

CHAPTER 4.3 INDIVIDUAL RIVER BASIN DESCRIPTION AND ASSESSMENTS

Potomac and Shenandoah River Basin

The Potomac-Shenandoah River basin, as its name implies, is made up of the Shenandoah River sub-basin and the Potomac River sub-basin. It occupies the northern portion of Virginia and covers 5,681 square miles or 13% of the Commonwealth's total area.

In Virginia, the Potomac-Shenandoah basin is defined by both hydrologic and political boundaries. The James River and Rappahannock River basins bound the basin to the south. The West Virginia and Maryland State lines and the District of Columbia bound the northern and western perimeter of the basin.

The headwaters of the Shenandoah River sub-basin begin in Augusta County and flow in a northeasterly direction for approximately 100 miles to the West Virginia state line. The basin averages 30 miles in width and covers 3,384 square miles.

The topography of the Shenandoah River sub-basin is characterized by rolling hills and valleys bordered by the Appalachian Mountains to the west and the Blue Ridge Mountains to the east. The Massanutten Mountain Range divides the Shenandoah River into the North and South Forks. Tributaries of the Shenandoah River exhibit steep profiles as they drain the surrounding mountain ridge. The mainstems of the Shenandoah exhibit a moderately sloping profile with occasional riffles and pools. Approximately 45% of the land is forested due to the large amount of federally-owned land and the steep topography. Farmland and pasture account for 39% of the land area, while 16% is urban.

The Potomac River sub-basin headwaters begin in Highland County. The drainage area is 323 square miles for the headwaters. The river then flows in a northeasterly direction through West Virginia and Maryland before joining the Shenandoah at Harper's Ferry, West Virginia. The Potomac River continues as the border between Maryland and Virginia. These waters flow approximately 200 miles in a southeasterly direction along Loudoun and Fairfax counties to its confluence with the Chesapeake Bay in Northumberland County. Approximately 2,298 of the 14,700 square miles of the Potomac River sub-basin drainage area lie in Virginia. The rest covers four states and the District of Columbia.

Gently sloping hills and valleys from Harpers Ferry to approximately 45 miles downriver characterize the topography of the upper Piedmont region of the Potomac River sub-basin. In the central Piedmont area, the profile is rather flat until it nears the fall line at Great Falls, where the stream elevation rapidly descends from over 200 feet to sea level. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain area. Approximately 40% of the Potomac River basin is forested, 33% is farmland and pasture and an estimated 27% is urban.

The 2010 population for the Potomac-Shenandoah River basin was approximately 3,141,200. The majority of the population resides in urban Virginia surrounding Washington, D.C. All or part of the following jurisdictions lie within the basin: Counties – Arlington, Augusta, Clarke, Fairfax, Fauquier, Frederick, Highland, King George, Loudoun, Northumberland, Page, Prince William, Rockingham, Shenandoah, Stafford, Warren, and Westmoreland; Cities – Alexandria, Fairfax, Falls Church, Harrisonburg, Manassas, Manassas Park, Staunton, Waynesboro, and Winchester.

The Potomac-Shenandoah River basin is divided into eight USGS hydrologic units as follows: HUC 02070001- South Branch Potomac; HUC 02070004 - Conococheague-Opequon; HUC 02070005 - South Fork Shenandoah; HUC 02070006 - North Fork Shenandoah; HUC 02070007 - Shenandoah; HUC 02070008 - Middle Potomac-Catoctin; HUC 02070010 - Middle Potomac-Anacostia-Occoquan; HUC 02070011 - Lower Potomac. The eight hydrologic units are further divided into 92 waterbodies or watersheds and 181 6th order sub-watersheds.

Public Concerns over Excessive Algae in the Shenandoah River

During the public comment period for the 2012 Integrated Report (March 26 to April 24, 2012), DEQ received over 80 comments from citizens regarding the presence of algae in the Shenandoah River. Comments were also received during the comment period for the 2014 IR (December 15, 2014 – January 30, 2015). Commenters expressed concern that algae in the river have impaired the recreation designated use. However, DEQ did not list the Shenandoah as impaired for the recreation use for the following principal reasons:

- Waters that do not meet Water Quality Standards due to a pollutant(s) may be listed as impaired. “Pollutant” is defined in Federal law and either narrative or numeric water quality standards may be used to list waters as impaired. However, an “impaired” designation can only be made based on specific and objective monitoring data, in terms of location, extent, and duration, as well as an accepted, scientifically valid assessment method that compares monitoring data to water quality standards or criteria.
- Virginia’s General Water Quality Criteria (narrative) provides that state waters shall be free from substances that interfere with designated uses, including those which *nourish* undesirable or nuisance aquatic plant life. The terms “undesirable or nuisance” are subjective and require interpretation and no numeric thresholds have been developed for Virginia waters. DEQ currently has no reliable methodology for specifically assessing the level of recreation use attainment in the context of what may or may not be a “nuisance”.
- There are no Federal numeric criteria classifying algae production as excessive or in violation of aesthetic criteria. Virginia currently has nutrient criteria for lakes designed to protect aquatic life and recreation. Virginia doesn’t currently have adopted water quality standards for nutrient levels in free flowing waters, but DEQ has been working for a number of years on a screening approach for nutrient criteria that appears very promising. Progress on this approach can be viewed at this web link: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards/NutrientCriteriaDevelopment.aspx>. DEQ will include work elements in the next annual (FY16) contract with its Academic Advisory Committee to further develop and refine this screening approach, based in part on comments received from EPA Region 3 in December 2014.
- Virginia’s recreational use assessment for rivers and streams is based on violations of E. coli bacteria, a numeric human health risk criterion. DEQ believes that standard is appropriate to determine recreational use support.
- There is insufficient data to list entire stretches of the North Fork, South Fork, and mainstem Shenandoah Rivers as impaired. The information received from concerned citizens was largely anecdotal. DEQ has maintained a long-standing policy of basing impairment decisions solely on data collected with an agency-approved quality assurance plan (Level III data).
- Local TMDLs have been developed in 17 tributaries to the Shenandoah Basin to address sediment and nutrients as causes for benthic impairments.
- In addition to the local TMDL’s, the Chesapeake Bay TMDL with its Virginia Watershed Implementation Plan will result in significant controls for inputs of nitrogen, phosphorus and sediment throughout the Shenandoah Basin.

In response to citizen comments to the draft 2014 IR, additional photographic evidence, and recent information provided by citizen groups, DEQ has determined that there is uncertainty about the attainment status of the recreation designated use for 7 assessment units in the Shenandoah River basin. These waters (listed in Table 4.3-a) comprise a total of 25 stream miles and are classified in the Assessment Database as Category 3C for the recreation use, meaning that DEQ has received information suggesting water quality problems may exist, but this information is not sufficient for making a determination of impairment at this time. The potential cause of impairment has been identified as algae. These waters will be prioritized for monitoring so that their attainment status can be resolved with additional data. DEQ intends to develop a scientifically valid field method for evaluating algae cover that can be applied consistently throughout the state, with an initial study area focused on the Shenandoah River. This path forward will consider recommendations from the Interstate Commission on the Potomac River Basin’s 2014-15 algal study, guidance developed by the agency’s own monitoring and assessment

staff, recommendations from the Academic Advisory Committee, and input from the Mid-Atlantic jurisdictions that comprise EPA Region III (PA, WV, MD, VA, DEQ and DC).

Table 4.3-a. Assessment units in the Shenandoah River that have been classified as having an indeterminate recreation use status, with algae identified as a potential cause of impairment.

Assessment Unit ID	Stream Name	Location Description	Length (mi)
VAV-B40R_SSF01B14	South Fork Shenandoah River	South Fork Shenandoah River from the Bentonville Landing Bridge downstream to the Andy Guest State Park STP outfall	2.2
VAV-B40R_SSF03A14	South Fork Shenandoah River	South Fork Shenandoah River from the Foster's Landing Rapids downstream to Seekford's Ford.	5.4
VAV-B37R_SSF02B14	South Fork Shenandoah River	South Fork Shenandoah River from Naked Creek downstream to the Shenandoah STP outfall.	2.0
VAV-B35R_SSF01A00	South Fork Shenandoah River	South Fork Shenandoah River from its confluence with Dry Run downstream to its confluence with Naked Creek.	3.6
VAV-B51R_NFS05A00	North Fork Shenandoah River	North Fork Shenandoah River from the Strasburg Public Water Intake downstream to the 5 mile upper limit of the PWS designation for the Winchester Public Water Intake.	1.6
VAV-B51R_NFS06A00	North Fork Shenandoah River	North Fork Shenandoah River from the 5 mile upper limit of the PWS designation for the Strasburg Public Water Intake downstream to the Strasburg Public Water Intake.	5.9
VAV-B45R_NFS02A00	North Fork Shenandoah River	North Fork Shenandoah River from its confluence with Fort Run downstream to its confluence with Plains Mill Spring Run.	4.5

Basin assessment information is included in the following figures and tables.

Figure 4.3-1 Designated Use support summary for Potomac-Shenandoah River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

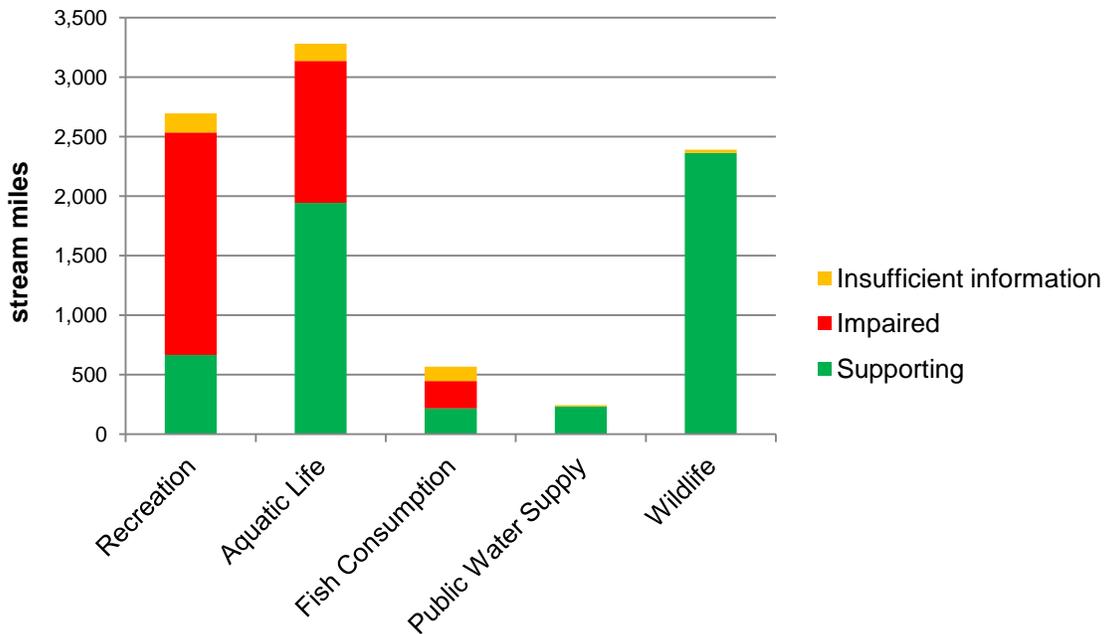
Basin Size: All Sizes Rounded to Nearest Whole Number

