Section II

Presenting Water Quality Information

Presenting Water Quality Information: 305(b) and the Index of Watershed Indicators

Introduction

Water quality data can be interpreted by resource managers, researchers, conservation groups, and other interested parties in a variety of ways, depending on how the data are collected, compiled, and presented. Because of these differences in data gathering and presentation, similar data gathered by different agencies might not be directly comparable. This section focuses on two ways water quality data are presented — through the 305(b) process and in EPA's Index of Watershed Indicators (IWI). Examples from South Carolina are used to illustrate the two methods of data presentation.

There are important links between the 305(b) process and the IWI. 305(b) data are an integral part of the indices used in the IWI. Both 305(b) and the IWI report on the condition and vulnerability of waterbodies. Condition indicators describe the current status and functions of a waterbody while vulnerability is influenced by environmental factors or activities that can place stress on the resource, though perhaps not to the point that its values or functions are impaired.

Paul Goetz, Cary, NC

What is the Index of Watershed Indicators?

The Index of Watershed Indicators (IWI) is a compilation of information on the condition of aquatic resources in the United States. Just as a physician might take your temperature and blood pressure, check your pulse, and listen to your heartbeat and respiration to determine the status of your health, the Index looks at a variety of indicators that point to whether rivers, lakes, streams, wetlands, and coastal areas are "well" or "ailing" and whether activities on the surrounding lands are placing these waters at risk.

The Index is in large part based on the June 1996 *Environmental Indicators of Water Quality in the United States*, developed by EPA in partnership with States, Tribes, private organizations, and other Federal agencies. The Indicators Report presents 18 national indicators of the health of our water resources. The Index evaluates a similar set of indicators, categorized as "condition" and "vulnerability" indicators, for each of 2,111 watersheds in 48 States. (Alaska, Hawaii, and the Territories will be added in future versions of the Index.)

Why Watersheds?

A watershed is defined in nature by topography. It is the land area that drains to a body of water, such as a lake, an estuary, or a river. The watershed's drainage affects the water flow or water level and, in many cases, the overall condition of downstream bodies of water. Thus, a lake, river, or estuary is a reflection of its watershed. EPA's Office of Water, along with many local groups and State agencies, has been emphasizing the importance of organizing water quality improvement efforts on a watershed basis. Downstream conditions are affected by all contributing input from upstream tributaries and adjacent land use activities.

What Is the Size of These Watersheds?

The U.S. Geological Survey (USGS) has developed and mapped a geographic Hydrologic Unit Classification (HUC) System of watersheds at four different scales. The lower 48 States, for example, are comprised of 18 basins known as regions. Subregions, identified with a 4-digit number, nest within the regions, and 6-digit accounting units are smaller yet. Within those accounting units are 8-digit cataloging units, which define watersheds that are generally greater than 700 square miles in drainage area. For the Index, watersheds are depicted at the 8-digit scale — the smallest unit in the nationally consistent HUC System. South Carolina, for example, has 31 cataloging units, which vary in size from about 500 to 1,800 square miles.

What Are the Indicators?

Phase I of the IWI project uses 15 indicators or data layers. They were selected because they are appropriate to the IWI objectives, they have relatively uniform availability across the Nation, and they can be depicted at the 8-digit HUC scale. Seven of the indicators are related to the condition of the aquatic resources, and eight are related to vulnerability. Phase II will include Alaska, Hawaii, and Puerto Rico and will add more data layers such as ground water.

Condition Indicators

1. **Assessed Rivers Meeting All Designated Uses Established by State or Tribal Water Quality Standards (§305(b))**: Information reported by States and Tribes on the percentage of waters within the watershed that meet all uses established for those waters as reported in 1994 or 1996 reports to Congress required under Clean Water Act Section 305(b).

2. **Fish and Wildlife Consumption Advisories**: Advisories recommended by States to restrict consumption of locally harvested fish or game due to the presence of contaminants. (data from EPA's National Listing of Fish and Wildlife Consumption Advisories)

3. **Indicators of Source Water Quality for Drinking Water Systems**: Three data sets combined to give insight on the extent to which waters from rivers, lakes, or reservoirs require treatment before use as drinking water based on (1) attainment of the "water supply" designated use under Section 305(b) based on river and lake waterbodies, (2) community water supply systems with treatment in place beyond conventional treatment or systems that were in violation of source-related standards in 1995 (Safe Drinking Water Information System [SDWIS]), and (3) presence of contaminants in source water at levels that exceed one-half the maximum contaminant level (MCL). (The MCL is the level to which a contaminant must be removed from drinking water to meet Safe Drinking Water Act safety requirements.) (data from EPA's STORET database)

4. **Contaminated Sediments**: The level of potential risk to human health and the environment derived from sediment chemical analysis, sediment toxicity data, and fish tissue residue data. (data from EPA's National Sediment Inventory)

5. **Ambient Water Quality Data — Four Toxic Pollutants**: Ambient water quality data showing percent exceedances of national criteria levels, over a 6-year period (1990-1996), of copper, hexavalent chromium, nickel, and zinc. (data from STORET)

Condition Indicators

Condition indicators describe the current status and functions of a waterbody. In the 305(b) process, States and Tribes evaluate conditions in a waterbody and report on whether it supports, partially supports, or does not support beneficial uses. The Index reports on a number of condition indicators, including fish consumption advisories, contaminated sediment, and wetlands loss.

