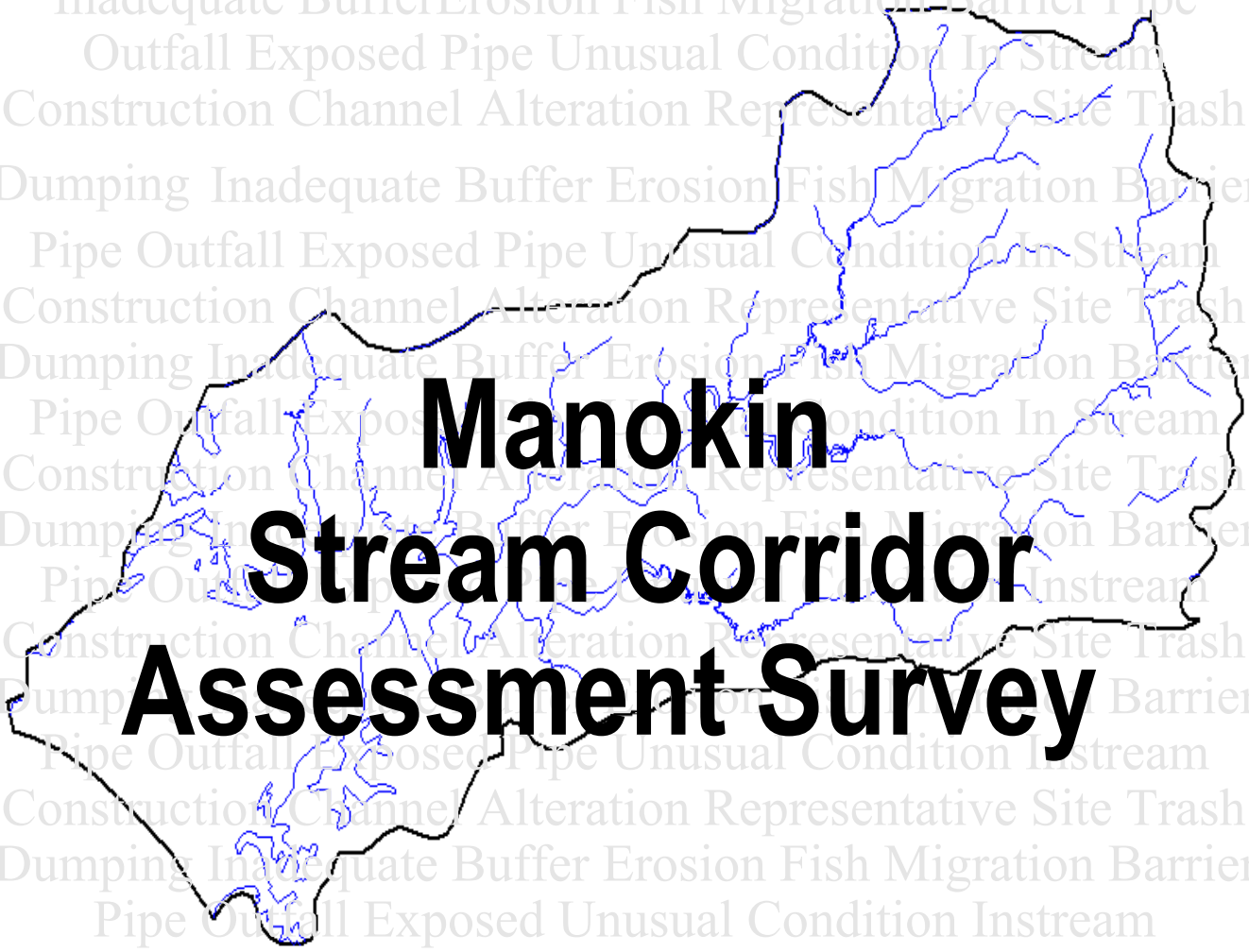

Manokin Stream Corridor Assessment Survey

Watershed Restoration Division
Chesapeake & Coastal Watershed Services
Maryland Department of Natural Resources
May 2002

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Governor

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MANOKIN RIVER

STREAM CORRIDOR ASSESSMENT SURVEY

BY

Stephen Czwartacki & Ken Yetman
Watershed Restoration Division
Coastal and Chesapeake Watershed Services
Maryland Department of Natural Resources

April 11, 2002

Financial Assistance provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration (NOAA). A report of the Manyland Coastal Zone Management Program, Departmant of Natural Resources pursuant to NOAA Award No. NA17OZ0118.

SUMMARY

The Manokin River watershed encompasses over 74,311 acres, which includes 59,384 acres of land and 14,927 acres of tidal water in Somerset County. In 1998, the Maryland Clean Water Action Plan identified the Manokin River as one of the State's water bodies that did not meet water quality requirements. In response to this finding, the Maryland Department of Natural Resources and the Somerset County Department of Public Works formed a partnership to do a Stream Corridor Assessment (SCA) survey of the Manokin River Watershed. The Manokin River lies within the Coastal Plain of Maryland. In 2000/2001 a Stream Corridor Assessment of the Manokin River stream network was performed. This survey is not intended to be a detailed scientific evaluation of the watershed. Instead, the Manokin River SCA survey was designed to provide a rapid overview of the entire stream network to determine where potential environmental problems are located and to collect some basic information about the stream. Results for this survey will be combined with other information on the Manokin River watershed to develop a Watershed Restoration Action Strategy.

Over 90 miles of non-tidal stream and 5,205 acres (8.13 mi^2) of tidal streams in the Manokin River Watershed were surveyed. It is important to note that the survey teams did not have access to 2.17 miles of non-tidal streams in the watershed. There were 109 potential environmental problems identified. The most common environmental concern seen during the SCA survey was inadequate buffers, which were reported at 59 sites. Other potential environmental problems recorded during the survey include: 18 sites with channelized stream segments, 14 altered shorelines, 7 erosion sites, 5 unusual conditions, 4 fish migration barriers, 1 Pipe outfall, and 1 active construction site near the stream.

At each site, data was collected about each problem, its location noted, and photographs taken to document existing conditions. To aid in prioritizing future restoration work, field crews rated all problem sites on a scale of 1 to 5 in three categories. They were: 1) the severity of the problem; 2) how correctable the specific problem was; and 3) how accessible the site was. In addition, field teams also collected information on both in and near stream habitat condition at 42 representative sites, and 15 tidal representative sites that were spaced at approximately ½ to ¾ mile intervals along the stream.

This SCA survey has been developed by the Maryland Department of Natural Resources (DNR) Watershed Restoration Division as a watershed management tool. One of the main goals of the SCA survey is to compile a list of observable environmental problems so that future restoration efforts can be better targeted. It is hoped that once a list of environmental problems has been compiled, a dialog can be initiated among resource managers on the goals and targets of future environmental restoration efforts in the Manokin River Watershed. It is important to note that all of the problems identified as part of the Manokin River Stream Corridor Assessment survey can be addressed through existing State or Local government programs. The value of the present survey is that it can help to place the problems in a watershed context, and can be used by a variety of resource managers to plan future restoration work.

ACKNOWLEDGMENTS

Without the hard work and dedication of the Pocomoke Crew of the Maryland Conservation Corps, this survey would not have been possible. The crew chief during the survey was Angela Baldwin. The crewmembers were Lisa Hoeben, Liz Houser, Eddie Pierce, David Simpson, Erica Wagenhals, and John Wilkens.

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INTRODUCTION

In 1998, Maryland's Clean Water Action Plan identified bodies of water that failed to meet water quality related requirements. One of the water bodies identified in the report was the Manokin River, which flows into the Chesapeake Bay. The Manokin River is located in the coastal plain on Maryland's Eastern Shore. The Manokin River Watershed encompasses approximately 59,384 acres and is entirely within Somerset County, Maryland. In response to the findings of the Maryland Clean Water Action Plan, the Maryland Department of Natural Resources has formed a partnership with Somerset County to work together to assess and improve environmental conditions in the Manokin Watershed. One of the initial goals of this partnership is to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Manokin River.

In order to develop a WRAS for the Manokin River, an overall assessment of the environmental conditions within the watershed is needed. This initial assessment is being accomplished using two approaches. First, a watershed characterization was done that compiles and analyzes existing water quality, land use, and living resources data about the Manokin River Watershed. The "Manokin River Watershed Characterization," was finalized in May 2001 and a copy can be found on DNR's web site at http://www.dnr.state.md.us/watersheds/surf/proj/wras.html. While the watershed characterization provides good overall information on environmental conditions within the Manokin Watershed, for the most part, information on the location of specific environmental problems is limited. To provide specific information on the location of environmental problems and restoration opportunities, a Stream Corridor Assessment (SCA) survey of the Manokin River Watershed was also done.

The Stream Corridor Assessment survey is a new survey that has been developed by DNR's Watershed Restoration Division as a watershed management tool to identify environmental problems and helps prioritize restoration opportunities on a watershed basis. As part of the survey, specially trained personnel walk the watershed's entire stream network and record information on a variety of environmental problems that can be easily observed within the stream corridor. The SCA survey was done over a 3-month period from April through June 2001.

There are approximately 90 miles of non-tidal stream, and 14,927 acres (23.32 mi^2) of tidal water within the Manokin River Watershed. Approximately 46% (27,577 acres) of the watershed is forested land with another 30% (17,704 acres) as agricultural land (Shanks, 2001). Figure 1 shows the geographic location of the watershed targeted in this survey. A digital orthophoto map of the Manokin River watershed is shown in Figure 2. The map is based on aerial photographs taken in April 1988, and April 1989. Figure 3 shows the same watershed boundaries superimposed on seven and ½ minute USGS topographic quadrangle maps.

As mentioned earlier the Maryland Department of Natural Resources is working with Somerset County to develop a Watershed Restoration Action Strategy (WRAS) of the Manokin River Watershed. As part of this process, data collected during the SCA survey will be used to help define present environmental conditions, as well as possible restoration opportunities in the watershed. This information combined with the watershed characterization and other local knowledge of the watershed, will be used to develop and Action Strategy for the Manokin River Watershed. The Watershed Restoration Action

Strategy in turn, will help guide future restoration efforts with the ultimate goals of restoring the areas natural resources and meeting State water quality standards.

As mentioned earlier, data collected during the SCA survey will be combined with information compiled in the watershed's characterization report to develop a Watershed Restoration Action Strategy for the Manokin River Watershed. The Watershed Restoration Action Strategy in turn, will help guide future restoration efforts with the ultimate goals of restoring the areas natural resources and meeting State water quality standards.

Manokin River Watershed Somerset County, Maryland

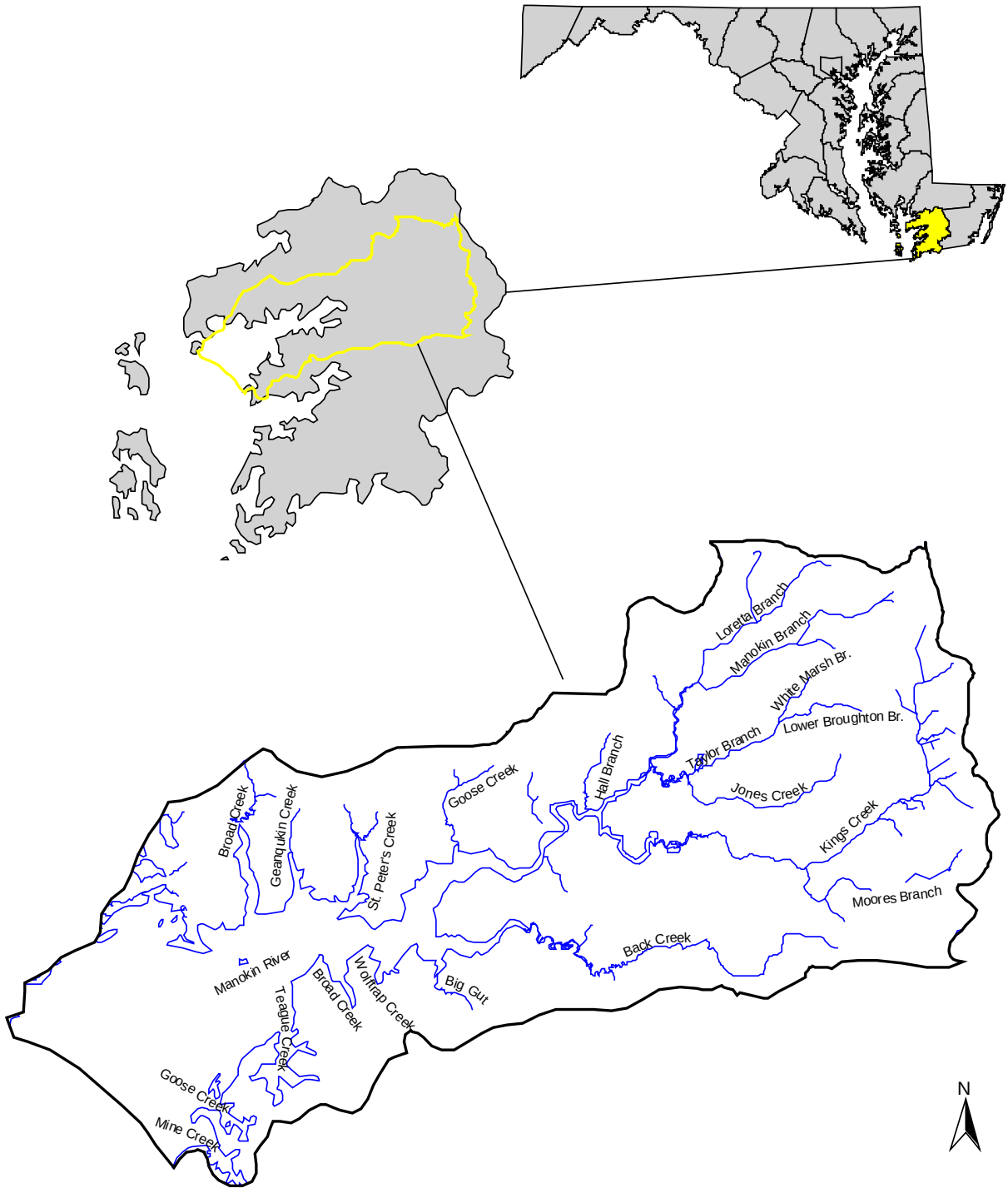

Figure 1: Manokin River SCA Survey Location

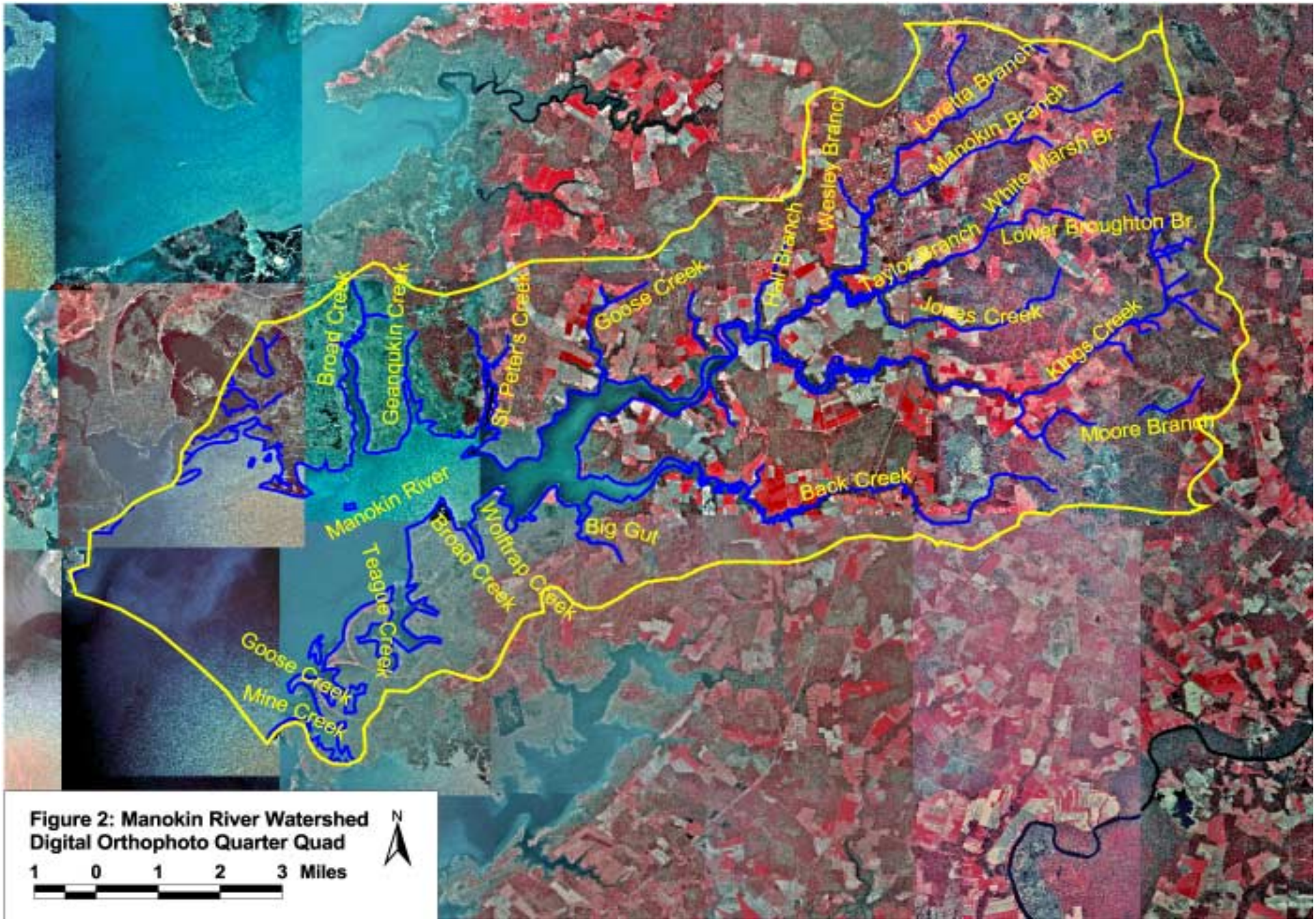
Loretta Branch
Manokin Branch
White Marsh Br.
Lower Broughton Br.
Wesley Branch
Pearl Branch
Taylor Branch
Jones Creek
Kings Creek
Moore Branch
Goose Creek
St. Peter's Creek
Broad Creek
Geanqukin Creek
Manokin River
Back Creek
Big Gut
Wolftrap Creek
Broad Creek
Teagues Creek
Goose Creek
Mine Creek
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Figure 2: Manokin River Watershed
Digital Orthophoto Quarter Quad
1 0 1 2 3 Miles

