Stream Corridor Assessment Survey for the Port Tobacco River Watershed, Charles County, Maryland

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

In 1998, the Maryland Clean Water Action Plan identified the Port Tobacco River watershed as one of the State's waterbodies that did not meet water quality requirements. In response to this finding, the Maryland Department of the Environment (MDE) and Charles County formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Port Tobacco River watershed. The following Stream Corridor Assessment (SCA) survey is part of the WRAS development process.

The SCA survey provides descriptive and positional data for potential environmental problems along a watershed's non-tidal stream network. Developed by the Maryland Department of Natural Resources (DNR) Watershed Services, the survey is a watershed management tool to identify environmental problems and prioritize restoration opportunities on a watershed basis. As part of the survey, trained personnel walk a watershed's streams and record data and locations for environmental problems that can be easily observed within the stream corridor. Each potential problem site is ranked on a scale of one to five for its severity, correctability, and access for restoration work.

SCA survey fieldwork for the Port Tobacco River began in March 2005 and was completed by May 2005. There are approximately 54 miles of streams in the watershed. The field crews walked approximately 46 miles (85%) of the watershed. Survey teams were not permitted access to all the watershed's streams and did not survey tidal areas.

For the streams assessed, survey teams identified 218 potential environmental problem sites. The most frequently observed potential problem sites were fish barriers, reported at 63 sites. Other potential environmental problems recorded during the survey included: 60 erosion sites, 41inadequately forested stream buffers, 21 pipe outfalls, 19 unusual conditions, 6 channel alterations, 6 exposed pipes, and 2 trash dumping sites (Table 1). Additionally, crews recorded descriptive habitat condition data at 35 representative sites. For sites in all categories, restoration opportunities exist to increase fish and wildlife habitat, and to improve other natural resources and resource services.

The Stream Corridor Assessment Survey is a rapid overview of the entire stream network in order to determine the location of potential environmental problems and to collect some basic habitat information about its streams. The present survey places individual stream problems in their watershed context and is intended as a tool for resource managers and land use planners to cooperatively and consistently prioritize future restoration work. Results of the survey will be shared with the Port Tobacco River WRAS committee, which is developing a WRAS for the Port Tobacco River. Information on the WRAS program can be found on the DNR website (www.dnr.maryland.gov/watersheds/wras).

INTRODUCTION

In 1998, Maryland's Clean Water Action Plan identified bodies of water that failed to meet water quality requirements or other natural resource goals. One of the areas identified in the report was the Port Tobacco River watershed. The Maryland Department of the Environment formed a partnership with Charles County to assess and improve environmental conditions in the Port Tobacco River Watershed. The main goal of this partnership is to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Port Tobacco River.

Located in southern Charles County, the watershed covers approximately 30,100 acres of land (47 square miles) in the Coastal Plain of Maryland (Figure 1). Figure 2 presents a digital orthophoto map of the watershed. Figure 3 shows the same watershed boundary superimposed on a 7.5 minute USGS topographic quadrangle map. Figure 4 depicts the areas of the watershed where the teams were not given permission to survey the streams.

The first step in developing a Restoration Action Strategy for this watershed is to complete an overall assessment of the conditions of the watershed and the streams it contains. This initial step was accomplished using three approaches. First, a watershed characterization was completed that compiles and analyzes existing water quality, land use, and living resource data about the watershed (Bruckler, Ellis, 2006). Secondly, a synoptic water quality survey was conducted at selected stations throughout the Port Tobacco River sub-watersheds to provide information on the present condition of aquatic resources (Primrose, 2006). Lastly, a Stream Corridor Assessment (SCA) survey was completed for the watershed's non-tidal stream network to provide specific information on the present location of potential environmental problems and restoration opportunities. This report details the results of the Port Tobacco River Stream Corridor Assessment survey and describes potential restoration opportunities within the watershed based on the survey.

Survey teams walked approximately 46 of the 54 miles of streams assigned in the Port Tobacco stream network. The survey began in March 2005 and was completed by May 2005. At each site, field crews collected descriptive data, recorded the locations on field maps, and took photographs to document each potential environmental problem observed. As an aid to prioritizing future restoration work, crews rated all problem sites on a scale of one to five in three categories: 1) how severe the problem is compared to others in its category; 2) how correctable the specific problem is, using current restoration techniques; and 3) how accessible the site is for work crews and any machinery necessary to complete restoration work. In addition, field teams collected descriptive data for both in- and near-stream habitat conditions at representative sites along the stream, at intervals of approximately ½ mile to 1 mile.

One of the main goals of the Port Tobacco River SCA survey is to compile a list of observable environmental problems in this watershed in order to accurately target future restoration efforts. Once this list is compiled and distributed, county planners, resource managers, and others can initiate a dialogue to cooperatively set the direction and goals for the watershed's management and plan future restoration work at specific problem sites. All of the problems identified as part

of the Port Tobacco River Stream Corridor Assessment survey can be addressed through existing State or local government programs.

To this end, the Maryland Department of the Environment is working with Charles County to develop a Watershed Restoration Action Strategy (WRAS) for the Port Tobacco River Watershed. As part of this process, data collected during the SCA survey will be used to identify present environmental conditions and possible restoration opportunities in the watershed. This information, along with the watershed characterization, synoptic water quality surveys, recent biological surveys, and local knowledge of the watershed will be used to develop a WRAS for the Port Tobacco River. The WRAS, in turn, will guide future restoration efforts with the ultimate goals of restoring the area's natural resources and meeting State water quality standards.

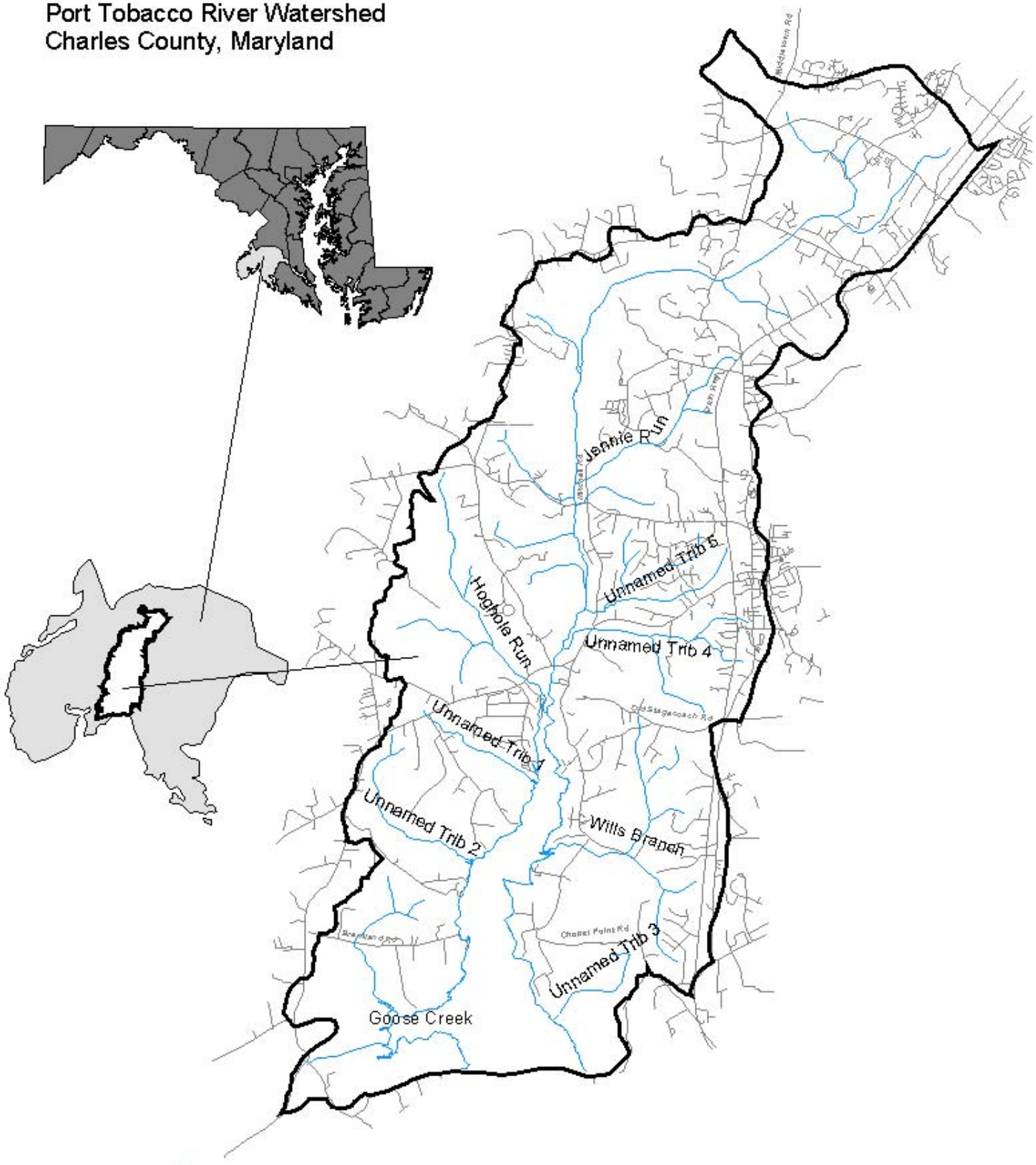

Figure 1: Map showing the location of the Port Tobacco River Watershed


Figure 2: Port Tobacco River Watershed
Digital Orthophoto Quarter Quad 1993
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MDE
MARYLAND
Robert L. Ehrlich, Jr., Governor
Michael S. Steele, Lt. Governor
Kendl P. Philbrick, Secretary
James A. Jacobsen, Deputy Secretary
Contact: Robin Pellicano 410-537-4215
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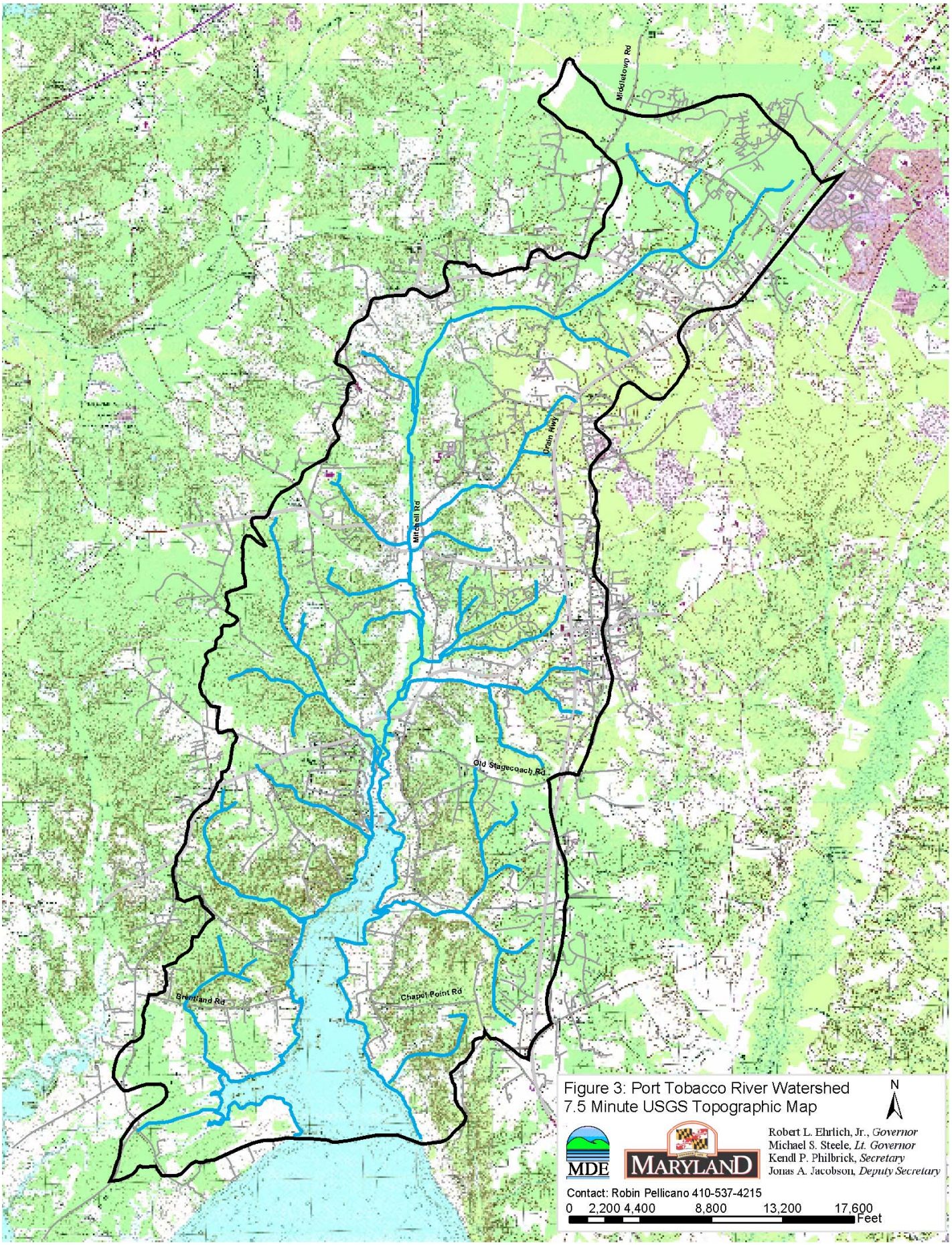
Feet


