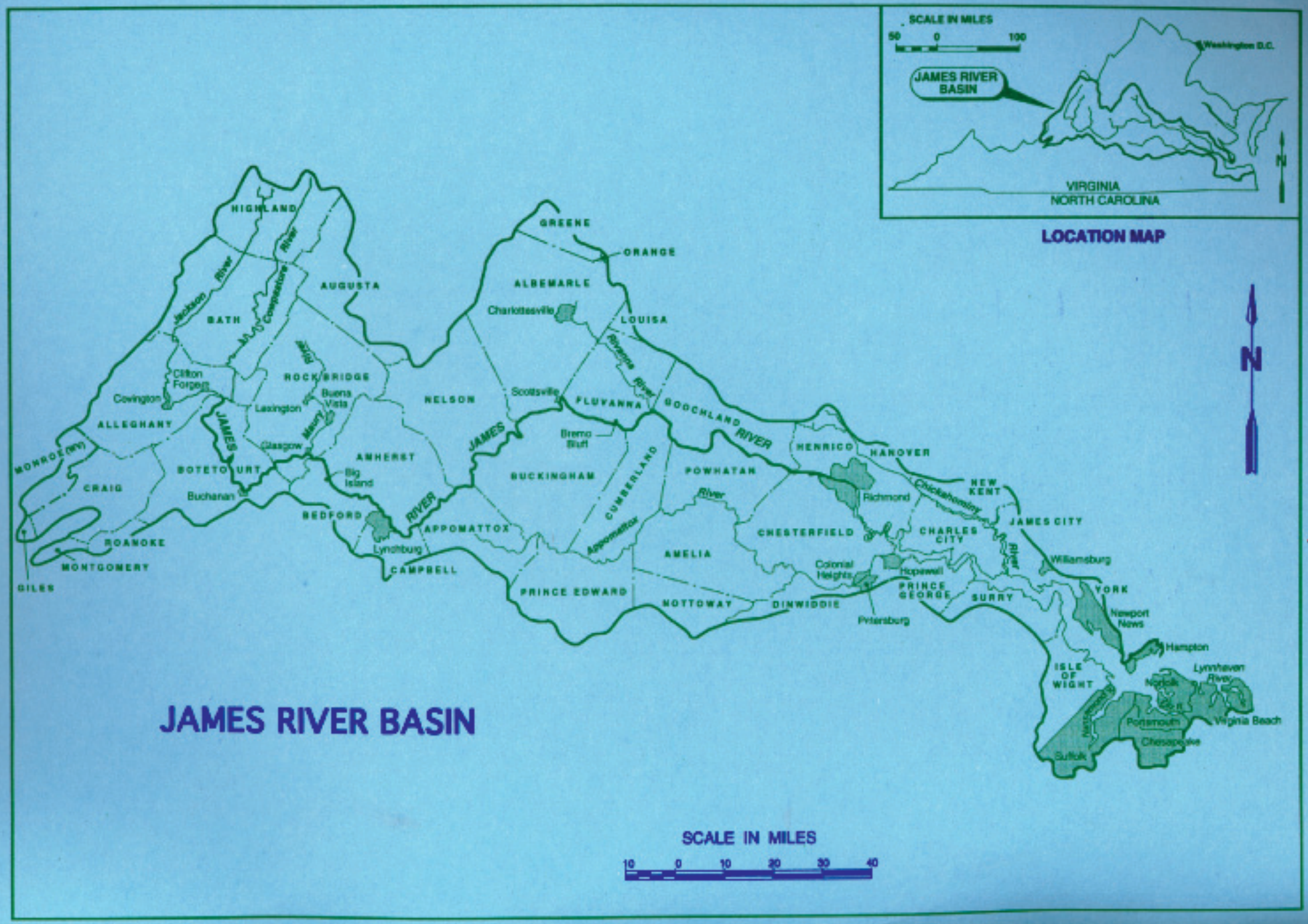
1998 Annual Report

James River Basin Association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Washington D.C.
JAMES RIVER BASIN
VIRGINIA
NORTH CAROLINA
LOCATION MAP
HIGHLAND
AUGUSTA
BATH
ROCKBRIDGE
ALLEGHANY
CRAIG
BOTETOURT
ROANOKE
MONTGOMERY
GILES
Clifton Forge
Covington
Lexington
Buena Vista
Glasgow
Buchanan
Big Island
Lynchburg
BEDFORD
AMHERST
NELSON
GREENE
ORANGE
ALBEMARLE
Charlottesville
LOUISA
Scottsville
FLUVANNA
BUCKINGHAM
Bremo Bluff
POWHATAN
CUMBERLAND
APPOMATTOX
CAMPBELL
PRINCE EDWARD
AMELIA
NOTTOWAY
DINWIDDIE
GOOCHLAND
HENRICO
HANOVER
Richmond
NEW KENT
CHESTERFIELD
CHARLES CITY
JAMES CITY
Williamsburg
Colonial Heights
Hopewell
PRINCE GEORGE
Petersburg
SURRY
YORK
Newport News
Hampton
ISLE OF WIGHT
Norfolk
Portsmouth
Virginia Beach
Chesapeake
Suffolk
Lynnhaven River
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James River Basin Association
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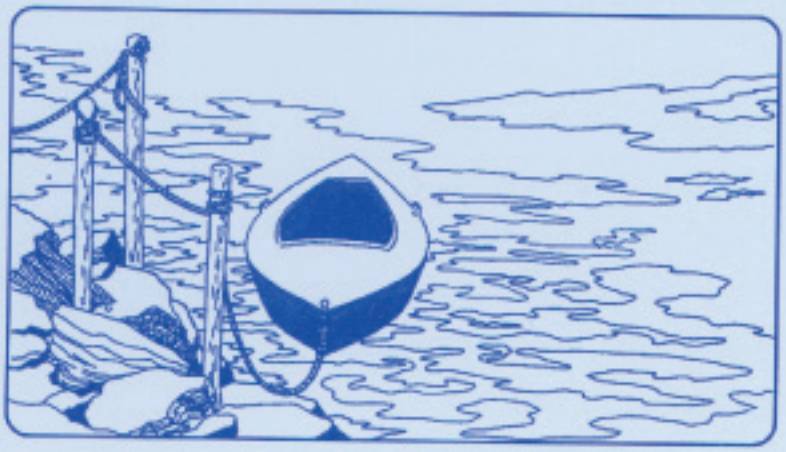
Lynchburg, Virginia 24505