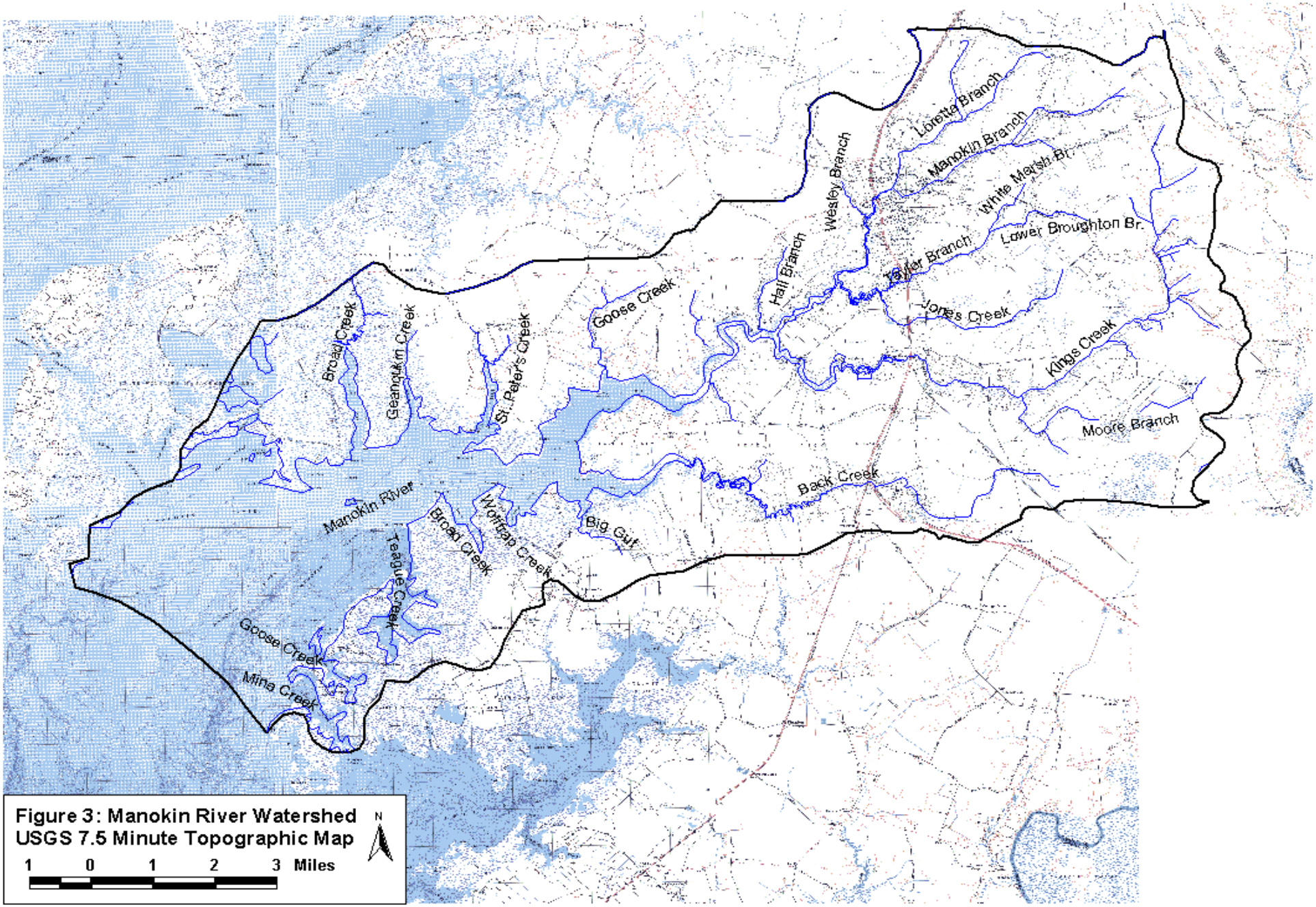

Figure 3: Manokin River Watershed
USGS 7.5 Minute Topographic Map

METHODS

To help identify some of the common problems that affect streams in a rapid and cost effective manner, the Watershed Restoration Division of the Maryland Department of Natural Resource has been working for the last several years to develop the Stream Corridor Assessment (SCA) survey. The four main objectives of the survey are:

1. To provide a list of observable environmental problems present within a stream system and along its riparian corridor.

2. To provide sufficient information on each problem so that a preliminary determination of both the severity and correctability of a problem can be made.

3. To provide sufficient information so that restoration efforts can be prioritized.

4. To provide a quick assessment of both in- and near-stream habitat conditions so that comparative assessments can be made of the condition of different stream segments.

It is important to note that the SCA survey is not intended to be a detailed scientific survey, nor will it replace the more traditional chemical and biological surveys. Instead, the SCA survey provides a rapid method of examining an entire drainage network so that future monitoring, management and/or conservation efforts can be better targeted. One advantage of the SCA survey over chemical and biological surveys is that the SCA survey can be done on a watershed basis both quickly and at relatively low cost. A copy of the survey protocols can be downloaded from DNR web site at http://dnrweb.dnr.state.md.us/download/bays/streams/surveyprotocols2.pdf.

Maryland's SCA survey is really not a new concept but a refinement of an old approach, which in its simplest form is often referred to as a stream walk survey. Many of the common environmental problems affecting streams, such as excessive stream bank erosion or blockages to fish migration, are fairly easy to identify by an individual walking along a stream. Furthermore, an advanced degree in forestry is not needed to identify a stream segment that doesn't have any trees along its banks, nor does one need a degree in sanitary engineering to see that a sewage pipeline has been exposed by stream bank erosion and is leaking sewage into the stream. With a limited amount of training, most people can correctly identify these common environmental problems.

As mentioned earlier, a walking survey of stream systems is not a new concept and there have been several attempts to standardize this approach over the years. Many earlier approaches such as EPA's, "Streamwalk Manual" (EPA, 1992), Maryland Save our Stream's "Conducting a Stream Survey," (SOS, 1970) and Maryland Public Interest Research Foundation "Streamwalk Manual" (Hosmer, 1988) were designed to be done by citizen volunteers with little or no training. While these surveys can be a good guide for citizens that are interested in looking at their community streams, the data collected during these surveys can vary significantly based on the background of the surveyor. In the Maryland Save our Stream "Stream Survey," for example, citizen groups are given some guidance on how to organize a survey and are provided a slide show explaining how to do the survey. After approximately one hour of training, citizen volunteers are then sent out in groups to walk designated stream segments. During the survey, volunteers usually walk their assigned stream segment in a couple of hours and return their data sheets to the survey organizers to be analyzed. While these surveys can help make communities more

aware of the problems present in their local stream, citizen groups normally do not have the expertise or resources to properly analyze or fully interpret the information collected. In addition, the data collected is usually only enough to indicate that a potential environmental problem exists at a specific location but does not provide sufficient information to judge the severity of the problem.

Other visual stream surveys, such as the National Resources Conservation Service's "Stream Visual Assessment Protocols" (NRCS, 1998), are designed to be done by trained professionals looking at a very specific stream reach, such as at a stream passing through an individual farmer's property. While this survey can provide useful information on a specific stream segment, it is usually not done on a watershed basis.

The Maryland SCA survey has been designed to bridge the gap between these two approaches. The survey is designed to be done by a small group of well-trained individuals that walk the entire stream network in a watershed. While the individuals doing the survey are usually not be a professional natural resource managers, they do receive several days of training in both stream ecology and SCA survey methods.

While almost any group of dedicated volunteers can be trained to do a SCA survey, the Maryland Conservation Corps (MCC) has proven to be an ideal group to do this work in Maryland. The Maryland Conservation Corps is part of the AmeriCorps Program, which was started to promote greater involvement of young volunteers in their communities and the environment. DNR's Forest and Park Service manage the MCC program. Volunteers with the MCC are 17-25 years old and can have educational backgrounds ranging from high school to graduate degrees. With the proper training and supervision, these young, intelligent and motivated volunteers are able to significantly contribute to the State's efforts to inventory and evaluate water quality and habitat problems from a watershed perspective. For more information on the Maryland Conservation Corps call their main office in Annapolis at (410) 260-8166 or visit their web site at: www.dnr.state.md.us/mcc.

Prior to the start of the Manokin SCA Survey, the 7 members of the MCC's Lower Eastern Shore Crew received a week of training. As part of this training, crewmembers learn how to identify common problems observable within the stream corridor, how to record problem locations on survey maps and how to fill out data sheets for specific problem. Procedures for documenting general stream conditions at reference sites were also reviewed during training. Reference sites are located at approximately 1/2-mile intervals along the stream. In addition to filling out a half page data sheet, field crews took photographs at all problem and reference sites to help document existing conditions. Detail information on the procedures used in the Maryland SCA survey can be found in, "Stream Corridor Assessment Survey – Survey Protocols" (Yetman, 2001). Copies of the survey protocols can be obtained by contacting the Watershed Restoration Division of the Maryland Department of Natural Resources in Annapolis, MD.

Several weeks prior to the beginning of the survey, letters were sent out to individual that own land along the stream. The letter was used to inform property owners that the survey was being done and gave them a phone number to call if they did not want MCC crews surveying the stream on their property. In addition, survey crews were instructed not to cross fence lines or enter any areas that are marked "No Trespassing" unless they have specific permission from the property owner. Figure 4 shows the areas that crews were not able to access directly during the survey. The area includes 1,357 acres (2.12 mi^2), which was approximately 2.27% of the land in the watershed**.** In some cases MCC crews were able to observe some environmental problems such as inadequate stream buffers and channel alteration from roads adjacent to these properties.

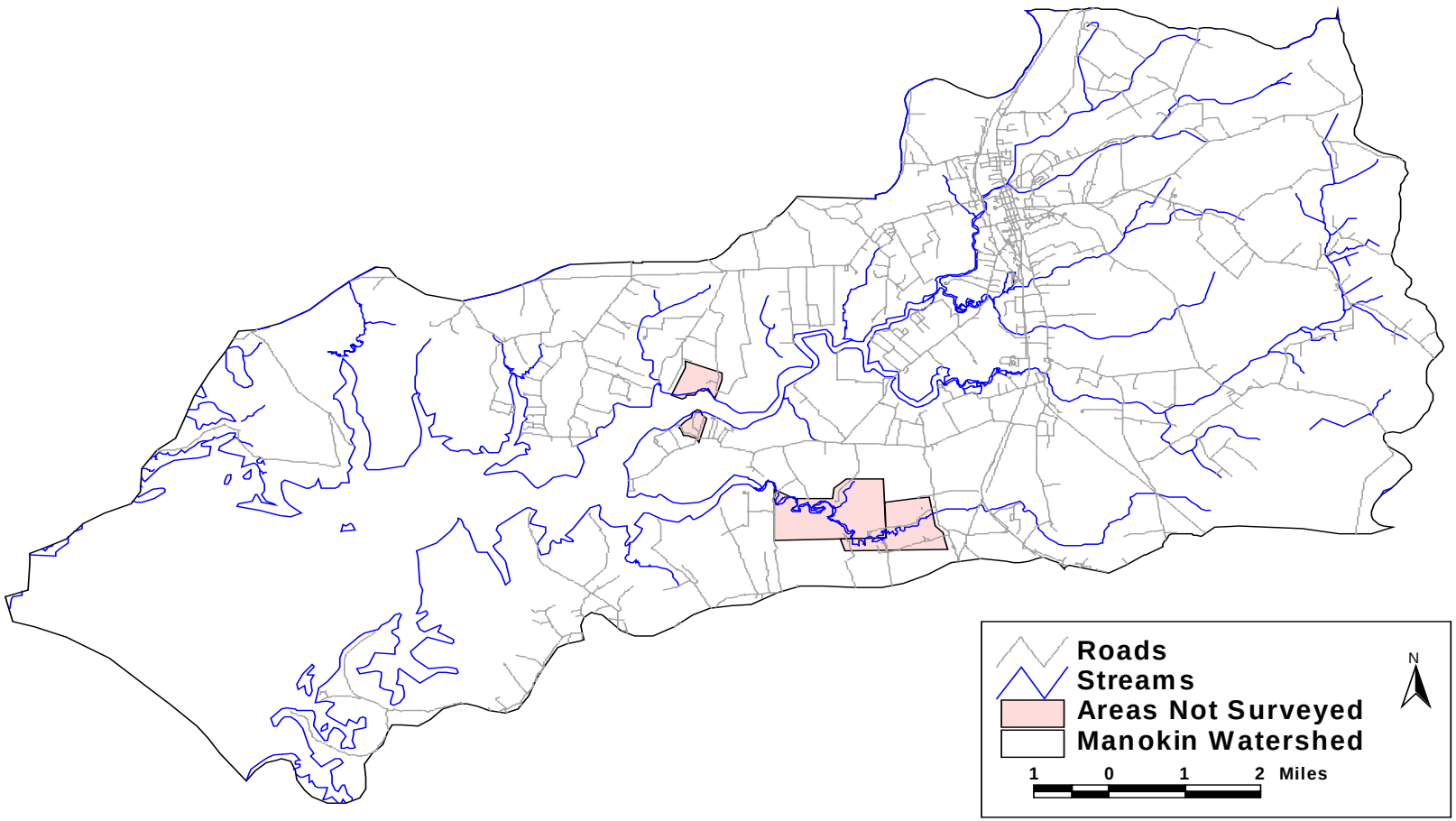

Figure 4: Manokin River Watershed Areas of No Access.

Field surveys of the Manokin River watershed began in April 2001, and over the next several months, the survey teams walked the stream's drainage network collecting information on potential environmental problems. Potential environmental problems commonly identified during the SCA Survey include: channelized stream sections, inadequate stream buffers, fish migration blockages, excessive bank erosion, near stream construction, trash dumping sites, unusual conditions, and pipe outfalls. As part of the survey, field teams also records information on the location of potential wetlands creation sites and collects data on the general condition of in-stream and riparian habitats.

The SCA survey was initially designed to be done along non-tidal streams and rivers. In the Manokin SCA survey there was an attempt to expand the survey to tidal waters. The tidal survey was conducted from a jon boat during the summer. A field team motored along the tidal shoreline and recorded the location of inadequate buffers and altered shorelines. The field team also periodically stopped to fill out a tidal representative site datasheet. The survey of the tidal waters in the Manokin River was fairly limited and some areas of the lower tidal estuary were not surveyed.

It is not unusual for an SCA survey to identify large number of problems in each problem category. For example, in an earlier survey of the Swan Creek Watershed in Harford County, a total of 453 potential environmental problems were identified along 96 miles of stream. The most frequently reported problem during the survey was stream bank erosion, which was reported at 179 different locations (Yetman et. al., 1996). Follow up surveys found that while stream bank erosion was a common problem throughout the watershed, the severity of the erosion problem varied substantially among the sites and that the erosion problems at many sites were fairly minor. Based on this experience the SCA survey has field crews evaluate and score all problems on a scale of 1 to 5 in three separate areas: problem severity, correctability, and accessibility. A major part of the crews training is devoted to how to properly rate the different problems identified during the survey.

While the ratings are subjective, they have proven to be very valuable in providing a starting point for more detailed follow-up evaluations. This is because in many cases, resource professionals such as fisheries biologists, foresters, hydrologists and engineers do not have the time to walk hundreds of miles of streams to determine where the problems are. What the SCA survey does is train the MCC and other groups to walk streams for them and collect some very basic information about commonly seen problems. Once the SCA survey has been completed, the data collected can then be used by different resource professionals to help target future restoration efforts. A regional forester for example can use data collected on inadequate stream buffers to help target future riparian buffer plantings, while the local fishery biologist can use the data on fish blockages to help target future fish passage projects to reestablish spawning runs. The inclusion of a rating system in the survey gives resource professional an idea of which sites the field crew believed were the most severe, easiest to correct and easiest to access. This information combined with photographs of the site can help resource managers focus their own follow up evaluations and fieldwork at the most important sites.

A general description of the rating system is given below. More specific information on the criteria used to rate each problem category is provided in the SCA – Survey Protocols (Yetman, 2000). It is important to note that the rating system is designed to contrast problems within a specific problem category. When assigning a severity rating to a site with an inadequate stream buffer for example, the rating is only intended to compare the site to other in the State with inadequate stream buffers. The rating is not intended to be applied across categories. A trash dumping site with a very severe rating may not necessarily be a more significant environmental problem than a stream bank erosion site that received a moderate severity rating.

The **problem severity** rating has generally been found to be the most useful rating and indicates how bad a specific problem is relative to others in the same problem category. The severity rating is used to answer questions such as, where are the worst stream bank erosion sites in the watershed, or where is the largest section of stream with an inadequate buffer. The scoring is based on the overall impression of the survey team of the severity of the problem at the time of the survey.

* A very severe rating of 1 is used to identify problems that have a direct and wide reaching impact on the stream's aquatic resources. Within a specific problem category, a very severe rating indicates that the problem is among the worst that the field teams have seen or would expect to see. Examples would include a discharge from a pipe that was discoloring the water over a long stream reach (greater than 1000 feet) or a long section of stream (greater than 1000 feet) with high raw vertical banks that appear to be unstable and eroding at a fast rate.

* A moderate severity rating of 3 is used to identify problems that appear to be having some adverse environmental impacts but the severity and/or length of stream affected is fairly limited. While a moderate severity rating would indicate that field crews did believe it was a significant problem, it also indicates that they have seen or would expect to see much worse problems in that specific problem category. Examples would include: a small fish blockage that was passable by strong swimming fish like trout, but a barrier to resident species such as sculpins; or a site where several hundred feet of stream had an inadequate forest buffer.

* A minor severity rating of 5 is given to problems that do not appear to be having a significant impact on stream and aquatic resources. A minor rating indicates that a problem was present but compared to other problems in the same category it would be considered minor. Examples would include: an outfall pipe from a storm water management structure that is not discharging during dry weather and does not have any erosion problem either at the outfall or immediately downstream, or a section of stream that has stable banks and some trees along both banks but the forest buffer is less than 50 feet.

The **correctability rating** provides a relative measure on how easily the field teams believe the problem can be corrected. The correctability rating can be helpful in determining which problems can be easily dealt with when developing a restoration plan for a drainage basin. One restoration strategy would initially target the severest problems that are the easiest to fix. The correctability rating can also be useful in identifying simple projects that can be done by volunteers, as opposed to projects that require more significant planning and engineering efforts.

* A minor correctability rating of 1 is assigned to problems that can be corrected quickly and easily using hand labor, with a minimum amount of planning. These types of projects would usually not need any Federal, State or local government permits. It is a job that small group of volunteers (10 people or less) could fix in a day or two without using heavy equipment. Examples would be removing debris from a blocked culvert pipe, removing less than two pickup truck loads of trash from an easily accessible area or planting trees along a short stretch of stream.

* A moderate correctability rating of 3 is given to sites that may require a small piece of equipment, such as a backhoe, and some planning to correct the problem. This would not be the type of project that volunteers would usually do by themselves, although volunteers could assist in some aspects of the project, such as final landscaping. This type of project would usually require a

week or more to complete. The project may require some local, State or Federal government notification or permits, however, environmental disturbance would be small and approval should be easy to obtain.