Middletown Rd
Drain Hwy
Mitchell Rd
Old Stagecoach Rd
Greenland Rd
Chapel Point Rd
Figure 3: Port Tobacco River Watershed
7.5 Minute USGS Topographic Map
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MDE
MARYLAND
Robert L. Ehrlich, Jr., Governor
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Kendl P. Philbrick, Secretary
Jonas A. Jacobson, Deputy Secretary
Contact: Robin Pellicano 410-537-4215
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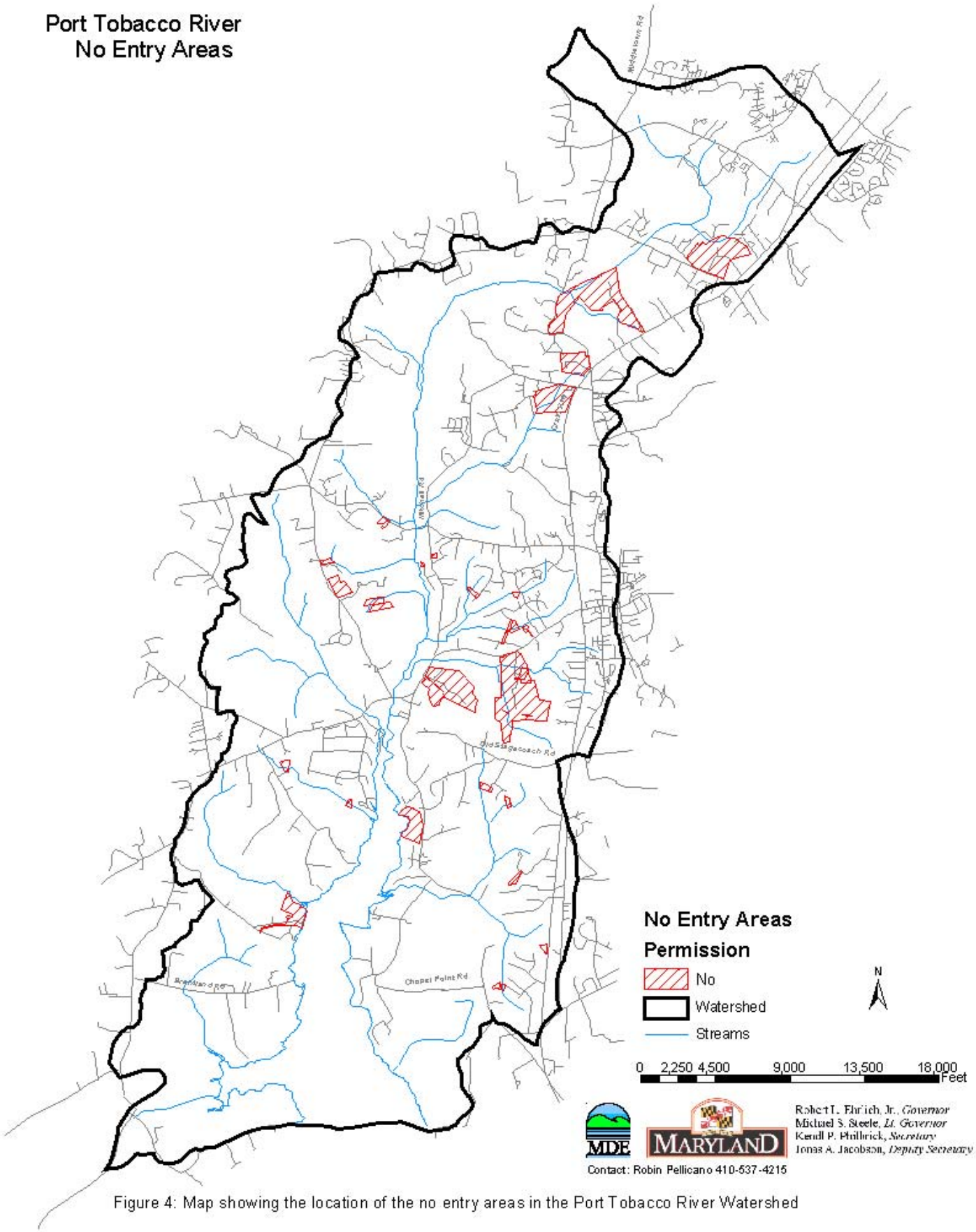

Figure 4: Map showing the location of the no entry areas in the Port Tobacco River Watershed

METHODOLOGY

Goals of the SCA Survey

To identify, in a rapid and cost-effective manner, some of the common problems that affect streams, the Watershed Services Unit of the Maryland Department of Natural Resources developed the Stream Corridor Assessment (SCA) survey. The four main objectives of the survey are to provide:

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

2. Sufficient data on each problem to make a preliminary assessment of both severity and correctability;

3. Sufficient data to prioritize restoration efforts;

4. A quick assessment of both in- and near-stream habitat conditions to make comparisons of the conditions of different stream segments.

The SCA survey provides a method for rapidly examining and cataloguing observable environmental problems within an entire drainage network to better target future monitoring, management and/or conservation efforts. The SCA is not a detailed scientific survey, nor will it replace chemical and biological surveys in determining overall stream conditions and health. Maryland's SCA survey is a refinement and systematization of an old approach – the stream walk survey. Many common environmental problems affecting streams can be readily identified by an individual walking along a stream. These include: excessive stream bank erosion, blockages to fish migration, stream segments without trees along their banks, or a pipe exposed by stream bank erosion leaking sewage into the stream. With a limited amount of training, most people can correctly identify these common environmental problems.

Over the years, many groups standardized a stream walk survey approach for their particular purpose or interest. 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), focused on utilizing citizen volunteers with little or no training. While these surveys can be a good guide for citizens interested in seeing their community's streams, the data collected during these surveys can vary significantly based on the background of the surveyor. In the Maryland Save Our Streams survey, for example, training for citizen groups includes giving guidance on how to organize a survey and a slide show explaining how to complete the fieldwork. After approximately one hour of training, citizen volunteers are sent out in groups to walk designated stream segments. During the survey, volunteers usually walk their assigned stream segment within a few hours and return their data sheets to the survey organizers for analysis. 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 collected information. In addition, the data collected from these surveys often only indicate that a potential environmental problem exists at a specific location, but do not provide sufficient information to assess the severity of the problem.

Other visual stream surveys, such as the Natural Resources Conservation Service's "Stream Visual Assessment Protocols" (NRCS, 1998), are designed for use by trained professionals analyzing a very specific stream reach type, such as 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 carried out on a watershed basis.

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

Field Training and Procedure

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, initiated to promote greater involvement of young volunteers in their communities and the environment. The MCC program is managed by DNR's Forest and Park Service. 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, MCC 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.maryland.gov/mcc.

Prior to the start of the Port Tobacco SCA survey, members of the MCC received training in assessing both environmental problem sites and habitat conditions in and along Maryland streams. For problem sites, crewmembers learned how to identify common problems observable within the stream corridor, record problem locations on survey maps, and accurately complete data sheets for each specific problem type. For habitat conditions, the crew learned and practiced assessing stream health based on established criteria indicating favorable conditions for macroinvertebrates and fish, and for healthy riparian habitat. These reference sites for habitat conditions are located at approximately 1/2- to 1-mile intervals along the stream. In addition, the field crew reviewed a standard procedure for assigning site numbers based on the 3-digit map number, 1-digit team number, and 2-digit problem number for each problem and reference site during the survey. Lastly, in order to have a visual record of existing conditions at the time of the SCA survey, the MCC crew received guidelines for taking photographs at all problem and reference sites.

Several weeks prior to the survey, property owners along the stream reach received letters explaining what the survey is and when it was to be completed. This letter also provided a phone

number to call if individuals wanted more information and a postcard for indicating whether crews would have permission to access the streams on their property. In addition, survey crews were instructed not to cross fence lines or enter any areas marked "No Trespassing" unless they had specific permission from the property owner.

The MCC crew conducted field surveys of the Port Tobacco River Watershed from March 2005 to May 2005. The survey teams walked the river's drainage network, collecting information on potential environmental problems. Those commonly identified during the SCA survey include: inadequate stream buffers, excessive bank erosion, channelized stream sections, fish migration blockages, in- or near-stream construction, trash dumping sites, unusual conditions, and pipe outfalls. In addition, the survey recorded information on the general condition of in-stream and riparian habitats and the location of potential wetland creation sites.

More detailed information on the procedures used in the Maryland SCA survey can be found in "Stream Corridor Assessment Survey – Survey Protocols" (Yetman, 2001). A copy of the survey protocols can found on DNR's web site at http://www.dnr.maryland.gov/streams/pubs/other.html. Hard copies of the protocols also can be obtained by contacting the Watershed Services Unit of the Maryland Department of Natural Resources, Annapolis, MD.

Overall Ranking System

SCA survey 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 crew's training on survey methods is devoted to properly rating the different problems identified during the survey. This ranking system developed from an earlier survey that found 453 potential environmental problems along 96 miles of stream in the Swan Creek Watershed in Harford County. The most frequently reported problem during the survey was stream bank erosion, 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, erosion varied substantially among sites, many of which were minor in severity. Based on this experience and its goal of prioritizing restoration work, the SCA survey rates the severity, correctibility, and access of each problem site.

While the ratings are subjective, they have proven useful as a starting point for more detailed follow-up evaluations. Once the SCA survey is completed, the collected data is available for resource professionals to use in targeting future restoration efforts. A regional forester, for example, can use data collected on inadequate stream buffers to plan future riparian buffer plantings, while the local fishery biologist can use data on fish blockages to target future fish passage projects. The inclusion of a rating system in the survey provides the resource professional with a list of sites the field crew considered 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.

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 and is not intended to be applied across categories. 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 others in the State with inadequate stream buffers. 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 **severity rating** indicates how bad a specific problem is relative to others in the same problem category. It is often the most useful rating because it answers 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, based on the established criteria for each problem category (Yetman, 2000).

- 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 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 are unstable and eroding at a rapid rate.

- A moderate severity rating of 3 identifies problems that have some adverse environmental impacts but the severity and/or length of affected stream 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 worse problems in the specific problem category. Examples include: a small fish blockage that is 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 has an inadequate forest buffer.

- A minor severity rating of 5 identifies problems that do not have a significant impact on stream and aquatic resources. A minor rating indicates that a problem is present, but compared to other problems in the same category it is considered minor. One example of a site with a minor rating is an outfall pipe from a storm water management structure that is not discharging during dry weather and does not have an erosion problem at the outfall or immediately downstream. Another example is a section of stream with stable banks that has a partial forest buffer less than 50 feet wide along both banks.

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, for example, would initially target the severest problems that are the easiest to fix. The correctability rating also can be useful in identifying simple projects that can be done by volunteers, as opposed to projects that require more significant planning and engineering efforts to complete.

- A minor correctability rating of 1 indicates problems that can be corrected quickly and easily using hand labor, with a minimal amount of planning. This type of project usually does not need any Federal, State or local government permits. It is a job that a small group of volunteers (10 people or less) could do in a day or two without using heavy equipment. Examples include 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 indicates sites that may require a small piece of equipment, such as a backhoe, and some planning to correct the problem. This is not the type of project that volunteers would usually do alone, although volunteers could assist in some aspects of the project, such as final landscaping. The work 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 limited and approval should be easy to obtain.

- A very difficult correctability rating of 5 indicates problems that require a large expensive effort to correct. These projects usually require heavy equipment, significant amount of funding ($100,000 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 include a potential restoration area where the stream is deeply incised several feet over a long distance (i.e., several thousand feet), or a fish blockage at a large dam.

The **accessibility rating** provides 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 a survey map and field observations. While factors such as land ownership and surrounding land use can enter into 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 indicates sites that are readily accessible both by car and on foot. Examples 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 indicates sites that are easily accessible by foot but not easily accessible by a vehicle. Examples would include a stream section that can be reached by crossing a large field or a site that is 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. To reach the site it would be necessary to hike at least a mile, and if equipment were needed to do the restoration work, an access road would need to be built through rough terrain. Examples include a site with no roads or trails nearby.

Data Analysis and Presentation

Following completion of the survey, crews entered information from the field data sheets into a Microsoft Access database and verified the accuracy of the data. Field crews organized the photographs taken during the survey. Members of the Department of the Environment's Technical and Regulatory Services Administration incorporated map locations, recorded data, and digitized photographs into ArcGIS computer software. The GIS project is an electronic database that integrates all the collected problem locations and descriptive data by site number, links photographs to each potential problem site, and produces the maps presented in this report. This data can then be used alongside other available digital geographic datasets for features within the watershed. A final copy of the ArcView files was given to the Charles County Planning Department for use in developing a Watershed Action Strategy for the Port Tobacco River Watershed.

RESULTS

The Stream Corridor Assessment Survey identified 218 potential environmental problems within the stream corridor (Table 1). At the time of the survey, the most frequently observed potential problem sites were fish barriers, reported at 63 sites. Other potential environmental problems recorded during the survey included: 60 erosion sites, 41inadequately forested stream buffers, 21 pipe outfalls, 19 unusual conditions, 6 channel alterations, 6 exposed pipes, and 2 trash dumping sites (Table 1). Crews also recorded descriptive habitat condition data at 35 representative sites. For sites in all categories, restoration opportunities exist to increase fish and wildlife habitat, and to improve other natural resources and resource services.

Table 1 presents a summary of survey results and Table 2 is a summary by stream reach. Appendices A and B list the data collected during the survey. Appendix A provides a listing of information by site number and location, referenced by both tributary name and x-y coordinates using Maryland State Plane 83 meters. Information in this format is useful in determining what problems are present along a specific stream reach. In Appendix B, the data is presented by problem type and lists the collected descriptive data. Presenting the data by problem type allows the reader to see which problems are rated as most severe or easiest to correct within each category. Result categories are discussed further in order of those with the greatest number of sites to those with the least.

Table 1. Summary of results from the Port Tobacco River SCA Survey

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Fish Barrier	63	N/A	-	-	5	1	57
Erosion	60	77,820 ft (14.70 miles)	2	10	23	16	9
Inadequate Buffer	41	50,095 ft (9.50 miles)	7	3	15	13	3
Pipe Outfall	21	N/A	-	-	10	2	9
Unusual Condition	19	N/A	-	1	14	-	4
Channel Alteration	6	1,255 ft (0.24 miles)	-	-	-	1	5
Exposed Pipe	6	N/A	-	-	4	2	-
Trash Dumping	2	N/A	-	-	1	-	1
Total	**218**		**9**	**14**	**72**	**35**	**88**
Comments	7						
Representative Sites	35						

Table 2. Summary of results by major stream reach

Stream Segment	Channel Alteration	Erosion	Exposed Pipes	Fish Barriers	Inadequate Buffers	Pipe Outfalls	Trash Dumping	Unusual Conditions	Representative Sites	Comments	Total
Goose Creek	-	4	-	1	1	-	-	1	2	2	11
Hoghole Run	1	6	-	5	9	4	1	1	5	-	31
Jennie Run	-	1	-	-	1	1	-	8	1	2	14
Port Tobacco River	5	17	2	11	16	5	-	1	9	2	68
Unnamed Trib 1	-	3	2	8	1	-	-	1	2	-	17
Unnamed Trib 2	-	3	-	4	1	-	-	-	2	-	10
Unnamed Trib 3	-	1	-	-	-	-	-	4	1	-	6
Unnamed Trib 4	-	8	-	4	3	2	-	3	4	1	25
Unnamed Trib 5	-	9	2	21	6	8	1	1	5	-	53
Wills Branch	-	8	-	9	3	1	-	-	4	-	25

Fish Migration Barriers

Fish migration barriers include anything in the stream that significantly interferes with the free, upstream movement of fish. Unimpeded fish passage is especially important for anadromous fish that live most of their lives in tidal waters but must migrate into non-tidal rivers and streams to spawn. Unobstructed upstream movement is also important for resident fish species, many of which also travel both up and down stream during different parts of their life cycle. In addition, without free fish passage, certain sections in a stream network become isolated from others. This becomes detrimental to species survival when a disturbance occurs in an isolated stretch of stream. A sediment discharge from a construction project, for example, or a sewage line break discharging into a small tributary can eliminate some or all of the fish species in an isolated stream stretch. With a fish blockage present, there is no avenue for fish to repopulate the inaccessible section. As a result, the disturbance will reduce diversity of the fish community in the area, and the remaining biological community may deviate from its natural balance and composition.

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. A structure becomes a blockage for fish if the stream water over or under it is too high, shallow, or fast. First, a vertical water drop such as a dam can be too high for fish to migrate over the obstacle. 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 one foot, providing there is sufficient water flow and depth. Second, water too shallow for fish passage can occur in channelized stream sections or at road crossings, where the entire stream volume is spread over a large, flat area. 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 is placed at a steep angle, and the water moving through the pipe has a velocity higher than a fish's swimming ability.