Rivers - 13,233 miles

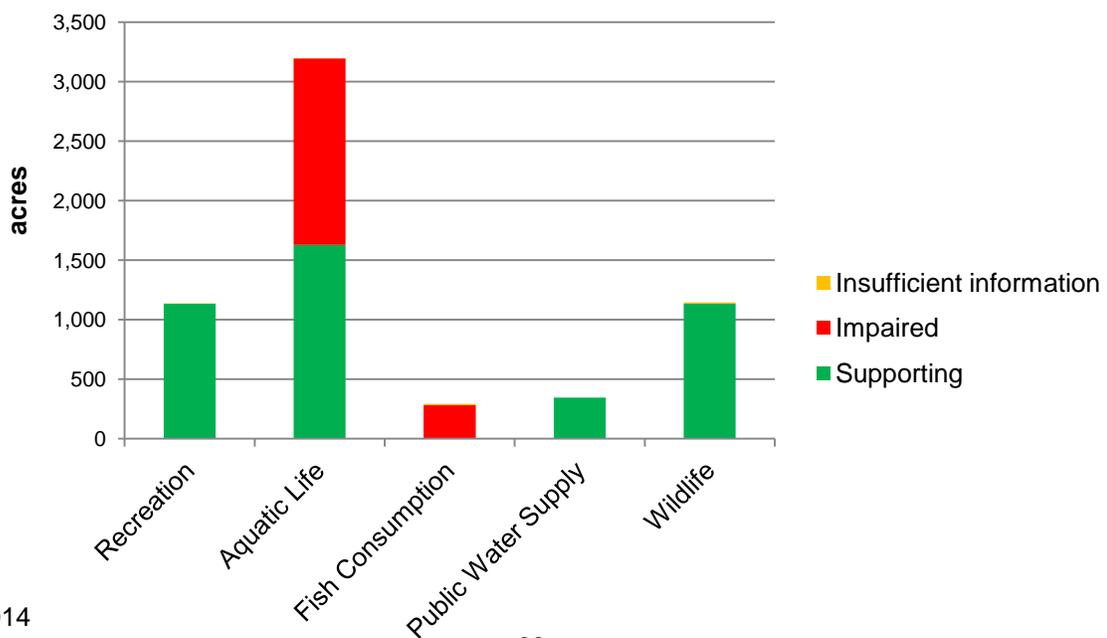
Lakes - 4,234 acres

Estuaries - 59 sq. miles

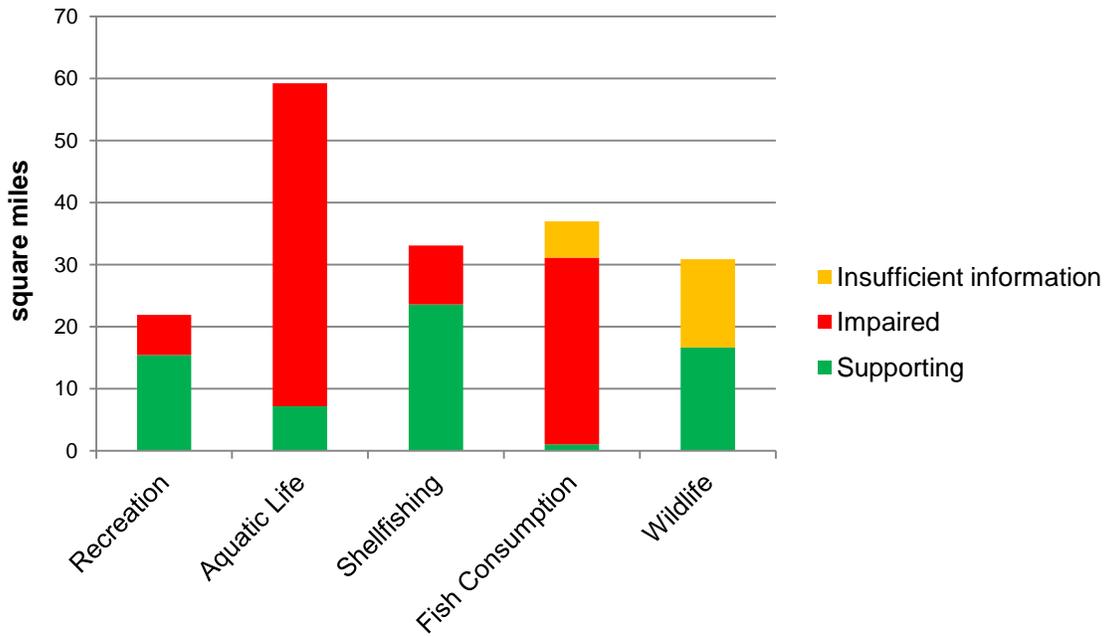
a) Rivers Assessment (10,052 miles were not assessed)



b) Lakes Assessment (926 acres were not assessed)



c) Estuaries assessment



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed.)

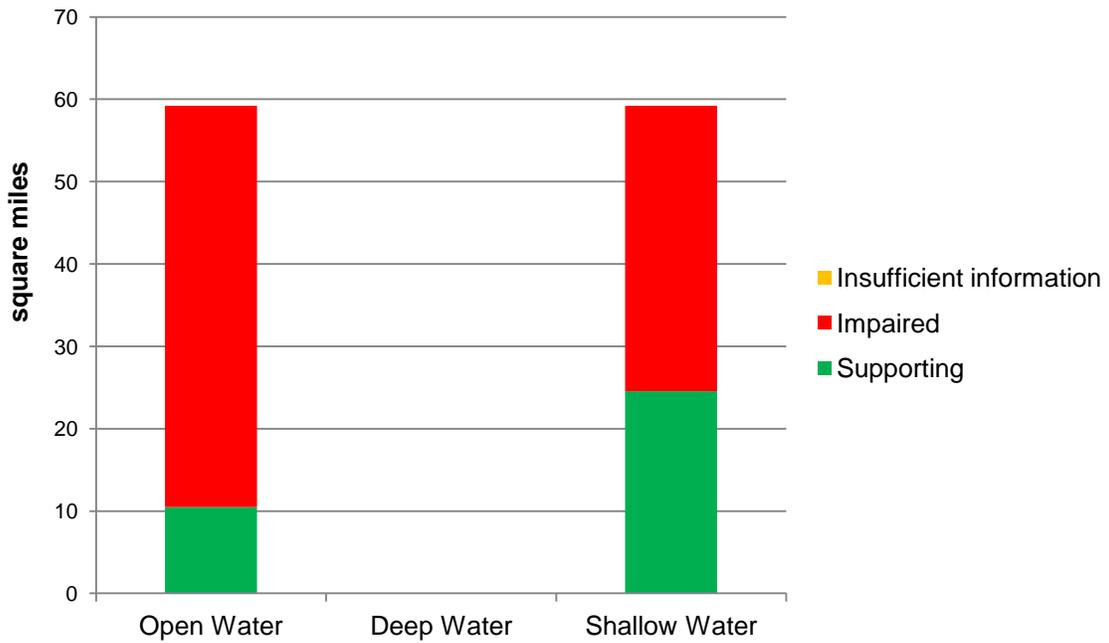


Table 4.3-1 Significant causes of designated use impairment in the Potomac-Shenandoah River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Bacteria	79%	Dissolved Oxygen	76%	Dissolved Oxygen	83%
Impaired Benthics	31%	PCBs in Fish Tissue	16%	Impaired Aquatic Plants	59%
pH	13%	Mercury in Fish Tissue	10%	PCBs in Fish Tissue	51%
Mercury in Fish Tissue	7%	Temperature	11%	Bacteria	20%
Dissolved Oxygen	9%	pH	1%	pH	2%
PCBs in Fish Tissue	5%	--	--	Impaired Benthics	1%

Table 4.3-2 Suspected sources of designated use impairment in the Potomac-Shenandoah River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Wildlife other than Waterfowl	63%	Natural Conditions	74%	Sources Outside State Borders	88%
Non-Point Sources	53%	Source Unknown	24%	Agriculture	88%
Agriculture	36%	Atmospheric Deposition (Toxics)	6%	Atmospheric Deposition (Nitrogen)	88%
Source Unknown	23%	Combined Sewer Overflows	6%	Industrial or Municipal Point Source Discharges	88%
Grazing in Riparian or Shoreline Zones	16%	Contaminated Sediments	6%	Internal Nutrient Recycling	88%
Waterfowl	15%	Upstream Source	6%	Loss of Riparian Habitat	88%

James River Basin

The James River Basin occupies the central portion of Virginia and covers 10,265 square miles or approximately 24% of the Commonwealth's total land area. It is Virginia's largest river basin and is made up of the Upper, Middle, and Lower James River sub-basins as well as the Appomattox River sub-basin.

The James River basin is defined by both hydrologic and political boundaries. The Potomac-Shenandoah River basin, the Rappahannock River basin and the York River basins bound the basin to the north. The

southern boundary is made up of the New River basin, the Roanoke River basin and the Chowan River basin. Its headwaters originate along the Virginia/West Virginia state line.

The James River basin begins in the Alleghany Mountains and flows in a southeasterly direction to Hampton Roads where it enters the Chesapeake Bay. The James is formed by the confluence of the Jackson and Cowpasture Rivers and flows 242 miles to the Fall Line at Richmond and another 106 miles to the Chesapeake Bay.

The topography of the James River basin varies throughout the four physiographic provinces that it spans. The Valley and Ridge Province extends from the Appalachian Plateau in West Virginia to the Blue Ridge Province. The Blue Ridge Province, a remnant of a former highland, differs from the Valley and Ridge Province. It is a province of rugged terrain with steep slopes and narrow ridges in the north and broad moderate slopes in the south. The Piedmont Province extends to the Fall Line and has scattered hills and small mountains, gradually turning into gently rolling slopes and lower elevation in the eastern portion of the province. The Fall Zone separates the Coastal Plain Province from the Piedmont. The Fall Zone is a three-mile stretch of river running through Richmond where the river descends 84 feet as it flows from the resistant rocks of the Piedmont to the softer sediments of the Coastal Plain.

Over 65% of the James River basin is forested, with 19% in cropland and pasture. Approximately 12% is considered urban. The 2010 population for the James River basin was approximately 2,892,000. This population is concentrated in two metropolitan areas: Tidewater, with over one million people, and the Greater Richmond – Petersburg area with over 650,000. Two smaller population centers are the Lynchburg and Charlottesville areas, each with over 100,000 people. All or portions of the following 38 counties and 17 cities lie within the basin: counties - Albemarle, Alleghany, Amelia, Amherst, Appomattox, Augusta, Bath, Bedford, Botetourt, Buckingham, Campbell, Charles City, Chesterfield, Craig, Cumberland, Dinwiddie, Fluvanna, Giles, Goochland, Greene, Hanover, Henrico, Highland, Isle of Wight, James City, Louisa, Montgomery, Nelson, New Kent, Nottoway, Orange, Powhatan, Prince Edward, Prince George, Roanoke, Rockbridge, Surry, and York; cities - Buena Vista, Charlottesville, Chesapeake, Colonial Heights, Covington, Hampton, Hopewell, Lexington, Lynchburg, Newport News, Norfolk, Petersburg, Portsmouth, Richmond, Suffolk, Williamsburg, and Virginia Beach.

Average annual precipitation is 42.5 inches. Average annual snowfall amount ranges from over 30 inches in the mountains to less than 10 inches along the coast.

Major tributaries to the James River are Jackson River, Cowpasture River, Craig Creek, Maury River, Tye River, Rockfish River, Slate River, Rivanna River, Willis River, Appomattox River, Chickahominy River, Pagan River, Nansemond River, and the Elizabeth River.

The James River Basin is divided into eight USGS hydrologic units as follows: HUC 02080201 –Upper James, HUC 02080202 – Maury, HUC 02080203 – Upper Middle James, HUC 02080204 – Rivanna, HUC 02080205 – Lower Middle James, HUC 02080206 – Lower James, HUC 02080207 – Appomattox, and HUC 02080208 – the Elizabeth. The eight hydrologic units are further divided into 109 waterbodies or watersheds and 298 6th order sub-watersheds.

Basin assessment information is presented in the following tables and figures.

Figure 4.3-2 Designated Use support summary for the James River basin.

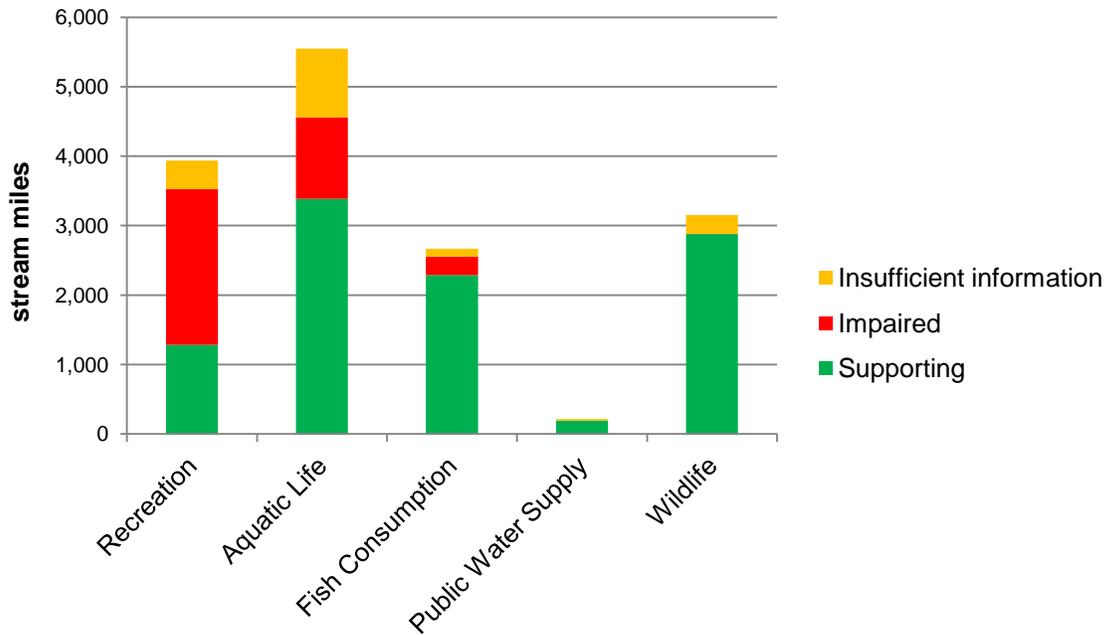
Basin Size: *All Sizes Rounded to Nearest Whole Number*