Table of Contents

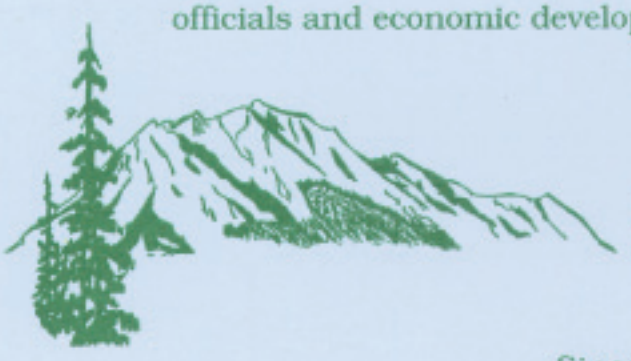


Letter from the President

The James River Basin Association in partnership with the Norfolk District Corps of Engineers is pleased to present the second James River Basin Annual Report. This report is a continuation of the James River Basin Association's almost 40-year commitment to the wise use and conservation of the natural resources in the basin. Next year, the Association plans to feature our membership's continuing progress toward this commitment.

We are most appreciative of the many persons and organizations whose participation and cooperation made the 1998 annual basin report possible, especially the Norfolk District Corps of Engineers professional staff for their outstanding efforts.

We hope that this report will be a valuable resource in keeping legislative officials and economic development staffs informed on the progress being made toward the Association's goals. Please use the Association as a resource in making decisions on the issues affecting our basin.



Sincerely,

Terrell J. Reid

Terrell J. Reid
President

About the James River Basin Association

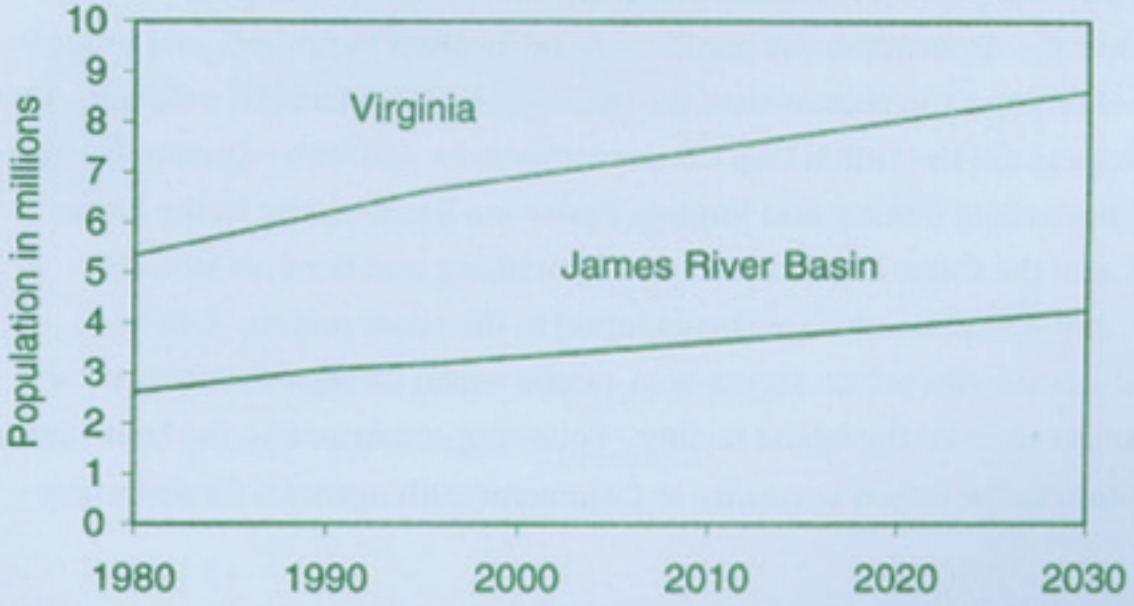
The James River Basin Association was first organized in 1958 and was an instrumental force in helping make Lake Moomaw and Gathright Dam become a reality as a flood protection project. Today, the Association focuses on a broad range of interests in the James River including economic development, conservation, agriculture, water quality improvement, and flood control. It includes a diverse membership of people working together and, with the public, to promote the wise use and protection of the natural resources within the basin. The Association firmly believes that economic development and environmental protection can coexist by sound and responsible action.

Activities include encouraging research, establishing forums of discussion, and advancing policies and programs consistent with the desires of the people who live and work in the basin. The Association was involved in the recent Richmond Floodwall project that will provide much needed protection for the downtown area. In the future, the Association will continue to be involved in projects and proposals to help ensure the resources of the James River are managed properly. Two such projects are the Dutch Gap Conservation Area and Water Quality Partnership. Chesterfield County and Virginia Power are participating in the former project, and the Cities of Richmond and Lynchburg and the firm McGuire, Woods, Battle, and Boothe are participating in the latter project. Other projects include two public access boat ramps which Georgia-Pacific is poised to construct near its Big Island facility. Following construction, the boat ramps will be donated or leased to county or Commonwealth agencies for operation.

Socio-Economics

According to estimates for 1996 (U.S. Census), the counties and cities which encompass the James River Basin contain over 3.2 million people, almost half of the Commonwealth's total population. Since 1980, the basin has grown at an average annual rate of 1.3 percent. As shown in the following figure, by the year 2030 the basin is projected to have almost 4.3 million residents, which equates to an average annual growth rate of 0.8 percent. Since 1980, growth has occurred primarily in the counties which are part of the Richmond, Newport News, Lynchburg, and Charlottesville regional areas and in the more suburban Cities of Chesapeake and Virginia Beach. The extreme western part of the basin and many of the older cities such as Richmond and Norfolk have lost population during this time. Projections through 2030 show continued growth in many areas, particularly in Chesterfield, Hanover, Henrico, and James City Counties and the Cities of Virginia Beach and Suffolk.

