data Management System

[Home](#) | [Locations](#) | [Indicators](#)

DEWA: Adams Creek

Invasive Exotics

Rusty Crayfish Presence		<input type="text"/>	T/F
-------------------------	--	----------------------	-----

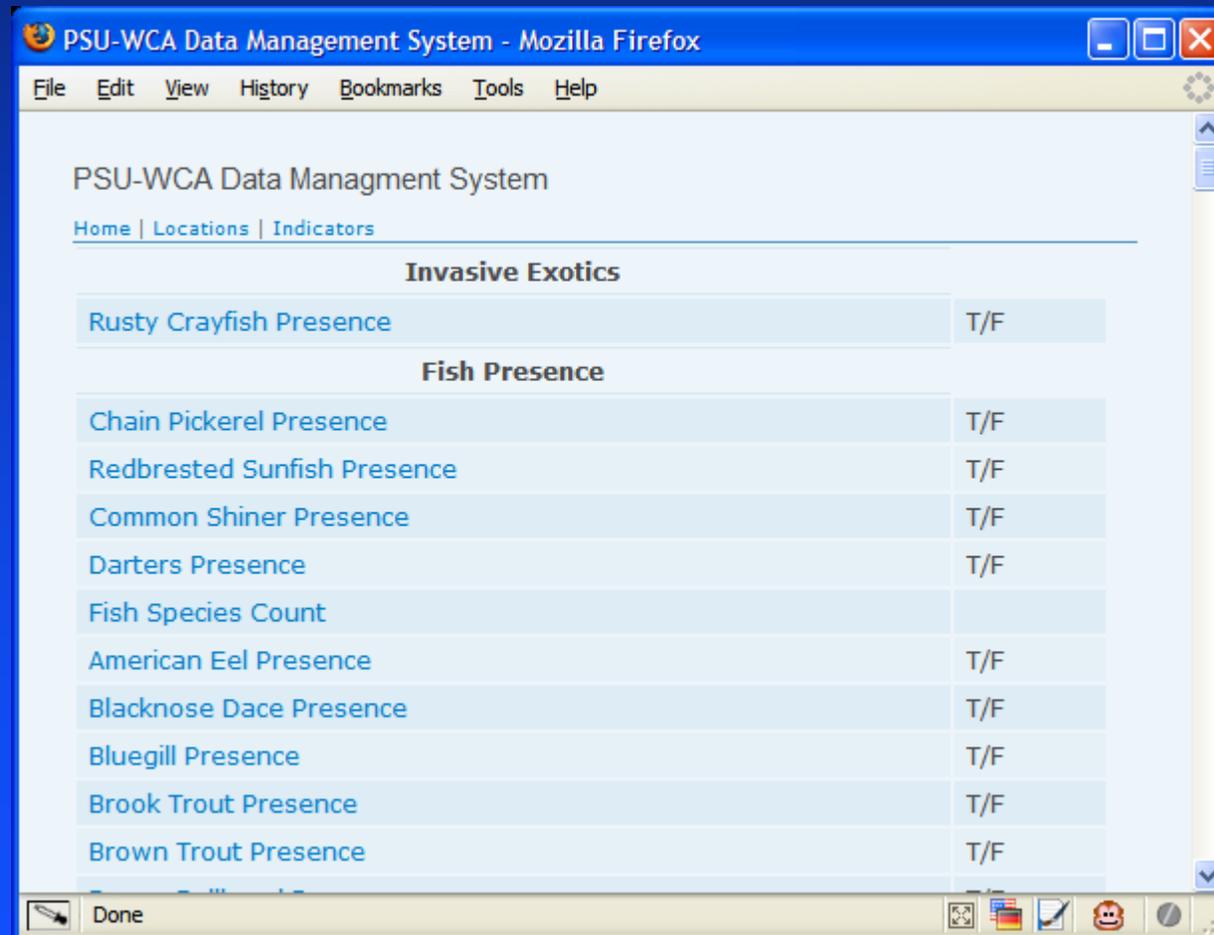
Fish Presence

Chain Pickerel Presence		<input type="text"/>	T/F
Redbreasted Sunfish Presence		<input type="text"/>	T/F
Common Shiner Presence		<input type="text"/>	T/F
Darters Presence		<input type="text"/>	T/F
Fish Species Count	16	<input type="text" value="16"/>	
American Eel Presence	1	<input type="text" value="1"/>	T/F
Blacknose Dace Presence	1	<input type="text" value="1"/>	T/F
Bluegill Presence	1	<input type="text" value="1"/>	T/F

Done

Data Entry – Indicators List

- Hyper-linked list of indicators



PSU-WCA Data Management System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

PSU-WCA Data Management System

[Home](#) | [Locations](#) | [Indicators](#)

Invasive Exotics

Rusty Crayfish Presence	T/F
---	-----

Fish Presence

Chain Pickerel Presence	T/F
Redbreasted Sunfish Presence	T/F
Common Shiner Presence	T/F
Darters Presence	T/F
Fish Species Count	
American Eel Presence	T/F
Blacknose Dace Presence	T/F
Bluegill Presence	T/F
Brook Trout Presence	T/F
Brown Trout Presence	T/F

Done

Data Entry – Adding/Editing Data by Indicator

- Ordered by park and watershed name

PSU-WCA Data Management System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

PSU-WCA Data Management System

[Home](#) | [Locations](#) | [Indicators](#)

Rusty_Crayfish_Presence

DEWA

Adams Creek	<input type="text"/>
Alicias Creek	<input type="text"/>
Big Bushkill	<input type="text"/>
Brodhead Creek	<input type="text"/>
Caledonia Creek	<input type="text"/>
Cherry Creek	<input type="text"/>
Conashaugh Creek	<input type="text"/>
Crawford Branch	<input type="text"/>
Dingmans Creek	<input type="text"/>
Direct Drainage	<input type="text"/>

Done

Data Entry – Adding an Indicator

- Automated database restructuring
- Control over grouping and ordering

PSU-WCA Data Management System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Add a new indicator:

Indicator

Fullname

Data Type

Group

Weight

Description

Add a new indicator group:

Group

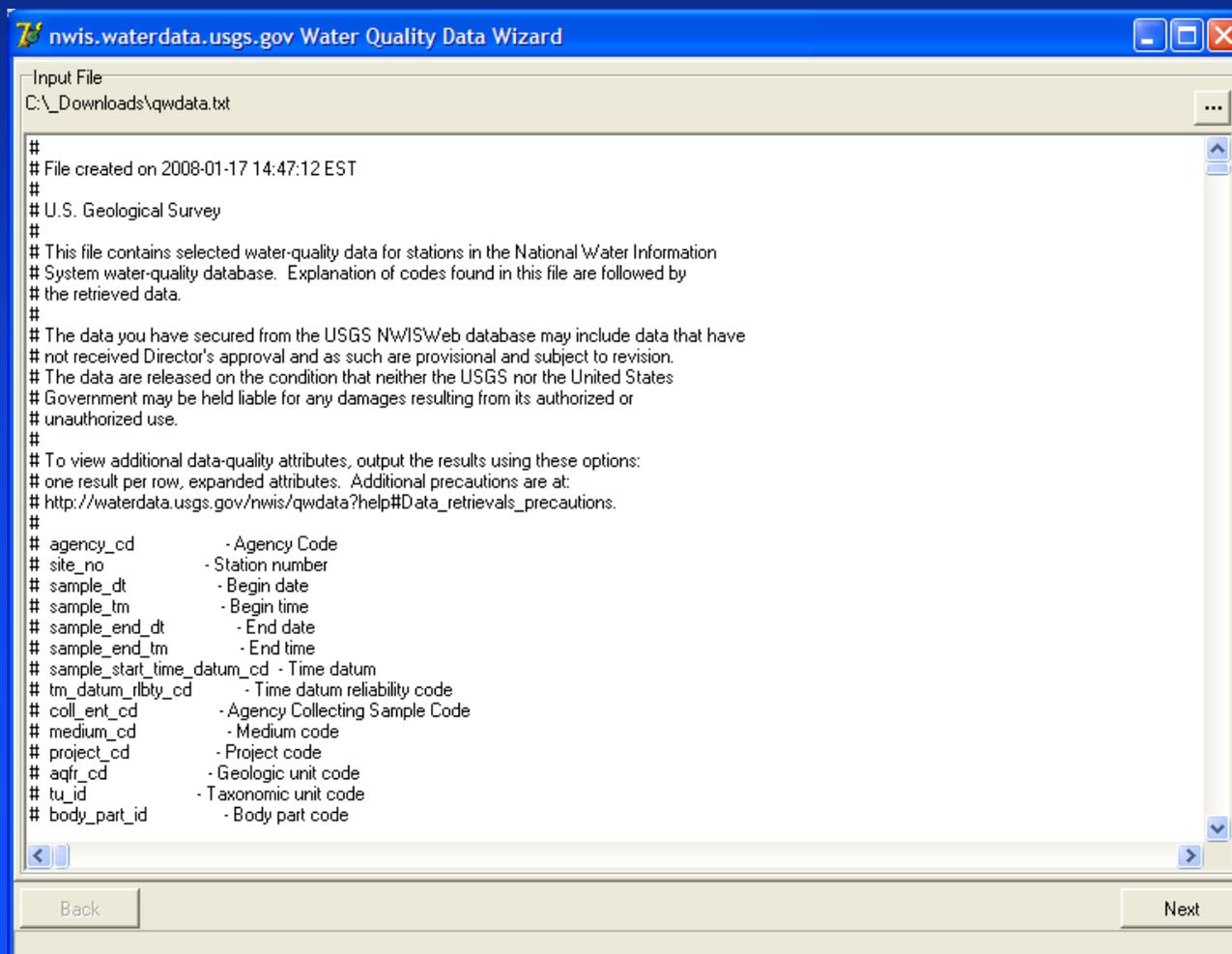
Weight

Done

Data Aggregation

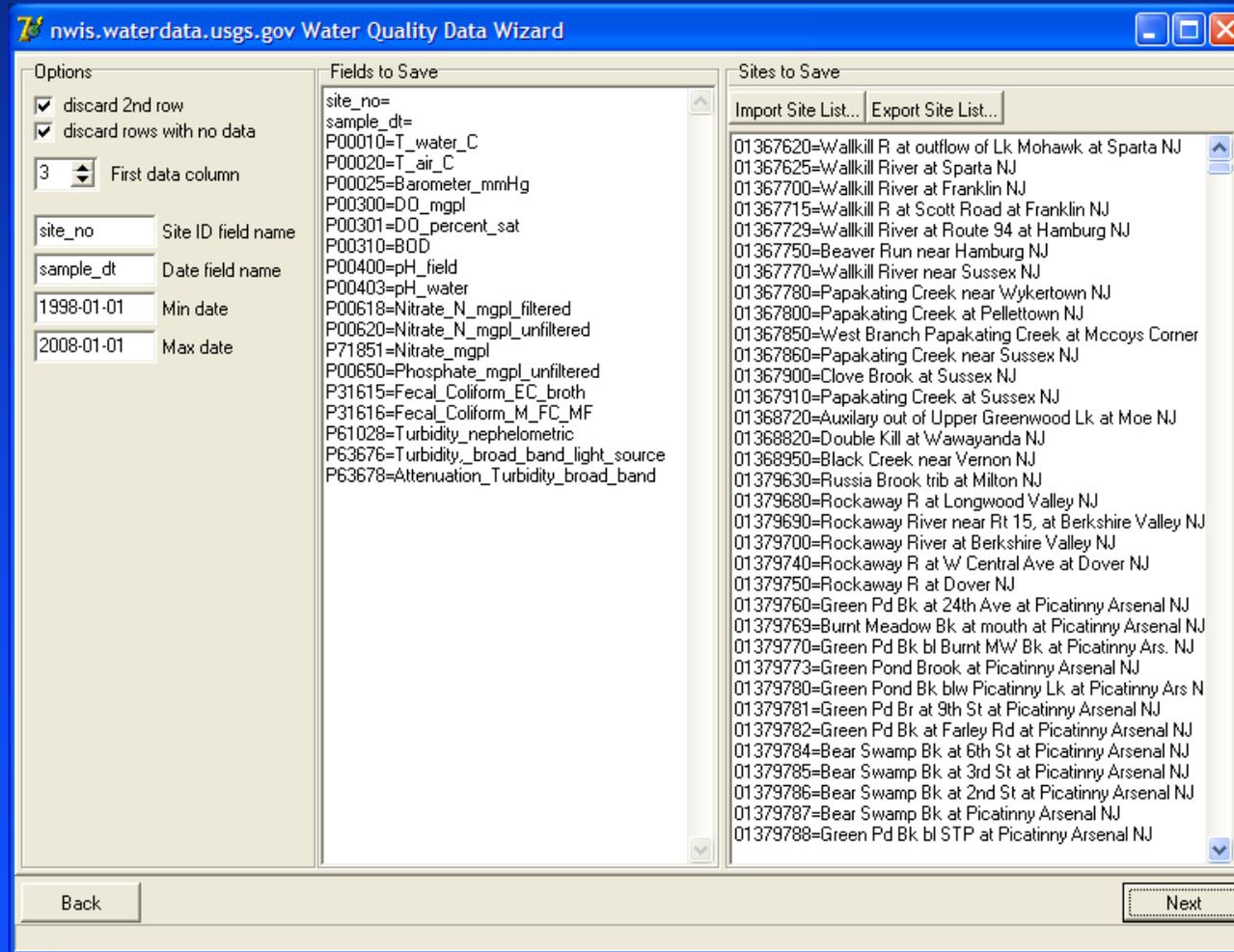
Water Quality Data Wizard

- Raw data from USGS – NWIS web site



Water Quality Data Wizard

- Configuration
- Auto-saved



Water Quality Data Wizard

- Parsed data
- Meaningful field names
- Filtered by gauge
- Filtered by date
- Empty rows eliminated

