Chapter 2: Subwatershed Characterization

2.1 Introduction

A **watershed** is an area of land and an associated network of steams or drains that convey stormwater downstream, generally to a single outlet point. A watershed acts like a funnel, channeling all water that falls within its boundaries into a waterway. Each watershed is separated from other watersheds by a physical barrier such as a ridge, hill or mountain and as a result water quantity and quality in an area depend upon the land use and land cover that exists within that watershed.

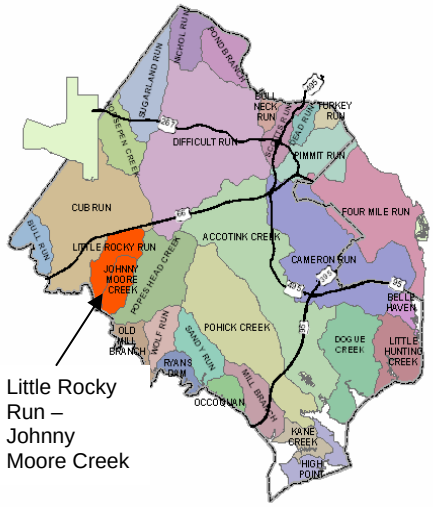


Figure 2-1: Location of Little Rocky Run and Johnny Moore Creek Watersheds in Fairfax County

Watersheds drain into other watersheds based on a geomorphological hierarchy, meaning that a larger watershed can be broken down into numerous subwatersheds based on the topography of an area. The Little Rocky Run watershed and the Johnny Moore Creek watershed are each divided into smaller **Watershed Management Areas** (WMAs) to make it easier to evaluate the characteristics of a portion of the watershed with similar land use and development characteristics. Using the WMAs, goals and objectives for the watershed can be refined to meet the needs of different problems and development types in the watershed.

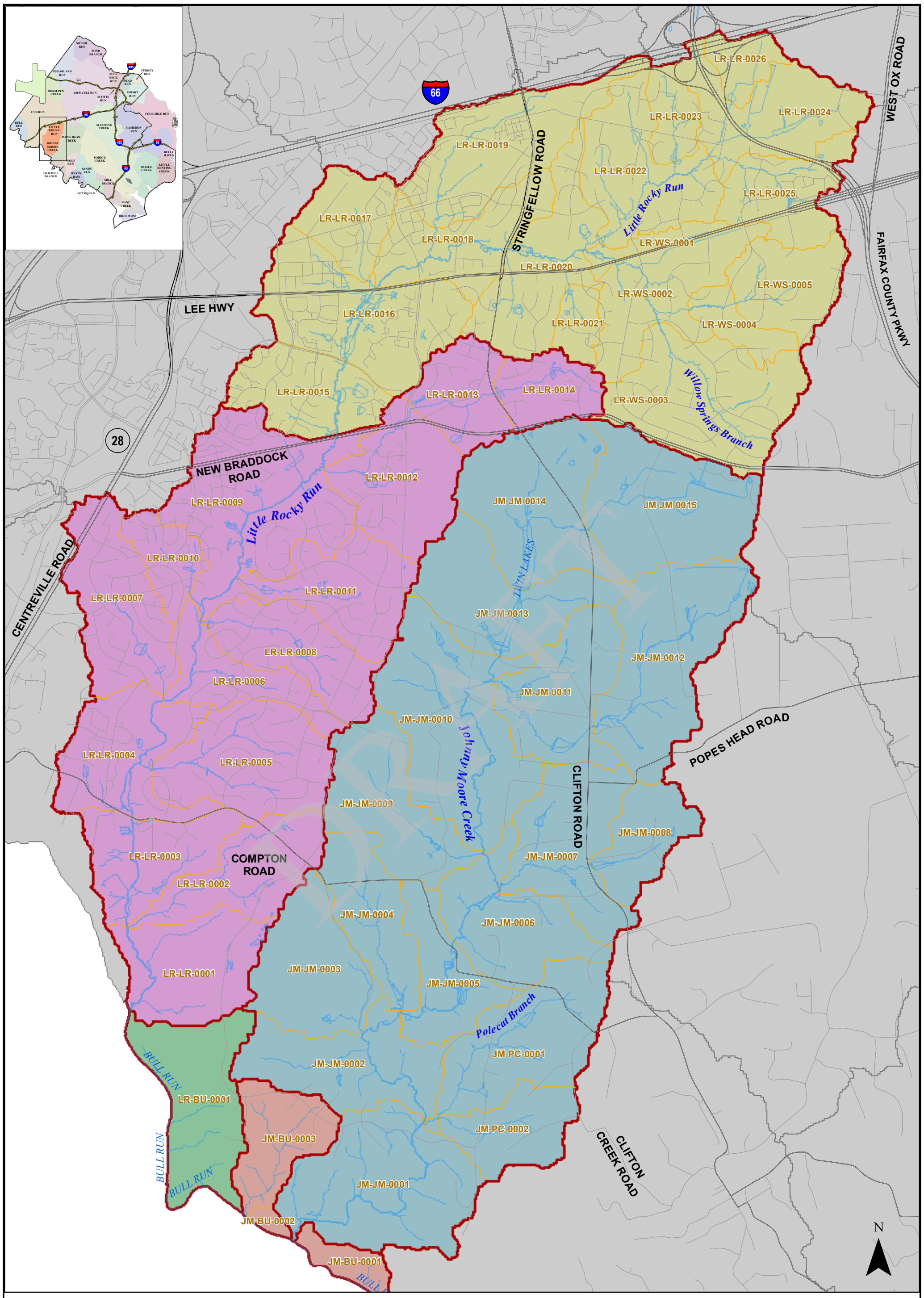
Little Rocky Run watershed is divided into three WMAs: Little Rocky Run-Upper, Little Rocky Run-Lower and Little Rocky Run-Bull Run. Johnny Moore Creek watershed is similarly divided into two WMAs, Johnny Moore and Johnny Moore-Bull Run. Both the Little Rocky Run-Bull Run and Johnny Moore-Bull Run WMAs are smaller areas that drain directly to Bull Run and are located in the southern part of the respective watersheds.