* A very difficult correctability rating of 5 is given to problems that would require a large expensive effort to correct. These projects would usually require heavy equipment, significant amount of funding ($100,000.00 or more), and construction could take a month or more. The amount of disturbance would be large and the project would need to obtain a variety of Federal, State and/or local permits. Examples would include a potential restoration area where the stream has deeply incised several feet over a long distance (i.e., several thousand feet) or a fish blockage at a large dam.

The **accessibility rating** is used to provide a relative measure of how difficult it is to reach a specific problem site. The rating is made at the site by the field survey team, using their field map and field observations. While factors such as land ownership and surrounding land use can enter into the field judgments of accessibility, the rating assumes that access to the site could be obtained if requested from the property owner.

* A very easy accessibility rating of 1 is assigned to sites that are readily accessible both by car and on foot. Examples would include a problem in an open area inside a public park where there is sufficient room to park safely near the site.

* A moderate accessibility rating of 3 is assigned to sites that are easily accessible by foot but not easily accessible by a vehicle. Examples would include a stream section that could be reached by crossing a large field or a site that was accessible only by 4-wheel drive vehicles.

* A very difficult accessibility rating of 5 is assigned to sites that are difficult to reach both on foot and by a vehicle. Examples would include a site where there are no roads or trails nearby. To reach the site it would be necessary to hike at least a mile. If equipment were needed to do the restoration work, an access road would need to be built through rough terrain.

Following the completion of the survey, information from the field data sheets were entered into a Microsoft Access database and verified by the field teams. In addition, the 156 photographs were taken during the survey were labeled and organized by site number in a binder so they can be easily worked with. The photographs were also digitized using a flat bed scanner and placed on a photo CD so they can be distributed to interested parties. Finally, all data collected during the survey was incorporated into an ArcView Geographical Information System (GIS). A final copy of ArcView files was given to Somerset County for their use in developing a Watershed Action Strategy for the Manokin River.

RESULTS

The Stream Corridor Assessment of the Manokin River Watershed started in April 2001, and most field data collection was completed by June 2001. The present survey covered all of the Manokin River Watershed.

An overall summary of survey results is presented in Table 1, while Table 2 summarizes the data by major stream segments. All data collected during the survey is presented in Appendices A and B. Appendix A provides a listing of information by problem number along with its location, using latitude and longitude coordinates. Information in this format is useful when working with maps showing the location of problem sites to determine what problems may be present along a specific stream reach. In Appendix B, the data is presented by problem type, with more detailed information about each problem. Presenting the data by problem type allows the reader to see which problems the field crews rated the most severe or easiest to fix within each category.

Table 1: Summary of results from the Manokin SCA Survey.

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Inadequate Buffers	**59**	**121,340 ft. (22.98 miles)**	13	4	6	13	23
Channel Alterations	**18**	**42,655 ft. (8.08 miles)**	4	5	4	4	1
Altered Shorelines	**14**	**3370 ft. (.64 miles)**	0	0	3	7	4
Erosion Sites	**7**	**7,335 ft. (1.39)**	2	1	1	2	1
Unusual Conditions	**5**	**NA**	0	0	0	2	3
Fish Blockages	**4**	**NA**	0	1	1	0	2
Pipe Outfalls	**1**	**NA**	0	0	1	0	0
In/Near Stream Construction	**1**	**NA**	0	0	0	0	1
Exposed Pipes	**0**	**NA**	0	0	0	0	0
Flood Prone Structures	**0**	**NA**	0	0	0	0	0
Trash Dumping	**0**	**NA**	0	0	0	0	0
TOTAL	**109**		**19**	**11**	**16**	**28**	**35**
Comments	**18**						
Representative Sites	**41**						
Tidal Representatives	**15**						

Table 2: Summary of results by major stream segment.

	Altered Shorelines	Channel Alterations	Comments	Erosion Sites	Fish Barriers	In/Near Stream Construction	Inadequate Buffers	Pipe Outfalls	Representative Sites	Tidal Representatives	Unusual Conditions	Total
Back Creek	2		2				5			2	2	13
Big Gut	1	1								1		3
Geanqukin Creek			1									1
Goose Creek			1									1
Hall Branch			1				1		1			3
Jones Creek									3			3
Kings Creek		7	2	6			10		14	2		41
Loretta Branch		1	2		1	1	4		7			16
Lower Broughton Branch			1				1		1		1	4
Manokin Branch		3		1	1		5		7			17
Manokin River	9	2	1				24			7		43
Moore Branch			1						1		1	3
St. Peter's Creek	1		4				4			1		10
Taylor Branch							2		3	1		6
Teague Creek		1					1					2
Wesley Branch		1	1		1			1	2		1	7
White Marsh Branch		1			1				2			4
Wolftrap Creek	1	1	1				2			1		6

Inadequate Buffers

Forested stream buffers are very important for maintaining healthy Maryland streams. They help shade the stream to prevent excessive solar heating and their roots stabilize the streams banks. Forest buffers also help remove nutrients, sediment and other pollutants from runoff and the leaves from trees are a major component of the stream's food web. Because of the importance of stream buffers, the state of Maryland has set a goal of recreating 1200 miles of forest stream buffers by the year 2010.

While there is no single minimum standard for how wide a forested stream buffer should be in Maryland, for the purposes of this study a forest buffer is generally considered inadequate if it is less than 50 feet wide, measured from the edge of the stream. Inadequate buffers were reported at 59 sites, during the Manokin SCA survey. The locations of the inadequate buffer sites are shown in Figure 5b.

The field crew provided a rough estimate of the length of the inadequate stream buffer at all sites and information is shown in Appendix B. Based on the data that was collected during the survey, there are approximately 121,340 feet (22.98 miles) of inadequate buffers in the Manokin River watershed. Field teams found inadequate buffers ranging in distance from 50 feet to 10,500 feet. Thirteen sites received very severe ratings, and another four sites received severe ratings (Figure 5a). All 17 sites involved long reaches of stream with very little vegetation on either stream bank. The Manokin River lies in an area that relies heavily on agriculture, which explains why the main causes sited for these very severe sites lacking buffers were crop fields. All of the very severe sites were found on the headwaters of the Manokin River, on Kings Creek (4 sites), the Manokin Branch (4 sites), and the Loretta Branch (2 sites). The majority of the inadequate buffers on the Manokin River received low to minor severities rating. Lawns were cited as the main land use in the buffer area. Other land uses cited as being in the buffer area include pastures, construction, and logging. Some of the sites that received the less severe ratings were in the tidal portion of the Manokin River. At these sites homeowners had cleared trees from a portion of the shoreline to provide a view of the water from a house.

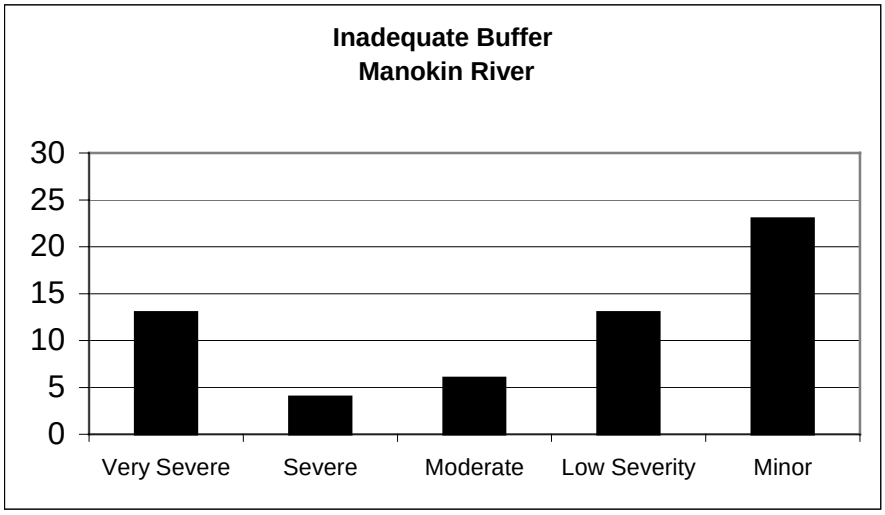

Figure 5a: Histograph showing the frequency of severity ratings given to inadequate buffer sites during the Manokin SCA survey.

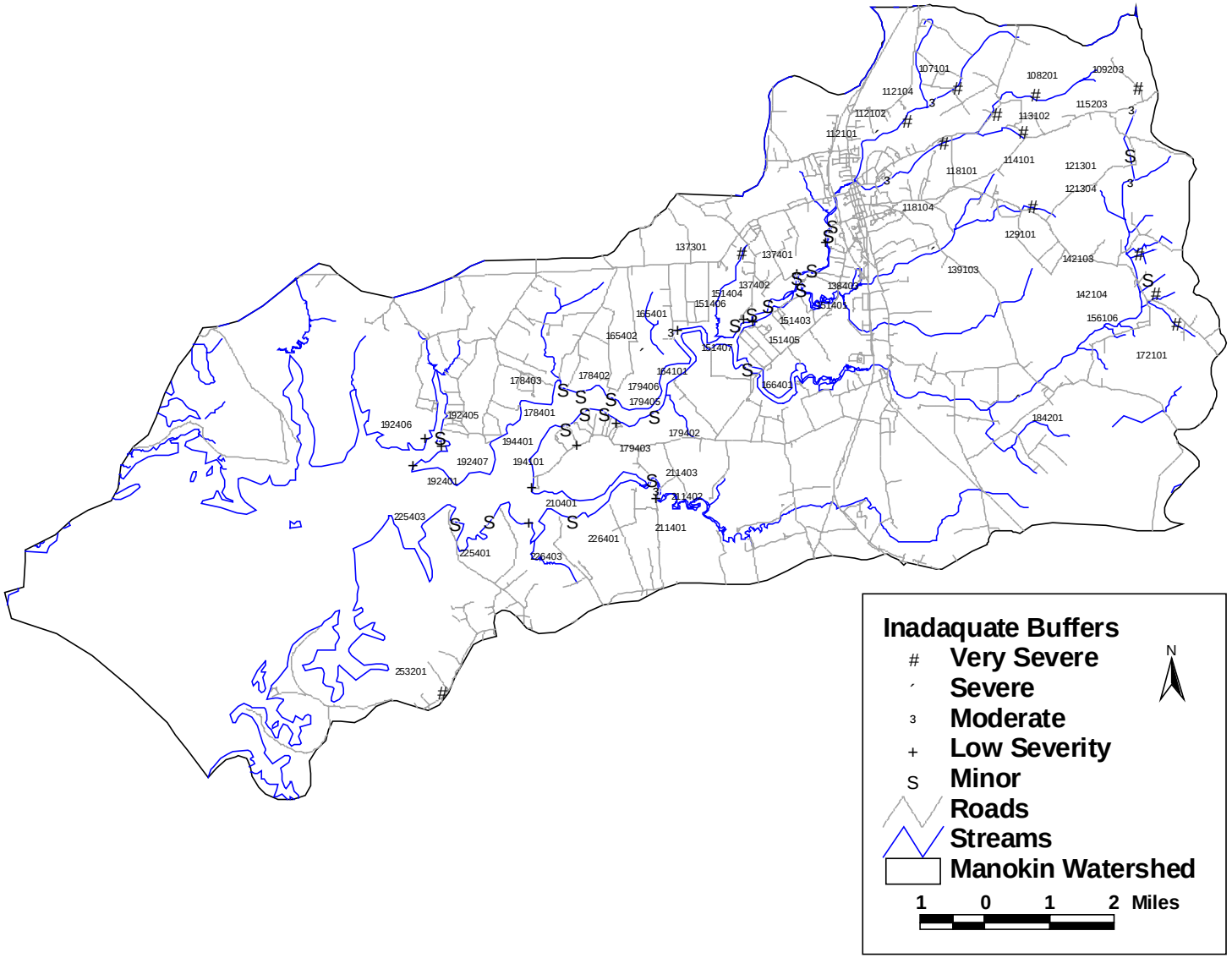

Figure 5b: Manokin River Watershed Inadequate Buffers.

Channel Alterations

Channel alteration sites are stream sections where the stream's banks and channel have been significantly altered from a natural condition. This includes areas where the stream may have been straightened and/or where the stream banks have been hardened using rock, gabion baskets or concrete over a significant length (usually 100 feet or more). It does not include road crossings unless a significant portion of the stream above or below the road has also been channelized. In addition, places where a small section of only one side of the stream's banks may have been stabilized to reduce erosion were not reported as channel alterations. For the purposes of this survey, channel alteration also does not include tributaries where storm drains were placed in the stream channel and the entire tributary is now piped underground. While these stream sections have been significantly altered, it is not possible to tell by walking the stream corridor precisely where this was done.

Field crews reported finding 18 sites were the stream's channel had been recognizably altered. The locations of channel alteration sites are shown in Figure 6b. Most sites were found in the headwaters of the Manokin River on Kings Creek (7 sites), Manokin Branch (4 sites), and Loretta Branch (3 sites). The total length of stream affected by channelization was estimated to be 42,655 feet or about 8.08 miles. Fourteen sites were reported to be earthen channels or agricultural ditches used to lower the water table for increased growing seasons. At the remaining sites, 3 were sites were places where riprap was used to stabilize a short section of stream and at one site concrete rubble was used to help harden a stream bank.

Most of the channel alteration sites in the Manokin River survey were given a moderate to severe rating (Figure 6a). No sites were given the highest rating of very severe, because a very severe channel alteration rating is usually only given to site were concrete is use to construct a trapezoid channel where there is no natural stream habitat present. The six sites (108202, 109203, 114101, 142103, 172101, and 253201) that received severe ratings were agricultural ditches that appear to receive routine maintenance. At six other sites (121301, 115204, 128104, 194101, 227101 and 239101) field teams reported that large sections (i.e., >1000 feet) of stream had been channelized but that the areas were no longer being maintained and the channel was in the process of reverting to a more natural channel. These sites received moderate severity ratings.

Many of the channel alteration sites in the Manokin River Watershed can best be described as agricultural ditches. Agricultural ditching is extensive on Maryland's Eastern Shore and was done to improve the agricultural use of poorly drained land. As part of these ditching operations, Public Ditching Associations (PDAs) were establish to manage and maintain the ditching networks. There are over 100 Public Ditching Associations on Maryland's Eastern Shore managing an estimated 821 miles of channelized streams (PDA Taskforce, 2000). On top of the public ditch system, there are hundreds of more miles of roadside and farm ditches that drain into PDAs waterways. Ditching is so extensive in many parts of Maryland's Eastern Shore that it is often very difficult to find any natural stream segment in any part of a watershed.

As part of the normal maintenance procedures along most agricultural ditches, the banks of the ditches are periodically mowed to prevent the growth of trees and other woody vegetation that could interfere with future maintenance the ditches. It is not surprising then that the presence of inadequate stream buffers coincided with the presence of ditches at 11 sites.

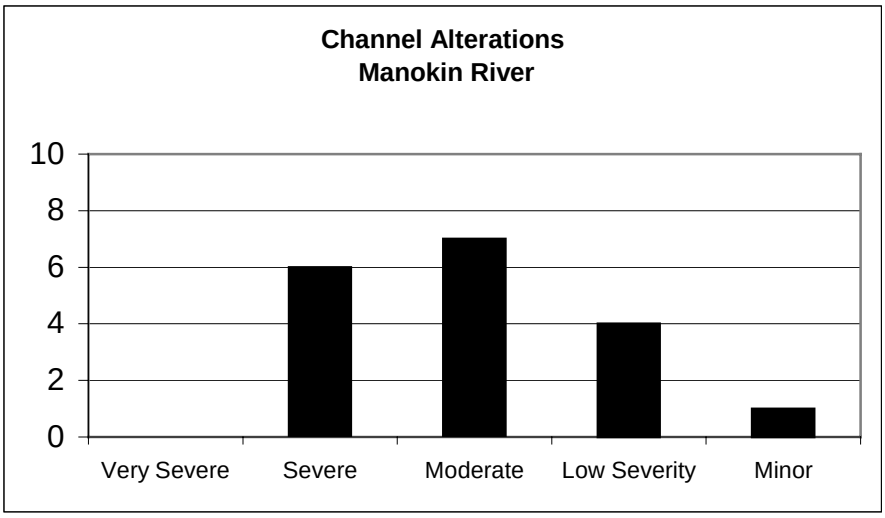

Figure 6a: Histograph showing the frequency of severity ratings given to channel alteration sites during the Manokin SCA survey.

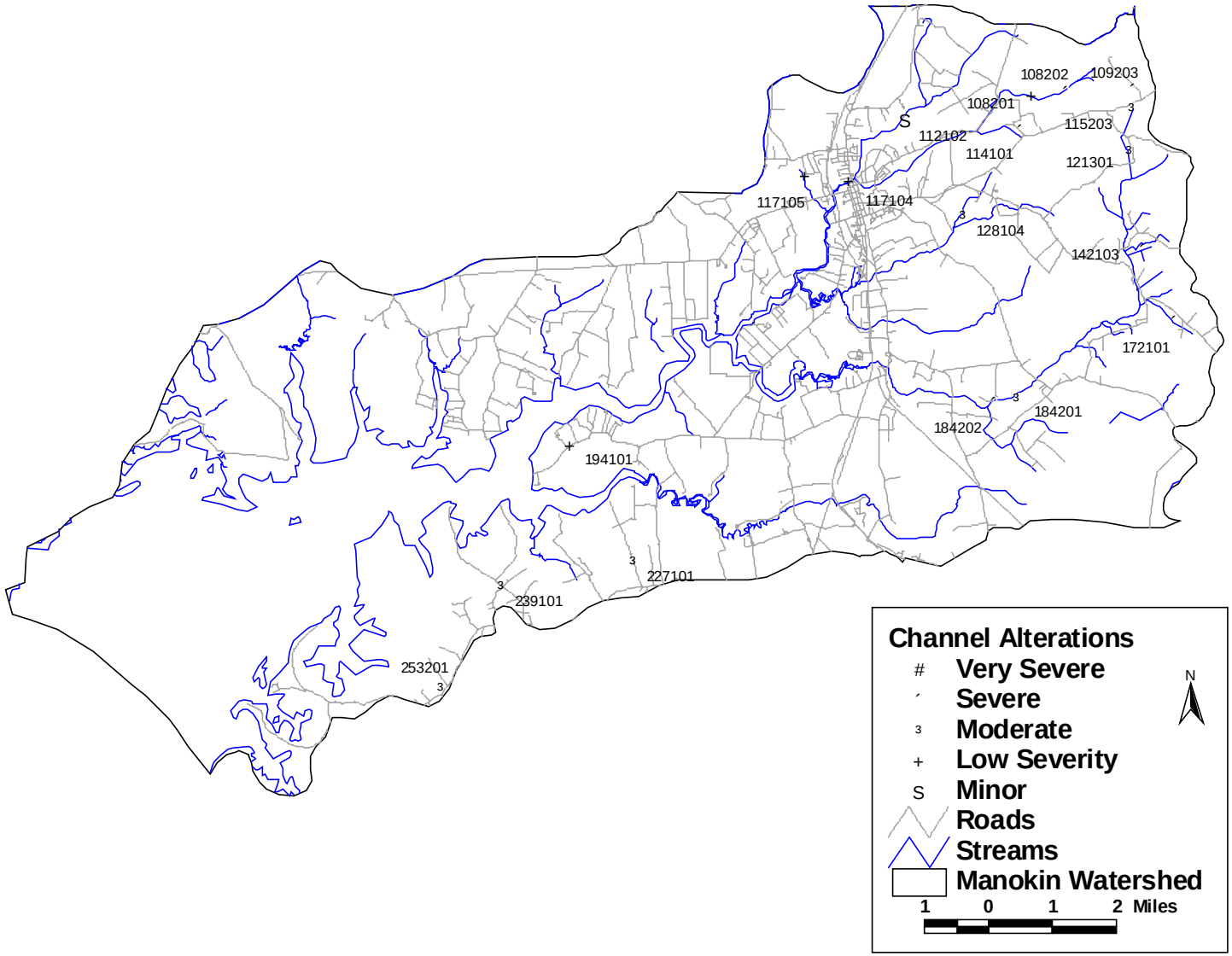

Figure 6b: Manokin River Watershed Channel Alterations.

