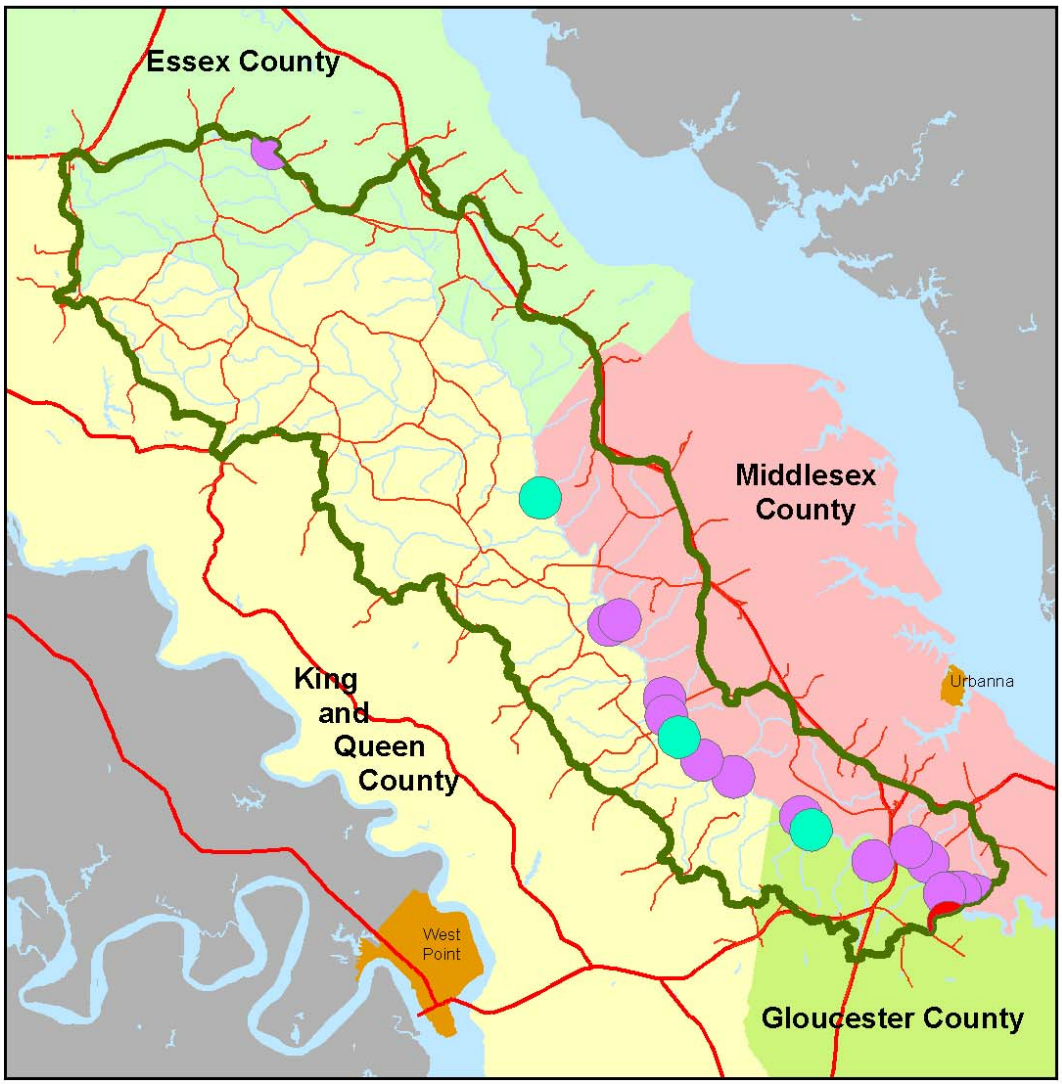

Figure 9. Occurrences of natural heritage resources in the Dragon Run watershed.

