

Index of Watershed Indicators: An Overview

U.S. Environmental Protection Agency
Office of Wetlands, Oceans, and Watersheds

Table of Contents

Introduction	1
Questions and Answers	3
Flow Charts for the Indicator Data Process	9
Methodology for Source Water Condition for Drinking Water	35
Methodology for Watershed Condition	37
Methodology for Watershed Vulnerability.....	38

Revised: August 2002

Introduction

The Index is a compilation of information on the "health" of aquatic resources in the United States. Just as a physician might take your temperature and your blood pressure, check your pulse, listen to your heart beat and respiration, evaluate your weight compared to your height, etc., 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 that affect our waters are placing them at risk.

The Index is based on the June 1996, 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 of Watershed Indicators evaluates a similar set of indicators for each of 2,111 watersheds, or "units" in the 48 states (Alaska, Hawaii, and Puerto Rico are currently being added to the Index.) will added in future versions of the Index.)

Objectives

In undertaking this project, EPA had several objectives in mind:

First, to develop a more complete descriptive technique for characterizing the condition and vulnerability of water resources nationally than has been available previously.

Second, to make this information available in a way that would inform and inspire Americans to learn more about their water resources, what affects those resources, and how to protect and restore them for our use and enjoyment and that of future generations. Along with the companion application, Surf Your Watershed, IWI can be a stimulus for actions within watersheds and a mechanism for exchanging information between watersheds on effective strategies and techniques.

We also wanted to create a tool to help water quality management professionals make better decisions on strategies and priorities for environmental programs.

Finally we wanted to establish a national baseline on the condition and vulnerability of aquatic resources that could be used over time to help us measure progress toward the goal that all watersheds be healthy and productive places.

Questions and Answers

What is a Watershed?

A watershed is the land area that drains to a waterbody and affects its flow, water level, loadings of pollutants, etc. In both a real and figurative sense, a lake or river 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.

Watersheds are defined in nature by topography. The US Geological Survey has developed a Hydrologic Unit Classification (HUC) System of watersheds at various scales and mapped these watersheds. The IWI is depicted at the "eight-digit scale -- the smallest nationally consistent set of watersheds in the HUC system." For more information on watershed management, see the EPA Watershed web site and the document Why watersheds.

What are the Indicators?

The first version of the Index of Watershed Indicators, released October 1997, uses fifteen indicators, sometimes referred to as "data layers." These were selected based their appropriateness to the IWI objectives, their relatively uniform availability across the nation, and the ability to depict them at the eight-digit Hydrologic Unit Code (HUC) scale. Seven of the indicators are related to the condition of the aquatic resources and eight are related to vulnerability -- conditions or activities that may place stress on the resources, though perhaps not to the point that its values or functions are currently impaired.

We are working to add additional indicators such as biological integrity, terrestrial condition, ground water, and air deposition to the IWI. This will help round out the picture we paint of watershed health. We are also working to add indicators which tell us what the programmatic response of agencies and individuals has been to the conditions of water resources.

The Condition Indicators

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

2. Fish and Wildlife Consumption Advisories - Recommendations by Tribes or States to restrict consumption of locally harvested fish or game due to the presence of contaminants. (National Listing of Fish and Wildlife Consumption Advisories)

3. Indicators of Source Water Quality for Drinking Water Systems - Three data sets combined to provide a partial picture of the condition of rivers, lakes/reservoirs, and ground waters used by public drinking water systems- a) State's assessment of surface waters meeting "water supply" designated use (305(b)); b) water system treatment and violation data appropriate to use as surrogates of source water condition (SDWIS); and c) occurrence at significant levels in source water of chemicals regulated under the Safe Drinking Water Act (STORET).

4. Contaminated Sediments - The level of potential risk to human health and the environment from sediment chemical analysis, sediment toxicity data, and fish tissue residue data. [(National Sediment Inventory)]

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

6. Ambient Water Quality Data - Four Conventional Pollutants - Ambient water quality data showing percent exceedences of national reference levels, over a six year period (1990-1996), of ammonia, dissolved oxygen, phosphorous, and pH. (STORET)

7. Wetland Loss Index - Percentage losses of wetlands over an historic period (1870-1980) and more recently (1986-1996). (US Fish and Wildlife Service National Wetland Inventory and Natural Resources Conservation Service National Resource Inventory)

The Vulnerability Indicators

8. Aquatic/Wetland Species at Risk - Watersheds with high occurrences of species at risk. (The Nature Conservancy/State Heritage Database).

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

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

11. Urban Runoff Potential - The potential for urban runoff impacts is estimated based on the percentage of impervious surface in the watershed (roads, paved parking, roofs, etc.)

12. Index of Agricultural Runoff Potential - A composite index comprised of a) a nitrogen runoff potential index, b) modeled sediment delivery to rivers and streams, and c) a pesticide runoff potential index. (Natural Resources Conservation Service and National Resources Inventory. For more information about agricultural pollution potential and what farmers are doing about it, see the Natural Resources Conservation Service's State of the Land.

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

14. Hydrologic Modification - Dams - This index 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. (Corps of Engineers)

15. Estuarine Pollution Susceptibility Index - This measures an estuary's susceptibility to pollution based on its physical characteristics and the propensity to concentrate pollutants. (National Oceanic and Atmospheric Administration)

Why is my watershed gray (why is my watershed in the insufficient data category)?

The Index of Watershed Indicators makes use of data collected at specific sites across the country. More data are available in some watersheds than others. In order to ensure that sufficient data exist to make a valid judgment of aquatic resource health, U.S. EPA set threshold levels for the number of indicators needed to categorize watersheds. For the condition assessment, watersheds must have information for at least four of the seven indicators. For the vulnerability assessment, at least six of the eight indicators are required.

In watersheds which fall short of these threshold requirements, the IWI categorizes them as having "insufficient data." These appear gray on the national characterization map. It is important to note that this categorization does not necessarily mean that there are no data available for the watershed. Information for those indicators with data is still portrayed on the individual data layer maps and on the individual IWI watershed profile in Surf Your Watershed (<http://www.epa.gov/iwi/>).

Individual indicators also have threshold levels for determining whether sufficient data exists for analysis in the IWI. A watershed painted gray on an individual data layer map does not mean that there are NO data, but rather that insufficient data exist for the purposes of the Index of

Watershed Indicators.

What is the overall quality of America's aquatic resources?

The Index of Watershed Indicators (IWI) shows that:

- 15% of our watersheds nationally have relatively good water quality;
- 36% have moderate problems;
- 22% of the watersheds have more serious water quality; and
- 27% do not have enough information to be characterized.

1 in 15 watersheds nationally is also highly vulnerable to further degradation.

What is the difference between condition and vulnerability?

The IWI assesses two different aspects of aquatic resource health: condition and vulnerability.

Condition indicators are designed to show existing water quality across the country. These indicators include such things as waters meeting state or tribal designated uses, contaminated sediments, ambient water quality, and wetlands loss.

Vulnerability indicators are designed to indicate where pollution discharges and other activities put pressure on the watershed. These could cause future problems to occur. Activities in this category include such things as pollutant loads discharged in excess of permitted levels, pollution potential from urban and agricultural lands, and changes in human population levels.

How does this information compare with my state's water quality report?

States are required to submit reports of water quality to EPA in even numbered years. These are often called section 305(b) reports. The IWI uses the state and tribal 305(b) report information on waters meeting their designated use as the most important indicator. This 305(b) water quality information is weighted more heavily than the other indicators to emphasize its importance. In the absence of sufficient 305(b) information in a watershed, the other six indicators of watershed condition are weighted more heavily to make up for this deficiency.

Because the IWI supplements the state and tribal water quality assessments with additional information, the two reports may not be exactly the same.

How can citizens use the IWI?

The IWI is an excellent example of how the government can provide information for the public's use in watershed protection and restoration.

The Index not only categorizes watersheds based on their overall aquatic health, but also provides more detailed information on 15 separate indicators at both national and local scales.

Interested citizens can, for instance, see where the contamination is, what the major sources are, whether discharge permit holders are in compliance, and where data are missing, and how one watershed compares to others. Detailed text describes the significance of the data, and it can be downloaded from the Internet.

How are indicators values and the overall index calculated?

For each condition indicator, values were selected which, in EPA's professional judgement, represent an appropriate basis to describe the aquatic resources within the watershed as having good quality, fewer problems or more problems. Similarly, for each vulnerability indicator, the Agency selected values that we believe are appropriate to differentiate "lower" from "higher" vulnerability. For most indicators we established a minimum number of observations necessary to assign a "score." In aggregating the 15 Indicators into the overall Index, Indicator #1, Assessed Rivers Meeting All Designated Use, is weighted more heavily than other Indicators because it is a comprehensive assessment and EPA believes considerable weight should be given to the State/Tribal 305(b) assessment process. All other indicators are weighted equally. Where there is insufficient data for a particular indicator we will display that on the map and present it in the Profile. At least 10 of the 15 data layers must be present to calculate the overall index for any given watershed. If Indicator #1 is not available, the values of the other indicators of condition are multiplied by three to derive an Index score.

How does the source water conditions for drinking water systems indicator relate to source water assessments required by the Safe Drinking Water Act?

The IWI includes a separate source water assessment data layer which combines three data sets into a single index to characterize source water condition. The IWI can be an initial tool for conducting source water assessments and implementing source water protection programs. Both IWI and the Surf website provide state and tribal drinking water quality managers access to information not readily available anywhere else. The IWI is not a substitute for state source water assessments that are currently being developed in the states or required by the Safe Drinking Water Act.

The IWI provides a watershed-level assessment of the condition and vulnerability of the water

resources. The source water delineations and assessments will supplement existing data sources and provide for the first time a comprehensive characterization of the risk to drinking water sources in the watershed. This will allow EPA and states to better target CWA program resources to address watersheds at risk.

How will the EPA use the IWI to improve watershed management?

EPA won't do it alone. EPA works through partnerships with states, tribes and other federal agencies, and local watershed organizations. Several federal, state and nongovernmental organizations contributed to this Index. These same agencies share in our past water quality successes and will continue to be involved in overcoming the water quality problems the IWI brings to light. The IWI maps will help coordinate and target agency programs or alter the mix of activities they support.

The IWI is intended to focus the resources of government programs and the public appropriately on watershed problems, and we expect our future efforts will make use of the IWI formats.

What is the relationship between the Index of Watershed Indicators and state 303(d) lists under the Clean Water Act?

The Clean Water Act requires states and authorized tribes to list waters for which point source technology-based limits are not enough to restore and protect water quality. States and tribes then prioritize these impaired waters and submit their "303(d) Lists" to USEPA.