Altered Shorelines

Altered shorelines are areas on tidal waters where the shoreline has been altered from a natural state. This would include beach armor such as bulkheads and rip-rap, or areas that have had sand or sediment placed in an area to create a swimming beach. Altered shoreline data was collected in the Manokin River SCA survey in an attempt to incorporate tidal areas in the survey.

The crews found 14 altered shorelines whose locations are shown in Figure 7b. Nine sites were along the banks of the Manokin River, 3 sites were on Back Creek, 1 site was on Wolftrap Creek, and 1 site was on St. Peter's Creek. Concrete rubble was reported being used to stabilize the shoreline at 7 sites, rip-rap was used at 5 sites, wood bulkheads were present at 3 sites and one site was a swimming beach. Lawns were found to be the predominant land use adjacent to the altered shorelines and were reported at 12 sites. Pavement was reported adjacent to 1 site and a public park was adjacent to another.

The lengths of banks affected by armored shorelines varied between 50 and 500 feet long. Most altered shoreline sites were fairly small and were given low to minor severity rankings (Figure 7a). All altered shoreline sites were also sites where there was an inadequate forest buffer along the shoreline. In fact, part of the reason that erosion was an issue at these sites was because trees had been removed from along the shoreline to provide the property owned with a water view from their home.

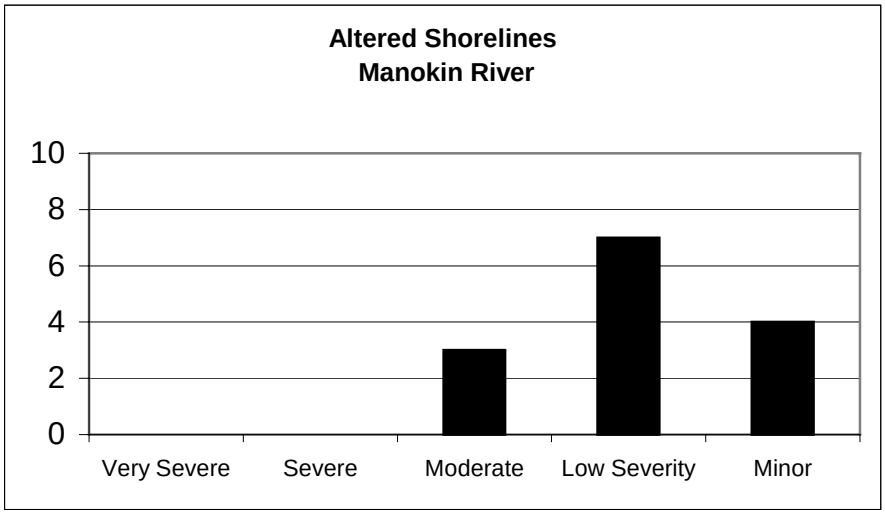

Figure 7a: Histograph showing the frequency of severity ratings given to altered shoreline sites during the Manokin SCA survey.

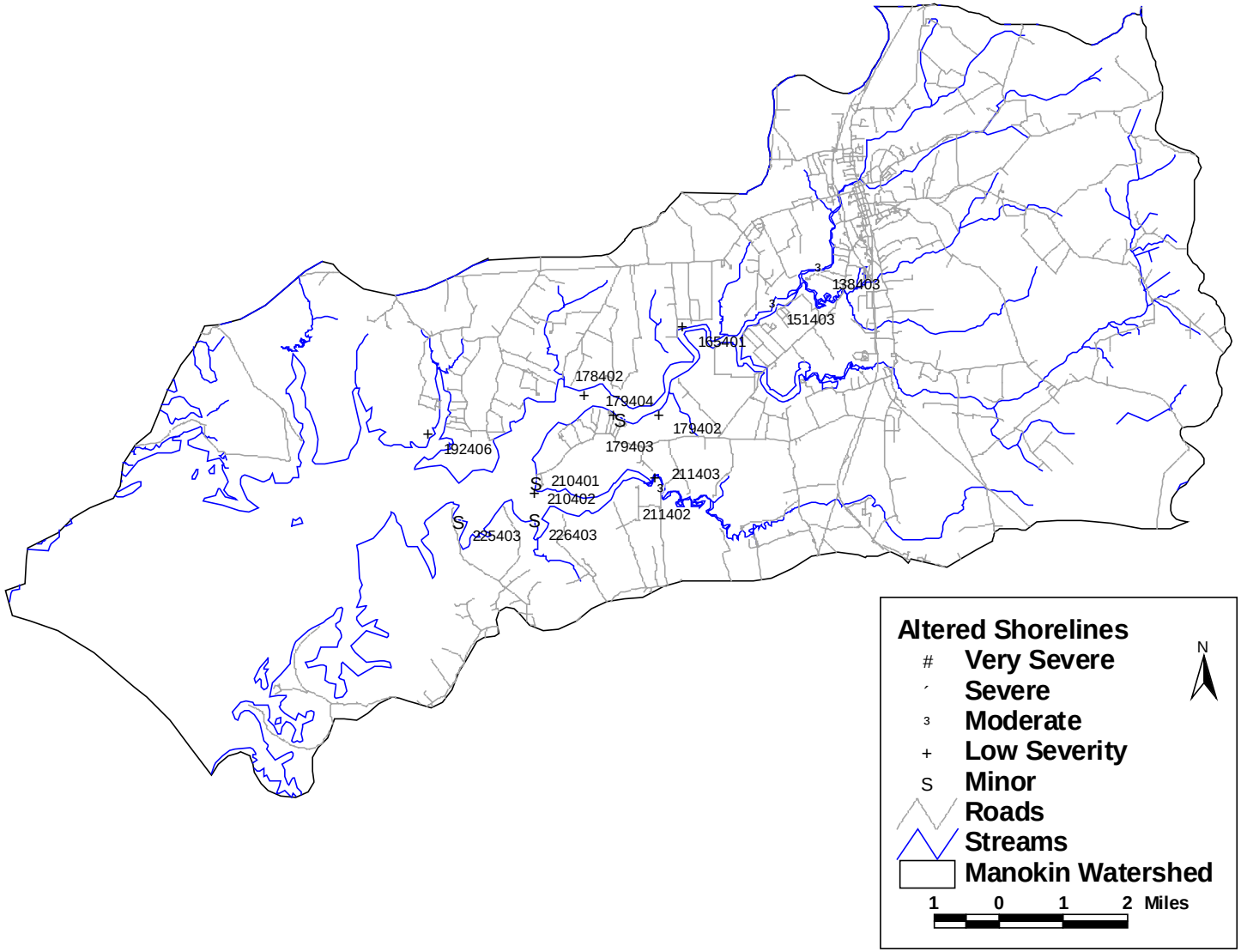

Figure 7b: Manokin River Watershed Altered Shorelines.

Erosion Sites

Erosion is a natural process, and it is necessary to maintain good aquatic habitat in a stream. Too much erosion, however, can have the opposite effect, destabilizing stream banks, destroying in-stream habitat and causing significant sediment pollution problems downstream. Severe erosion problems occur when a stream's hydrology, geometry and/or sediment supply have been significantly altered. This often occurs when land use in a watershed changes. Increases in the amount of impervious surfaces, construction in the floodplain and alterations to channel alignments can all destabilize stream banks. These activities can set off a series of channel readjustments that can extend over decades, during which time excessive amounts of sediment from unstable eroding stream banks can have very detrimental impacts on the stream's aquatic resources.

In the SCA survey, unstable eroding streams are defined as areas where the stream banks are almost vertical and the roots from the vegetation along the stream's banks are unable to hold the soil on the banks. Unstable eroding stream banks were reported at 7 sites. It is important to note that the SCA survey is only a visual survey of the stream network. While survey teams are asked to comment whether they believed the stream was down-cutting, widening, or head cutting at a specific site, the only way to really know the full significance of the erosion processes at a specific site is to do more detailed monitoring.

The locations of bank erosion sites are shown in Figure 8b. All of the erosion sites are on the headwaters of the Manokin. Six sites are on Kings Creek, and one site is on the Manokin Branch. These sites range in length from 25 feet to 3000 feet. Erosion sites observed during the Manokin SCA survey were given severity ratings from moderate to minor (Figure 8a). It is estimated that the total amount of unstable eroding stream banks in the Manokin River Watershed is approximately 7,335 feet (1.4 miles).

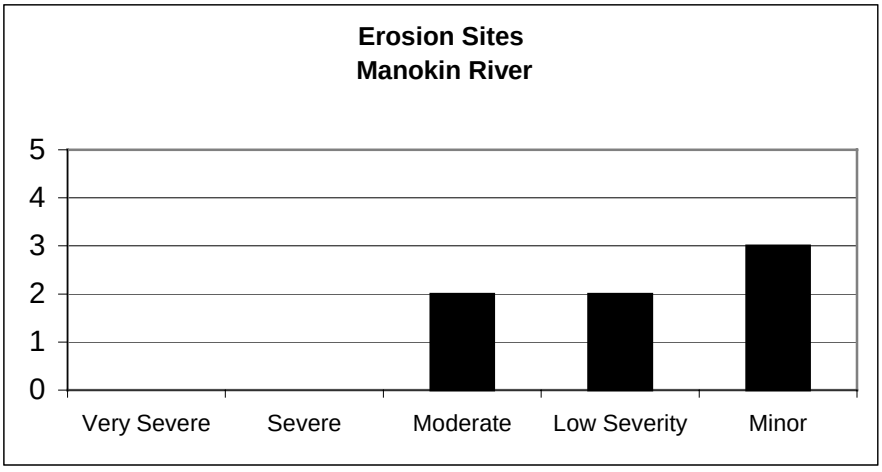

Figure 8a: Histograph showing the frequency of severity ratings given to erosion sites during the Manokin SCA survey.

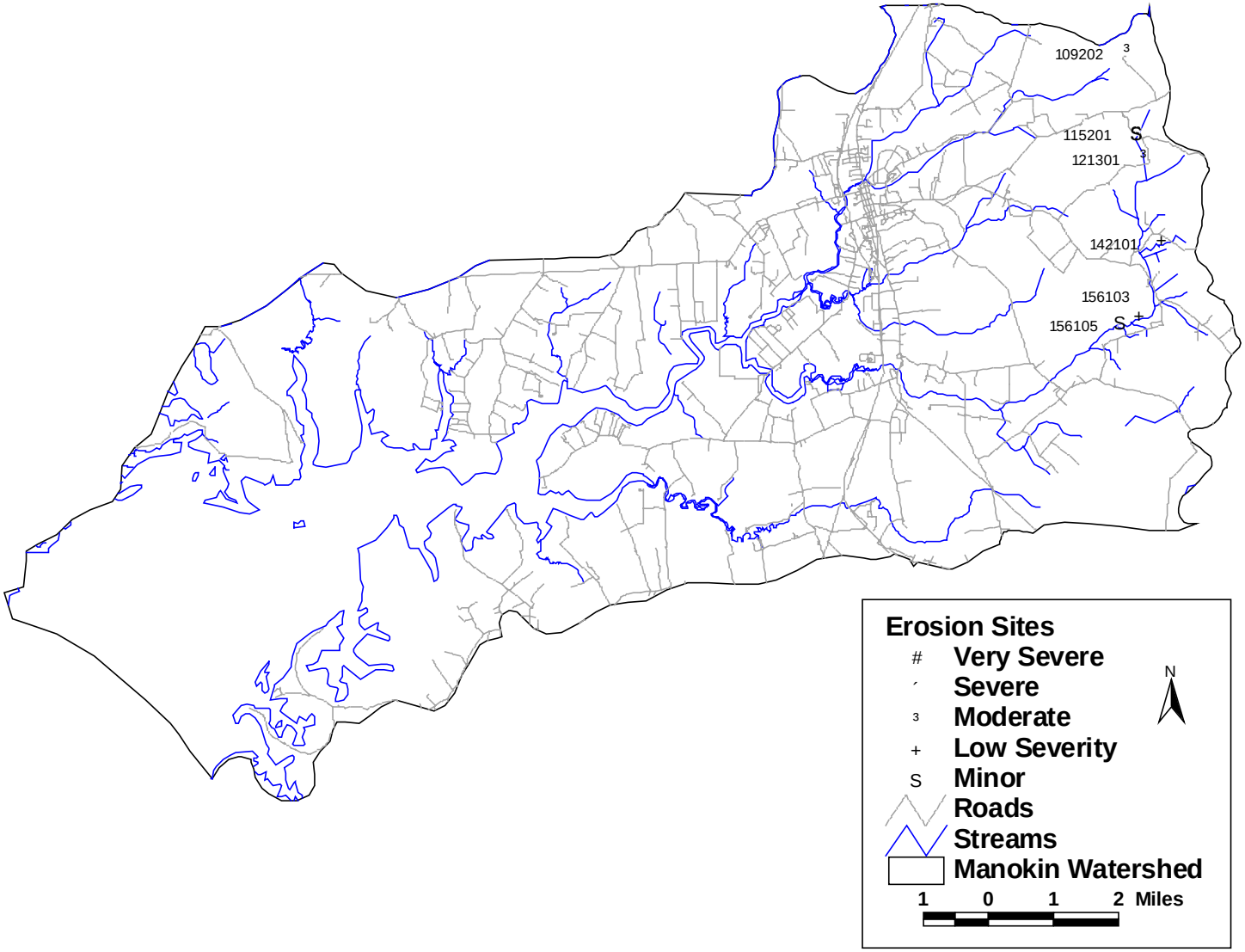

Figure 8b: Manokin River Watershed Erosion Sites.

Unusual Conditions/Comments

The unusual condition/comment data sheets are used by field teams to record the location of anything out of the ordinary, or to provide some additional written comments on a specific problem. Five unusual condition sites were identified during the Manokin River survey and their locations are shown in Figure 9b. In addition, 15 comment data sheets were filled out. All unusual condition sites were given low to minor severity ratings (Figure 9a).

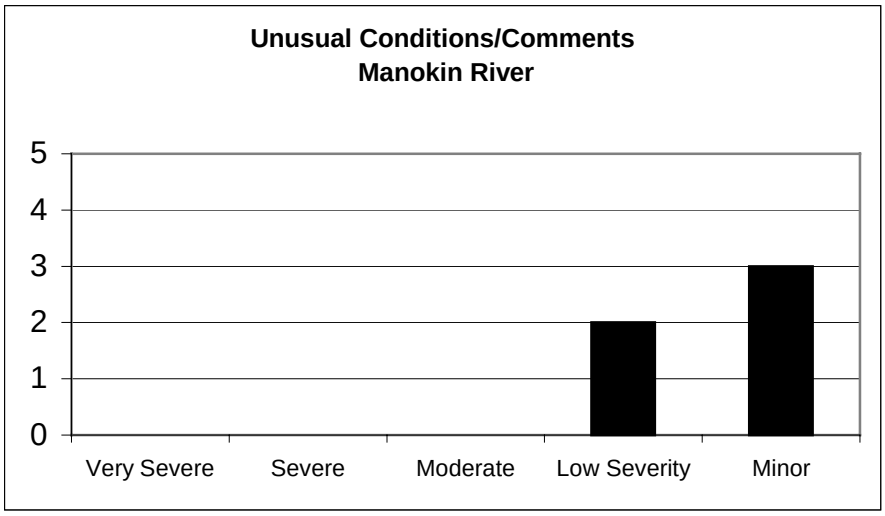

Figure 9a. Histograph showing the frequency of severity ratings given to unusual condition sites during the Manokin SCA survey.

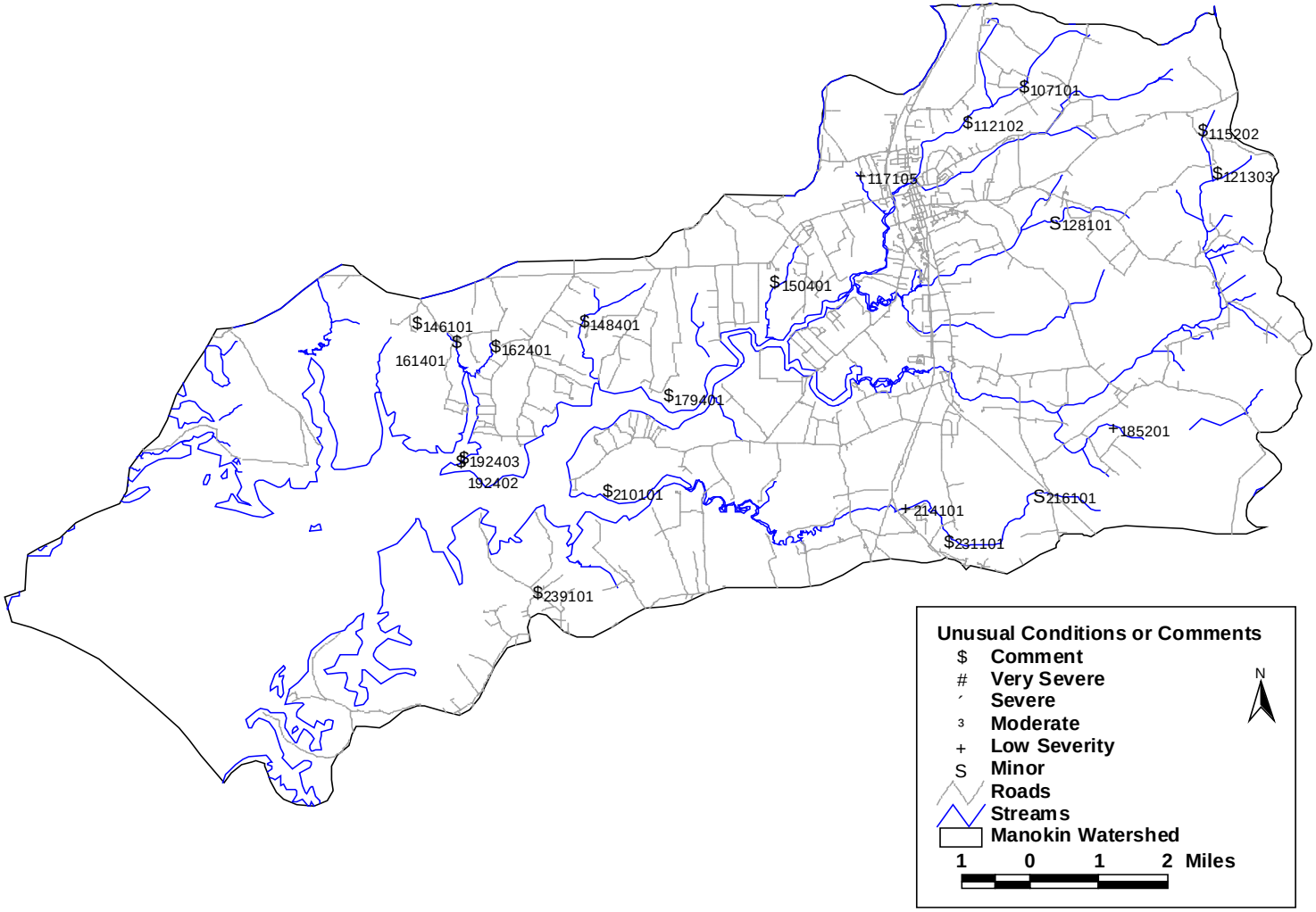

Figure 9b: Manokin River Watershed Unusual Conditions and Comments.

