The Lower Rush River Subwatershed in Rappahannock County, Virginia

A subwatershed analysis and goals prepared by RappFLOW Volunteers and Partners. This work is supported in part by a grant from the National Fish and Wildlife Foundation.

WORKING DRAFT September 9, 2006

Landowners, community leaders, and conservation experts are invited to help complete this analysis and provide vision for the future. Please give comments and suggestions to Beverly Hunter (540) 937-4744 bev_hunter@earthlink.net

RappFLOW volunteers collecting water samples in Rush River in July 2006. Photo by Ellie Clark.

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1) Executive Summary

This subwatershed analysis is part of an 18-month study, "People, land and water of the Upper Thornton River Watershed," conducted by RappFLOW, its 12 partners and dozens of volunteers, and funded in part by the National Fish and Wildlife Foundation's Chesapeake Bay Small Watershed grant program. Individuals and organizations participating in this work are identified in Appendix 1 to this report.

We compared 13 subwatersheds in the Upper Thornton River watershed in terms of land cover, stream buffers, protection from development, and other factors. The Lower Rush, an area of about four and a half square miles just below the town of Washington, was discovered to be the least well protected of the 13 subwatersheds from future development and water quality impairments. Additional reasons for choosing to focus on this subwatershed in more depth include the following:

- The segment of the Rush River that flows into the Lower Rush was designated by the Virginia Department of Environmental Quality (DEQ) as "303d Impaired" for e coli bacteria.
- The Town of Washington obtained a permit from DEQ to discharge effluent from a public sewage treatment plant into the Rush River upstream of the Lower Rush.
- Landowners and residents in the Lower Rush subwatershed indicated strong interest in the quality of water in the Rush River and in the health of their watershed, by participating in public meetings, RappFLOW's survey of landowner concerns and values, and volunteer work on this study.
- The subwatershed includes a mix of agricultural, residential, and commercial land uses that are representative of the land uses in Rappahannock County. By analyzing this subwatershed, we may identify watershed management tools that will apply throughout the county and in similar rural Virginia watersheds.

Sections 2 and 3 of this report provide data, summaries, analyses and maps based on dozens of sources of information concerning the land, land uses, land cover, and water in this subwatershed and the Rush River that flows into the subwatershed. Landowners, residents, and local experts are invited to add information based on their local knowledge. For example, what problems have residents had with quantity or quality of well water? What is their experience with flooding? Section 4 summarizes the values and concerns expressed by respondents to RappFLOW's landowner survey.

We suggest in Section 5 a set of goals for consideration by landowners working together as a community. The goals address values and concerns expressed by landowners as well as analysis of land use factors that affect water quality, and potential future development of the land. The goals are designed to improve the health of the watershed for water quality and wildlife, and to protect the health of the watershed and quality of life for its residents in the future. These goals can be achieved by individual landowners using existing tools and incentives, and might be facilitated by additional tools provided by local government.

Goal 1: Reduce the amount of potential future land subdivision and residential development.

A build-out analysis shows that the population of this small area can increase from the present 300 to 800 residents through subdivision and development by right of existing parcels. Nearly half of the land in this small subwatershed is in parcels of 50 acres or larger. Protecting some of this land now against further future subdivision and development will result in economic and environmental benefits to the individual landowners and to the community, as well as protect against further compromises to the quantity and quality of surface and ground water and wildlife.

The primary tool and incentives to use in achieving this goal include conservation easements, land use taxation, and purchase of development rights. At present, only four percent of the subwatershed area is in conservation easement, in contrast with 18% for the county overall.

Goal 2: Increase the riparian buffer area that is managed to provide protection for streams, water quality, and wildlife habitat.

As discussed in Section 3 of this report, about 46 percent of the 360 acres of riparian buffer area in the Lower Rush subwatershed is currently in forest cover. Forested riparian buffers are the most important factor in protecting water quality, stream integrity, ground water, and fish and wildlife. Nearly twice the existing riparian buffer area could be improved and managed to provide vegetative protection. About 12% is unlikely to become forested due to road crossings and commercial areas.

The primary tools that landowners can use to achieve this goal are the Conservation Incentive Programs offered in the Culpeper Soil and Water Conservation District. Only 86 acres in this subwatershed were protected through these programs prior to 2006. A single farmer in the Lower Rush subwatershed in 2006 is fencing and planting 42 acres of streamside buffer -- 12 percent of the total riparian buffer area of the subwatershed -- through a combination of these programs.

Another set of tools is being developed by RappFLOW and its partners. This program educates and engages landowners in evaluating and improving vegetative buffers.

Goal 3: Ensure that future residential and commercial development is done in a manner that protects the quality of surface water.

While goal 1 would reduce the amount of future development, some development will take place. Strong enforcement of existing county ordinances such as the zoning, subdivision, and erosion and sedimentation control ordinances, provides some protection for the watershed. Concerned citizens and landowners can help achieve the goal of protecting water resources by working with county leaders to encourage enforcement of existing ordinances and development of additional ordinances designed for this purpose. Developers in the commercial area must submit site plans to the CSWCD for approval. Additional tools for ensuring high quality development will include a proposed stormwater ordinance and a master plan for the commercial district. The master plan would include onsite water quality treatment of storm water through landscape design principles advocated for “Low Impact Development (LID).”

Some counties have ordinances that protect riparian buffer zones from future development. For example, a Stream Protection Overlay District (SP) is designed to apply special regulations to the riparian buffer area of a specified width on each side of or perennial streams and wetlands adjacent to those streams. The purpose of the buffer is to retard runoff, prevent erosion, filter nonpoint source pollution from runoff, moderate stream temperature, and provides for the ecological integrity of stream corridors and networks.

2) Overview

This subwatershed analysis is part of an 18-month study of the Upper Thornton River Watershed, conducted by RappFLOW and its partners and volunteers and funded in part by the National Fish and Wildlife Foundation's Chesapeake Bay Small Watershed grant program. Individuals and organizations participating in this work are identified in Appendix A to this report. More information on the overall study is available at www.rappflow.org and at RappFLOW Headquarters in Sperryville, VA.

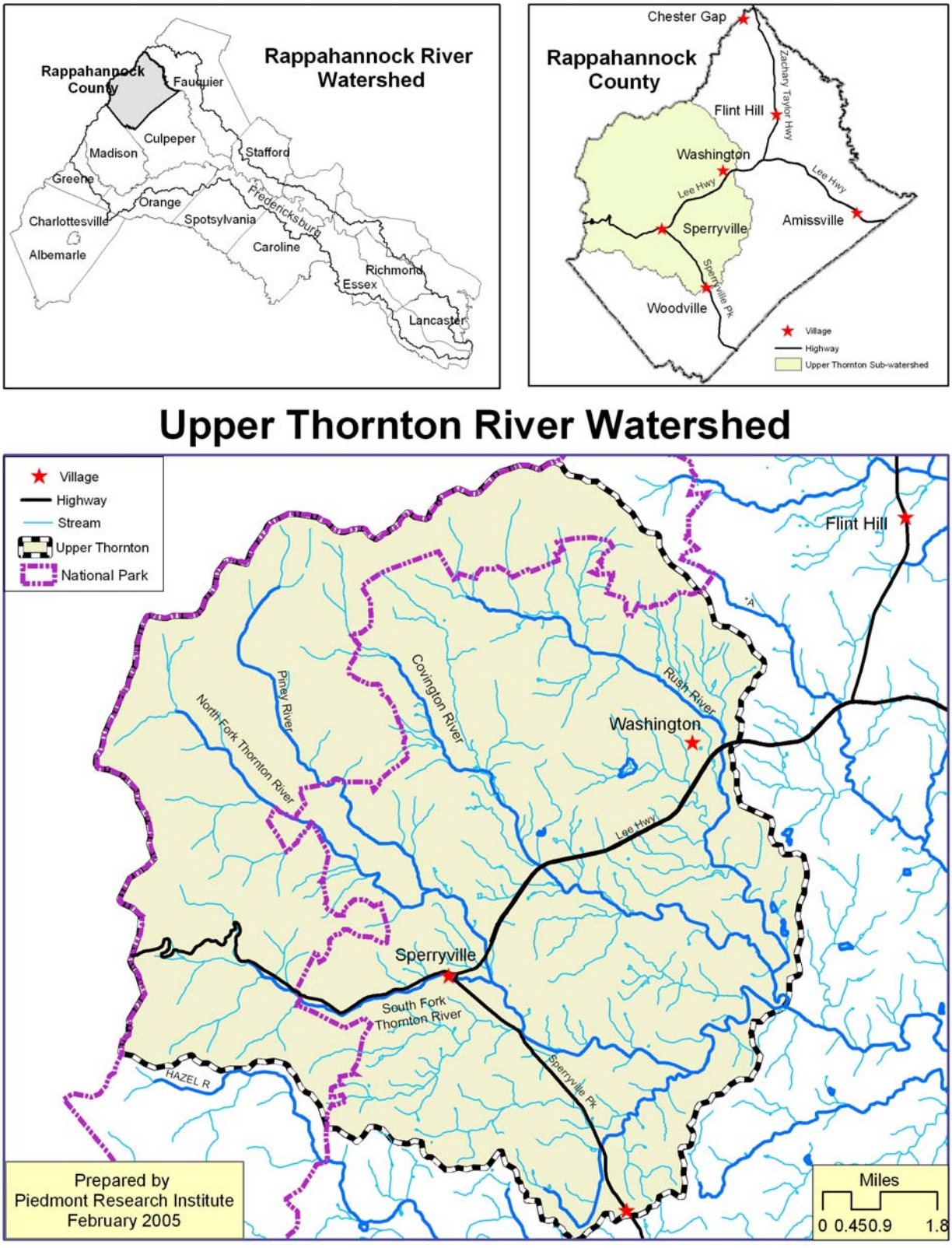
Purposes

The purposes of this document are as follows:

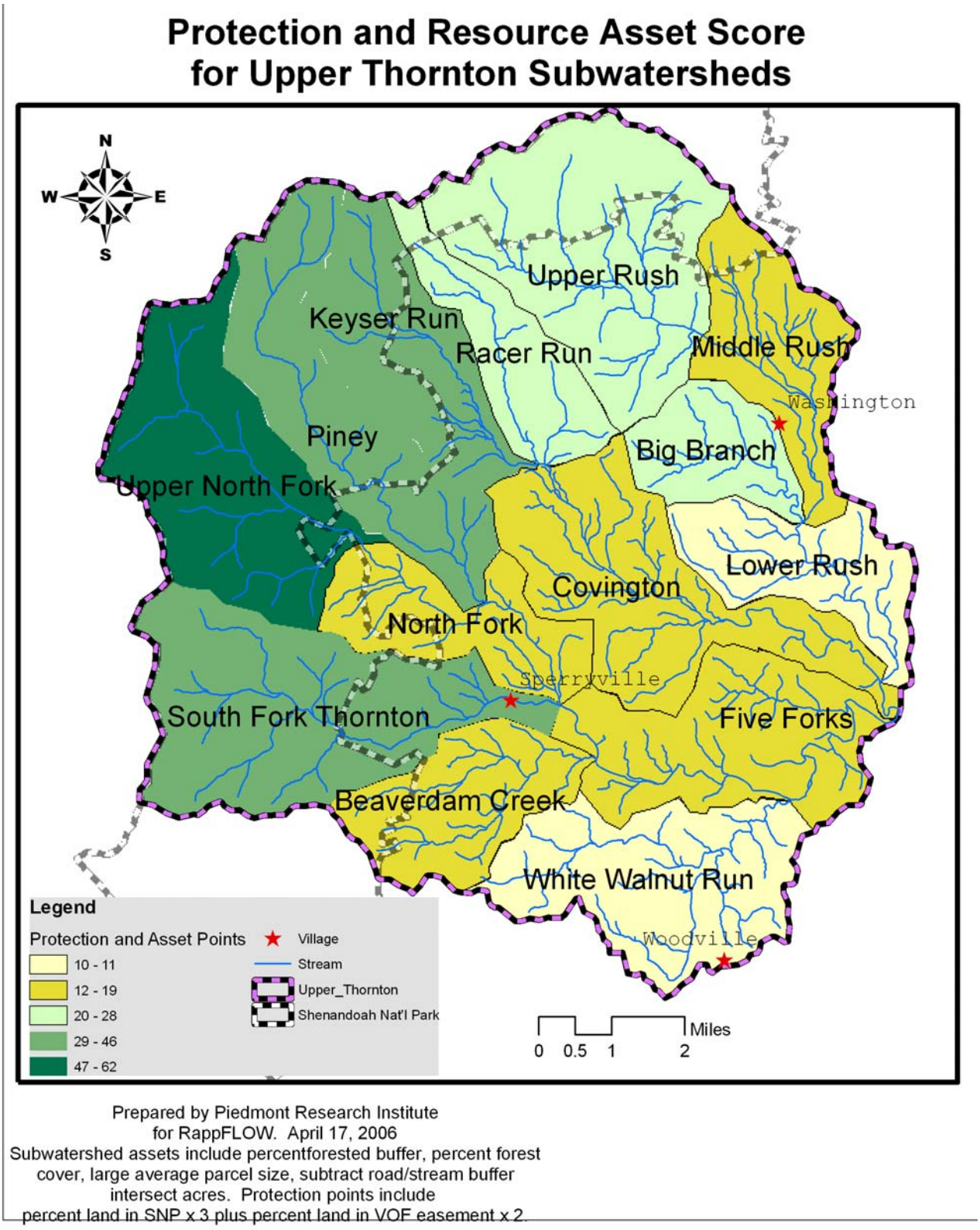
a) Provide an example subwatershed analysis that could provide a model for future studies of watersheds in Rappahannock County and similar rural areas. Identify the kinds of information that are needed in order to create a useful assessment of a watershed.
b) Inform landowners in this subwatershed area of the health of their subwatershed, and factors that may affect their subwatershed in future.
c) Invite landowners to contribute further information based on their knowledge and experience.
d) Provide a basis for landowners working together as a local community to consider goals for future protection of their local watershed area.
e) Identify available tools and incentives for improving the health of the subwatershed.
f) Identify possible actions individual landowners can take to improve the subwatershed and water quality in the streams and wells.
g) Identify possible actions community organizations can take to improve the health of the subwatershed.
h) Identify possible public policy and local government programs that could improve this subwatershed and by implication other subwatersheds.