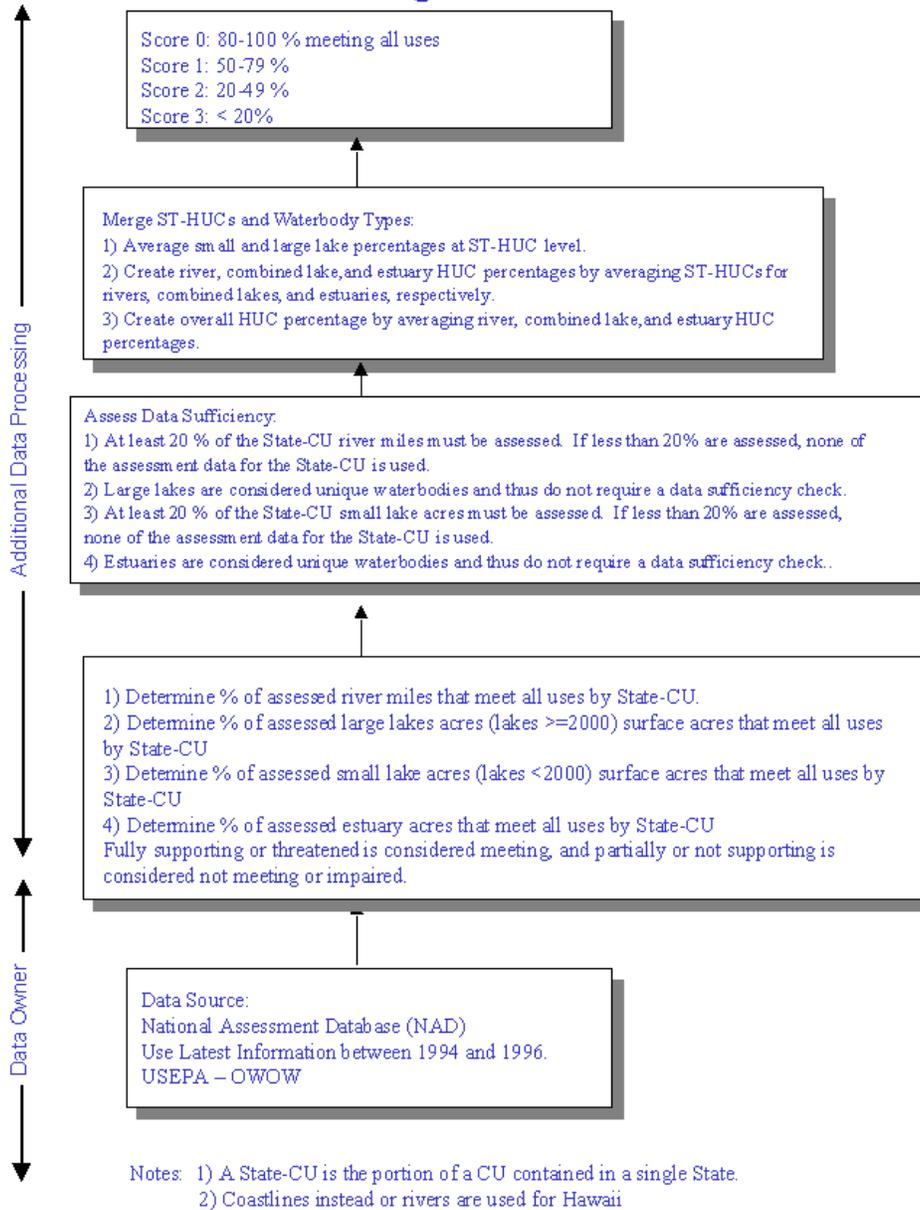
At this time, the Index of Watershed Indicators does not directly take into account waters placed on a state 303(d) list under the Clean Water Act. However, the IWI and 303(d) lists do make use of some of the same information. When state 303(d) lists are geo-referenced in the future, the IWI will be able to better reflect this information.

The Data Behind the IWI

You can access the data used to develop the national maps by going to the Environmental Information Management System (<http://oaspub.epa.gov/eims/eimsstart>). Click the "Enter EIMS" button and then search by map title.

Flowcharts for Indicator Data Processes - Version 1.3

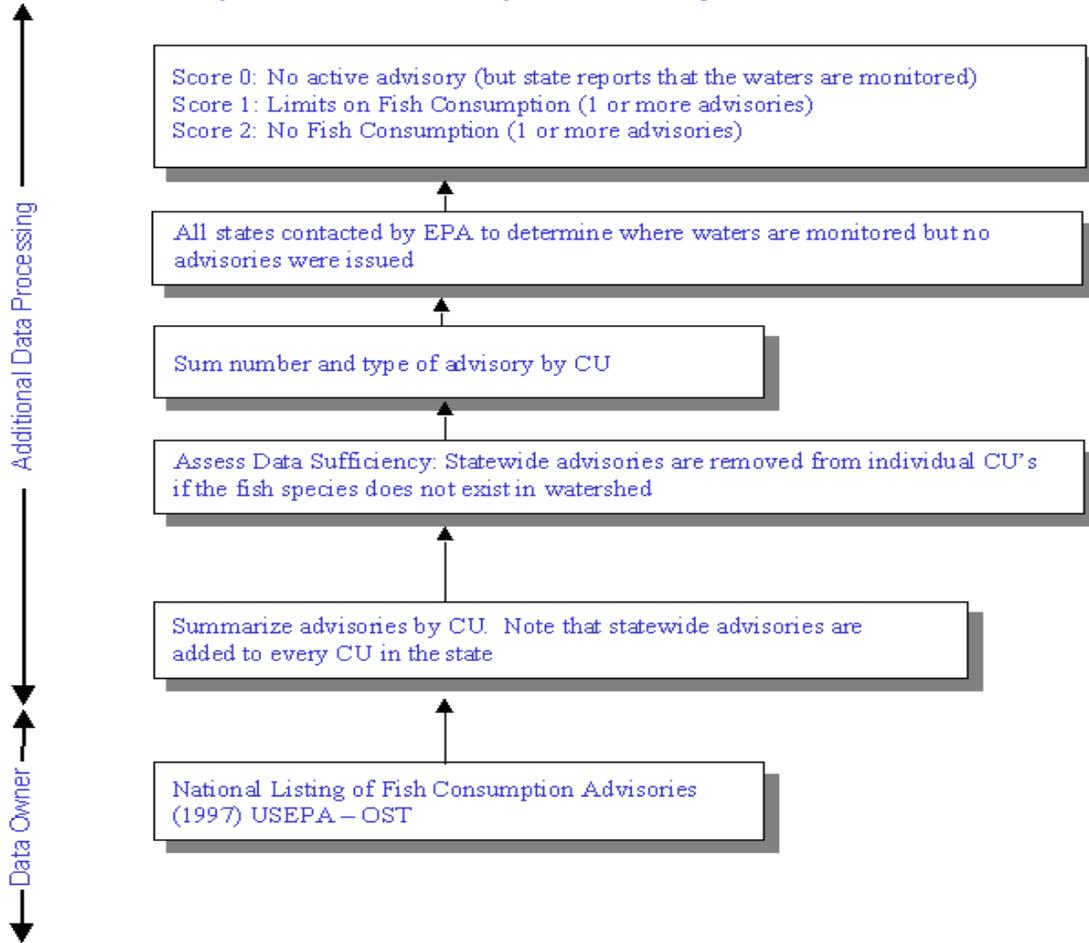
Map 1 – Assessed Rivers, Lakes, and Estuaries Meeting All Designated Uses



1. Assessed Rivers, Lakes, and Estuaries* Meeting All Designated Uses Set in State/Tribal Water Quality Standards 1994/1996 Using Latest State Information

Flowcharts for Indicator Data Processes - Version 1.3

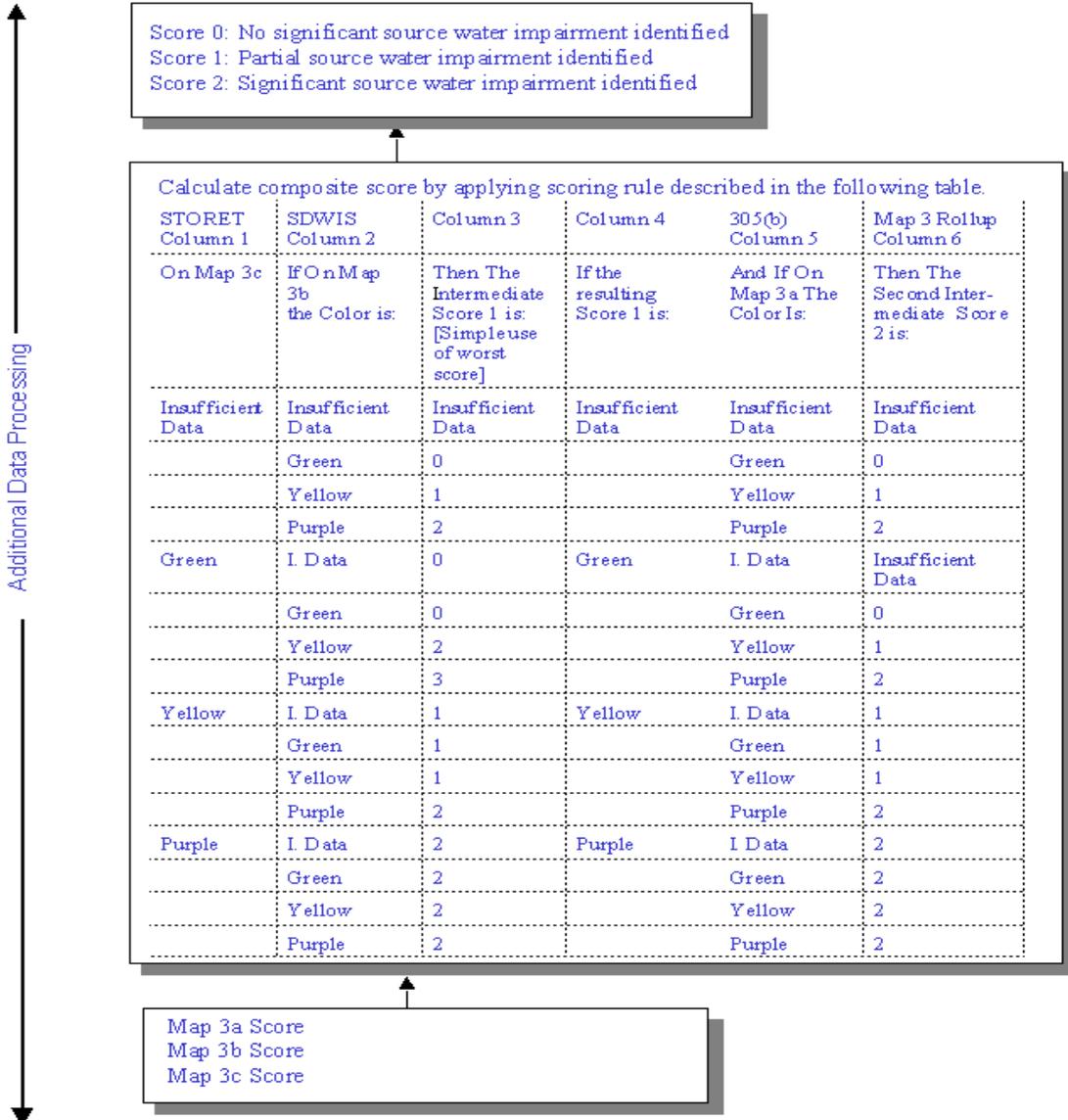
Map 2 – Fish Consumption Advisory



2. Fish and Wildlife Consumption Advisories 1997

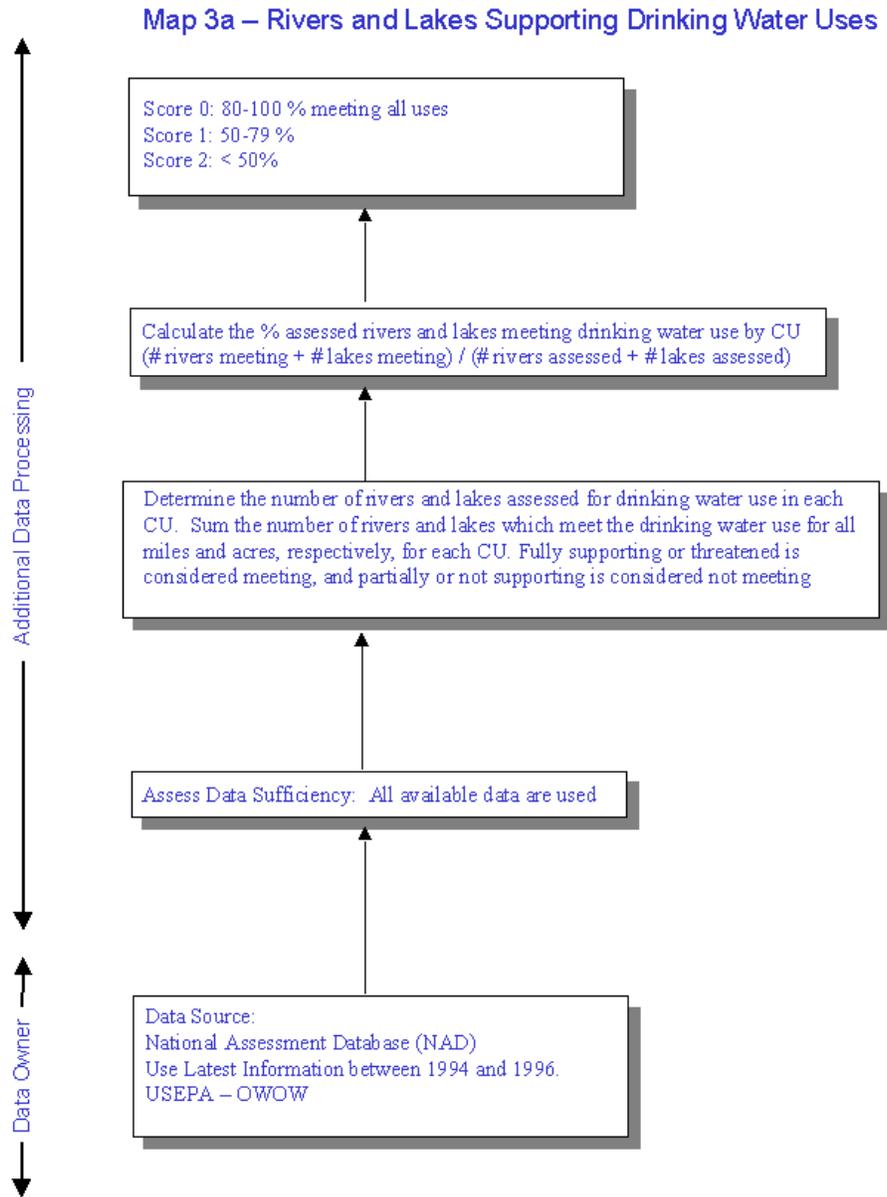
Flowcharts for Indicator Data Processes - Version 1.3