nwis.waterdata.usgs.gov Water Quality Data Wizard

Output

site_no	sample_dt	T_water_C	T_air_C	Barometer_m	DO_mgpl	DO_percent	BOD	pH_field	pH_water	Nitrate_N_mg	Nitri
01367620	2001-06-29	27.0	31.5		7.9			8.4			
01367620	2004-10-13	17.6	20.0		8.6	90		8.3	8.0		
01367620	2005-03-02							7.7	7.4		
01367620	2005-04-19	17.9		744	10.8	114		8.4	8.3		
01367620	2005-06-07	24.3	24.0	750	8.7	104		8.3	8.2		
01367620	2005-07-27	30.6	30.1	757	8.9	122		7.3	8.1		
01367625	1998-02-18	4.5		735	12.2	98	2.4	8.2	8.0	0.33	
01367625	1998-05-21	22.0		735	8.2	98	1.4	8.1	8.0	0.20	
01367625	1998-06-08										
01367625	1998-06-17										
01367625	1998-07-20										
01367625	1998-08-19	18.0		747	8.5	92	1.3	8.2	7.9	0.47	
01367625	1998-09-15										
01367625	1998-11-05	9.0		738	12.0	107	1.0	7.9	8.2	0.87	
01367625	1999-01-28	3.5		740	12.8	99	1.0	7.0	7.9	0.41	
01367625	1999-05-13	14.0		742	10.3	103	1.5	8.4	8.2	0.73	
01367625	1999-08-12	19.0		742	8.0	89	1.2	8.1	8.0	0.88	
01367625	1999-11-09	10.0		745	10.6	96	3.0	8.2	7.9	0.40	
01367625	2000-02-23	3.5		755	13.5	103	2.0	8.3	7.5	0.50	
01367625	2000-05-18	18.0		740	8.7	95	1.4	8.1	8.1	0.51	
01367625	2000-06-28										
01367625	2000-07-03										
01367625	2000-07-10										
01367625	2000-07-17										
01367625	2000-07-24										
01367625	2000-08-08	25.0		742	7.3	91	2.1	8.1	8.0	0.50	
01367625	2000-11-16	8.0	7.0	740	11.4	88	2.0	8.0	7.0	0.40	

Back Next

Water Quality Data Wizard

- Data aggregation
- Most recent data by gauge

nwis.waterdata.usgs.gov Water Quality Data Wizard

Summary

site_no	sample_dt	T_water_C	T_air_C	Barometer_m	DO_mgpl	DO_percent	BOD	pH_field	pH_water	Nitrate_N_mg	Nitri
01367620	2005-07-27	30.6	30.1	757	8.9	122		7.3	8.1		
01367625	2007-05-07	16.5	21.0	761	10.6	108	1.0	8.4	8.4	0.82	
01367700	2006-05-17	13.0	19.0	741	8.4	82		7.8	8.0		
01367715	2006-05-17	13.4	16.5	742	8.8	87	2.1	8.2	7.9	0.16	
01367729	2006-05-17	13.8	19.9	740	9.8	97		8.3	8.4	1.99	
01367770	2007-05-07	13.1	14.0	761	10.3	98	1.0	7.8	8.1	5.05	
01367780	2002-08-07	17.0	23.0	745	8.2	87	1.1	8.0	8.0	0.13	
01367800	2007-06-06	15.8	18.0	748	8.0	81	1.0	8.0	7.6	0.55	
01367850	2000-08-09	22.5		751	9.1	107	1.2	7.9	8.0	0.61	
01367860	1998-09-15	21.0		753	8.9	101	1.0	8.1	7.9	1.03	
01368820	2007-05-14	16.5	19.5	741	8.8	93	1.3	7.4	7.6	0.04	
01379680	1999-09-14	19.5		747	7.0	78	1.0	7.8	7.8	0.04	
01379700	1998-09-22	21.0		740	6.7	78	1.0	7.4	7.5	0.08	
01379800	1998-09-16	20.0		742	5.5	62	1.0	7.8	7.8	0.10	
01379853	1998-09-22	20.0		742	6.5	74	1.0	7.8	7.9	0.32	
01379870	2004-08-11	19.7	30.5	746	7.7	86	1.0	7.3	7.6	1.60	
01380100	2007-05-16	19.8	4.0	739	7.5	85	1.0	6.8	7.5	0.15	
01380320	2007-05-10	20.1	24.5	748	7.8	86	2.1	7.2	7.8	0.30	
01380500	2003-10-08	10.9	18.0	759	11.0	100		7.6			
01381050	2000-08-23	16.0		755	9.0	92	1.0	7.7	7.4	0.07	
01382410	2002-09-03	22.0	29.0	740	13.2	156	1.0	8.0	8.1	0.22	
01382450	2000-08-10	21.0		755	8.6	97	1.0	7.5	7.5	0.31	
01382500	2007-06-06	17.8	15.5	743	8.8	93	1.0	7.5	7.8	0.14	
01382960	2004-09-08	18.1	21.6	748	8.7	93	1.0	8.2	7.4	0.07	
01438400	2004-12-15	1.0	-2.0	760	12.8	90		7.5	7.9	0.17	
01438500	2007-05-21	15.5	13.0	756	8.1	82	1.0	7.1	8.3	0.16	
01438600	2004-12-15	1.0	-2.0	760	12.8	90		7.5	7.9	0.17	

Back Next

Water Quality Data Wizard

- Exports tab-delimited text
- Imports into Excel, Access, ArcGIS, etc.

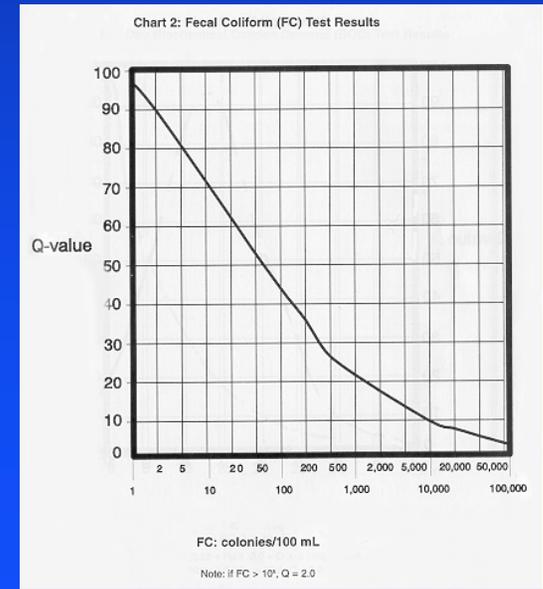
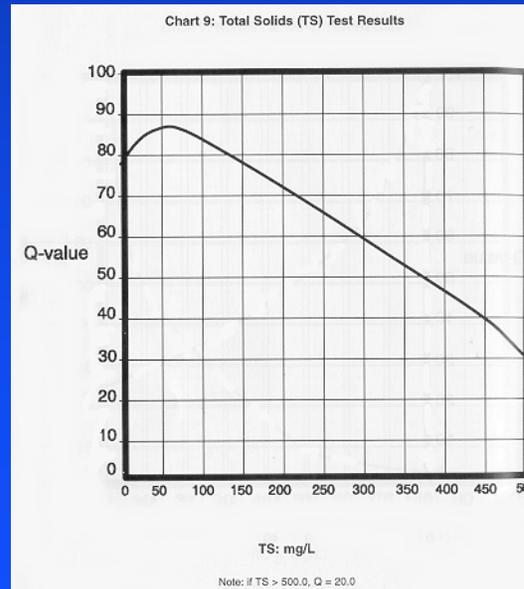
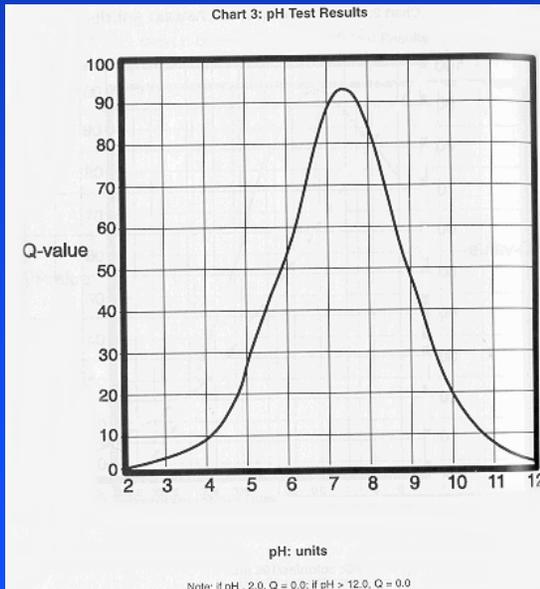
1998-2007_wq_data.txt - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	site_no	sample_dt	T_water_C	T_air_C	Baromete	DO_mgpl	DO_perce	BOD	pH_field	pH_water	Nitrate_N	Nitrate_N	Nitrate_m	Phosphati	Fecal_Coli	Fecal_C
2	1367620	7/27/2005	30.6	30.1	757	8.9	122		7.3	8.1						
3	1367625	5/7/2007	16.5	21	761	10.6	108	1	8.4	8.4	0.82		3.64			500
4	1367700	5/17/2006	13	19	741	8.4	82		7.8	8						
5	1367715	5/17/2006	13.4	16.5	742	8.8	87	2.1	8.2	7.9	0.16		0.708			300
6	1367729	5/17/2006	13.8	19.9	740	9.8	97		8.3	8.4	1.99		8.8			
7	1367770	5/7/2007	13.1	14	761	10.3	98	1	7.8	8.1	5.05		22.3			500
8	1367780	8/7/2002	17	23	745	8.2	87	1.1	8	8	0.13		0.558			130
9	1367800	6/6/2007	15.8	18	748	8	81	1	8	7.6	0.55		2.43			3000
10	1367850	8/9/2000	22.5		751	9.1	107	1.2	7.9	8	0.61		2.7			3500
11	1367860	9/15/1998	21		753	8.9	101	1	8.1	7.9	1.03		4.55			3500
12	1368820	5/14/2007	16.5	19.5	741	8.8	93	1.3	7.4	7.6	0.04		0.173			170
13	1379680	9/14/1999	19.5		747	7	78	1	7.8	7.8	0.04		0.19			
14	1379700	9/22/1998	21		740	6.7	78	1	7.4	7.5	0.08		0.372			490
15	1379800	9/16/1998	20		742	5.5	62	1	7.8	7.8	0.1		0.452			330
16	1379853	9/22/1998	20		742	6.5	74	1	7.8	7.9	0.32		1.4			9200
17	1379870	8/11/2004	19.7	30.5	746	7.7	86	1	7.3	7.6	1.6		7.1			110
18	1380100	5/16/2007	19.8	4	739	7.5	85	1	6.8	7.5	0.15		0.677			130
19	1380320	5/10/2007	20.1	24.5	748	7.8	86	2.1	7.2	7.8	0.3		1.35			300
20	1380500	10/8/2003	10.9	18	759	11	100		7.6							
21	1381050	8/23/2000	16		755	9	92	1	7.7	7.4	0.07		0.332			20
22	1382410	9/3/2002	22	29	740	13.2	156	1	8	8.1	0.22		0.992			20
23	1382450	8/10/2000	21		755	8.6	97	1	7.5	7.5	0.31		1.39			790
24	1382500	6/6/2007	17.8	15.5	743	8.8	93	1	7.5	7.8	0.14		0.606			700
25	1382960	9/8/2004	18.1	21.6	748	8.7	93	1	8.2	7.4	0.07		0.297			20
26	1438400	12/15/2004	1	-2	760	12.8	90		7.5	7.9	0.17		0.753			
27	1438500	5/21/2007	15.5	13	756	8.1	82	1	7.1	8.3	0.16		0.691			20
28	1439830	12/15/2004	1	-2.5	758	13	94	2.2	7.1	8.1	0.08		0.367			20
29	1439920	12/15/2004	1	-2	760	13.2	93		7.5	8	0.46		2.06			
30	1440000	6/5/2007	17.1	30	740	8.2	85	1	7.8	7.6	0.09		0.385			9000
31	1440100	12/15/2004	2	0	763	12.4	90		6.7	7.6						