Context: Rappahannock River Basin, Upper Thornton Watershed, and Lower Rush Subwatershed

The Lower Rush is one of thirteen subwatersheds we defined within the Upper Thornton River Watershed, an area of approximately 93 square miles that lies wholly within Rappahannock County. Map 1 shows the Upper Thornton in the context of the overall Rappahannock River Basin and Rappahannock County. The study, "People, land and water of the Upper Thornton River Watershed," is available at www.rappflow.org.



Map 1: Upper Thornton River Watershed in Context



Map 2: Subwatershed ratings in Upper Thornton River Watershed.

We divided the Upper Thornton River watershed (known as "E05" in the Virginia state system for identifying hydrological units) into 13 small subwatersheds for purposes of the study. Small (less than ten square miles) subwatersheds are a good size unit for study because the people who live and own land there are familiar with the area and can help in gathering information, expressing their concerns, and protecting their watershed. In conducting the study, we followed and adapted methods used by the Center for Watershed Protection (CWP), a professional organization specializing in watershed protection. (For more information on CWP, please see http://www.cwp.org .)

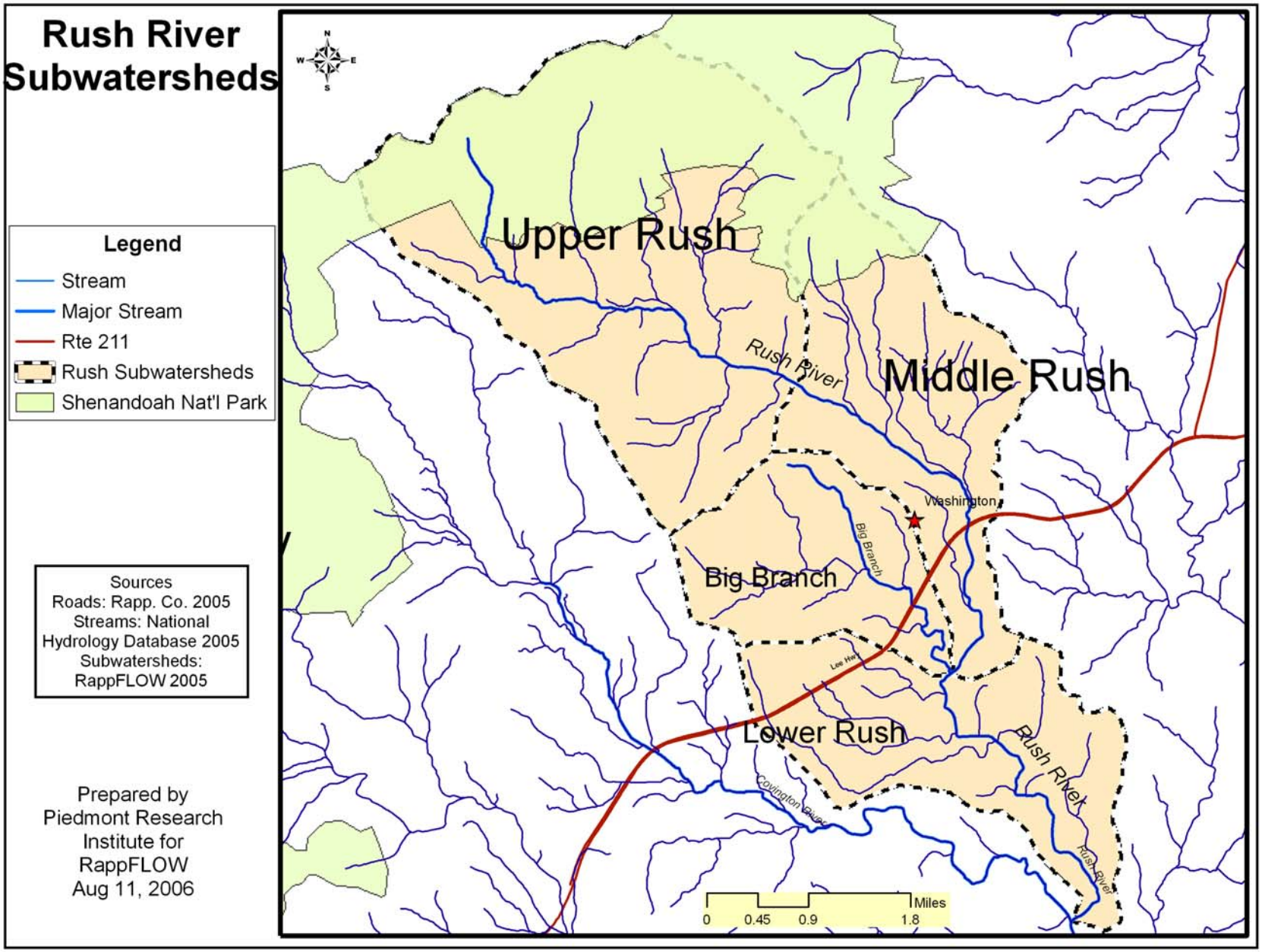
Why we chose the Lower Rush subwatershed for this assessment.

When we assessed all thirteen subwatersheds in the Upper Thornton River watershed, the Lower Rush was determined to be one of the least well protected from future development and water quality impairments. (See Map 2: Subwatershed Ratings.) For this reason, we chose the Lower Rush for more detailed analysis. Other factors that contributed to the choice of the Lower Rush for this analysis include the following:

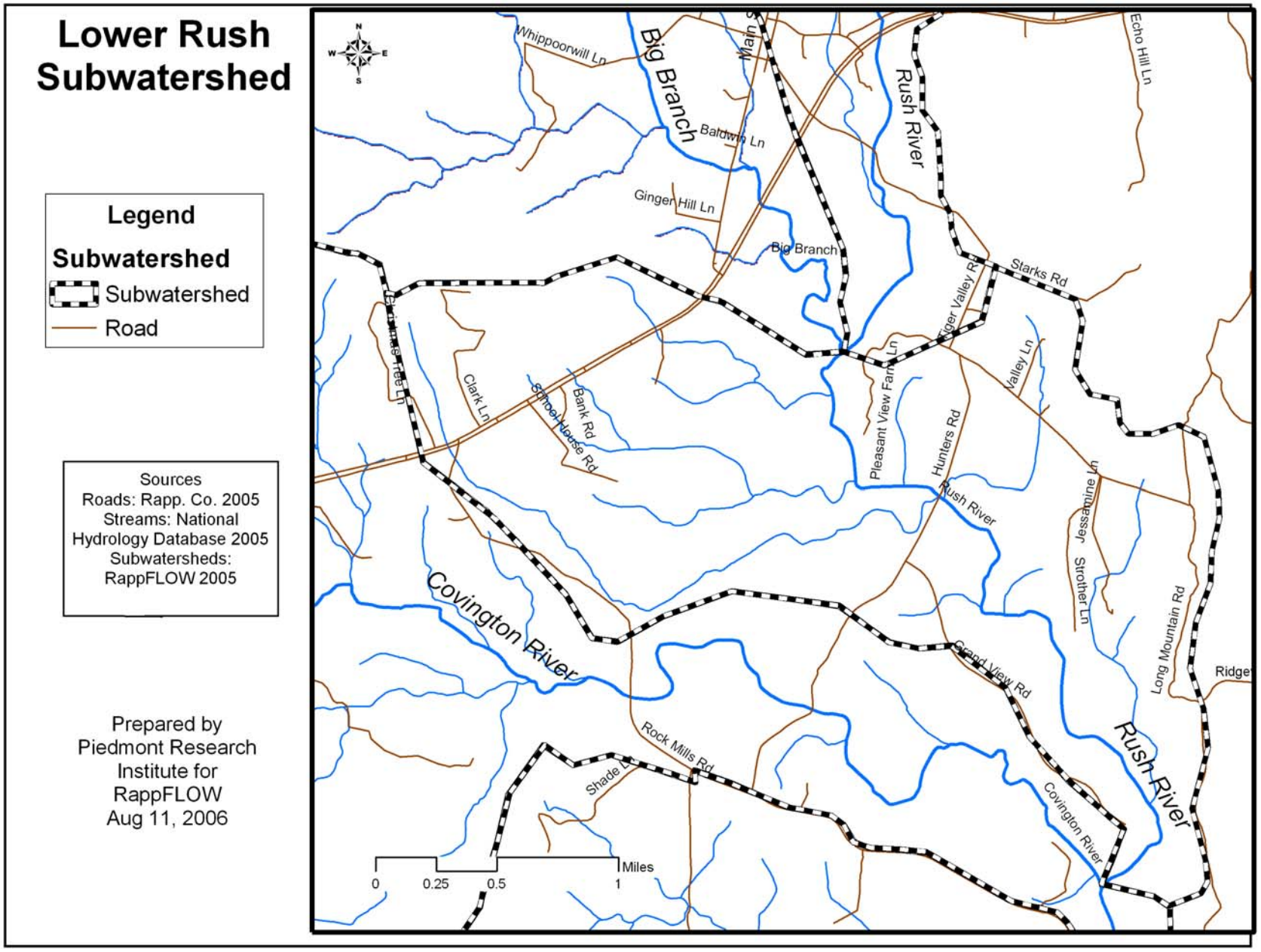
- The segment of the Rush River that flows into the Lower Rush subwatershed has been identified by the Virginia Department of Environmental Quality (DEQ) as "303d Impaired" for ecoli bacteria.
- The Town of Washington has obtained a permit from VA DEQ to discharge the effluent from a public sewage treatment plant into the Rush River immediately upstream of the Lower Rush subwatershed.
- Landowners and residents in the Lower Rush subwatershed have indicated strong interest in the quality of the water in the Rush River and in the health of their watershed, as evidenced through their participation in public meetings on the subject, their participation in RappFLOW's Upper Thornton Watershed survey of landowner concerns and values, and their volunteer work to assist in this study.
- The Lower Rush subwatershed includes a mix of agricultural, residential, and commercial land uses that are representative of the land uses in Rappahannock County. By analyzing the Lower Rush subwatershed, we may identify factors and watershed management tools that will be useful to apply more broadly throughout the county and in similar rural Virginia watersheds.

Rush River and Tributary Streams

The Rush River has its headwaters in the Shenandoah National Park and flows about 12.5 miles through the Upper, Middle, and Lower Rush subwatersheds before its confluence with the Thornton River near Rock Mills. Big Branch tributary joins the Rush at the northern edge of the Lower Rush subwatershed. See Map 3: Rush River subwatersheds.



Map 3: Rush River Subwatersheds



Map 4: Lower Rush Subwatershed with streams and roads

3) Describing the Lower Rush Subwatershed

The Lower Rush subwatershed is an area of 2,855 acres or 4.46 square miles, just south of the town of Washington. Map 4: Lower Rush Subwatershed shows the Lower Rush with its surrounding subwatersheds, roads, and streams.