Map 3: Indicators of Source Water Condition for Drinking Water Systems



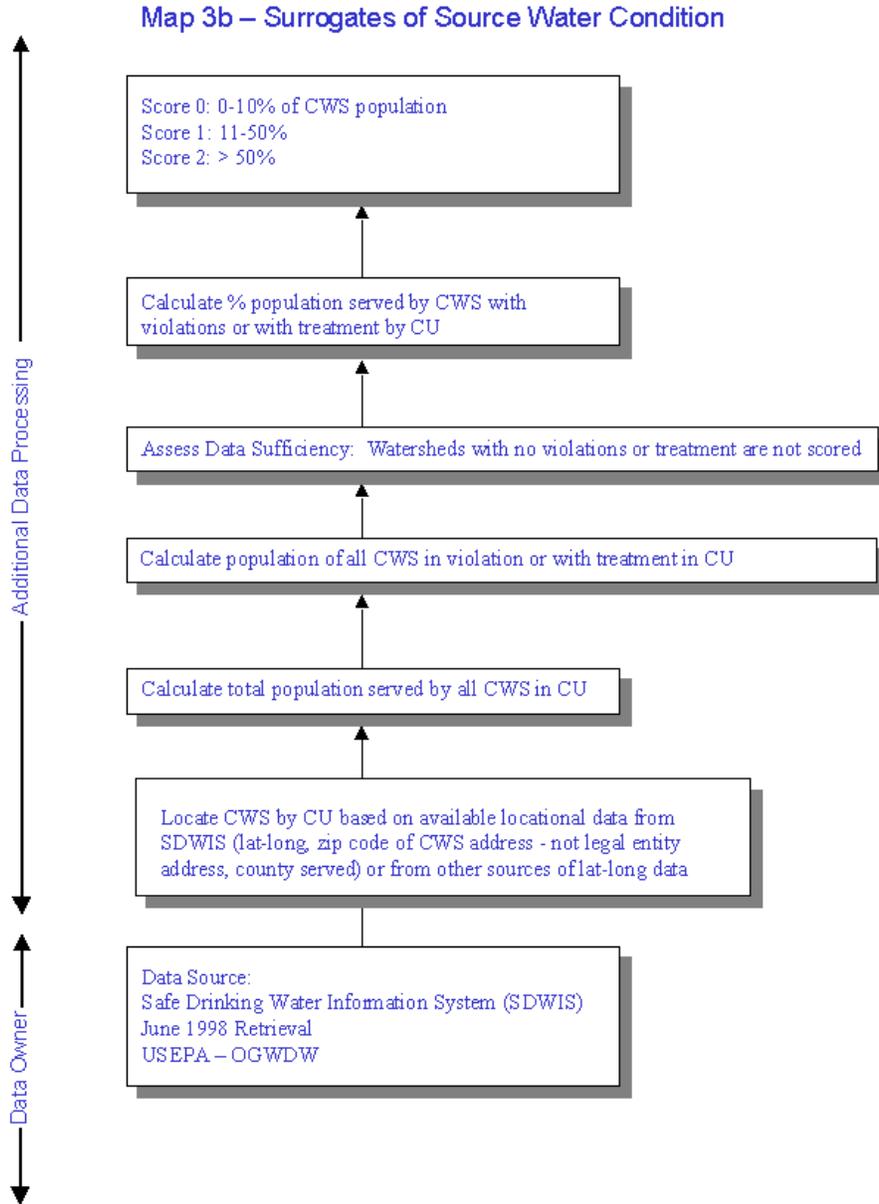
3. Indicators of Source Water Condition for Drinking Water Systems 1990-1997

Flowcharts for Indicator Data Processes - Version 1.3



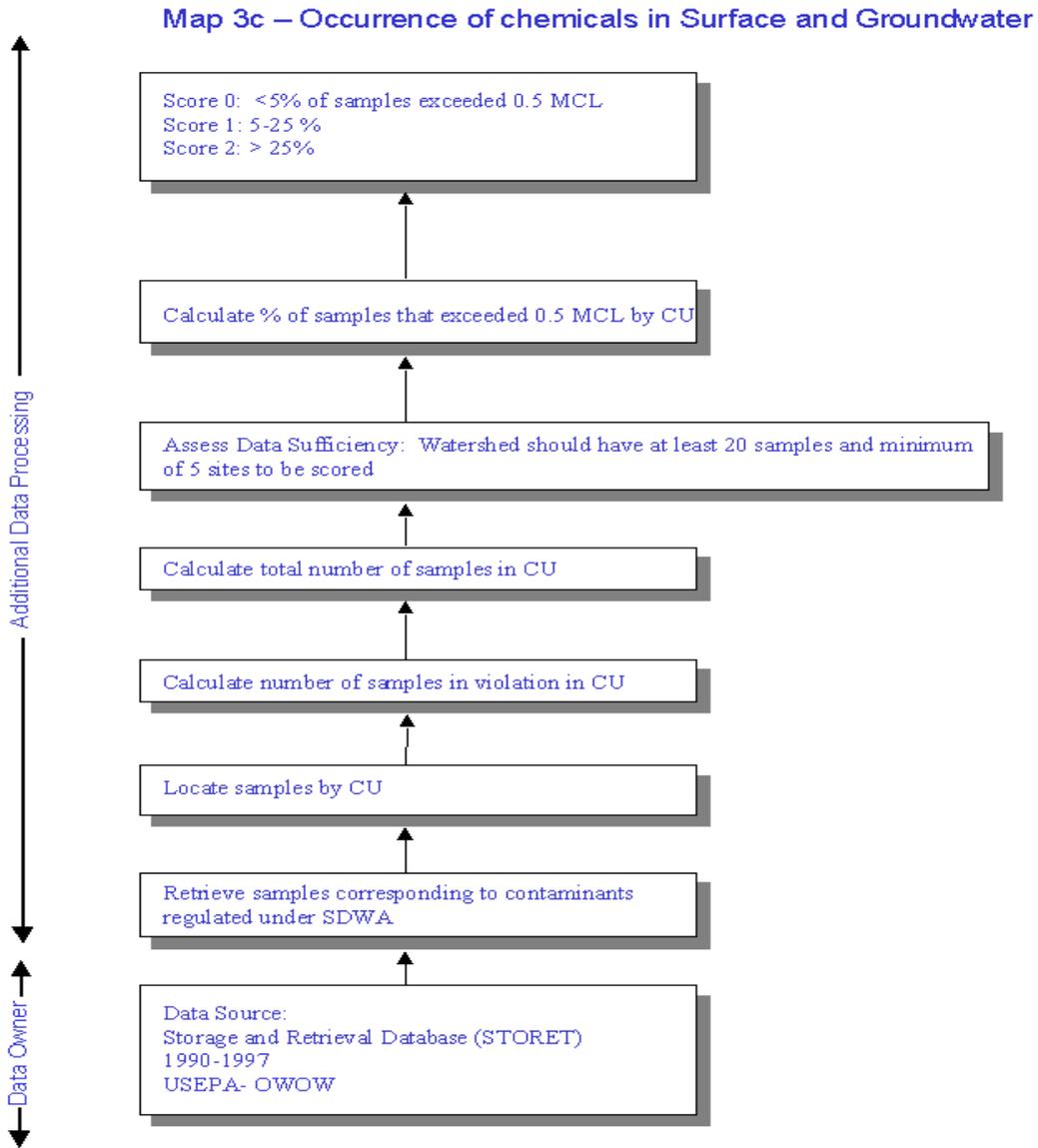
3a. River and Lakes Supporting Drinking Water Uses 1994/1996

Flowcharts for Indicator Data Processes - Version 1.3



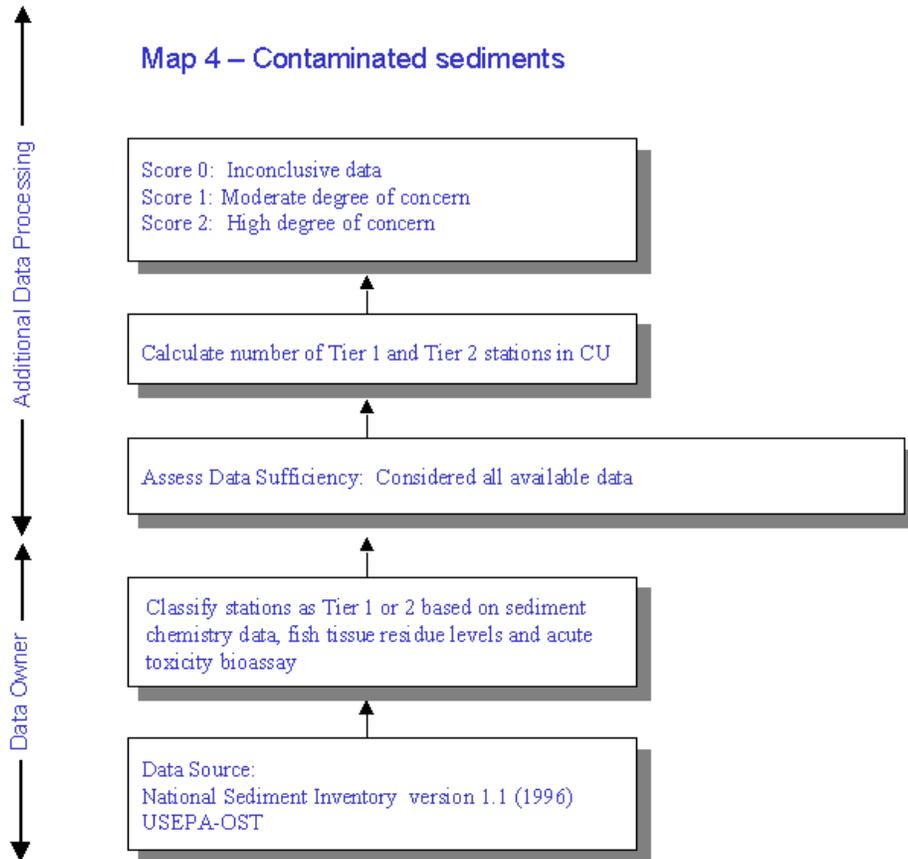
3b. Surrogates of Source Water Condition 1991-1996

Flowcharts for Indicator Data Processes - Version 1.3



3c. Occurance of Chemicals in Surface and Ground Waters that are Regulated in Drinking Water 1990-1997

Flowcharts for Indicator Data Processes - Version 1.3



Note:

Moderate degree of concern = watersheds with 10 or more Tier 1 stations and greater than 75% of all stations are Tier 1 or Tier 2.