Vulnerability Indicators

Vulnerability indicators describe environmental factors or activities that can place stress on the resource, though perhaps not to the point that its values or functions are impaired. In the 305(b) process, States and Tribes report on waterbodies that currently support a beneficial use, but are threatened for that use do to circumstances in the surrounding watershed. The Index reports on a number of vulnerability indicators, including species at risk, pollutant loads, runoff potential, etc.

6. **Ambient Water Quality Data — Four Conventional Pollutants**: Ambient water quality data showing percent exceedances of national reference levels, over a 6-year period (1990-1996), of ammonia, dissolved oxygen, phosphorus, and pH. (data from STORET)

7. **Wetlands Loss Index**: Percentage of wetlands loss over a historic period (1870-1980) and more recently (1986-1996). (data from U. S. Fish and Wildlife Service's National Wetland Inventory and Natural Resources Conservation Service's National Resource Inventory, respectively)

Vulnerability Indicators

8. **Aquatic/Wetlands Species at Risk**: Watersheds with high occurrences of species at risk. (data from The Nature Conservancy and State Heritage databases)

9. **Pollutant Loads Discharged Above Permitted Discharge Limits — Toxic Pollutants**: Discharges over a 1-year period for toxic pollutants, combined and expressed as a percentage above or below the total discharges allowed under the National Pollutant Discharge Elimination System (NPDES) permitted amount. (data from EPA's Permit Compliance System)

10. **Pollutant Loads Discharged Above Permitted Discharge Limits — Conventional Pollutants**: Discharges over a 1-year period for conventional pollutants combined and expressed as a percentage above or below the total discharges allowed under the NPDES permitted amount. (data from EPA's Permit Compliance System)

11. **Urban Runoff Potential**: An estimate of the potential for urban runoff impacts based on the percentage of impervious surface in the watershed, e.g., roads, paved parking, and roofs. (data from USGS and Census Bureau)

12. **Index of Agricultural Runoff Potential**: A composite index composed of (1) a nitrogen runoff potential index, (2) modeled sediment delivery to rivers and streams, and (3) a pesticide runoff index. (data from Natural Resources Conservation Service)

13. **Population Change**: Population growth rate as a surrogate of many stress-producing activities from urbanization. (data from Census Bureau)

14. **Hydrologic Modification — Dams**: An index that shows relative reservoir impoundment volume in the watershed. The process of impounding streams changes their characteristics, and the reservoirs and lakes formed in the process can be more susceptible to pollution stress. (data from Corps of Engineers)

15. **Estuarine Pollution Susceptibility Index**: An index that measures an estuary's susceptibility to pollution based on its physical characteristics and its propensity to concentrate pollutants. (data from National Oceanic and Atmospheric Administration)

What are Some of the Benefits of the Index?

- **A focus on watershed resources:** The Index provides easy-to-get information from many sources about local watersheds and their needs.
- **Knowledge is power**: The Index enables managers and residents to understand, and therefore act responsibly about, their watershed.
- **Progress**: Together, many organizations and people have been working to maintain and improve our water quality, and they have been successful in many areas, while maintaining population and economic growth.
- **Partners**: Various Federal, State and nongovernmental organizations have begun to combine their information to tell a coordinated story. Using this information, the combined forces of these organizations can work together to better address our remaining problems and protection needs.
- **Missing data:** Indicators with too little data are clearly shown in grey, indicating where information needs to be collected.
- **Monitoring**: IWI uses information from many public and private sources to provide a full picture of watershed health.

Where Can You View the IWI?

The Index of Watershed Indicators can be viewed on the Internet at http://www.epa.gov/surf/iwi and in a hard copy report available from the National Center for Environmental Publications and Information (NCEPI). The Index includes a map of the United States with color-coded information on the overall condition/vulnerability of each watershed, as well as national maps depicting each data layer for all watersheds. The Internet version of the Index provides links to a broad range of support material.

For instance, an individual *Watershed Profile* page (see example from South Carolina) presents a map of each Cataloging Unit shown in relation to adjacent watersheds and the boundary of the State in which it is primarily located. This profile also describes the physical features and demographics of the watershed and display its *Overall Watershed Score* (one of seven categories) and the scores for each individual indicator.

How Is the Overall Watershed Score Developed?