Rivers - 26,058 miles

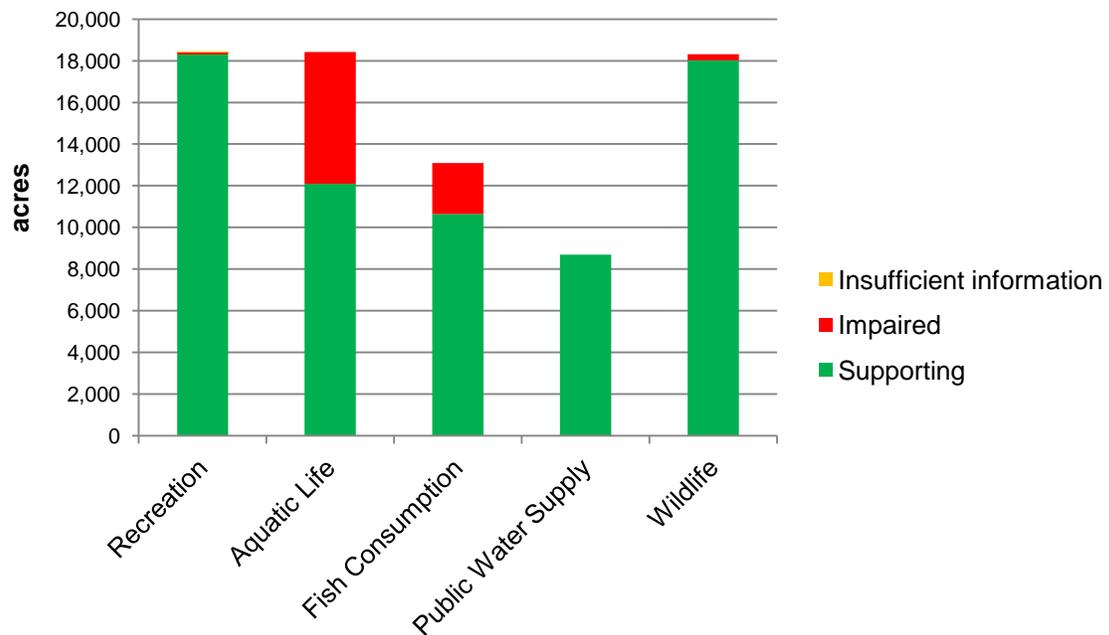
Lakes - 18,490 acres

Estuaries - 265 sq. miles

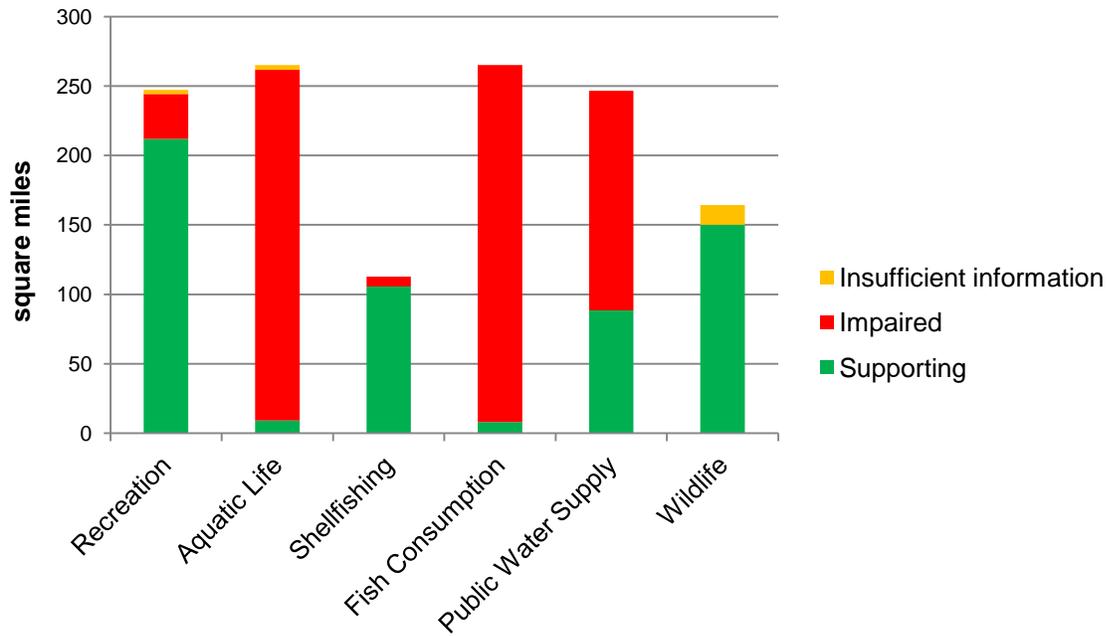
a) Rivers Assessment (19,445 miles were not assessed)



b) Lakes Assessment (11 acres were not assessed)



c) Estuaries assessment



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed).

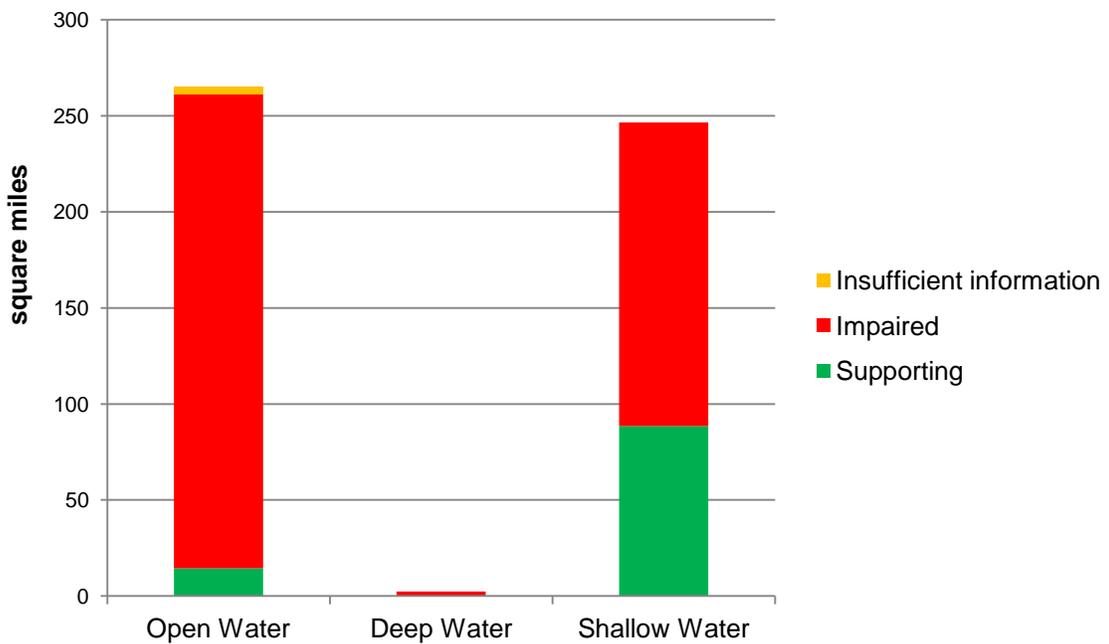


Table 4.3-3 Significant causes of designated use impairment in the James River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Bacteria	74%	Dissolved Oxygen	77%	PCBs in Fish Tissue	97%
Impaired Benthics	19%	Mercury in Fish Tissue	33%	Dissolved Oxygen	82%
Dissolved Oxygen	12%	Total Phosphorous	26%	Chlorophyll a	76%
PCBs in Fish Tissue	8%	pH	6%	Impaired Benthics	45%
pH	8%	Copper	4%	Impaired Aquatic Plants	60%
Temperature	4%	PCB in Fish Tissue	4%	Bacteria	13%

Table 4.3-4 Suspected sources of designated use impairment in the James River Basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Non-Point Sources	54%	Source Unknown	93%	Source Unknown	98%
Wildlife other than Waterfowl	40%	Natural Conditions	19%	Industrial or Municipal Point Source Discharges	96%
Source Unknown	24%	Atmospheric Deposition (Toxics)	15%	Agriculture	86%
Unspecified Domestic Waste	22%	Dam or Impoundments	7%	Atmospheric Deposition (Nitrogen)	86%
Livestock Grazing or Feeding Operations	22%	Urbanized High Density Areas	4%	Internal Nutrient Recycling	86%
Agriculture	21%	Changes in Ordinary Stratification and Bottom Water Hypoxia/Anoxia	3%	Loss of Riparian Habitat	86%

Rappahannock River Basin

The Rappahannock River basin is located in the northeastern portion of Virginia and covers 2,712 square miles or approximately 6% of the Commonwealth's total area.

The Rappahannock River basin is bordered by the Potomac-Shenandoah basin to the north and the York River basin and Chesapeake/Atlantic Coastal basin to the south and east. The headwaters lie in Fauquier and Rappahannock counties and flow in a southeasterly direction to its confluence with the Chesapeake Bay between Lancaster and Middlesex counties. The Rappahannock River basin is 184 miles in length and varies in width from 20 to 50 miles. The Rappahannock River basin's major tributaries are the Hazel River, Thornton River, Mountain Run, Rapidan River, Robinson River, Cat Point Creek, and the Corrotoman River.

The topography of the Rappahannock River basin changes from steep slopes to flat land as it flows from the Blue Ridge Mountains to the Chesapeake Bay. About 51% of the basin land is forested, while pasture and cropland make up another 36%. Only about 6% of the land area is considered urban.

Most of the Rappahannock River basin lies in the eastern Piedmont and Coastal Plain areas of the Commonwealth while its headwaters, located on the eastern slopes of the Blue Ridge, are considered to be in the northwestern Piedmont section.

The 2010 population of the Rappahannock River basin was approximately 483,770. The basin is mostly rural in character with no large population centers. However, the basin has seen increasing urban pressure from the influence of metropolitan Washington in the Fredericksburg and Fauquier areas of the basin. All or portions of the following 17 counties and one city lie within the basin: Albemarle, Caroline, Culpeper, Essex, Fauquier, Greene, King George, Lancaster, Madison, Middlesex, Northumberland, Orange, Rappahannock, Richmond, Spotsylvania, Stafford, and Westmoreland; City - Fredericksburg.

The Rappahannock River Basin is divided into two USGS hydrologic units as follows: HUC 02080103 – Rapidan – Upper Rappahannock; and HUC 02080104 – Lower Rappahannock. The two hydrologic units are further divided into 26 waterbodies or watersheds and 74 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

Figure 4.3-3 Designated use support summary for the Rappahannock River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

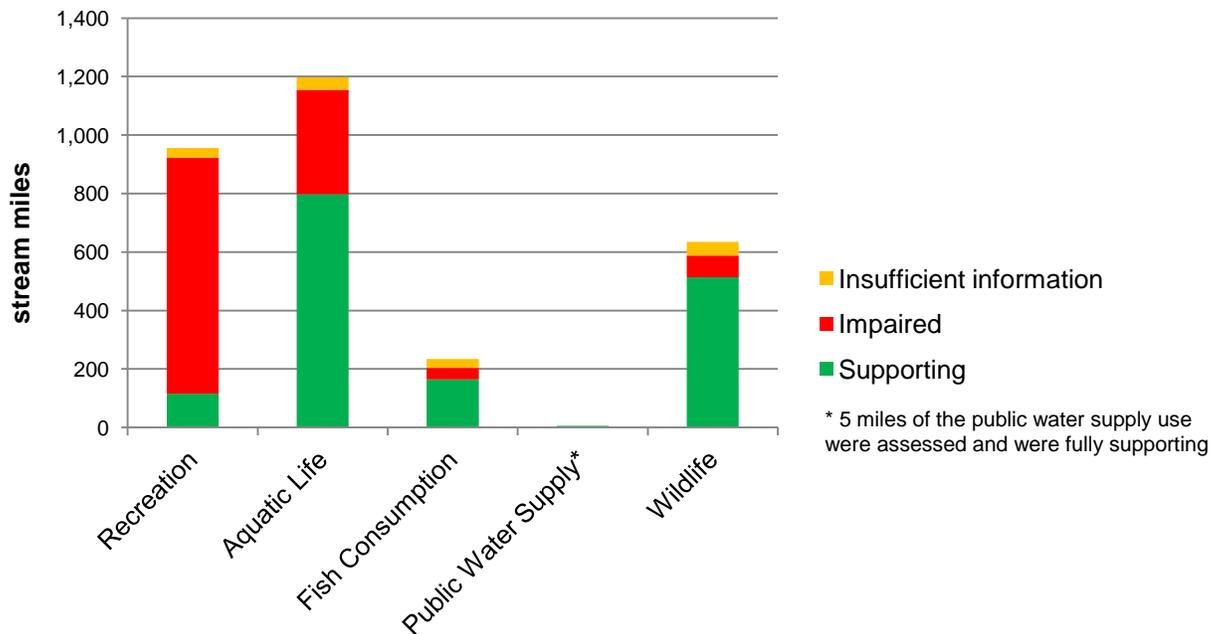
Basin Size: All Sizes Rounded to Nearest Whole Number