WMAs are generally about 4 square miles in area and are further broken down for this study into **subwatersheds** of between 100 and 300 acres. The subwatersheds provide further detail about the WMAs, especially the water quality and quantity issues of smaller tributaries and land use patterns that are not covered at the WMA scale. By examining data at the subwatershed level, drainage patterns, problem areas and possible solutions can be assessed in manageable work units. The information gained from the subwatershed assessment will be used to help prioritize possible future investments in water quality. Map 2-1 shows the WMAs and subwatersheds used in our water quality examination.

Sections 1-2 of this Chapter provide an introduction and a description of the methodologies used to assess the stream conditions in the watersheds. Sections 3-5 provide a summary of the stream conditions in the WMAs as follows:

- Section 3 Johnny Moore Creek and Johnny Moore Creek – Bull Run WMAs
- Section 4 Little Rocky Run – Lower and Little Rocky Run – Bull Run WMAs
- Section 5 Little Rocky Run – Upper WMA

Section 6 provides a summary of the subwatershed characterization results.



Map 2-1
Little Rocky Run - Johnny Moore Creek Subwatersheds

Watershed Management Areas

- Johnny Moore
- Johnny Moore- Bull Run
- Little Rocky Run- Bull Run
- Little Rocky Run- Lower
- Little Rocky Run- Upper

0 5001,000 2,000 Feet

2.2 Watershed Characterization Approach

The successful development of a Watershed Management Plan (WMP) requires the assessment of the interaction between pollutant sources, watershed stressors and conditions within streams and other water bodies. Each watershed must be evaluated in light of its unique conditions. Management opportunities should then be identified based on the effects of pollutants and stressors on watershed functions, both in the immediate vicinity of these stressors, as well as farther downstream. Watershed characterization was performed using consistent methods for evaluating watershed management needs while ensuring that the WMPs are developed with appropriate attention to watershed-specific conditions.

The County has developed goals and objectives to be applied to all watersheds during the WMP development process. The countywide goals and objectives will allow WMP recommendations to be linked to a Countywide Watershed Assessment. The countywide watershed planning goals are to:

1) Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology.
2) Protect human health, safety and property by reducing stormwater impacts.
3) Involve stakeholders in the protection, maintenance and restoration of County watersheds.