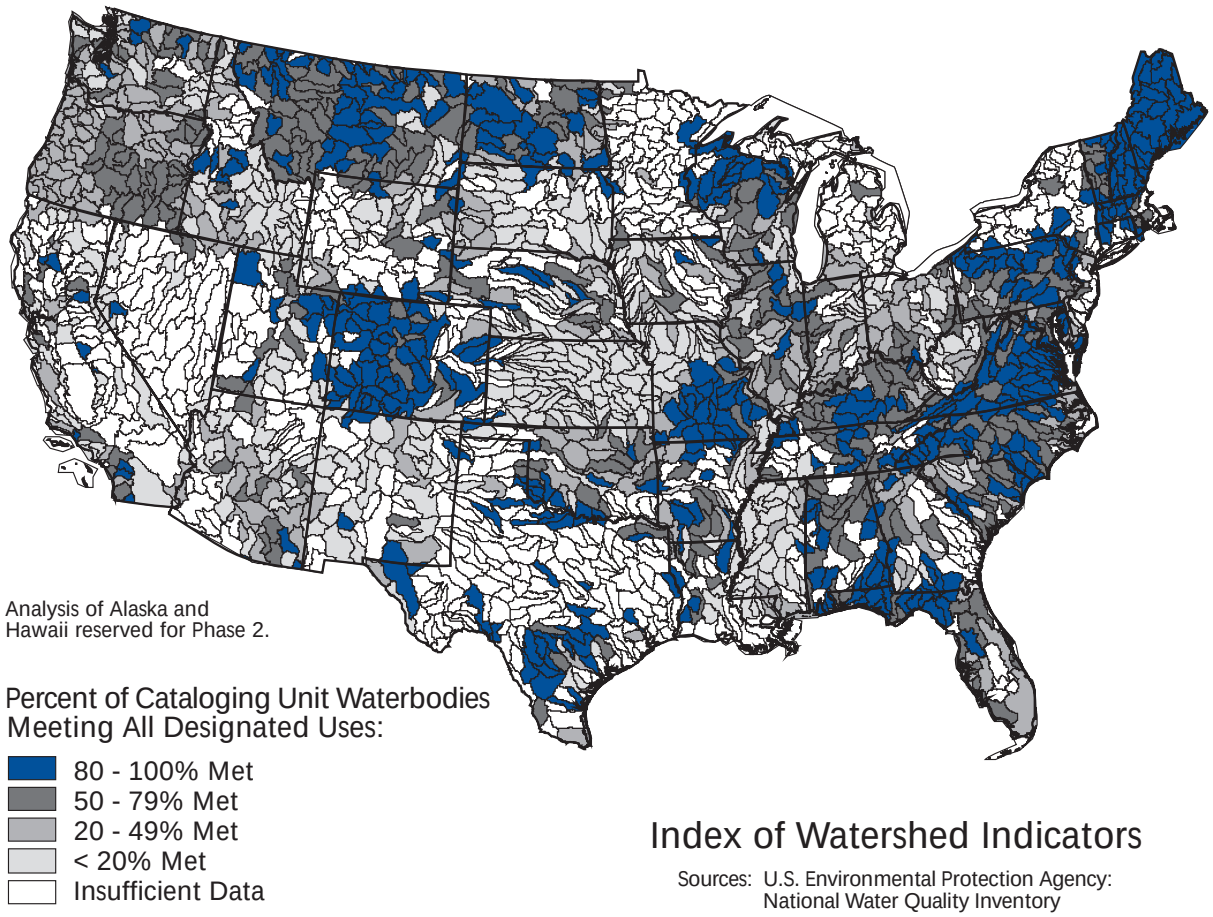
Each watershed is identified as having good quality, less serious or more serious problems, and high or low vulnerability. There is a separate category for watersheds with too little data for a valid characterization. Condition and vulnerability indicators are evaluated separately for each watershed.

For the indicators, a minimum number of observations is necessary to assign a "score." If data for a particular indicator are insufficient, that is displayed on the map and indicated in the Profile. At least 4 of 7 condition indicators and 6 of 8 vulnerability indicators must be present to calculate the overall index for any given watershed.

NOTE: Detailed information on sources of data, the method used to characterize each data layer, and the method for combining individual indicators into the overall Index is available through the Internet at www.epa.gov/surf.

In aggregating the 15 indicators into the overall Index, Indicator 1, Assessed Rivers Meeting All Designated Uses, is weighted more heavily than other indicators because it is a comprehensive assessment and EPA believes considerable weight should be given to the State and Tribal 305(b) assessment process.

Figure 1. Assessed Rivers Meeting All Designated Uses Set in State/Tribal Water Quality Standards 1994/1996



All other indicators are weighted equally. If Indicator 1 is not available, the values of the other condition indicators are increased by a factor of 3 to derive an Index score.

How Are 305(b) Data Used in the IWI?

The IWI map of "assessed rivers meeting all designated uses established by state or tribal water quality standards" (Figure 1) presents a national picture of the overall health condition of individual watersheds. Correctly read, the information provided is interpreted as follows: "In X watershed, Y percent (as a range) of the assessed stream miles in the watershed meet all designated uses." Watersheds in which a high percentage of waterbodies meet designated uses generally have better water quality than watersheds in which the percentage is low. Designated uses can be drinking water supply, aquatic life support, fish and shellfish consumption, primary and secondary contact recreation, and agriculture. Where a watershed shows a lower degree of overall designated use attainment, it is helpful to be able to break out data summaries for specific uses. Different uses employ different benchmarks to define use attainment (e.g., bacteria counts for swimming use and dissolved oxygen levels for aquatic life use).

Data summaries on such pollution stressors or the sources of the stressors may also be needed for many management decisions. The potentials of such supplemental data presentations are illustrated below.

Data Presentations — South Carolina Example

While the 305(b) process and the IWI depict similar water quality data, they differ both in scope and scale. As discussed, the Index deals with a variety of indicators, a number of which draw on data gathered through means other than the 305(b) process. IWI and 305(b) data are also presented at different scales. 305(b) data are typically gathered at the waterbody level and then aggregated to the State level for reporting in the *National Water Quality Inventory*, while IWI presents data at the HUC level. The following example using data from South Carolina demonstrates how data are reported through IWI and the 305(b) process and compares and contrasts the two presentations.