In restoration work, priority is given to removing fish barriers that will yield access to the greatest quality and quantity of upstream habitat per dollar spent. The mainstem is ideally kept as barrier-free as possible, allowing anadromous fish to migrate to spawn and a source of fish species for tributaries in the event of a disturbance. Restoration planning includes targeting removal of barriers that isolate entire tributaries, those that isolate significant portions of the upper tributary, and those that isolate quality fish habitat. Also, the best restoration sites are far from other existing fish barriers.

The Port Tobacco River SCA survey found 63 fish migration barriers. The locations of fish blockages are shown in Figure 5b. Fish barriers in this watershed are due to natural falls (9), road crossings (10), beaver dams (13), and debris dams (31). Five of these sites received a moderate rating. They were all at road crossings. One site to note is 192101. This site is on Hoghole Run where it crosses under Port Tobacco Road. There is a fish ladder there but the field crews noted that the water might be moving too fast through the ladder for some fish to migrate up it.

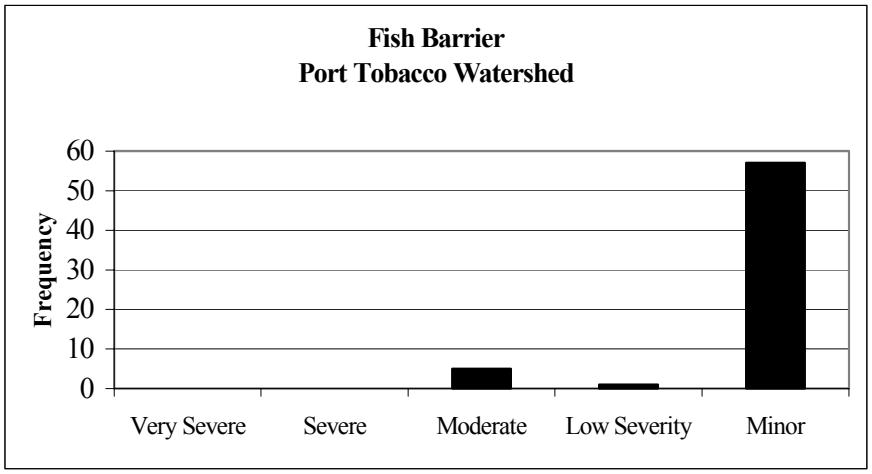

Figure 5a. Histograph showing the frequency of severity ratings given to fish barrier sites during the Port Tobacco River SCA survey.

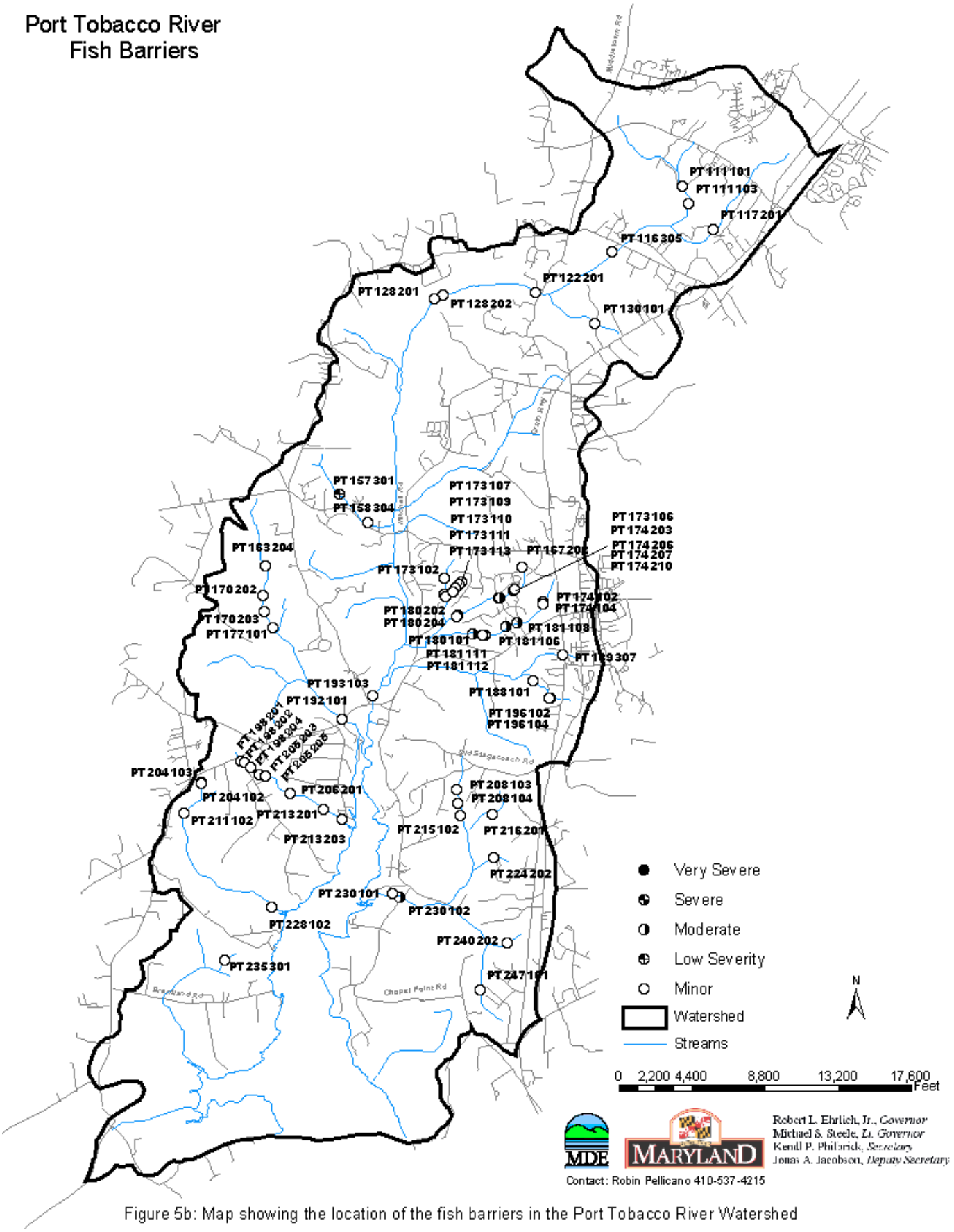

Figure 5b: Map showing the location of the fish barriers in the Port Tobacco River Watershed

Erosion Sites

Erosion is a natural process necessary to maintain good aquatic habitat. Too much erosion, however, can have the opposite effect on the stream by destabilizing stream banks, destroying in-stream habitat, and causing significant sediment pollution problems downstream. Erosion problems occur when either a stream's hydrology and/or sediment supply are significantly altered. This often occurs below a specific alteration, such as a pipe outfall or road crossing, or when land use in a watershed changes. For example, as a watershed becomes more urbanized, forest and agricultural fields are developed into residential housing complexes and commercial properties. As a result, the amount of impervious surface, or land area where rainwater cannot seep into groundwater directly, increases in a drainage basin. This causes the amount of runoff entering a stream to increase. Over time, a stream channel will adjust to the greater rain-induced flows by eroding the streambed and banks to raise water-carrying capacity. This channel readjustment can extend over decades, during which time excessive amounts of sediment from unstable eroding stream banks can have very detrimental impacts on a stream's aquatic resources.

In this survey, unstable eroding streams are defined as areas where the stream banks are almost vertical, and the vegetative roots along the stream are unable to hold the soil onto the banks. While survey teams are asked to visually assess whether the stream was downcutting, widening, or headcutting at a specific site, the only way to evaluate the full significance of the erosion processes at a specific site is to do more detailed monitoring over time.

The SCA survey found 60 eroding stream banks over the length of 77,820 feet (14.70 miles) of stream, or about 32 percent of the 46 miles streams surveyed. The severity and location of erosion sites is shown in Figure 6b. Two sites are ranked as very severe (Figure 6a). Sites 175101 and 187201 were 4 feet in height and 2000 feet and 4000 feet long respectively. (Appendix B).

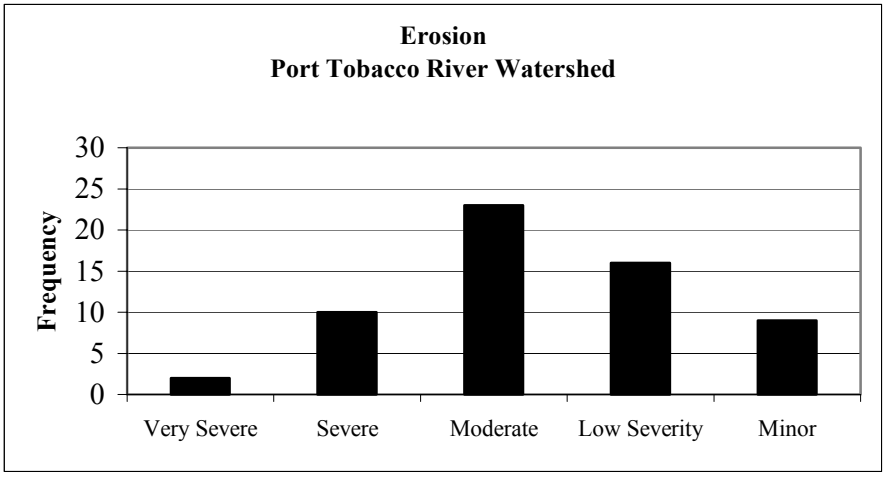

Figure 6a. Histograph showing the frequency of severity ratings given to erosion sites during the Port Tobacco River SCA survey.

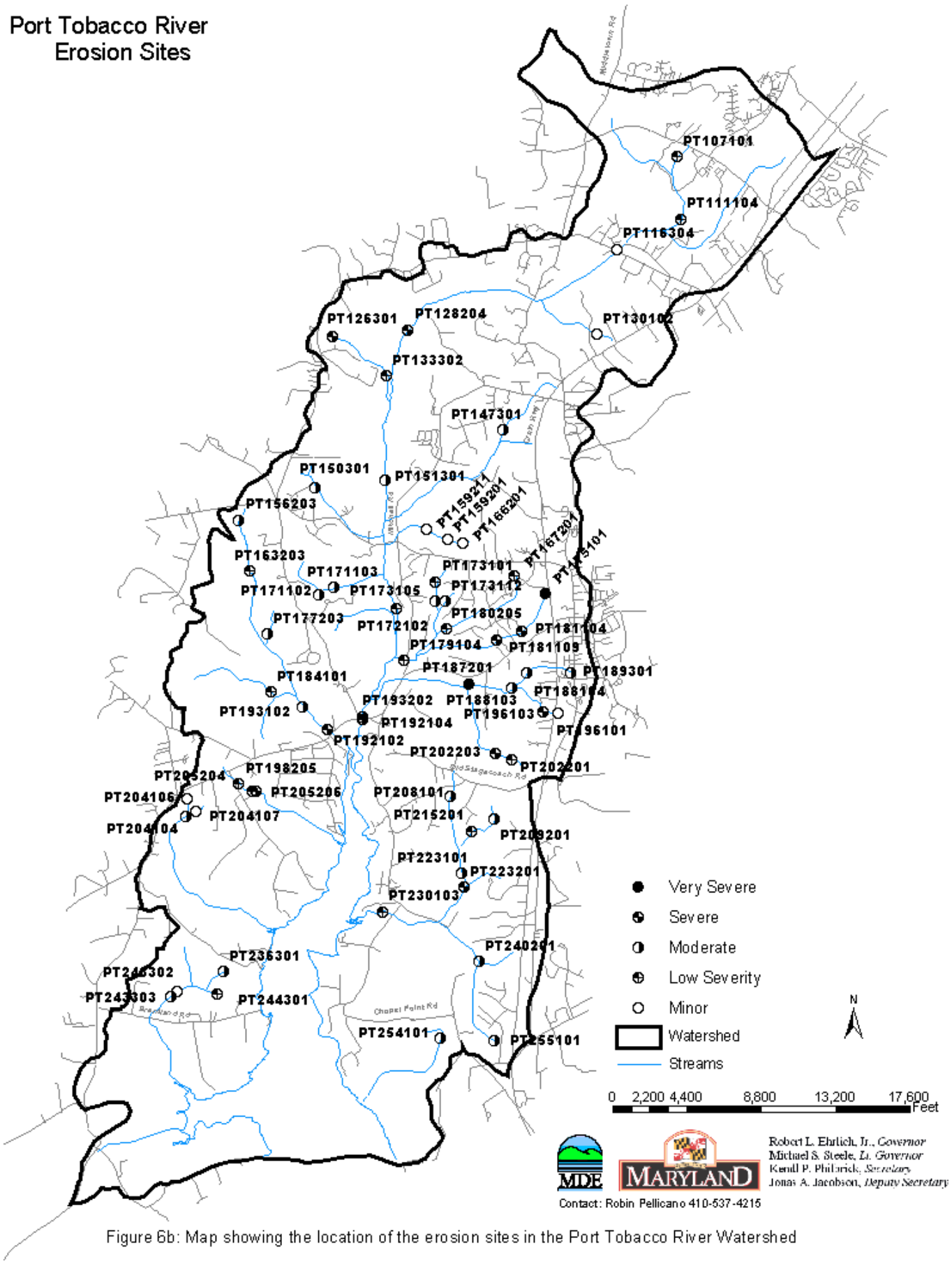

Figure 6b: Map showing the location of the erosion sites in the Port Tobacco River Watershed

Inadequate Buffers

Forests are the historically occurring ecosystem around Maryland streams and are very important for maintaining stream health in Maryland. Forested buffer areas along streams play a crucial role in increasing water quality, stabilizing stream banks, trapping sediment, mitigating floods, and providing the required habitat for all types of stream life, including fish. Tree roots capture and remove pollutants and excess nutrients from shallow flowing water, and their structure helps prevent erosion and slow down water flow, reducing sediment load and the risk of flooding. Shading from the tree canopy provides the cooler water temperatures necessary for most stream life, especially cold-water species like trout. In smaller streams such as those surveyed, terrestrial plant material falling into the stream is the primary source of plant food for stream life. Tree leaves provide seasonal, instant food for stream life, while fallen tree branches and trunks provide a more consistent, slow-release food source throughout the year. Tree roots and snags also provide necessary fish habitat. Maintaining healthy streams and forest buffers are important to reducing the nutrient and sediment loadings to the Chesapeake Bay.

While there is no single minimum standard for how wide a stream buffer should be in Maryland, for the purposes of this study a forest buffer is considered inadequate if it is less than 50 feet wide, measured from the edge of the stream. The severity of inadequate forest buffers is based on both the length and width of the site. Those sites over 1,000 feet long with no forest on either side of the stream rank as the most severe. For streams on the Eastern Shore there is also the consideration of whether or not the channel is a drainage ditch. Drainage ditched with little to no water in the entire ditch is considered less severe than a ditch with water. A fourth ranking, wetland potential, rates if there is a potential of creating a wetland. The rating is based on bank height and slope of the areas.

Survey crews identified 41 inadequate buffer sites with a total length of 50,095 feet (9.5 miles), or approximately 20 percent of the 49 miles streams surveyed. The severity and location of inadequate buffer sites is shown in Figure 7b. Ten sites are ranked as very severe or severe. The other thirty-one sites are moderate, of low severity, or minor (Figure 6a). Land use along the stream at inadequate buffer sites was reported as mostly shrubs, small trees and pasture.