Data Assessment

Water Quality Index (WQI)

- Weighted sum of 9 indicator Q-values
- Variables are independent
- Each indicator has its own Q-value curve



WQI Components

- Biological Oxygen Demand (BOD)
- Dissolved Oxygen (DO)
- Fecal Colliforms
- Nitrate
- pH
- Temperature Change
- Total Dissolved Solids
- Total Phosphate
- Turbidity

WQI Model

- Represent Q-value curves with fuzzy curves

WQI Model

- Represent Q-value curves with fuzzy curves
- Evaluate each indicator against its fuzzy curve

WQI Model

- Represent Q-value curves with fuzzy curves
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- Aggregate results of indicators with data using a special weighted average function

WQI Model

- Represent Q-value curves with fuzzy curves
- Evaluate each indicator against its fuzzy curve
- Aggregate results of indicators with data using a special weighted average function
- Classify the results aggregation with a fuzzy argument

WQI Model

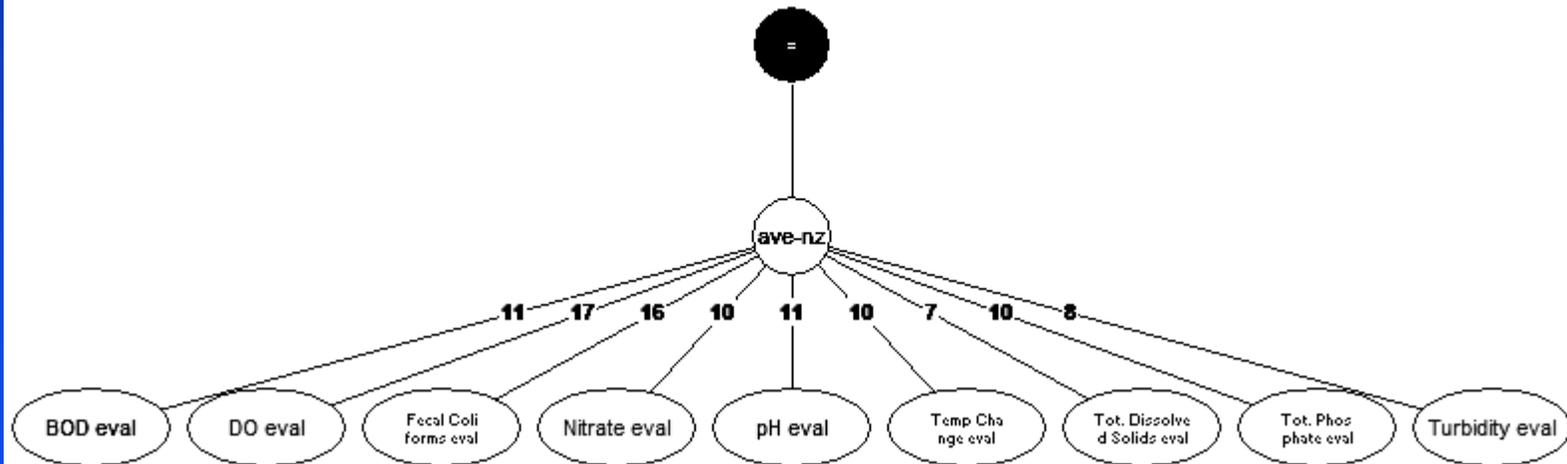
- Represent Q-value curves with fuzzy curves
- Evaluate each indicator against its fuzzy curve
- Aggregate results of indicators with data using a special weighted average function
- Classify the results aggregation with a fuzzy argument
- Map the results of the individual indicators and the aggregation

WQI Model

- Represent Q-value curves with fuzzy curves
- Evaluate each indicator against its fuzzy curve
- Aggregate results of indicators with data using a special weighted average function
- Classify the results aggregation with a fuzzy argument
- Map the results of the individual indicators and the aggregation
- Map the “holes” – missing data

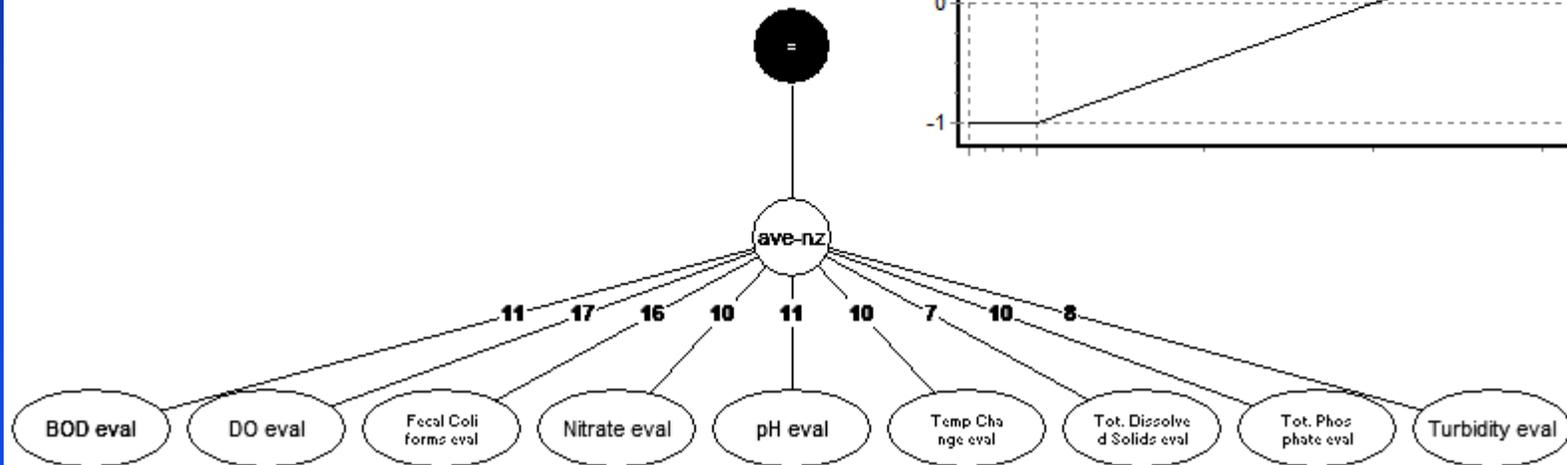
WQI Model

WQI Score - partial

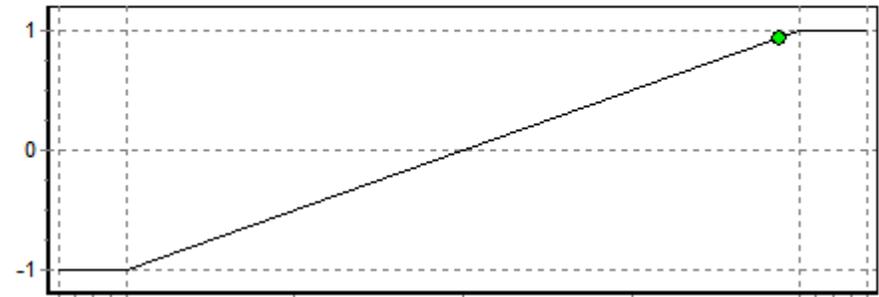


WQI Model

WQI Score - partial



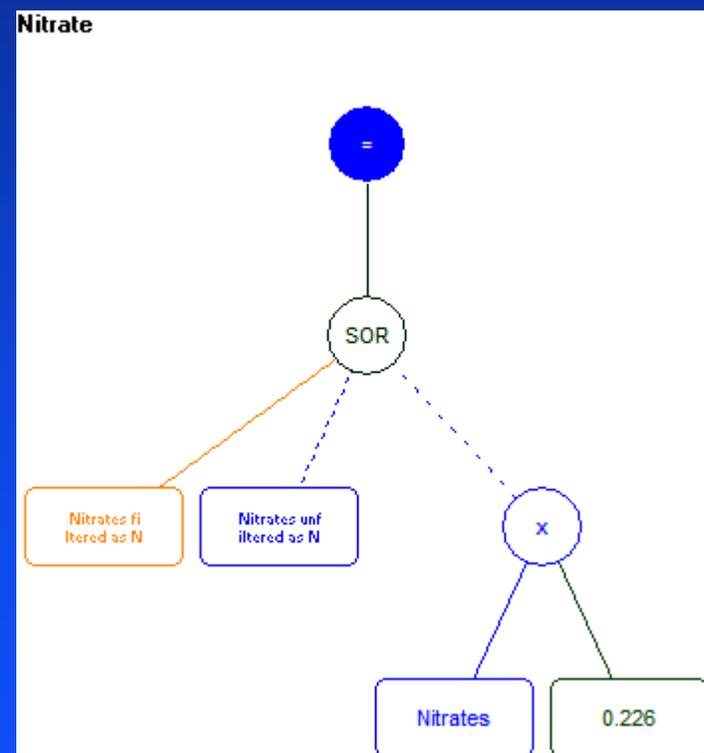
WQI Score - partial
25-90



Results Synthesis

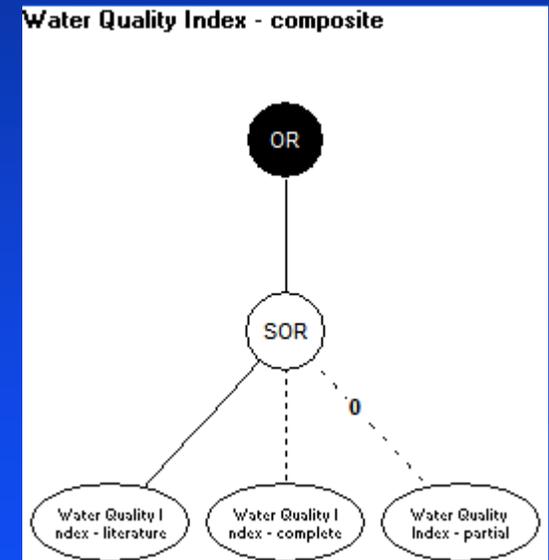
Selector of Multiple Inputs for Single Indicator

- Chooses first (left to right) route that has sufficient data
- Place methods in order of preference (best source/method first)