JAMES RIVER BASIN POPULATION GROWTH



The James River Basin is the most diversified region in the Commonwealth of Virginia. The western and central portions of the basin are recognized for agricultural and forest products, manufacturing and wholesale trade, chemical companies, pulp and paper mills, sand and gravel, mining, and electric utilities. The eastern portion is recognized for shipbuilding, the military, and commercial port activities. The James River Basin flows into Hampton Roads, one of the greatest natural ports on the East Coast. Tourism is a major industry in the James River Basin, attracting millions to fishing, hiking, sailing, boating, and antique shops, not to mention the historical areas of Williamsburg, Jamestown, and Richmond.

As indicated in the following table, James River Basin employment in 1995 exceeded 1 million or about 47 percent of the Commonwealth's total of 2,481,306. The largest sector was the services industry which accounted for 34 percent of basin employment. Retail trade and manufacturing were a distant second and third with 23 percent and 16 percent, respectively.

The James River Basin watershed accounts for over 40 percent of the Commonwealth's employment, wages, and commercial establishments. Employment by industry (exclusive of government and military) within the basin increased from about 0.89 million in 1985 to 1.17 million in 1995, reflecting an average annual growth rate of 2.81 percent, which essentially equaled the 2.83 percent rate for the Commonwealth as a whole. The highest growth rates in the study area during this time period occurred in Chesterfield, Goochland, Hanover, Henrico, New Kent, James City, and York Counties, and in the City of Virginia Beach. Areas of low growth include Alleghany County and the nearby cities and counties, the more rural area to the southwest of

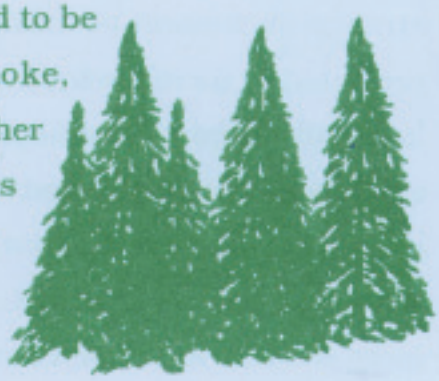
Petersburg, and the City of Richmond. Employment projections for the metropolitan areas within the basin indicate an average annual growth rate of 0.70 from 1993 to 2045, slightly below the projection for the Commonwealth (Bureau of Economic Analysis [BEA]). The largest increases in employment would be expected to correspond to the areas experiencing high growth rates in population.

JAMES RIVER BASIN EMPLOYMENT BY INDUSTRY

Item	Virginia	James River Basin	% of Virginia
Total Employment	2,481,306	1,167,757	47
Wages and Salary ($1,000)	63,266,420	25,870,657	41
Proprietors	162,378	74,997	46
Industry			
Agricultural Services	19,168	7,627	40
Mining	14,505	308	2
Construction	158,172	79,372	50
Manufacturing	404,233	190,242	47
Transportation, Commerce, and Public Utilities	141,942	64,470	45
Wholesale Trade	129,199	63,493	49
Retail Trade	549,803	269,455	49
Finance, Insurance, and Real Estate	165,377	89,499	54
Services	896,580	402,072	45
Unclassified establishments	2,327	449	19

Source: Bureau of the Census, 1995 data.

Unemployment rates as of September 1997 (Virginia Employment Commission) varied from a low of 1.7 for Albemarle County to 8.3 percent for Portsmouth. The counties with the lowest rates tend to be located in the vicinity of Charlottesville, Roanoke, Williamsburg, and west of Richmond. Areas with higher rates can be found in the older cities such as Portsmouth and Petersburg and some of the more rural counties such as Surry, Louisa, and Prince Edward.



Income levels within the basin vary considerably, for both per capita and median family income. According to BEA data, the 1993 per capita income varied from a high of $26,279 in Goochland County to a low of $13,279 for Prince Edward County. Median family income figures for 1989 showed most of the areas with the highest incomes were the counties in the Richmond metropolitan area and James City, York, Albemarle, and Roanoke Counties. Areas with the lowest incomes were the rural Counties of Highland, Cumberland, Nottoway, Prince Edward, and Buckingham and the Cities of Clifton Forge, Covington, Norfolk, and Petersburg.

Hampton Roads commerce exceeded 75 million tons in 1996 and ranked 14th among the leading U.S. ports. Total commerce on the James River from the deepwater terminal in Richmond to Hampton Roads has increased 40 percent since 1994. In 1996, 67 percent of the commerce was sand and gravel, followed by petroleum, chemical, farm, and manufacturing products and equipment.

Projected growth in the James River Basin is expected to parallel the Commonwealth and major metropolitan areas. Total employment earnings for the BEA areas of Richmond-Petersburg and Norfolk-Virginia Beach-Newport News are projected to increase from about $14.1 billion in 1995 to just under $22 billion in 2020. Employment is projected to reach 2 million by 2020. The graph exhibits modest projected growth rates of from less than 1 percent for employment to around 1.4 percent in industry earnings over the next 20 years for the two BEA areas in the James River Basin.