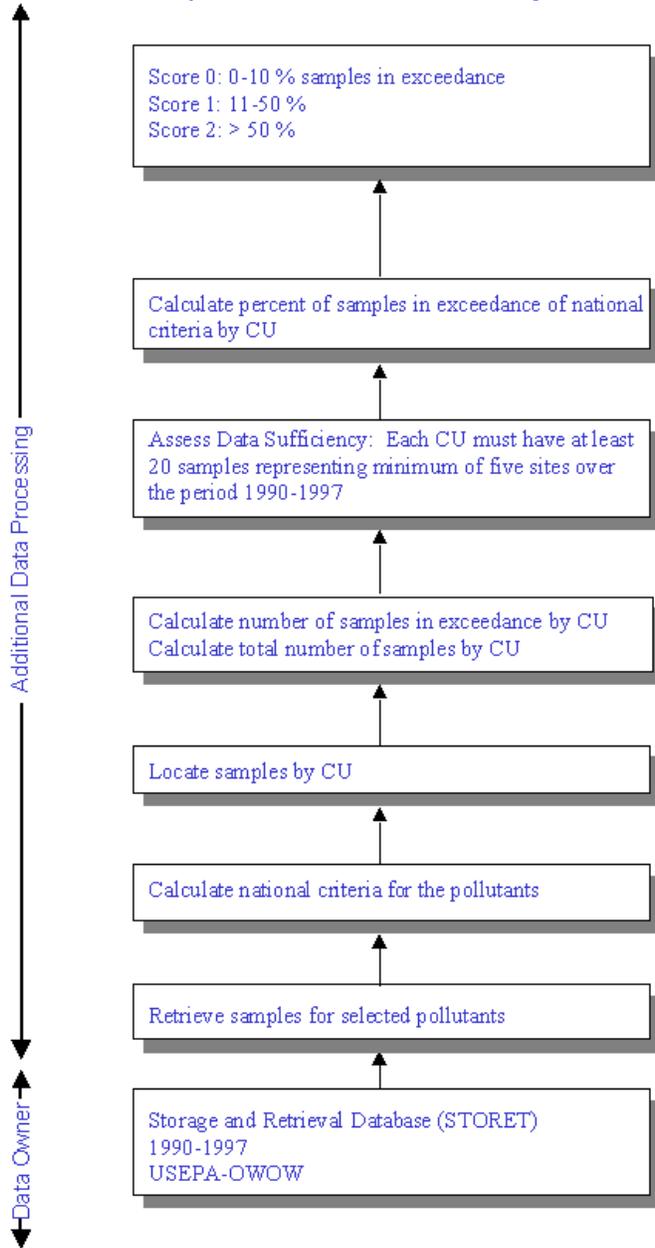
High degree of concern = watersheds with 20 or more Tier 1 stations and greater than 75% of all stations are Tier 1 or Tier 2.

Inconclusive data = watersheds with data but do not have moderate or high degree of concern

4. Contaminated Sediments 1980-1993

Flowcharts for Indicator Data Processes - Version 1.3

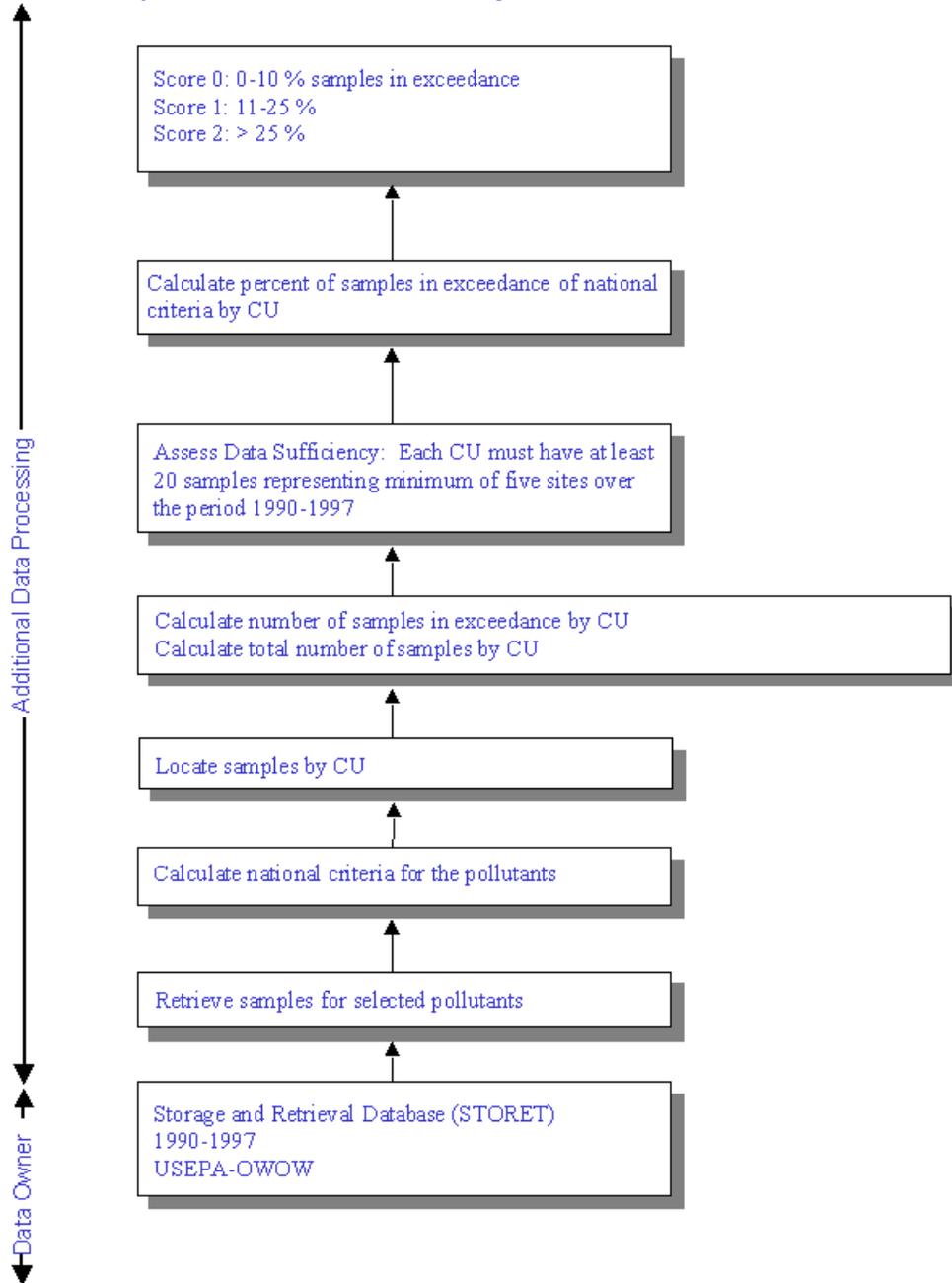
Map 5 – Ambient Water Quality Data – Toxic Pollutants



5. Ambient Water Quality Data - Four Toxic Pollutants 1990-1997

Flowcharts for Indicator Data Processes - Version 1.3

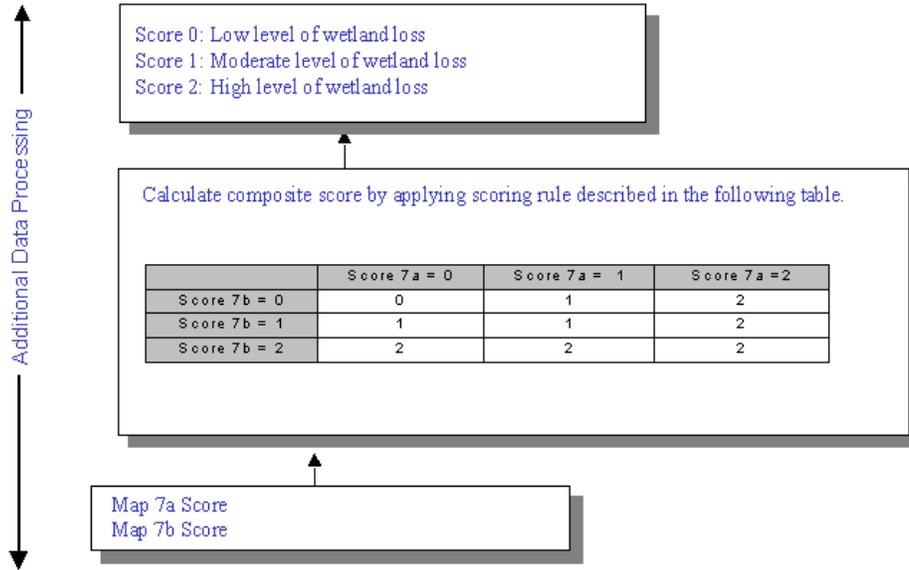
Map 6 – Ambient Water Quality Data – Conventional Pollutants



6. Ambient Water Quality Data - Four Conventional Pollutants 1990-1997

Flowcharts for Indicator Data Processes - Version 1.3

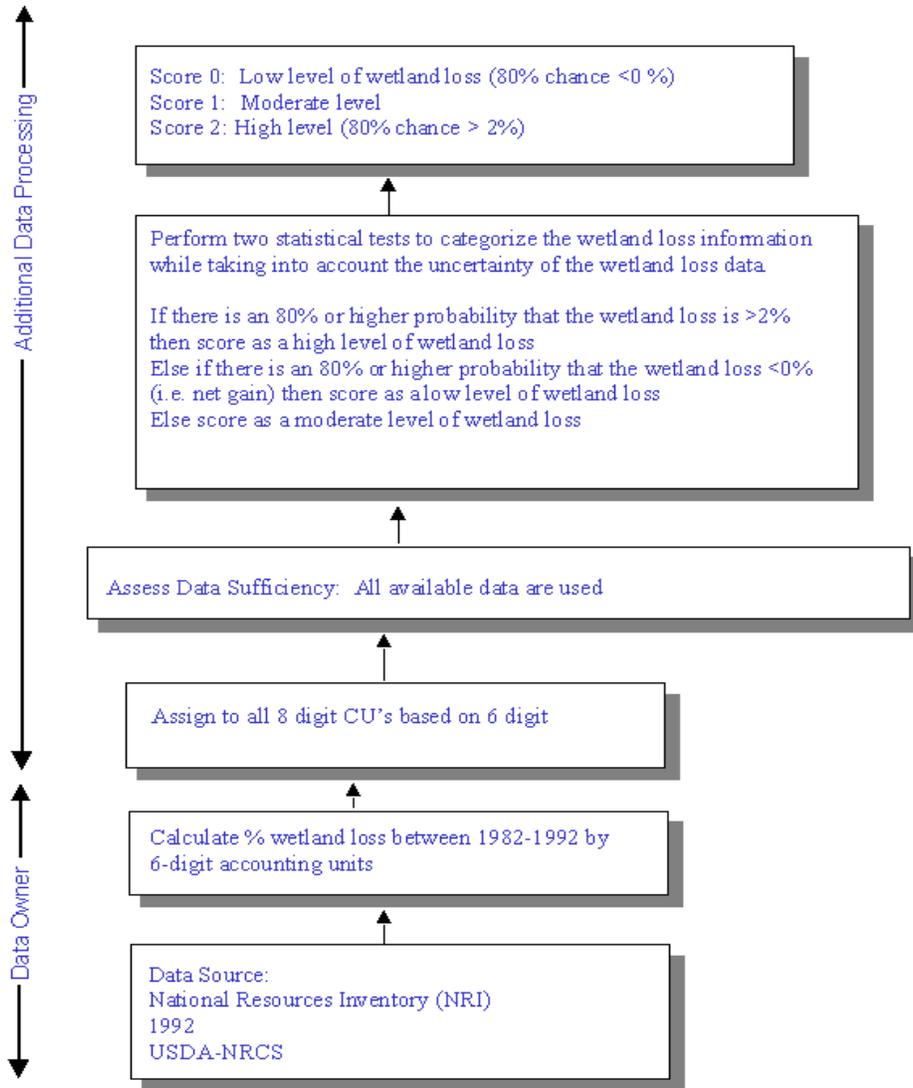
Map 7: Data Profile for Wetland Loss Index



7. Wetland Loss Index 1982-1992; 1780-1980

Flowcharts for Indicator Data Processes - Version 1.3

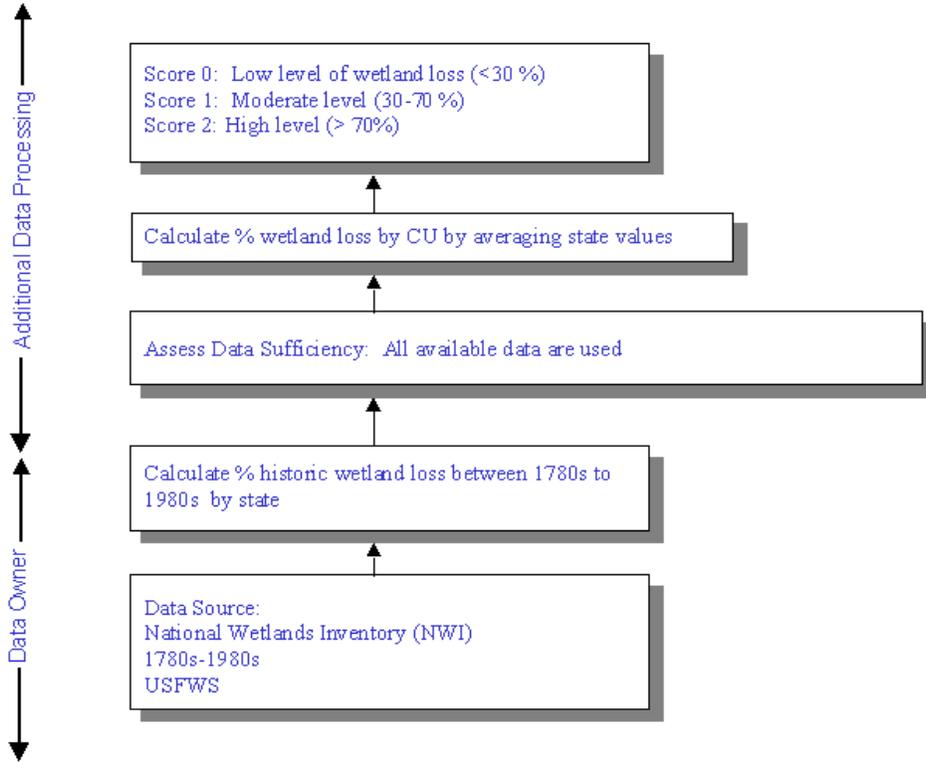
Map 7a – Wetland Loss Measured by the NRI