Any inadequate buffer site would benefit from the restoration of trees along both stream banks. For sites on agricultural land, farmers also may qualify for federal and state government financial incentives for allowing 50-foot forest buffers to grow on their farmland. Sites such as headwater streams, or those that form gaps in existing forested buffer areas, may have particular natural resource value.

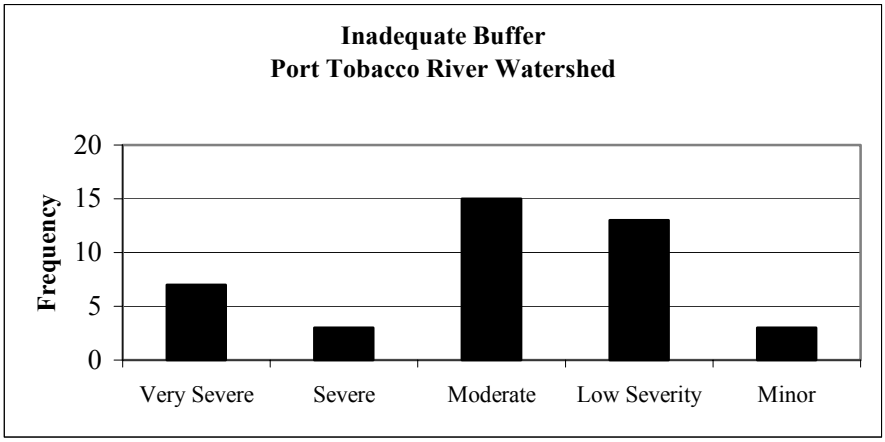

Figure 7a. Histograph showing the frequency of severity ratings given to inadequate buffer sites during the Port Tobacco River SCA survey.

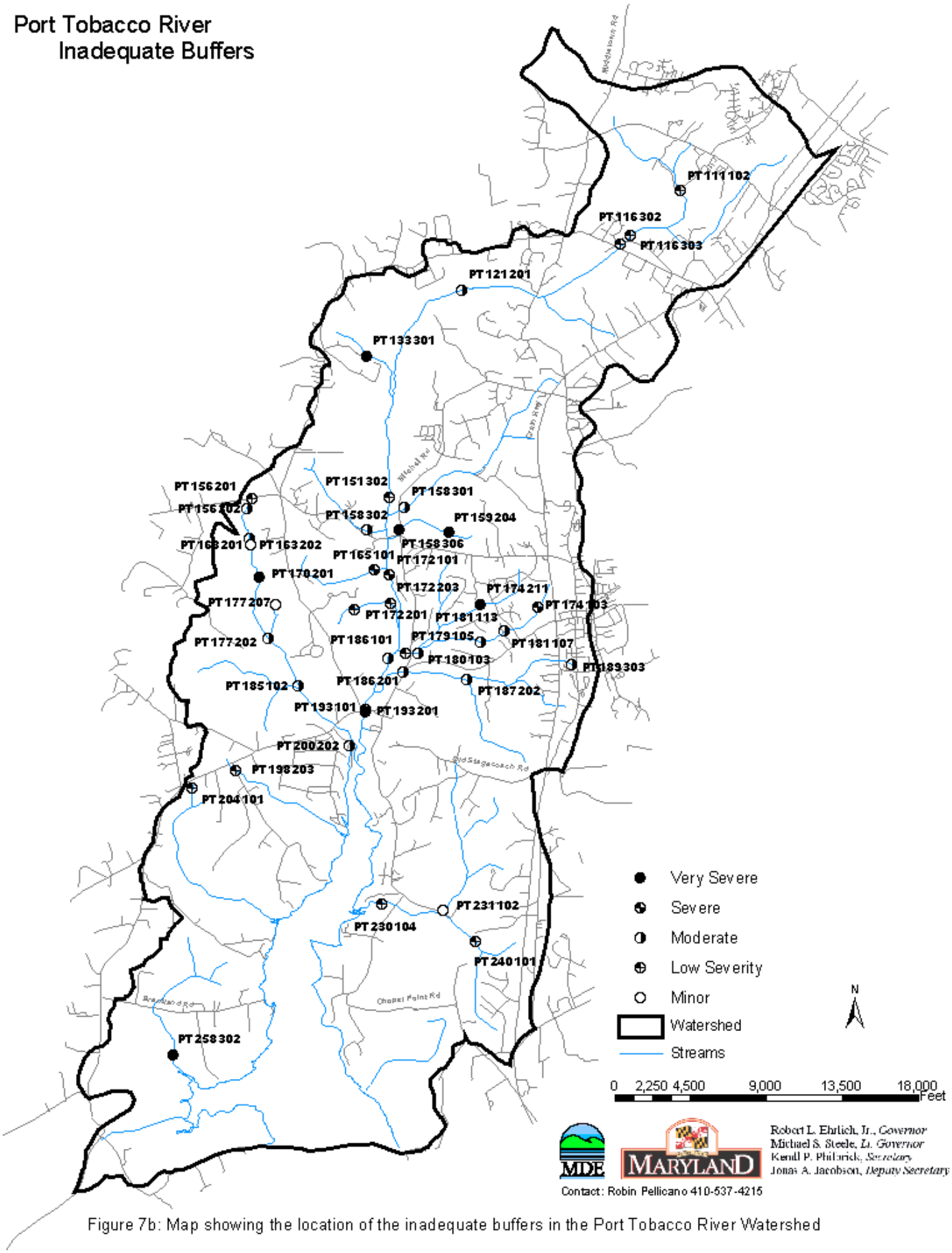

Figure 7b: Map showing the location of the inadequate buffers in the Port Tobacco River Watershed

Pipe Outfalls

Pipe outfalls include any pipes or small, constructed channels that discharge into the stream through the stream corridor. Pipe outfalls are considered a potential environmental problem in the survey because they can carry uncontrolled runoff and pollutants such as oil, heavy metals and nutrients to a stream system. The survey crew identified a total of 21 pipe outfalls. The severity and location of pipe outfall sites is shown in Figure 8b.

Ten of the pipes had a discharge. All were clear with no odor. The pipes were rated as moderate. The remaining pipes did not have any discharge. No immediate follow-up actions were taken as part of this study to determine the source of the color coming from the pipes. In addition, no estimate was made of the amount of fluid released from the pipes.

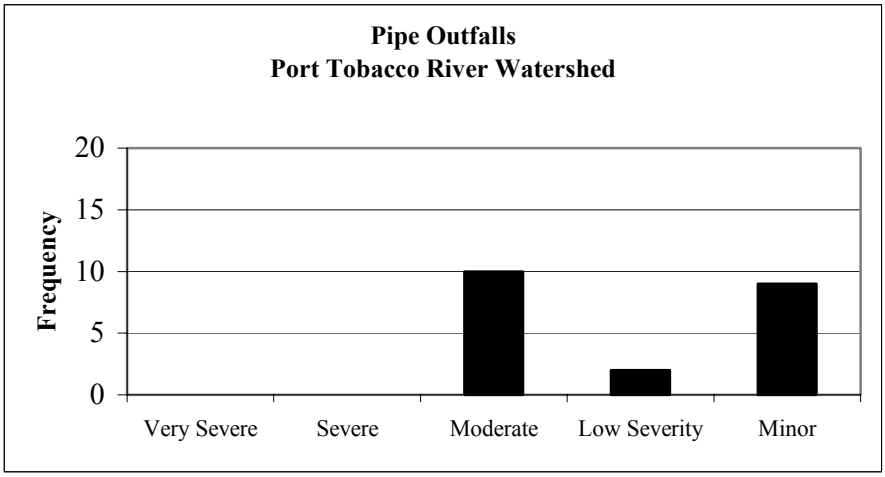

Figure 8a. Histograph showing the frequency of severity ratings given to pipe outfalls sites during the Port Tobacco River SCA survey.

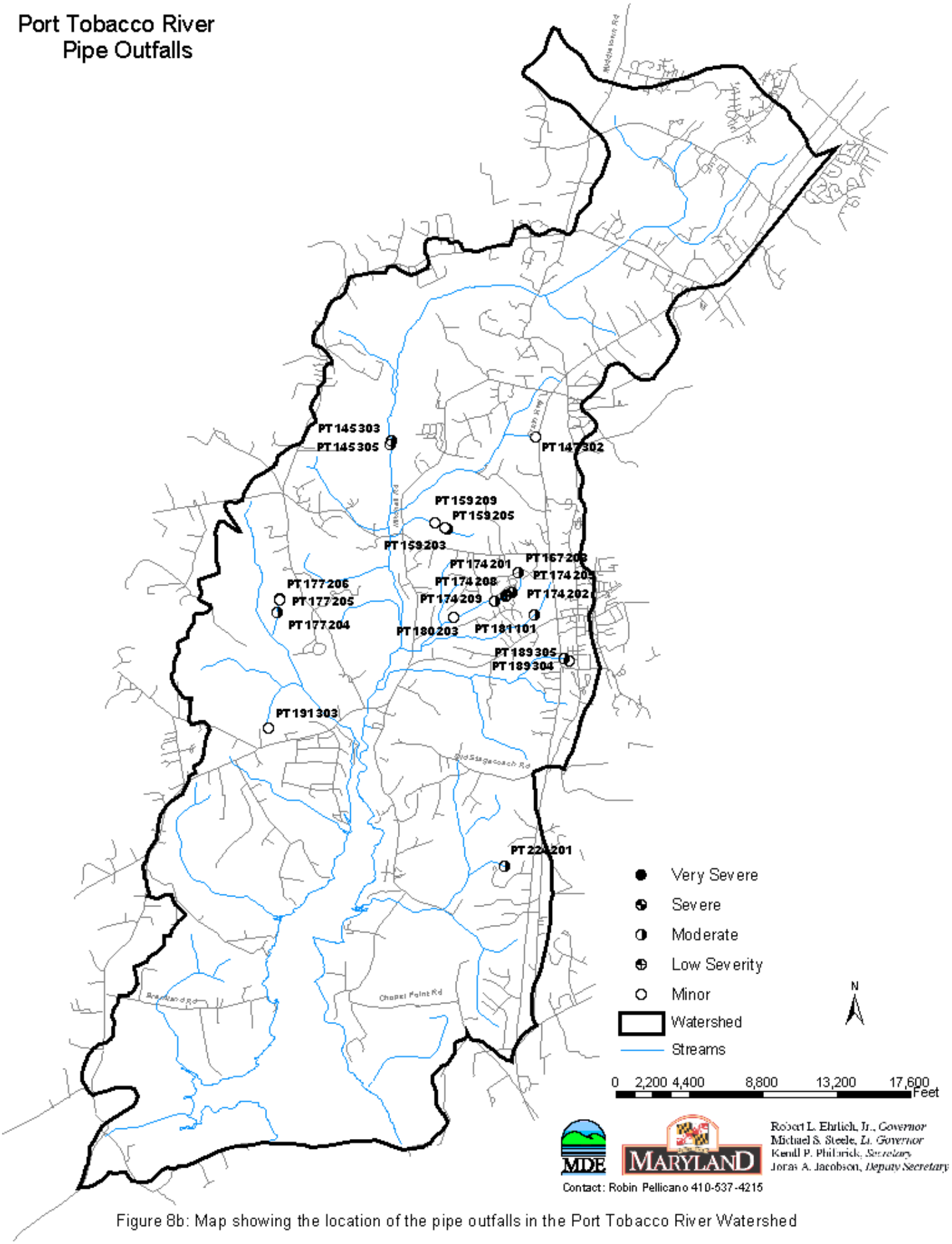

Figure 8b: Map showing the location of the pipe outfalls in the Port Tobacco River Watershed

Unusual Conditions or Comments

Survey teams record unusual conditions or comments to note the location of anything out of the ordinary observed during the survey, or to provide additional written comments on a specific problem site. The survey crew identified nineteen unusual conditions and recorded seven comments throughout the Port Tobacco River watershed. The severity and location of unusual conditions sites is shown in Figure 9b.

The nineteen unusual conditions sites included those with excessive algae (7), large numbers of trees down (3), piped streams (2), water clarity/color issues (2) and one site (PT165102) with a blockage causing the stream to be diverted into a nearby cow pasture. This last site was given a severe ranking (Figure 9a).

Comment sites include data on places where survey crews encountered streams not on the map, large numbers of trees down, and vegetation in the water. At one site, PT181106, the team indicated that erosion might be causing a pipe to collapse.

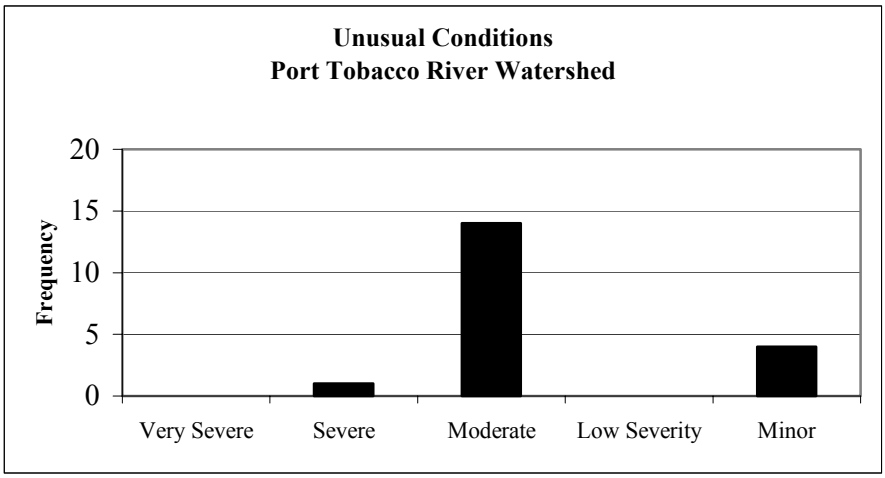

Figure 9a. Histograph showing the frequency of severity ratings given to unusual condition sites during the Port Tobacco River SCA survey.