Fish Migration Barriers

Fish migration barriers are anything in the stream that significantly interferes with the free movement of fish upstream. Unimpeded fish passage is especially important for anadromous fish that live much of their lives in tidal waters but must move into non-tidal rivers and streams to spawn. Unimpeded upstream movement is also important for resident fish species, many of which also move both up and down stream during different parts of their life cycle. Without free fish passage, some of the sections in a stream network can become isolated. If a disturbance occurs in an isolated stretch of stream, such as a sewage line break that discharges a large amount of raw sewage into a small tributary, some or all fish species may be eliminated from that isolated section of stream. With a fish blockage present and no natural way for a fish to repopulate the isolated stream section, the diversity of the fish community in an area will be reduced and the remaining biological community may be out of natural balance.

Fish blockages can be caused by man-made structures such as dams or road culverts, and by natural features such as waterfalls or beaver dams. Fish blockages occur for three main reasons. First, a vertical water drop such as a dam can be too high for fish to jump or swim over. A vertical drop of 6 inches may cause a fish passage problem for some resident fish species, while anadromous fish can usually move through water drops of up to 1 foot, providing there is sufficient flow and water depth. The second reason a structure may be a fish passage problem is because the water is too shallow. This can often occur in channelized stream sections or at road crossing where the water from a small stream has been spread over a large flat area and the water is not deep enough for fish to swim through. Finally, a structure may be a fish blockage if the water is moving too fast through it for fish to swim through. This can occur at road crossings where the culvert pipe has been placed at a steep angle and the water moving through the pipe has a velocity that is higher than a fish's swimming ability.

Four fish migration barriers were reported during the survey. The locations of fish migration blockages are shown in Figure 10b. Two were weir structures, one was a pond, and one was a temporary debris jam. The pond and debris jam were given minor severity ratings (Figure 10a). Site 118102 is at a USGS gauging weir on Manokin Branch. The weir had a 4-foot drop at the downstream end and was given a severe rating. Site 112102 is another small weir on Loretta Branch and was given a moderate severity rating.

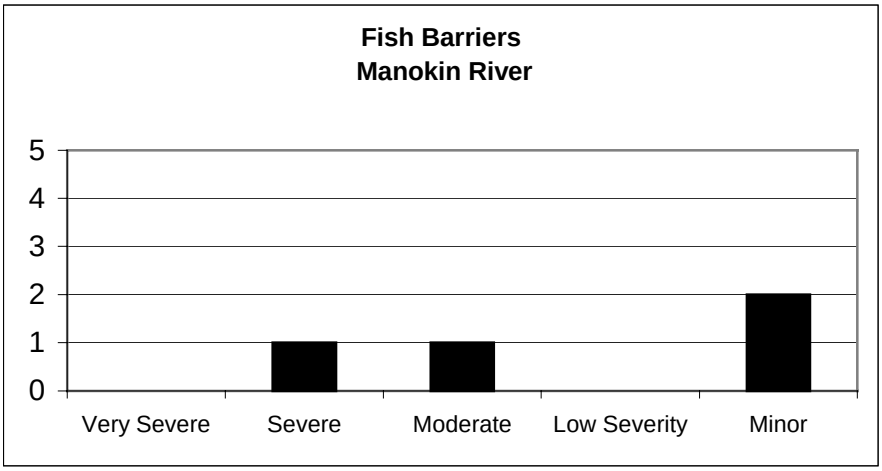

Figure 10a. Histograph showing the frequency of severity ratings given to fish migration barriers sites during the Manokin SCA survey.

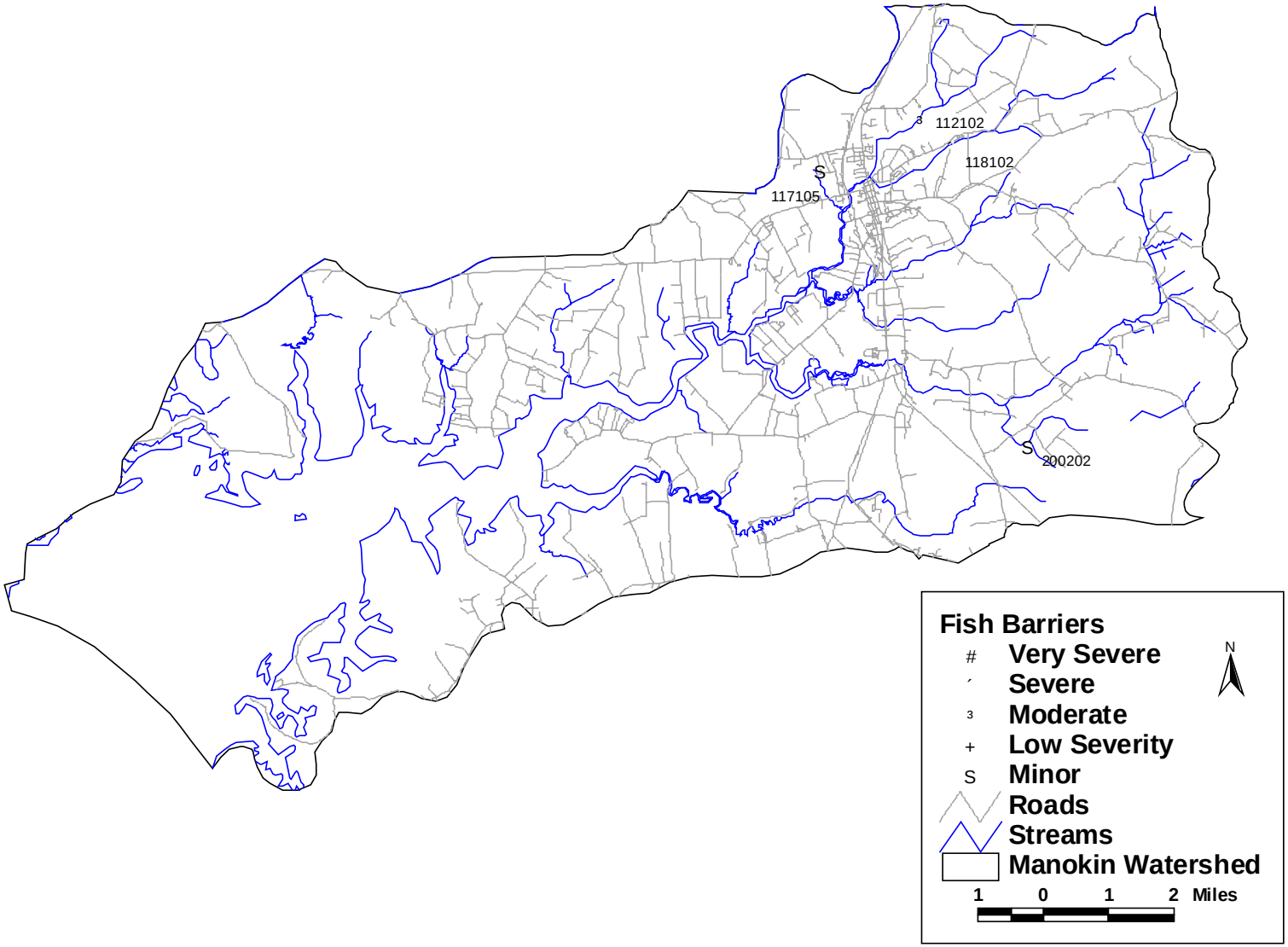

Figure 10b: Manokin River Watershed Fish Barriers.

Pipe Outfalls

Pipe outfalls include any pipes or small man made channels that discharge into the stream through the stream corridor. Pipe outfalls are considered potential environmental problems in the survey because they can carry uncontrolled runoff and pollutants such as oil, heavy metals and nutrients to a stream system. Only one pipe outfall was identified during the Manokin River survey. The pipe outfall was from the Princess Anne Wastewater Treatment Plant and discharged into the tidal portion of the Manokin River (Figure 11b). The discharge from the pipe was clear and there was no odor. The pipe outfall was given a moderate severity rating.

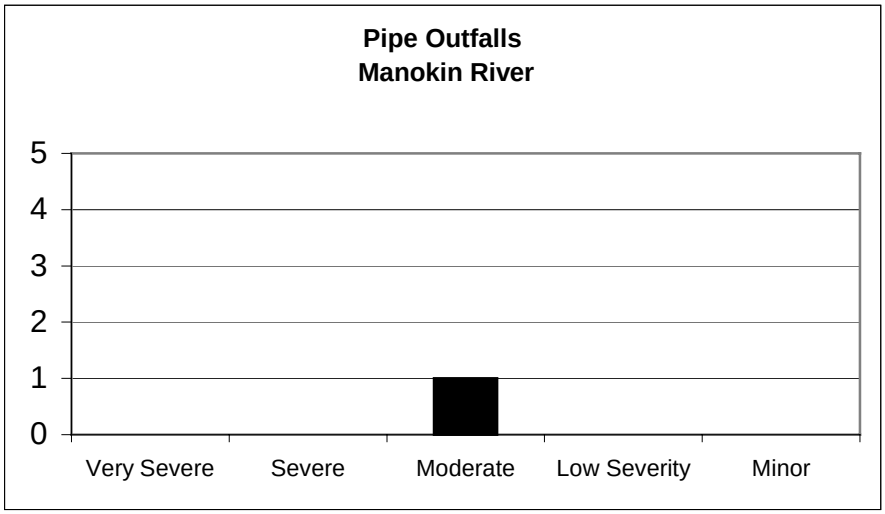

Figure 11a: Histograph showing the frequency of severity ratings given to pipe outfall sites during the Manokin SCA survey.

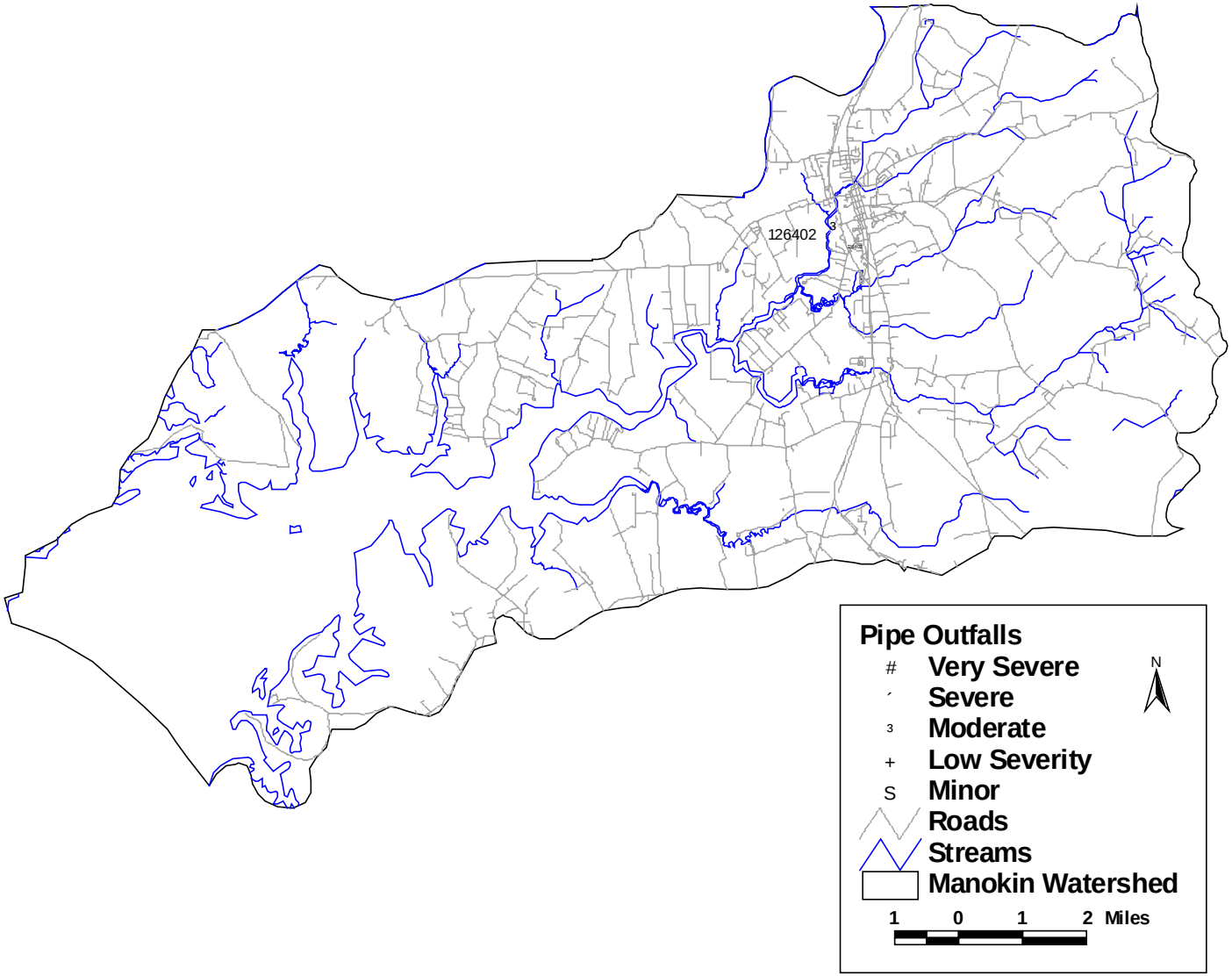

Figure 11b: Manokin River Watershed Pipe Outfalls.

In/Near Stream Construction Sites

In or near stream construction data sheets are used to document the locations of construction disturbances seen by the survey teams inside or near the stream corridor. Survey team members are not trained sediment inspectors but as part of their training they do receive a quick review of the different type of sediment control measures they may see while doing a SCA survey. Survey teams report evidence of inadequate sediment control measures or if sediment pollution from the site has affected the stream.

In or near stream construction was only reported at one site during the Manokin River survey. Site 112101 is a bridge construction project going over the Loretta Branch just above Princess Anne (Figure 12b), and was reported to have adequate sediment control. The site was given a minor severity rating (Figure 12a).

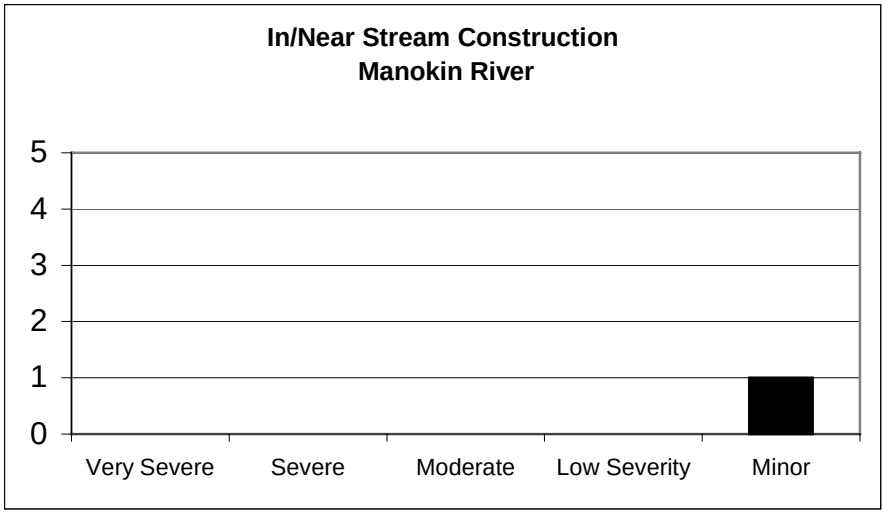

Figure 12a: Histograph showing the frequency of severity ratings given to in/near stream construction sites during the Manokin SCA survey.