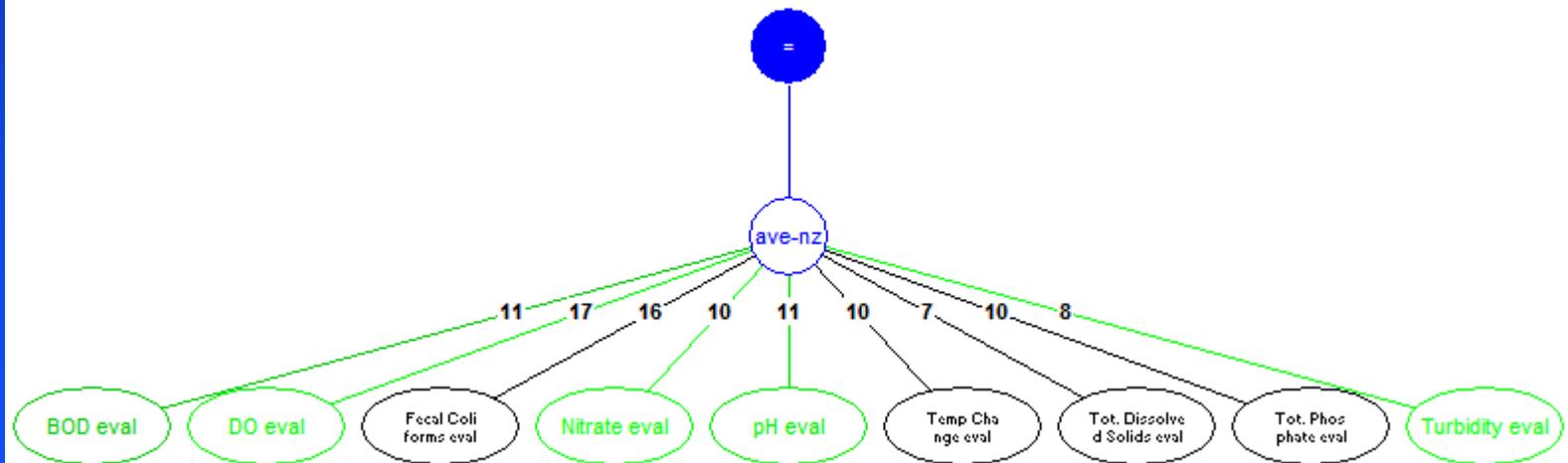
Selection from Multiple Evaluation Methods

- Preferred method first
- Third method allows missing data

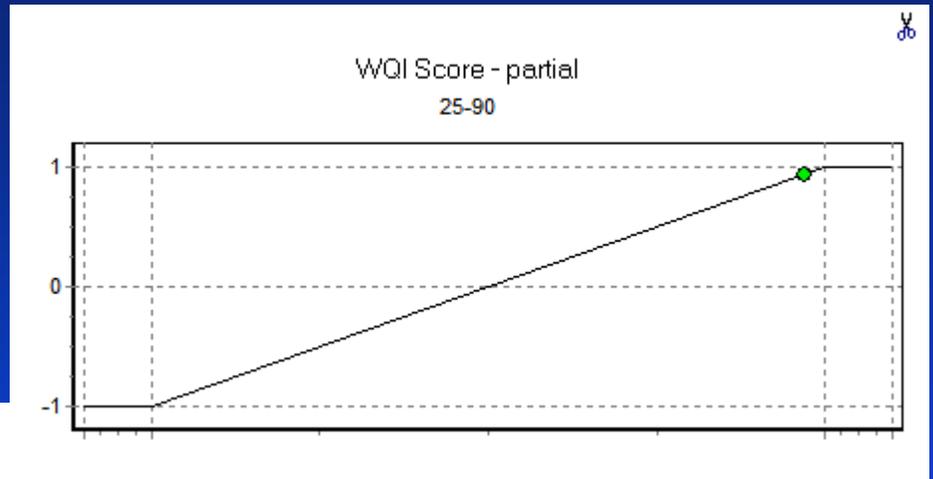


WQI Score – Partial Data

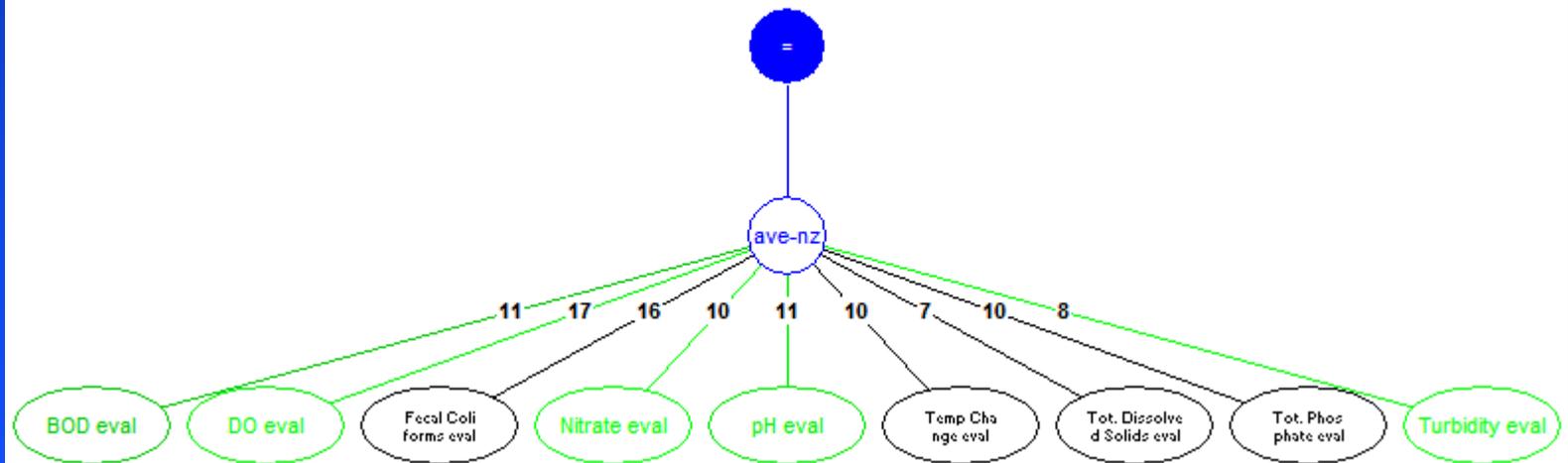
WQI Score - partial



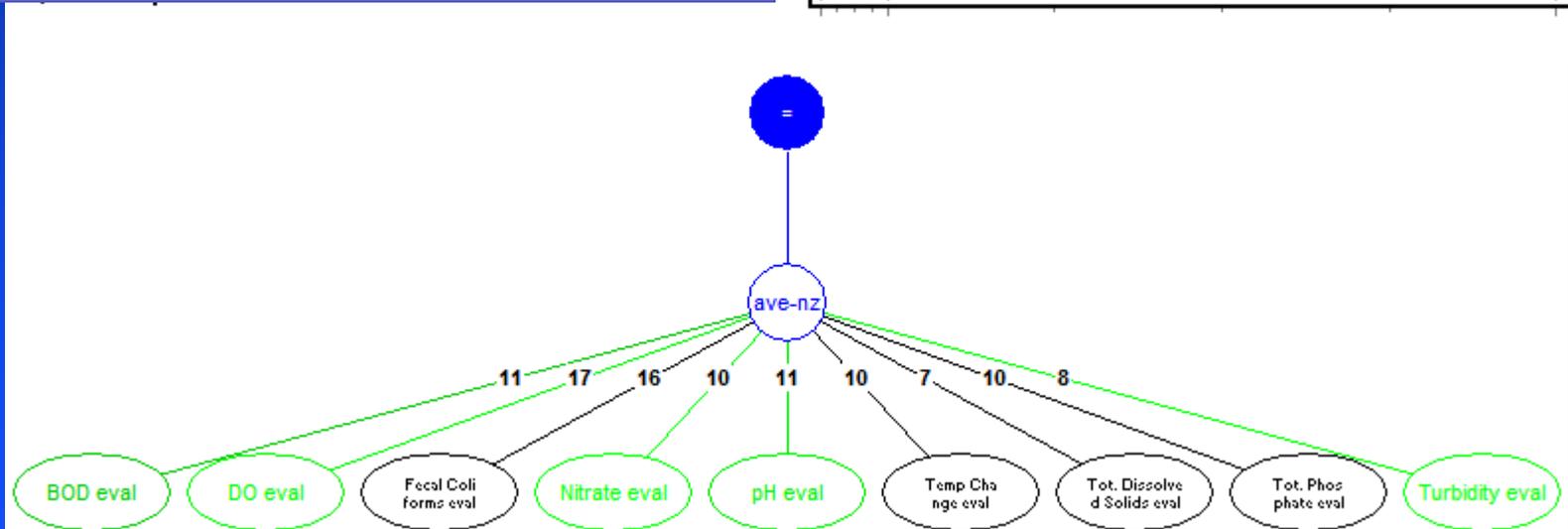
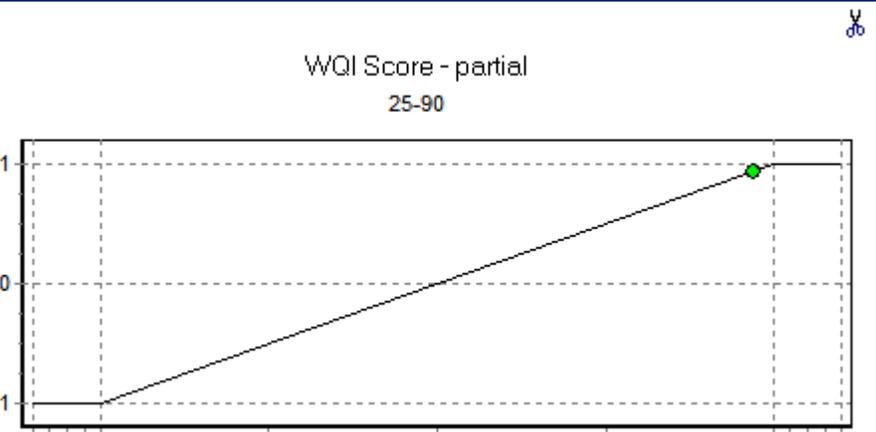
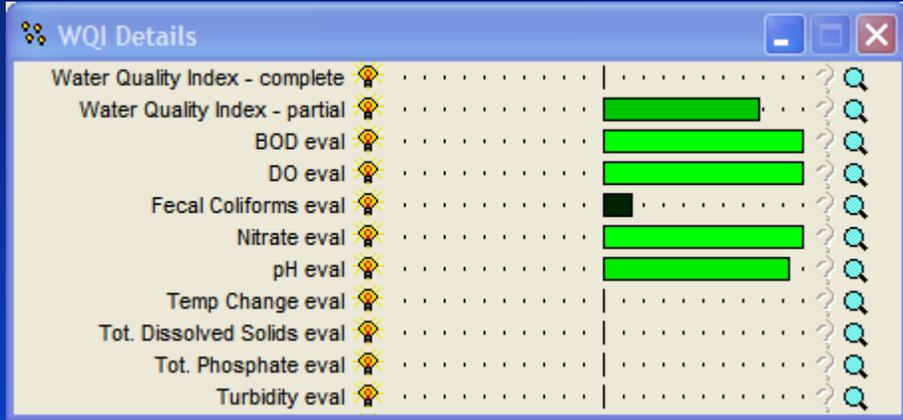
WQI Score