7a. Wetland Loss Measured by National Wetlands Inventory 1982-1992

Flowcharts for Indicator Data Processes - Version 1.3

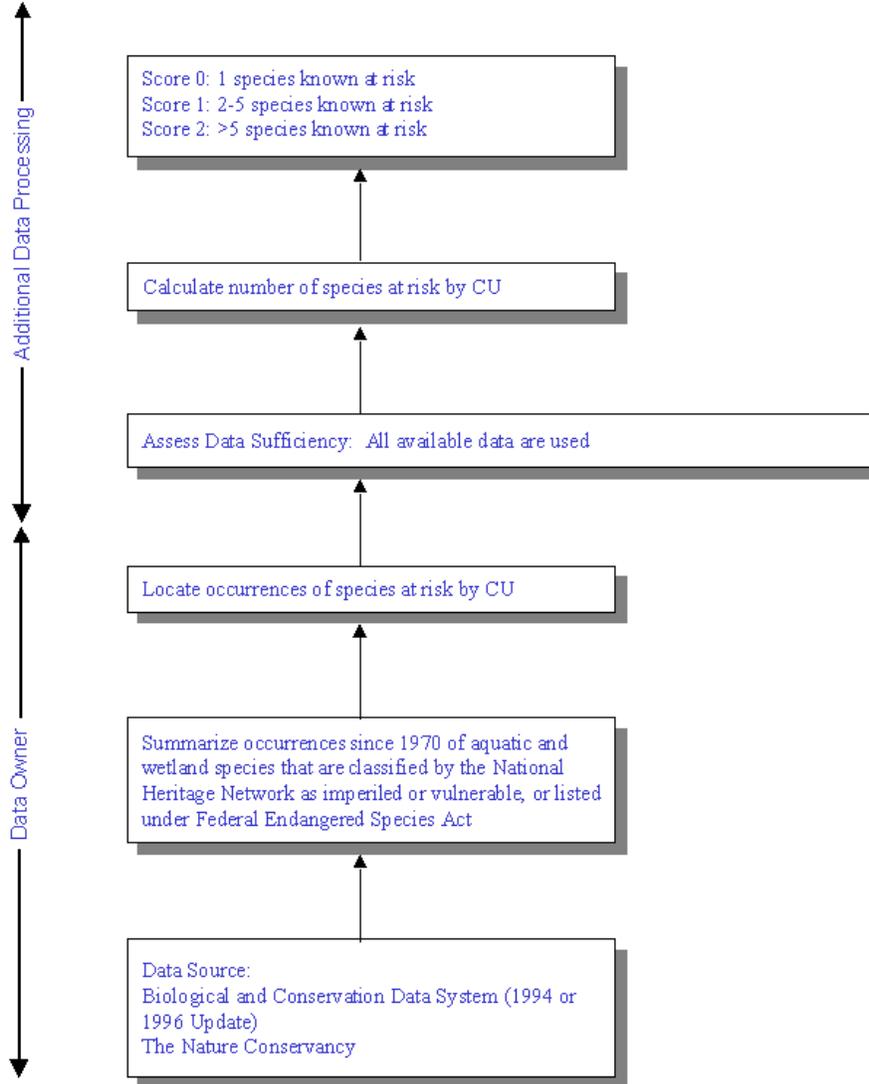
Map 7b – Wetland Loss Measured by the NWI



7b. Wetland Loss Measured by National Wetlands Inventory 1780-1980s

Flowcharts for Indicator Data Processes - Version 1.3

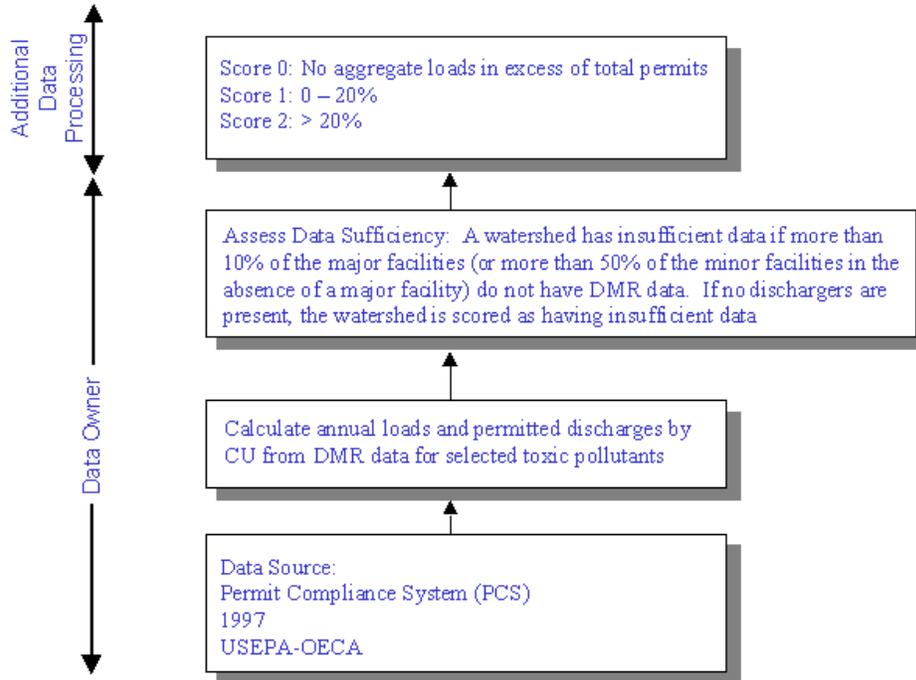
Map 8. Aquatic/Wetland Species at Risk



8. Aquatic/Wetland Species at Risk 1996

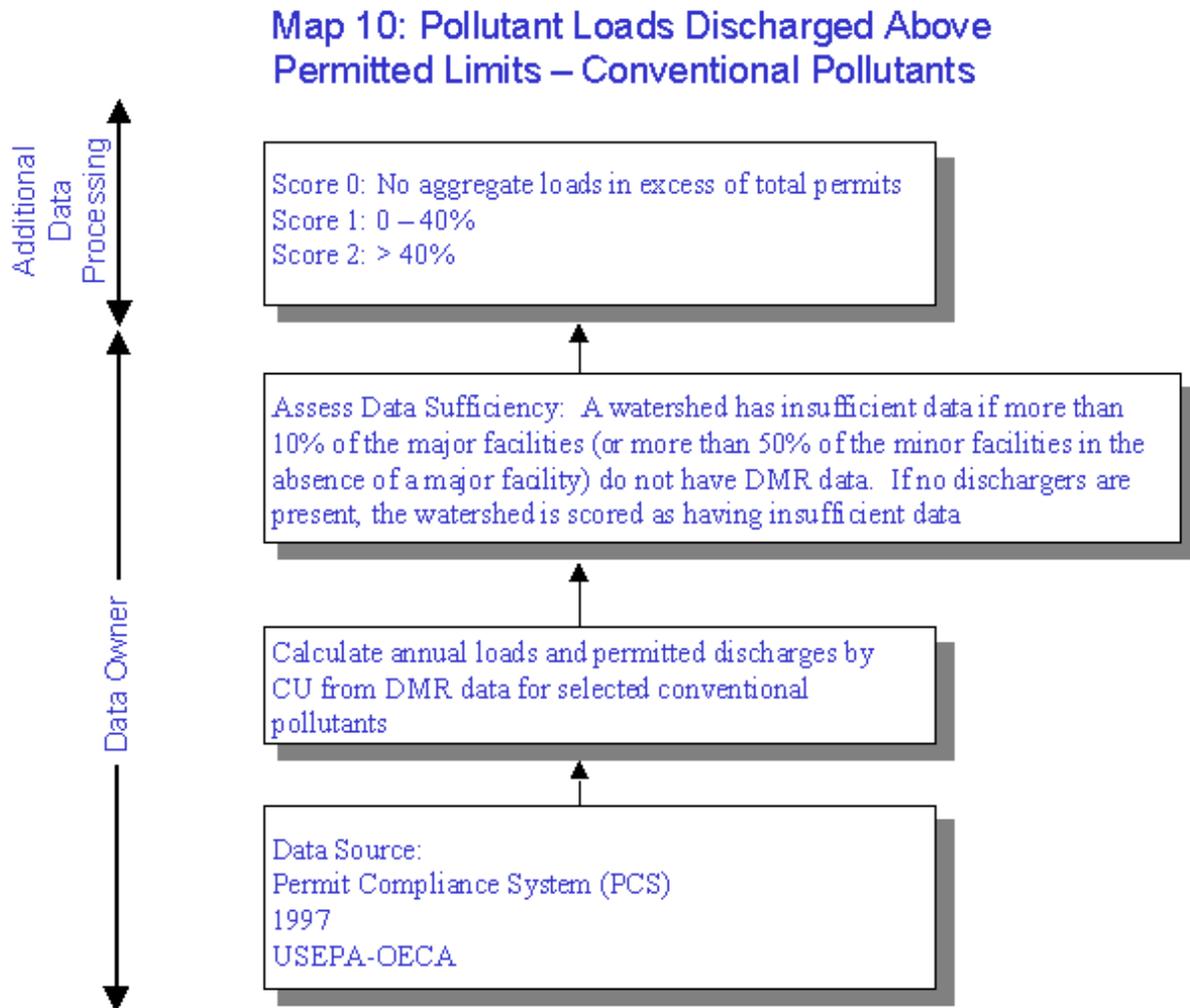
Flowcharts for Indicator Data Processes - Version 1.3

Map 9: Pollutant Loads Discharged Above Permitted Limits – Toxic Pollutants



9. Pollutant Loads Discharged Above Permitted Limits - Toxic Pollutants 1998

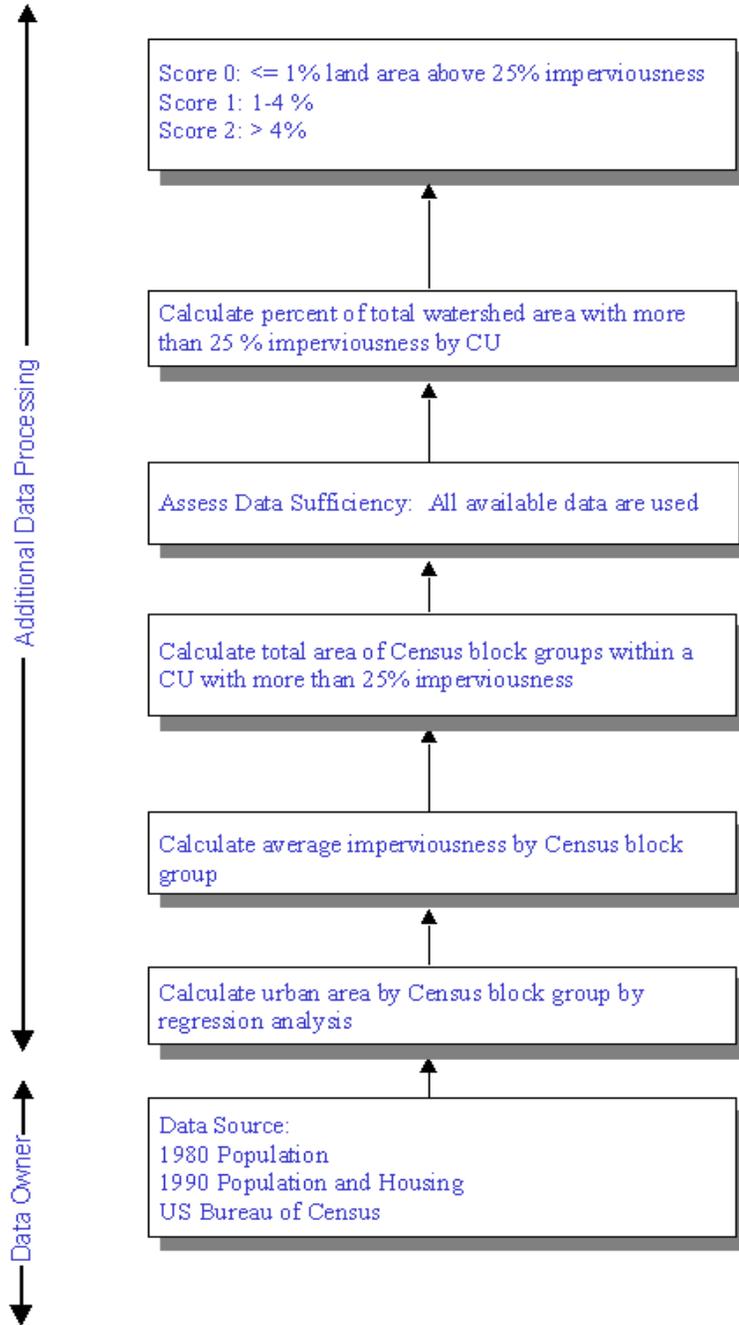
Flowcharts for Indicator Data Processes - Version 1.3