Figure 2 is a table of individual use support in South Carolina taken

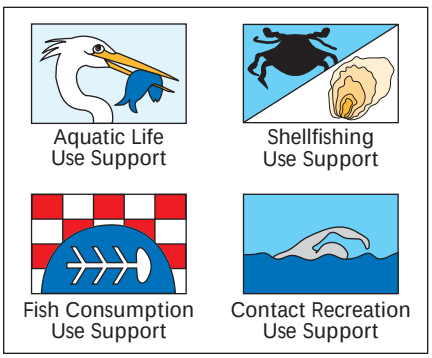
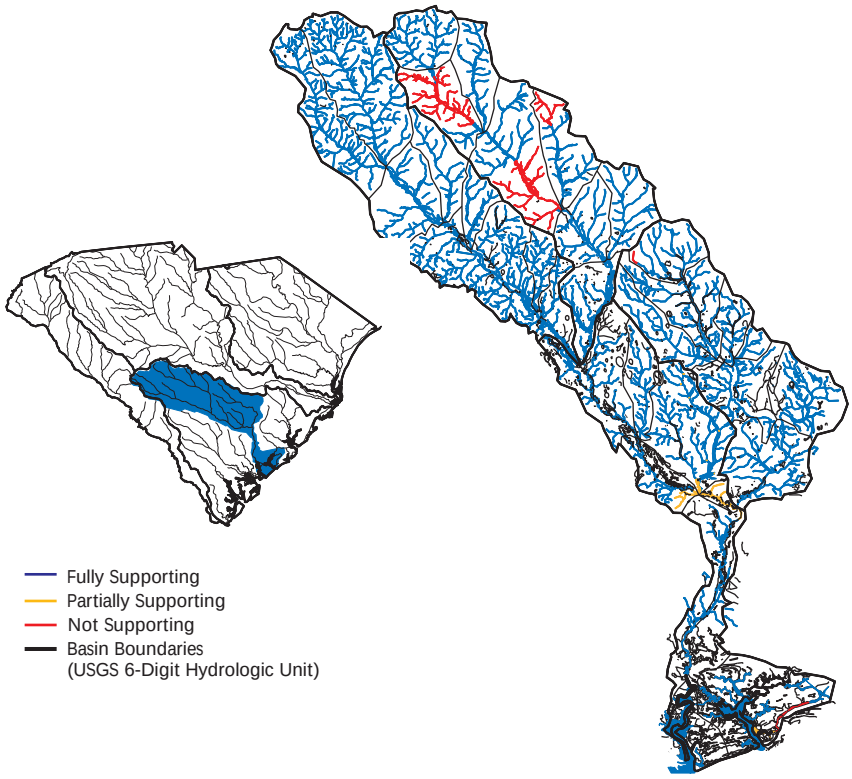


Figure 2. Individual Use Support in South Carolina in 1994

Designated Use		Percent: Good (Fully Supporting)	Good (Threatened)	Fair (Partially Supporting)	Poor (Not Supporting)	Poor (Not Attainable)
Rivers and Streams (Total Miles = 35,461)						
Aquatic Life Use Support	Total Miles Surveyed 26,314	91	0	4	5	0
Fish Consumption Use Support	–	–	–	–	–	–
Contact Recreation Use Support	26,314	63	0	16	21	0
Lakes (Total Acres = 525,000)						
Aquatic Life Use Support	Total Acres Surveyed 211,244	99	0	0	1	0
Fish Consumption Use Support	–	–	–	–	–	–
Contact Recreation Use Support	211,245	99	0	<1	<1	0
Estuaries (Total Square Miles = 945)						
Aquatic Life Use Support	Total Square Miles Surveyed 343	75	0	12	13	0
Fish Consumption Use Support	–	–	–	–	–	–
Shellfishing Use Support	–	–	–	–	–	–
Contact Recreation Use Support	343	86	0	6	8	0

Figure 3. South Carolina's Edisto Watershed

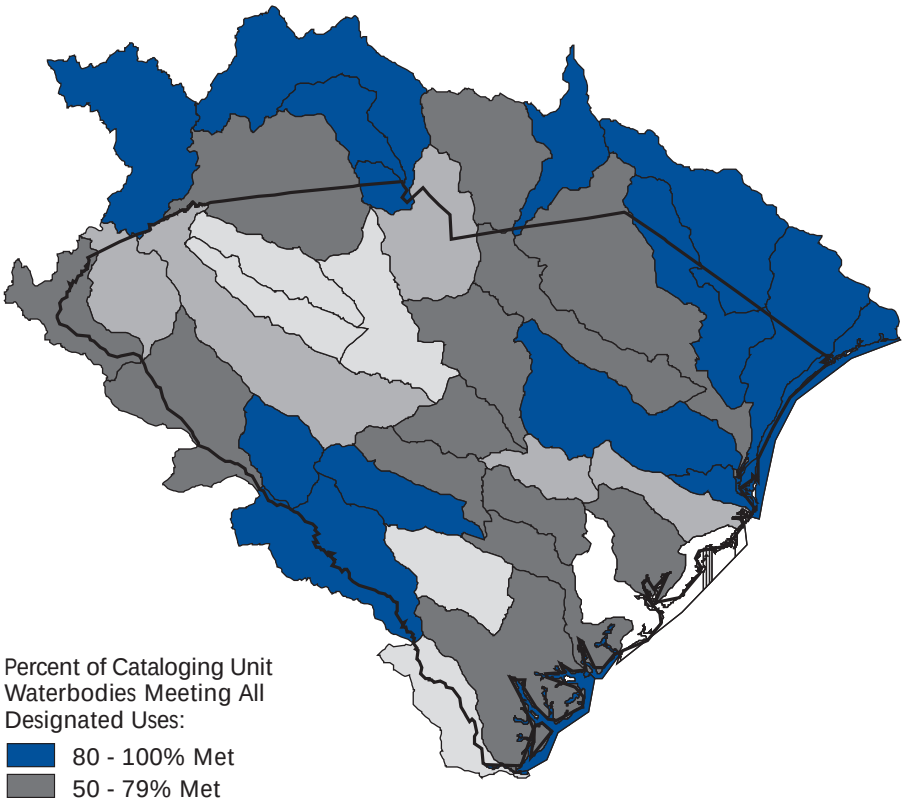


from the 1994 *National Water Quality Inventory* summary document. These data were originally gathered at the waterbody level. In other words, State resource managers assessed particular rivers, lakes, and estuaries in South Carolina, then compiled statistics at the statewide level. For example, the data show that 91% of rivers in South Carolina fully support aquatic life use, as opposed to 75% of estuarine waters. In this format, the data are useful to individuals interested in general water quality conditions across the State, such as a concerned citizen or legislator.