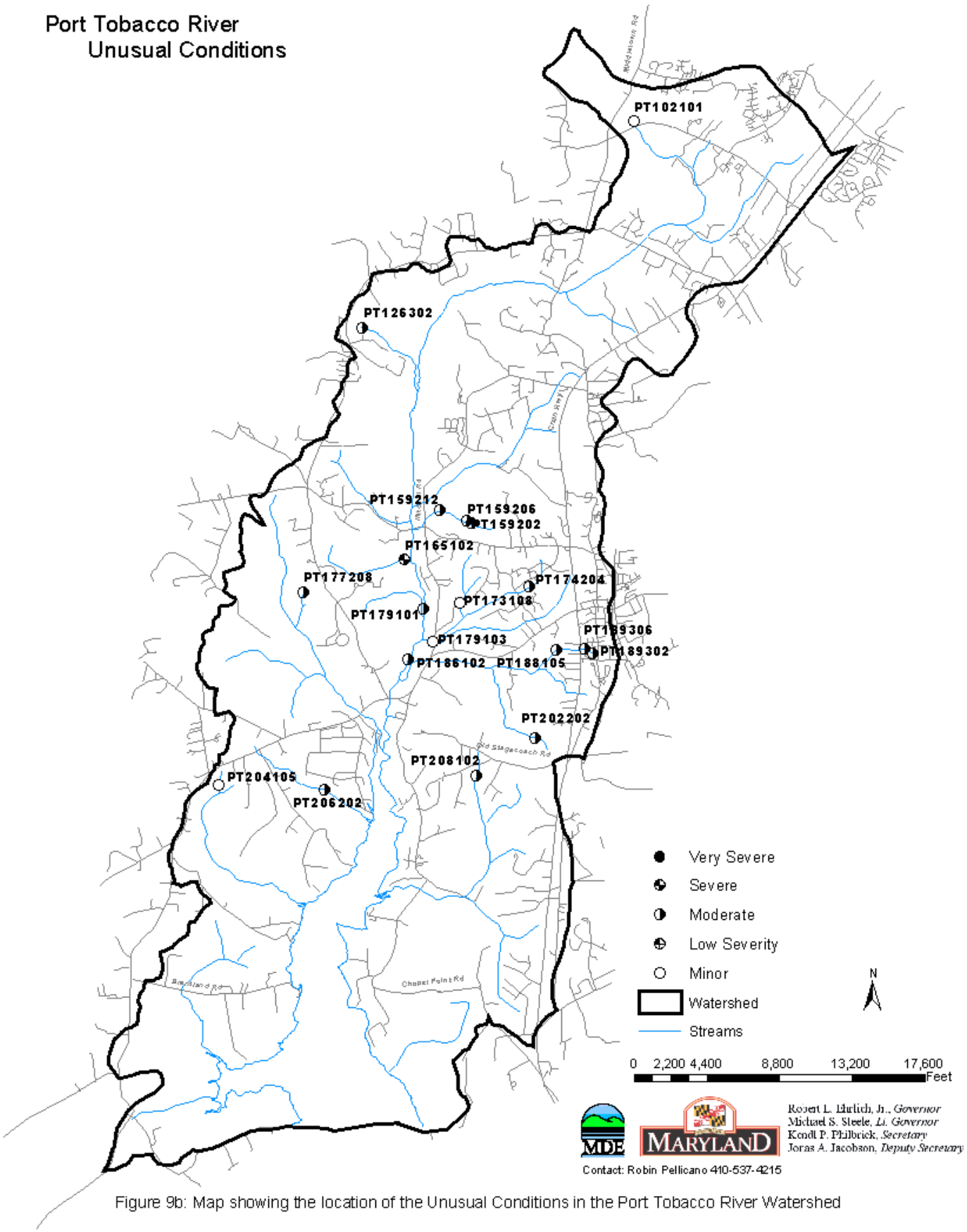

Figure 9b: Map showing the location of the Unusual Conditions in the Port Tobacco River Watershed

Channel Alterations

Channel alterations are sections where the stream's banks or channel are significantly altered from their naturally occurring structure or condition. These channelized streams are straightened, deepened, and/or the banks hardened using rock, gabion baskets or concrete over a significant length of stream (usually 100 feet or more). Most frequently, channels are altered to decrease the likelihood of flooding by increasing stream velocity through an area, making stream channelization more common near development or roadways. On Maryland's Eastern Shore, earth channels also are created for drainage purposes.

For the purposes of this survey, there are three types of channel alterations not recorded. The first are tributaries where the entire stream branch is piped underground and storm drains replace the stream channel. While these stream sections are significantly altered, it is not possible to know precisely where this was done by walking the stream corridor. Secondly, crews do not specifically record road crossings unless a significant portion of the stream above or below the road is channelized. Lastly, the survey does not report places where a small section of only one side of the stream bank is stabilized to reduce erosion.

Results of this survey show recognizably altered stream channels at 6 sites. The severity and location of channel alteration sites is shown in Figure 10b. The total length of stream affected by channelization is estimated to be 1,255 feet (-.24 miles). Severity rankings for the sites range from low severity to minor with most sites ranked minor in severity (Figure 10a).

Restoring channel alteration sites can increase fish and wildlife habitat and may allow more time for nutrient uptake in the waterway. In its simplest form, restoration for earth channels includes allowing vegetation and/or tree roots to stabilize the sediment along the channel, causing sinuosity to re-form naturally. This sinuosity may re-form within the bed of the channelization or along its banks, depending on the site and the depth of the channel alteration.

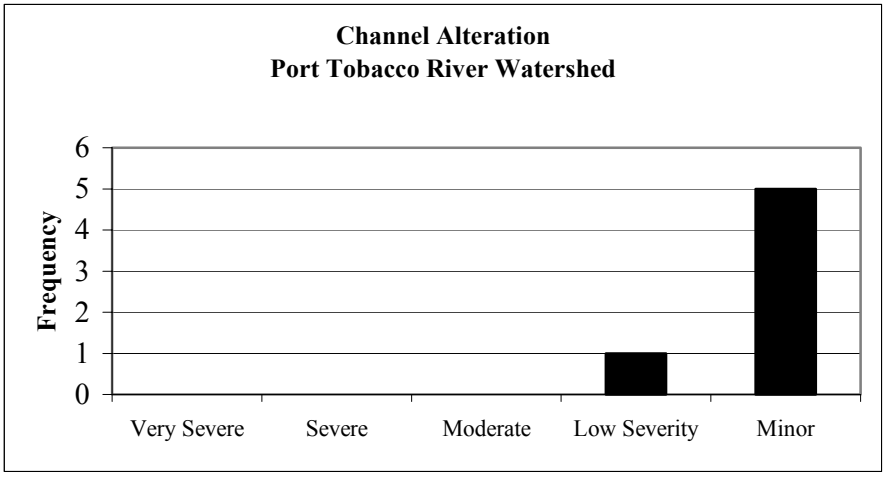

Figure 10a. Histograph showing the frequency of severity ratings given to channel alteration sites during the Port Tobacco River SCA survey.

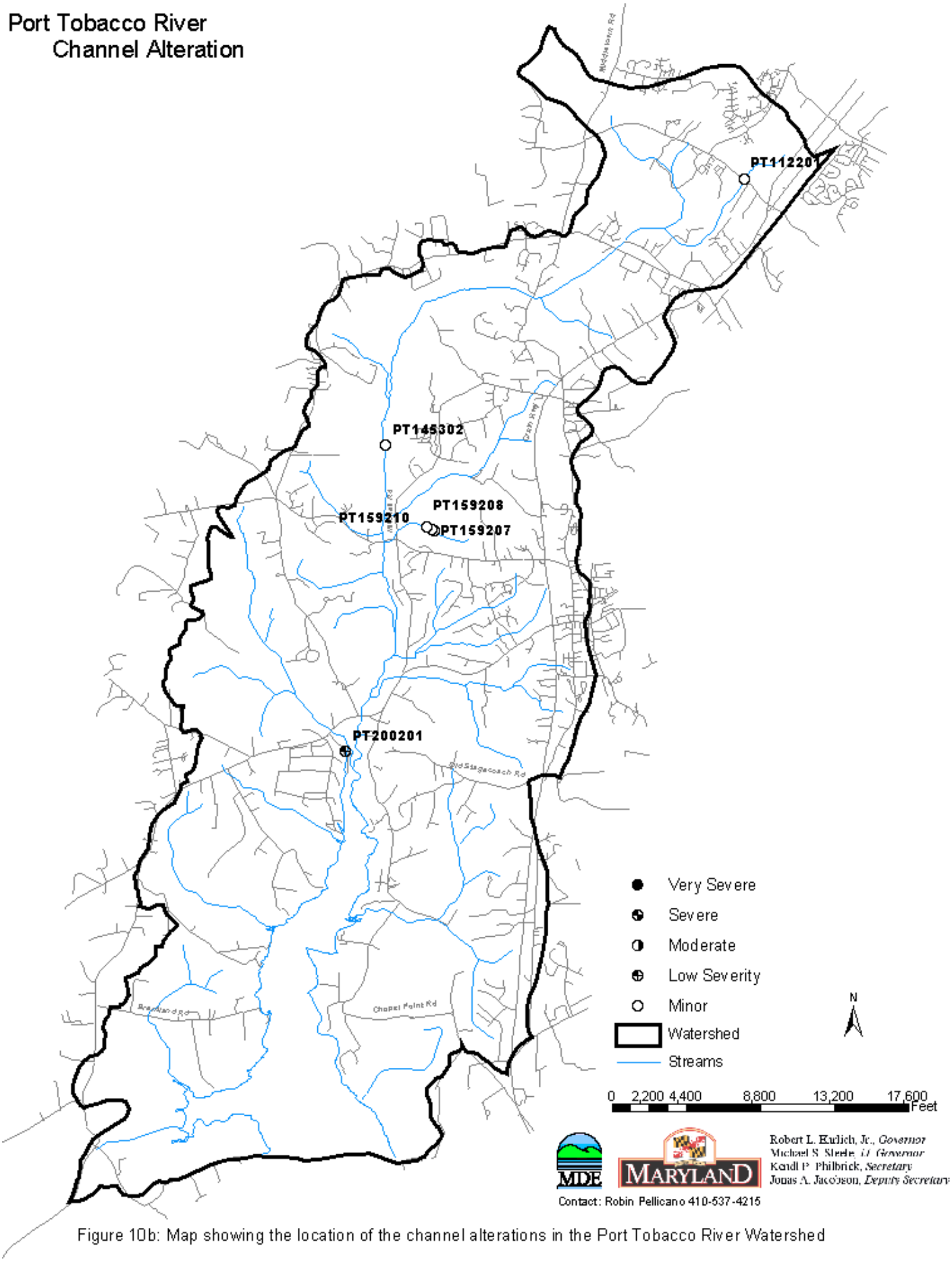

Figure 10b: Map showing the location of the channel alterations in the Port Tobacco River Watershed

Exposed Pipes

Any pipes in the stream or along the stream's immediate banks that could be damaged by a high flow event are recorded as exposed pipes in the SCA survey. Exposed pipes include: 1) manhole stacks in or along the edge of the stream channel, 2) pipes that are exposed along the stream banks, 3) pipes that run under the stream bed and were exposed by stream down-cutting, and 4) pipes built over a stream that are low enough to be affected by frequent high storm flows. Exposed pipes do not include pipe outfalls with only the open end of the pipe exposed to the streambed.

In urban areas, it is very common for pipelines and other utilities to be placed in the stream corridor. This is especially true for gravity sewage lines, which depend on the continuous downward slope of the pipeline to move sewage to a pumping station or treatment plant. Since streams flow through the lowest points of the local landscape, engineers often build sewage lines paralleling streams to collect sewage from adjacent neighborhoods. While the pipelines are stationary, streams migrate to different areas within the floodplain. Over time, this variance in stream location can expose previously buried pipelines, making them vulnerable to puncture by debris in the stream. Fluids in the pipelines can be discharged into the stream, causing a serious water quality problem.

Field crews observed six exposed pipes during the survey. All were rated moderate to low for severity (Figure 11a). Some pipes were rated as moderate because they are located along the stream or along the bottom were they may be damaged by debris. None of the pipes were reported to have any discharge at the time of the survey. Locations of these sites are shown in Figure 11b.

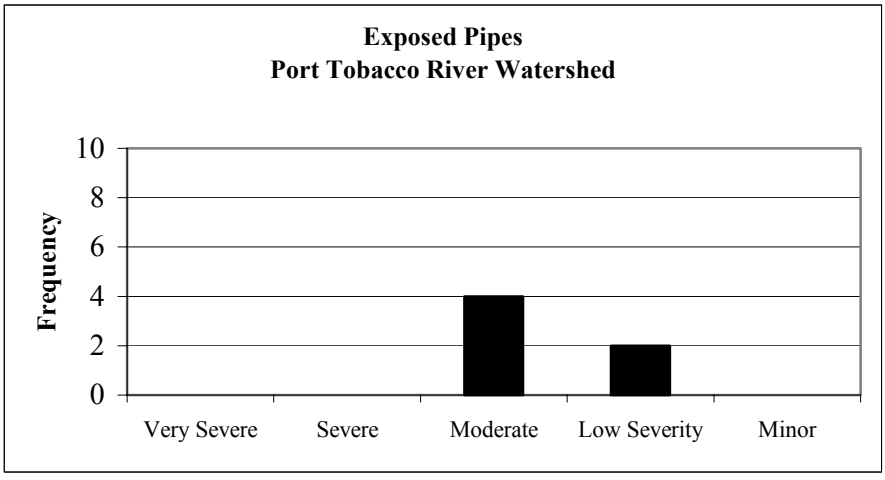

Figure 11a. Histograph showing the frequency of severity ratings given to exposed pipes sites during the Port Tobacco River SCA survey.

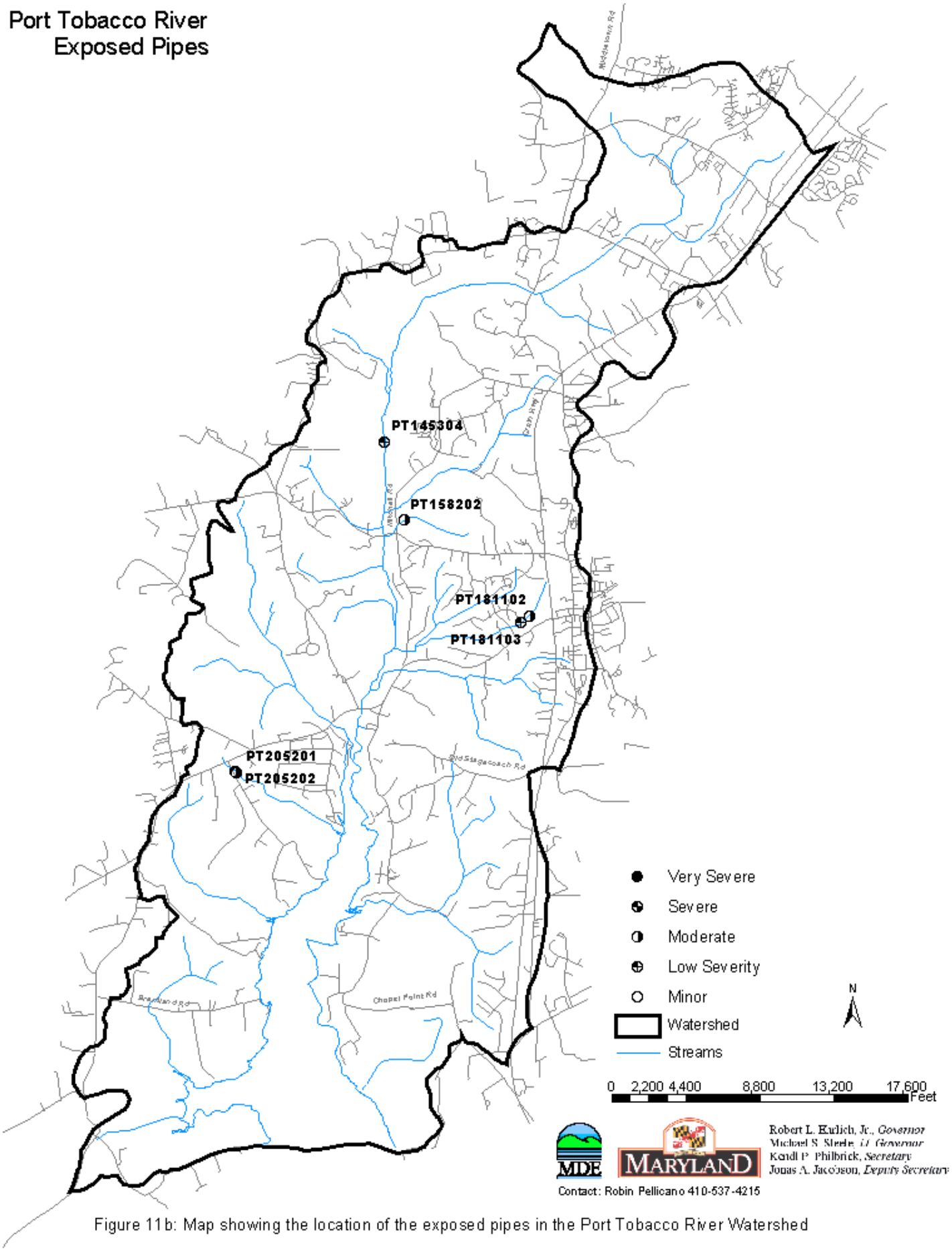

Figure 11b: Map showing the location of the exposed pipes in the Port Tobacco River Watershed

Trash Dumping

Trash dumping sites are places where large amounts of trash are situated inside the stream corridor, either as a site of deliberate dumping or as a place where trash tends to accumulate (often a result of storm drainage). Site severity rankings are based on size, contents of trash, and potential impact on the stream. Survey crews found two trash dumping sites (Figure 12b). Site PT192103 was a dumping site for several vehicles. It was given a moderate severity rating. Site PT174101 was construction trash. It was rated minor in severity.