Baldcypress Woodland/Savanna, Fluvial Terrace Woodland, and Tidal Freshwater Marsh (see **Appendix A** for descriptions). The Baldcypress-Tupelo Swamp community (**Figure 10**) also harbors a number of rare plant and animal species. Rare animals include bald eagle, great purple hairstreak, blackwater bluet, robust baskettail, cypress sphinx, Selys' sunfly, fine-lined emerald and Southern pitcher-plant mosquito. Rare plants include cuckooflower, red turtlehead, Parker's pipewort, pineland tick-trefoil, river bulrush, Northern purple pitcher-plant, and cypress-knee sedge (Belden, Jr. et al., 2001; Belden, Jr. et al., 2003). The Dragon Run also harbors a number of rookeries for colonial water birds, such as egrets and herons. Other natural communities that occur in the Dragon Run include: Coastal Plain/Piedmont Bottomland Forest; Coastal Plain/Piedmont Acidic Seepage Swamp; and Coastal Plain Semipermanent Impoundment (Belden, Jr. et al., 2003).

Figure 10. Baldcypress-Tupelo Swamp community.

In addition to natural heritage resources, the Dragon Run supports a diversity of freshwater and estuarine fishes, aquatic macroinvertebrates, freshwater bivalves (primarily unionid mussels), and herptefauna (amphibians and reptiles) (McIninch et al., 2003). At least forty-five fish species from nineteen families have been collected in the Dragon Run, representing a mixed assemblage of mostly lowland freshwater forms that is highly dynamic spatially and temporally. At least sixty-five macroinvertebrate species from fourteen orders and forty-seven families have been recorded from the Dragon Run.

The watershed contains only limited examples of invasive, or non-native, species, again emphasizing a relatively intact natural system. Currently, blue catfish, common reed, Asiatic dayflower and Japanese stiltgrass occur in the Dragon Run in limited quantities (**Figure 11**).