Figure 3, also taken from the 1994 *National Water Quality Inventory* summary document, represents another depiction of 305(b) data. This figure shows a map of South Carolina's Edisto watershed. Each stream in the watershed is color-coded to its corresponding use support status. This type of map is particularly helpful to watershed resource managers who need to prioritize water quality monitoring and restoration projects in a watershed. For example, red areas (which do not support all beneficial uses) might be targeted for improvement measures or additional research.

The map in Figure 3 was generated through a process called reach indexing, whereby waterbody-level 305(b) use support data were linked to a map of South Carolina's hydrography. Reach indexing is the process of linking water quality information to the EPA Reach File, a hydrography dataset at the 1:100,000 scale that will eventually become part of a Federal standard National Hydrography Dataset (NHD). The link between the map and the water quality data is made using a geographic information system (GIS). Reach indexing gives States powerful mapping and spacial analysis capabilities for specific streams within a watershed.

Figure 4. Assessed Rivers Meeting All Designated Uses in South Carolina



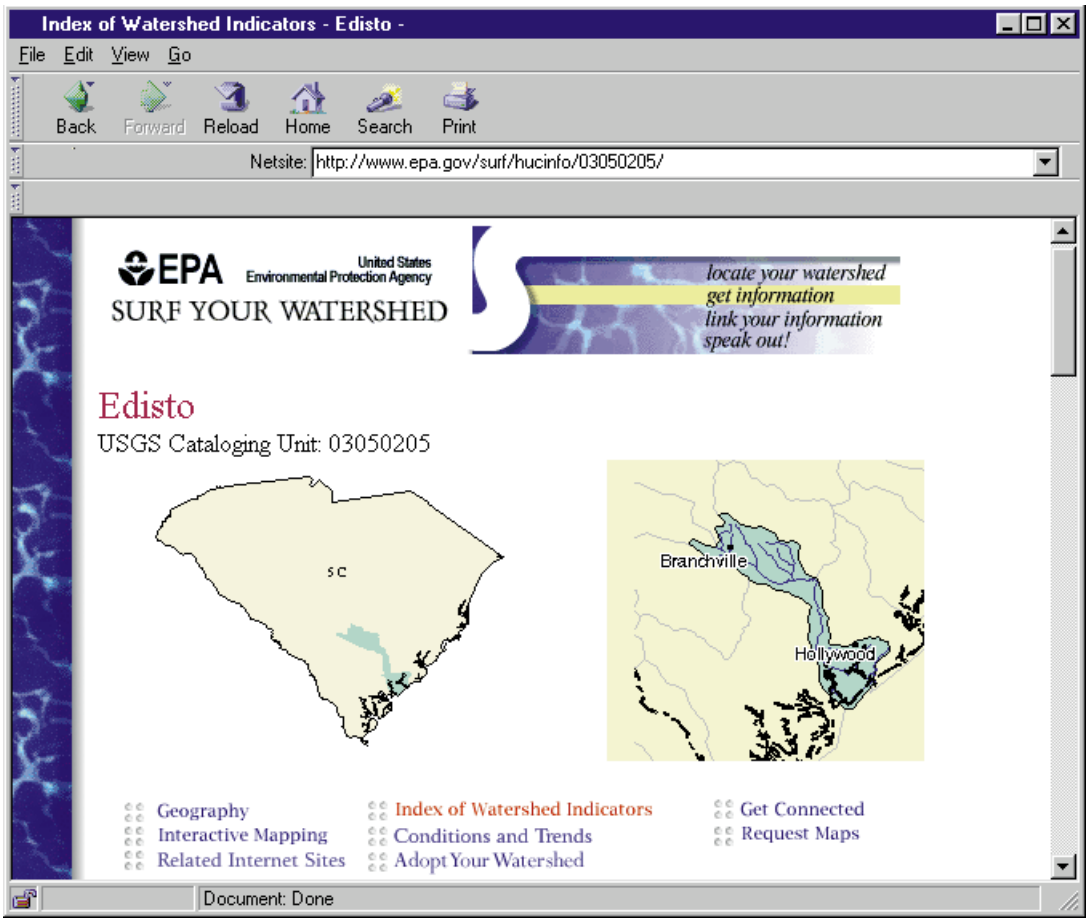
IWI displays information at the same watershed scale as the map of the Edisto watershed shown above. Figure 4 is an example of one way in which the IWI presents information. The figure shows all the watersheds in South Carolina color-coded by the IWI indicator of the percent of the watershed meeting all designated uses. A map at this scale might benefit a State resource manager who needs information on how to allocate resources across South Carolina.

A resource manager might also want to view information just for a single watershed in South Carolina. Through EPA's World Wide Web page, *Surf Your Watershed*, individuals can choose a particular watershed in a State and obtain IWI information. Figure 5 shows the option of obtaining IWI information for the Edisto watershed.