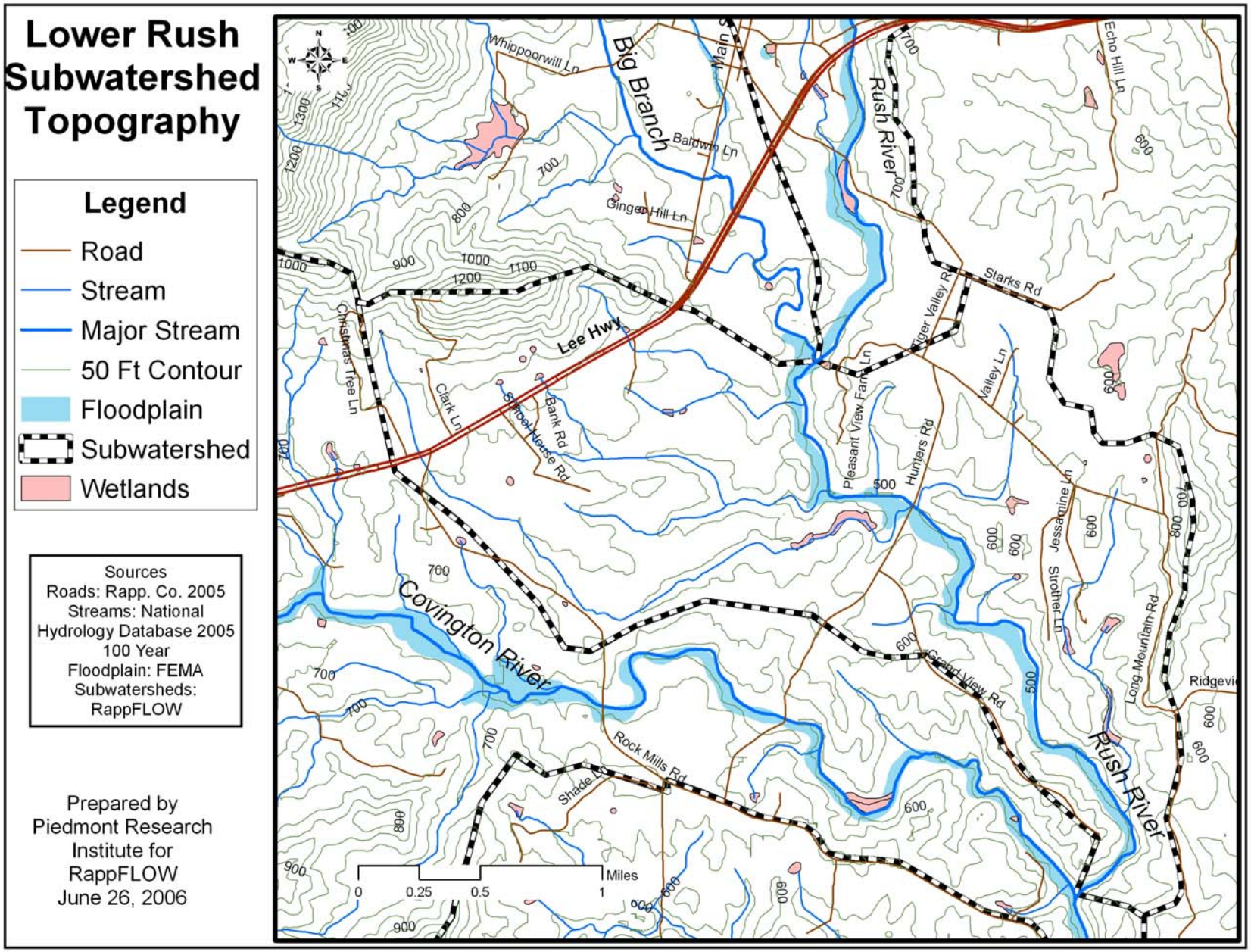
3.1 Topography, soils and water

Map 5 shows the topography of the subwatershed. Most of the area is fairly flat, between 500 and 600 feet in elevation. On the northwestern edge is (name) mountain, at elevation 1200 feet, and on the eastern edge is Long Mountain at 900 feet.
Soils. We would like to characterize the soils in this subwatershed, and seek individuals with the needed expertise to assist in doing this. Georeferenced shapefiles for Rappahannock County soils are not available.

Streams, ponds, wetlands and floodplains. There are a little over 15 miles of streams and about nine acres of ponds in the Lower Rush subwatershed, as calculated from the National Hydrology Database. One small, unnamed tributary to the Rush River flows from the eastern side of the town of Washington. Another small, unnamed stream flows from the western side of the town into Big Branch, which in turn is a tributary to the Rush. On the basis of the National Wetlands Inventory we calculated there are only about 22 acres of wetlands in this subwatershed. One-hundred-year floodplains as defined by FEMA are also shown in map 5.

Water flow in the Rush River. The amount of water flowing in the Rush River varies greatly. From 1954 to 1977, the US Geological Survey had a water flow monitoring station on the Rush River just outside the town of Washington. The meter recorded the cubic feet of water flow per second (cfps), and the average flow was recorded on a daily basis. For that thirteen-year period, the average daily flow varied from a low of zero (0) cfps on many occasions, to a high of 1140 mean daily cfps on August 18, 1955. The highest flow rate recorded was 2880 cfps on October 9, 1976. The lowest annual mean was 7.70 cfps in 1966 and the highest annual mean was 30 in 1972.

Groundwater. All residents in the Lower Rush subwatershed obtain their drinking water from wells. Our survey of landowner values and concerns (see section 4 below) offers 12 water issues and respondents were asked to choose THREE of the most concern to them. Out of these, 88% of respondents in the Lower Rush subwatershed chose “quality of well water” and 44% cited “adequate supply of good drinking water” as one of their biggest concerns. We are seeking information on this subject from landowners, residents, and other knowledgeable persons.



Map 5: Topography and floodplains in Lower Rush subwatershed

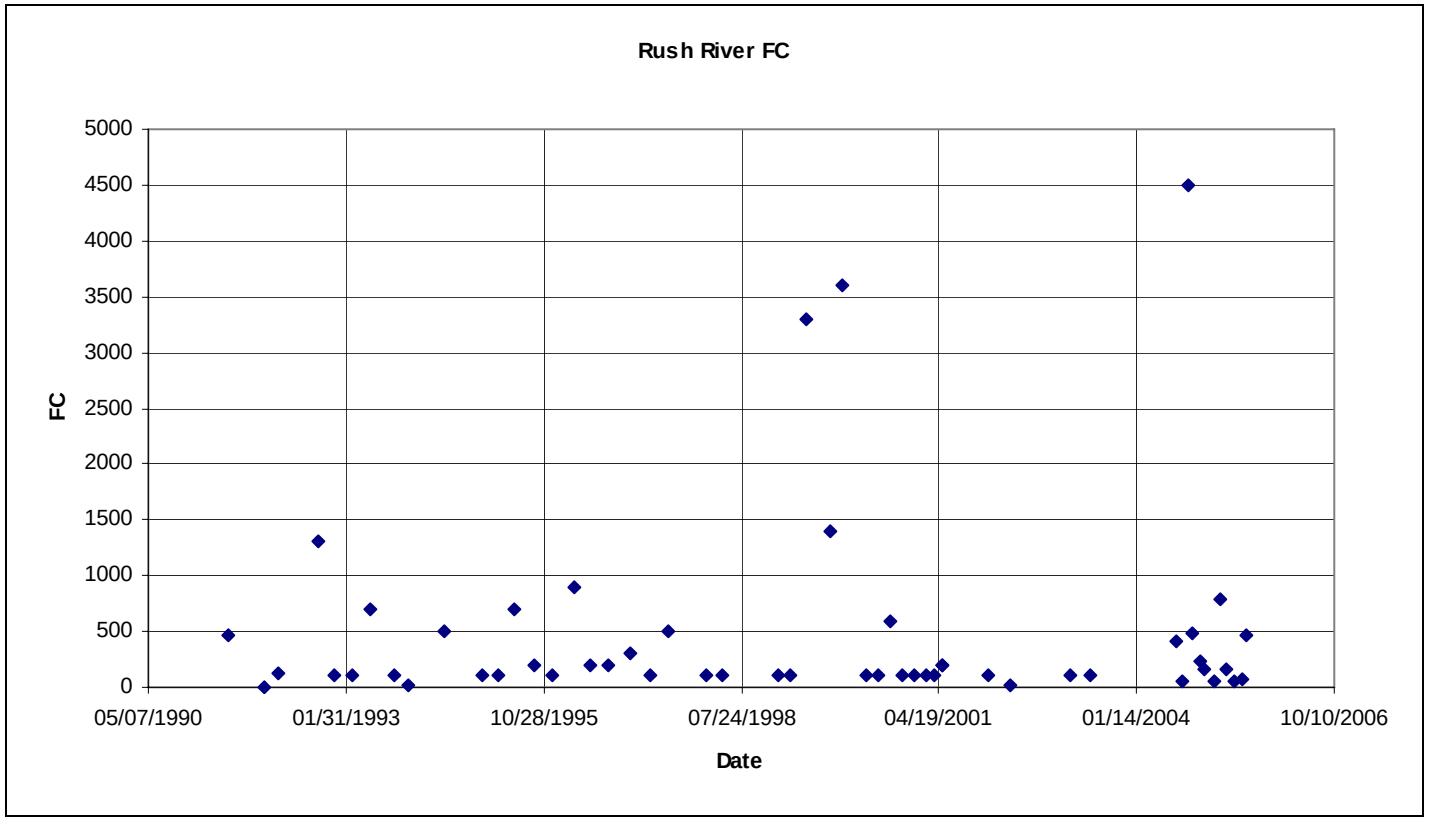
3.2 Water Quality

Water quality data for the Rush River and its tributary streams are available from four main sources:

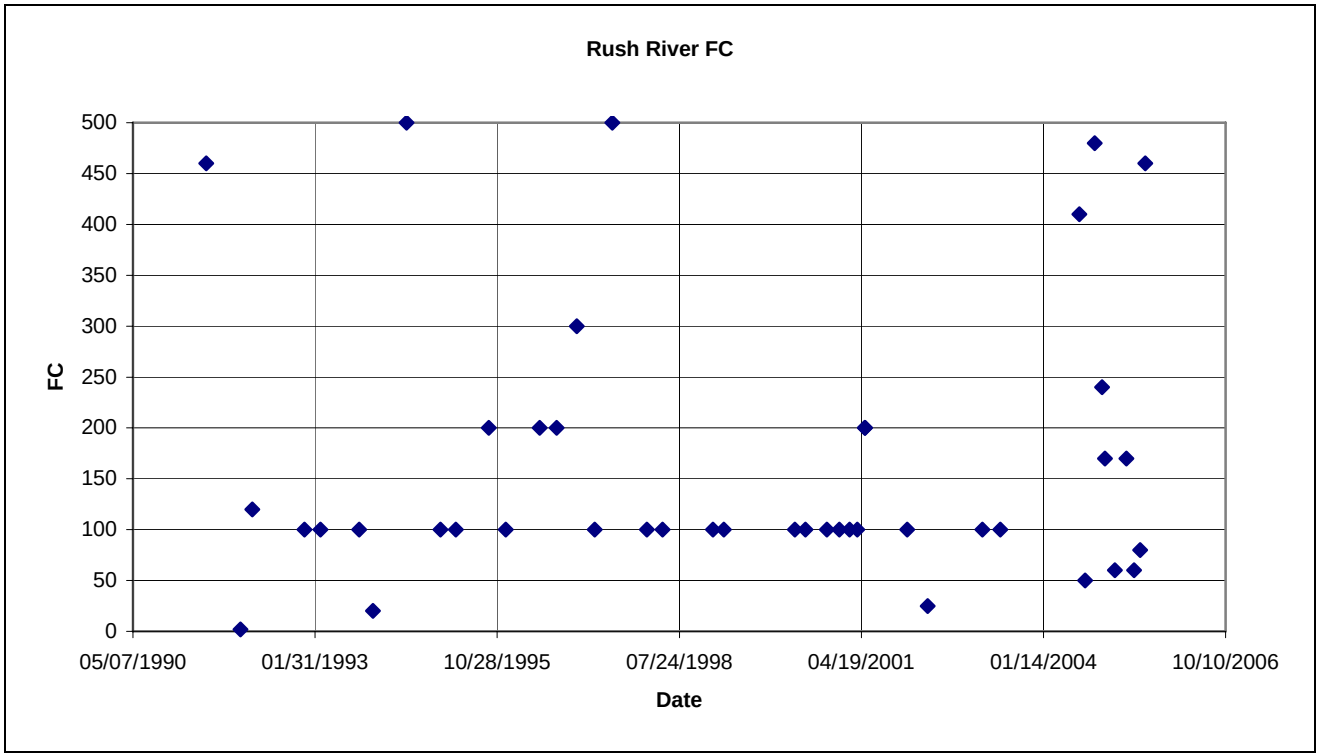
1. historical water quality data from the VA DEQ ambient monitoring station near the town of Washington;
2. information about the sources of e coli bacteria, collected by VA DEQ in conjunction with the Washington application for sewage effluent discharge;
3. Virginia Save Our Streams (SOS) invertebrate monitoring station at that same location;
4. data collected by RappFLOW volunteers in the spring of 2006 at 13 locations along the Rush River and tributaries.

DEQ Monitoring Data. In 2004, the VA DEQ designated a segment of the Rush River as "303d impaired" for fecal coliform bacteria. Sufficient exceedances of the instantaneous fecal coliform bacteria criterion (4 of 17 samples - 23.5%) were recorded at DEQ's ambient water quality monitoring station 3-RUS005.66 at Route 211/522 to assess this stream segment as not supporting of the Recreation Use goal for the 2004 water quality assessment.

Graph 1 shows the historical data from the DEQ monitoring station from 1990 to 2006 for fecal coliform, with the extremely high values shown. Graph 2 shows more detail for the values below 500 colonies/100 ml.



Graph 1: Fecal coliform values from DEQ station on Rush River at Old Mill.



Graph 2: Fecal coliform data from DEQ monitoring station showing values up to 500 colonies per milliliter.

Fecal coliform and E. coli are two types of bacterial standards for water quality. Both are found in animals, including humans. Virginia recently changed its standard measure of water quality from fecal coliform to E. coli.

Sources of E. coli. "Bacterial source tracking" is a method used to identify the percentage of wildlife, human, livestock, and pet sources of E. coli within a water sample. MapTech, a contractor to the VA DEQ, studied monthly water samples from the DEQ monitoring station on the Rush River outside the town of Washington between July 2004 and July 2005. In general, on those occasions when the E. coli levels exceeded the state water quality standards (September 2004 and March 2005), the predominant source was livestock. In other cases the predominant sources were wildlife, livestock, and pets. In none of the cases was the majority source attributed to humans. (Source: MapTech. "Bacterial source tracking analyses to support Virginia's TMDL's". 2005.)