10. Pollutant Loads Discharged Above Permitted Limits - Conventional Pollutants 1998

Flowcharts for Indicator Data Processes - Version 1.3

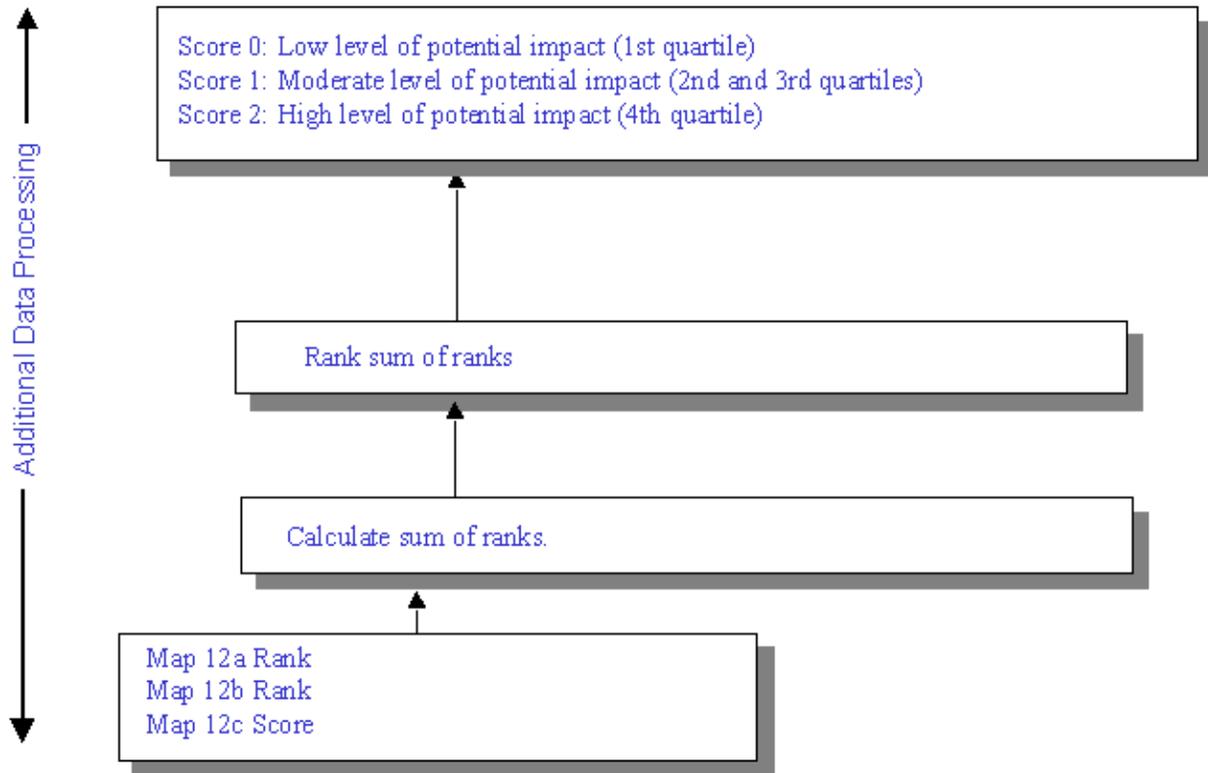
Map 11: Urban Runoff Potential



11. Urban Runoff Potential 1990

Flowcharts for Indicator Data Processes - Version 1.3

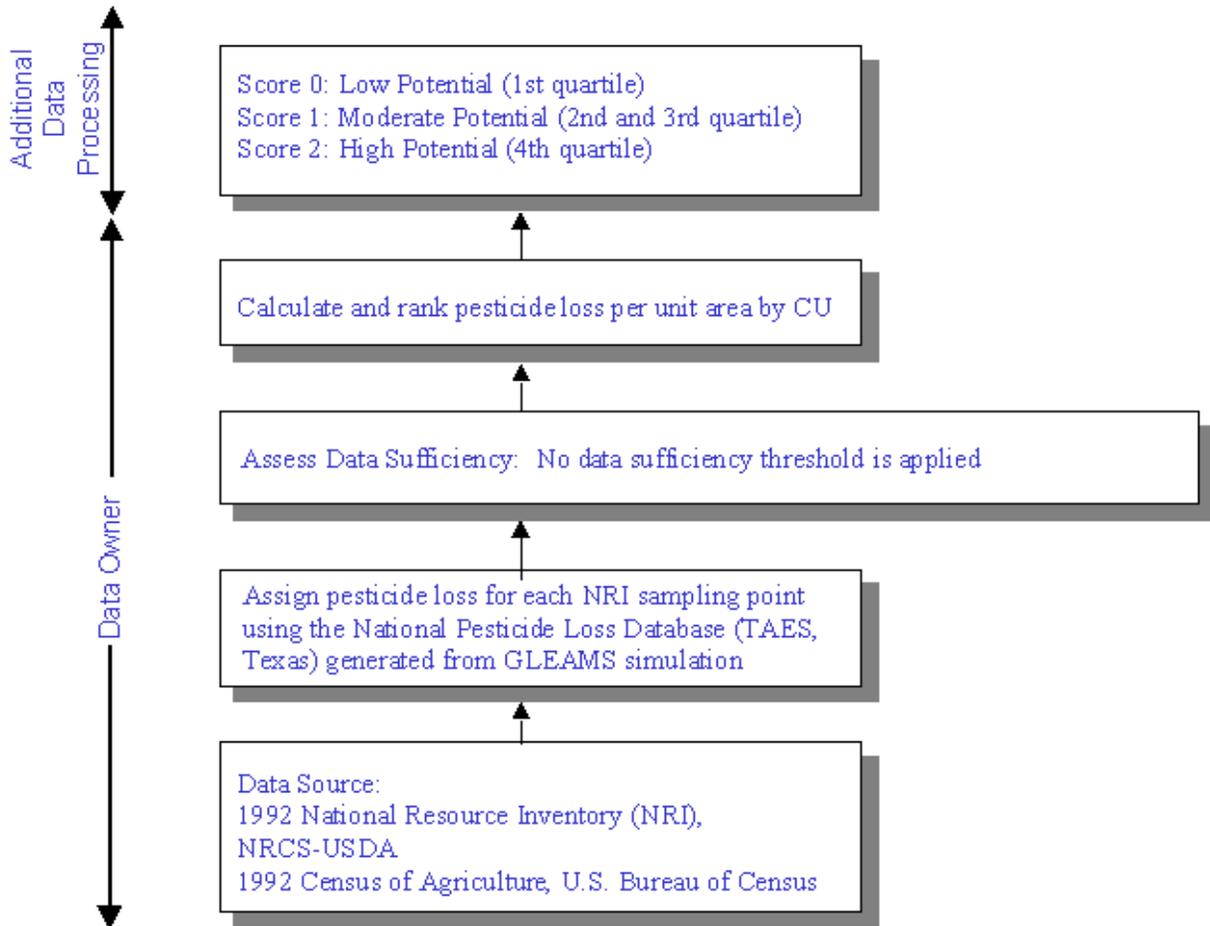
Map 12: Index of Agricultural Runoff Potential



12. Index of Agricultural Runoff Potential (Based Upon Nitrogen, Sediment and Pesticide)(1990-1995)

Flowcharts for Indicator Data Processes - Version 1.3

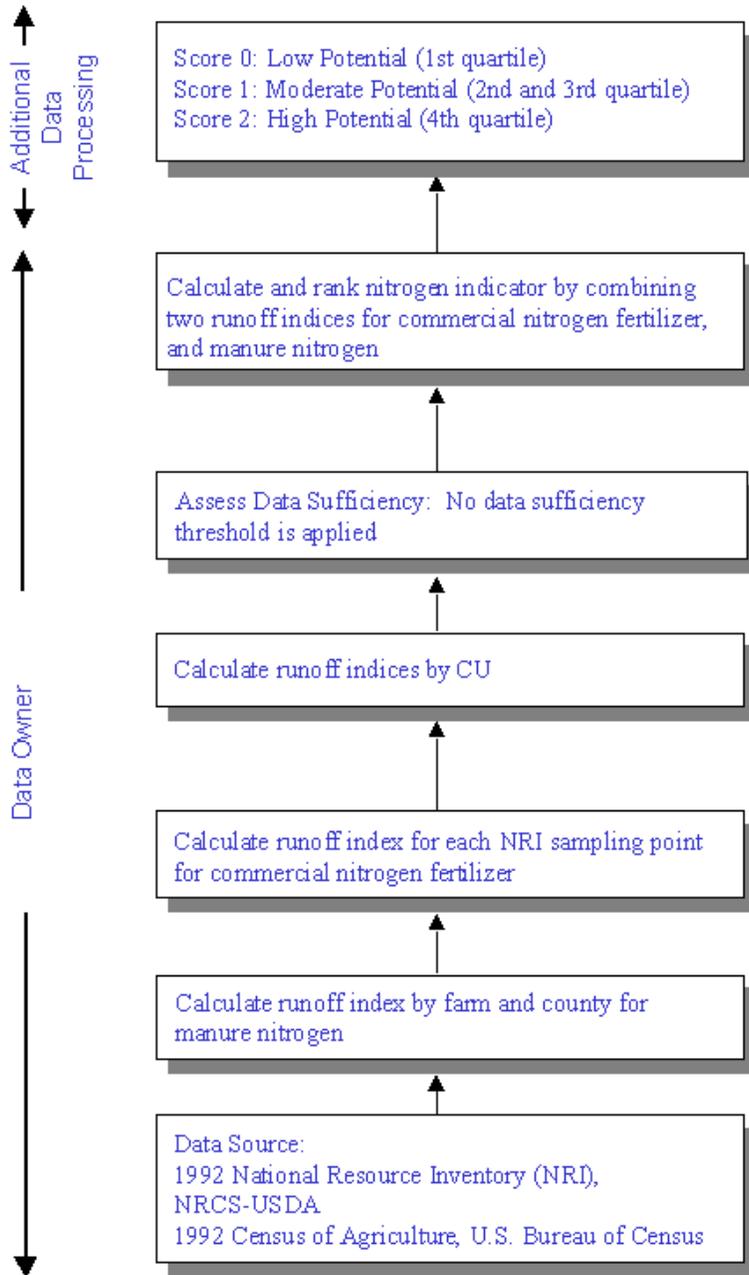
Map 12a: Potential Pesticide Runoff from Farm Fields