Rivers - 6,490 miles

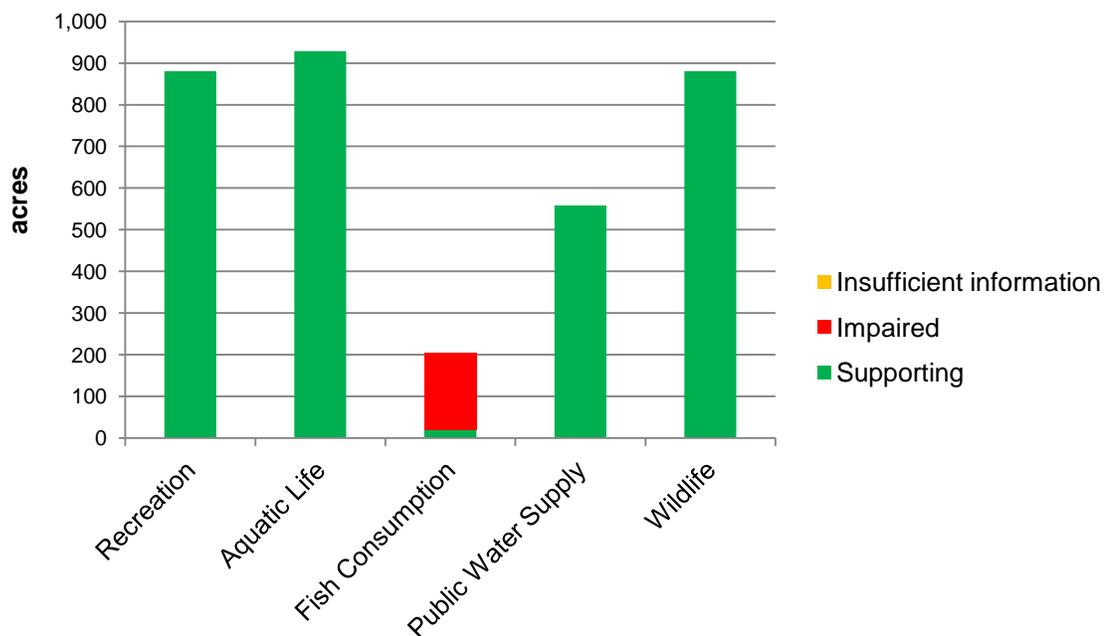
Lakes - 948 acres

Estuaries - 155 sq. miles

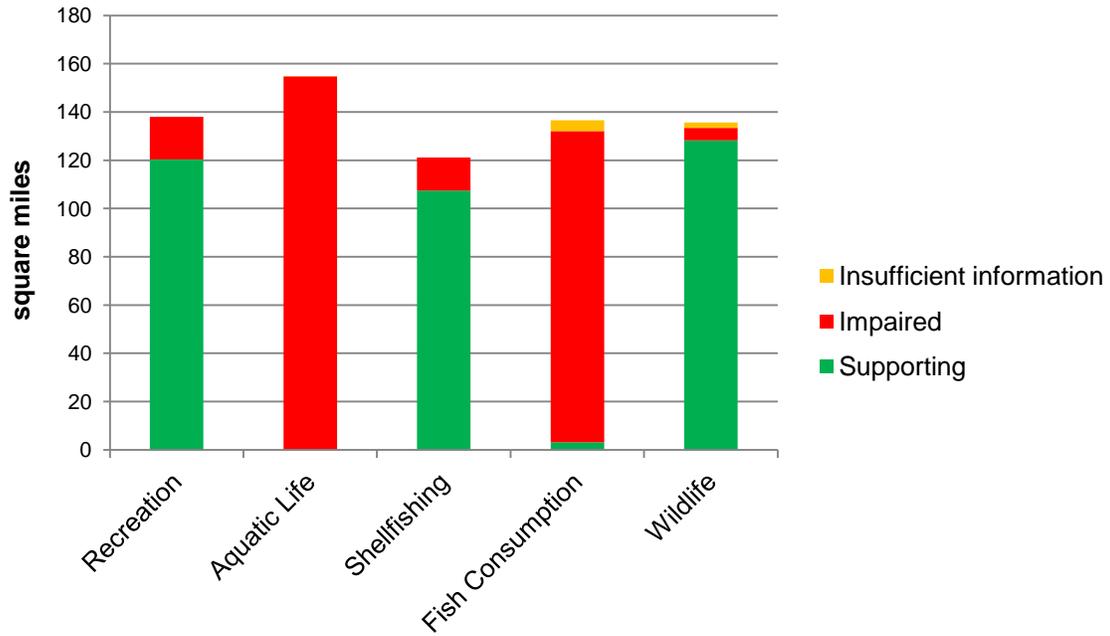
a) Rivers Assessment (5,333 miles were not assessed)



b) Lakes Assessment



c) Estuaries assessment



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed).

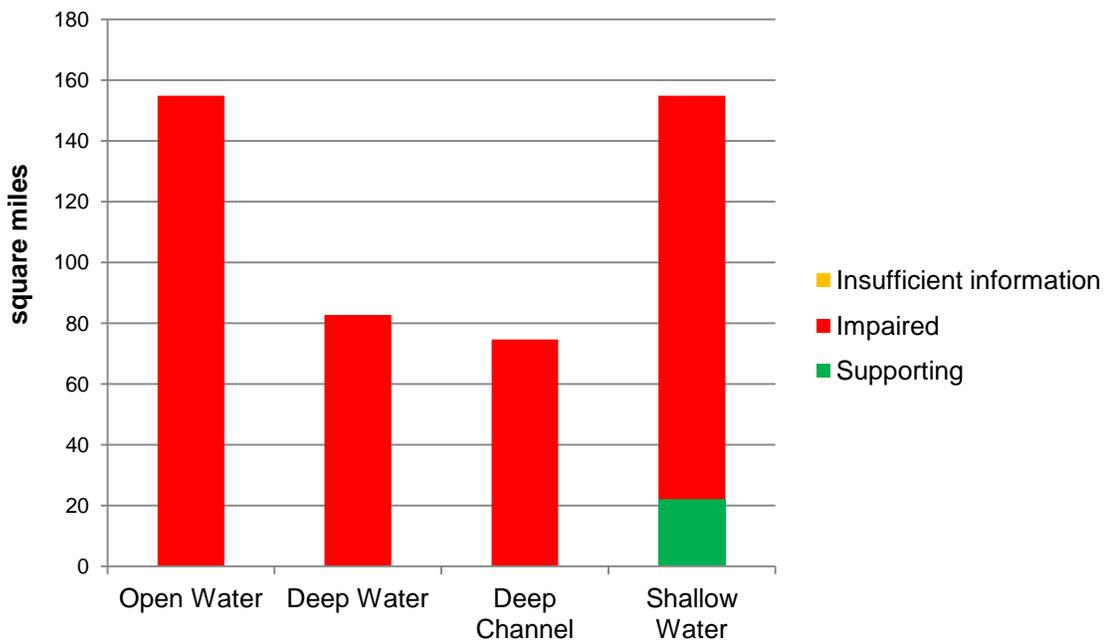


Table 4.3-5 Significant causes of designated use impairment in the Rappahannock River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Bacteria	82%	Mercury in Fish Tissue	100%	Dissolved Oxygen	100%
Dissolved Oxygen	20%	--	--	PCB in Fish Tissue	83%
pH	14%	--	--	Impaired Benthics	80%
Impaired Benthics	10%	--	--	Bacteria	19%
Mirex	8%	--	--	Impaired Aquatic Plants	86%
PCBs in Fish Tissue	3%	--	--	Chloride	3%

Table 4.3-6 Suspected sources of designated use impairment in the Rappahannock River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Livestock Grazing or Feeding Operations	46%	Source Unknown	100%	Agriculture	100%
Waterfowl	46%	Atmospheric Deposition (Toxics)	26%	Atmospheric Deposition (Nitrogen)	100%
Wildlife other than Waterfowl	46%	--	--	Municipal or Industrial Point Source Discharges	100%
Waste from Pets	42%	--	--	Internal Nutrient Recycling	100%
Non-Point Sources	31%	--	--	Loss of Riparian Habitat	100%
On-site Septic Treatment Systems	28%	--	--	Sources Outside State Borders	100%

Roanoke River Basin

The Roanoke River basin covers 6,393 square miles or approximately 15% of the Commonwealth's total area. In addition to the Roanoke itself, the basin also contains the Yadkin River sub-basin.

The Virginia portion of the Roanoke River basin is defined by both hydrologic and political boundaries. The basin is bound by the James River basin on the north, to the east by the Chowan River basin, and to the west by the New River basin. The southern boundary of the basin is the Virginia/North Carolina state line.

The topography of the Roanoke River basin ranges from steep slopes and valleys in the Valley and Ridge Province to gently sloping terrain east of the mountains in the Piedmont Province.

The Roanoke River basin headwaters begin in the mountainous terrain of eastern Montgomery County and flow in a southeasterly direction to the Virginia/North Carolina state line. The Roanoke basin passes through three physiographic provinces- the Valley and Ridge Province to the northwest, and the Blue Ridge and Piedmont Provinces to the southeast.

The Roanoke watershed is large enough to accommodate two major reservoirs, Smith Mountain and Leesville Lakes to the north and Kerr Reservoir and Lake Gaston located at the junction of the Roanoke River and the North Carolina state line. These reservoirs range in size from the 33,300 acre Kerr Reservoir to the 2,600-acre Leesville Lake. These impoundments are used for both recreation and hydroelectricity. Major tributaries in the northern section of the basin are the Little Otter and Big Otter Rivers along with the Blackwater and Pigg Rivers. Major tributaries in the southern portion include the Dan River, Smith River, and Banister River. Over 62% of the Roanoke River Basin is forested, while nearly 25% is in cropland and pasture. Approximately 10% is considered urban.

The 2010 population for the Roanoke River Basin was approximately 943,200. All or portions of the following 17 counties and 5 cities lie within the basin: counties – Appomattox, Bedford, Botetourt, Brunswick, Campbell, Carroll, Charlotte, Floyd, Franklin, Grayson, Halifax, Henry, Mecklenburg, Montgomery, Patrick, Pittsylvania, and Roanoke; cities – Bedford, Danville, Martinsville, Roanoke, and Salem.

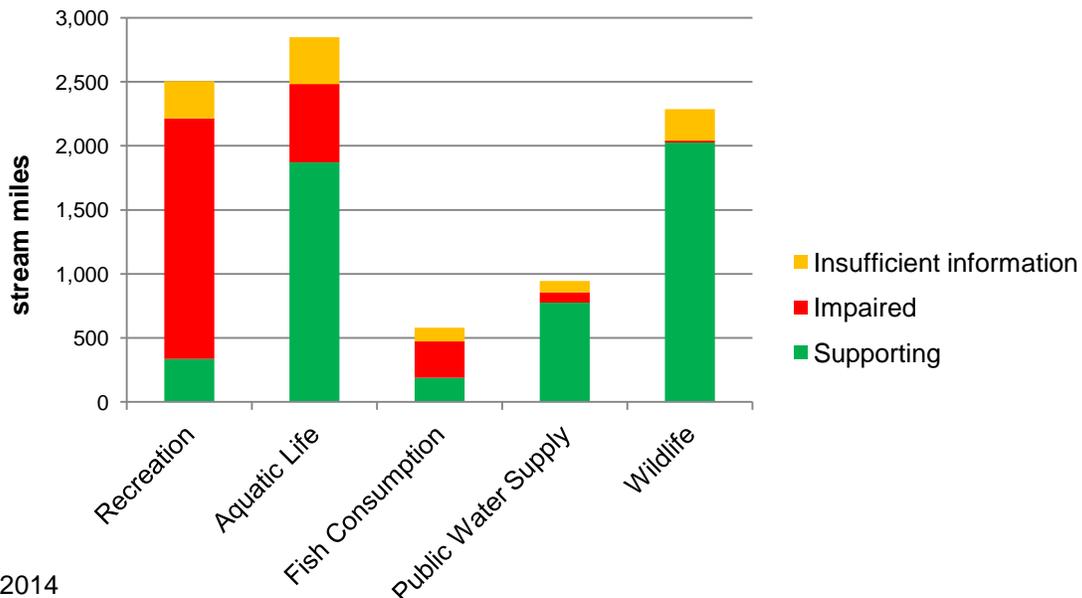
The Roanoke River basin is divided into seven USGS hydrologic units as follows: HUC 03010101 – Upper Roanoke; HUC 03010102 – Middle Roanoke; HUC 03010103 – Upper Dan; HUC 03010104 – Lower Dan; HUC 03010105 – Banister; HUC 03010106 – Roanoke Rapids and HUC 03040101 – Upper Yadkin. The seven hydrologic units are further divided into 87 waterbodies or watersheds and 202 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

Figure 4.3-4 Designated use support summary for the Roanoke River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

Basin Size: All Sizes Rounded to Nearest Whole Number
 Rivers - 17,276 miles
 Lakes - 66,777 acres
 Estuaries - 0 sq. miles

a) Rivers Assessment (14,668 miles were not assessed)



b) Lakes Assessment (1,353 acres were not assessed)

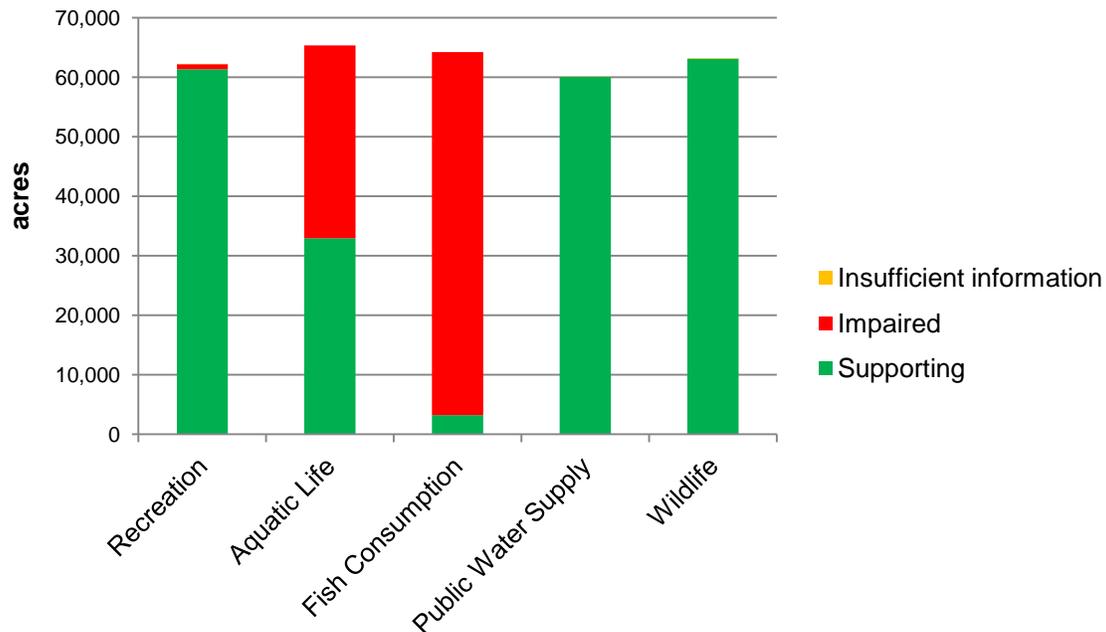


Table 4.3-7 Significant causes of designated use impairment in the Roanoke River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>	
Bacteria	88%	PCBs in Fish Tissue	93%
Impaired Benthics	20%	Mercury in Fish Tissue	71%
Mercury in Fish Tissue	11%	Dissolved Oxygen	52%
PCBs in Fish Tissue	11%	Bacteria	1%
Temperature	5%	pH	<1%
Dissolved Oxygen	4%	DDD/DDE	<1%

Table 4.3-8 Suspected sources of designated use impairment in the Roanoke River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>	
Wildlife other than Waterfowl	81%	Source Unknown	99%
Livestock Grazing or Feeding Operations	78%	Natural Conditions	52%
Unspecified Domestic Waste	77%	Wildlife other than Waterfowl	1%
Waste from Pets	45%	Unspecified Domestic Waste	1%
On-Site Septic Treatment Systems	34%	Livestock Grazing or Feeding Operations	1%
Source Unknown	30%	On-site Septic Treatment Systems	1%

Chowan River-Dismal Swamp Basin

The Chowan River and Dismal Swamp basin is located in the southeastern portion of Virginia and covers 4,220 square miles or approximately 10% of the Commonwealth's total area.