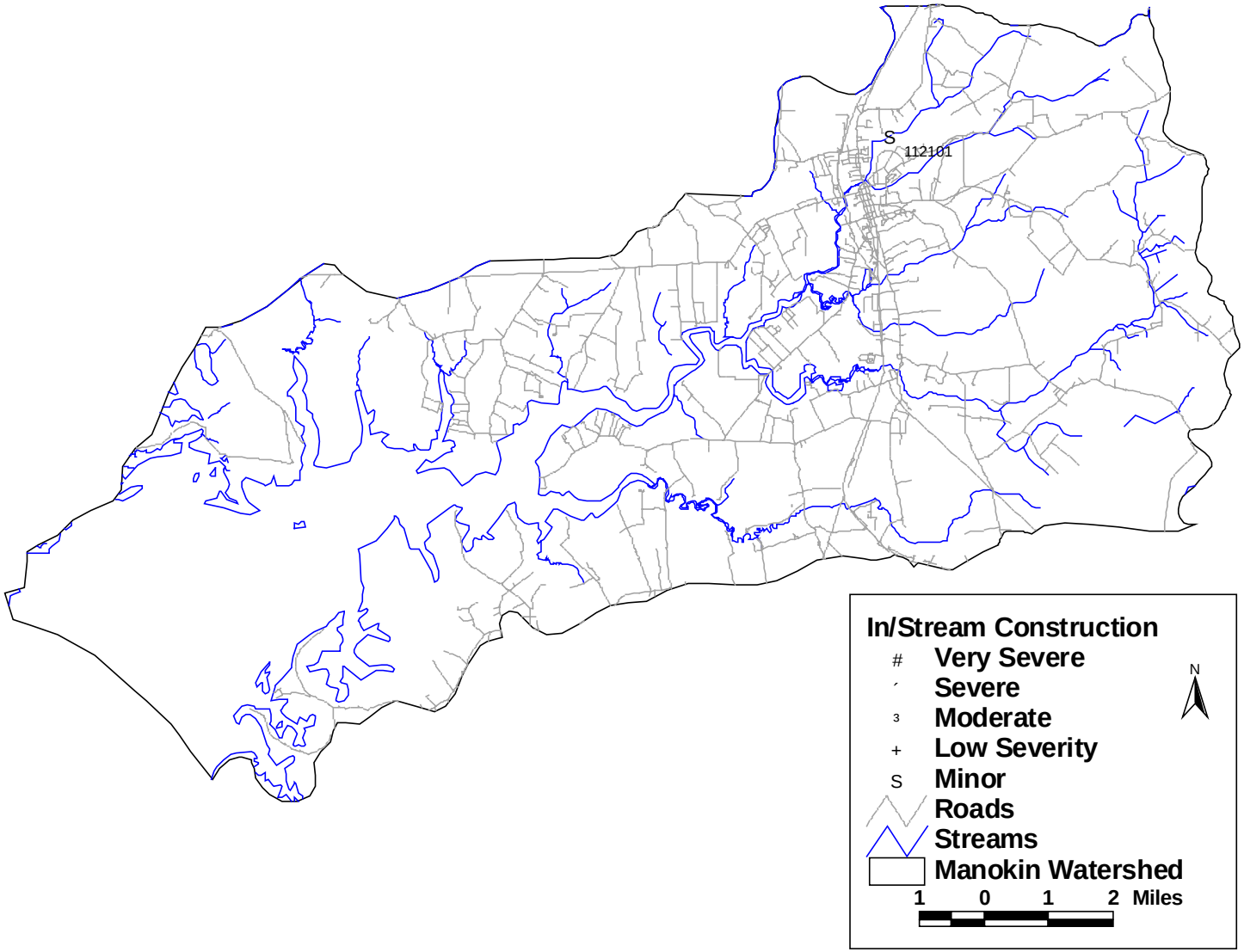

Figure 12b: Manokin River Watershed In/Near Stream Construction Sites.

Representative Sites

Representative sites are used to document the general condition of both in-stream habitat and the adjacent riparian (stream bank) corridor. The representative site evaluations procedures used during the survey are very similar to the habitat evaluations done as part of the Maryland Save-Our-Stream's Heartbeat Program and are based on the habitat assessment procedures outlined in EPA's rapid bioassessment protocols (Plafkin, et. al., 1989). At each representative site, data was collected on 10 separate parameters. Habitat parameters that were evaluated include:

* Attachment Sites for Macroinvertebrates
* Shelter for Fish
* Sediment Deposition
* Channel Flow Status
* Condition of Banks
* Embeddedness
* Channel Alteration
* Stream Velocity and Depth
* Bank Vegetation Protection
* Riparian Vegetative Zone Width

For each of the above habitat parameters, a rating of optimal, sub-optimal, marginal or poor was assigned based on the grading criteria developed for each parameter. In addition to the habitat ratings, data was collected on the stream's wetted width and pool depths at both runs and riffles at each representative site. Depth measurements were taken along the stream thalweg. At representative sites, field crews also indicated whether the bottom sediments in the area were primarily silts, sands, gravel, cobble, boulders, or bedrock.

Representative site evaluations were completed at approximately ½ mile intervals along the stream. Forty-two representative data sheets were filled out during this survey. Locations of representative sites are shown in Figure 13 and the data is presented in Appendix B The tidal regions in the Manokin River watershed have also been surveyed, and that information can be found in the tidal representative section.

Kings Creek, one of the larger tributaries draining into the Manokin River, tended to have higher ratings for conditions such as embeddedness, channel alteration, and velocity/depth. This suggests inadequate buffers, channel alterations, and erosion sites are predominant in this subwatershed. This is consistent with agricultural areas. Earth channels have historically been dug in this area to lower the high water table. This combined with plowing and mowing up to the bank of a stream can cause minor erosion.

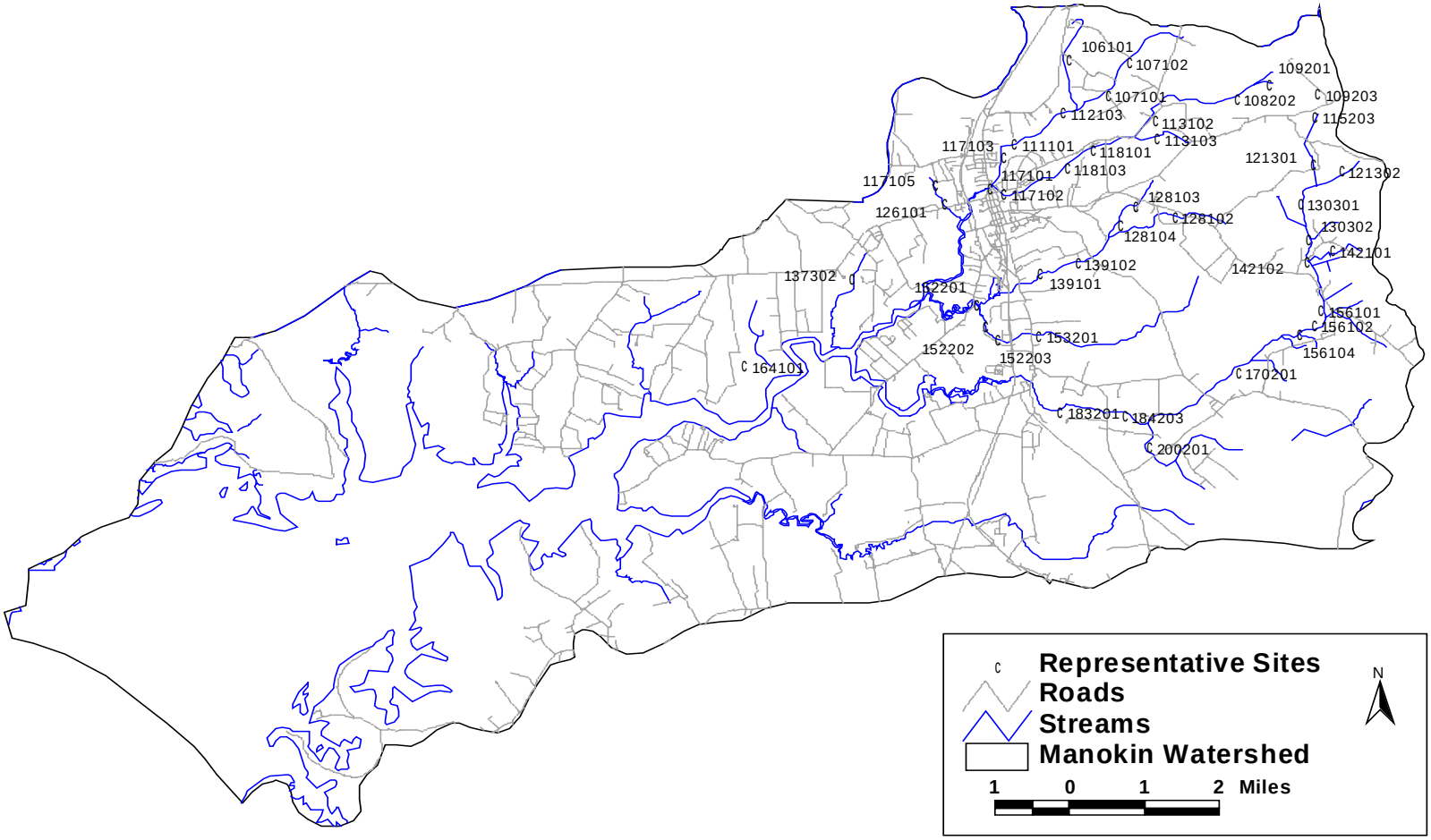

Figure 13: Manokin River Watershed Representative Sites.

Tidal Representative

As discussed in the methods section, the SCA survey was initially designed to be done along non-tidal streams and rivers. In the Manokin SCA survey there was an attempt to expand the survey to tidal waters. This was done using a jon boat that motored along the tidal shoreline of the Manokin River. Due to time constraints, the survey concentrated up the upper tidal portion of the Manokin River. At locations where erosion problems, altered shorelines or inadequate buffers were seen along the shoreline, an appropriate data sheet was filled out and a photograph taken. Periodically during the survey the field team also stopped and filled out a tidal representative data sheet. The main purpose of the tidal representative sites is to collect photo-documentation of general conditions at those sites.

There were 15 tidal representative sites in the Manokin SCA survey. The location of the sites can be seen in Figure 14. Seven tidal representative sites were taken in the Manokin River, 2 were taken at Back Creek, 2 were taken at King's Creek, 1 at Big Gut, 1 at St. Peter's Creek, 1 at Taylor Branch, and 1 at Wolftrap Creek.

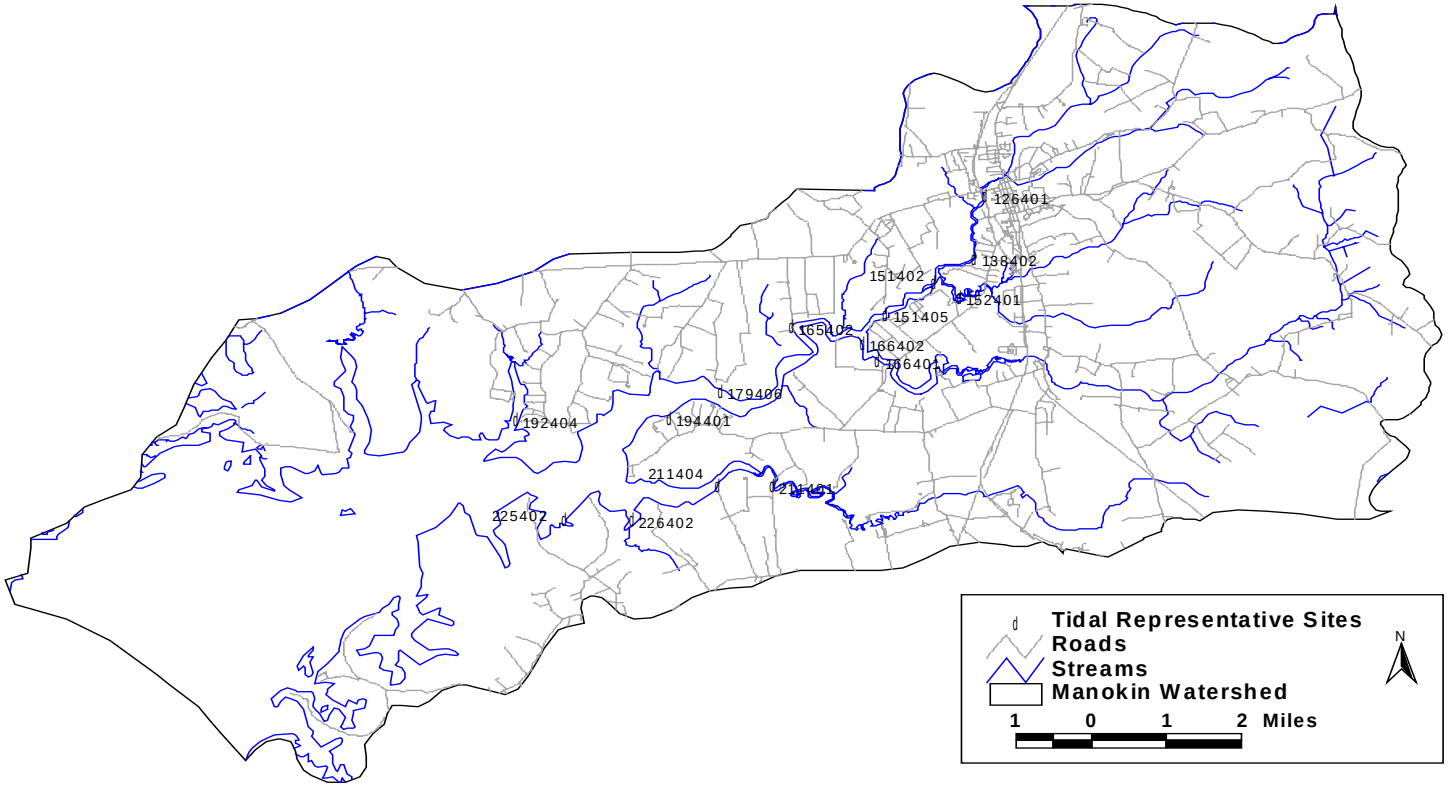

Figure 13: Manokin River Watershed Tidal Representative Sites.

DISCUSSION

The main purpose of the Manokin SCA survey was to examine the river and stream network, and identify potential environmental problems that may be present. The survey was done in the spring of 2001 and over 83 miles of stream were walked. In addition a boat survey of the tidal shoreline was also done. During the SCA survey, 109 potential environmental problem sites were identified. These include 59 inadequate buffers sites, 18 channel alteration sites, 14 altered shoreline sites, 7 erosion sites, 5 unusual condition sites, 4 fish migration blockages, 1 pipe outfall, and 1 active construction site near the stream.

Inadequate buffers were the most commonly environmental problem reported during this survey. Though most were given a low to minor severity rating, thirteen were given very severe ratings. This information has been given to the DNR's Somerset County Forester who will use the data to identify locations were stream and river-side buffers could be established.

Channel alteration was the second most frequently reported environmental problem in the survey. Most of the channel alteration sites can best be described as agricultural ditches. Agricultural ditching is extensive on Maryland's Eastern Shore and was done to improve the agricultural use of poorly drained land. Agricultural ditching dates back to 1789 in Maryland with the ditching of Long Marsh in Queen Anne's and Caroline County. During the early and middle part of the 1900's extensive ditching occurred throughout Maryland's Eastern Shore. As part of these ditching operations, Public Ditching Associations (PDAs) were establish to manage and maintain the ditching networks. There are over 100 Public Ditching Associations on Maryland's Eastern Shore managing an estimated 821 miles of channelized streams (PDA Taskforce, 2000). On top of the public ditch system, there are hundreds of more miles of roadside and farm ditches that drain into PDAs waterways.

The Public Ditching Associations routinely maintained their agricultural ditches by mowing along the ditches banks to prevent the grown of trees and other woody plants. It is not surprising then that the presence of inadequate stream buffers coincided with the presence of ditches at 11 sites.

Because of questions about the environmental effects of agricultural ditches on the Chesapeake Bay's aquatic resources, a Public Drainage Taskforce was formed in June of 1999. The Taskforce was made up representatives of both the environmental and agricultural communities. The task force was charged with developing, "recommendations, which would enhance the Eastern Shore environment and the agricultural community by considering changes in public land drainage" (Bell and Favero, 2000). In October 2000, the task force published their final report, which was entitled, "Moving Water." The report contained 7 general recommendations including a recommendation to form an interagency public drainage coordinating group (Bell and Favero, 2000). The interagency coordinating group is chaired by the Maryland Department of Agricultural and is presently looking at best management practices (BMPs) that should be used on agricultural ditches in Maryland. Additional information about the Pubic Drainage Taskforce and the work of the interagency coordination committee can be obtained from the Office of Resource Conservation at the Maryland Department of Agricultural in Annapolis, Maryland.

While the SCA survey was designed to be done on non-tidal streams there was some attempt to expand the survey to tidal water during this survey. The tidal survey was conducted from a jon boat and was done primarily in the upper tidal portion of the watershed. Results from the tidal survey found most

problem sites were at water front home locations where trees had been cleared between the house and the water to provide the home with a water view. At some of these site stone or concrete rubble were used to address erosion problems cause by the lack of trees along a portion of the shoreline.

Stream erosion problems were reported at 7 sites during the survey. Most of the erosion problems were considered to be fairly minor problems. Two sites, however, were given a moderate severity rating, and follow-up monitoring of these sites should be considered.

Four fish barriers were also identified during the SCA survey. The most significant barrier was at a USGS gauging weir near Princess Anne. In 2001, fish surveys by the University of Maryland Eastern Shore reported finding both adult and young-of-year river herring, white perch, and yellow perch in the Manokin Branch just below the weir. This information suggests that the weir is a blockage to anadromous fish. Follow up surveys are needed to determine how important the blockage is and if there is a significant amount of anadromous spawning habitat above the blockage.

The SCA survey has been developed by DNR's Watershed Restoration Division as a watershed management tool to both quickly assess the general condition of a stream corridor and to provide a list of potential environmental problems present within the corridor. One of the main goals of the SCA survey is to provide some basic information about each problem so that future restoration efforts can be better targeted. It is hoped that now that a SCA survey has been completed for the Manokin River watershed, a dialog can continue among resource managers on the goals and targets of future restoration efforts in the watershed. It is important to note that all of the problems identified in this survey can be addressed through existing State and Local Government programs. The value of the survey is that it can help place the problems in a watershed context and can be used by a variety of resource managers to plan future restoration work.

As mentioned earlier, the Maryland Dept. of Natural Resources has formed a partnership with Somerset County to develop a Watershed Restoration Action Strategy (WRAS) for the Manokin River watershed. Results from this survey will be combined with other information about the area to help establish priorities for the types and location of restoration projects that will be pursued in the Manokin River Watershed in the future. Information on the Manokin River Watershed Action Strategy can be found on DNR's site (www.dnr.state.md.us/watersheds/surf/proj/wras.html) or by contacting the Somerset County Department of Public Works in Princess Anne, Maryland.