12a. Potential Pesticide Runoff from Farm Fields 1990-1995

Flowcharts for Indicator Data Processes - Version 1.3

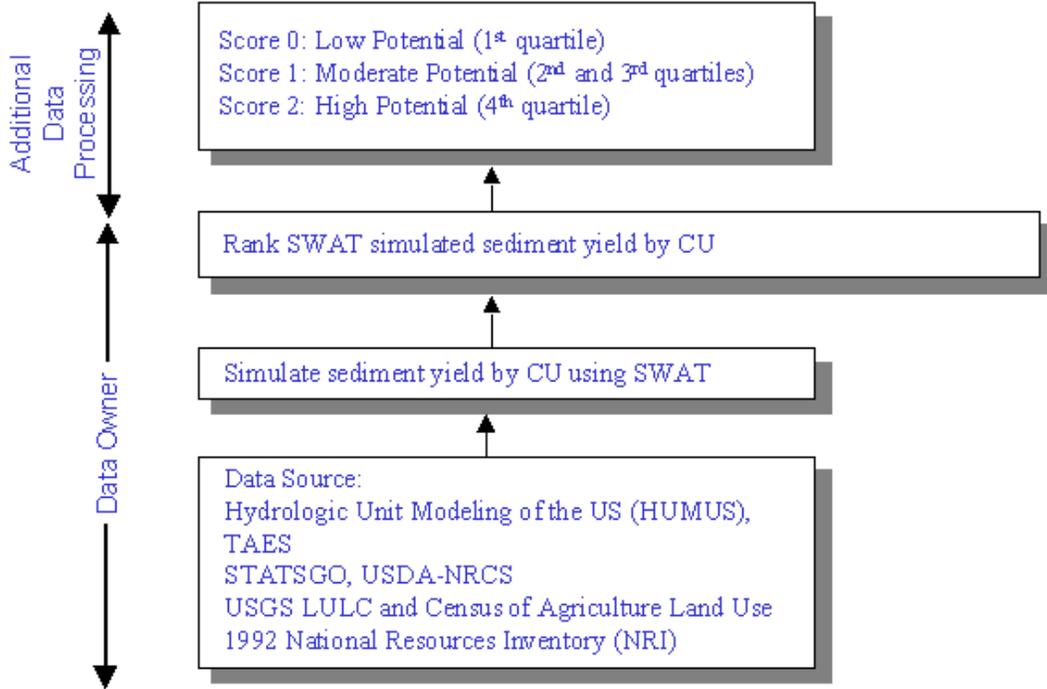
Map 12b: Potential Nitrogen Runoff from Farm Fields



12b. Potential Nitrogen Runoff from Farm Fields 1990-1995

Flowcharts for Indicator Data Processes - Version 1.3

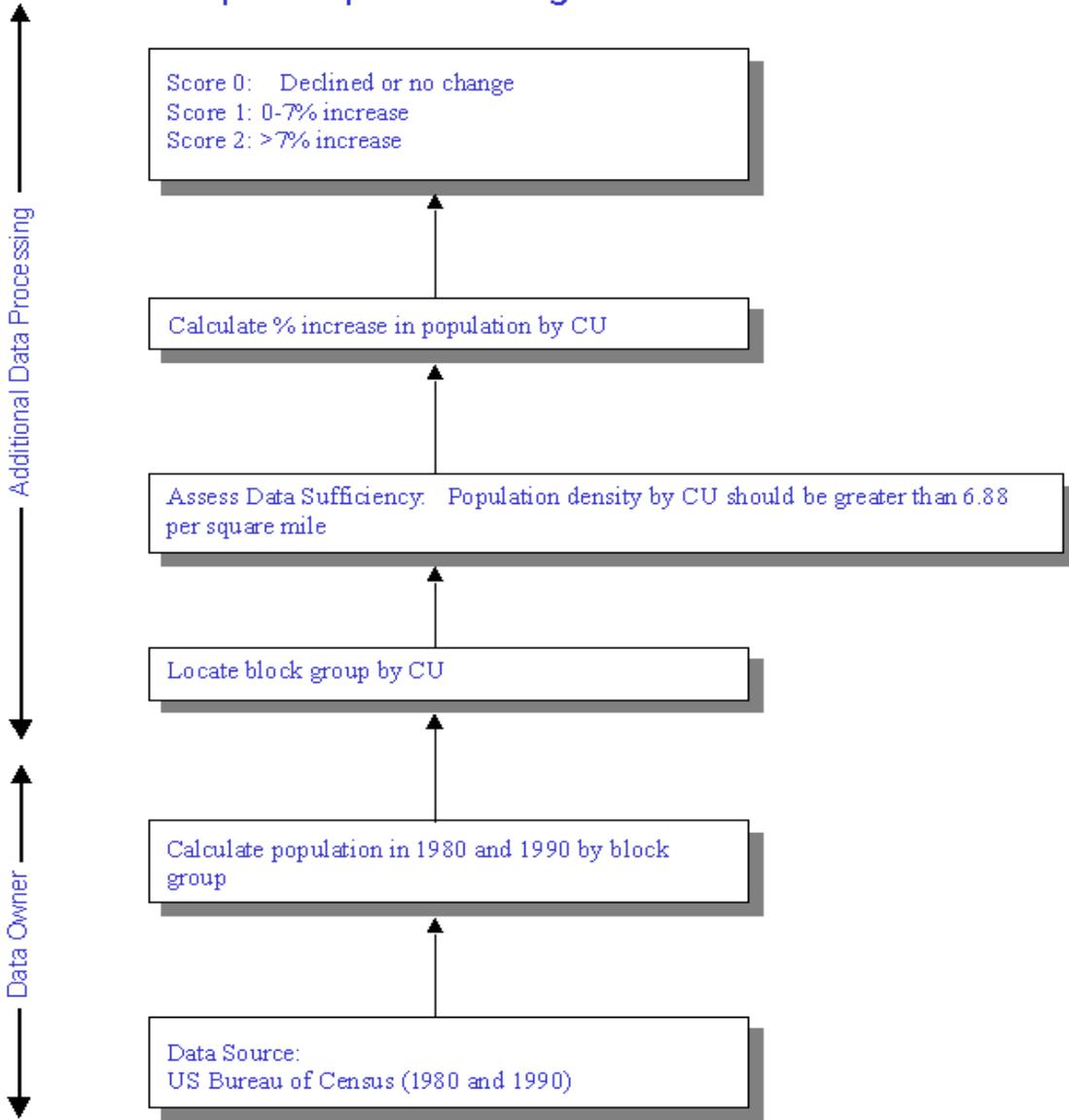
Map 12c: Sediment Delivery from Cropland and Pastureland



12c. Sediment Delivery to Rivers and Streams from Cropland and Pastureland 1990-1995

Flowcharts for Indicator Data Processes - Version 1.3

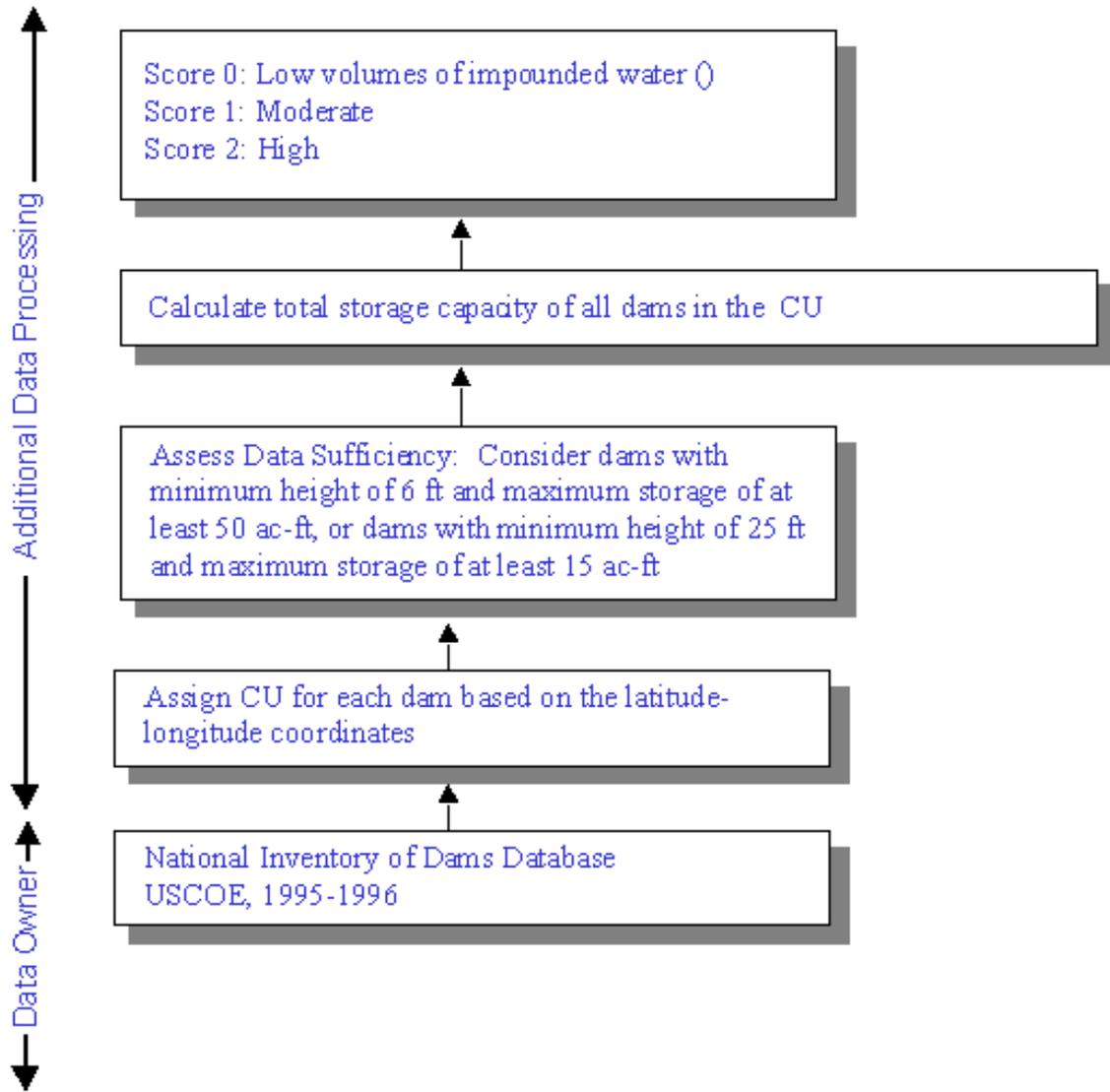
Map 13: Population Change



13. Population Change 1980-1990

Flowcharts for Indicator Data Processes - Version 1.3

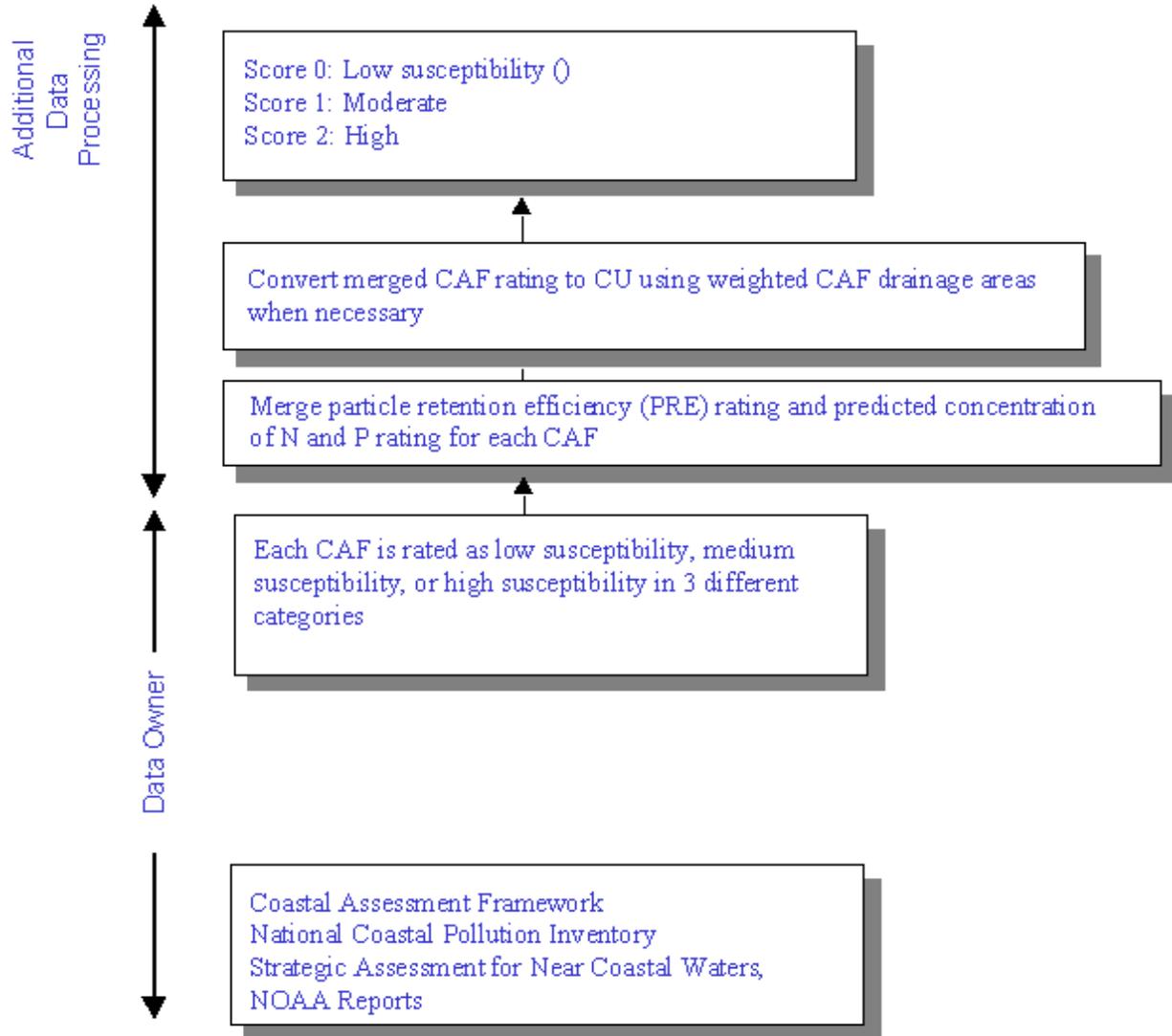
Map 14: Hydrologic Modification Caused by Dams