Figure 6 presents the IWI indicators for the Edisto watershed as they are displayed in *Surf Your Watershed*. In addition to an overall watershed score, there are also scores for both the condition and vulnerability of the Edisto watershed. As discussed above, 305(b) assessment data for the watershed are used to determine the designated use attainment score. This indicator is weighed more heavily than the others.

Through *Surf Your Watershed*, the IWI makes available 305(b) data aggregated at the watershed scale. Figures 7 and 8 display aquatic life use support in the Edisto watershed for rivers and estuarine waters,

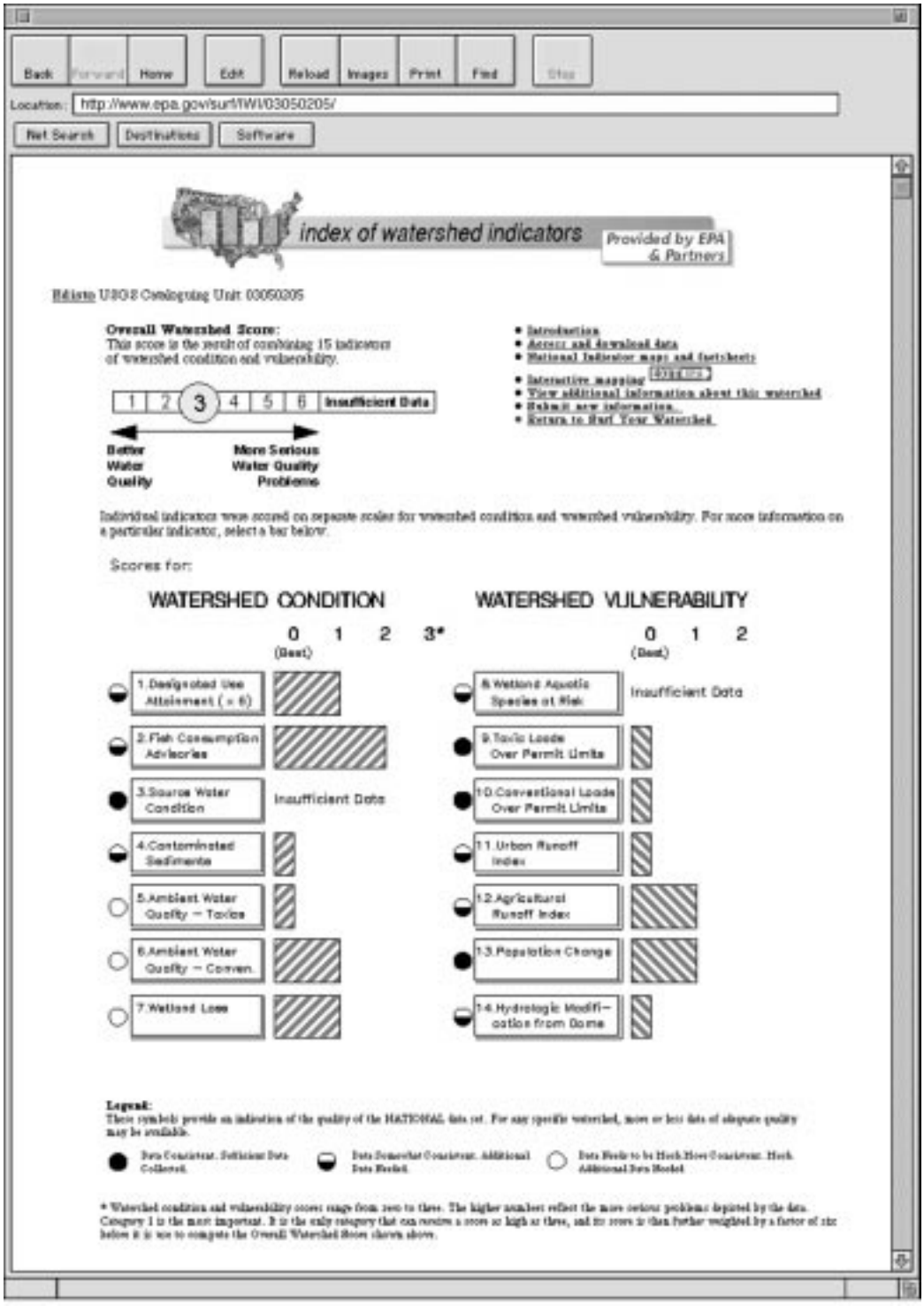
Figure 5. Surf Your Watershed World Wide Web Page for the Edisto Watershed



respectively. The data show that over 90% of the rivers and estuarine waters in the watershed fully support aquatic life use. It is interesting to compare these values to the statewide numbers presented in Figure 2. While statewide, 91% of South Carolina rivers fully supported aquatic life use, only 75% of the State's estuarine waters fully supported this use. Thus, the data tell us that the Edisto watershed has better than average estuarine water quality than compared to the State as a whole. This type of information can be helpful for a water quality manager interested in targeting resources across the State.

The IWI also makes available 305(b) data on the causes and sources of impairment at the watershed level. As Figure 3 demonstrates, there is a "hot spot" in the Edisto basin where a number of streams do not support all beneficial uses. It might be helpful for resource managers planning programs to improve water quality in the area to have information on the causes and sources of this impairment. The cause and source information for the Edisto watershed available through the IWI (Figures 9 and 10) indicates that the most prevalent causes of impairment in rivers are pathogens and turbidity, and the most prevalent sources of pollution are agriculture, natural sources, and municipal point sources.