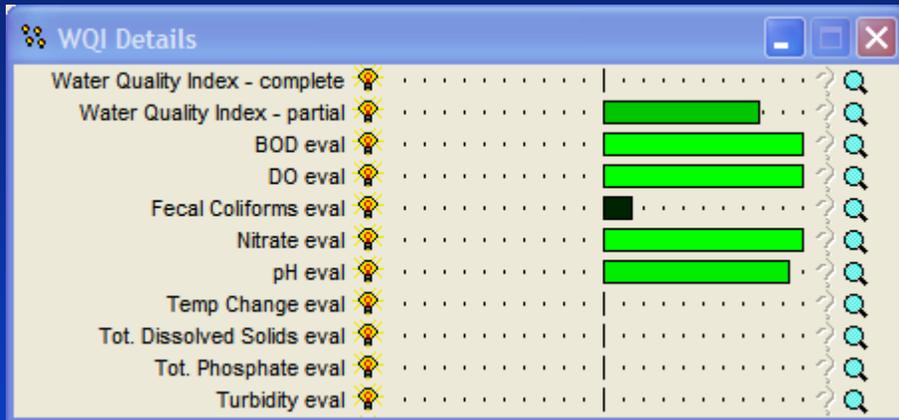
WQI Score - partial



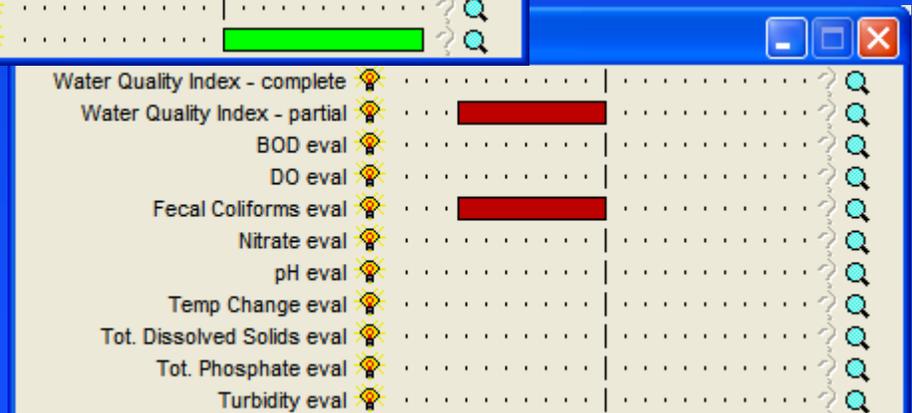
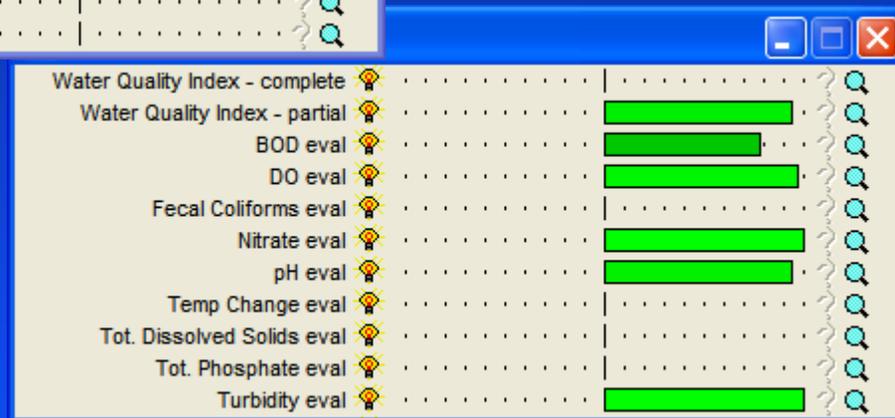
WQI Score



WQI Score



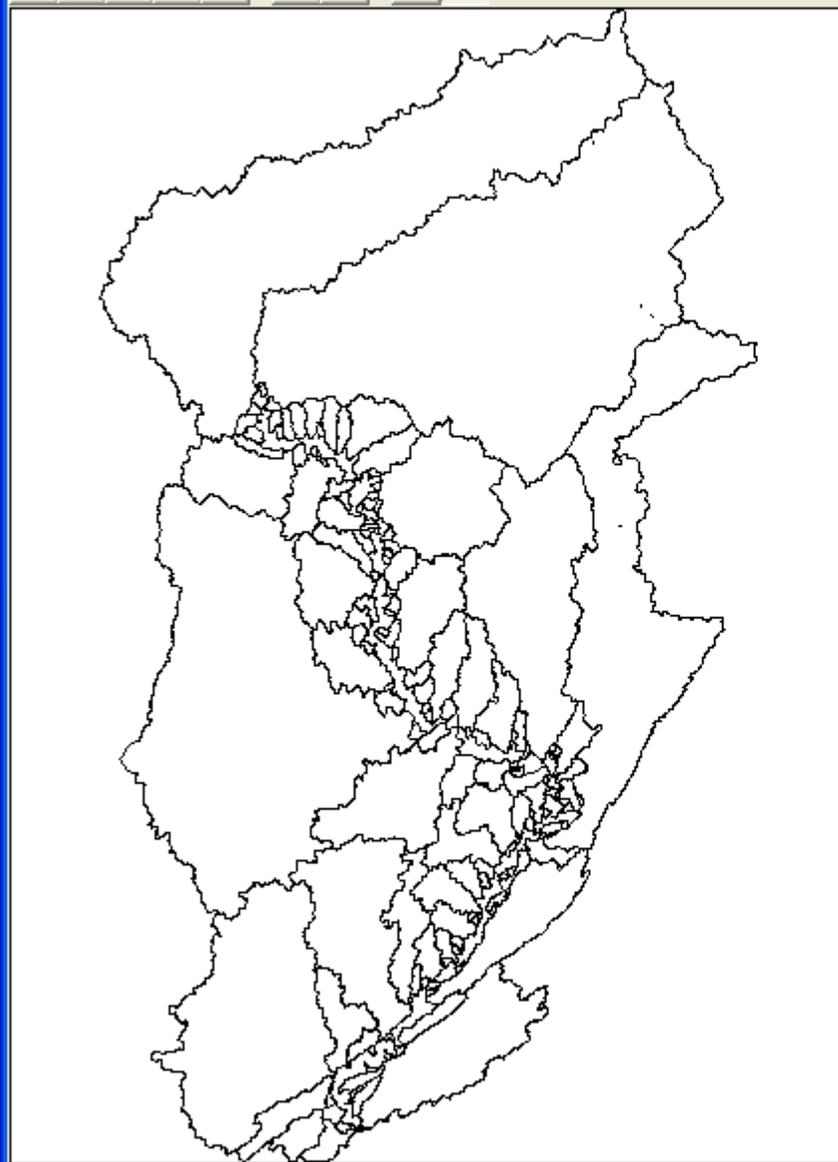
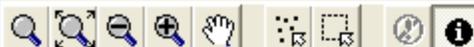
- Same gauge
- Different times



Results Display



File Setup Map Knowledge Base Results Help



Results

Aggregation

none

Topic Displayed on Map

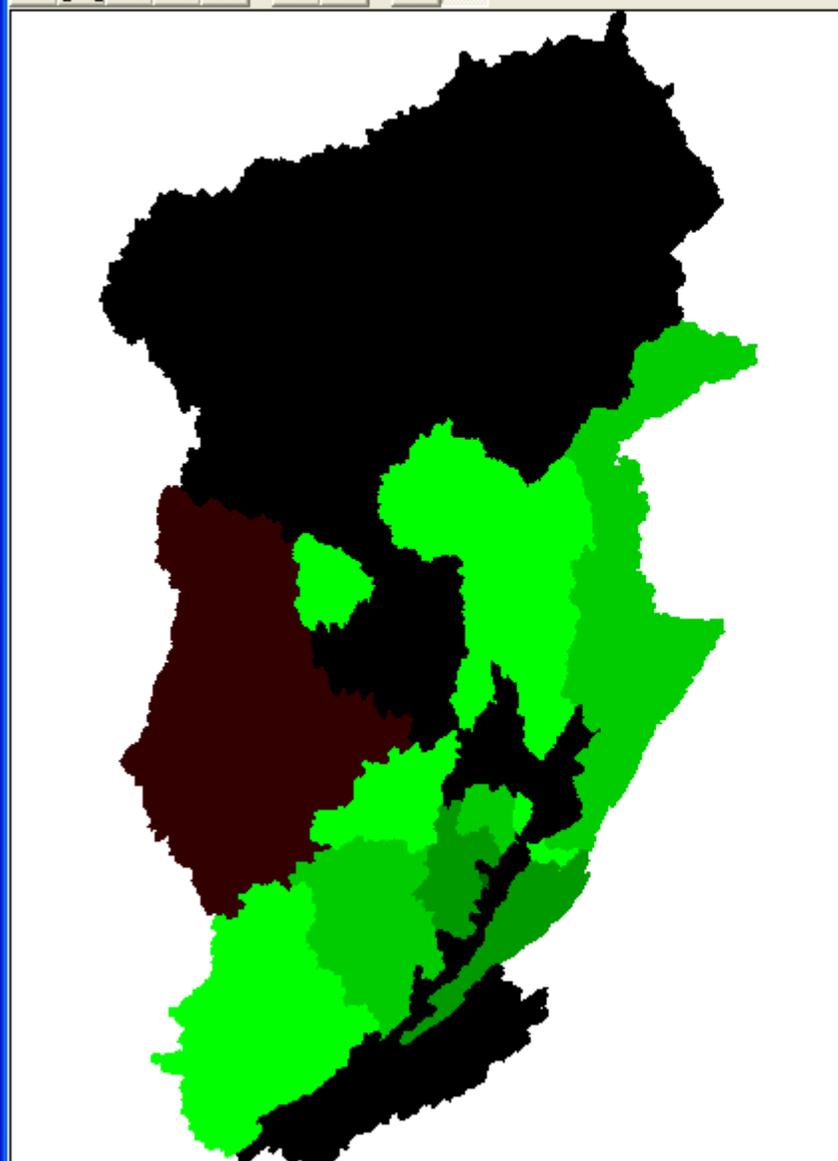
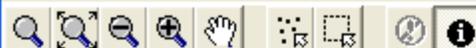
Antecedents

Legend Stats Results Inputs Watershed_fina

Name	Value	Data %
BOD eval		
Data Sufficiency		
DO eval		
Fecal Coliforms eval		
Nitrate eval		
pH eval		
Temp Change eval		
Tot. Dissolved Solids eval		
Tot. Phosphate eval		
Turbidity eval		
Water Quality Index - complete		
Water Quality Index - partial		



File Setup Map Knowledge Base Results Help



Results

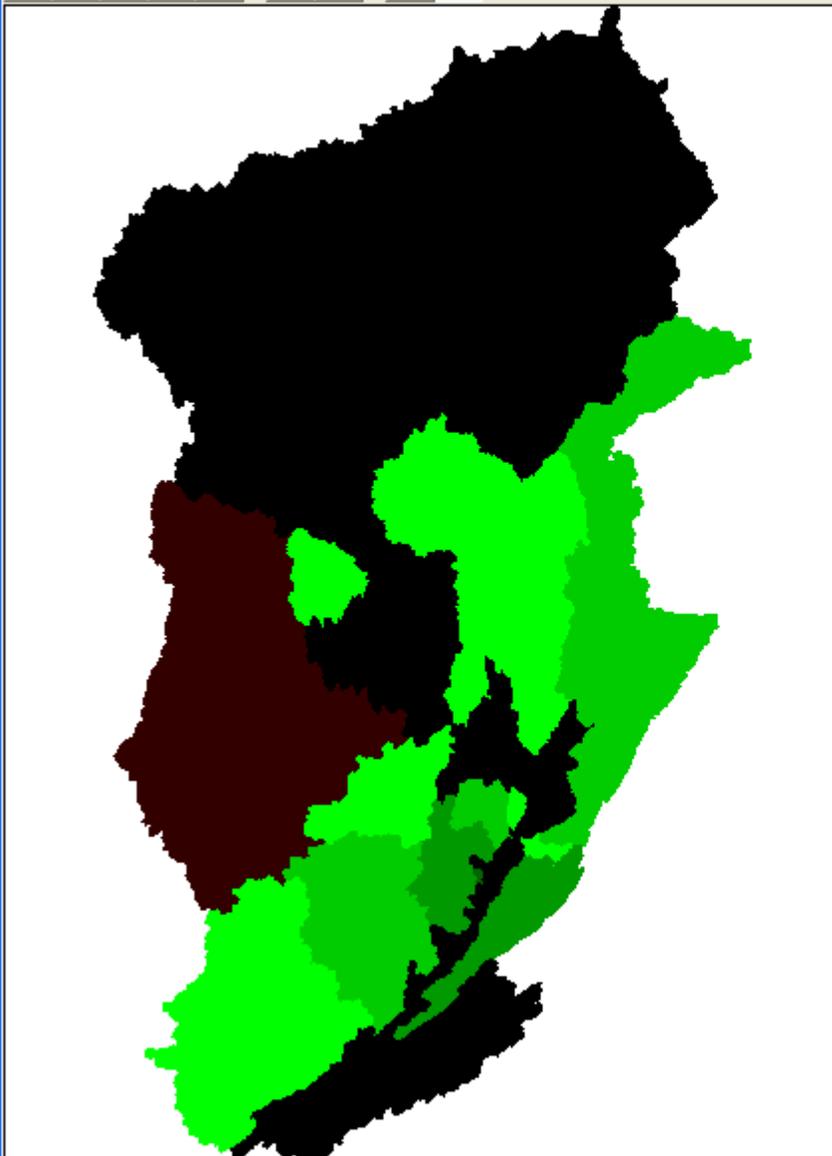
Aggregation
 none

Topic Displayed on Map
 Water Quality Index - partial

Antecedents

Legend Stats Results Inputs Watershed_fina

Name	Value	Data %
BOD eval		
Data Sufficiency		
DO eval		
Fecal Coliforms eval		
Nitrate eval		
pH eval		
Temp Change eval		
Tot. Dissolved Solids eval		
Tot. Phosphate eval		
Turbidity eval		
Water Quality Index - complete		
Water Quality Index - partial		