PROJECTED GROWTH IN INDUSTRY EARNINGS AND EMPLOYMENT, 1988-2020

Hydrology

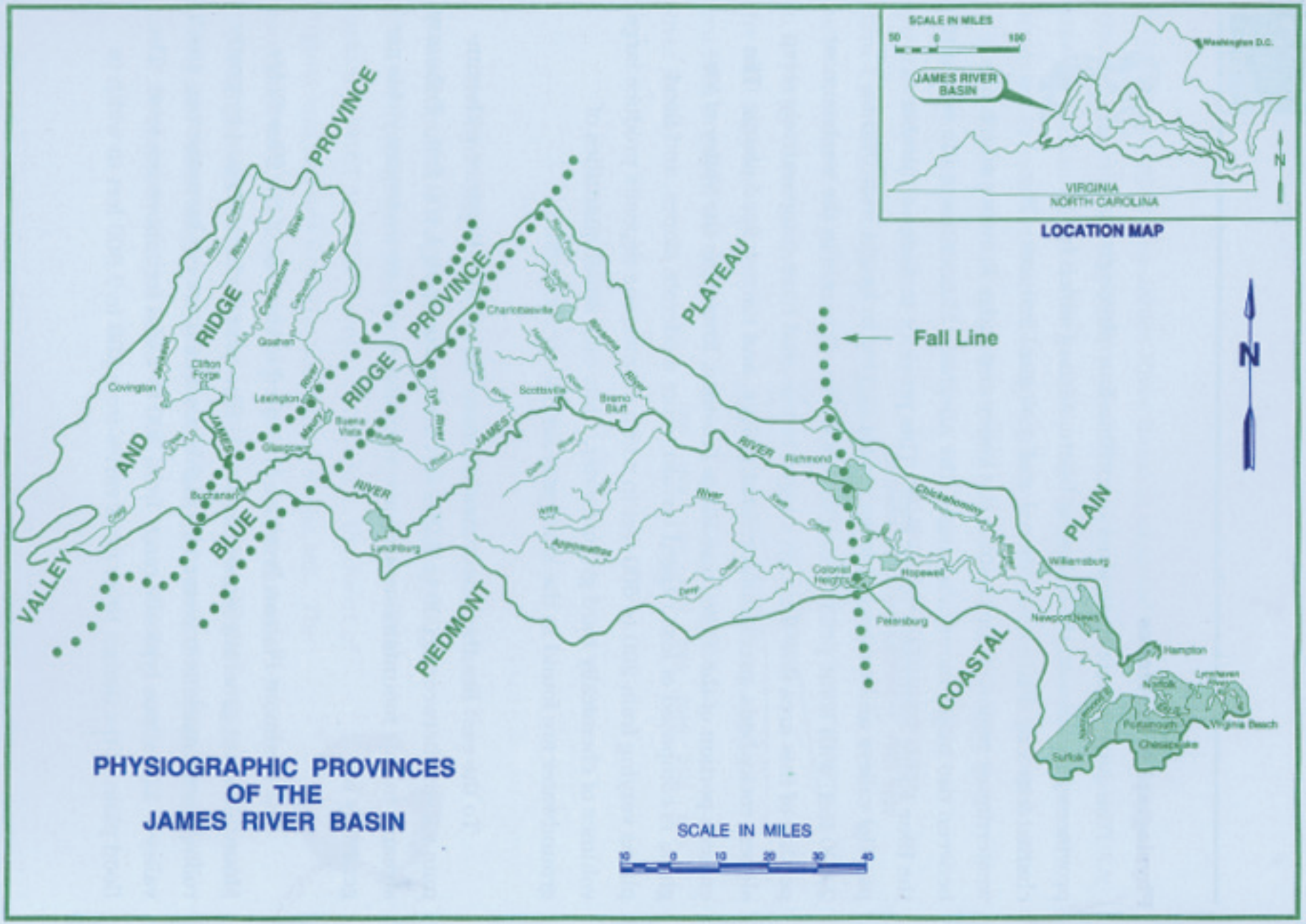
The hydrology of the James River Basin is a function of its latitudinal and longitudinal location, elevation, geology, extent of development and modification, and climate. The basin is located near the Eastern Seaboard in the heart of Virginia and extends from the mountains to the sea. The watershed contains approximately 10,100 square miles, or about 25 percent of the total area of the Commonwealth. The basin is approximately 240 miles long, averages 40 to 50 miles in width, and includes all or part of 39 counties and 18 cities.

Physiographic Provinces

The James River watershed lies within four physiographic provinces as shown on the following figure, each of which is characterized by distinct elevational and geological features. The westernmost region of the basin is the Valley and Ridge Province which lies between two major mountain ranges, the Allegheny Mountains to the west and the Blue Ridge Mountains to the east. This province includes a number of parallel valleys and somewhat lower ridges varying in height from 700 to 2,000 feet, with some peaks rising to 3,000 feet. Streams in the westernmost portion of this area flow through rugged terrain and have comparatively steep slopes, rocky beds, precipitously sided valleys, and narrow flood plains. The eastern portion of the Valley and Ridge Province, known as the Valley of Virginia, is composed of less rugged terrain, more moderate slopes, and flood plains varying from 200 to 500 feet in width. Limestone deposits produce large volumes of chemically hard groundwater, while only small quantities of groundwater are found in the shale and sandstone formations.

To the east lies the mostly mountainous Blue Ridge Province with summits varying between 2,000 to 3,000 feet and peaks up to 4,400 feet. Tributary streams in this mountainous area are precipitous, and groundwater yields are generally low.

The Piedmont Plateau Province is located to the east of the Blue Ridge Mountains and generally slopes eastward. The area is characterized by gently rolling conformations traversed by highlands which are cut by numerous small valleys. Elevations typically range from 200 to 1,000 feet above sea level. The flood plain of the James River itself varies from 500 to 2,500 feet in width in


SCALE IN MILES
50 0 100
JAMES RIVER BASIN
Washington D.C.
VIRGINIA
NORTH CAROLINA
LOCATION MAP
VALLEY AND RIDGE PROVINCE
BLUE RIDGE PROVINCE
PIEDMONT PLATEAU
COASTAL PLAIN
Fall Line
N
Covington
Clifton Forge
Lexington
Buena Vista
Glasgow
Buchanan
Lynchburg
Charlottesville
Scottsville
Bremo Bluff
Richmond
Petersburg
Colonial Heights
Hopewell
Williamsburg
Newport News
Hampton
Norfolk
Portsmouth
Chesapeake
Virginia Beach
Suffolk
JAMES RIVER
PHYSIOGRAPHIC PROVINCES
OF THE
JAMES RIVER BASIN
SCALE IN MILES
10 0 10 20 30 40

this area. The amount of groundwater in the Piedmont region is generally modest while the quality is typically good.

Below the fall line at the eastern escarpment of the Piedmont Plateau lies the Coastal Plain, the easternmost region of the James River Basin. This area is relatively flat and featureless, rising in a series of terraces from sea level to an elevation 200 feet above sea level. The James River and its tributaries in the Coastal Plain are typically tidally influenced, and the alluvial soils in this region generally contain large amounts of high quality groundwater.