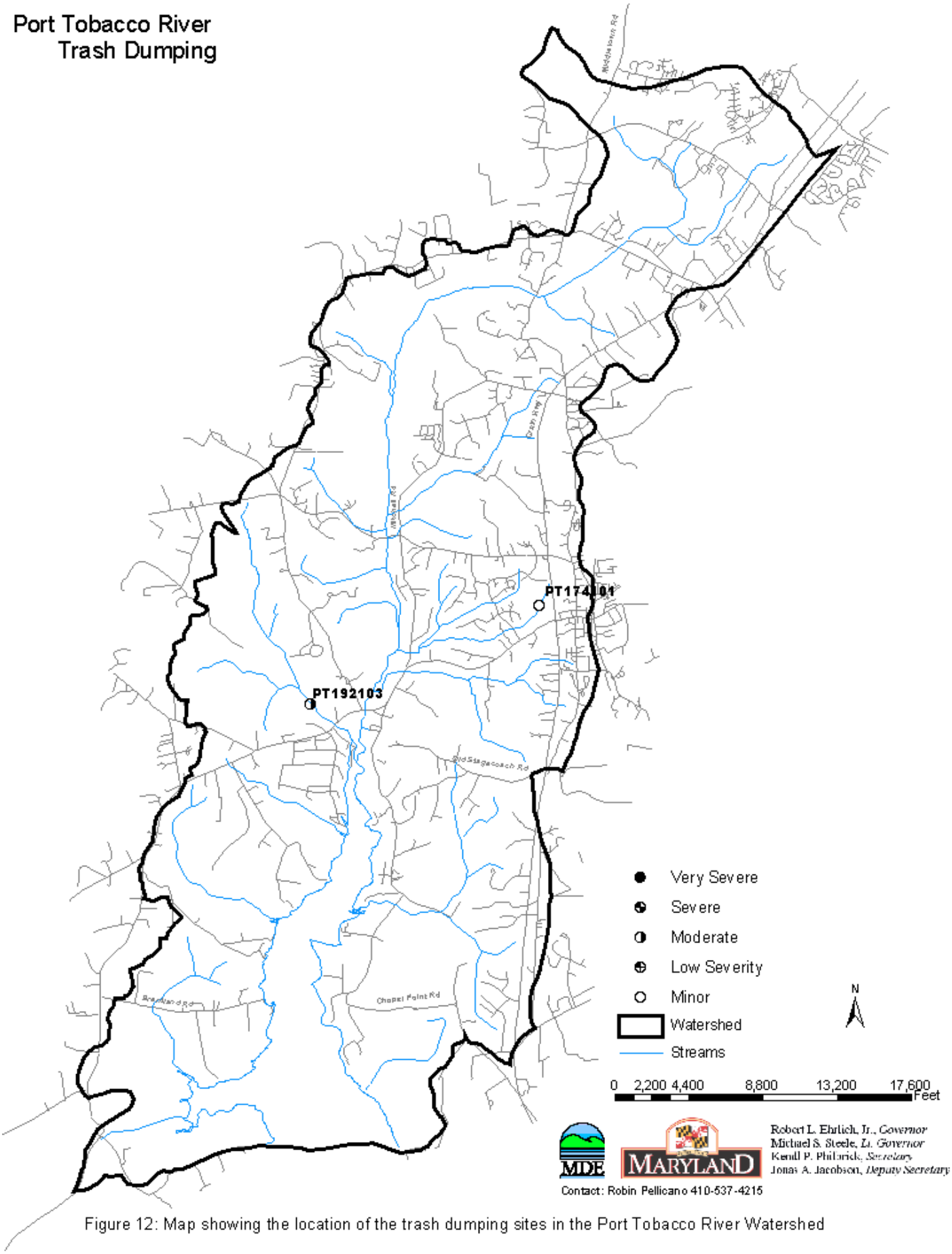

Figure 12: Map showing the location of the trash dumping sites in the Port Tobacco River Watershed

Representative Sites

Representative sites are used to document the general condition of both in-stream habitat and the adjacent riparian corridor (including and up to 50 feet beyond the stream bank). The SCA survey's representative site evaluations are based on the habitat assessment procedures outlined in EPA's rapid bioassessment protocols (Plafkin, et. al., 1989), and they are very similar to the habitat evaluations of Maryland Save-Our-Stream's Heartbeat Program. At each representative site, the following 10 separate categories related to stream habitat health are evaluated:

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

Under each category, field crews base a rating of optimal, suboptimal, marginal or poor on established grading criteria developed to reflect ideal wildlife habitat for rocky bottom streams. In addition to the habitat ratings, teams collect data on the stream's wetted width and pool depths at both runs and riffles at each representative site. Depth measurements are taken along the stream thalweg (main flow channel). At representative sites, field crews also indicate whether the bottom sediments are primarily silt, sand, gravel, cobble, boulder, or bedrock. Representative sites are located at approximately half- to one-mile intervals along the stream. Survey crews evaluated 35 representative sites in the Port Tobacco River watershed.

Attachment sites for macroinvertebrates were rated, on average, as suboptimal. In coastal plain streams there may be limited gravel riffles for macroinvertebrates to exist. There were some gravel riffles present in most of the wider streams. Embeddedness was found to be mostly marginal. The bottom substrate of the streams was mostly sand or silt. Shelter for fish was varied from stream to stream and even between locations on the same stream. Channel Alteration rates the amount of man-made changes to the stream channel. The streams in this watershed were found to be unaltered at most sites, though it was indicated that some areas may have been altered in the past but were no longer maintained. There was sediment deposition at many of the representative sites. Sand or gravel bars were found at many sites. This indicates some erosion may be taking place upstream. The condition of the banks was rated as mostly suboptimal. There were some areas of erosion present at many of the sites but these were small. For riparian vegetative zone width the sites were rated as mostly optimal or suboptimal, indicating representative sites in mostly forested areas. There were other areas where the rating was marginal or poor.

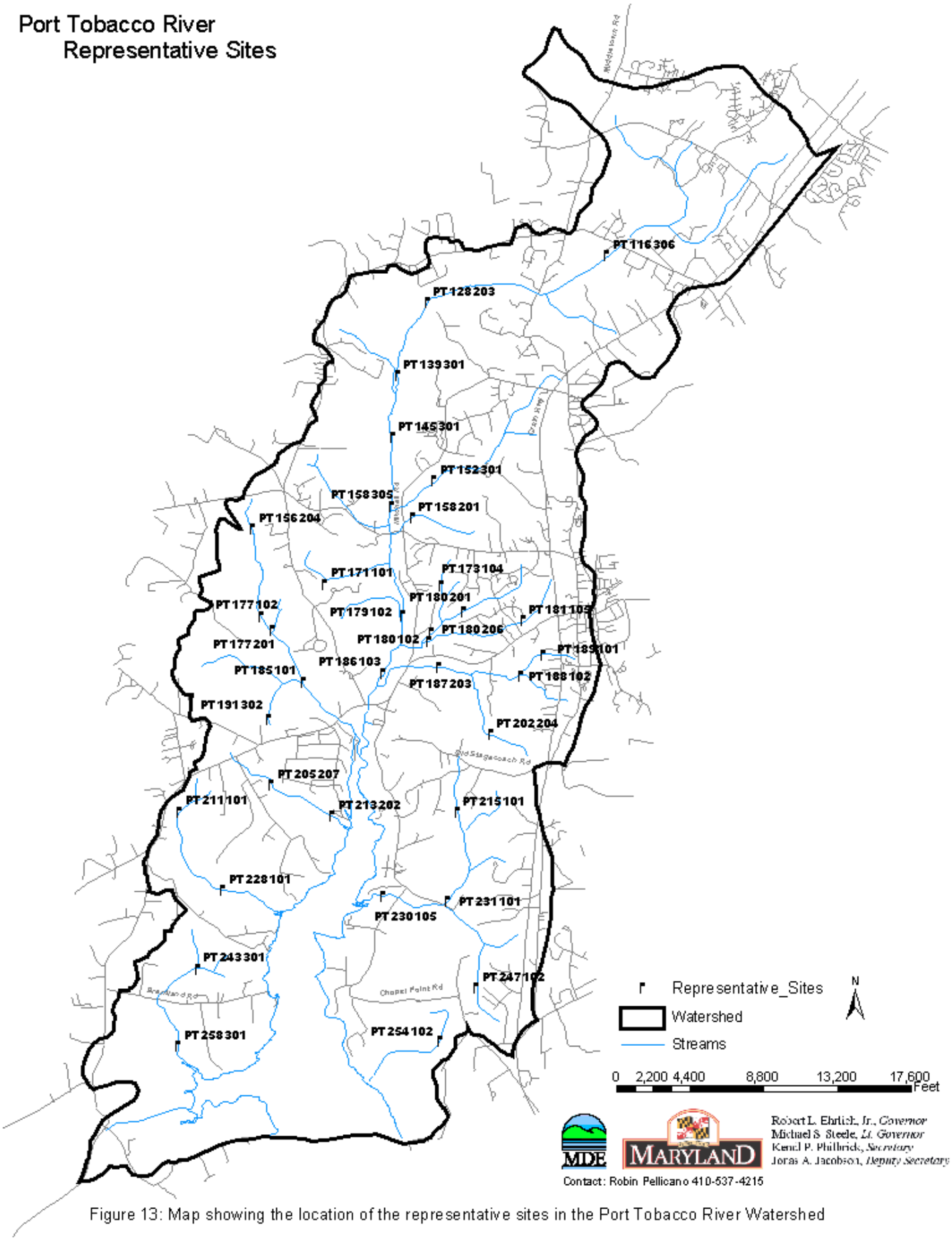

Figure 13: Map showing the location of the representative sites in the Port Tobacco River Watershed

DISCUSSION

The results of the Port Tobacco River SCA survey list, summarize, and show the locations of observable environmental problems along the stream corridor network in this watershed. Each potential problem site has a corresponding ranking for severity, correctibility, and access and a photograph of the site. The data from this effort can be used to target future restoration efforts. After this list of potential problem sites is compiled and distributed, county planners, resource managers, and others can initiate a dialogue to cooperatively set the direction and goals for the watershed's management and plan future restoration work at specific problem sites. In addition, this data can be combined with other GIS data and local information to prioritize areas for restoration.

The GIS and attribute data for the sites described in the SCA survey can be combined with other existing GIS datasets to further prioritize areas for restoration. Projects can be targeted to restoring areas with rare or threatened species, gaps in continuous forest or the State's Green Infrastructure, or where quality fish and wildlife habitat are found. In addition, sites can be prioritized for restoration based on their location in headwater areas, streams that deposit directly into the Chesapeake Bay, areas of specific local interest, or where the surrounding land use is particularly suited to restoration projects.

As previously stated, the Maryland Department of the Environment has formed a partnership with Charles County to develop a Watershed Restoration Action Strategy (WRAS) for the Port Tobacco River watershed. Results from this survey will be combined with other GIS data and local information about the area to establish priorities for the types and locations of restoration projects that will be pursued in the watershed in the future. The present survey places individual stream problems into their watershed context and is intended for use by resource managers and land-use planners to cooperatively and consistently prioritize future restoration work. Results of the present survey will be shared with the Port Tobacco River WRAS committee, which is developing a WRAS for the Port Tobacco River. Information on the Port Tobacco WRAS can be found on the DNR web site (www.dnr.maryland.gov/wras).

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Without the hard work and dedication of the Maryland Conservation Corps, this survey would not have been possible. The crew chief during the survey was Dawn Letts. The crewmembers were Thanh Dang, Kelley Diamond, Paige Fletcher, Fiona Foley, Sophia Ibach, and Even Lesavoy.