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Appendix A

Listing of sites by site number

Appendix A– Manokin River Watershed

Site ID	Problem	Severity	Correctability	Access	Location	X Coordinates	Y Coordinates
MK106101	Representative Site				Loretta Branch	516036.00640	63859.04308
MK107101	Comment				Loretta Branch	516960.12738	63097.33629
MK107101	Inadequate Buffers	1	1	2	Loretta Branch	516916.13486	63063.49589
MK107101	Representative Site				Loretta Branch	516870.69482	63028.81436
MK107102	Representative Site				Loretta Branch	517332.37182	63794.44860
MK108201	Channel Alteration	4	4	1	Manokin Branch	518841.65381	62887.52579
MK108201	Inadequate Buffers	1	2	1	Manokin Branch	518889.03037	62884.49589
MK108202	Channel Alteration	2	2	2	Manokin Branch	519701.20005	62941.67043
MK108202	Representative Site				Manokin Branch	519650.43945	62931.51831
MK109201	Representative Site				Manokin Branch	520347.55175	63269.92235
MK109202	Erosion Site	3	3	1	Manokin Branch	520861.92588	64038.09950
MK109203	Channel Alteration	2	3	1	Kings Creek	521376.30001	63019.50336
MK109203	Inadequate Buffers	1	2	1	Kings Creek	521440.59678	63060.11185
MK109203	Representative Site				Kings Creek	521410.14042	63043.19164
MK111101	Representative Site				Loretta Branch	514868.79046	61845.24137
MK112101	In/Near Stream Construction	5			Loretta Branch	514990.61591	61878.06656
MK112101	Inadequate Buffers	2	2	1	Loretta Banch	514963.54359	61861.82316
MK112102	Channel Alteration	5	4	2	Loretta Branch	515643.05888	62232.71399
MK112102	Comment				Loretta Branch	515624.10826	62211.05613
MK112102	Fish Barrier	3	3	2	Loretta Branch	505602.45040	62189.39827
MK112102	Inadequate Buffers	1	3	2	Loretta Banch	515659.30228	62254.37184
MK112103	Representative Site				Loretta Branch	515908.36765	62576.53248
MK112104	Inadequate Buffers	3	1	2	Loretta Banch	516306.33079	62668.57838
MK113102	Representative Site				Manokin Branch	517890.06166	62378.90453
MK113103	Representative Site				Manokin Branch	517930.67015	61961.99076
MK114101	Channel Alteration	2	3	1	Manokin Branch	518556.04080	61970.11246
MK114101	Inadequate Buffers	1	2	1	Manokin Branch	518577.69866	61956.57629
MK115201	Erosion Site	5	3	3	Kings Creek	521090.01020	61986.35585
MK115202	Comment				Kings Creek	521122.49699	62013.42817
MK115203	Channel Alteration	3	1	2	Kings Creek	521352.61173	62519.68061
MK115203	Inadequate Buffers	3	1	2	Manokin Branch	521322.83218	62465.53596
MK115203	Representative Site				Kings Creek	521336.36834	62492.60828
MK115301	Erosion Site	5	3	2	Kings Creek	521090.01020	61932.21120
MK117101	Representative Site				Loretta Branch	514319.22231	60770.80856
MK117102	Representative Site				Manokin Branch	514633.26125	60632.73972
MK117103	Representative Site				Loretta Branch	514638.67571	61507.17574
MK117104	Channel Alteration	4	4	1	Manokin River	514238.00534	60738.32177
MK117105	Channel Alteration	4	5	1	Wesley Branch	513146.99074	60884.51232
MK117105	Fish Barrier	5	5	1	Wesley Branch	513155.11243	60946.77866
MK117105	Representative Site				Wesley Branch	513165.94163	60862.85446
MK117105	Unusual Condition	4	4	1	Wesley Branch	513146.99074	60916.99910
MK118101	Inadequate Buffers	1	1	1	Kings Creek	516579.76125	61688.56030
MK118101	Representative Site				Manokin Branch	516552.68893	61672.31691
MK118102	Fish Barrier	2	4	1	Manokin Branch	516360.47543	61555.11243
MK118103	Representative Site				Manokin Branch	515997.70631	61244.57421

Appendix A Manokin River Watershed

Site ID	Problem	Severity	Correctability	Access	Location	X Coordinates	Y Coordinates
MK118104	Inadequate Buffers	3	1	1	Manokin Branch	515199.07279	60749.15070
MK121301	Channel Alteration	3	1	2	Kings Creek	521268.68753	61450.32386
MK121301	Erosion Site	3	3	2	Kings Creek	521276.80923	61390.76475
MK121301	Inadequate Buffers	5	1	1	Manokin Branch	521274.10200	61420.54431
MK121301	Representative Site				Kings Creek	521282.22369	61352.86350
MK121302	Representative Site				Kings Creek	521910.30158	61185.01510
MK121303	Comment				Kings Creek	521466.31549	60963.02205
MK121304	Inadequate Buffers	3	1	3	Kings Creek	521274.10200	60654.39757
MK126101	Representative Site				Wesley Branch	513344.61869	60410.74667
MK126401	Tidal Representative				Manokin River	513966.91198	60286.52066
MK126402	Inadequate Buffers	5	2	1	Kings Creek	513807.18528	59650.32108
MK126402	Pipe Outfall	3	3	1	Manokin River	513804.47805	59628.66322
MK126403	Inadequate Buffers	5	4	1	Manokin River	513715.13938	59398.54848
MK128101	Unusual Condition	5	1	2	Lower Broughton Branch	517681.60478	59763.71816
MK128102	Representative Site				Lower Broughton Branch	518317.80436	60080.46433
MK128103	Representative Site				White Marsh Branch	517478.56236	60326.82247
MK128104	Channel Alteration	3	1	4	Whitemarsh Branch	517113.08600	59844.93513
MK128104	Representative Site				White Marsh Branch	517137.45110	59869.30022
MK129101	Inadequate Buffers	1	3	1	Manokin River	518824.05680	60110.24389
MK130301	Representative Site				Kings Creek	521022.32940	60394.50328
MK130302	Representative Site				Kings Creek	521190.17780	59511.94556
MK13102	Inadequate Buffers	1	4	1	Lower Broughton Branch	517909.01229	62400.56239
MK137301	Inadequate Buffers	1	3	1	Hall Branch	511522.28125	58962.68409
MK137302	Representative Site				Hall Branch	511354.43285	58583.67157
MK137401	Inadequate Buffers	4	4	1	Manokin River	512913.79863	58469.96781
MK137402	Inadequate Buffers	5	3	1	Manokin River	512932.74926	58329.19174
MK138401	Inadequate Buffers	4	4	1	Manokin River	513661.55028	59274.26393
MK138402	Tidal Representative				Manokin River	513715.64575	58698.53355
MK138403	Altered Shoreline	3	3	1	Manokin River	513352.43329	58536.24713
MK138403	Inadequate Buffers	5	4	1	Manokin River	513321.52159	58547.83902
MK139101	Representative Site				Taylor Branch	515418.00994	58688.02518
MK139102	Representative Site				Taylor Branch	516225.68105	58968.78704
MK139103	Inadequate Buffers	2	1	1	Taylor Branch	516352.60079	58961.09494
MK142101	Erosion Site	4	2	2	Kings Creek	521740.92088	59280.31733
MK142101	Representative Site				Kings Creek	521710.15246	59268.77917
MK142102	Representative Site				Kings Creek	521176.85900	58988.01731
MK142103	Channel Alteration	2	2	1	Kings Creek	521637.07745	58984.17125
MK142103	Inadequate Buffers	1	2	1	Kings Creek	521471.69718	58926.48046
MK142104	Inadequate Buffers	5	1	1	Kings Creek	521737.07483	58288.03568
MK146101	Comment				Geanqukin Creek	502733.72753	57238.06325
MK148401	Comment				Goose Creek	506649.00937	57288.06193
MK150401	Comment				Hall Branch	511114.27677	58261.11331
MK151401	Inadequate Buffers	5	3	1	Taylor Branch	513044.99531	58068.81067
MK151402	Tidal Representative				Manokin River	512848.84662	58080.34883

Appendix A– Manokin River Watershed

Site ID	Problem	Severity	Correctability	Access	Location	X Coordinates	Y Coordinates
MK151403	Altered Shoreline	3	3	1	Manokin River	512206.55579	57618.82248
MK151403	Inadequate Buffers	5	3	1	Manokin River	512202.70973	57653.53696
MK151404	Inadequate Buffers	5	3	1	Manokin River	511787.33602	57449.59615
MK151405	Inadequate Buffers	4	3	1	Manokin River	511837.33471	57264.98562
MK151405	Tidal Representative				Manokin River	511825.79655	57234.21719
MK151406	Inadequate Buffers	4	3	1	Manokin River	511575.80311	57334.21457
MK151407	Inadequate Buffers	5	3	1	Manokin River	511391.19257	57161.14219
MK152201	Representative Site				Taylor Branch	514037.27696	57949.58303
MK152202	Representative Site				Jones Creek	514229.57960	57414.98168
MK152203	Representative Site				Taylor Branch	514498.80330	57080.37508
MK152401	Tidal Representative				Taylor Branch	513391.14007	57688.05143
MK153201	Representative Site				Taylor Branch	515391.08757	57191.91061
MK156101	Representative Site				Kings Creek	521467.46652	57827.66315
MK156102	Representative Site				Kings Creek	521332.08546	57449.21155
MK156103	Erosion Site	5	2	3	Kings Creek	521169.01282	57415.36628
MK156104	Representative Site				Kings Creek	520999.78649	57224.60206
MK156105	Erosion Site	4	2	3	Kings Creek	520701.33279	57239.98627
MK156106	Inadequate Buffers	1	2	1	Kings Creek	521882.84023	57916.89158
MK161401	Comment				St. Peter's Creek	503640.24220	56772.30624
MK162401	Comment				St. Peter's Creek	504554.06436	56673.84729
MK164101	Inadequate Buffers	2	2	1	Manokin River	509049.33097	56415.39253
MK164101	Representative Site				Manokin River	509040.10045	56461.54517
MK165401	Altered Shoreline	4	3	1	Manokin River	509978.53735	57089.22100
MK165401	Inadequate Buffers	4	3	1	Manokin River	509944.69208	57079.99047
MK165402	Inadequate Buffers	3	4	1	Manokin River	509781.61944	56947.68625
MK165402	Tidal Representative				Manokin River	509818.54155	56941.53257
MK166401	Inadequate Buffers	5	3	1	Kings Creek	511692.33851	56073.86304
MK166401	Tidal Representative				Kings Creek	511664.64693	56086.17041
MK166402	Tidal Representative				Kings Creek	511338.50165	56520.00517
MK170201	Representative Site				Kings Creek	519679.82114	56298.47253
MK172101	Channel Alteration	2	3	1	Kings Creek	522421.95474	57180.64660
MK172101	Inadequate Buffers	1	2	1	Kings Creek	522424.39395	57167.21577
MK178401	Inadequate Buffers	5	3	1	Manokin River	507630.90667	54963.12297
MK178402	Altered Shoreline	4	4	1	Manokin River	507504.75614	55396.95773
MK178402	Inadequate Buffers	5	3	1	Manokin River	507532.44772	55403.11142
MK178403	Inadequate Buffers	5	3	1	Manokin River	507080.15190	55550.79985
MK179401	Comment				Manokin River	508615.49621	55446.18721
MK179402	Altered Shoreline	4	3	1	Manokin River	509369.32257	54901.58612
MK179402	Inadequate Buffers	5	3	1	Manokin River	509353.93836	54880.04822
MK179403	Altered Shoreline	5	4	1	Manokin River	508400.11725	54772.35874
MK179403	Inadequate Buffers	4	3	1	Manokin River	508418.57830	54747.74400
MK179404	Altered Shoreline	4	4	1	Manokin River	508255.50566	54883.12507
MK179405	Inadequate Buffers	5	3	1	Manokin River	508107.81723	54947.73875
MK179406	Inadequate Buffers	5	3	1	Manokin River	508286.27408	55316.95983
MK179406	Tidal Representative				Manokin River	508313.96566	55301.57562

Appendix A Manokin River Watershed

Site ID	Problem	Severity	Correctability	Access	Location	X Coordinates	Y Coordinates
MK183201	Representative Site				Kings Creek	515836.84510	55369.26615
MK184201	Channel Alteration	3	3	2	Kings Creek	518430.62317	55246.19246
MK184201	Inadequate Buffers	2	1	2	Kings Creek	518461.39159	55267.73035
MK184202	Channel Alteration	4	4	2	Kings Creek	517907.55997	55150.81035
MK184203	Representative Site				Kings Creek	517236.80835	55252.34614
MK185201	Unusual Condition	5	1	2	Moore Branch	519052.14532	54646.20821
MK192401	Inadequate Buffers	4	3	1	St. Peter's Creek	503301.78955	53683.15657
MK192402	Comment				St. Peter's Creek	503751.00852	53812.38394
MK192403	Comment				St. Peter's Creek	503827.92958	53898.53553
MK192404	Tidal Representative				St. Peter's Creek	503954.08011	54556.97978
MK192405	Inadequate Buffers	5	3	1	Manokin River	504012.54012	54384.67661
MK192406	Altered Shoreline	4	4	1	St. Peter's Branch	503634.08851	54400.06082
MK192406	Inadequate Buffers	4	3	1	Manokin River	503605.62746	54369.29240
MK192407	Inadequate Buffers	4	3	1	Manokin River	504043.30854	54166.22081
MK194101	Channel Alteration	3	2	1	Manokin River	507255.53191	54116.99133
MK194101	Inadequate Buffers	4	2	1	Manokin River	507430.91192	54184.68186
MK194401	Inadequate Buffers	5	3	1	Manokin River	507160.14980	54590.82505
MK194401	Tidal Representative				Manokin River	507197.07191	54590.82505
MK200201	Representative Site				Moore Branch	517775.25575	54513.90399
MK200202	Fish Barrier	5	2	2	Moore Branch	518286.01158	518286.01158
MK210101	Comment				Back Creek	507187.84138	53110.86390
MK210401	Altered Shoreline	5	4	1	Manokin River	506295.55711	53178.55443
MK210401	Inadequate Buffers	4	3	1	Manokin River	506286.32658	53144.70916
MK210402	Altered Shoreline	4	4	1	Manokin River	506270.94237	52923.17652
MK211401	Inadequate Buffers	4	3	1	Back Creek	509409.32152	52861.63967
MK211401	Tidal Representative				Back Creek	509403.16784	52889.33125
MK211402	Altered Shoreline	3	5	1	Back Creek	509403.16784	53021.63547
MK211402	Inadequate Buffers	3	5	1	Back Creek	509406.24468	52981.63652
MK211403	Altered Shoreline	4	3	1	Back Creek	509295.47836	53295.47444
MK211403	Inadequate Buffers	5	3	1	Back Creek	509317.01625	53317.01233
MK211404	Tidal Representative				Back Creek	508252.42882	52883.17757
MK214101	Unusual Condition	4	4	1	Back Creek	514209.19552	52695.49019
MK216101	Unusual Condition	5	1	4	Back Creek	517326.03678	52981.63652
MK225401	Inadequate Buffers	5	3	1	Wolftrap Creek	505224.81599	52280.11647
MK225402	Tidal Representative				Wolftrap Creek	504969.43808	52027.81541
MK225403	Altered Shoreline	5	4	1	Wolftrap Creek	504372.53067	52224.73331
MK225403	Inadequate Buffers	5	3	1	Wolftrap Creek	504372.45354	52224.78687
MK226401	Inadequate Buffers	5	3	1	Back Creek	507329.37612	52270.88595
MK226402	Tidal Representative				Big Gut	506409.40027	52024.73856
MK226403	Altered Shoreline	5	4	1	Big Gut	506264.78869	52246.27121
MK226403	Inadequate Buffers	4	3	1	Back Creek	506227.86658	52237.04068
MK227101	Channel Alteration	3	2	1	Big Gut	508806.26043	51169.37640
MK231101	Comment				Back Creek	515163.01664	51855.51224
MK239101	Channel Alteration	3	1	1	Wolftrap Creek	505510.96232	50535.54689
MK239101	Comment				Wolftrap Creek	505550.96127	50566.31531

Appendix A– Manokin River Watershed

Site ID	Problem	Severity	Correctability	Access	Location	X Coordinates	Y Coordinates
MK253201	Channel Alteration	2	2	1	Broad Creek	503991.00222	47994.07514
MK253201	Inadequate Buffers	1	4	1	Teague Creek	504024.84749	47960.22988

Appendix B

Listing of sites by problem category

Inadequate Buffers -- Manokin River Watershed

Problem	Site ID	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	LandUseRight	LandUseLeft	RecentlyestablishedLivestock	Severity	Correctability	Access
Inadequate Buffer	MK107101	Both	Neither	0	0	7000	7000	Forest	Forest	No	No	1	1	2
Inadequate Buffer	MK108201	Both	Both	0	0	2500	1500	Crop field	Crop field	No	No	1	2	1
Inadequate Buffer	MK109203	Both	Both	0	0	4500	4500	Pasture	Pasture	No	No	1	2	1
Inadequate Buffer	MK112102	Right	Neither	100	0	0	10500	Crop field	Forest	No	No	1	3	2
Inadequate Buffer	MK113102	Both	Both	0	0	3000	3000	Crop field	Paved	No	No	1	4	1
Inadequate Buffer	MK114101	Both	Both	0	0	1500	1500	Crop field	Crop field	No	No	1	2	1
Inadequate Buffer	MK118101	Both	Both	0	0	1500	1500	Lawn	Crop field	No	No	1	1	1
Inadequate Buffer	MK129101	Both	Both	0	0	3000	3000	Pasture	Pasture	No	Cattle	1	3	1
Inadequate Buffer	MK137301	Both	Both	0	0	1250	1250	Crop field	Crop field	No	No	1	3	1
Inadequate Buffer	MK142103	Both	Both	0	5	3000	3000	Crop field	Crop field	No	Cattle	1	2	1
Inadequate Buffer	MK156106	Both	Both	0	0	2500	2500	Crop field	Crop field	No	No	1	2	1
Inadequate Buffer	MK172101	Both	Both	0	0	3000	3000	Crop field	Crop field	No	No	1	2	1
Inadequate Buffer	MK253201	Both	Both	0	0	2000	2000	Marsh	Marsh	No	No	1	4	1
Inadequate Buffer	MK112101	Both	Both	0	0	300	300	Construction	Construction	No	No	2	2	1
Inadequate Buffer	MK139103	Both	Both	0	0	500	500	Lawn	Lawn	No	No	2	1	1
Inadequate Buffer	MK164101	Right	Right	100	0	0	1500	Crop field	Forest	No	No	2	2	1
Inadequate Buffer	MK184201	Left	Left	0	100	400	0	Forest	Crop field	No	No	2	1	2
Inadequate Buffer	MK112104	Left	Neither	0	100	500	0	Forest	Timbercut	Yes	No	3	1	2
Inadequate Buffer	MK115203	Both	Both	2	2	2500	2500	Shrubs & small trees	Clearcut	No	No	3	1	2
Inadequate Buffer	MK118104	Right	Right	50	0	0	500	Lawn	Forest	No	No	3	1	1
Inadequate Buffer	MK121304	Both	Both	0	0	2000	2000	Shrubs & small trees	Shrubs & small trees	No	No	3	1	3
Inadequate Buffer	MK165402	Right	Right		10		1000	Lawn	Crop field	No	No	3	4	1
Inadequate Buffer	MK211402	Left	Left	10		400		Marsh	Paved	No	No	3	5	1
Inadequate Buffer	MK137401	Right	Right		10		300	Lawn	Marsh	No	No	4	4	1
Inadequate Buffer	MK138401	Left	Left	20		120		No Info	Lawn	No	No	4	4	1
Inadequate Buffer	MK151405	Left	Left	10		400		Marsh	Lawn	No	No	4	3	1
Inadequate Buffer	MK151406	Right	Right		10		400	Lawn	Marsh	No	No	4	3	1
Inadequate Buffer	MK165401	Right	Right		15		800	Lawn	Marsh	No	No	4	3	1
Inadequate Buffer	MK179403	Left	Left	10		3000		Marsh	Lawn	No	No	4	3	1
Inadequate Buffer	MK192401	Right	Right		10		3000	Lawn	Marsh	No	No	4	3	1
Inadequate Buffer	MK192406	Left	Left	5		400		Marsh	Lawn	No	No	4	3	1
Inadequate Buffer	MK192407	Left	Left	10		1000		No info	Lawn	No	No	4	3	1