The James River Basin contains 12 major tributaries of the James River with drainage areas in excess of 200 square miles, as shown in the following table.

PRINCIPAL TRIBUTARIES OF THE JAMES RIVER

Tributary	Drainage area[1]	Confluence location[2]
Jackson River	905	339
Cowpasture River	464	339
Craig Creek	373	324
Maury River	839	281
Tye River	418	215
Rockfish River	247	197
Slate River	245	174
Rivanna River	770	163
Willis River	278	156
Appomattox River	1,600	75
Chickahominy River	462	47
Nansemond River	219	8

[1]Square miles.
[2]Miles above the mouth.

Climate

The climate of the James River Basin is generally of continental origin. For the most part, air masses which influence the weather in the basin move from the interior of North America and are modified by the influence of the Appalachian and Blue Ridge Mountains. Warm air from the Gulf Stream in the Atlantic Ocean tends to moderate the climate of the Coastal Plain portion of the basin. Hot, humid weather is frequent in the summer, but extended hot, dry weather can occasionally create drought conditions within the basin.

The average annual temperature of the James River Basin is approximately 56 degrees, although extreme temperatures below zero and above 100 degrees Fahrenheit have been recorded. In fact, subzero temperatures occur annually in the portion of the basin west of the Blue Ridge Mountains and occasionally over the entire basin.

Average annual precipitation for the basin is approximately 42 inches and is fairly constant in its distribution over the basin, varying no more than 5 or 6 inches from the average in any one area. Average annual snowfall ranges from over 30 inches in the mountains to less than 10 inches along the coast.

There are three general types of storms that can cause precipitation within the James River Basin—continental, coastal, and frontal storms. Continental storms originate over the western or central portion of the United States and generally move eastward. Unusually intense winter storms, such as the March 1913 and March 1936 storms, can produce extreme floods along the non-tidal streams within the basin.

Coastal storms can occur as a result of either tropical storms or hurricanes, or extra-tropical storms such as northeasters. Tropical storms or hurricanes usually originate in the Eastern Atlantic Ocean near the Cape Verde Island off the coast of Africa, or in the western Caribbean Sea/Gulf of Mexico area during the summer and fall months. These storms can adversely impact the basin with either inland flooding associated with intense rainfall over the mountainous areas, such as occurred in August 1969 (Hurricane Camille), June 1972 (Tropical Storm Agnes), and November 1985 (Hurricane Juan), or with flooding along the tidal areas of the basin as a result of storm surge and wind-driven waves such as occurred twice in 1933 and once in 1936.

Extra-tropical coastal storms generally originate near the mid-Atlantic coastline during the fall, winter, and spring months. The March 1962 (Ash Wednesday) storm, which caused widespread destruction along the mid-Atlantic and northern Atlantic shorelines, is the most severe northeaster experienced within the tidal portion of the James River Basin this century.

Frontal storms form along the boundary between warm and cold air masses. Although they can be quite intense at times, producing flash flooding conditions in a very short time, their relatively rapid movement typically prevents widespread flooding. From a basinwide standpoint, these storms are inconsequential when compared to the other two types of storms, but can be quite memorable in isolated areas.

Floods

The James River Basin upstream of the fall line at the eastern edge of the Piedmont Plateau is subject to fluvial flooding as a result of runoff from rainfall and/or snowmelt, while the Coastal Plain portion of the basin is subject to tidal flooding associated with coastal storms. There have been a large number of floods over the years that have affected portions of the basin; however, the largest flood events experienced by the majority of the basin susceptible to fluvial flooding include the August 1969, June 1972, and November 1985 flood events.

The tidal areas of the James River Basin downstream of Hopewell are susceptible to tidal flooding resulting from hurricanes and northeasters. Historical records indicate that major flooding occurred in the tidal portions of the James River and its tributaries as a result of hurricanes in September 1667, October 1693, October 1749, and five or more times in both the nineteenth and twentieth centuries, including the flood of record in August 1933. Numerous northeasters have also caused flooding in the tidal portions of the James; most noteworthy is the March 1962 flood.

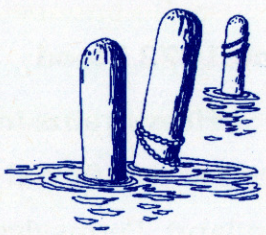
August 1933 Flood

The highest storm surge this century in the tidal portion of the James River Basin occurred during the passage of a hurricane through the Hampton Roads area on August 23, 1933. The storm center crossed the Atlantic Ocean coastline near Ocracoke Inlet, North Carolina and followed a track northward through Norfolk and up the western edge of the Chesapeake Bay toward Washington, D.C. Sustained wind speeds between 70 to 88 miles per hour

were recorded in the Hampton Roads area. Tide levels reached 8.9 feet above mean lower low water (the lower of the two low waters of any tidal day).

March 1962 Flood

The March 1962 northeaster is especially noteworthy for its persistence, extending through five consecutive high tide cycles. The storm battered the entire mid-Atlantic coastline of the United States from March 6th to 9th and was unusual in its composition and its behavior. The storm stopped its northward movement and moved erratically off the Delaware, Maryland, and Virginia coasts for a day before slowly drifting off into the Atlantic during the next 2 days. This movement set up a large, strong north to northeast wind field which pushed storm tides into the Chesapeake Bay and its tributaries, including the lower James River. The maximum tide reached 8.2 feet above mean lower low water in Hampton Roads.



August 1969 Flood

This flood was caused by an extremely rare combination of weather events which interacted to produce an exceptional magnitude of concentrated rainfall. As remnants of Hurricane Camille moved out of eastern Kentucky into southwest Virginia in the late hours of August 19th, they joined a large mass of maritime/tropical air lying over the upper James River Basin. This air mass was highly concentrated with moisture at an extremely low altitude. Continuous thunderstorm activity for about 8 hours during the height of the storm, combined with the lifting effects of the mountains, produced one of the United States' all-time meteorological anomalies in Nelson County, Virginia.