Appendix A: Listing of Sites by Site Number

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT102101	Unusual condition	5	3	1	402573.94899	104754.23356	Port Tobacco River
PT107101	Erosion	4	3	3	403775.72369	104183.80519	Port Tobacco River
PT111101	Fish Barrier	5	3	3	403771.51670	103589.36551	Port Tobacco River
PT111102	Inadequate Buffer	4	3	3	403805.33546	103531.80717	Port Tobacco River
PT111103	Fish Barrier	5	3	3	403893.09227	103278.60632	Port Tobacco River
PT111104	Erosion	4	3	3	403845.23946	103073.13655	Port Tobacco River
PT112201	Channel Alteration	5	3	1	404991.10379	103747.20260	Port Tobacco River
PT116301	Comment				403002.52322	102823.88463	Port Tobacco River
PT116302	Inadequate Buffer	4	2	1	402881.01835	102721.09706	Port Tobacco River
PT116303	Inadequate Buffer	4	2	1	402712.44909	102561.37825	Port Tobacco River
PT116304	Erosion	5	2	1	402677.50028	102526.85435	Port Tobacco River
PT116305	Fish Barrier	5	2	3	402492.36452	102377.11881	Port Tobacco River
PT116306	Representative Site				402417.20408	102314.40459	Port Tobacco River
PT117201	Fish Barrier	5	1	4	404334.84951	102787.69793	Port Tobacco River
PT121201	Inadequate Buffer	3	2	5	399843.01921	101734.99023	Port Tobacco River
PT122201	Fish Barrier	5	1	2	401086.79616	101649.67468	Port Tobacco River
PT126301	Erosion	2	3	4	397553.60252	100963.27988	Port Tobacco River
PT126302	Unusual condition	3	3	2	397571.02355	100948.67242	Port Tobacco River
PT128201	Fish Barrier	5	1	5	399395.77531	101601.25234	Port Tobacco River
PT128202	Fish Barrier	5	1	5	399225.15444	101535.13292	Port Tobacco River
PT128203	Representative Site				399149.45329	101457.76353	Port Tobacco River
PT128204	Erosion	2	2	5	398919.60221	101084.52261	Port Tobacco River
PT130101	Fish Barrier	5	3	1	402175.46019	101078.59276	Port Tobacco River
PT130102	Erosion	5	1	2	402329.30604	101008.53020	Port Tobacco River
PT133301	Inadequate Buffer	1	3	1	398123.75904	100536.10760	Port Tobacco River
PT133302	Erosion	4	3	5	398525.84305	100256.75116	Port Tobacco River
PT139301	Representative Site				398610.20563	100130.97884	Port Tobacco River
PT145301	Representative Site				398516.76779	99000.02536	Port Tobacco River
PT145302	Channel Alteration	5	3	2	398530.23329	98967.58033	Port Tobacco River
PT145303	Pipe Outfall	3	3	2	398529.38214	98968.57576	Port Tobacco River
PT145304	Exposed Pipe	4	2	2	398511.83339	98932.54955	Port Tobacco River
PT145305	Pipe Outfall	3	5	2	398508.89665	98895.41973	Port Tobacco River
PT147301	Erosion	3	3	3	400624.24582	99277.84859	Jennie Run
PT147302	Pipe Outfall	5	1	1	401142.65597	99031.49794	Jennie Run
PT150301	Erosion	3	4	2	397246.89189	98245.24836	Port Tobacco River
PT151301	Erosion	3	3	5	398502.43208	98378.34010	Port Tobacco River
PT151302	Inadequate Buffer	4	4	5	398520.63464	97980.41747	Port Tobacco River
PT152301	Representative Site				399281.16558	98205.67794	Jennie Run
PT156201	Inadequate Buffer	4	1	1	396039.50370	97950.91014	Hoghole Run
PT156202	Inadequate Buffer	3	3	3	395955.40325	97772.67892	Hoghole Run
PT156203	Erosion	3	2	3	395866.31688	97661.51578	Hoghole Run
PT156204	Representative Site				395968.68813	97320.10446	Hoghole Run
PT157301	Fish Barrier	4	1	1	397486.46222	97947.83883	Port Tobacco River
PT158201	Representative Site				398882.00207	97521.01264	Port Tobacco River
PT158202	Exposed Pipe	3	3	1	398869.10189	97515.19917	Port Tobacco River
PT158301	Inadequate Buffer	3	5	1	398797.41898	97799.58938	Jennie Run
PT158302	Inadequate Buffer	3	3	2	398122.48213	97384.99532	Port Tobacco River
PT158304	Fish Barrier	5	1	1	397998.04527	97425.75679	Port Tobacco River
PT158305	Representative Site				398501.05007	97734.36503	Port Tobacco River
PT158306	Inadequate Buffer	1	5	1	398701.05259	97389.52494	Port Tobacco River
PT159201	Erosion	5	1	5	399630.93870	97322.12759	Port Tobacco River

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT159202	Unusual condition	3	3	2	399590.27457	97339.19101	Port Tobacco River
PT159203	Pipe Outfall	3	1	1	399544.19072	97363.17786	Port Tobacco River
PT159204	Inadequate Buffer	1	4	1	399606.67987	97332.30704	Port Tobacco River
PT159205	Pipe Outfall	5	2	1	399508.53054	97381.88104	Port Tobacco River
PT159206	Unusual condition	3	5	1	399495.19496	97388.87533	Port Tobacco River
PT159207	Channel Alteration	5	1	1	399407.31749	97431.38770	Port Tobacco River
PT159208	Channel Alteration	5	1	1	399362.97375	97451.77065	Port Tobacco River
PT159209	Pipe Outfall	5	1	1	399314.78162	97473.92254	Port Tobacco River
PT159210	Channel Alteration	5	1	1	399280.88557	97489.50313	Port Tobacco River
PT159211	Erosion	5	1	1	399251.20408	97502.36973	Port Tobacco River
PT159212	Unusual condition	3	3	1	398986.84321	97587.65506	Port Tobacco River
PT163201	Inadequate Buffer	3	3	3	395990.77427	97232.20046	Hoghole Run
PT163202	Inadequate Buffer	5	2	4	396009.84152	97106.82478	Hoghole Run
PT163203	Erosion	4	3	4	396066.56061	96742.08296	Hoghole Run
PT163204	Fish Barrier	5	2	5	396125.61199	96631.80654	Hoghole Run
PT165101	Inadequate Buffer	2	3	3	398244.61291	96651.56933	Port Tobacco River
PT165102	Unusual condition	2	3	3	398341.59358	96663.07551	Port Tobacco River
PT166201	Erosion	5	1	4	399901.93605	97248.31416	Port Tobacco River
PT167201	Erosion	4	2	3	400834.11537	96659.00140	Unnamed Trib 5
PT167202	Fish Barrier	5	1	1	400833.29871	96605.47250	Unnamed Trib 5
PT167203	Pipe Outfall	3	3	1	400832.82388	96574.34900	Unnamed Trib 5
PT170201	Inadequate Buffer	1	3	3	396170.01354	96534.85913	Hoghole Run
PT170202	Fish Barrier	5	3	4	396090.46667	96093.23230	Hoghole Run
PT170203	Fish Barrier	5	3	4	396098.40918	95793.23534	Hoghole Run
PT171101	Representative Site				397284.74261	96309.84298	Port Tobacco River
PT171102	Erosion	3	2	3	397297.47477	96325.90819	Port Tobacco River
PT171103	Erosion	3	3	3	397584.75745	96459.85469	Port Tobacco River
PT172101	Inadequate Buffer	2	3	3	398535.75205	96560.86233	Port Tobacco River
PT172102	Erosion	4	3	3	398706.80821	96069.60329	Port Tobacco River
PT172201	Inadequate Buffer	4	3	3	397883.80763	95943.59258	Port Tobacco River
PT172202	Comment			3	397886.12674	95943.59066	Port Tobacco River
PT172203	Inadequate Buffer	4	3	3	398538.53500	96060.68938	Port Tobacco River
PT173101	Erosion	4	3	3	399414.83571	96556.98641	Unnamed Trib 5
PT173102	Fish Barrier	5	1	1	399406.01388	96411.43813	Unnamed Trib 5
PT173104	Representative Site				399414.78678	96284.72538	Unnamed Trib 5
PT173105	Erosion	3	4	3	399414.25710	96199.84862	Unnamed Trib 5
PT173106	Fish Barrier	5	3	3	399415.08507	96126.30938	Unnamed Trib 5
PT173107	Fish Barrier	5	1	2	399423.97031	96071.90254	Unnamed Trib 5
PT173108	Unusual condition	5	3	1	399375.47024	95857.58466	Unnamed Trib 5
PT173109	Fish Barrier	5	2	2	399719.12050	96341.91295	Unnamed Trib 5
PT173110	Fish Barrier	5	1	3	399673.57683	96295.12151	Unnamed Trib 5
PT173111	Fish Barrier	5	1	3	399608.97176	96223.42844	Unnamed Trib 5
PT173112	Erosion	3	3	3	399593.40270	96212.38607	Unnamed Trib 5
PT173113	Fish Barrier	5	2	3	399559.26148	96163.01133	Unnamed Trib 5
PT174101	Trash Dumping	5	1	2	401236.58117	96014.26365	Unnamed Trib 5
PT174102	Fish Barrier	5	1	2	401225.04702	95977.64859	Unnamed Trib 5
PT174103	Inadequate Buffer	2	4	3	401224.62120	95976.16723	Unnamed Trib 5
PT174104	Fish Barrier	5	1	3	401213.84986	95930.17856	Unnamed Trib 5
PT174201	Pipe Outfall	4	1	1	400617.42232	96152.31616	Unnamed Trib 5
PT174202	Pipe Outfall	4	1	1	400630.68074	96159.64088	Unnamed Trib 5
PT174203	Fish Barrier	5	1	1	400679.26440	96186.48132	Unnamed Trib 5

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT174204	Unusual condition	3	3	1	400653.24941	96172.10913	Unnamed Trib 5
PT174205	Pipe Outfall	3	3	1	400729.65700	96209.82868	Unnamed Trib 5
PT174206	Fish Barrier	5	2	2	400706.11940	96201.31758	Unnamed Trib 5
PT174207	Fish Barrier	5	1	1	400430.93744	96056.52211	Unnamed Trib 5
PT174208	Pipe Outfall	5	3	1	400406.36005	96056.75466	Unnamed Trib 5
PT174209	Pipe Outfall	3	3	1	400406.36005	96056.75466	Unnamed Trib 5
PT174210	Fish Barrier	3	5	1	400398.45781	96055.57388	Unnamed Trib 5
PT174211	Inadequate Buffer	1	1	5	400187.52483	96039.12722	Unnamed Trib 5
PT175101	Erosion	1	4	5	401406.37009	96348.92727	Unnamed Trib 5
PT177101	Fish Barrier	5	1	5	396268.25443	95510.00419	Hoghole Run
PT177102	Representative Site				396137.91522	95720.70123	Hoghole Run
PT177201	Representative Site				396339.14652	95468.72278	Hoghole Run
PT177202	Inadequate Buffer	3	2	3	396322.82178	95418.18848	Hoghole Run
PT177203	Erosion	3	3	3	396374.77713	95622.04195	Hoghole Run
PT177204	Pipe Outfall	3	3	3	396442.64476	95855.67210	Hoghole Run
PT177205	Pipe Outfall	5	1	3	396490.55270	96085.64620	Hoghole Run
PT177206	Pipe Outfall	5	1	3	396489.13924	96083.52275	Hoghole Run
PT177207	Inadequate Buffer	5	1	1	396468.48507	96026.07830	Hoghole Run
PT177208	Unusual condition	3	3	1	396484.14706	96065.38665	Hoghole Run
PT179101	Unusual condition	3	4	3	398695.05042	95753.10348	Port Tobacco River
PT179102	Representative Site				398695.14088	95729.71020	Port Tobacco River
PT179103	Unusual condition	5	3	3	398862.66786	95144.95255	Unnamed Trib 5
PT179104	Erosion	4	3	3	398838.87086	95140.58443	Unnamed Trib 5
PT179105	Inadequate Buffer	4	3	3	398811.00006	95147.55213	Unnamed Trib 5
PT180101	Fish Barrier	3	2	3	399938.83942	95400.26905	Unnamed Trib 5
PT180102	Representative Site				399175.25039	95270.09379	Unnamed Trib 5
PT180103	Inadequate Buffer	3	3	2	399044.42845	95154.51187	Unnamed Trib 5
PT180201	Representative Site				399823.58840	95804.36351	Unnamed Trib 5
PT180202	Fish Barrier	5	1	4	399650.62763	95732.68982	Unnamed Trib 5
PT180203	Pipe Outfall	5	1	4	399648.32634	95749.51975	Unnamed Trib 5
PT180204	Fish Barrier	5	1	4	399622.81512	95719.68100	Unnamed Trib 5
PT180205	Erosion	4	4	4	399603.02027	95709.93405	Unnamed Trib 5
PT180206	Representative Site				399226.81190	95407.14114	Unnamed Trib 5
PT181101	Pipe Outfall	3	2	4	401132.78139	95807.10128	Unnamed Trib 5
PT181102	Exposed Pipe	3	4	1	401122.33432	95789.13684	Unnamed Trib 5
PT181103	Exposed Pipe	4	3	3	400976.15996	95668.94903	Unnamed Trib 5
PT181104	Erosion	2	4	3	400969.98477	95663.85661	Unnamed Trib 5
PT181105	Representative Site				400891.42037	95640.65969	Unnamed Trib 5
PT181106	Fish Barrier	3	1	1	400751.22640	95589.91791	Unnamed Trib 5
PT181106	Comment				400752.30654	95589.83263	Unnamed Trib 5
PT181107	Inadequate Buffer	3	1	2	400617.21668	95548.41759	Unnamed Trib 5
PT181108	Fish Barrier	3	5	1	400544.78543	95530.33140	Unnamed Trib 5
PT181109	Erosion	2	3	3	400517.44963	95510.68420	Unnamed Trib 5
PT181111	Fish Barrier	5	2	4	400148.13726	95375.08955	Unnamed Trib 5
PT181112	Fish Barrier	5	2	4	400111.07329	95381.31834	Unnamed Trib 5
PT181113	Inadequate Buffer	3	2	3	400174.44497	95353.28798	Unnamed Trib 5
PT184101	Erosion	4	4	5	396448.60139	94582.57247	Hoghole Run
PT185101	Representative Site				396899.09328	94508.85874	Hoghole Run
PT185102	Inadequate Buffer	3	5	3	396876.75859	94564.69522	Hoghole Run
PT186101	Inadequate Buffer	3	3	3	398498.70648	95048.41257	Port Tobacco River
PT186102	Unusual condition	3	3	3	398420.17892	94826.46299	Port Tobacco River

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT186103	Representative Site				398346.77884	94667.80137	Port Tobacco River
PT186201	Inadequate Buffer	3	3	3	398774.20049	94815.90651	Unnamed Trib 4
PT187201	Erosion	1	4	2	400025.37075	94724.44943	Unnamed Trib 4
PT187202	Inadequate Buffer	3	3	2	399921.95692	94664.53767	Unnamed Trib 4
PT187203	Representative Site				399356.80579	94788.36291	Unnamed Trib 4
PT188101	Fish Barrier	5	1	2	401041.03585	94544.17375	Unnamed Trib 4
PT188102	Representative Site				400844.29627	94634.37511	Unnamed Trib 4
PT188103	Erosion	3	2	4	400791.90866	94645.48763	Unnamed Trib 4
PT188104	Erosion	3	2	4	401061.78420	94916.95067	Unnamed Trib 4
PT188105	Unusual condition	3	4	3	401144.33437	95001.08834	Unnamed Trib 4
PT189101	Representative Site				401264.70916	95020.70447	Unnamed Trib 4
PT189301	Erosion	3	1	1	401841.28332	94929.52701	Unnamed Trib 4
PT189302	Unusual condition	3	4	1	401826.55032	94936.66186	Unnamed Trib 4
PT189303	Inadequate Buffer	3	1	1	401821.77598	94938.97396	Unnamed Trib 4
PT189304	Pipe Outfall	5	1	1	401751.33483	94973.08697	Unnamed Trib 4
PT189305	Pipe Outfall	3	3	1	401671.36001	95011.81692	Unnamed Trib 4
PT189306	Unusual condition	3	3	1	401670.68139	95012.14556	Unnamed Trib 4
PT189307	Fish Barrier	5	4	1	401579.04047	95008.85159	Unnamed Trib 4
PT191301	Comment				396264.78127	93990.35737	Hoghole Run
PT191302	Representative Site				396254.93481	93831.87301	Hoghole Run
PT191303	Pipe Outfall	5	2	3	396282.86708	93737.21367	Hoghole Run
PT192101	Fish Barrier	5	3	1	397519.64568	93836.52839	Hoghole Run
PT192101	Comment				397519.64568	93836.52839	Hoghole Run
PT192102	Erosion	2	5	5	397463.78115	93892.39292	Hoghole Run
PT192103	Trash Dumping	3	3	4	397107.42103	94219.63702	Hoghole Run
PT192104	Erosion	3	4	4	397015.34969	94316.59738	Hoghole Run
PT193101	Inadequate Buffer	4	3	2	398086.47328	94122.18018	Port Tobacco River
PT193102	Erosion	3	2	2	398085.08058	94119.59373	Port Tobacco River
PT193103	Fish Barrier	5	2	3	398091.74338	94272.92631	Port Tobacco River
PT193201	Inadequate Buffer	1	3	1	398086.54334	94093.37840	Port Tobacco River
PT193202	Erosion	2	3	1	398086.54334	94093.37840	Port Tobacco River
PT196101	Erosion	5	1	1	401619.02837	94191.30736	Unnamed Trib 4
PT196102	Fish Barrier	5	1	1	401360.66380	94210.07993	Unnamed Trib 4
PT196103	Erosion	2	3	3	401357.41517	94210.06351	Unnamed Trib 4
PT196104	Fish Barrier	5	1	1	401340.62739	94214.70371	Unnamed Trib 4
PT198201	Fish Barrier	5	1	1	395673.34263	93068.17970	Unnamed Trib 1
PT198202	Fish Barrier	5	1	1	395733.73232	93031.64767	Unnamed Trib 1
PT198203	Inadequate Buffer	4	2	1	395735.96897	93030.90212	Unnamed Trib 1
PT198204	Fish Barrier	5	1	2	395848.54729	92952.61918	Unnamed Trib 1
PT198205	Erosion	4	3	3	395864.94943	92927.27042	Unnamed Trib 1
PT200201	Channel Alteration	4	4	2	397804.64426	93463.63022	Hoghole Run
PT200202	Inadequate Buffer	3	4	2	397804.64426	93463.63022	Hoghole Run
PT202201	Erosion	4	2	3	400787.30596	93362.53812	Unnamed Trib 4
PT202202	Unusual condition	3	2	3	400755.55590	93370.47564	Unnamed Trib 4
PT202203	Erosion	2	3	3	400494.04683	93478.97611	Unnamed Trib 4
PT202204	Representative Site				400303.54833	93553.91398	Unnamed Trib 4
PT204101	Inadequate Buffer	4	2	1	394946.84588	92700.75518	Unnamed Trib 2
PT204102	Fish Barrier	5	2	3	394944.49929	92682.34353	Unnamed Trib 2
PT204103	Fish Barrier	5	3	3	394942.66747	92667.97076	Unnamed Trib 2
PT204104	Erosion	5	3	3	394939.07176	92648.63430	Unnamed Trib 2
PT204105	Unusual condition	5	3	3	394920.55111	92496.01181	Unnamed Trib 2