The basin extends eastward from Charlotte County to the Chesapeake Bay. The Chowan River-Dismal Swamp basin in Virginia is defined by both hydrologic and political boundaries - the James River basin to the north, the Chesapeake/Atlantic and Small Coastal River basins to the east, the Roanoke River basin to the west and the Virginia/North Carolina State line to the south. The basin is approximately 145 miles in length and varies from 10 to 50 miles in width. The Chowan River-Dismal Swamp basin flows through the Piedmont and Coastal Plain Physiological Provinces. The Chowan portion flows 130 miles from west to east, crossing both the Piedmont and Coastal Plain, while the Dismal Swamp lies entirely within the Coastal Plain. The Piedmont portion is characterized by rolling hills, steeper slopes and somewhat more pronounced stream valleys. The Coastal Plain, in contrast, is nearly flat with a descending series of terraces.

The Chowan River-Dismal Swamp basin is mostly rural with approximately 64% of its land covered by forest. Cropland and pasture make up another 28%, while only about 6% is classified as urban.

The 2010 population for the Chowan River-Dismal Swamp basin was approximately 597,900. All or portions of the following 13 counties and 6 cities lie within the basin: counties – Brunswick, Charlotte, Dinwiddie, Greensville, Isle of Wight, Lunenburg, Mecklenburg, Nottoway, Prince Edward, Prince George, Southampton, Surry, and Sussex; Cities – Chesapeake, Emporia, Franklin, Petersburg, Suffolk, and Virginia Beach.

Major tributaries of the Chowan River are the Meherrin, the Nottoway and the Blackwater. The Nottoway and the Blackwater join at the Virginia/North Carolina state line to form the Chowan River. The Dismal Swamp portion is mostly flat with many swamp and marshland areas.

The Chowan River-Dismal Swamp basin is divided into five USGS hydrologic units as follows: HUC 03010201 – Nottoway; HUC 03010202 – Blackwater; HUC 03010203 – Chowan; HUC 03010204 – Meherrin; and HUC 03010205 – Albemarle Sound. The five hydrologic units are further divided into 42 waterbodies or watersheds and 127 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

Figure 4.3-5 Designated use support summary for the Chowan River-Dismal Swamp basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

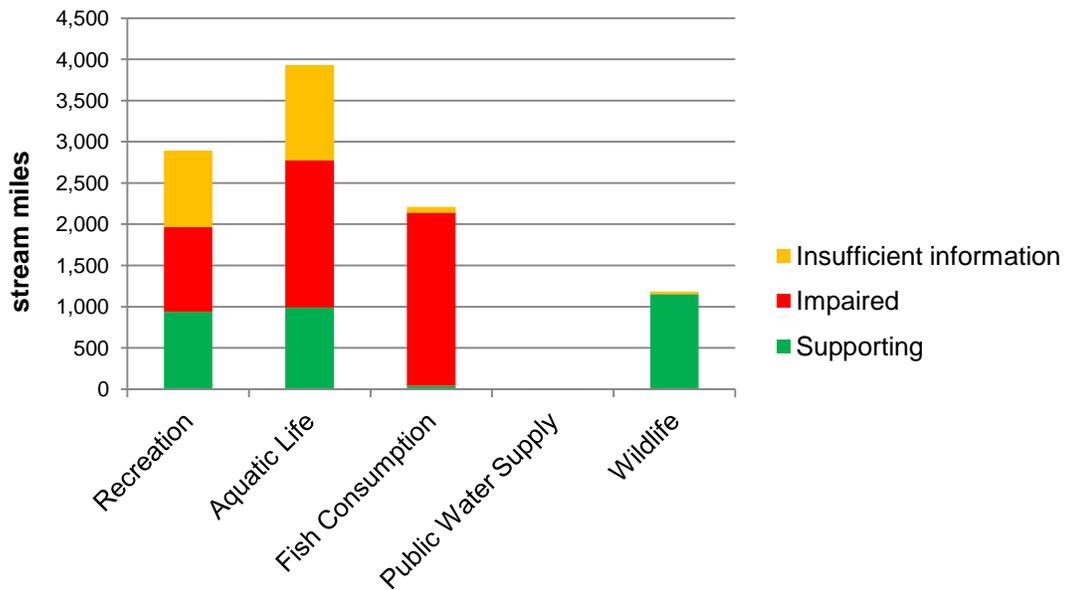
Basin Size: All Sizes Rounded to Nearest Whole Number

Rivers - 10,927 miles

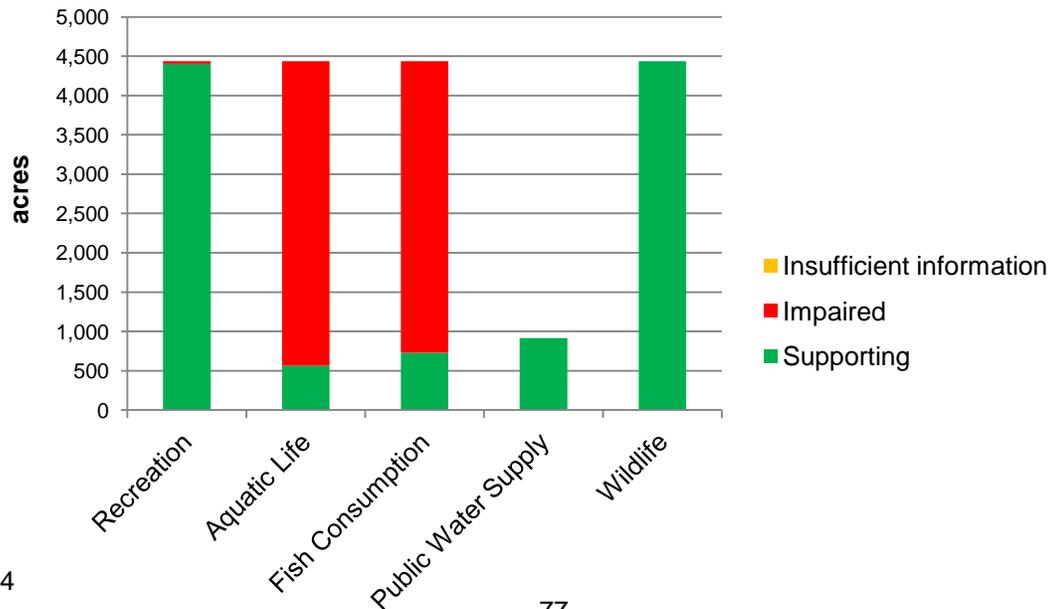
Lakes - 4,699 acres

Estuaries - 39 sq. miles

a) Rivers Assessment (6,740 miles were not assessed)



b) Lakes Assessment (263 acres were not assessed)



c) Estuaries assessment

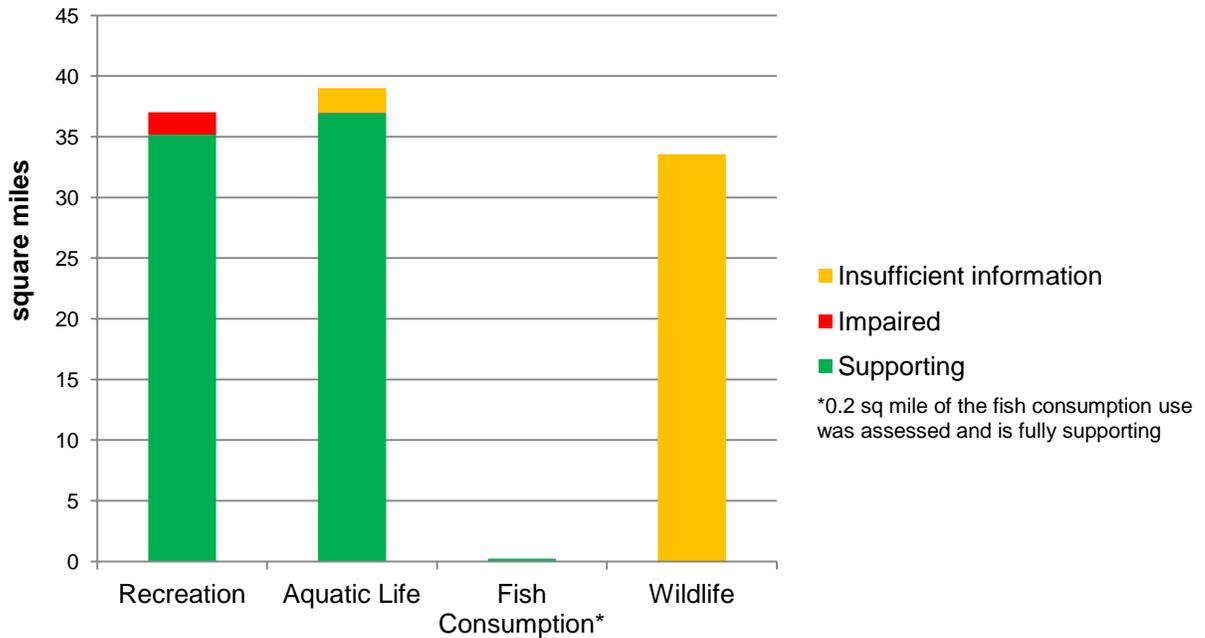


Table 4.3-9 Significant causes of designated use impairment in the Chowan River-Dismal Swamp basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Mercury in Fish Tissue	58%	Mercury in Fish Tissue	89%	Bacteria	100%
Dissolved Oxygen	44%	pH	81%	Dissolved Oxygen	3%
Bacteria	28%	Total Phosphorus	8%	pH	1%
Impaired Benthics	6%	Dissolved Oxygen	7%	--	--
pH	3%	Bacteria	1%	--	--
PCBs in Fish Tissue	1%	--	--	--	--

Table 4.3-10 Suspected sources of designated use impairment in the Chowan River-Dismal Swamp basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Source Unknown	71%	Source Unknown	100%	Source Unknown	98%
Natural Conditions	41%	Natural Conditions	3%	Natural Conditions	4%

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Atmospheric Deposition (Toxics)	25%	--	--	Crop Production	2%
Non-Point Sources	14%	--	--	Livestock Grazing or Feeding Operations	2%
Wildlife other than Waterfowl	9%	--	--	On-site Septic Treatment Systems	2%
Municipal Point Source Discharges	7%	--	--	Waterfowl or Wildlife	2%

Tennessee-Big Sandy River Basin

The segment of the Tennessee and Big Sandy River basin which lies in Virginia is made up of the Holston, Clinch-Powell, and Big Sandy River sub-basins. These sub-basins are located in the extreme southwest portion of Virginia and cover 4,132 square miles or approximately 10% of the Commonwealth's total land area.

The Virginia portion of the Tennessee-Big Sandy River basin is defined by both hydrologic and political boundaries. The West Virginia state line lies to the north, Kentucky to the west, and Tennessee to the south. The New River basin makes up the eastern boundary.

While numerous southwestern Virginia streams feed the Tennessee and Big Sandy Rivers, neither river forms within the Commonwealth itself. The Big Sandy sub-basin contains the Levisa and Tug Forks that flows northward into Kentucky forming the Big Sandy River. The southwestward flowing Holston, Clinch, and Powell tributaries form the Tennessee River in Tennessee. Both of the major river sub-basins eventually empty into the Gulf of Mexico via the Ohio and Mississippi Rivers.

The Tennessee-Big Sandy River basin spans three physiographic provinces: Appalachian Plateau, Valley and Ridge, and the Blue Ridge. The Big Sandy portion of the basin lies within the Appalachian Plateau. This province is characterized as rugged, with mountainous terrain and steep valleys. Parallel valleys and ridges running in a northeast to southwest direction characterize the Tennessee portion, lying in the Valley and Ridge Province. A small portion of the basin, located in the Blue Ridge Province, is more like a plateau with no single, prominent ridge that characterizes the province to the southeast.

Within Virginia, approximately 48% of the Tennessee River basin is forested, while cropland and pasture make up another 39.7%. The Big Sandy portion of the basin is approximately 86% forest, with only about 5% in cropland and pasture. Urban areas make up only a small percentage of the total land area.

The 2010 population for the Tennessee-Big Sandy River Basin was approximately 458,700. All or parts of the following jurisdictions lie within the basin: counties – Bland, Buchanan, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe; Cities – Bristol and Norton.