Table 5.68 Bacterial Source Tracking for Rush River at Station 3RUS005.66.

VADEQ ID	Date of Sample	Lab ID	HUP ID	Number of Isolates	*E. coli* (cfu/100 ml)	Wildlife	Human	Livestock	Pet
3RUS005.66	7/28/2004	D3578	E05	24	400	8%	4%	**21%**	**67%**
3RUS005.66	8/30/2004	D3675	E05	9	70	0%	0%	**33%**	**67%**
3RUS005.66	9/28/2004	D3789	E05	24	6,000	**17%**	**12%**	**63%**	8%
3RUS005.66	10/21/2004	D3832	E05	24	142	0%	**17%**	**71%**	**12%**
3RUS005.66	11/30/2004	D3956	E05	24	164	**50%**	**29%**	**21%**	0%
3RUS005.66	12/16/2004	D4012	E05	24	90	8%	**46%**	8%	**38%**
3RUS005.66	2/8/2005	D4136	E05	18	32	**33%**	**33%**	**17%**	**17%**
3RUS005.66	3/8/2005	D4200	E05	24	790	**17%**	4%	**62%**	**17%**
3RUS005.66	4/13/2005	D4289	E05	24	171	**54%**	**17%**	4%	**25%**
3RUS005.66	5/25/2005	D4427	E05	24	90	**46%**	8%	**21%**	**25%**
3RUS005.66	6/28/2005	D4495	E05	24	122	**75%**	0%	**21%**	4%
3RUS005.66	7/26/2005	D4599	E05	24	150	**29%**	4%	**21%**	**46%**

BOLD type indicates a statistically significant value.
*NVI - No Viable isolates

Macroinvertebrate data. Volunteers trained by the Virginia Save Our Streams (VA SOS) program monitor macroinvertebrates in streams. The result is summarized by an index, in which a score of 0 – 6 is considered "unacceptable" and a score of 7 – 12 is "acceptable" water condition. The higher the score, the healthier the stream.

Macroinvertebrates are animals that have no backbone and are visible without magnification. Stream-bottom macroinvertebrates include such animals as crayfish, mussels, aquatic snails, aquatic worms, and the larvae of aquatic insects. Stream-bottom macroinvertebrates are a link in the aquatic food chain. In most streams, the energy stored by plants is available to animal life either in the form of leaves that fall in the water or in the form of algae that grows on the stream bottom. The algae and leaves are eaten by macroinvertebrates. The macroinvertebrates are a source of energy for larger animals such as fish, which in turn, are a source of energy for birds, raccoons, watersnakes, and even fishermen.

Stream-bottom macroinvertebrates differ in their sensitivity to water pollution. Some stream-bottom macroinvertebrates cannot survive in polluted water. Others can survive or even thrive in polluted water. In a healthy stream, the stream-bottom community will include a variety of pollution-sensitive macroinvertebrates. In an unhealthy stream, there may be only a few types of nonsensitve macroinvertebrates present.

Stream-bottom macroinvertebrates provide information about the quality of a stream over long periods of time. It may be difficult to identify stream pollution with water analysis, which can only provide information for the time of sampling. Even the presence of fish may not provide information about a pollution problem because fish can move away to avoid polluted water and then return when conditions improve. However, most stream-bottom macroinvertebrates cannot move to avoid pollution. A macroinvertebrate sample may thus provide information about pollution that is not present at the time of sample collection.

The macroinvertebrate monitoring station on the Rush River is near the Old Mill off Library Road. The table below shows the index for that site since 2001. Historically the index was in the "acceptable" range but in the spring of 2006 it was in the "unacceptable" range.

Date	Index
Spring 01	9
Summer 01	12
Fall 01	10
Winter 02	10
Spring 02	9
Summer 02	9
Fall 02	no data
Spring 03	9
Summer 03	7
Winter 06	10
Spring 06	5

RappFLOW water quality monitoring.

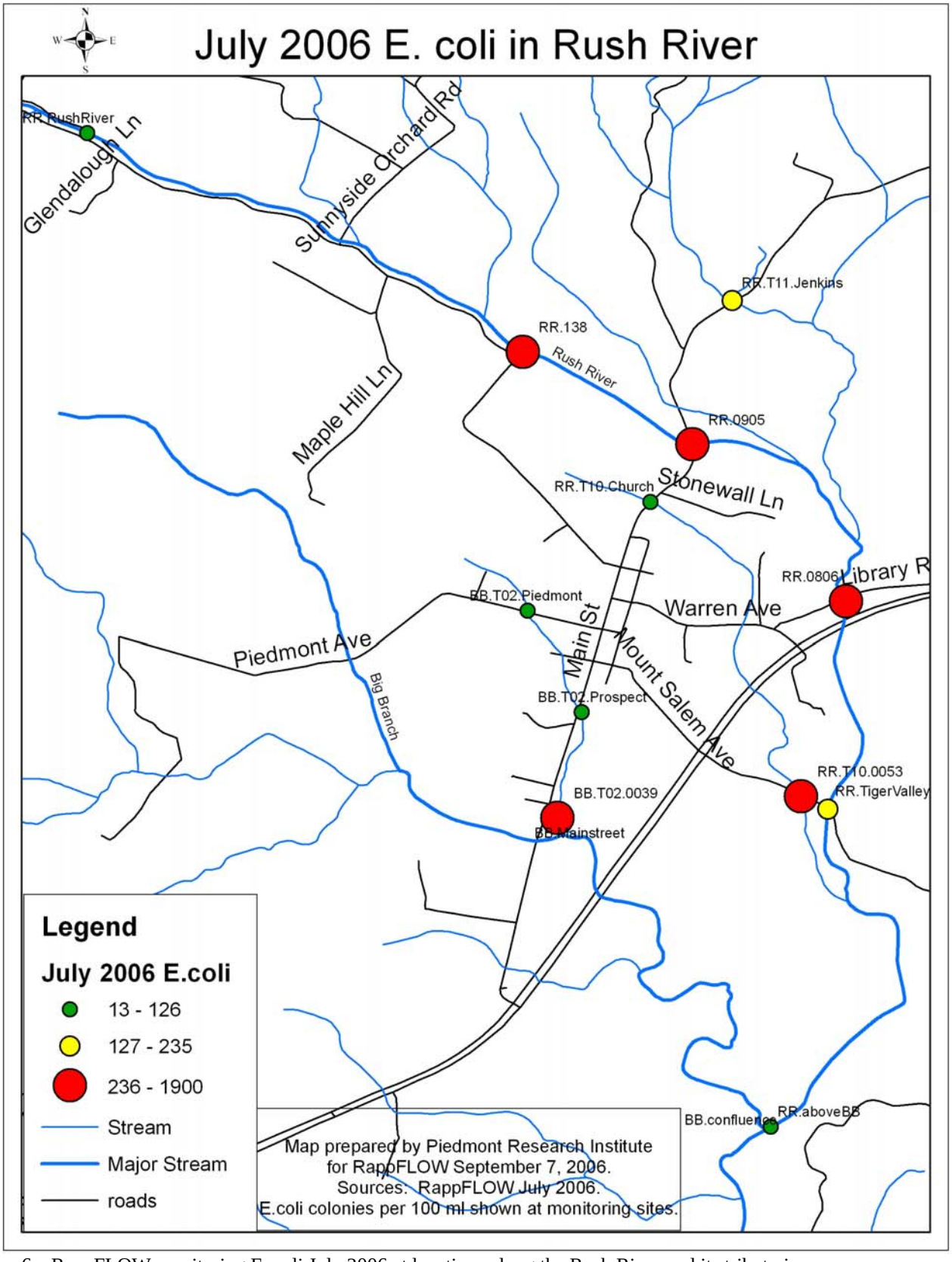
In the winter of 2006, many residents and landowners in the Rush River watershed were concerned about water quality in the Rush River. This concern was expressed in several meetings related to the town of Washington's plan to discharge sewage effluent into the Rush River. In response to these concerns, RappFLOW set up a program to monitor water quality at several locations along the main stem of the Rush River and its tributaries. James Beckley of the VA DEQ assisted by training RappFLOW leaders in the use of equipment and materials for monitoring Dissolved Oxygen, pH, temperature, and E. Coli bacteria, and in establishing Quality Assurance Procedures so that the data will be useful to the DEQ. Selection of locations for monitoring was based on several considerations, including the desire to identify potential sources of the bacterial impairment of the streams, to provide a baseline reading on Dissolved Oxygen at various locations before the sewage treatment plant is constructed, and accessibility of the sites by volunteer monitors.

Trained volunteers collected and summarized data in April, May, July, and August 2006, at sixteen locations along the Rush River and its tributaries. Readings for E. coli in July are shown on Map 6a: RappFLOW Monitoring E. coli. Note that E. coli exceeded standards at several locations. Readings for Dissolved Oxygen in August are shown in Map 6b: RappFLOW Monitoring Dissolved Oxygen.

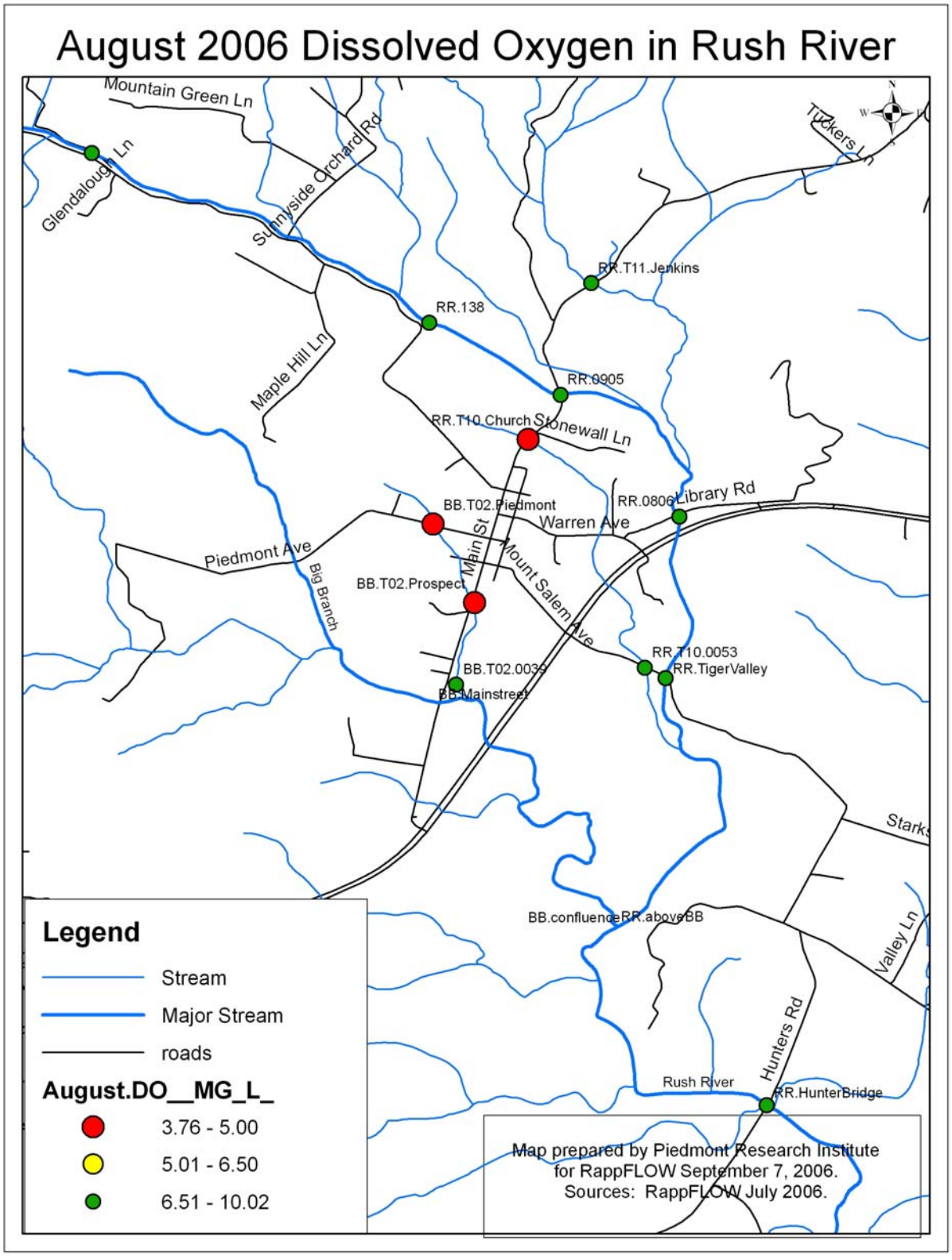
A spreadsheet showing all of the RappFLOW monitoring data is shown in Appendix 2.

Fish and Wildlife.

Residents and landowners are invited to contribute their knowledge on this subject to this study.



Map 6a: RappFLOW monitoring E. coli July 2006 at locations along the Rush River and its tributaries.



Map 6b: RappFLOW monitoring data. Dissolved Oxygen in August 2006.

3.3 How is the land used?

The ways in which the land is used, especially the extent to which forest protects the streams, is the main determinant of the health of the watershed.

Population. There are an estimated 120 dwellings in the subwatershed. At an average of 2.5 persons per dwelling (Census 2000), there are an estimated 300 residents. This is a population density of approximately 67 persons per square mile. The overall county population density in 2000 was 26.2 persons per square mile. (Source: Rappahannock Comprehensive Plan 2004).