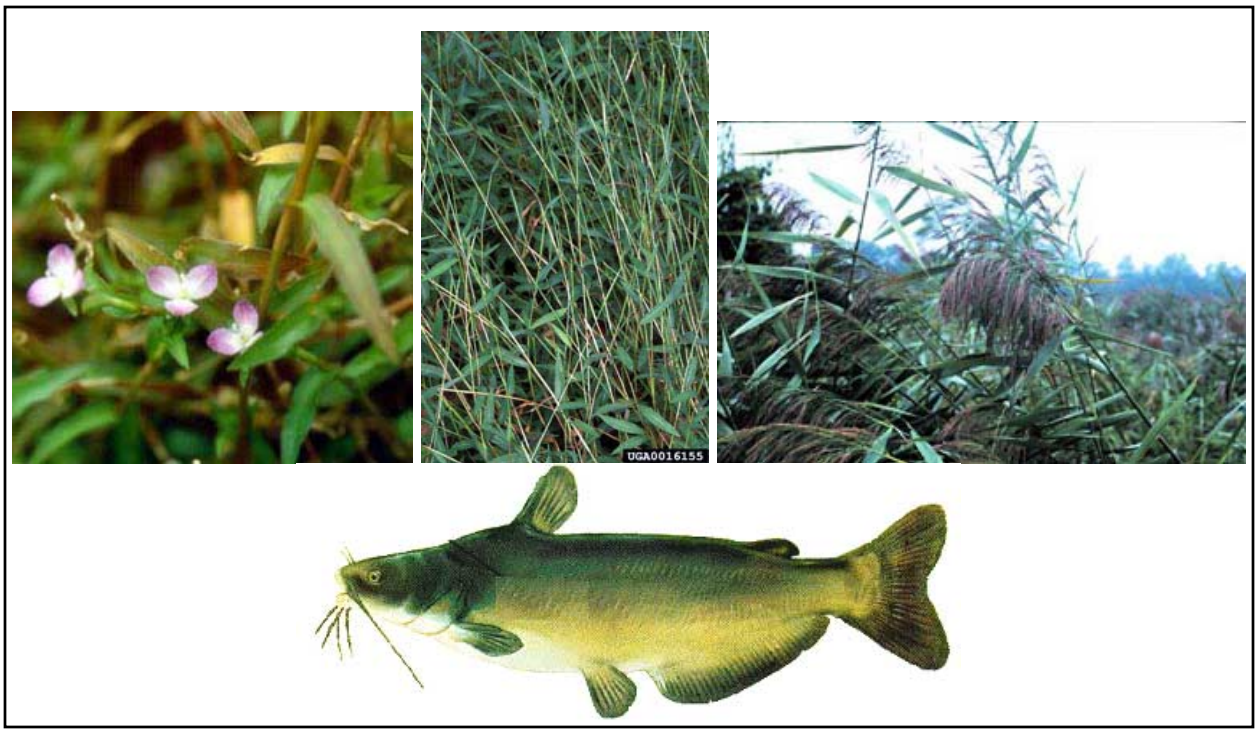

Figure 11. Invasive species of the Dragon Run - clockwise: Asiatic dayflower (Brent Steury, NPS); Japanese stiltgrass (Ted Bodner); Common reed (Joseph McCauley, USFWS); Blue catfish (www.landbigfish.com)

According to the National Wetland Inventory, wetlands along the Dragon Run (**Figure 12**) are Palustrine, mostly Forested Wetlands except for Emergent Wetlands in Meggs Bay. U.S. Route 17 is the approximate demarcation between tidal wetlands and non-tidal wetlands. The hydrologic regime of most Dragon Run wetlands is Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded (Belden, Jr. et al., 2001).

The U.S. Geological Survey (USGS) maintained a streamflow gaging station at Church View (Route 602) from 1943 to 1981 that received drainage from 60% of the watershed (84 square miles) and has maintained a streamflow gaging station at Mascot (Route 603) since 1981 that receives drainage from 75% of the watershed (105 square miles). Median daily streamflow at Mascot from 1981 to 1999 was 79 ft^3/sec and varied between 0.01-6050 ft^3/sec. Median daily streamflow at Church View from 1943 to 1981 was 57 ft^3/sec and varied from 0-3790 ft^3/sec. Compared to other coastal plain stream systems such as the Chickahominy River (New Kent County), the Mattaponi River (King William County), and Cat Point Creek (Richmond County), the Dragon Run exhibits lower median daily streamflow per square mile of drainage area. Base flow, fed primarily by groundwater discharge, accounts for two-thirds of the Dragon Run's total streamflow, with the remaining third attributable to surface water runoff. Of the annual precipitation, only one-third becomes streamflow, with two-thirds lost to evapotranspiration. Seasonally, streamflow is highest in the spring and lowest in the fall (MPPDC, 2001).

Figure 12. Wetlands in the Dragon Run watershed.

Geological features are described by the following excerpt from *A Natural Heritage Inventory of the Dragon Run Watershed* (Belden, Jr. et al., 2001):

Surficial deposits of riverine terraces bordering Dragon Run from the vicinity of the Essex-Middlesex county line to Meggs Bay belong to the Shirley Formation and the Sedgefield Member of the Tabb formation. The middle Pleistocene Shirley Formation consists of light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat; the Sedgefield Member is of upper Pleistocene age and consists of pebbly to bouldery, clayey sand and fine to medium, shelly sand grading upward to sandy and clayey silt. Somewhat higher topography away from the waterway is underlain by the Chesapeake Group. This consists of fine to coarse quartzose sand, silt, and clay (variably shelly and diatomaceous) deposited in shallow waters of the upper Pliocene and lower Miocene periods. At still higher elevations, the Windsor Formation is found, consisting of gray and yellowish to reddish-brown sand, gravel, silt, and clay of lower Pleistocene or upper Pliocene age. At higher elevations southwest of Dragon Run, two other formations are prevalent, both of upper Pliocene age. The Bacons Castle Formation is characterized by gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay and the Moorings Unit by white, light gray, and grayish-yellow quartzose sand and clay to grayish-brown clayey silt and silty clay.