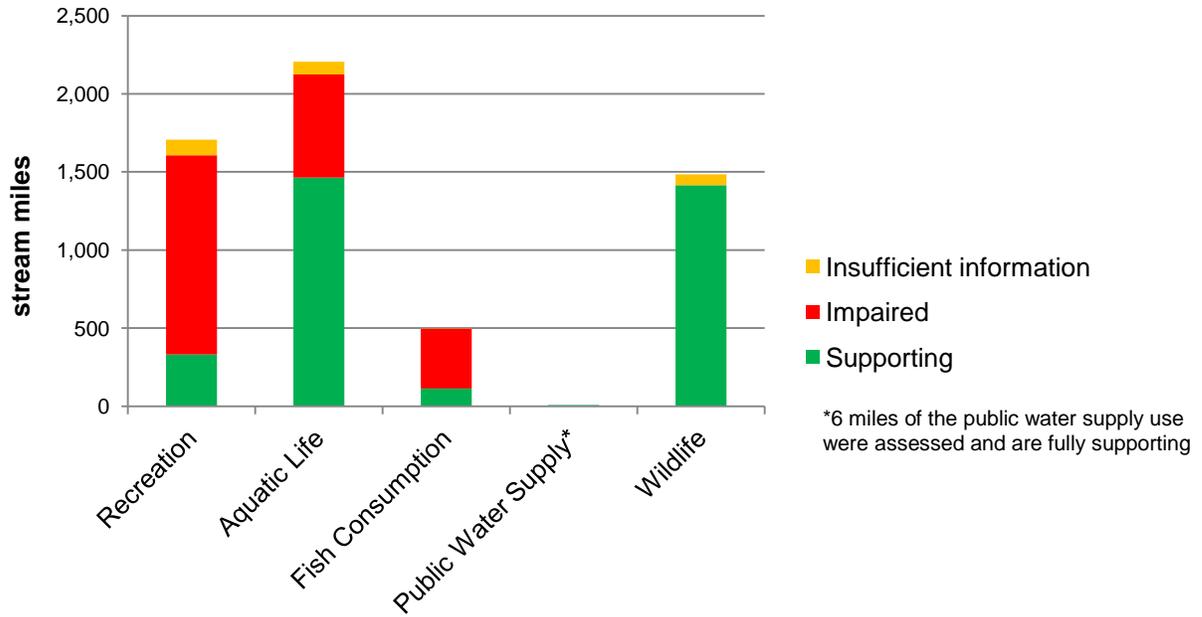
The Tennessee-Big Sandy River basin is divided into six USGS hydrologic units as follows: HUC 05070201 – Tug Fork; HUC 05070202 – Upper Levisa; HUC 06010101 – North Fork Holston; HUC 06010102 - South and Middle Fork Holston; HUC 06010205 – Upper Clinch; and HUC 06010206 – Powell River. The six hydrologic units are further divided into 56 waterbodies or watersheds and 135 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

Figure 4.3-6 Designated use support summary for the Tennessee-Big Sandy River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

Basin Size: All Sizes Rounded to Nearest Whole Number
 Rivers - 10,665 miles
 Lakes - 3,856 acres
 Estuaries - 0 sq. miles

a) Rivers Assessment (8,329 miles were not assessed)



b) Lakes Assessment

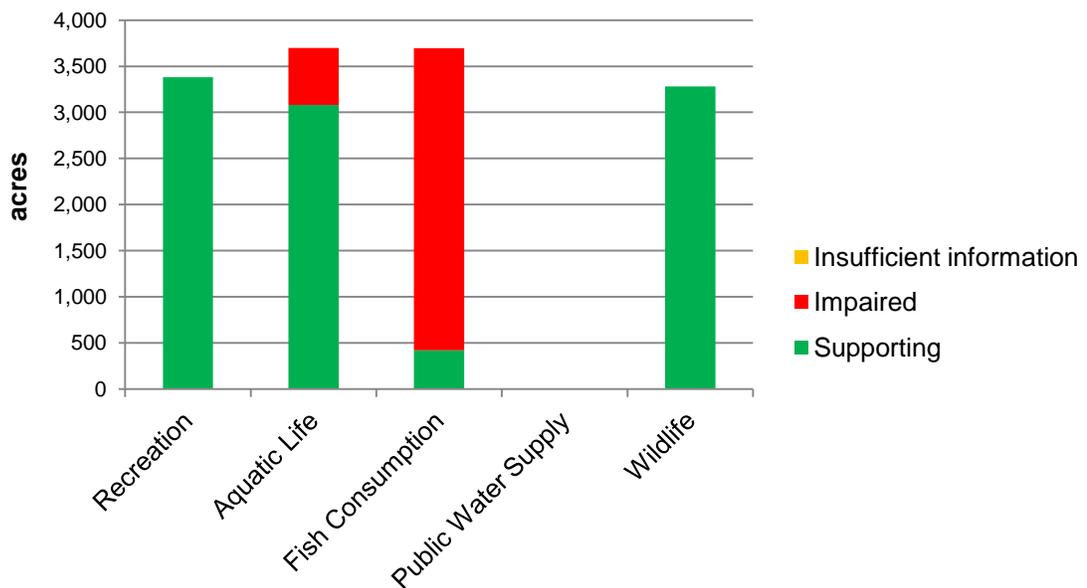


Table 4.3-11 Significant causes of designated use impairment in the Tennessee-Big Sandy River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>	
Bacteria	72%	Mercury in Fish Tissue	89%
Impaired Benthics	34%	PCBs in Fish Tissue	46%
PCB in Fish Tissue	17%	pH	15%
Sedimentation/Siltation	7%	Temperature	11%
Mercury in Fish Tissue	5%	--	--
Temperature	4%	--	--

Table 4.3-12 Suspected sources of designated use impairment in the Tennessee-Big Sandy River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>	
Unrestricted Cattle Access	43%	Source Unknown	49%
Rural Residential Areas	40%	Atmospheric Deposition (Toxics)	42%
Source Unknown	25%	Natural Conditions	17%
Sewage Discharges in Unsewered Areas	16%	--	--
Coal Mining	12%	--	--
Inactive Abandoned Mine Lands	7%	--	--

Chesapeake Bay/Atlantic Ocean and Small Coastal Basins

The Chesapeake Bay/Atlantic Ocean and small coastal basins are located in the eastern part of Virginia and covers 3,592 square miles or approximately 8% of the Commonwealth’s total land area. The combined basins encompass the small bays, river inlets, islands and shoreline immediately surrounding the Chesapeake Bay and the southern portion of the Delmarva Peninsula. These basins also include the Chesapeake Bay itself.

The Chesapeake Bay/Atlantic Ocean and small coastal basins are defined by both hydrologic and political boundaries. The Potomac River, the Rappahannock River, the York River, the James River, and the Chowan River-Dismal Swamp basins border the small coastal basins to its west. The Eastern Shore portion is bordered on the west by the Chesapeake Bay, on the north by Maryland, and on the east by the Atlantic Ocean.

The topography of the Chesapeake Bay/Atlantic Ocean and small coastal basins vary little. The basins lie within the Coastal Plain Physiographic Province where elevations average no more than a few feet above sea level. More significant elevation occurs along the central spine of the Eastern Shore portion, which forms a plateau about 45 feet above sea level. Much of these basins consist of marshland. About 30% of the Chesapeake Bay/Atlantic Ocean and small coastal basins are forested, while nearly 22% is in cropland and pasture. Approximately 24% is considered urban.

The 2010 population for the Chesapeake Bay/Atlantic Ocean and small coastal basins was approximately 741,800. All or portions of the following jurisdictions lie within these basins: Counties – Accomack, Essex, Gloucester, King and Queen, Lancaster, Matthews, Middlesex, Northampton, Northumberland, and York; Cities – Hampton, Newport News, Norfolk, Poquoson, and Virginia Beach.

Tributaries in the Chesapeake Bay/coastal basins drain into the Chesapeake Bay or the Atlantic Ocean. Major tributaries flowing into the Chesapeake Bay from the western shore are the Great Wicomico River, Piankatank River, Fleets Bay, Mobjack Bay including the East, North, Ware, and Severn Rivers, Poquoson River, Back River and Lynnhaven River. Tributaries in the Eastern Shore portion that drain into the Bay are Pocomoke River, Onancock, Pungoteague, Occohannock, and Nassawadox Creeks. Machipongo River, Assawoman Creek, Parker Creek, Folly Creek, and Finney Creek drain east directly into the Atlantic Ocean.

The Chesapeake Bay/Atlantic Ocean and small coastal basins are divided into seven USGS hydrologic units as follows: HUC 02060009 – Pocomoke; HUC 02060010 – Chincoteague; HUC 02080101 – Lower Chesapeake Bay; HUC 02080102 – Great Wicomico-Piankatank; HUC 02080108 – Lower Lynnhaven-Poquoson; HUC 02080109 – Western Lower Delmarva; and HUC 02080110 – Tangier. The seven hydrologic units are further divided into 24 waterbodies or watersheds and 73 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

Figure 4.3-7 Designated use support summary for the Chesapeake Bay/Atlantic Ocean and small coastal basins. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

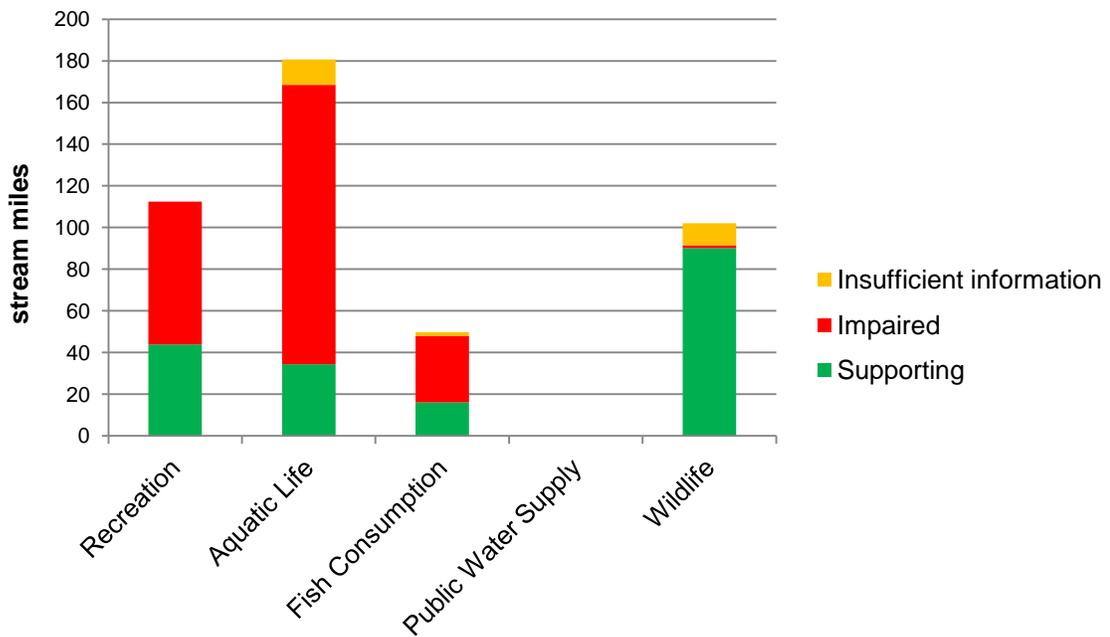
Basin Size: All Sizes Rounded to Nearest Whole Number