Land Cover. Land cover in the subwatershed area can most easily be visualized through aerial photos. Map 7 shows the aerial photo taken in 2002.

By analyzing the National Land Cover Database, (USGS 2002), we calculated that the Lower Rush subwatershed is approximately 46 percent forest cover, about 48 percent hay/pasture, about 3 percent low intensity residential, and contains small percentages of transitional land cover, industrial, row crops, open water, or wetlands.

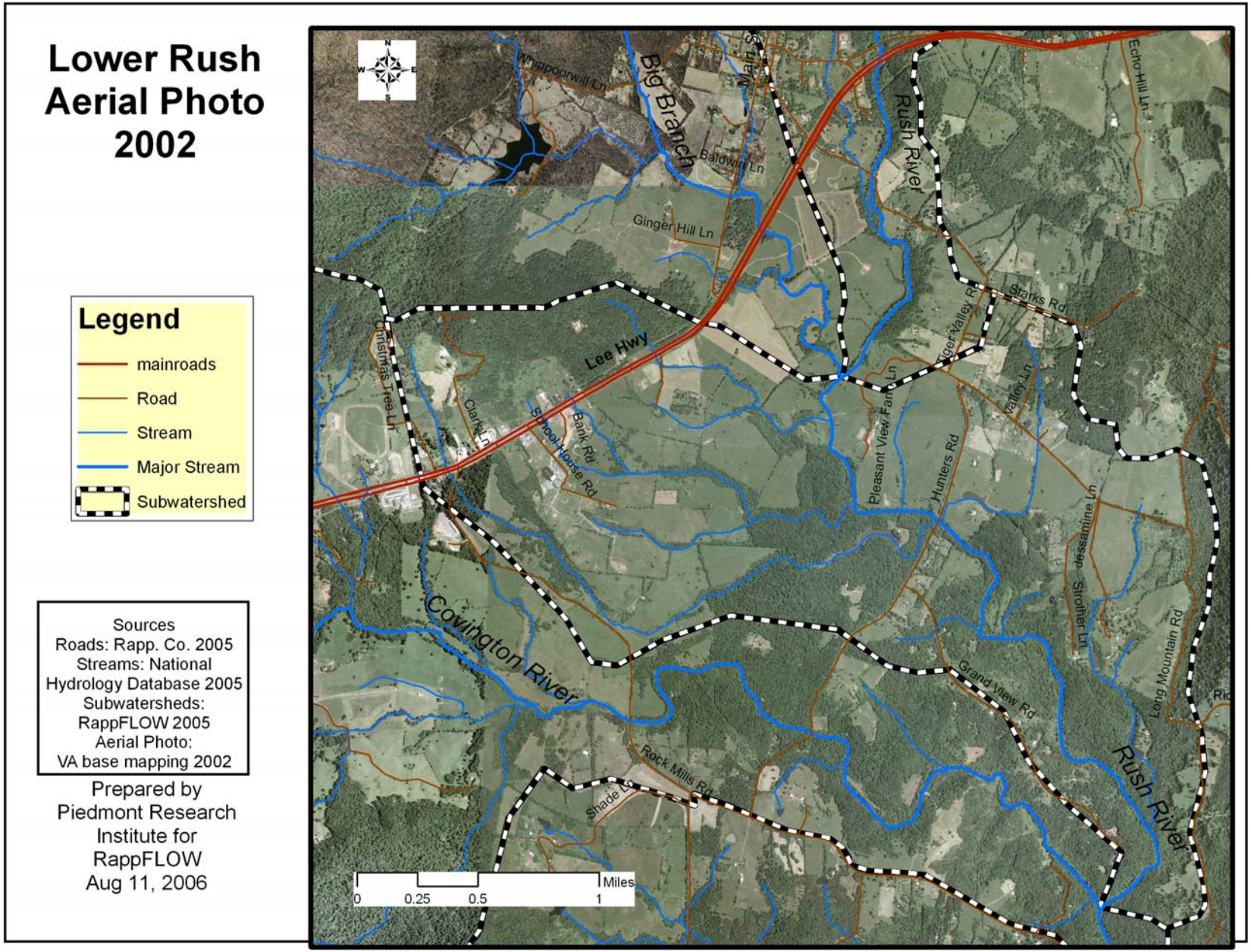
Vegetation along Streams. There are about 360 acres of area within 100 feet of the streams in the Lower Rush subwatershed. We used two methods to assess the vegetative cover of this buffer area.

Method 1: Aerial Photo. Using an aerial photo, we classified this stream buffer area as to whether it is fully vegetated (forest), partially vegetated, few or no trees, or a road crossing. This result is shown in Map 9: Stream Buffers. Using this method, the approximate percentages of stream buffer areas in the lower Rush are shown in Table 1:

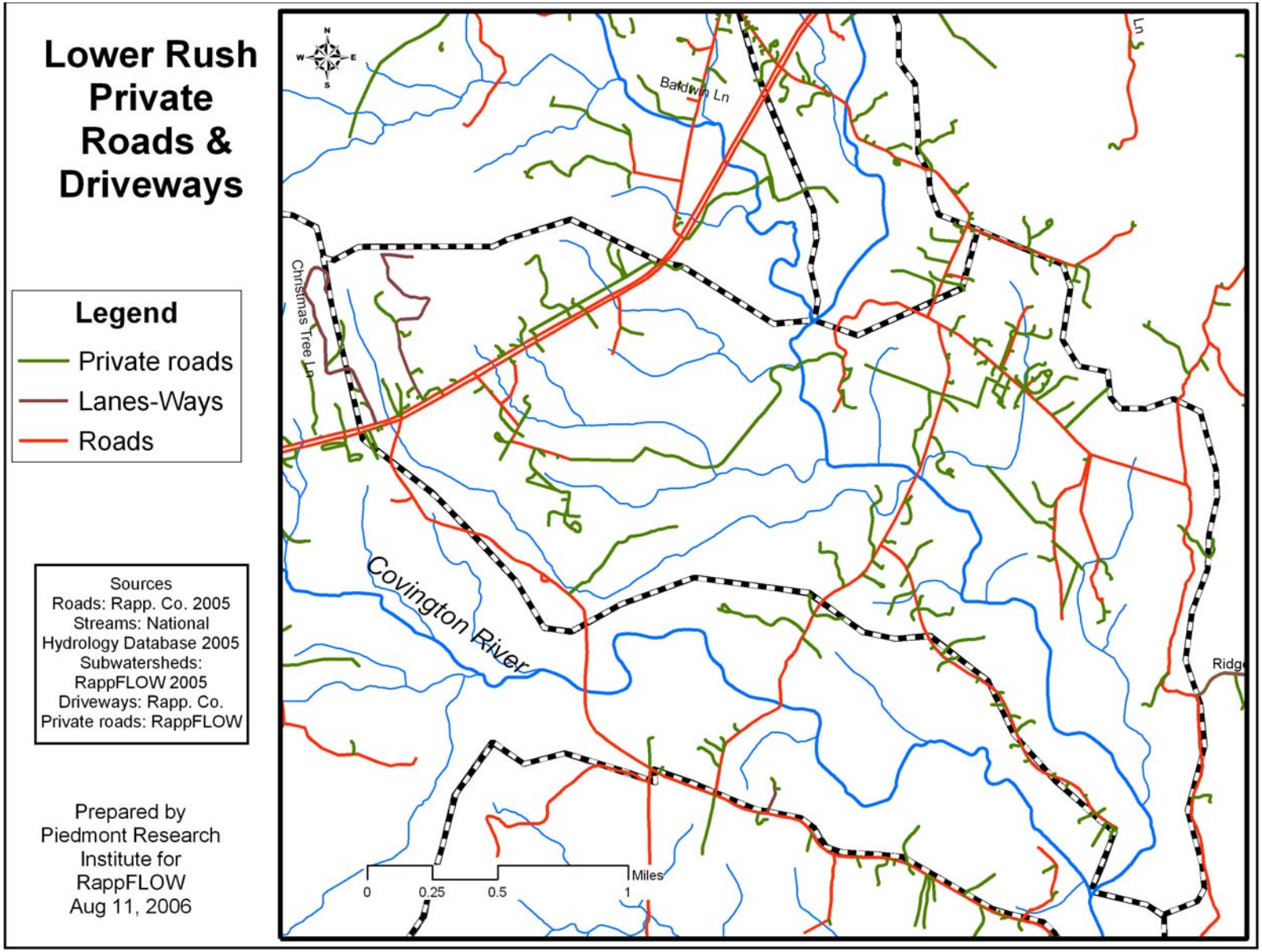
Buffer Vegetation	Buffer Area in Acres	Percent of total buffer area
Fully vegetated	165.7	46
Partially vegetated	96	26
Few or no trees	54	15
Road crossing	44	12

Table 1: Stream Buffer Vegetation in Lower Rush Subwatershed

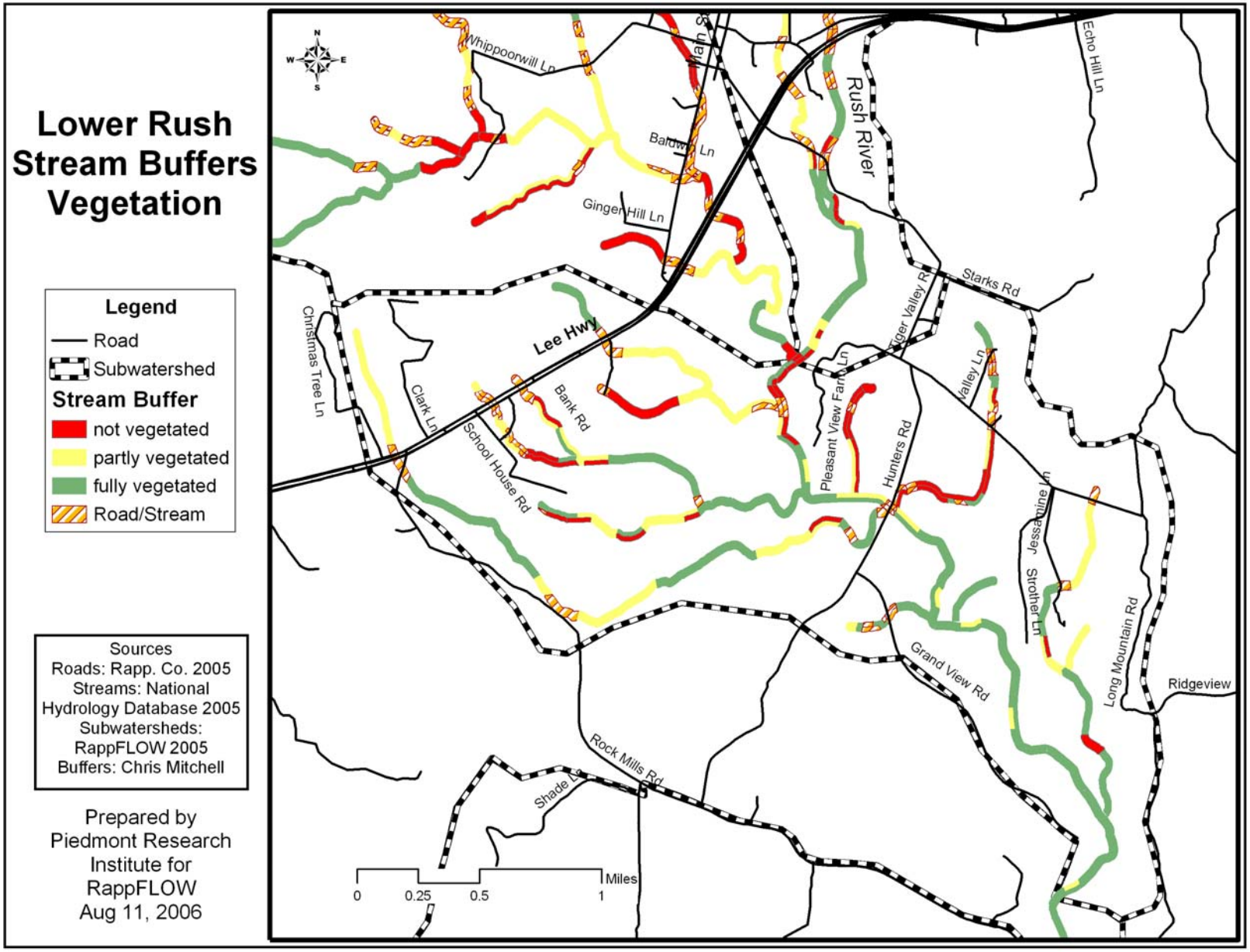
Method 2: NLCD. We extracted a 100-foot buffer area along the streams from the National Land Cover Database and calculated the percentage of that buffer area that was classified as forest by the NLCD. The result, 47.4 percent forested, correlates well with the results using the aerial photo method. The aerial photo method is more accurate and more current than the NLCD with respect to specific locations along the stream, but the overall percentage of forest cover is nearly the same using both methods.



Map 7: Aerial photo 2002



Map 8: Lower Rush Subwatershed Private Roads and Driveways



Map 9: Stream Buffers Vegetation

Roads, Private Roads and Driveways. In addition to public roads, there are about 34 miles of private roads, lanes, driveways and farm roads in the Lower Rush subwatershed. Map 8 shows these private roads.