Watershed elevation ranges from 180 feet to near sea-level. Detailed soils information can be found in the *Soil Survey* for each county (Note: King and Queen County does not have a published *Soil Survey*). Many of these soils are considered prime farmland and are suitable for silviculture. Generally, soil associations are as follows:

Essex County

Emporia-Slagle-Atlee; Rumford-Suffolk-Emporia - somewhat excessively drained to moderately well drained loamy and sandy soils (Hoppe, 1989)

Middlesex County

Suffolk-Eunola-Remlik; Kempsville-Suffolk-Kinston; Emporia-Slagle-Nevarc - deep, well drained to poorly drained loamy or clayey soils (Newhouse et al., 1985); Pocaty-Kinston-Bibb - deep, very poorly to poorly drained organic and loamy soils that are flooded by fresh and brackish water (Newhouse et al., 1985)

Gloucester County

Suffolk-Eunola-Kenansville; Emporia-Hapludults-Wrightsboro - deep, well drained to moderately well drained loamy or clayey soils (Newhouse et al., 1980)

DCR's Shoreline Erosion Advisory Service identified five areas of streambank erosion in the lower Dragon Run (Vanlandingham, 2003). The lower Dragon Run undergoes an average of less than one foot per year of erosion that is mostly attributable to high water flow undercutting the stream bank during storms. These erosion "hot spots" are relatively few and small and are unlikely to cause impairment to the stream.

Water Quality

Water Quality Assessment

The primary water contaminant sources in the Dragon Run are point source discharges and nonpoint source pollution from precipitation (atmospheric deposition), residential land use, agricultural land use, and forested lands (MPPDC, 2002). According to the Virginia Department of Environmental Quality (DEQ), the Dragon Run generally exhibits

medium nutrient levels and is listed as “impaired” for pH, fecal coliform bacteria, mercury, and lead (DEQ, 2002). Based on agricultural, urban, and forested pollution loadings potential determined by DCR, however, the overall nonpoint source pollution potential rating is low for the Dragon Run (DCR, 2002).

Point source discharges, which are permitted and monitored by the Virginia Department of Environmental Quality, are relatively easy to quantify and, in turn, control or track. Point source discharges to the Dragon Run include: stormwater runoff from a wood treatment facility (arsenic, chromium, copper) at Pitts Lumber Company, Inc. to an intermittent stream adjacent to U.S. Route 17 in Middlesex County (Permit #VA0083011); discharge from a sewage treatment plant (biological oxygen demand, total suspended solids, ammonia nitrogen, total residual chlorine, pH, fecal coliform) at Rappahannock Community College to an intermittent stream near Glenns in Gloucester County (Permit #VA0028461); and discharge from a wellwater treatment plant (pH, total suspended solids) at the Miller’s Square Subdivision to an intermittent stream near Miller’s Tavern in Essex County (Permit #VA0075302). According to the Shoreline Sanitary Survey (Smither et al., 2003), there are 9 other indirect sources of pollution, including five animal pollution sources (Middlesex County near Saluda and Stormont and Gloucester County near Glenns); a solid waste dumpsite in Middlesex County near Stormont; and a potential pollution source in Middlesex County in Saluda. Furthermore, a network of water quality monitoring wells is maintained at the Browning-Ferris Industries landfill in King and Queen County.

Throughout the Chesapeake Bay, atmospheric deposition (e.g. precipitation) contributes a significant amount of the total nutrient loadings in coastal waters (MPPDC, 2001). Air quality is not currently monitored in the watershed.

More than 90% of residents in Gloucester, King and Queen, and Middlesex Counties use on-site wastewater treatment systems, commonly known as septic systems (MPPDC, 2001). When operated properly, conventional septic systems remove nutrients and fecal coliform. Conventional septic systems can pose potential environmental and health risks due to inappropriate design, poor maintenance, poor soils, or inefficient nitrogen removal. Driven by changes to Department of Health regulations for on-site wastewater treatment systems (12 VAC 5-610-10 et seq. effective July 2000), the popularity of “engineered” on-site wastewater treatment systems is increasing. These alternative systems, when properly maintained, can be effective at removing nutrients and fecal coliform in areas where conventional septic systems are ineffective. Regardless of the type, however, improperly maintained or failing septic systems pose significant environmental and health risks by contributing nutrients, pathogenic bacteria, and viruses to groundwater.

Forested lands, representing a significant land area, yield low nutrient input to streams relative to other land uses in the watershed. Best Management Practices (BMPs) are designed to minimize these inputs. For example, forested riparian buffers provide effective protection for water quality. The watershed currently exhibits intact riparian buffers.