Results

Aggregation: none

Topic Displayed on Map: Water Quality Index - partial

Antecedents:

Data Dissatisfaction

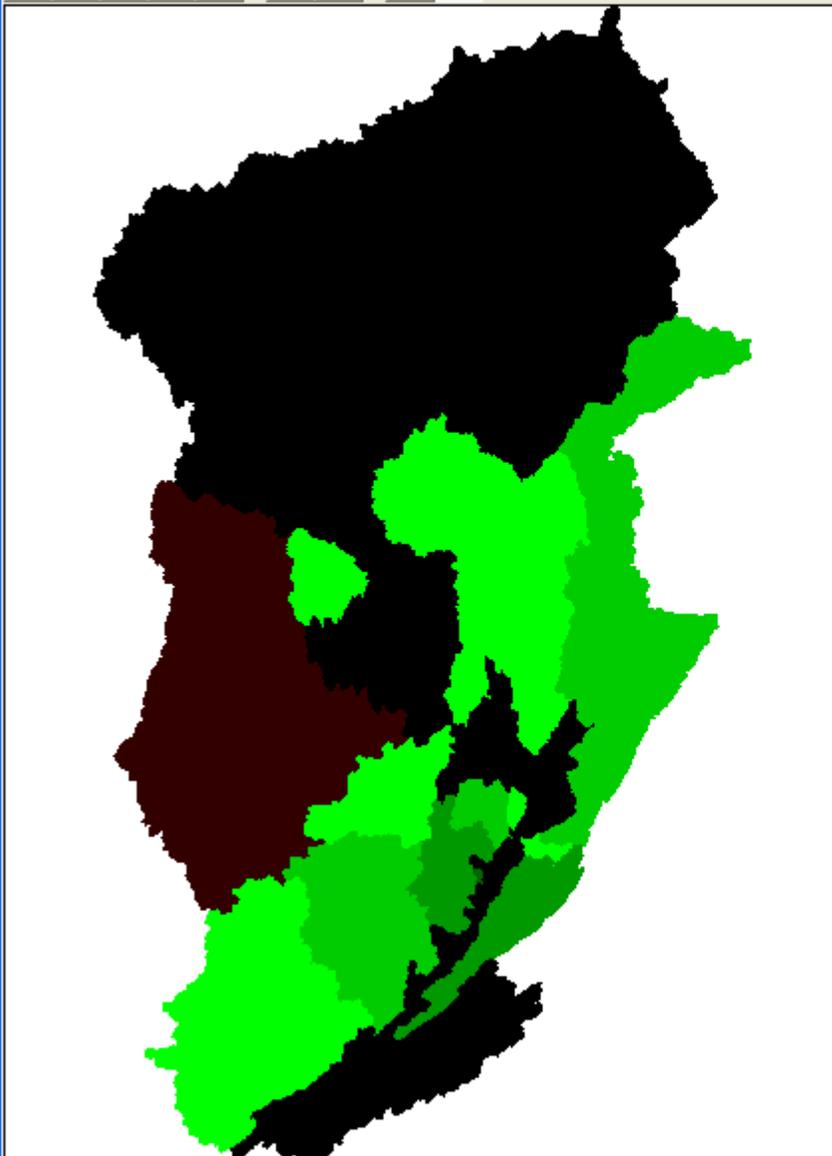
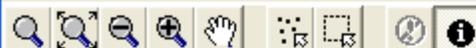
Water Quality Index - partial

True

False



File Setup Map Knowledge Base Results Help



Results

Aggregation
 none

Topic Displayed on Map
 Water Quality Index - partial

Antecedents

Legend | Stats | Results | Inputs | Watershed_fina

Name		Data %
BOD eval	-	0
Data Sufficiency	-0.778	17
DO eval	-0.231	100
Fecal Coliforms eval	-	0
Nitrate eval	1.000	100
pH eval	-1.000	100
Temp Change eval	-	0
Tot. Dissolved Solids eval	-	0
Tot. Phosphate eval	-	0
Turbidity eval	-	0
Water Quality Index - complete	-	67
Water Quality Index - partial	-0.130	38

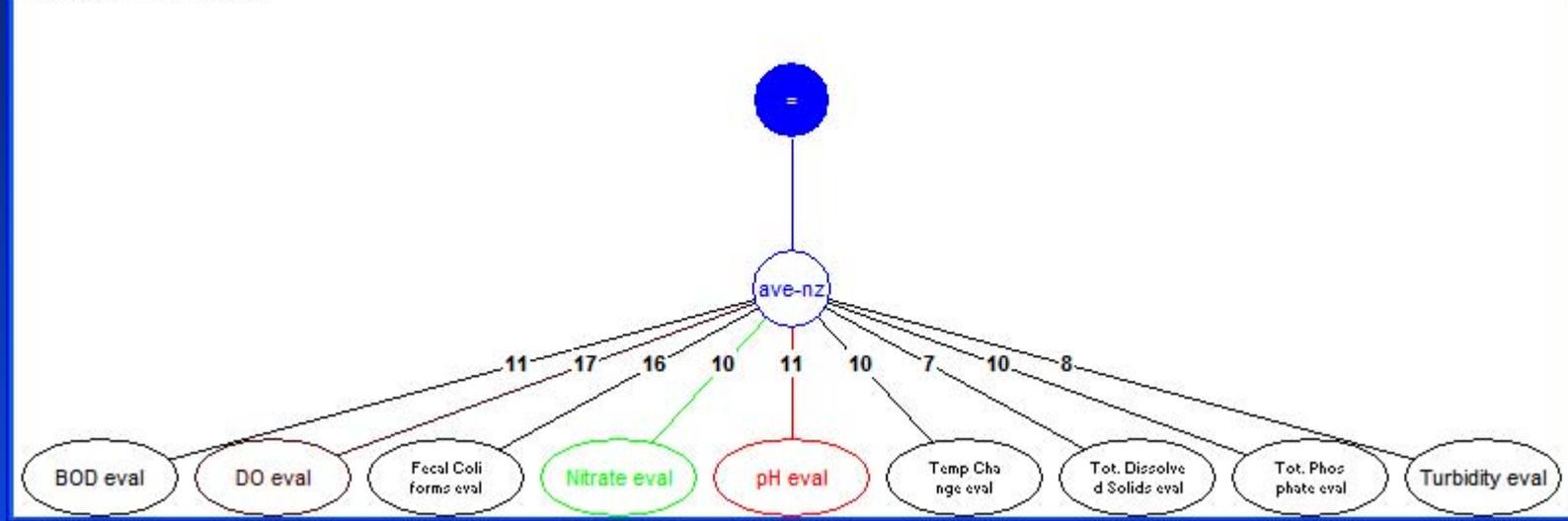
GeoNetWeaver 2007.12.19 - beta

File Setup Map Knowledge Base Results Help

Results
Aggregation: none

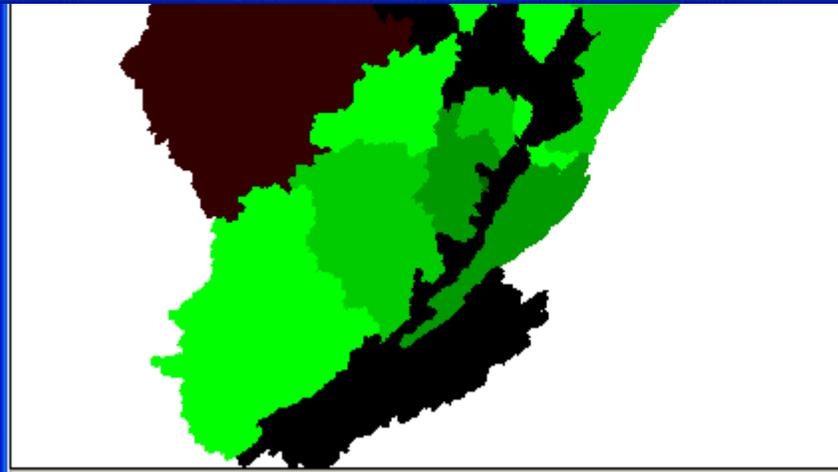
WQI Score - permissive

WQI Score - permissive



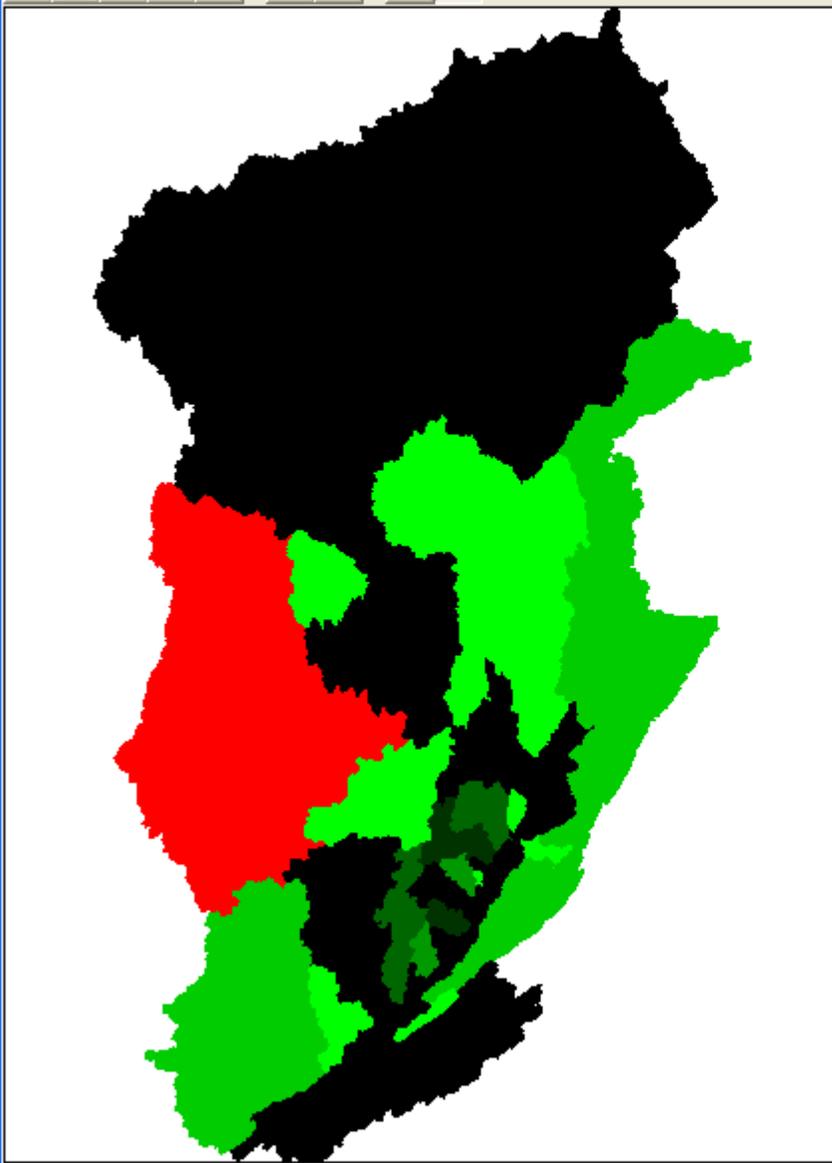
Watershed_fina

	Data %
-	0
-0.778	17
-0.231	100
-	0
1.000	100
-1.000	100
-	0
-	0
-	0
-	0
-	0
-	0
complete	67
Water Quality Index - partial	-0.130 38