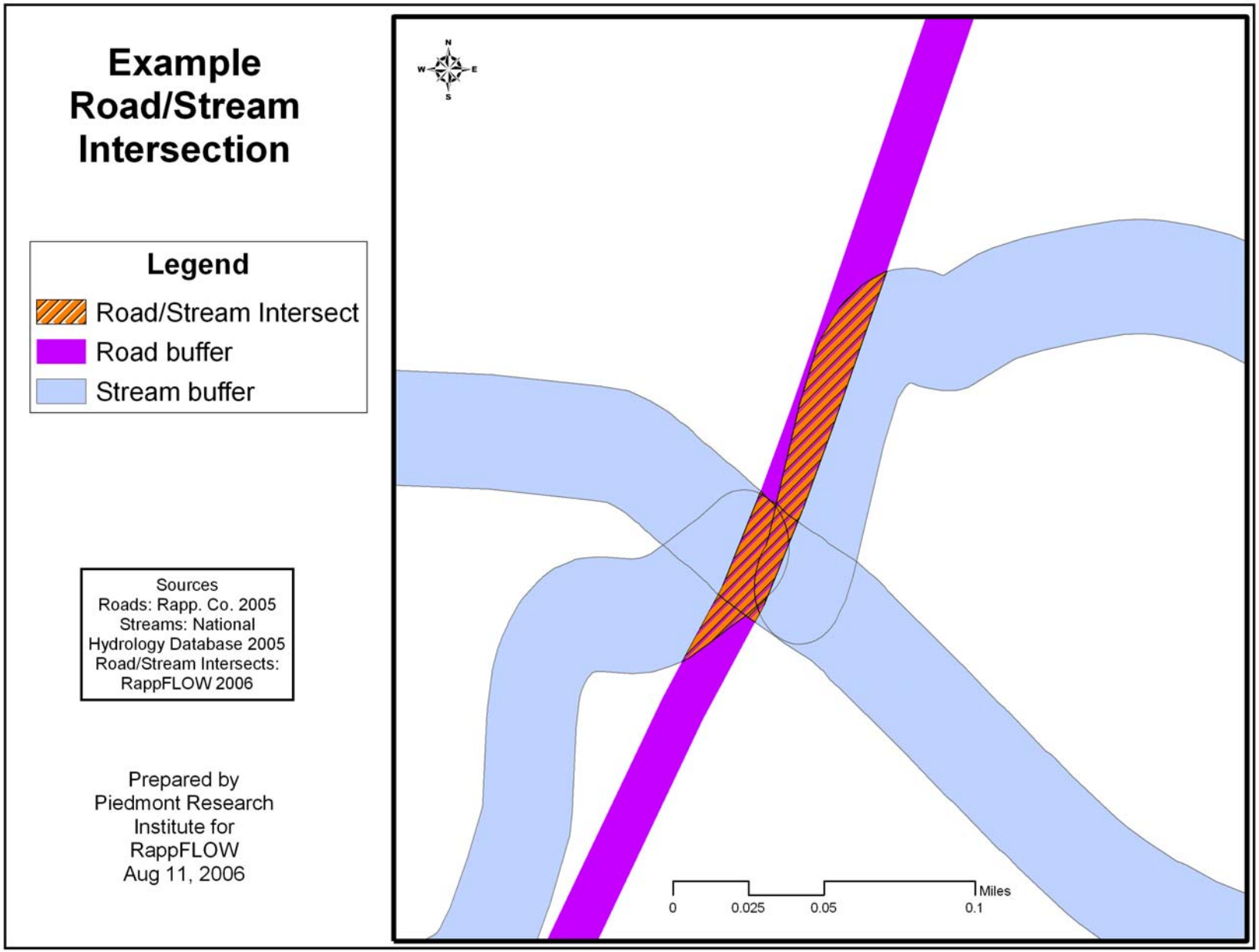
Road/Stream Intersections. When a road crosses a stream or is in the stream buffer area, it may compromise the stream in several ways. Pollutants from vehicles and road maintenance easily wash into the stream. The impervious surface of the road causes storm water to run quickly into the stream, increasing the erosion and sedimentation. Culverts channelize the water in the stream, making it flow faster during storms and thus causing damage to the stream banks. Roads break up the forest cover, reducing the passageway for wildlife.

For the entire Upper Thornton River Watershed, we identified areas where roads intersect with streams. The stream buffer area is 100 feet on both sides of the streams. The road buffer area is 40 feet for secondary roads and 100 feet for major highways. This is illustrated by example in Map 10. We then computed for each subwatershed the total acreage of road/stream intersections. This computation enabled us to compare the relative amount of road/stream intersection area across subwatersheds. Using this method, the Lower Rush contains 12.26 acres of road/stream intersection area.

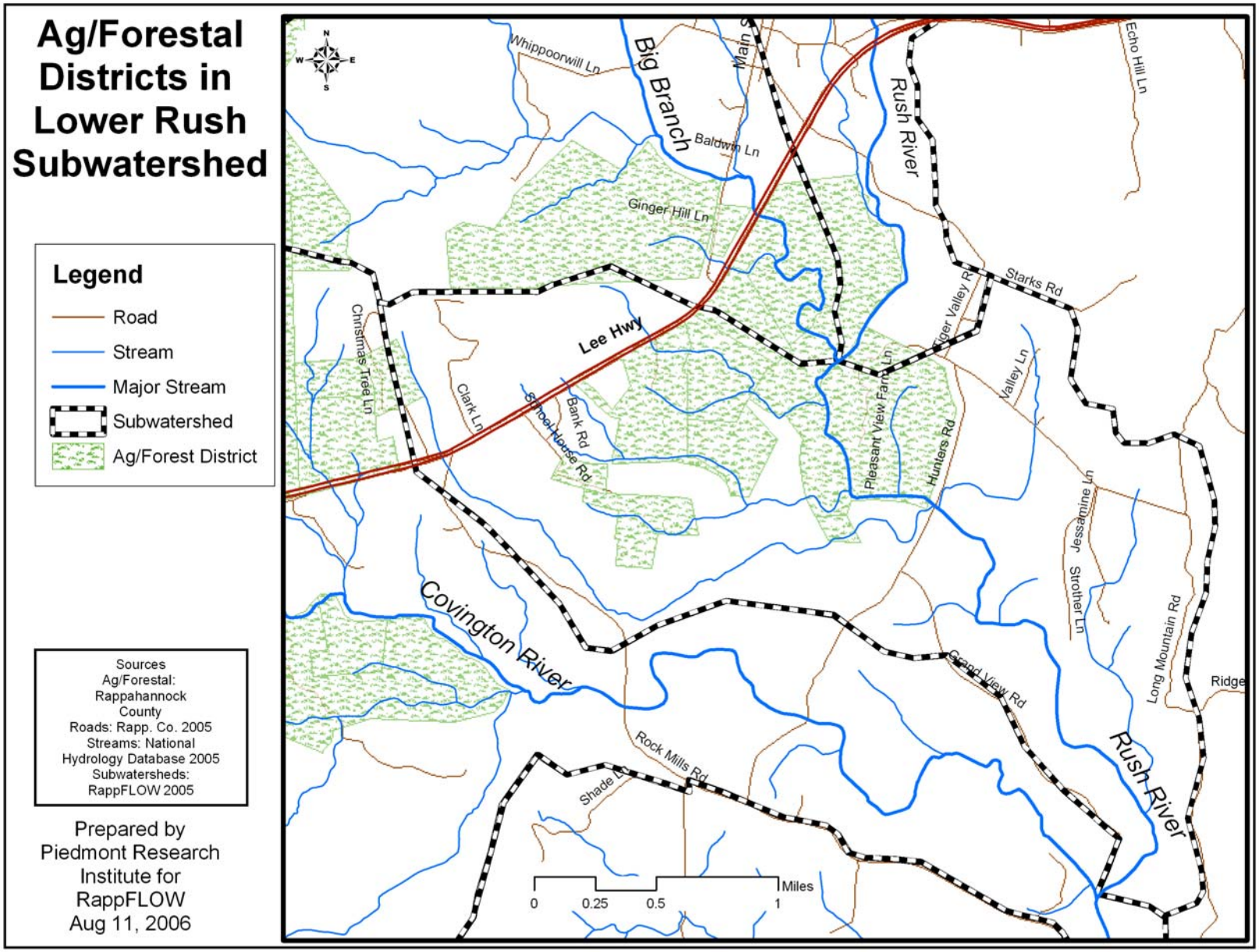
In this method, we used the Rappahannock County roads database to identify road buffer areas. The road/stream intersection area shown in Table 1 above is considerably greater (44 acres), because that analysis is based on the aerial photo which reveals farm roads and other private roads that are not included in the county roads map.

Stream Buffers and Land Use. In the Lower Rush subwatershed, most of the stream buffer areas that are unprotected by forest cover are found in areas of agricultural land use. In most cases where streams are flowing through non-agricultural residential land use, they are in forest. This is the case even on small residential parcels. On the small residential parcels where a stream is flowing through the property, compromises to the stream buffer area are typically resulting from roads and driveway crossings.

Parcel Size. There are approximately 210 parcels in the Lower Rush subwatershed. Twenty-one parcels are 50 acres or greater. The parcels that are 50 acres or more represent approximately 43% of the total Lower Rush subwatershed area.



Map 10: Example Road/Stream Intersects



Map 11: Agricultural/Forestal Districts in Lower Rush Subwatershed

Agricultural/Forestal Districts.

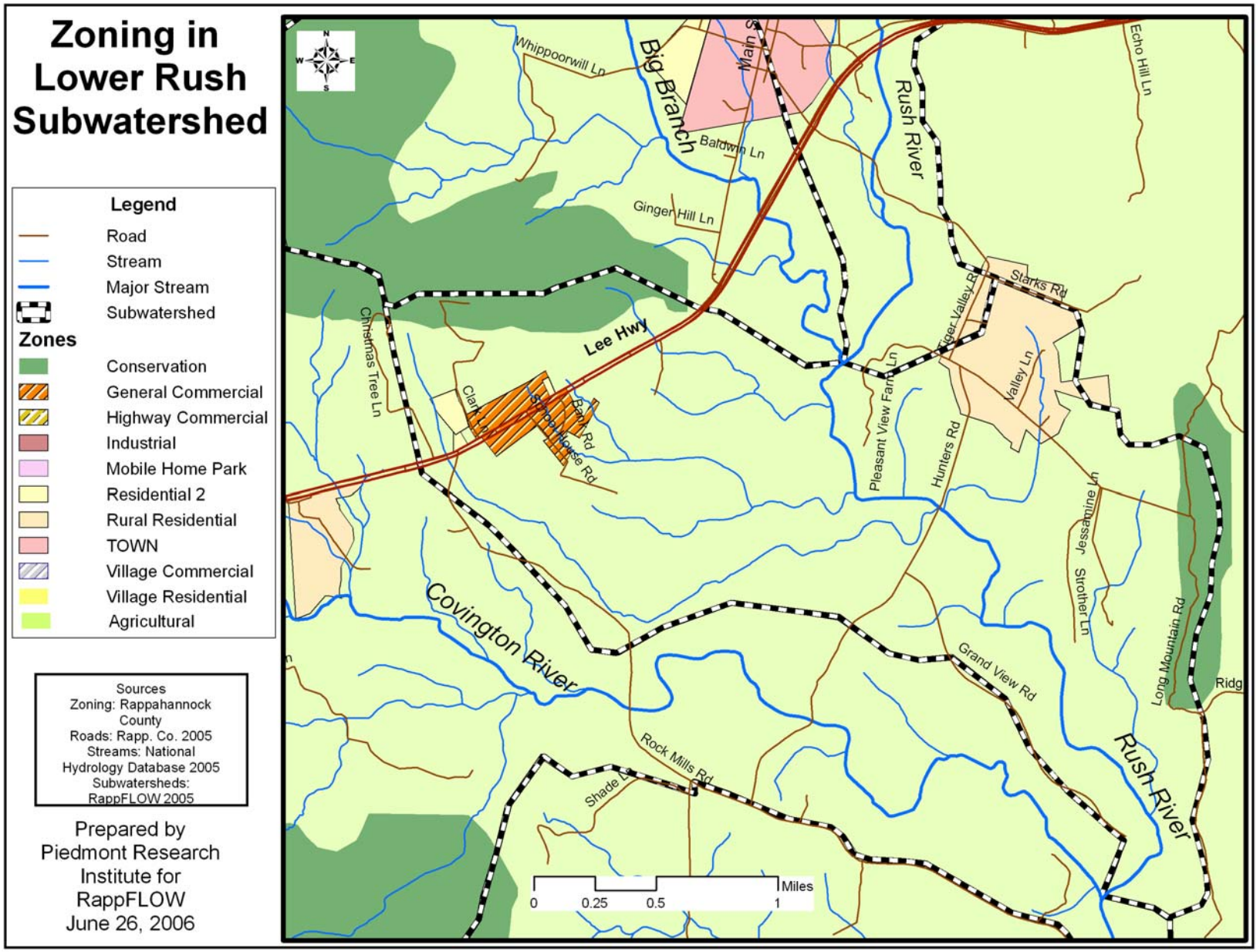
As shown in Map 11, a large section of land in the Lower Rush subwatershed is in Ag/Forestal District. These districts provide protection from land subdivision for a period of ten years and provide some protections for the land owners.