By contrast, agricultural land use in rural and semirural areas in Virginia can be the source of significant sediments, fecal coliform bacteria, and nutrients such as nitrogen and phosphorus. Nitrogen is transported through the groundwater, whereas phosphorus is generally transported on soil particles in surface water. BMPs such as fencing cattle out of streams, conservation tillage, and expanded riparian buffers are designed to minimize these inputs.

Residential and commercial land uses typically contribute less nutrients and sediments than agriculture, but more than forestry. These residential and commercial contributions are mainly attributable to reduced or no riparian buffers, chemical application for landscaping, and stormwater runoff.

Water Quality Monitoring

Water quality data sets in the watershed are sparse in quantity, duration, and parameters measured. Existing data sets include: STORET, a database managed by the Virginia Department of Environmental Quality (DEQ); data collections during fish surveys by the Virginia Department of Game and Inland Fisheries (DGIF) and Virginia Commonwealth University (VCU); data collections by the Chesapeake Bay National Estuarine Research Reserve in Virginia at the Virginia Institute of Marine Science (VIMS); and a now-defunct volunteer water quality monitoring program in the watershed (MPPDC, 2001).

Two stations are currently sampled regularly by the DEQ. Station DRN003.40 is located at the U.S. Route 17 bridge and Station DRN010.48 is located at the Route 603 bridge near Mascot. Data are available from DRN003.40 for the period 1968-1974 and 1992-present and from DRN010.48 for the period 1992-present. Samples are evaluated bimonthly for nutrients, fecal coliform, suspended solids, dissolved oxygen, pH, salinity, and temperature and are occasionally evaluated for pesticides, toxic metals, and other harmful compounds (MPPDC, 2001). The data sets collected at these sampling stations were used by the DEQ to list the Dragon Run as “impaired” for pH and fecal coliform bacteria. Fish tissue samples were used by the DEQ to list the Dragon Run as “impaired” for mercury and lead. The Virginia Department of Health issued a health advisory for the Dragon Run for mercury contamination in largemouth bass (DOH, 2003). The DEQ attributes the pH impairment to natural causes, citing the acidic nature of water in swamps. The DEQ lists the cause of the fecal coliform and mercury and lead impairments as unknown. Potential sources of fecal coliform bacteria include: wildlife; failing septic systems; and livestock. Potential sources of metals include: atmospheric deposition; automobile and roadway deposits; and industrial operations.

Data collected by the DGIF in 1995-1996 and 1998 includes temperature, Secchi depth, pH, dissolved oxygen, conductivity, salinity, alkalinity, hardness, and total dissolved solids. Nutrient data are very limited and were frequently below detection limits. Dissolved oxygen at sampling stations with no or low flow frequently violated daily minimum standards to support aquatic life (MPPDC, 2001).

VIMS data from 2000-2001 measured temperature, salinity, total dissolved solids, pH, dissolved inorganic nitrogen, and fecal coliform bacteria. Of specific note, samples from Briery Swamp exhibited high nitrate and fecal coliform levels, indicating the presence of subsurface agricultural or wastewater drainage (MPPDC, 2001).

A weekly volunteer water quality monitoring program collected data throughout the watershed during the period 1994-1997, although monitoring was not continuous at all eight sites. Measurements included dissolved oxygen, Secchi depth, water and air temperature, pH, and water color. The findings indicated: low dissolved oxygen during warm temperatures and high dissolved oxygen during cold temperatures; low Secchi depth values during the summer associated with algal blooms and storm events; and acidic pH values in the upper Dragon Run with slightly more basic pH values in the tidal waters (MPPDC, 2001).

Impervious Cover

One key indicator of water quality status and stream health is the percentage of impervious surface in a watershed. The Dragon Run watershed exhibits a very low level of impervious cover and, in turn, is in good condition (e.g. natural heritage resources).