A record 27 inches of rain fell in an 8-hour period in portions of Nelson County. In a 12-hour period, Camille produced 82 percent of the probable maximum rainfall (defined as the theoretical maximum greatest precipitation that is physically possible for a particular geographical location) over a 200-square-mile area and 73 percent of the probable maximum rainfall over a 1,000-square-mile area, mostly confined to Nelson County and vicinity. Nearly 150 flood-related deaths were recorded within the James River Basin. The August 1969 flood is the flood of record for tributaries in and around Nelson County.

June 1972 Flood

Heavy rains in June 1972 associated with Tropical Storm Agnes produced severe fluvial flooding in Virginia and areas to the north, including Maryland, Pennsylvania, and New York. In Virginia, heavy rainfall and showers on the afternoons and evenings of June 17th and 18th saturated the upper and central James River Basin. The rainshield associated with Agnes reached southern Virginia on June 20th, with the heaviest rainfall occurring the following day, Wednesday, June 21st and lingering into the early hours of the next morning. Downstream of Bremo Bluff and along the Appomattox River, the June 1972 flood is generally the flood of record.

November 1985 Flood

In early November 1985, remnants of Hurricane Juan and a blocking high-pressure system off the east coast combined to cause record flooding in a large portion of the upper James River Basin. Hurricane Juan moved north out of the Gulf of Mexico and dissipated in the Ohio River Valley on November 1st and 2nd. Meanwhile, the blocking high-pressure system off the east coast

caused unusual amounts of moisture to move northward, resulting in heavy rains from North Carolina to New York from November 3rd to 5th. Rainfall amounts of 10 to 11 inches were measured in the headwaters of the James, while Montebello, located approximately 15 miles northeast of Buena Vista, recorded nearly 19 inches of rainfall for the 5-day period (November 1st to 5th). The November 1985 flood is the flood of record for much of the basin upstream of Bremo Bluff.

Flood Protection Measures

The Gathright Dam and Lake Moomaw project was constructed on the Jackson River about 10 miles north of Covington to provide, among other things, flood control to downstream areas as far as Richmond. Since filling operations began in 1979, the project has prevented more than $180 million in damages (at current price levels). Local flood protection projects in Buena Vista, Scottsville, and Richmond, and the hurricane protection project in Norfolk have combined to prevent $40 million in damages (at current price levels) over their relatively short existence. In addition, projects and actions implemented by individual residents and industries, local communities, and Commonwealth and Federal agencies, including the Natural Resources Conservation Service and the Federal Emergency Management Agency, have also provided untold millions of dollars in flood damage reduction within the James River Basin.

Hindrances to Flood Protection

Unfortunately, there are many areas within the basin that remain exposed to the threat of flooding. Many of these areas have been considered for various types of flood reduction and flood protection projects, but because

of the lack of economic justification, an insufficient tax base to support a project, and/or the disruption and environmental effects of implementing a project, these communities remain exposed to flooding. Perhaps the greatest hindrance to providing flood protection for these areas is the scattered and low density of development which increases the cost of implementing flood reduction and/or flood protection measures, while at the same time limiting the benefits that could be attributed to flood reduction or protection.

Another significant hindrance to flood protection for many areas of the James River Basin is the history of the basin itself. The James River Basin is one of the earliest areas of development by Western or European man since the settlement of Jamestown. Roads, railroads, communities, and public utilities and other facilities have been continuously built along the flat flood plains of the basin since the 17th century. Virtually any flood reduction and/or flood protection facilities that would be considered for implementation today would conflict with these developments and facilities, making construction around or relocation of these facilities or developments cost prohibitive.

Droughts

Droughts are a normal part of the earth's climate, and essentially no geographic area, including the James River Basin, is immune from occasional periods of very low precipitation. It is difficult to identify when a drought begins or ends since it typically emerges slowly from an insignificant beginning of a few weeks with minimal or no rainfall. Droughts can impact large areas of the country or only small portions of an individual river basin. Droughts can also vary in their length and severity. While droughts and their severity are generally identified and measured utilizing meteorologic and/or hydrologic parameters, it is the negative economic, social, and environmental impacts of

droughts that make them memorable. Severe droughts have occurred in Virginia in 1755, 1785, 1793, 1806, 1826 to 1827, 1838 to 1840, 1845, 1876, 1881, 1895, 1925 to 1926, 1929 to 1931, 1962 to 1971, and 1980 to 1982.

1838 to 1840 Drought

Available information seems to indicate that this drought, which extended over a 21-month period, was the most severe drought in the James River Basin since the settlement of Jamestown. Based on the severity, wide distribution, and long duration, it appears that this drought is without parallel in the meteorological annals of the eastern United States. Newspaper accounts indicate that this drought extended as far south as Georgia, as far west as Arkansas, as far north as Maryland and Ohio, and eastward to the coast with great crop damage in those states and in Tennessee and Virginia. Many creeks within the James River Basin went dry and wells had to be deepened.

1929 to 1931 Drought

The 1929 to 1931 drought was another widespread drought, affecting approximately 20 percent of all of the counties in the United States at that time. The drought began in December 1929, extended through all of 1930, and persisted until the end of March 1931—a period of 16 months. Abnormally low streamflows forced many power plants along the James River to suspend operations for considerable periods of time. Crop losses in the upper portion of the James River Basin were estimated near 65 percent. The Richmond News Leader placed estimates of losses due to the drought near $100 million at that time.

1962 to 1971 Drought

This drought was also a severe drought for the James River Basin. The annual departures of streamflow from the normal streamflow for more than 8 years made the streamflow deficit for this drought larger than any drought in the 20th century. Record low flows were established in some portions of the James River Basin in January 1966.

1980 to 1982 Drought

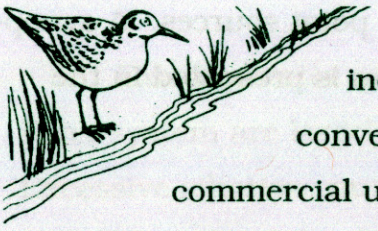
The 1980 to 1982 drought was relatively short when compared to other droughts of the 20th century, but the magnitude of departures from normal streamflow at many gaging stations was extreme. Between June and December of 1980, central Virginia received only 42 percent of its normal amount of precipitation, while the rainfall in Tidewater was 40 percent below normal and 20 percent below normal in the region west of the Shenandoah Valley. Low flows in the James River, combined with favorable light conditions and warm temperatures, contributed to algae blooms between Lynchburg and Richmond. This bloom caused taste and odor problems in Richmond's drinking water during October 1980.