Figure 6. Water Quality Information Presented Graphically on *Surf Your Watershed*



As displayed in *Surf Your Watershed*, IWI indicators of the condition of the watershed are scored and assigned to one of three categories — better water quality, water quality with less serious problems, and water quality with more serious problems. Second, indicators of vulnerability are scored to create two characterizations of vulnerability — high and low. These two sets of indicators are then combined to create the Overall Watershed Score illustrated at the right.

Figure 7. Aquatic Life Use Support for Rivers in the Edisto Watershed

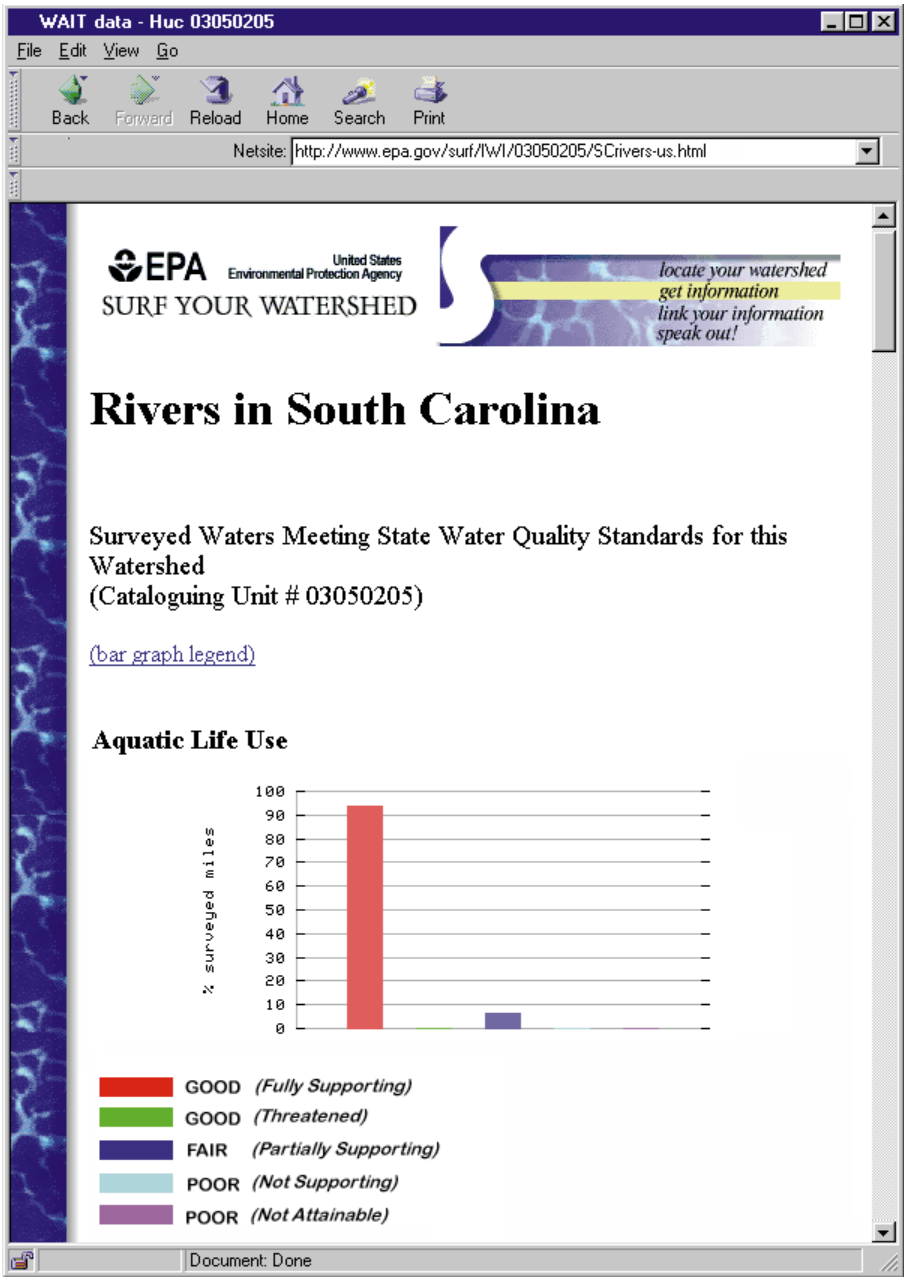


Figure 8. Aquatic Life Use Support for Estuarine Waters in the Edisto Watershed