Impervious surfaces (e.g. paved streets and parking lots, rooftops) are hardened areas that do not allow infiltration of rainwater and promote runoff to streams. This runoff often occurs at a higher volume and velocity than normal stream flow and can lead to stream erosion and instability. Runoff also carries pollutants that are not absorbed by soil and plants and can lead to degraded water quality. The Center for Watershed Protection (2002) has developed a watershed vulnerability analysis that relies on an impervious cover model. The model indicates that watersheds are generally in good condition when impervious cover is less than 10%. From 10-25% impervious cover, watersheds are generally impacted, which means that they only partially support their intended uses (e.g. drinking, swimming, shellfish harvest). Above 25% impervious cover, watersheds generally do not support their intended uses at all.

Impervious cover can be estimated for the Dragon Run watershed. Based on the 1994 aerial photography, we learn that 1.3% of the watershed is commercial or residential development. Assuming 100% imperviousness, a highly conservative estimate, the watershed is approximately 1.3% impervious surface. The sparse road network is likely to add modestly to this estimate. Since the Dragon Run watershed exhibits less than 10% impervious cover, the Center for Watershed Protection's model (2002) predicts that it is in good condition, which is confirmed by the MPPDC's Dragon Run Watershed Land-Water Quality Preservation Project (MPPDC, 2001).

Recreation and Access

Significant recreational activities and opportunities exist in the Dragon Run watershed, including hunting, fishing, hiking, and boating. Educational opportunities and activities also exist. Meanwhile, access often requires landowner permission; public access is limited.

Hunting represents a significant recreational activity that generates at least $300,000 per year in the watershed. Seventeen hunt clubs lease approximately 42,000 acres, or 46%, of land in the watershed for hunting - mainly deer, turkey, and waterfowl (MPPDC, 2002). Hunt club leases provide income to landowners and offer hunting access to many acres of private lands.

Fishing is also a significant recreational activity in the Dragon Run. According to the DGIF, the Dragon Run's share of the state's fishing value is more than $1.6 million, including trip related expenses such as food and lodging and transportation (MPPDC, 2002). Fishing by boat is popular in the lower Dragon, while bank and fly fishing are more common in the upper Dragon. Fishermen regularly use the public, unpaved lot at Route 603 near Mascot, and a public boat ramp exists at Harcum in the Piankatank River (Gloucester County). Otherwise, landowner permission is generally required.

The Virginia Birding and Wildlife Trail for the Coastal Area, published in 2002 (DGIF, 2002a), describes two sites within the Dragon Run watershed. First, Rappahannock Community College (public), located in Glenns on State Route 33 in Gloucester County, offers wooded trails adjacent to a tributary to the Dragon Run. Second, the Friends of Dragon Run (private) offer a birding trail with views of the Dragon Run and the Baldcypress-Tupelo Swamp community. The site is located near Mascot on Route 603 with parking in a public, unpaved lot. It is important to note that the Friends' site and adjacent properties are privately owned.

Additionally, a 121-acre tract on Route 603 near Mascot is part of the Virginia Estuarine and Coastal Research Reserve System (public). The site can be accessed with permission and is used for research, long-term monitoring and education.

Besides the sites near Route 603, the Dragon Run Access Plan (MPPDC, 1994) indicates other traditional access sites in the watershed. Landowner permission is generally required at these sites, which include: Route 604 at the Essex/King and Queen county line (Byrd's Bridge); Route 602 at the Middlesex/King and Queen county line (Ware's Bridge); and U.S. Route 17 at the Middlesex/Gloucester county line (James Vincent Morgan Bridges).

Boating is also a significant recreational activity in the watershed. Motorized pleasure craft seasonally utilize the lower Dragon. Self-propelled boating is common from Route 602 to Meggs Bay. For example, waterfowl hunters often make short trips in canoes or jon boats, while guided and unguided paddling trips also occur. Several organizations offer guided paddling trips on the Dragon Run (**Figure 13**), including Gloucester County Parks and Recreation (2 trips/summer; ~30 people/summer); Chesapeake Bay Foundation (since 1995, 56 trips; 1080 people; for middle and high school students in Middlesex and Gloucester Counties); Rappahannock Community College (1 3-day trip/year; ~20 people); and Friends of Dragon Run (15-20 trips/year; ~200 people/year). Some outdoor outfitters offer guided trips by appointment.