The prolonged shortage of rainfall and streamflow caused an estimated $200 million in crop and livestock losses in Virginia. A significant number of localities within the Commonwealth were forced to institute voluntary and mandatory water conservation and restriction programs. More so than any other drought in the history of the Commonwealth, this drought focused attention on the real water needs of communities and the inherent difficulties associated with obtaining reliable long-term water supplies.

Water Quality

Socio-Economic Factors Affecting Water Quality

Various socio-economic factors such as population growth and land use affect water quality in the basin. Population growth tends to put additional stress on natural systems through the demand for more potable water and the corresponding increase of wastewater treatment demands. Growth which occurs in areas reliant on septic systems can adversely affect the water quality of the streams in the area through the drainage from such systems. Associated with these population increases are land use changes which involve conversions from undeveloped land to residential and commercial uses. This development creates more runoff and thus a potential for a decline in water quality. Industrial land use has the potential to be a source of water quality degradation unless proper measures are taken to control the waste products generated in the manufacturing process.



The infrastructure of the cities and counties in the basin is a critical element in dealing with water quality. Water and sewage treatment facilities influence water quality through water withdrawals and discharges to the James River and its tributaries. Transportation systems, specifically port facilities and highways, can also influence the river's quality as point sources of runoff and chemical contamination.

Another factor affecting water quality and water management is the level of community support for measures which protect and regulate water resources. The financial strength of the community and its residents can also

affect the ability to pay for additional facilities and programs to enhance water quality. Although protection of water supplies through managed growth is a current trend, it is often very difficult to enact and enforce such measures. Similarly, restrictions on wastewater discharges or regulations on treatment can be difficult to enact because of their economic costs to municipalities and industries.

Water Quality Impairment

The quality of water in the James River has greatly improved in recent years, largely due to control measures implemented by point sources. A synopsis of the current water quality in the James River Basin is presented in the following table.

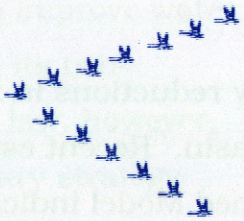
IMPAIRED RIVER MILES AND ASSOCIATED CAUSES IN THE JAMES RIVER BASIN

Pollutant	Number of river miles	
	Major impact	Moderate/ minor impact
Pesticides	0	298.16
Nutrients	0	4.69
pH	7.16	189.0
Organic enrichment/low dissolved oxygen	9.97	26.39
Pathogen indicators (fecal coliforms, etc.)	62.56	201.15
Industrial point sources	1.17	298.16
Municipal point sources	2.16	4.10
Combined sewer overflow	5.83	23.20
Agriculture	36.24	155.50
Silviculture (ornamental plant farms, etc.)	19.45	0
Urban runoff/storm sewers	9.02	4.69
Atmospheric deposition (acid rain, etc.)	7.16	0

Source: Virginia 1996 Water Quality Assessment [305(b)] Report.

Upper James River Basin

With only two exceptions, water quality in the river above the City of Richmond is considered to be in good to excellent condition. Although progress is being made, some pollution problems still persist in the Lynchburg vicinity, including upriver and downriver areas (high bacterial counts in the summer), and below Covington (low dissolved oxygen problems during the summer months). The compressed urban area at the Fall Line at Richmond, in an otherwise forested and agricultural watershed, impacts water quality in the transition zone between the upper and lower James.



Existing water quality impacts in the upper James River system are largely attributable to non-point pollution. Excessive siltation, nutrient loading, and herbicide/pesticide runoff from land development and poor agricultural practices are primary concerns. Acidic precipitation is still a concern in the upper James in affecting the biotic integrity of several streams.

Lower James River Basin

From central Richmond downstream to the Hampton Roads harbor, the primary water quality issues are: (1) combined sewer overflows (CSOs), (2) urban runoff, and (3) various point source discharges. Downstream from Richmond about 22 miles, at the confluence with the Appomattox River, the Hopewell area also impacts the tidal fresh waters with industrial discharges. From 1966 through 1975, this area was the site of illegal discharges of Kepone, a persistent insecticide. After continuous non-detectable results, water column monitoring was discontinued in 1981. Kepone levels in finfish, groundwater, and sediment have decreased since the onset of the problem. (Draft Virginia 1998 Water Quality Assessment [305(b)] Report).

Urban and industrial development in Hampton Roads, including the naval facilities at Sewells Point in Norfolk, apparently have a minor effect on these open waters. Generally, the substantial tidal exchange of this area contributes to maintaining good water quality.

Water Quality Trends

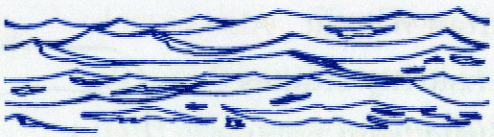
Water quality is expected to continue to improve in the James River in the future. Widespread decreases in algal growth rates in the James River appear to be linked to improving water quality conditions indicated by reductions in nutrients. Nutrient loads are gradually decreasing in the basin. Recent estimates generated by the Chesapeake Bay Program's Watershed Model indicate an overall reduction of 18 percent in nitrogen loads and 57 percent reduction in phosphorus loads since 1985 (Draft Virginia Tributary Strategy Technical Synthesis Workshop Report, April 1998). Nutrient reduction has been identified as a key Chesapeake Bay restoration effort, with the goal of 40 percent reduction of nutrients entering the bay by the year 2000 set in the 1987 Bay Agreement, and reinforced in the 1992 Nutrient Reevaluation. The Chesapeake Bay Program's Watershed Model is expected to provide information in the near future which will be used to evaluate nutrient reduction goals, as needed, for individual rivers. Specific nutrient reduction goals for the James River have not yet been established.

The Cities of Lynchburg and Richmond are continuing to construct projects consistent with CSO control plans adopted by these cities. Upon completion of these projects over the next decade, the impact of CSO on James River water quality should continue to be significantly reduced.