14. Hydrologic Modification Caused by Dams, 1995-1996

Flowcharts for Indicator Data Processes - Version 1.3

Map 15: Estuarine Pollution Susceptibility Index



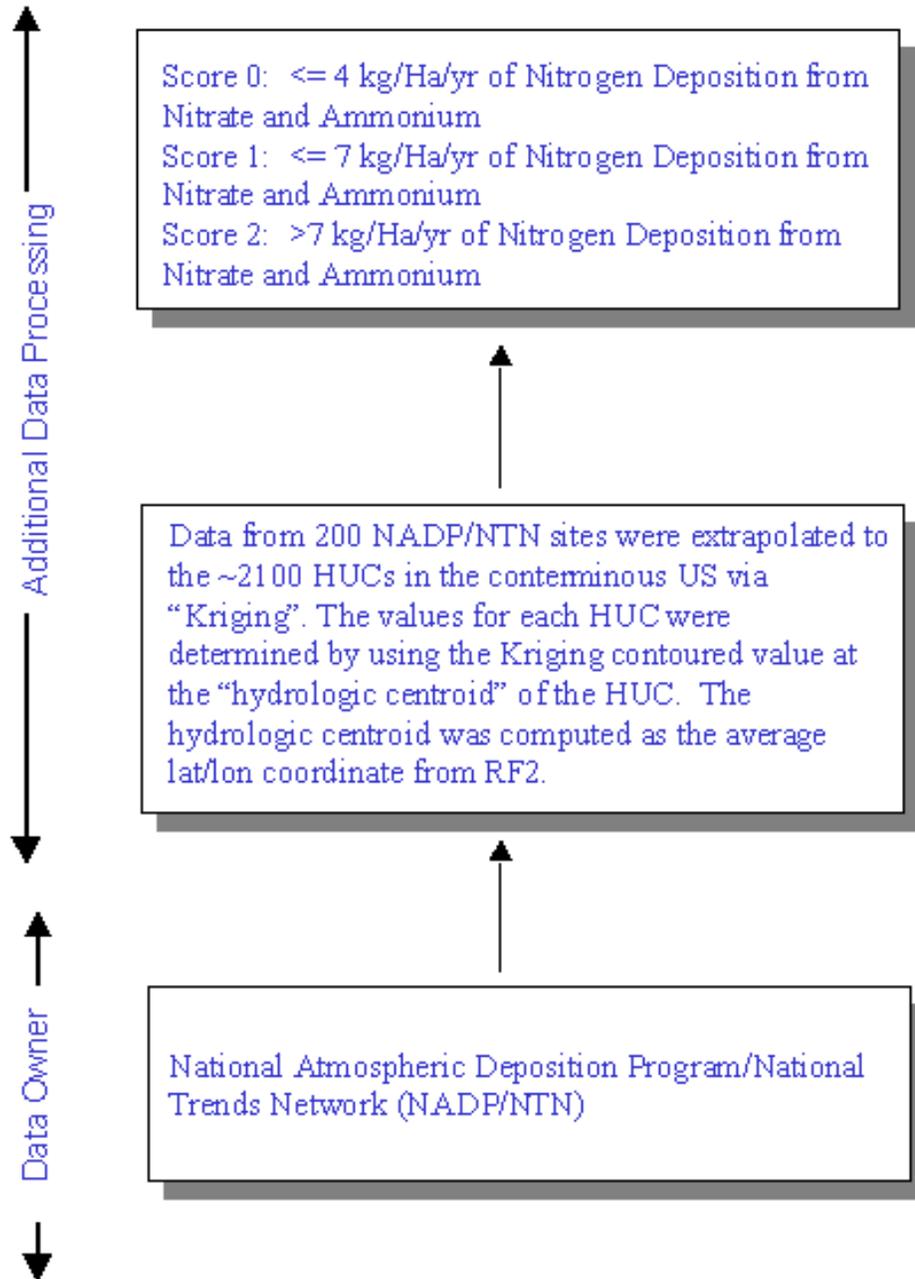
15. Estuarine Pollution Susceptibility Index Based Upon Pollution Loads and Pollution Retention Characteristics of Estuaries, 1989-1991

Flowcharts for Indicator Data Processes - Version 1.3

16. Intentionally Skipped

Flowcharts for Indicator Data Processes - Version 1.3

Map 17: Atmospheric Deposition



17. Atmospheric Deposition

Methodology for Source Water Condition for Drinking Water

Three component indicators: 1) Occurrence of Contaminants in Surface and Ground Waters (Map 3c), 2) SDWIS Surrogates of Source Water Condition (Map 3b), and 3) Rivers and Lakes Supporting State Drinking Water Uses (Map 3a), were first merged into a single Indicator of Source Water Condition for Drinking Water Systems and this indicator was tallied with other indicators of watershed condition using conditional weights that do not double count the scores assigned in Map 1 derived from the state 305(b) report.

First, The initial score the two maps 3c and 3b were combined to show use the worst reported condition. The resulting intermediate map was then combined with the information in Map 3a.

The resulting scores are all in the customary 0,1,2, Insufficient data categories scores shown in column 4. Column 4 values are then combined with Map 3c to produce Map 3.

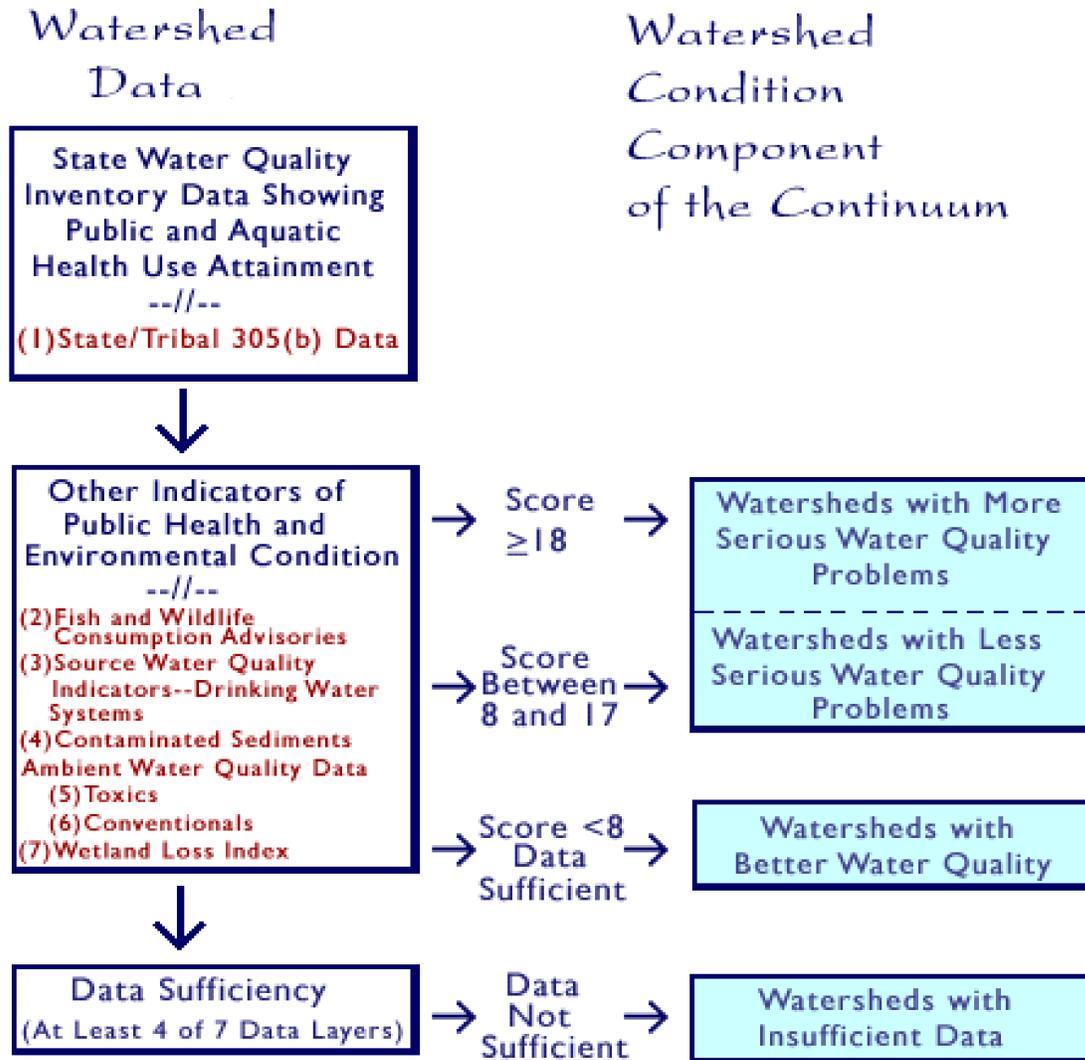
STORET Column 1	SDWIS Column 2	Column 3	Column 4	305(b)Column 5	Map 3 Rollup Column 6
On Map 3c	If On Map 3b the Color is:	Then The Intermediate Score 1 is: [Simple use of worst score]	If the resulting Score 1 is:	And If On Map 3a The Color Is:	Then The Second Intermediate Score 2 is:
Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
	Green	0		Green	0
	Yellow	1		Yellow	1
	Purple	2		Purple	2
Green	I. Data	0	Green	I. Data	Insufficient Data
	Green	0		Green	0
	Yellow	2		Yellow	1
	Purple	3		Purple	2
Yellow	I. Data	1	Yellow	I. Data	1
	Green	1		Green	1
	Yellow	1		Yellow	1
	Purple	2		Purple	2
Purple	I. Data	2	Purple	I. Data	2
	Green	2		Green	2
	Yellow	2		Yellow	2
	Purple	2		Purple	2

Scoring Map 3 In the overall NWAP Rollup

The decision key below resolves the differences that may arise from using both maps 1 and 3 in the same overall NWAP rollup. Map 1 shows the extent to which the designated uses in state water quality standards are met, and Map 3 shows the degree to which just the state drinking water designated uses are met according to the new composite map 3a, 3b, and 3c composite. The intention was to add points in the master watershed condition composite only to those watersheds that should get increased "badness" points because of drinking water conditions revealed in Map 3. The table below is the derivation of how that was done.

Map 3 Condition	If Condition On Map 1 is:	Then Use As Map 3 Score in the overall rollup
Insufficient Data	Insufficient Data	Zero
	Green	Zero
	Yellow	zero
	Purple	Zero
Green	I. Data	Zero
	Green	Zero
	Yellow	Zero
	Purple	Zero
Yellow	I. Data	1
	Green	1
	Yellow	Zero
	Purple	Zero
Purple	I. Data	2
	Green	2
	Yellow	1
	Purple	Zero

Methodology for Watershed Condition



Methodology for Watershed Vulnerability

Watershed
Data

Watershed
Vulnerability
Component
of the Continuum