File Setup Map Knowledge Base Results Help



Results

Aggregation

none

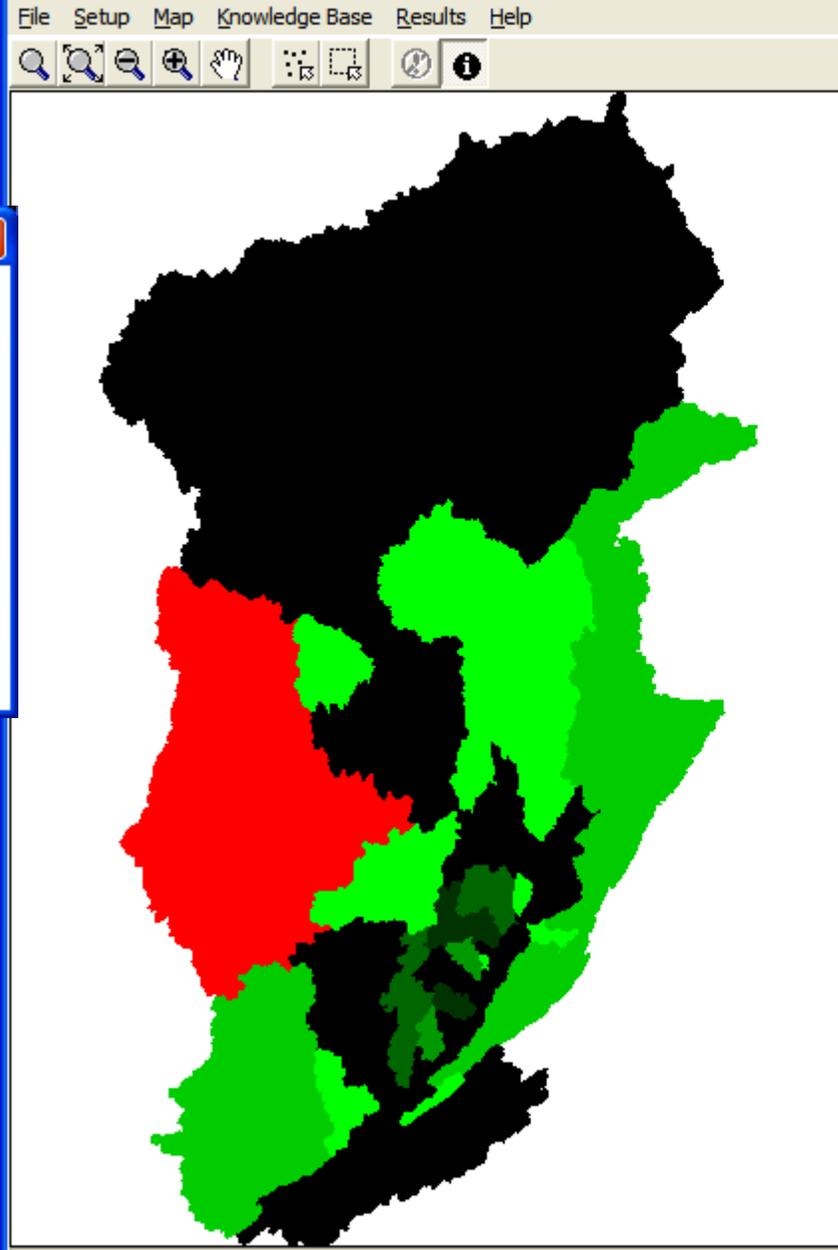
Topic Displayed on Map

pH eval

Antecedents

Legend Stats Results Inputs Watershed_fina

Name		Data %
BOD eval	-	0
Data Sufficiency	-0.778	17
DO eval	-0.231	100
Fecal Coliforms eval	-	0
Nitrate eval	1.000	100
pH eval	-1.000	100
Temp Change eval	-	0
Tot. Dissolved Solids eval	-	0
Tot. Phosphate eval	-	0
Turbidity eval	-	0
Water Quality Index - complete	-	67
Water Quality Index - partial	-0.130	38



p...

pH eval

OR

pH calc

25-90

Results

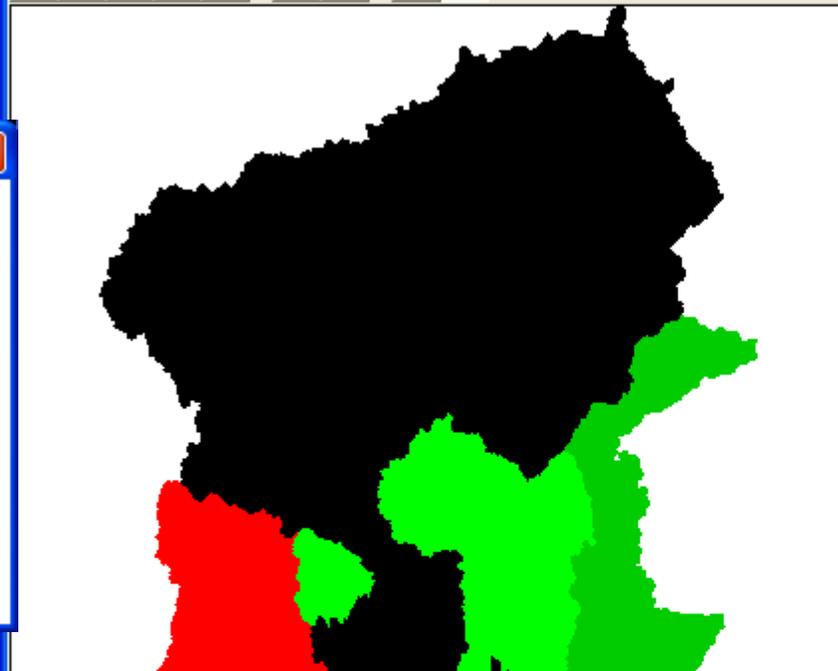
Aggregation: none

Topic Displayed on Map: pH eval

Antecedents:

Legend | Stats | Results | Inputs | Watershed_fina

Name		Data %
BOD eval	-	0
Data Sufficiency	-0.778	17
DO eval	-0.231	100
Fecal Coliforms eval	-	0
Nitrate eval	1.000	100
pH eval	-1.000	100
Temp Change eval	-	0
Tot. Dissolved Solids eval	-	0
Tot. Phosphate eval	-	0
Turbidity eval	-	0
Water Quality Index - complete	-	67
Water Quality Index - partial	-0.130	38



p...

pH eval

OR

pH calc

25-90

Results

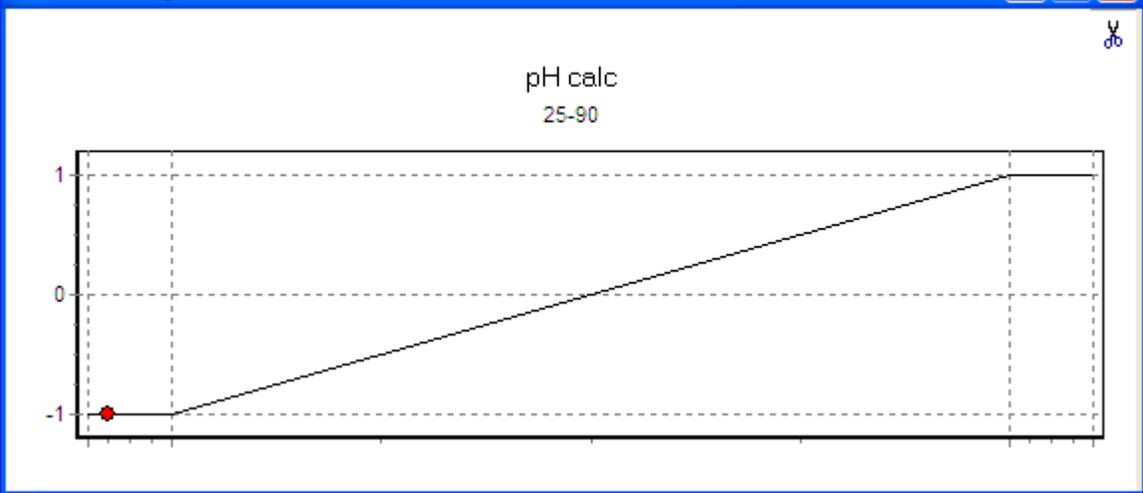
Aggregation: none

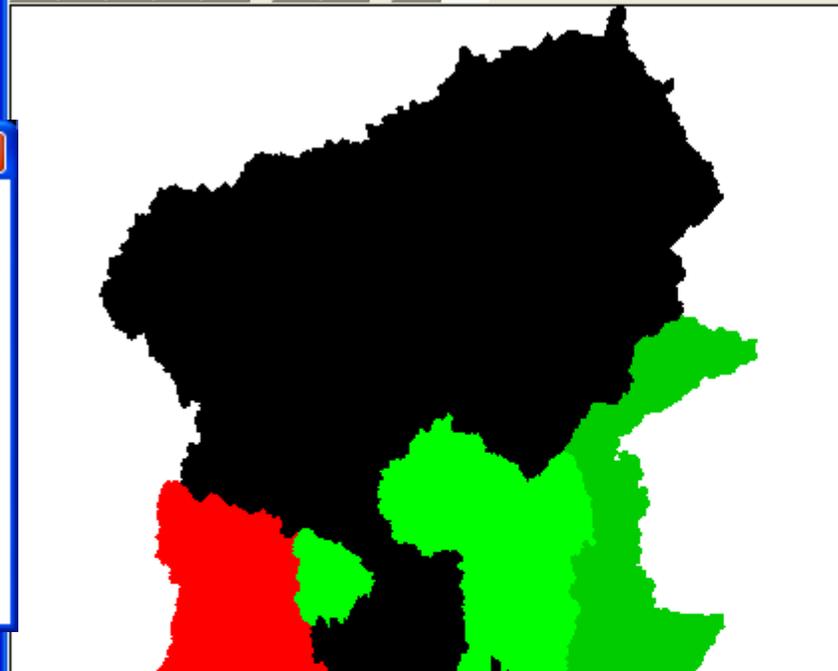
Topic Displayed on Map: pH eval

Antecedents:

Name		Data %
BOD eval	-	0
Data Sufficiency	-0.778	17
DO eval	-0.231	100
Fecal Coliforms eval	-	0
Nitrate eval	1.000	100
pH eval	-1.000	100
Temp Change eval	-	0
Tot. Dissolved Solids eval	-	0
Tot. Phosphate eval	-	0
Turbidity eval	-	0
Water Quality Index - complete	-	67
Water Quality Index - partial	-0.130	38

25-90 in pH calc





p... [min] [max] [close]