Rivers - 1,882 miles

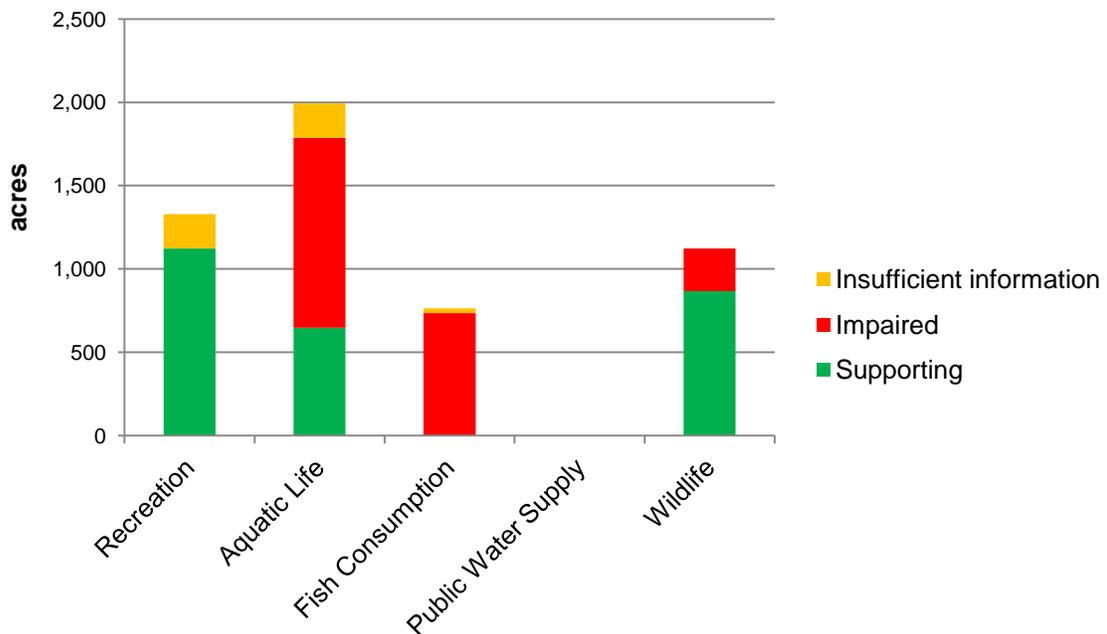
Lakes - 2,149 acres

Estuaries – 2,236 sq. miles

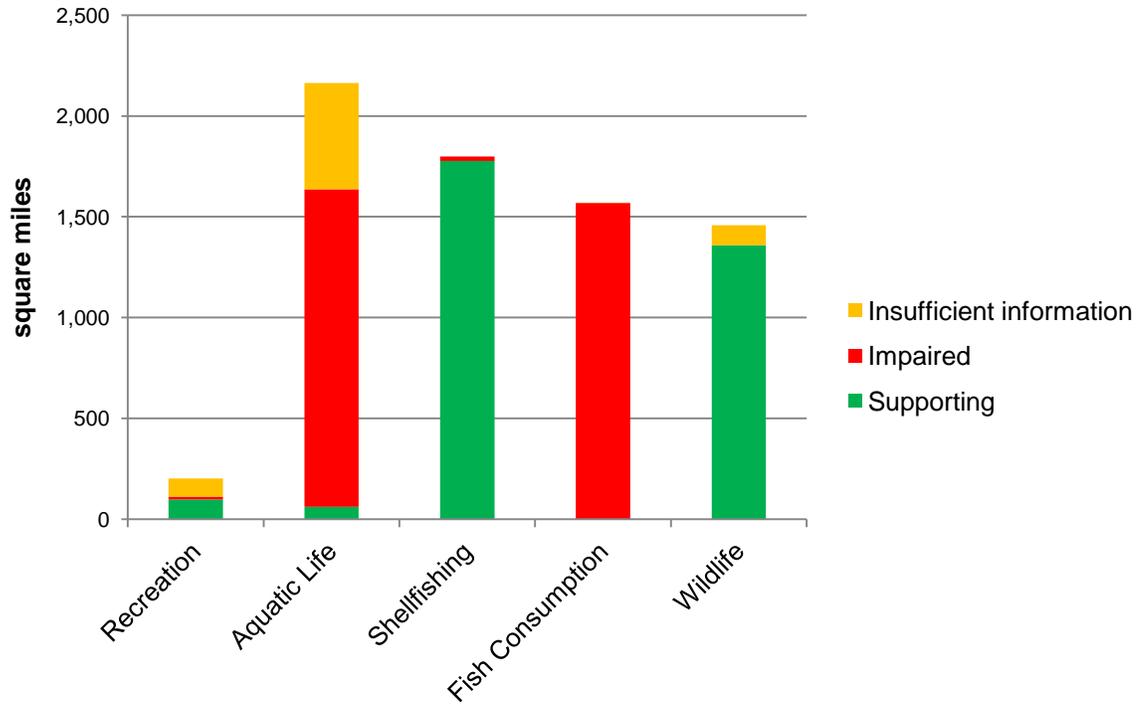
a) Rivers Assessment (1,705 miles were not assessed)



b) Lakes Assessment (307 acres were not assessed)



c) Estuaries assessment (388 square miles were not assessed)



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed).

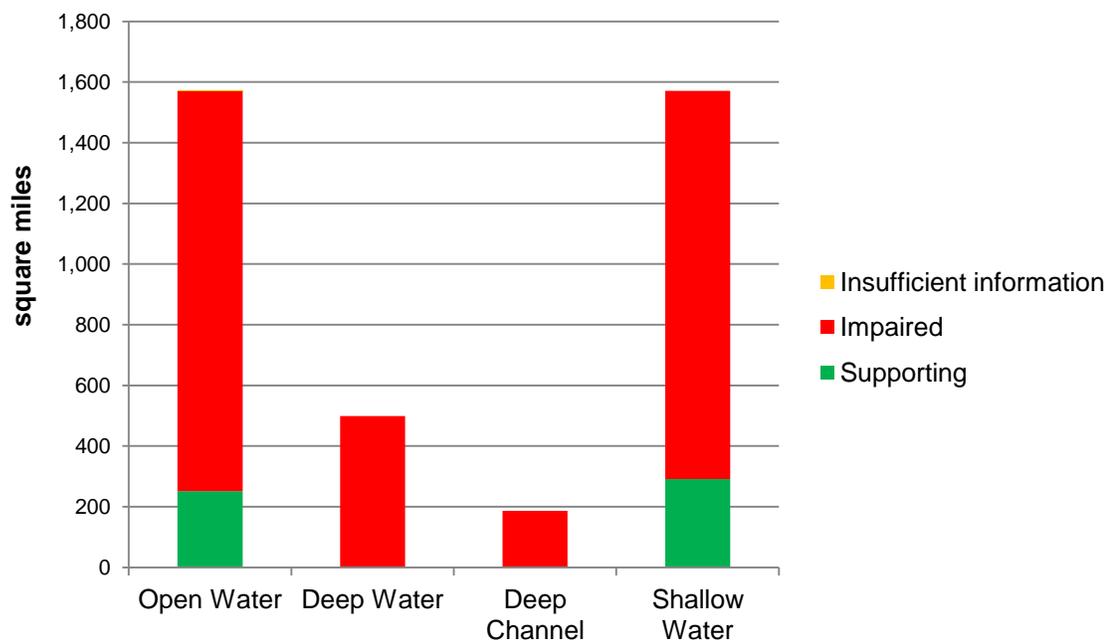


Table 4.3-13 Significant causes of designated use impairment in the Chesapeake Bay/Atlantic Ocean and small coastal basins, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Dissolved Oxygen	65%	Dissolved Oxygen	74%	PCBs in Fish Tissue	99%
pH	45%	Chlorophyll a	73%	Dissolved Oxygen	85%
Bacteria	46%	Total Phosphorus	73%	Impaired Aquatic Plants	81%
Mercury in Fish Tissue	22%	PCBs in Fish Tissue	62%	Impaired Benthics	2%
Impaired Benthics	24%	Mercury in Fish Tissue	45%	Bacteria	2%
Copper	1%	Copper	22%	Mercury in Fish Tissue	<1%

Table 4.3-14 Suspected sources of designated use impairment in the Chesapeake Bay/Atlantic Ocean and small coastal basins, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Natural Conditions	58%	Source Unknown	100%	Internal Nutrient Recycling	100%
Source Unknown	61%	Residential Districts	57%	Loss of Riparian Habitat	100%
Atmospheric Deposition (Toxics)	22%	Urbanized High Density Areas	22%	Atmospheric Deposition (Nitrogen)	100%
Non-Point Sources	22%	--	--	Agriculture	100%
Urbanized High Density Areas	1%	--	--	Industrial Point Source Discharges	100%
Leaking Underground Storage Tanks	1%	--	--	Sources Outside State Borders	100%

York River Basin

The York River basin lies in the central and eastern section of Virginia and covers 2,674 square miles or 6% of the Commonwealth's total area. It is defined by hydrologic boundaries. The basin is bound by the Rappahannock River basin to the north, the James River basin to the south and west and the Chesapeake Bay/Atlantic Ocean and small coastal basins to the east.

The headwaters of the York River begin in Orange County and flow in a southeasterly direction for approximately 220 miles to its mouth at the Chesapeake Bay. The basin's width varies from five miles at the mouth to 40 miles at its headwaters.

The basin is comprised of the York River and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The York River itself is only about 30 miles in length. The Pamunkey River's major tributaries are the North and South Anna Rivers and the Little River, while the major Mattaponi tributaries are the Matta, Po, and Ni Rivers.

Lying in the Piedmont and Coastal Plain physiographic provinces, the basin's topography is characterized by slightly rolling hills at the headwaters or extreme western portion, to gently sloping hills and flat farmland near its mouth. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain. Approximately 65% of the land area is forest. Farmland and pasture account for approximately 20% of the land area. Approximately 10% of the river basin land area is urban.

The 2010 population for the York River basin was approximately 435,400. The majority of the population is rural and is evenly distributed throughout the basin. The only major city that falls within this basin is a portion of Williamsburg. All or portions of the following thirteen counties lie within the basin: Albemarle, Caroline, Fluvanna, Gloucester, Goochland, Hanover, James City, King and Queen, King William, Louisa, New Kent, Orange, Spotsylvania, and York.

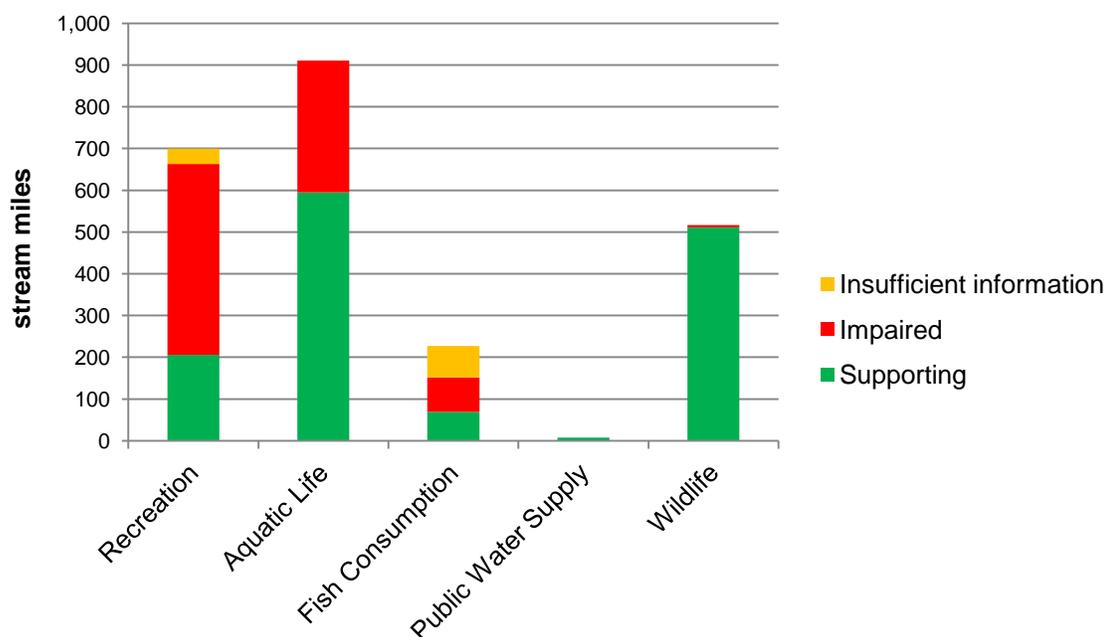
The York River basin is divided into three USGS hydrologic units as follows: HUC 02080105 – Mattaponi; HUC 02080106 - Pamunkey and HUC 02080107 - York. The three hydrologic units are further divided into 27 waterbodies or watersheds and 69 6th order sub-watersheds.

Basin assessment information is presented in the following figures and tables.

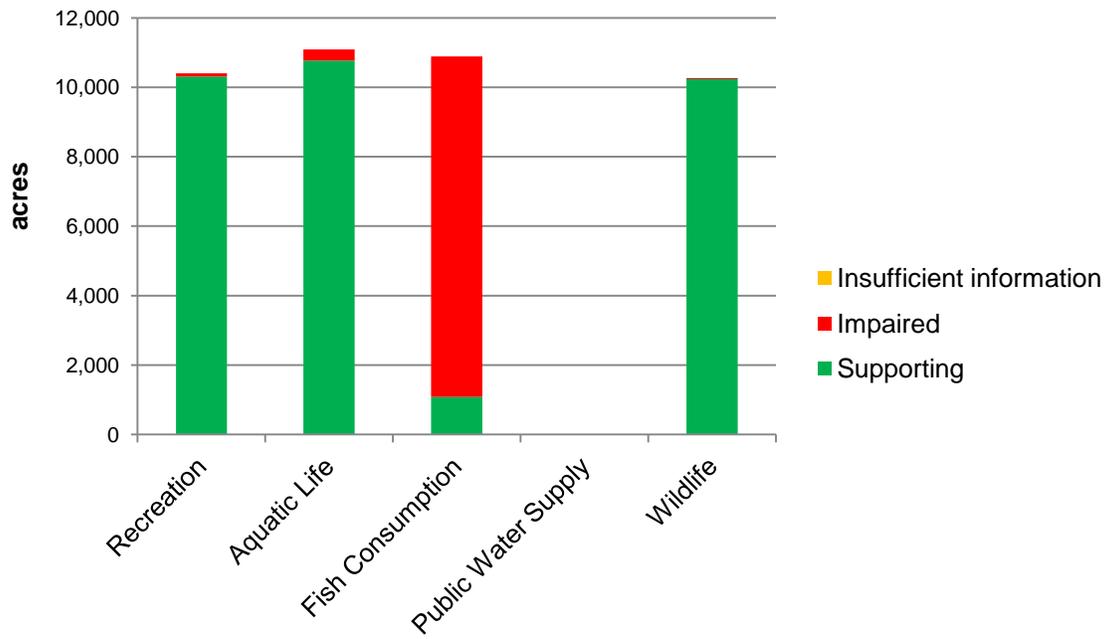
Figure 4.3-8 Designated use support summary for the York River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”.)