Zoning

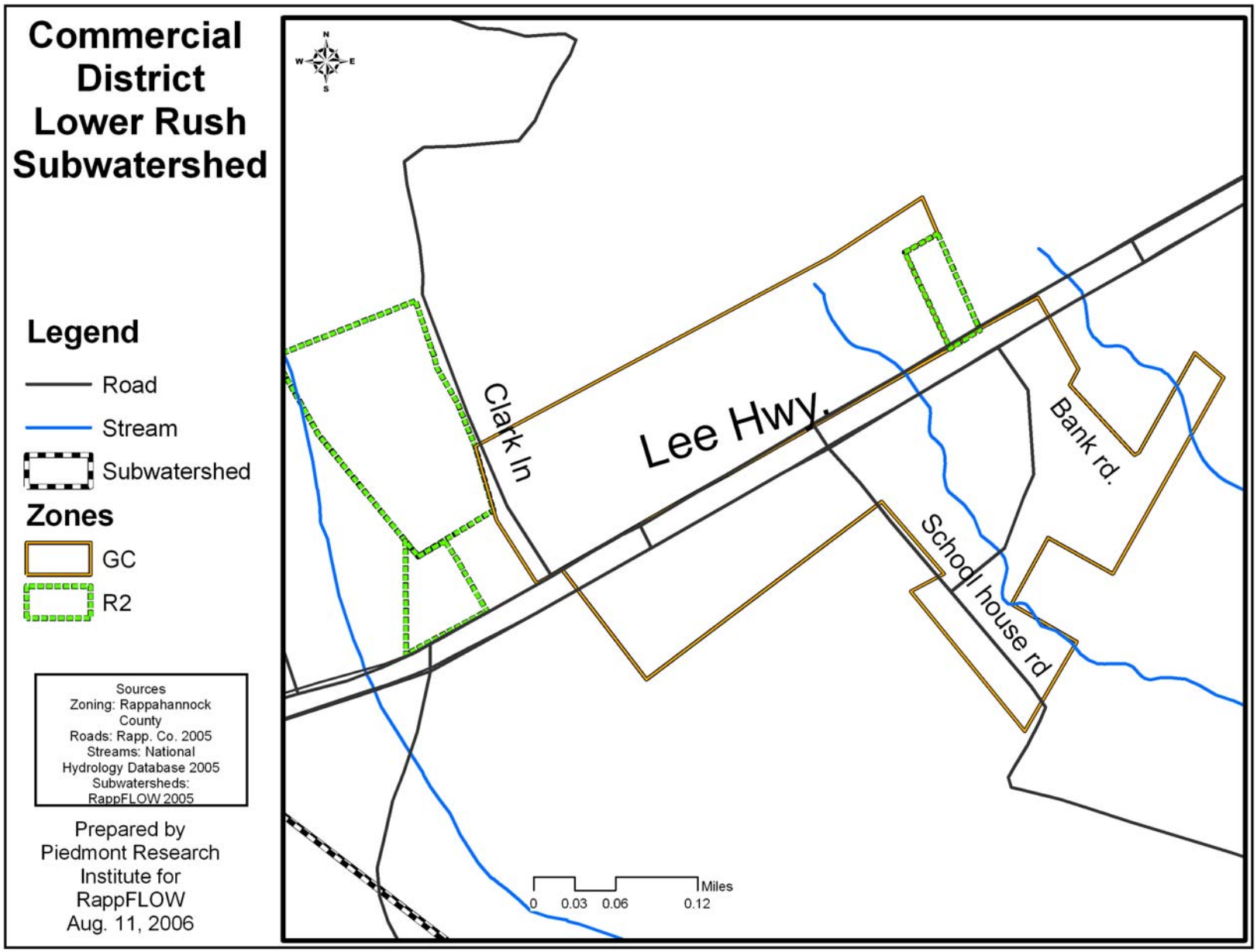
As shown in Map 12, the land area of the Lower Rush subwatershed is predominantly zoned Agricultural. In Agricultural zone, one dwelling is permitted per 25 acres. However, many smaller parcels predated the zoning ordinance and thus have higher density of dwellings.

The County's main General Commercial zone of 60 acres on Rte. 211 is in the northwestern part of the Lower Rush subwatershed. See map 13. There is also an area of a little less than 200 acres on the northeast part of the subwatershed that is zoned Rural Residential (5 acre parcels).

Corps of Engineers Study Site. A small area near the commercial zone is being studied by the U.S. Corps of Engineers. It encompasses the commercial zone and tributaries of the Rush, down to their confluence with the Rush River. A report from the contractor is expected sometime in 2007.



Map 12: Zoning



Map 13: Commercial District

4) Landowner Values and Concerns

On January 30, 2006, RappFLOW volunteers mailed 998 surveys to all known addresses of residents and landowners in the Upper Thornton River Watershed, identified by one of thirteen subwatersheds. The survey is shown in Appendix 3 to this report. Respondents were offered a free aerial photo of their property as an incentive to return the survey.

For the Lower Rush subwatershed, surveys were sent to 117 addresses and 33 persons responded, for a response rate of 27 percent. This high participation rate coincided with the active participation of Lower Rush landowners in other activities related to the watershed and water quality in early 2006. Landowners were concerned about the proposed permit to discharge sewage treatment plant effluent from the Town of Washington into the Rush River.

The purposes of this survey are as follows:

1. Learn from residents and landowners what are their interests and concerns about their local watersheds. RappFLOW is applying this information to its assessment of the 13 subwatersheds in the Upper Thornton Watershed.
2. Determine priorities for RappFLOW volunteer efforts based on the concerns and knowledge of a broad spectrum of citizens.
3. Provide information to county leaders about the concerns and priorities of a broad spectrum of citizens with regard to watershed protection and health.
4. Expose citizens to watershed and water quality concepts and issues, and identify needs for public education regarding these issues.
5. Encourage a broad range of citizens and community leaders to become more engaged in watershed management activities and practices.

Who Responded to the Survey? About a third of Lower Rush respondents to the survey have lived here either "all my life" or 20 years or more. About a third have lived here less than 10 years, and about a third have lived here between 10 and 20 years. They own parcel sizes from 5 to 400 acres. Nine respondents own parcels of 50 to 400 acres – representing over half of the larger landowners in this subwatershed. Nine respondents own parcels of less than 10 acres, and fourteen own parcels between 10 and 49 acres in size.

Land Uses. The most frequent land uses are for residence, family recreation, and gardens for personal use. Fourteen reported "wildlife conservation" and nine use their land for hunting. Eight respondents use their land for livestock or grazing; six raise animals for sale. In the streams, seven reported fishing, three boating, and four swimming. One respondent cited "logging for timber" as a land use.

Values. The survey offers 17 answers for what a person values the most in their watershed, and asks respondents to check the THREE most important to them. Views and scenery; privacy and lack of commercial traffic; and quality of life are the three answers most frequently chosen by respondents in the Lower Rush subwatershed. No respondents cited income from farm or forest as one of their three highest values, and only two cited market value of their property as a highest value. About a third of the respondents cited air

quality, water quality, wildlife or diversity of plants and animals as one of their highest values. Two cited health of livestock or crops as a highest value.

Water Issues. The survey offers 12 water issues and respondents were asked to choose THREE of the most concern to them. Out of these, 88% of respondents chose "quality of well water" and 44% cited "adequate supply of good drinking water" as one of their biggest concerns. "Bacterial contamination of stream water" was of high concern to 44% of Lower Rush respondents. Need to clean up Chesapeake Bay is a major issue for 31 percent of respondents from the Lower Rush subwatershed. Sufficient water for livestock is a major concern to three respondents, which is half of the respondents who raise animals for sale.

Watershed threats. The survey offers 19 threats to the watershed, and asks respondents to choose the THREE that concern them the most. In the Lower Rush subwatershed, the threat of most concern to the most people is "Public sewage treatment plant discharge to streams." In the Lower Rush, 48% of respondents cited this as a high priority threat, in comparison with that concern cited by 29% of overall Upper Thornton Watershed respondents to the survey. More than a third of Lower Rush respondents cited Population growth (34%) and Subdivision of land parcels (38%) as threats of highest concern. "Septic tanks and other private sewage disposal" was a high concern cited by 31% of Lower Rush respondents, whereas this threat was cited by only 20% of the overall Upper Thornton watershed respondents to the survey. "Lack of forested buffers along streams and ponds" was cited as a threat of high concern to only four respondents from the Lower Rush, and "Stream bank erosion" was cited by only one respondent.

Public Expenditures. "I support expenditures of public money on watershed protection and restoration." This statement was answered by 30 respondents from the Lower Rush. Of these, 93 percent answered "yes."

Community and local government efforts. The survey offers 18 possible individual and community efforts on watershed protection. Respondents checked all items they encourage. Nearly all respondents to the survey checked at least one of these items. The following table shows the percentage of respondents who encourage certain efforts that are now or might be supported by community groups or county government. Cluster development and stormwater management were selected by fewer than a third of the respondents.

TYPE of EFFORT	PERCENT of Lower Rush Respondents Encouraging
County subdivision ordinances to control development	68.75
Education for school children	62.5
Public education re water quality	62.5
County zoning to protect streams	53.125
Low impact development	46.875
Enforce Erosion & Sediment control ordinances	46.875

Purchase Development Rights	40.625
Cluster development	31.25
Stormwater management	25

Landowner Efforts. The following table shows the percentage of respondents who encourage efforts typically undertaken by landowners, sometimes with the assistance of volunteers, community organizations, or state government agencies. Sixty-five percent of respondents encourage conservation easements, which is consistent with the concerns about population growth and subdivision of land parcels.

TYPE of EFFORT	PERCENT of Lower Rush Respondents Encouraging
Conservation easements	65.625
Sustainable farming	53.125
Stream restoration	50
Protect, restore vegetative stream buffers	50
Volunteer stream monitoring	46.875
Help landowners implement BMPs	40.625
Ecologically friendly products	37.5
Sustainable forestry	31.25

5) Goals and Tools for Protecting and Improving the Lower Rush Subwatershed

Taking into consideration the current status and potential future development of this subwatershed, and the concerns of landowners, the following goals might be established by the community:

1) Reduce the potential for future land subdivision, residential development and population growth.
2) Increase the percentage of riparian buffer zone that is managed to provide protection for streams, water quality, and wildlife habitat.
3) Ensure that future residential and commercial development is done in a manner that protects the quality of surface water.

Goal 1: Reduce the potential for future land subdivision, residential development and population growth

As discussed in section 3 above, more than a third of Lower Rush survey respondents cited Population growth (34%) and Subdivision of land parcels (38%) as threats of highest concern. Views and scenery; privacy and lack of commercial traffic; and quality of life are the three highest values they cited for their watershed. Sixty-five percent of respondents said they encourage conservation easements. Under current zoning and subdivision restrictions, approximately 110 new developable parcels could be subdivided from existing parcels in agricultural and residential zones. In addition, there are about 90 existing parcels that do not have dwellings on them. In combination, the construction of dwellings on existing parcels plus newly subdivided parcels could yield about 200 new dwellings. At an average of 2.5 persons per dwelling, this would yield an additional 500 population beyond the current estimate of 300 residents, and a population density of about 180 persons per square mile.

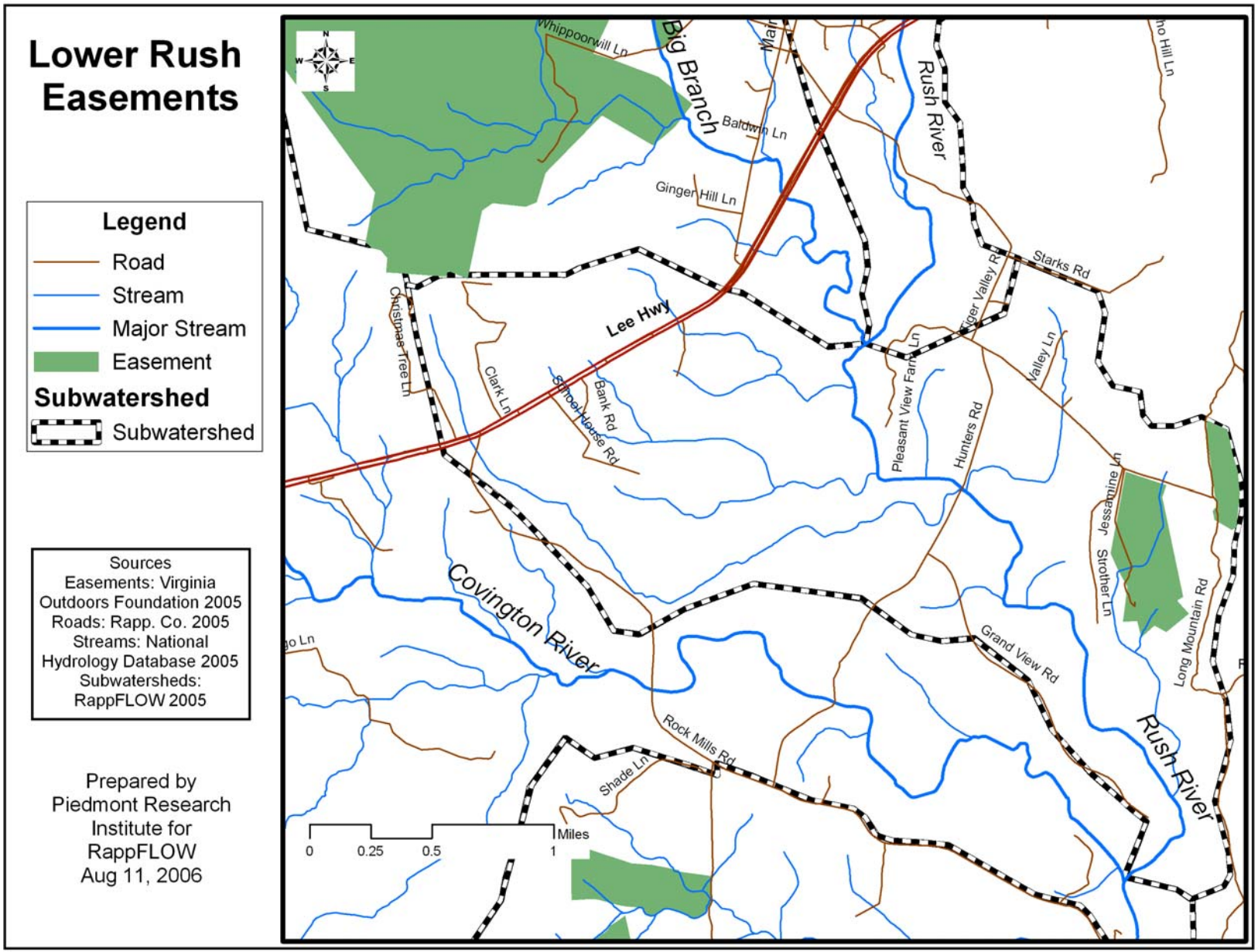
At present, there are on average about .16 miles of private road or driveway per developed parcel. Development of 200 parcels would add about 32 miles of private road to the present 34 miles. This would further fragment forests and compromise stream buffer areas, and contribute to sedimentation and erosion of streams.