The countywide objectives are linked to the above goals. These objectives were consolidated from a list of over 50 stakeholder-defined objectives from previous WMPs. The shorter list of objectives allows for a countywide evaluation that addresses stakeholder concerns while providing an efficient and effective means of assessment. The final objectives are presented in the Table 2-1. This table also shows how each objective is linked to the three watershed planning goals. The countywide goals and objectives will be applied to all WMP assessments and recommendations. Additional watershed-specific goals and objectives that are recommended by local stakeholders may also be incorporated into the WMP development process. The objectives listed under Category 5 (Stewardship) will be considered during countywide watershed assessment but are not addressed in the ranking approach used in development of this workbook.

Table 2-1. Fairfax County Watershed Planning Final Objectives

Objective		Linked to Goal(s)
CATEGORY 1. HYDROLOGY		
1A.	Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat and support biota.	1
1B.	Minimize flooding to protect property, human health and safety.	2
CATEGORY 2. HABITAT		
2A.	Provide for healthy habitat through protecting, restoring and maintaining riparian buffers, wetlands and instream habitat.	1
2B.	Improve and maintain diversity of native plants and animals in the County.	1
CATEGORY 3. STREAM WATER QUALITY		
3A.	Minimize impacts to stream water quality from pollutants in stormwater runoff.	1, 2

Objective		Linked to Goal(s)
CATEGORY 4. DRINKING WATER QUALITY		
4A.	Minimize impacts to drinking water sources from pathogens, nutrients and toxics in stormwater runoff.	2
4B.	Minimize impacts to drinking water storage capacity from sediment in stormwater runoff.	2
CATEGORY 5 STEWARDSHIP		
5A.	Encourage the public to participate in watershed stewardship.	3
5B.	Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives.	3
5C.	Improve watershed aesthetics in Fairfax County.	1, 3

2.2.1 Watershed Impact Indicators

The purpose of the subwatershed ranking approach is to provide a systematic means of planning management implementation countywide that will achieve the County's watershed management goals and objectives. Since the objectives cannot be directly measured, the methods require measurable indicators that are directly linked to the objectives. One or more indicators for each objective were selected, including predictive and non-predictive, or observed, indicators. Predictive indicators, such as simulated data, can be used to compare existing and future conditions. Non-predictive indicators cannot measure future conditions but will still be useful in assessing existing watershed impacts within Fairfax County.

The watershed impact indicators used in the subwatershed ranking approach are described below:

Benthic Communities: Benthic communities consist of aquatic insects that are good indicators of watershed health. The scoring for this indicator is based on the 1999 *Fairfax County Stream Protection Strategy Baseline Study* that provided scoring based on the number and diversity of the benthic community at sampling sites.

Fish Communities: The scoring for this indicator is based on the 1999 *Fairfax County Stream Protection Strategy Baseline Study* that provided scoring based on the number and diversity of the fish community at sampling sites.

Aquatic Habitat: The scoring for this indicator is based on the *Fairfax County Stream Physical Assessment* that provided scoring based on a number of stream features that provide data about the diversity of the habitat and its ability to support a diverse aquatic community.

Channel Morphology: The scoring for this indicator is based on the *Fairfax County Stream Physical Assessment* and the *Fairfax County Stream Protection Strategy Baseline Study*. A channel evolution model (CEM)-based geomorphic assessment was performed in these studies to assess the evolutionary stage of the stream reaches. The CEM was used to identify stream successional stages from an early stable system through an unstable changing environment to a stable system.

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Instream Sediment: The scoring for this indicator is based on bank vegetative protection and bank stability assessment from the *Fairfax County Stream Physical Assessment* and the *Fairfax County Stream Protection Strategy Baseline Study*.

Residential Building Hazards: The scoring for this indicator is based on the number of residential buildings in the floodplain per square mile. This number was generated using the County's Geographic Information System (GIS) data.

Non-residential Building Hazards: The scoring for this indicator is based on the number of non-residential buildings in the floodplain per square mile. This number was generated using the County's GIS data.

Flood Complaints: The scoring for this indicator is based on the number of flood complaints per square mile. This indicator was based on data from the County's Drainage Complaints database.

Resource Protection Area (RPA) Riparian Habitat: The scoring for this indicator is based on the percentage of riparian habitat in the regulated Chesapeake Bay RPA. The riparian habitat was based on the National Wetlands Inventory, George Mason tidal wetland data and the Virginia Department of Forestry's (VDOF) 2005 Virginia Forest Cover Map.