Virginia Water Quality Programs

The Virginia Department of Environmental Quality (DEQ) is responsible for developing and implementing policies, programs, and procedures to assure proper use and management of the Commonwealth's water resources. More than a dozen programs are now in place which contribute to these objectives.

The 1996 Virginia General Assembly passed legislation that provided a framework and deadline for completion (July 1, 1998) of the James River tributary strategy. Under this new law, "The Secretary of Natural Resources shall coordinate the development of tributary plans designed to improve water quality and restore living resources of the Chesapeake Bay and its tributaries...." The reduction of nutrients is the main focus of this law, however, local water quality issues may be addressed through the tributary strategy process as well.



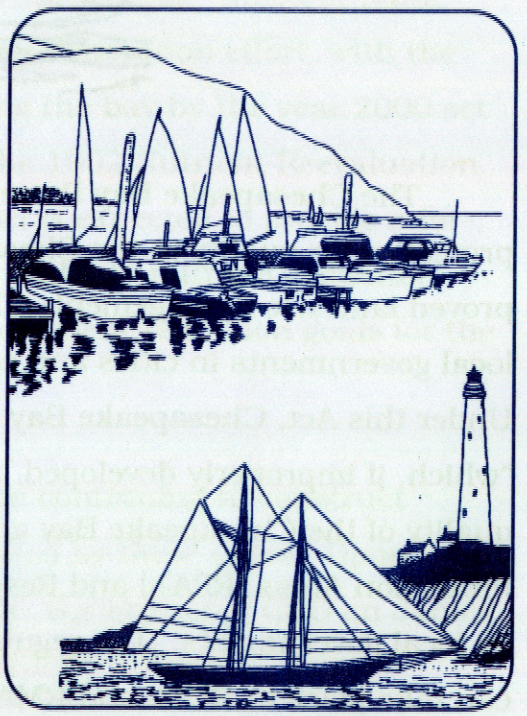
The Chesapeake Bay Preservation Act (1988) established programs to protect water quality in the Chesapeake Bay and its tributaries through improved land use management. The state developed regulations implemented by local governments in cities and counties bordering tidal waters of Virginia. Under this Act, Chesapeake Bay Preservation Areas are designated as lands "which, if improperly developed, may result in substantial damage to the water quality of the Chesapeake Bay and its tributaries." They include Resource Protection Areas (RPA's) and Resource Management Areas (RMA's) delineated by local governments. The regulations restrict the types of development which can take place in RPA's and RMA's.

Water Quality Information

Water quality information for the basin will soon be available on the Virginia Water Resources Research Center website *(http://www.vwrrc.vt.edu/vwrrc.html)*. The U.S. Environmental Protection Agency link entitled "Surf Your Watershed" *(http://www.epa.gov/surf/surf_search.html)* includes water quality data for many watersheds in Virginia. DEQ water quality data is available on the DEQ website *(http://www.deq.state.va.us/)*. Water quality trend studies for the James River have recently been published by the Virginia office of the U.S. Geological Survey. Hank Johnson is the local point of contact at (804) 278-4750, extension 238.

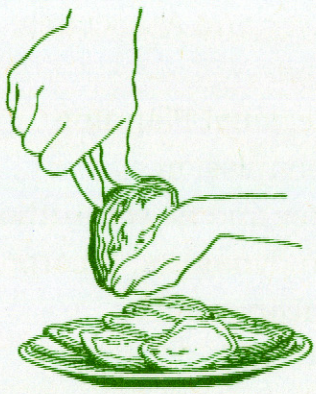
Fisheries Trends

Between Gathright Dam and the City of Covington, the Jackson River remains a high-quality trout fishery, but land practices adjacent to the river are a constant threat to trout habitat. Also, Virginia's trout stream sensitivity studies indicate that much of its wild trout habitat is vulnerable to stream acidification. Decline in the population of rainbow trout and poor brook trout reproduction have been observed. Stream stocking programs have been implemented in an effort to maintain trout populations.

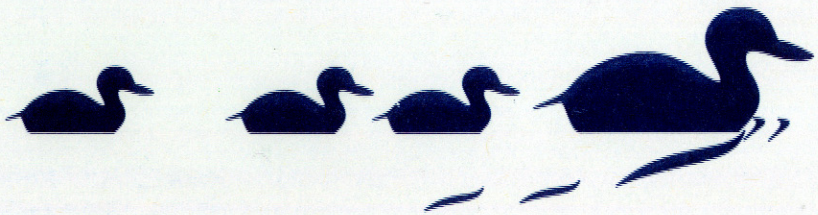


Historic stocks of migratory fish in the James River have been significantly reduced. Overfishing, construction of dams, pollution, and habitat destruction have had

a pronounced impact. A concerted government and citizen effort is underway to reverse these population declines. Dams are being breached and fishways constructed to reintroduce migratory fish into historic spawning and rearing areas. Four dams in Richmond have been breached to provide fish passage. Current construction of fish passage facilities at Bosher Dam, the last remaining impediment at the fall line, will provide access to more than 134 miles of spawning habitat.



Oyster abundance in the James River and Chesapeake Bay is estimated at no more than 1 percent of historic levels. The continuing decline of the oyster population is a complex problem related to outbreaks of disease epidemics, commerical overharvesting, and environmental degradation. The Hampton Roads area, downstream from the oyster seed beds, has a significant hard clam fishery and finfishery. Concerns about elevated levels of heavy metals in bottom sediments due to discharges in the 1950s and 1960s have been unfounded to date, as there has been no detectable impact on the fisheries in this area.



Memberships

American Electric Power
Appomattox River Water Authority
Babcock and Wilcox
BARC Electrical Cooperative
City of Clifton Forge
City of Lynchburg
City of Newport News
City of Norfolk, Department of Utilities
City of Richmond
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Richmond Regional Planning District Commission
Rivanna Water and Sewer Authority
Sydnor Hydrodynamics, Incorporated
Synergics, Incorporated
Town of Scottsville
Upper Occoquan Sewage Authority
U.S. Army Corps of Engineers
Virginia Hot Springs, Incorporated
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Notes

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