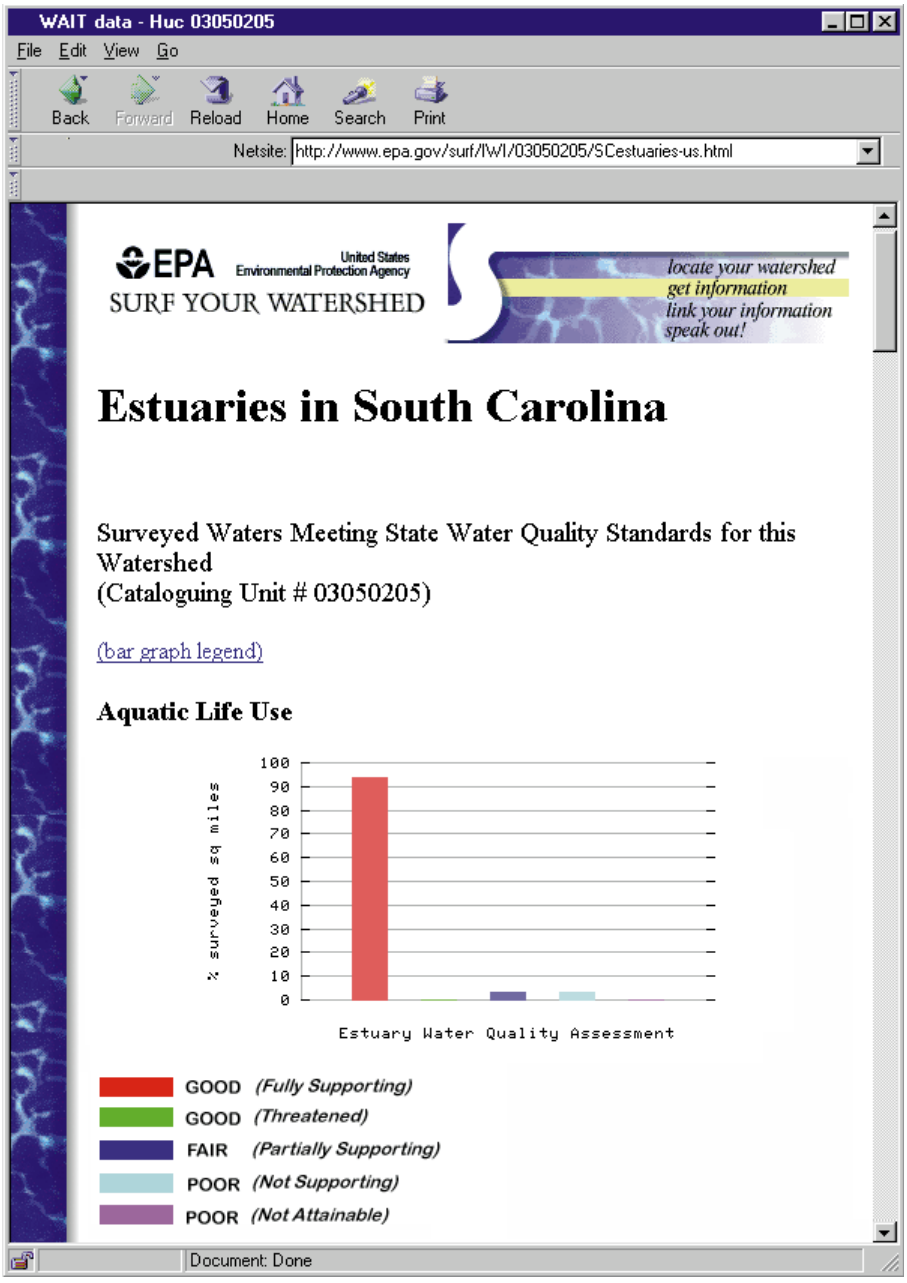
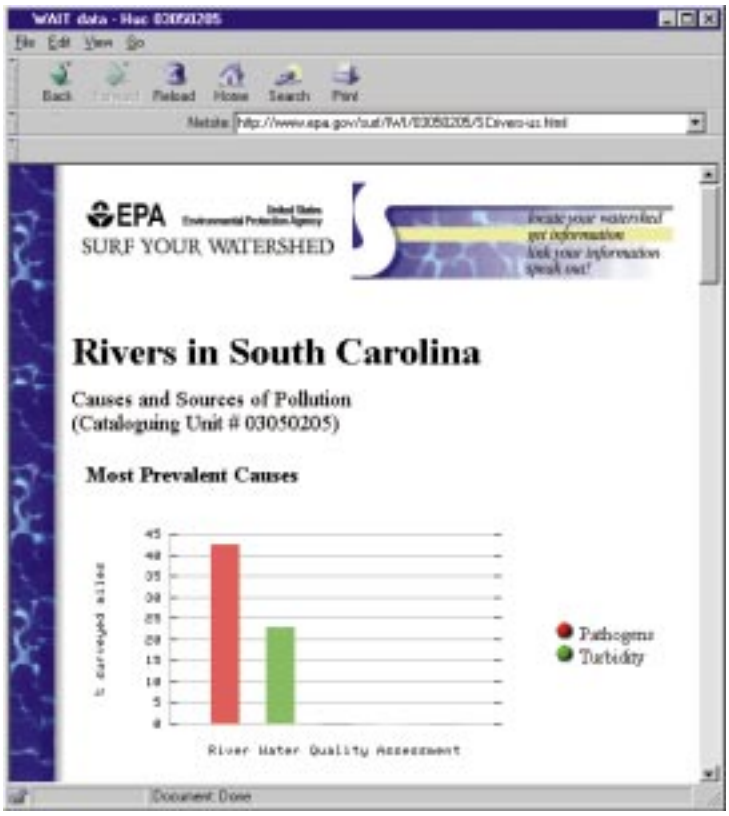


Figure 9. Major Causes of Impairment to Rivers in the Edisto Watershed



Conclusion

As the South Carolina example demonstrates, 305(b) and the IWI offer many ways of viewing water quality information. The scale at which data are aggregated, whether it be at the National, regional, State, watershed, or waterbody level, provides us with various "snapshots" of water quality conditions and vulnerability. All of the presentations are valid, but each is an attempt to present information in a different way, and each has strengths and weaknesses. Determining which presentation is best depends on the needs of the resource manager.

Figure 10. Major Sources of Impairment to Rivers in the Edisto Watershed