Tools: Conservation Easements

Conservation easements through the Virginia Outdoors Foundation (VOF) or other land trusts represent a significant opportunity for landowners to protect a substantial part of the Lower Rush Subwatershed from further subdivision and development. Forty-three percent of the land area of the Lower Rush Subwatershed is still in parcels of 50 acres or more, which is the minimum size easement for VOF.

Less than four percent of the land area in the Lower Rush subwatershed is now protected by conservation easement. This area is shown in green in Map 14. In Rapppahannock County overall, easements represent 18 percent of privately owned land area.

(should we elaborate here on the benefits to the landowner of donating conservation easements?)



Map 14: Conservation Easements

Tools: Land Use Taxation

Rappahannock County does employ a land-use taxation rate, which is an essential tool to enable large landowners to continue farming rather than subdividing and selling their land. In land-use, land is taxed based upon its economic value for the agricultural use to which it is being put, rather than on the basis of market value. The land-use taxation applies only to the land being used for agriculture; the house and surrounding yard are taxed at full market value.

One suggestion that has been made is for the county to expand the land use taxation program to include some tax incentive for a land owner to maintain "open space." In this case, a landowner would be able to get some reduction in his tax rate based upon his maintaining the land in forest, even if he is not using the forest for commercial logging purposes and thus is not getting income from the forest.

Tools: Purchase of Development Rights (PDR)

In a PDR program, a certain value is placed upon a landowner's right to subdivide his property under existing zoning and subdivision ordinances. Those rights can be purchased by a government agency (or by some other organization such as a land trust.) This enables the landowner, such as a farmer with limited income, to obtain needed income (from the purchase of the rights), without having to subdivide and sell his property. The advantage of a PDR program to the citizens of the community is that they protect their locality from excessive population growth and hence from higher taxes in future. The program also benefits all residents of the community by keeping the land scenic and rural, as well as maintaining healthier ecosystems by avoiding development, thus contributing to the quality of life. Rappahannock County now has a limited PDR program in its Farmland Preservation Program, but that has very limited funding at present. One option for the taxpayers of the county is to encourage the county government to expand the PDR program through a small tax on property, earmarked for this purpose.

Goal 2: Increase the percentage of riparian buffer zone that is managed to provide protection for streams, water quality, and wildlife habitat.

As discussed in Section 3 of this report, about 46 percent of the 360 acres of riparian buffer area in the Lower Rush subwatershed is currently in forest cover.

Why riparian buffers are important.

A buffer is a strip of land that separates two different ecosystems. In the case of riparian buffers, the buffer separates the stream or pond from the farmland, backyard, developed area, or road surrounding it. The word riparian refers to the area adjacent to a body of water, in this case a stream or pond, which provides a transition between the aquatic and upland environments. This area many times is not clearly defined and can vary in size. A forested riparian buffer is a type of buffer along a stream or river that is made up of trees, shrubs, and other forest-like vegetation.[1]

The riparian area can be divided into three zones, as shown below in Figure 1

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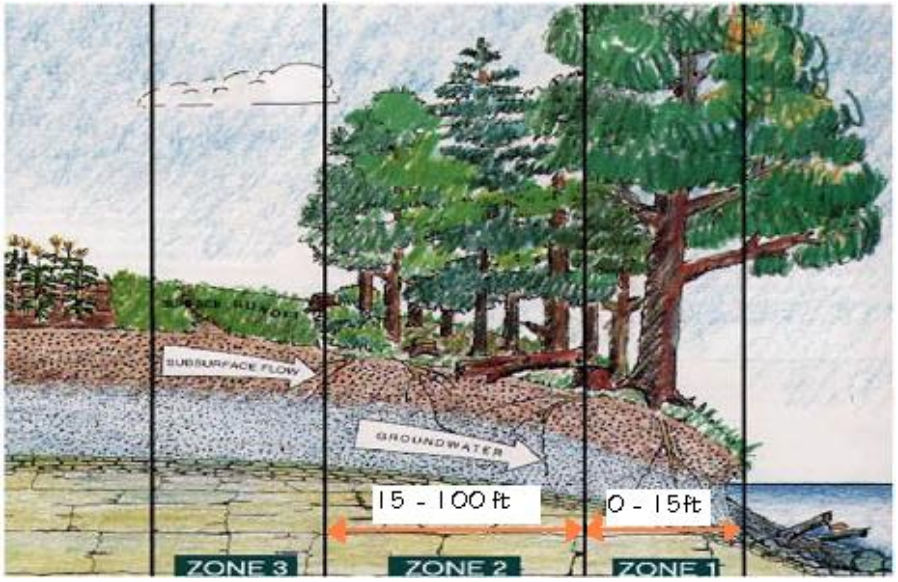

Figure 1: Riparian Buffer Zones[1]

Zone 1 occupies the first 15 feet from the stream bank and ideally should be made up of undisturbed mature forest. The primary purpose of this region of the buffer is to stabilize the stream bank and provide shade to the stream.

Zone 2 is the land from 15 to 100 feet from the bank, and is ideally a managed forest; meaning that the forest is being maintained to ensure that it is able to effectively filter the water. The primary purpose of this zone is to remove, transform, or store nutrients, sediments and other pollutants flowing over the surface and through the groundwater before they can reach the stream or aquifers.

Zone 3 is an optional zone used primarily for run off control in areas where a higher flow is expected. It typically consists of a grass filter strip that slows the run off and allows more the water to enter the ground.

Forested riparian buffers are designed to meet the following four main objectives:

1. They help prevent upland sources of pollution from reaching the stream by trapping, filtering, and converting sediments, nutrients, and chemicals.
2. They are able to supply food, cover, and thermal protection to fish and wildlife.

3. They serve as a means of preserving the integrity of the stream in terms of aquatic organisms, depth, flow, and width by slowing the water and stabilizing the bank.
4. They refresh ground water by slowing the water down and allowing it to penetrate the soil, watering plants and refilling aquifers which wells draw water from.

For these reasons forested buffers are considered the most beneficial type of riparian buffers.

Tools: Conservation Incentive Programs

The Culpeper Soil and Water Conservation District (CSWCD) administers several programs funded by the federal and state government to provide technical and financial assistance to land owners for soil and water conservation purposes.
As of early 2006, there were only 86 acres of stream buffers in the Lower Rush subwatershed protected through agricultural Best Management Practices (BMPs) implemented with support of the CREP program administered by the US Department of Agriculture. There were no acres of BMP's implemented through Virginia cost-sharing programs, except in conjunction with the CREP implementation.
In the summer of 2006, Robert Haskell, owner of Pleasant View Farm, began the implementation of BMP's funded through a combination of CREP and Virginia incentive programs. The farm is building 16,700 feet of fencing along the Rush River and its tributaries, and planting trees in 42 acres of riparian buffer area. This single project will increase the percentage of forested stream buffer by about 12 percent in this subwatershed.

Conservation Incentive Programs

The table below summarizes conservation incentive programs offered in the Culpeper SWCD.
For more information about any of these programs, call (540) 825-8591

Program	Cost Share Rate to Establish Practices	Agreement Period	Requirements	Annual Rental and Other Payments	Other Cost-Sharing	Where & When to Sign-Up
CRP Conservation Reserve Program	50%	10 years	history of cropland during at least 4 out of 6 years (1999 - 2006)	Soil Rental Rate, +$5 maintenance	None	When announced
CRP Continuous	50%	10 years	waterways and riparian areas plus cropland & pasture	Same as CRP + incentive payments	VA BMP Program	FSA Continuous Signup
CREP Conservation Reserve	50 %	10 - 15 years	livestock exclusion, riparian buffers	$75 - $100/acre	VA BMP Program	FSA Continuous Signup

Enhancement Program			minimum 35' – 100', only grazed pastureland or cropland			
WRP Wetlands Reserve Program	75 - 100%	Permanent Easement, 30-year Easement, 10-year Cost Share Agreement	livestock exclusion, must join two natural areas, must be a prior converted wetland	One time payment for up to 100% of appraised Ag value	None	NRCS Continuous Signup
EQIP Environmental Quality Incentives Program	Varies	2-10 years Must be part of a conservation plan	threat to soil, water, air, and related natural resources on land	None	VA BMP Cost Share Program	FSA or NRCS
WHIP Wildlife Incentive Program	75% of estimated costs	5 - 10 years	not restricted to agricultural land	None	Partners for Wildlife, VA BMP Program	NRCS Continuous Signup
RT Reforestation of Timberlands	$22/acre	10 years	Water quality BMP's must be installed. Pines only.100-acre maximum.	None	None	VA Department of Forestry
Partners for Fish and Wildlife	75% to 100%	10-year-minimum	wetland restoration, stream stabilization, riparian fencing, buffer establishment, alternate water sources, or waterfowl impoundments.	None	VA BMP, WRP, Partners for Wildlife	Culpeper SWCD
Virginia BMP Program	up to 75% plus incentive	5 - 10 years	existing water quality problems	None	None	Culpeper SWCD
Virginia BMP Loan Program	Low interest 3% loans – no maximum.	Up to 10 years	must be an eligible practice	None	None	Culpeper SWCD
BMP Tax Credit Program	25% of out-of-pocket expenses	5 - 10 years	existing water quality problem	None	BMP Program	Culpeper SWCD
Virginia Small Business Environmental Compliance Assistance Fund	Low-interest (3%) loan of up to $100,000	variable	Small business finance compliance with Federal Clean Air Act, voluntary pollution prevention, or Agricultural BMP's	None	None	DEQ Culpeper SWCD

Tools: Landowner education, assessments, and restoration of riparian buffers

In the summer of 2006, RappFLOW began building the foundation for a program to engage landowners in learning about riparian buffers and in evaluating the quality and effectiveness of buffers. This foundation includes research on the subject of riparian buffers, consultation with experts from the Department of Forestry and the CSWCD, draft handbook and buffer assessment forms, a draft step-

by-step strategy, and workshops conducted with landowners and other interested persons. Further development and implementation of this program will be a significant resource in support of the goal of increasing the riparian buffer quality in the Lower Rush and elsewhere. Documents related to this program are available on the RappFLOW web site www.rappflow.org.

Goal 3: Ensure that future residential and commercial development is done in a manner that protects the quality of surface water.

While goal 1 would reduce the amount of future development, some development will take place. Strong enforcement of existing county ordinances such as the zoning, subdivision, and erosion and sedimentation control ordinances, provides some protection for the watershed. Concerned citizens and landowners can help achieve the goal of protecting water resources by working with county leaders to encourage enforcement of existing ordinances and development of additional ordinances designed for this purpose.

Tools: Low Impact Development

Map 13 shows the commercial zone of about 60 acres on Rte 211 that was established by the county. Developers in the commercial area must submit site plans to the CSWCD for approval. Additional tools for ensuring high quality development will include a proposed stormwater ordinance and a master plan for the commercial district. The master plan would include onsite water quality treatment of storm water through landscape design principles advocated for "Low Impact Development (LID)."

Tools: Ordinances to Protect Riparian Buffer Zones

Some counties have ordinances that protect riparian buffer zones from future development. For example, a Stream Protection Overlay District (SP) is designed to apply special regulations to the riparian buffer area of a specified width on each side of or perennial streams and wetlands adjacent to those streams. The purpose of the buffer is to retard runoff, prevent erosion, filter nonpoint source pollution from runoff, moderate stream temperature, and provides for the ecological integrity of stream corridors and networks.

Appendices – separate volume

1. ***Study Participants and Partners***
2. ***RappFLOW Water Quality Monitoring Data***
3. ***Landowner Survey***
4. ***Resources***