Basin Size: *All Sizes Rounded to Nearest Whole Number*
 Rivers - 6,707 miles
 Lakes - 11,341 acres
 Estuaries – 82 sq. miles

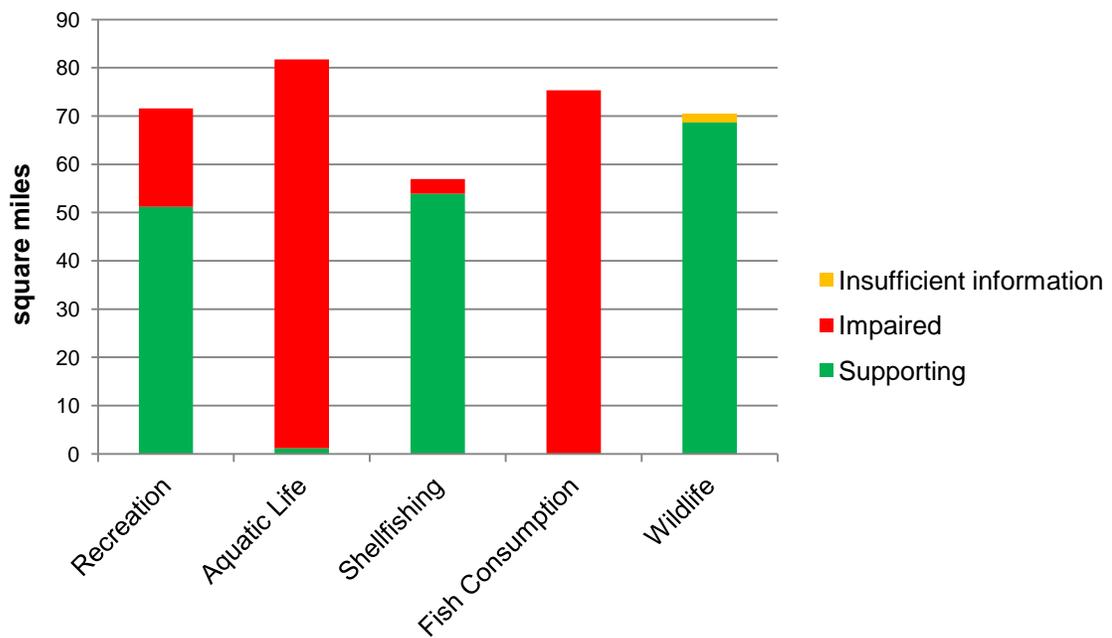
a) Rivers Assessment (5,787 miles were not assessed)



b) Lakes Assessment (71 acres were not assessed)



c) Estuaries assessment



- d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed).

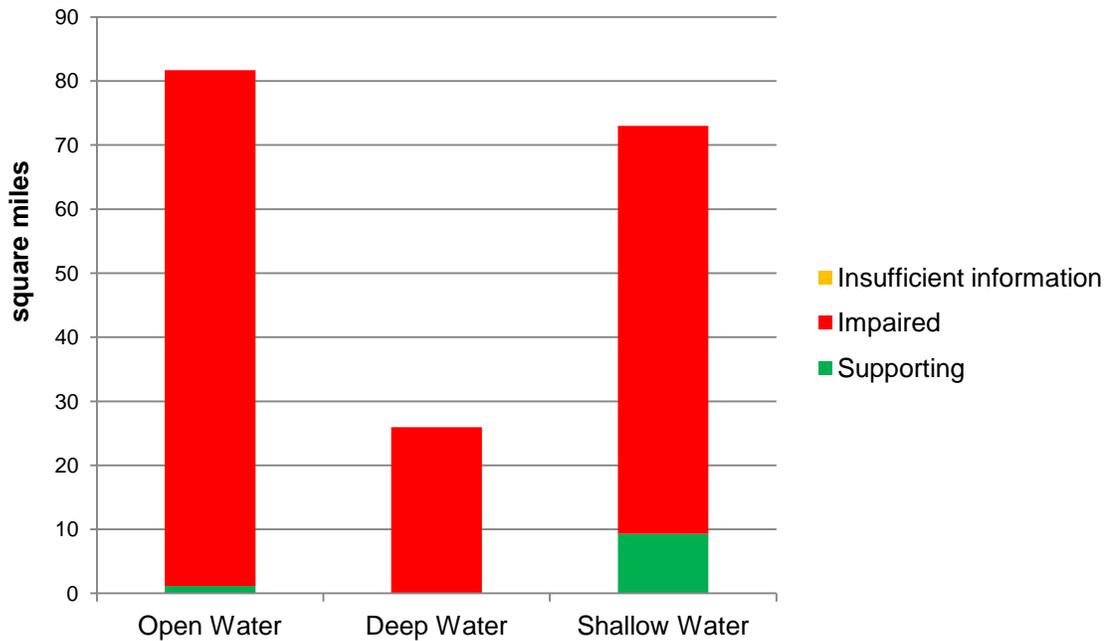


Table 4.3-15 Significant causes of designated use impairment in the York River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Bacteria	75%	PCBs in Fish Tissue	95%	PCBs in Fish Tissue	94%
pH	24%	Mercury in Fish Tissue	22%	Dissolved Oxygen	100%
Dissolved Oxygen	25%	PCBs in Water Column	12%	Impaired Aquatic Plants	79%
PCBs in Fish Tissue	10%	Dissolved Oxygen	3%	Bacteria	27%
Mercury in Fish Tissue	8%	PAHs (Benzo(a)pyrene, Benzo[b,k]fluoranthene)	1%	Mercury in Fish Tissue	22%
Impaired Benthics	11%	Bacteria	1%	Impaired Benthics	7%

Table 4.3-16 Suspected sources of designated use impairment in the York River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Source Unknown	56%	Source Unknown	100%	Industrial or Municipal Point Source Discharges	100%

<i>Rivers</i>		<i>Lakes</i>		<i>Estuaries</i>	
Natural Conditions	35%	Changes in Ordinary Stratification and Bottom Water Hypoxia/Anoxia	3%	Source Unknown	94%
Grazing in Riparian or Shoreline Zones	26%	Inactive Abandoned Mine Lands	<1%	Agriculture	100%
Impacts from Land Application of Wastes	26%	--	--	Atmospheric Deposition (Nitrogen)	100%
Livestock Grazing or Feeding Operations	26%	--	--	Internal Nutrient Recycling	100%
Runoff from Forest/Grassland/Parkland	26%	--	--	Loss of Riparian Habitat	100%

New River Basin

The New River basin is located in southwest Virginia and covers 3,068 square miles or approximately 7% of the Commonwealth's total land area. The New River flows from its headwaters in Watauga County, North Carolina in a northeasterly direction to Radford, Virginia, and then in a northwesterly direction to Glen Lyn, where it exits into West Virginia. There it flows to the confluence of the Gauley River forming the Kanawha River, a tributary to the Ohio River.

The New River basin in Virginia is defined by both hydrologic and political boundaries. It is bordered by the James River basin and Roanoke River basin to the east, and the Tennessee and Big Sandy River basin to the west. The southern boundary of the Virginia portion is the North Carolina state line and its northwest boundary is the West Virginia state line.

The New River basin runs 115 miles in length from Blowing Rock, North Carolina to Bluestone Dam near Hinton, West Virginia with a maximum basin width of 70 miles near Rural Retreat, Virginia. The Virginia portion of the New River basin is 87 miles in length.

The topography of the New River basin is generally rugged; the upper reaches of its tributaries are extremely steep. High mountains, narrow valleys and steep ravines characterize the basin. There are ten tributaries in the Upper New River basin each having more than 100 square miles in drainage area and many others with forty or more square miles.

The New River basin is the least densely populated of the Commonwealth's major river basins. The higher elevations of the basin have steep slopes and are thickly forested, while the mount bases are mostly used for agriculture. Approximately 59% of its land is forested. Cropland and pasture make up another 35%, with approximately 3% considered urban.

The 2010 population for the New River basin was approximately 412,900. All or portions of the following jurisdictions lie within the basin: Counties - Bland, Carroll, Craig, Floyd, Giles, Grayson, Montgomery, Pulaski, Smyth, Tazewell, Wythe; Cities - Galax and Radford.

The New River basin is divided into two USGS hydrologic units as follows: HUC 05050001 – Upper New; and HUC 05050002 – Middle New. The two hydrologic units are further divided into 38 waterbodies or watersheds and 88 6th order watersheds.

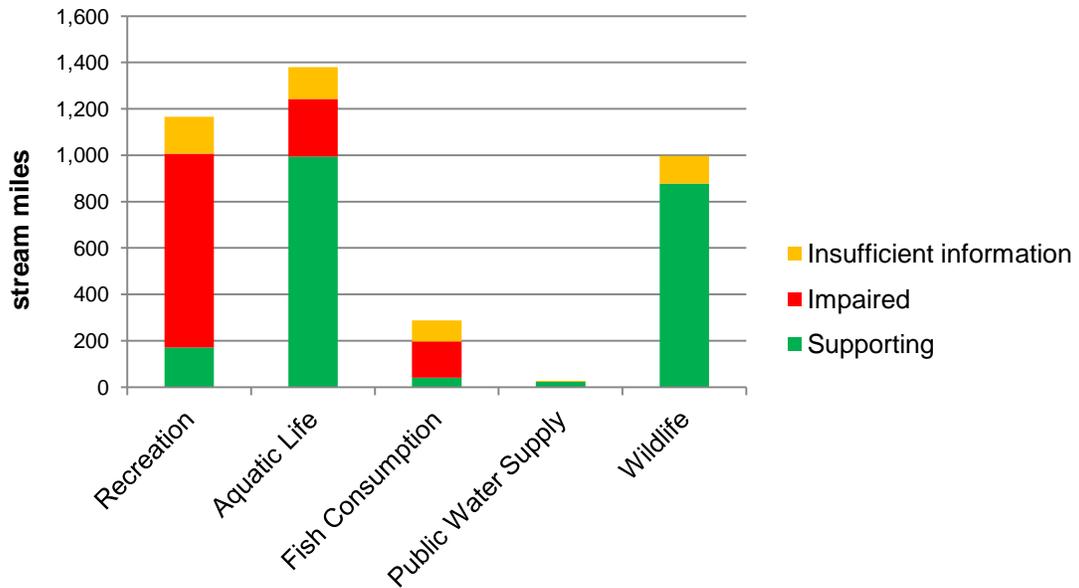
Basin assessment information is presented in the following figures and tables.

Final 2014

Figure 4.3-9 Designated use support summary for the New River basin. (Note: Waters that have some data, but not enough to determine use support, are classified as having “Insufficient information”)

Basin Size: All Sizes Rounded to Nearest Whole Number
 Rivers - 7,686 miles
 Lakes - 4,662 acres
 Estuaries - 0 sq. miles

a) Rivers Assessment (6,383 miles were not assessed)



b) Lakes Assessment (36 acres were not assessed)

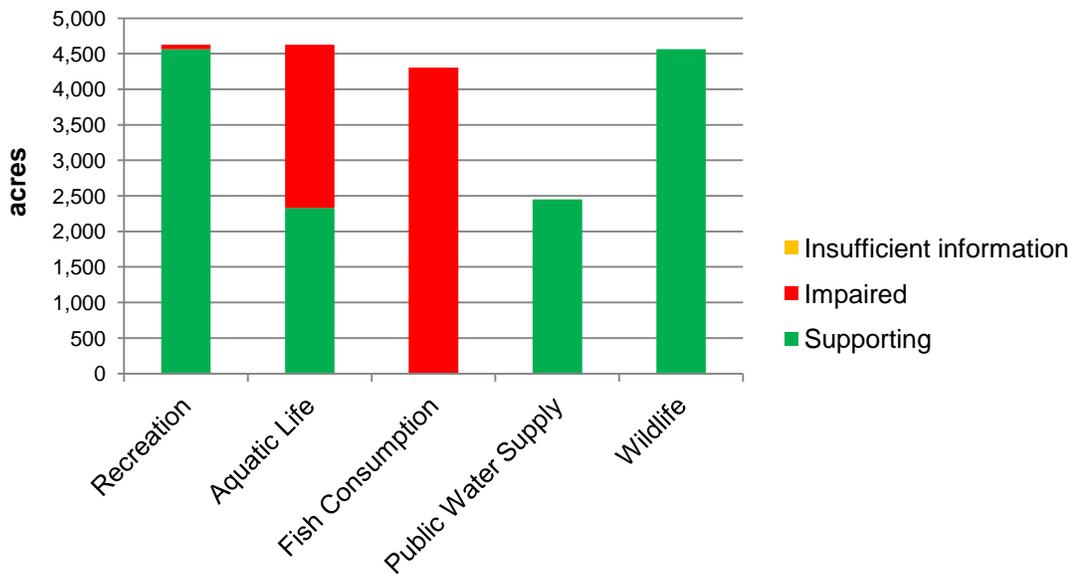


Table 4.3-17 Significant causes of designated use impairment in the New River basin, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

<i>Rivers</i>		<i>Lakes</i>	
Bacteria	85%	PCBs in Fish Tissue	99%
Temperature	13%	Dissolved Oxygen	53%
Impaired Benthics	12%	Bacteria	1%
PCBs in Fish Tissue	12%		
Mercury in Fish Tissue	3%	--	--
Sedimentation/Siltation	2%	--	--

Table 4.3-18 Suspected sources of designated use impairment in the New River basin, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

<i>Rivers</i>		<i>Lakes</i>	
Livestock Grazing or Feeding Operations	49%	Source Unknown	99%
Source Unknown	46%	Natural Conditions	53%
On-site Septic Treatment Systems	31%	Livestock Grazing or Feeding Operations	1%
Unspecified Domestic Waste	32%	On-site Septic Treatment Systems	1%
Wildlife other than Waterfowl	32%	Unspecified Domestic Waste	1%
Non-Point Source Wet Weather Discharges	25%	Wildlife other than Waterfowl	1%