Inadequate Buffers -- Manokin River Watershed

Problem	Site ID	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	LandUseRight	LandUseLeft	RecentlyestablishedLivestock	Severity	Correctability	Access
Inadequate Buffer	MK194101	Both	Both	5	5	3500	3500	Crop field	Crop field	No	No	4	2	1
Inadequate Buffer	MK210401	Left	Left	10		800		Marsh	Lawn	No	No	4	3	1
Inadequate Buffer	MK211401	Right	Right		10		400	Crop field	Marsh	No	No	4	3	1
Inadequate Buffer	MK226403	Left	Left	10		100		Marsh	Lawn	No	No	4	3	1
Inadequate Buffer	MK121301	Left	Left	0	100	3000	0	Forest	Clearcut	No	No	5	1	2
Inadequate Buffer	MK126402	Left	Left	20		100		No Info	Sewage Tx Plant	No	No	5	2	1
Inadequate Buffer	MK126403	Left	Left	20		60		Marsh	Lawn	No	No	5	4	1
Inadequate Buffer	MK137402	Left	Left	5		60		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK138403	Left	Left	0		160		No Info	Lawn	No	No	5	4	1
Inadequate Buffer	MK142104	Both	Neither	5	5	2000	2000	Crop field	Crop field	No	No	5	1	1
Inadequate Buffer	MK151401	Right	Right		10		100	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK151403	Left	Left	0		150		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK151404	Right	Right		10		100	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK151407	Left	Left	10		200		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK166401	Left	Left	30		200		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK178401	Right	Right		0		100	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK178402	Left	Left	15		150		Forest	Lawn	No	No	5	3	1
Inadequate Buffer	MK178403	Right	Right		10		100	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK179402	Left	Left	0		300		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK179405	Left	Left	5		200		No Info	Lawn	No	No	5	3	1
Inadequate Buffer	MK179406	Left	Left	0		300		No Info	Lawn	No	No	5	3	1
Inadequate Buffer	MK192405	Right	Right		5		50	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK194401	Left	Left	20		100		Marsh	Lawn	No	No	5	3	1
Inadequate Buffer	MK211403	Right	Right		0		100	Lawn	Marsh	No	No	5	3	1
Inadequate Buffer	MK225401	Left	Left	20		60		No Info	Lawn	No	No	5	3	1
Inadequate Buffer	MK225403	Left	Left	10		50		No Info	Lawn	No	No	5	3	1
Inadequate Buffer	MK226401	Left	Left	20		80		Marsh	Lawn	No	No	5	3	1

Channel Alterations -- Manokin River Watershed

Problem	Site ID	Type	BottomWidth(ft)	Length(ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	LengthAbove(ft)	LengthBelow(ft)	Severity	Correctability	Access
Channel Alteration	MK108202	Earth channel	120	2500	Yes	No	No	No	0	0	2	2	2
Channel Alteration	MK109203	Earth channel	96	4500	Yes	No	No	No	0	0	2	3	1
Channel Alteration	MK114101	Earth channel	120	1500	Yes	Yes	Yes	No	0	0	2	3	1
Channel Alteration	MK142103	Earth channel	84	2000	Yes	Yes	Yes	No	0	0	2	2	1
Channel Alteration	MK172101	Earth channel	96	3000	Yes	Yes	Yes	No	0	0	2	3	1
Channel Alteration	MK253201	Earth channel	36	2000	Yes	No	No	No	0	0	2	2	1
Channel Alteration	MK115203	Earth channel	48	2500	Yes	No	No	No	0	0	3	1	2
Channel Alteration	MK121301	Earth channel	60	3000	Yes	Yes	No	No	0	0	3	1	2
Channel Alteration	MK128104	Earth channel	60	1500	Yes	Yes	No	No	0	0	3	1	4
Channel Alteration	MK184201	Earth channel	36	350	Yes	Yes	No	No	0	0	3	3	2
Channel Alteration	MK194101	Earth channel	60	3500	Yes	Yes	Yes	No	0	0	3	2	1
Channel Alteration	MK227101	Earth channel	40	4500	Yes	Yes	Yes	No	0	0	3	2	1
Channel Alteration	MK239101	Earth channel	66	8500	Yes	Yes	Yes	No	0	0	3	1	1
Channel Alteration	MK108201	Rip-Rap	132	50	Yes	No	No	No	0	0	4	4	1
Channel Alteration	MK117104	Rip-Rap	300	80	Yes	No	No	No	0	0	4	4	1
Channel Alteration	MK117105	Earth channel	480	2000	Yes	No	No	No	0	0	4	5	1
Channel Alteration	MK184202	Concrete Rubble	84	75	Yes	Yes	No	No	0	0	4	4	2
Channel Alteration	MK112102	Rip-rap	144	100	Yes	No	No	No	0	0	5	4	2

Altered Shorelines -- Manokin River Watershed

Problem	Site ID	Type	Length (ft)	Land Use Above Site	Severity	Correctability	Access
Altered Shoreline	MK138403	Wood bulkhead	160	Lawn	3	3	1
Altered Shoreline	MK151403	Concrete rubble	150	Lawn	3	3	1
Altered Shoreline	MK211402	Broken concrete	400	Paved road	3	5	1
Altered Shoreline	MK165401	Concrete rubble	300	Lawn	4	3	1
Altered Shoreline	MK178402	Concrete rubble	300	Lawn	4	4	1
Altered Shoreline	MK179402	Bulkhead/rip-rap/concrete rubble	160	Lawn	4	3	1
Altered Shoreline	MK179404	Wood bulkhead	500	Lawn	4	4	1
Altered Shoreline	MK192406	Bulkhead/rip-rap	200	Lawn	4	4	1
Altered Shoreline	MK210402	Rip-rap	300	Lawn	4	4	1
Altered Shoreline	MK211403	Concrete rubble	100	Lawn	4	3	1
Altered Shoreline	MK179403	Rip-rap	200	Lawn	5	4	1
Altered Shoreline	MK210401	Sandy beach	500	Public park	5	4	1
Altered Shoreline	MK225403	Rip-rap	50	Lawn	5	4	1
Altered Shoreline	MK226403	Concrete rubble	50	Lawn	5	4	1

Erosion Sites -- Manokin River Watershed

Problem	Site ID	Type	Possible Cause	Length(ft)	Height(ft)	Landuseright	Landuseleft	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	MK109202	Downcutting	Below channelization	1000	5.5	Forest	Forest	No		3	4	1
Erosion	MK121301	Downcutting	Below channelization	3000	4	Forest	Forest	No		3	5	2
Erosion	MK142101	Downcutting	Other	3000	2	Forest	Forest	No		4	5	2
Erosion	MK156105	Widening	natural	250	5.5	Forest	Forest	No		4	2	3
Erosion	MK115201	Widening	Below road crossing	25	6	Forest	Forest	No		5	3	3
Erosion	MK115301	Widening	Bend at steep slope	30	7	Forest	Forest	No		5	3	2
Erosion	MK156103	Widening	natural	30	5.5	Forest	Forest	No		5	2	3

Unusual Conditions\Comments -- Manokin River Watershed

Problem	Site ID	Type	Description	Potential Cause	Severity	Correctability	Access
Unusual Condition	MK117105	Algae	orange algae on the right side of the stream when looking upstream.	unknown, probably natural	4	4	1
Unusual Condition	MK214101	other	marsh/ stream blocked to create pond. Pond with stagnant water	unknown	4	4	1
Unusual Condition	MK128101	other	metal pipe in the middle of the stream. Approximately 25 feet in length. Stream in good shape otherwise, meanders nicely.	time- probably once a drainage pipe for ag field.	5	1	2
Unusual Condition	MK185201	other	no stream in stream bed. Dry about 6000 ft.	natural	5	1	2
Unusual Condition	MK216101	other	stream bed dry, approximate distance 13,500 ft		5	1	4
Comment	MK107101	other	long stretch of stream with inadequate buffer. Buffer present but set back approximately 20 feet from stream. 7000 ft in length.	access roads for crop fields			
Comment	MK112102	other	long stretch of stream (2-3 miles) with left side of stream unbuffered. Stream shaded most of the way, with room for trees to be planted.	agricultural			
Comment	MK115202	ditching	freshly dug ditch follows along entire road then joins to stream. In both directions. Still has dirt pile on sides where it was dug. Has flow	agricultural			
Comment	MK121303	other	new road, probably logging, put in that crosses stream. New channelized ditches along roadside coming off of stream. Lots of grown over clear cut areas on and around stream. Heard logging operation in the distance.				
Comment	MK146101	other	all wetlands/tidal area. 1200 ft.	natural			
Comment	MK148401	other	goose creek. Tidal marsh, end of stream, entering into manokin river bed. Starts at 8 ft wide and opens into open water. Appears not to be a maintained channelized area. Surrounded by marsh vegetation/wetlands	natural			

Unusual Conditions\Comments -- Manokin River Watershed

Problem	Site ID	Type	Description	Potential Cause	Severity	Correctability	Access
Comment	MK150401	other	stream opens up into tidal marsh from this point. Hall branch towards Manokin mainstem. 45 ft in width	natural			
Comment	MK161401	other	tidal marsh 3000 ft to open water at st. james creek. Approximately 8 ft wide	natural			
Comment	MK162401	other	tidal marsh 9000 ft to open water at st. peter's creek. Approximately 8 ft wide, widening to 100 ft at st. peters creek.	natural			
Comment	MK179401	other	2800 ft tidal leading into open water at mainstem manokin. 6 ft wide and 6 ft deep. Tidal marsh all around, not maintained. Farm field on left and meadow on right	natural			
Comment	MK192402	other	marina, public boat launch area				
Comment	MK192403	other	crab shed				
Comment	MK210101	other	all wetlands, no stream. 1200 ft in length	natural			
Comment	MK231101	other	dry stream, becomes marsh	natural			
Comment	MK239101	other	all wetlands/ 8500 ft	natural			

Fish Barriers -- Manokin River Watershed

Problem	Site ID	Blockage	Type	Reason	Drop(In)	Depth(In)	Severity	Correctability	Access
Fish Barrier	MK118102	Total	Weir	Too high	48		2	4	1
Fish Barrier	MK112102	Total	Weir	Too high	24		3	3	2
Fish Barrier	MK117105	Total	Pond	Too shallow		12	5	5	1
Fish Barrier	MK200202	Temporary	Other/natural	Too shallow		0	5	2	2

Pipe Outfalls -- Manokin River Watershed

Problem	Site ID	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Purpose	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	MK126402	other	Smooth Metal Pipe	Left bank	10	10	Sewage	TRUE	Clear	None	3	3	1

In\Near Stream Construction -- Manokin River Watershed

Problem	Site ID	Type of Activity	Sediment Control	Why, if inadequate	Excess Sediment?	Length	Company	Severity
In/Near Stream Construction	MK112101	Road crossing	Adequate		No	300	unknown	5

Representative Sites A -- Manokin River Watershed

Problem	Site ID	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Hall Branch											
Representative Site	MK137302	Poor	Poor	Poor	Suboptimal	Marginal	Poor	Marginal	Optimal	Suboptimal	Optimal
Jones Creek											
Representative Site	MK152202	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK152203	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	MK153201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Kings Creek											
Representative Site	MK109203	Suboptimal	Suboptimal	Marginal	Marginal	Marginal	Marginal	Marginal	Optimal	Optimal	Suboptimal
Representative Site	MK115203	Marginal	Marginal	Marginal	Marginal	Marginal	Poor	Poor	Optimal	Optimal	Optimal
Representative Site	MK121301	Poor	Poor	Poor	Poor	Optimal	Poor	Suboptimal	Poor	Poor	Suboptimal
Representative Site	MK121302	Poor	Poor	Marginal	Poor	Optimal	Poor	Optimal	Suboptimal	Suboptimal	Poor
Representative Site	MK130301	Marginal	Poor	Suboptimal	Poor	Optimal	Marginal	Optimal	Suboptimal	Marginal	Optimal
Representative Site	MK130302	Poor	Poor	Poor	Poor	Optimal	Poor	Optimal	Marginal	Marginal	Optimal
Representative Site	MK142101	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Optimal	Optimal	Suboptimal
Representative Site	MK142102	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK156101	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK156102	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK156104	Suboptimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Marginal	Optimal	Optimal	Optimal
Representative Site	MK170201	Marginal	Marginal	Suboptimal	Optimal	Poor	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
Representative Site	MK183201	Marginal	Marginal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK184203	Marginal	Poor	Suboptimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal	Suboptimal
Loretta Branch											
Representative Site	MK106101	Poor	Poor	Marginal	Poor	Marginal	Marginal	Suboptimal	Optimal	Optimal	Poor
Representative Site	MK107101	Marginal	Poor	Marginal	Suboptimal	Poor	Marginal	Optimal	Optimal	Optimal	Suboptimal
Representative Site	MK107102	Poor	Poor	Poor	Suboptimal	Marginal	Poor	Suboptimal	Optimal	Optimal	Suboptimal
Representative Site	MK111101	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	MK112103	Poor	Poor	Poor	Marginal	Optimal	Marginal	Optimal	Optimal	Optimal	Marginal
Representative Site	MK117101	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK117103	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Lower Broughton Branch											
Representative Site	MK128102	Marginal	Poor	Suboptimal	Optimal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Suboptimal
Manokin Branch											
Representative Site	MK108202	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal

Representative Sites A -- Manokin River Watershed

Problem	Site ID	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Representative Site	MK109201	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK113102	Poor	Poor	Marginal	Marginal	Marginal	Poor	Suboptimal	Optimal	Optimal	Poor
Representative Site	MK113103	Suboptimal	Poor	Marginal	Suboptimal	Marginal	Marginal	Suboptimal	Suboptimal	Optimal	Suboptimal
Representative Site	MK117102	Marginal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	MK118101	Marginal	Poor	Poor	Suboptimal	Poor	Marginal	Suboptimal	Suboptimal	Optimal	Poor
Representative Site	MK118103	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Moore Branch											
Representative Site	MK200201	Poor	Poor	Suboptimal	Suboptimal	Poor	Poor	Marginal	Optimal	Suboptimal	Optimal
Taylor Branch											
Representative Site	MK139101	Poor	Poor	Marginal	Optimal	Suboptimal	Poor	Suboptimal	Optimal	Suboptimal	Optimal
Representative Site	MK139102	Poor	Poor	Suboptimal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK152201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Wesley Branch											
Representative Site	MK117105	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	MK126101	Poor	Suboptimal	Suboptimal	Optimal	Suboptimal	Poor	Poor	Optimal	Optimal	Suboptimal
White Marsh Branch											
Representative Site	MK128103	Suboptimal	Poor	Optimal	Optimal	Marginal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal
Representative Site	MK128104	Marginal	Poor	Marginal	Marginal	Optimal	Poor	Suboptimal	Optimal	Suboptimal	Optimal

Representative Sites B -- Manokin River Watershed

Problem	Site ID	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Hall Branch								
Representative Site	MK137302	0	72	0	0	6	0	Silt
Jones Creek								
Representative Site	MK152202	480	480	480	120	120	120	Sand
Representative Site	MK152203	0	144	48	0	18	25	Sand
Representative Site	MK153201	24	5	18	4	5	5	Silt
Kings Creek								
Representative Site	MK109203	0	6	96	0	5	12	Sand
Representative Site	MK115203	0	48	0	0	12	0	Sand
Representative Site	MK121301	0	60	0	0	11	0	Sand
Representative Site	MK121302	0	24	0	0	12	0	Silt
Representative Site	MK130301	36	60	24	24	18	11	Silt
Representative Site	MK130302	0	84	0	0	12	0	Silt
Representative Site	MK142101	30	60	0	2	5	0	Sand
Representative Site	MK142102	48	108	4	14	10	12	Sand
Representative Site	MK156101	8	12	3	5	14	12	Silt
Representative Site	MK156102	72	120	72	12	24	18	Silt
Representative Site	MK156104	18	30	26	3	6	1	Silt
Representative Site	MK170201	48	48	36	4	12	24	Sand
Representative Site	MK183201	96	96	36	6	24	30	Sand
Representative Site	MK184203	36	96	36	3	12	12	Silt
Loretta Branch								
Representative Site	MK106101	18	108	24	8	16	12	Sand
Representative Site	MK107101	84	84	30	8	10	12	Silt
Representative Site	MK107102	12	72	12	10	12	12	Silt
Representative Site	MK111101	0	30	8	0	10	10	Sand
Representative Site	MK112103	0	144	0	0	48	0	Silt
Representative Site	MK117101	360	360	30	10	10	10	Sand
Representative Site	MK117103	0	480	8	0	42	8	Silt
Lower Broughton Branch								
Representative Site	MK128102	24	72	12	6	10	8	Silt
Manokin Branch								
Representative Site	MK108202	0	120	3	0	5	6	Sand
Representative Site	MK109201	16	48	13	7	7	10	Sand

Representative Sites B -- Manokin River Watershed

Problem	Site ID	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Representative Site	MK113102	0	84	0	0	18	0	Silt
Representative Site	MK113103	24	84	24	6	10	12	Silt
Representative Site	MK117102	15	25	8	2.5	4	8	Silt
Representative Site	MK118101	24	84	48	6	12	6	Silt
Representative Site	MK118103	72	96	12	6	6	8	Gravel
Moore Branch								
Representative Site	MK200201	4	12	36	3	3	3	Silt
Taylor Branch								
Representative Site	MK139101	0	84	0	0	8	0	Sand
Representative Site	MK139102	0	84	8	0	10	24	Sand
Representative Site	MK152201	0	360	0	0	60	0	Sand
Wesley Branch								
Representative Site	MK117105	0	0	0	0	0	0	Sand
Representative Site	MK126101	0	0	60	0	0	2.5	Sand
White Marsh Branch								
Representative Site	MK128103	48	96	36	4	8	6	Silt
Representative Site	MK128104	24	60	0	4	4	0	Silt

Tidal Representative Sites -- Manokin River Watershed

Problem	Site ID	Land Use Left Shore	Land Use Right Shore	Describe Environment
Tidal Representative	MK126401	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK138402	Forest	Marsh	Freshwater Marsh
Tidal Representative	MK151402	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK151405	Lawn	Marsh	Freshwater Marsh
Tidal Representative	MK152401	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK165402	Marsh	Marshe	Freshwater Marsh
Tidal Representative	MK166401	Marsh	Lawn	Freshwater Marsh
Tidal Representative	MK166402	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK179406	Lawn	Lawn	Freshwater Marsh
Tidal Representative	MK192404	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK194401	Lawn/Marsh	Lawn/Marsh	Open Water
Tidal Representative	MK211401	Marsh	Forest	Freshwater Marsh
Tidal Representative	MK211404	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK225402	Marsh	Marsh	Freshwater Marsh
Tidal Representative	MK226402	Marsh	Marsh	Freshwater Marsh