pH eval

OR

pH calc

25-90

Results

Aggregation: none

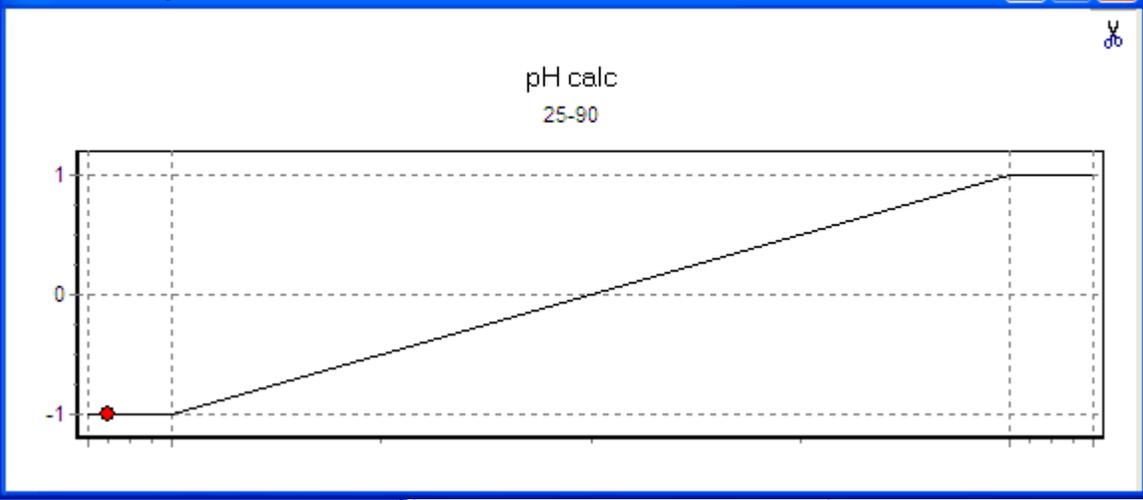
Topic Displayed on Map: pH eval

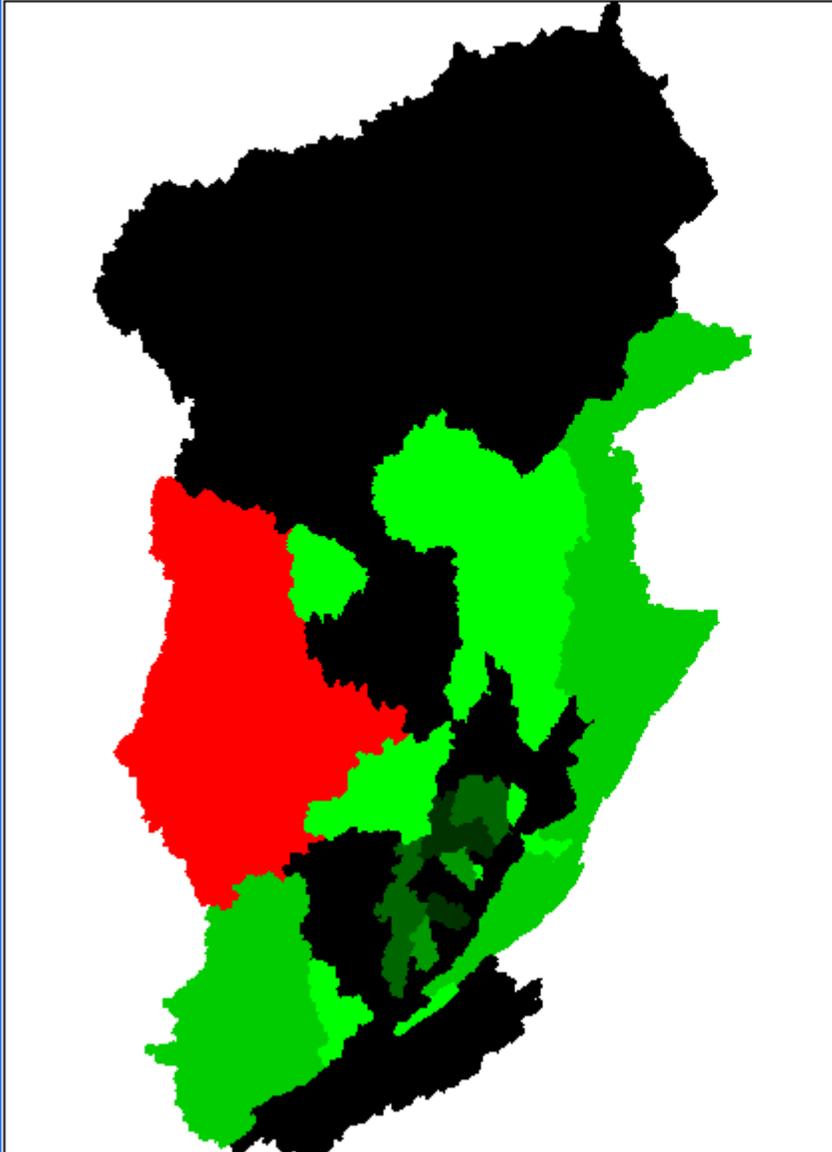
Antecedents:

Legend | Stats | Results | Inputs | Watershed_fina

Name		Source
BOD	0	Watershe
DO	155	Watershe
Fecal Coliforms ECBroth	0	Watershe
Fecal Coliforms MFCMF	0	Watershe
Nitrates	0.699	Watershe
Nitrates filtered as N	0.16	Watershe
Nitrates unfiltered as N	0	Watershe
pH_field	10	Watershe
pH_lab	9.5	Watershe
Temp Change		Watershe
Tot. Dissolved Solids		Watershe
Tot. Phosphate	0	Watershe
Turbidity	0	Watershe

? 25-90 in pH calc [min] [max] [close]





Results

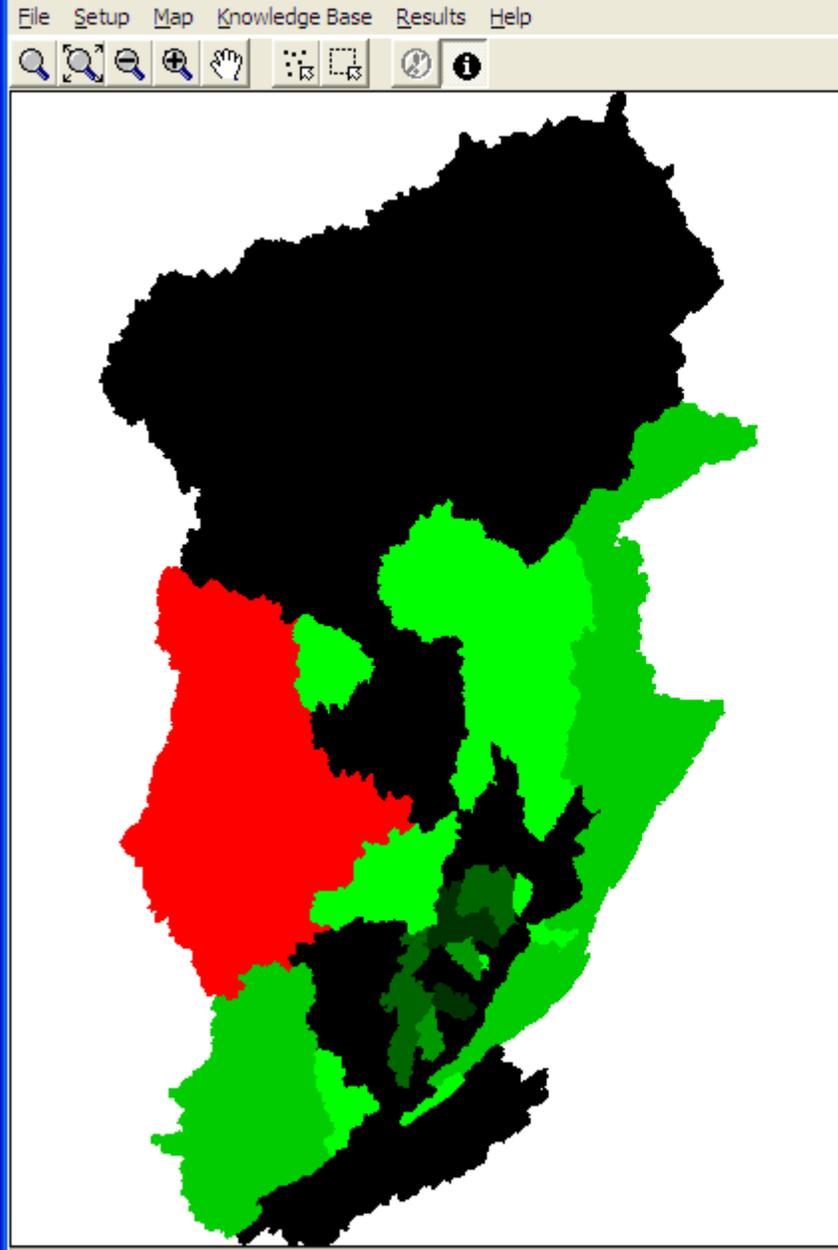
Aggregation: none

Topic Displayed on Map: pH eval

Antecedents:

Legend | Stats | Results | Inputs | Watershed_fina

Name		Source
BOD	0	Watershe
DO	155	Watershe
Fecal Coliforms ECBroth	0	Watershe
Fecal Coliforms MFCMF	0	Watershe
Nitrates	0.699	Watershe
Nitrates filtered as N	0.16	Watershe
Nitrates unfiltered as N	0	Watershe
pH_field	10	Watershe
pH_lab	9.5	Watershe
Temp Change		Watershe
Tot. Dissolved Solids		Watershe
Tot. Phosphate	0	Watershe
Turbidity	0	Watershe



Results

Aggregation: none

Topic Displayed on Map: pH eval

Antecedents:

Legend | Stats | Results | Inputs | Watershed_fina

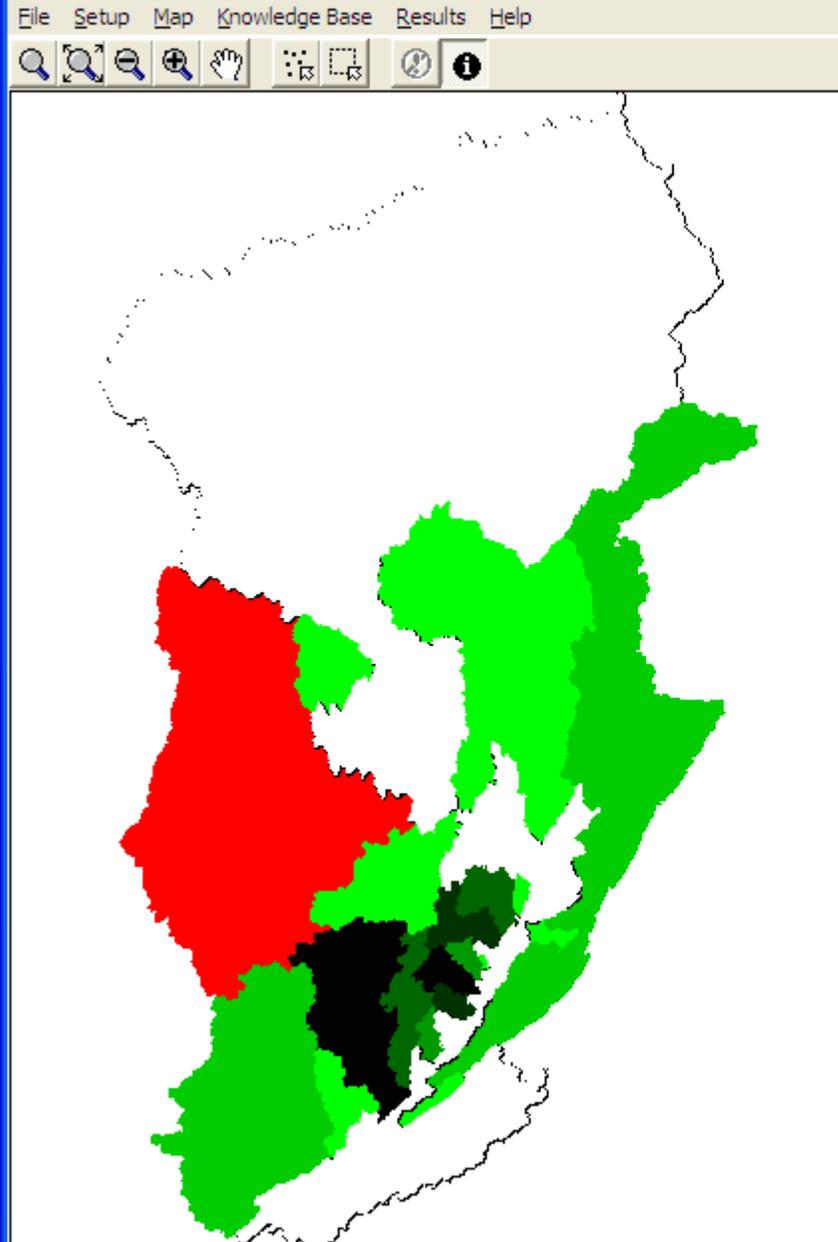
Data Dissatisfaction

pH eval

True

-

False



Results

Aggregation: none

Topic Displayed on Map: pH eval

Antecedents:

Legend | Stats | Results | Inputs | Watershed_fina

Data Dissatisfaction

pH eval

True

False

WCA Models in Development

Water Quality (chemical/physical)

- Water Quality Index
- Watersheds Hydrologic Flow
- Mainstem Hydrologic Flow
- Impoundments

Water Quality (biologic)

- Fish Indices of Biotic Integrity
- Fish (native vs non-native & natural vs recreational goals)
- Macroinvertebrate Indices
- Periphyton
- Rare Aquatic Species

Terrestrial

- Change in Forest Cover
- % Watershed in Natural Condition
- Road Density
- Road Stream Crossings
- % Impervious Surface
- Riparian Forest Fragmentation
- % Core Forest
- % Edge
- % Perforated Forest
- Rare Communities/Species
- Invasive Species
- Human Stressors

Conclusion

Conclusion

- Makes the most of the available data
- Consistency across landscape
- Easily modify/extend models
- Reusable as new data is acquired
- Dynamic view of analysis and data requirements

Remember...

Remember...

“... you go to assessment with the data you have, not the data you might want or wish to have ...”

Paraphrase of D. Rumsfeld, 2006-04-07



Contact Info

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- NetWeaver/GeoNetweaver – rules-of-thumb.com
- EMDS - www.institute.redlands.edu/emds