Headwater Riparian Habitat: The scoring for this indicator is based on the percentage of forest or wetland areas within 100-feet of streams for the riparian areas upstream of the RPA boundaries.

Wetland Habitat: The scoring for this indicator is based on the percentage of wetland habitat. The wetland habitat was based on the National Wetlands Inventory and George Mason tidal wetland data.

Terrestrial Forested Habitat: The scoring for this indicator is based on the percentage of forested habitat based on the VDOF forested cover classifications.

***E. Coli*:** The scoring for this indicator is based on the average of all reported *E. coli* concentrations per 100 mL. This data was based on the number of *E. coli* per 100 milliliter (#/100mL) as reported in the EPA STORET database and fecal coliform per 100 milliliter (#/100mL). Additional bacteria data were obtained from available Fairfax County Health Department data. To maximize the amount of data employed for this metric, fecal coliform data were converted to *E. coli* concentrations using the Virginia Department of Environmental Quality (VADEQ) in-stream translator equation (VDEQ, 2003).

Upland Sediment: The scoring for this indicator is based on the modeled average annual sediment load in tons/acre/yr.

Nitrogen: The scoring for this indicator is based on the modeled average annual nitrogen load in pounds/acre/yr.

Phosphorus: The scoring for this indicator is based on the modeled average annual phosphorus load in pounds/acre/yr.

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Table 2-2 lists the selected indicators, noting the indicator type and the objective(s) each indicator is linked to.

Table 2-2. Countywide Watershed Impact Indicators

Indicator	Predictive	Linked to Objectives
Benthic Communities	No	1A, 2B, 3A
Fish Communities	No	1A, 2B, 3A
Aquatic Habitat	No	1A, 2A
Channel Morphology	Yes	1A
Instream Sediment	No	1A, 3A, 4B
Residential Building Hazards	Yes	1B
Non-residential Building Hazards	Yes	1B
Flood Complaints	No	1B
RPA Riparian Habitat	Yes	2A
Headwater Riparian Habitat	Yes	2A
Wetland Habitat	Yes	2A
Terrestrial Forested Habitat	Yes	2A
E. Coli	No	3A, 4A
Upland Sediment	Yes	3A, 4A, 4B
Nitrogen	Yes	3A, 4A
Phosphorus	Yes	3A, 4A

2.2.2 Source Indicators

The watershed impact indicators provide information on how endpoints of watershed processes are impacted by adverse watershed conditions. The source indicators will assist in the evaluation of the sources and stressors that impact these watershed endpoints as well. The recommended source indicators are described below:

- Channelized/Piped Streams – percent channelized/piped by stream length
- Directly Connected Impervious Area (DCIA) (predictive) - % DCIA
- Impervious Surface (predictive) - % Impervious
- Stormwater Outfalls – number of stormwater outfalls per mile of stream length
- Parcels Served by Septic Tanks – number of parcels served per square mile
- Streambank Buffer Deficiency - % buffer area disturbed (non-forest buffer area)

- Total Nitrogen Load (predictive) – see watershed impact indicator for nitrogen
- Total Phosphorus Load (predictive) – see watershed impact indicator for phosphorus

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- Total Suspended Sediment Load (predictive) – see watershed impact indicator for sediment
- Total Urban Land Cover (predictive) – % urban land cover (low, medium and high density residential; low and high intensity commercial; institutional; industrial; and transportation)
- Virginia Pollutant Discharge Elimination System (VPDES) Permitted Point Sources – number of point sources per square mile

These indicators were scored and combined to determine objective composite scores and overall composite scores. These scores were used to compare the subwatersheds with respect to the objectives.

2.2.3 Programmatic Indicators

A third set of indicators, termed "Programmatic Indicators," will also be used to help evaluate watershed management needs. These indicators illustrate the extent and location of existing and past management efforts. The following types of management in each watershed will be inventoried in the WMA:

- Detention Facilities
- Stream Restoration
- Riparian Buffer Restoration
- BMP Facilities
- Low Impact Development
- Inspection and Maintenance of Stormwater Management Facilities
- Inspection and Repair of Stormwater Infrastructure and Outfalls
- Dumpsite Removal
- Regional Ponds
- Volunteer Monitoring
- Subarea Treatment (used in watershed modeling studies)

Data for these indicators will be considered during identification and evaluation of watershed management needs, but were not considered in the composite scoring described above.

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