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT204106	Erosion	5	3	3	395085.11542	92427.10517	Unnamed Trib 2
PT204107	Erosion	3	3	3	394902.66354	92337.37334	Unnamed Trib 2
PT205201	Exposed Pipe	3	3	1	395813.60792	92977.29295	Unnamed Trib 1
PT205202	Exposed Pipe	3	3	1	395839.20471	92960.73032	Unnamed Trib 1
PT205203	Fish Barrier	5	1	3	396003.32527	92814.67808	Unnamed Trib 1
PT205204	Erosion	4	3	4	396096.67825	92804.13823	Unnamed Trib 1
PT205205	Fish Barrier	5	2	4	396132.81488	92792.09268	Unnamed Trib 1
PT205206	Erosion	2	5	4	396172.00370	92798.29379	Unnamed Trib 1
PT205207	Representative Site				396318.01514	92630.98351	Unnamed Trib 1
PT205209	Comment				396551.39759	92474.39142	Unnamed Trib 1
PT206201	Fish Barrier	5	1	5	396584.52284	92466.86295	Unnamed Trib 1
PT206202	Unusual condition	3	1	5	396878.13301	92400.61245	Unnamed Trib 1
PT206203	Comment				397087.27311	92268.73514	Unnamed Trib 1
PT208101	Erosion	3	5	4	399687.46720	92702.95896	Wills Branch
PT208102	Unusual condition	3	3	3	399676.09502	92673.04060	Wills Branch
PT208103	Fish Barrier	5	1	3	399633.76059	92541.36489	Wills Branch
PT208104	Fish Barrier	5	1	2	399651.93894	92303.12135	Wills Branch
PT209201	Erosion	3	3	4	400469.89739	92287.03967	Wills Branch
PT211101	Representative Site				394644.71902	92148.19617	Unnamed Trib 2
PT211102	Fish Barrier	5	3	3	394632.96796	92124.06640	Unnamed Trib 2
PT213201	Fish Barrier	5	1	4	397200.27922	92191.39989	Unnamed Trib 1
PT213202	Representative Site				397427.88177	92058.68744	Unnamed Trib 1
PT213203	Fish Barrier	5	3	5	397524.30926	91996.51226	Unnamed Trib 1
PT215101	Representative Site				399694.10311	92126.83968	Wills Branch
PT215102	Fish Barrier	5	1	4	399712.61815	92071.47069	Wills Branch
PT215201	Erosion	4	3	4	400052.94761	92059.68262	Wills Branch
PT216201	Fish Barrier	5	1	3	400295.99096	92085.96690	Wills Branch
PT223101	Erosion	3	3	4	399875.08254	91324.67067	Wills Branch
PT223201	Erosion	2	5	4	399930.72959	91072.59103	Wills Branch
PT224201	Pipe Outfall	3	3	2	400575.57143	91236.78628	Wills Branch
PT224202	Fish Barrier	5	3	4	400315.70589	91310.51293	Wills Branch
PT228101	Representative Site				395428.04580	90714.13625	Unnamed Trib 2
PT228102	Fish Barrier	5	2	3	396246.21546	90392.12570	Unnamed Trib 2
PT230101	Fish Barrier	3	3	1	398604.44668	90579.96742	Wills Branch
PT230102	Fish Barrier	5	3	3	398451.51196	90638.61073	Wills Branch
PT230103	Erosion	4	3	3	398452.64938	90631.25252	Wills Branch
PT230104	Inadequate Buffer	4	2	3	398383.64261	90607.34704	Wills Branch
PT230105	Representative Site				398352.42730	90600.77540	Wills Branch
PT231101	Representative Site				399514.96954	90506.93448	Wills Branch
PT231102	Inadequate Buffer	5	1	3	399503.69219	90482.23656	Wills Branch
PT235301	Fish Barrier	5	1	4	395373.82974	89424.45115	Goose Creek
PT236301	Erosion	3	3	4	395579.19361	89550.95530	Goose Creek
PT240101	Inadequate Buffer	4	3	3	400075.84089	89927.18190	Wills Branch
PT240201	Erosion	3	3	3	400192.48757	89739.89006	Wills Branch
PT240202	Fish Barrier	5	3	3	400564.60233	89737.92253	Wills Branch
PT243301	Representative Site				394967.45689	89274.09498	Goose Creek
PT243302	Erosion	5	1	4	394740.09218	89187.90402	Goose Creek
PT243303	Erosion	3	3	4	394626.30526	89115.58389	Goose Creek
PT244301	Erosion	4	2	3	395464.18985	89146.79920	Goose Creek
PT247101	Fish Barrier	5	3	3	400054.48305	88874.07598	Wills Branch
PT247102	Representative Site				400047.43731	88914.09799	Wills Branch

Appendix A- Port Tobacco River

Site	Problem	Severity	Correctability	Access	X_COORD	Y_COORD	Stream
PT254101	Erosion	3	3	4	399505.75079	88368.05941	Unnamed Trib 3
PT254102	Representative Site				399374.31791	87945.83130	Unnamed Trib 3
PT255101	Erosion	3	3	3	400465.05813	88321.23604	Wills Branch
PT258301	Representative Site				394609.24575	87866.64774	Goose Creek
PT258302	Inadequate Buffer	1	3	4	394607.59213	87866.64774	Goose Creek

Appendix B: Listing of Sites by Problem Category

Fish Barriers

Problem	Site	Blockage	Type	Reason	Drop(In)	Depth(In)	Severity	Correctability	Access
Fish Barrier	PT174210	Total	Road crossing	Too shallow		1	3	5	1
Fish Barrier	PT180101	Temporary	Debris dam	Too high	152		3	2	3
Fish Barrier	PT181106	Temporary	Road crossing	Too high	12		3	1	1
Fish Barrier	PT181108	Total	Road crossing	Too high	24		3	5	1
Fish Barrier	PT230101	Temporary	Road crossing	Too high	12		3	3	1
Fish Barrier	PT157301	Partial	Road crossing	Too high	6		4	1	1
Fish Barrier	PT111101	Temporary	Beaver dam	Too high	30		5	3	3
Fish Barrier	PT111103	Temporary	Beaver dam	Too high	36		5	3	3
Fish Barrier	PT116305	Temporary	Beaver dam	Too high	30		5	2	3
Fish Barrier	PT117201	Temporary	Beaver dam	Too high	36		5	1	4
Fish Barrier	PT122201	Temporary	Beaver dam	Too high	20		5	1	2
Fish Barrier	PT128201	Temporary	Beaver dam	Too high	6		5	1	5
Fish Barrier	PT128202	Temporary	Beaver dam	Too high	12		5	1	5
Fish Barrier	PT130101	Total	Road crossing	Too high	6		5	3	1
Fish Barrier	PT158304	Temporary	Debris dam	Too high	8		5	1	1
Fish Barrier	PT163204	Temporary	Natural falls	Too high	12		5	2	5
Fish Barrier	PT167202	Total	Road crossing	Too shallow		1	5	1	1
Fish Barrier	PT170202	Temporary	Beaver dam	Too high	36		5	3	4
Fish Barrier	PT170203	Temporary	Beaver dam	Too high	30		5	3	4
Fish Barrier	PT173102	Temporary	Debris dam	Too high	8		5	1	1
Fish Barrier	PT173106	Temporary	Debris dam	Too high	24		5	3	3
Fish Barrier	PT173107	Temporary	Debris dam	Too high	8		5	1	2
Fish Barrier	PT173109	Temporary	Debris dam	Too high	7		5	2	2
Fish Barrier	PT173110	Temporary	Debris dam	Too high	9		5	1	3
Fish Barrier	PT173111	Temporary	Debris dam	Too high	12		5	1	3
Fish Barrier	PT173113	Temporary	Debris dam	Too high	8		5	2	3
Fish Barrier	PT174102	Temporary	Debris dam	Too high	18		5	1	2
Fish Barrier	PT174104	Temporary	Debris dam	Too high	12		5	1	3
Fish Barrier	PT174203	Temporary	Debris dam	Too high	18		5	1	1
Fish Barrier	PT174206	Partial	Natural falls	Too high	8		5	2	2
Fish Barrier	PT174207	Temporary	Debris dam	Too high	36		5	1	1
Fish Barrier	PT177101	Temporary	Beaver dam	Too high	18		5	1	5
Fish Barrier	PT180202	Temporary	Beaver dam	Too high	12		5	1	4
Fish Barrier	PT180204	Temporary	Beaver dam	Too high	24		5	1	4

Fish Barriers

Problem	Site	Blockage	Type	Reason	Drop(In)	Depth(In)	Severity	Correctability	Access
Fish Barrier	PT181111	Temporary	Debris dam	Too high	12		5	2	4
Fish Barrier	PT181112	Temporary	Debris dam	Too high	6		5	2	4
Fish Barrier	PT188101	Temporary	Debris dam	Too high	8		5	1	2
Fish Barrier	PT189307	Total	Road crossing	Too high	12		5	4	1
Fish Barrier	PT192101	Partial	Road crossing	Too fast			5	3	1
Fish Barrier	PT193103	Temporary	Debris dam	Too high	12		5	2	3
Fish Barrier	PT196102	Temporary	Debris dam	Too high	24		5	1	1
Fish Barrier	PT196104	Temporary	Natural falls	Too high	12		5	1	1
Fish Barrier	PT198201	Temporary	Debris dam	Too shallow		5	5	1	1
Fish Barrier	PT198202	Temporary	Debris dam	Too high	18		5	1	1
Fish Barrier	PT198204	Temporary	Debris dam	Too high	12		5	1	2
Fish Barrier	PT204102	Temporary	Debris dam	Too high	12		5	2	3
Fish Barrier	PT204103	Temporary	Debris dam	Too high	8		5	3	3
Fish Barrier	PT205203	Temporary	Debris dam	Too high	12		5	1	3
Fish Barrier	PT205205	Temporary	Debris dam	Too high	30		5	2	4
Fish Barrier	PT206201	Temporary	Debris dam	Too high	24		5	1	5
Fish Barrier	PT208103	Temporary	Debris dam	Too shallow		0.75	5	1	3
Fish Barrier	PT208104	Partial	Natural falls	Too high	18		5	1	2
Fish Barrier	PT211102	Temporary	Debris dam	Too high	10		5	3	3
Fish Barrier	PT213201	Temporary	Debris dam	Too high	18		5	1	4
Fish Barrier	PT213203	Total	Natural falls	Too high	30		5	3	5
Fish Barrier	PT215102	Temporary	Debris dam	Too high	18		5	1	4
Fish Barrier	PT216201	Total	Natural falls	Too high	12		5	1	3
Fish Barrier	PT224202	Total	Natural falls	Too high	12		5	3	4
Fish Barrier	PT228102	Temporary	Beaver dam	Too shallow		18	5	2	3
Fish Barrier	PT230102	Total	Natural falls	Too high	36		5	3	3
Fish Barrier	PT235301	Total	Natural falls	Too high	12		5	1	4
Fish Barrier	PT240202	Total	Road crossing	Too high	16		5	3	3
Fish Barrier	PT247101	Temporary	Debris dam	Too high, too fast	42		5	3	3

Erosion

Problem	Site	Type	Possible Cause	Height(ft)	Length(ft)	Landuseleft	Landuseright	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	PT175101	Downcutting	Unknown	4	2000	changes	changes	No		1	4	5
Erosion	PT187201	Widening	Unknown	4	4000	Forest	Forest	No		1	4	2
Erosion	PT126301	Widening	Bend at steep slope	3	2000	Shrubs/small trees	Shrubs/small trees	No		2	3	4
Erosion	PT128204	Widening	Unknown	3	4000	Forest	Forest	No		2	2	5
Erosion	PT181104	Widening	Bend at steep slope	25	100	Lawn	Shrubs/small trees	No		2	4	3
Erosion	PT181109	Widening	Bend at steep slope	10	300	crop field	Shrubs/small trees	No		2	3	3
Erosion	PT192102	Widening	Unknown	3	2000	Forest	Forest	No		2	5	5
Erosion	PT193202	Widening	Bend at steep slope	4	2000	Shrubs/small trees	Shrubs/small trees	No		2	3	1
Erosion	PT196103	Downcutting	Unknown	5	3000	Forest	Forest	No		2	3	3
Erosion	PT202203	Downcutting	Unknown	6	700	Forest	Forest	No		2	3	3
Erosion	PT205206	Widening	Bend at steep slope	3	3500	Forest	Forest	No		2	5	4
Erosion	PT223201	Widening	Unknown	5	2500	Forest	Forest	No		2	5	4
Erosion	PT147301	Widening	Bend at steep slope	3	1100	Forest	Forest	No		3	3	3
Erosion	PT150301	Widening	Bend at steep slope	3	2400	Forest	Forest	No		3	4	2
Erosion	PT151301	Widening	Bend at steep slope	3	1000	Forest	Forest	No		3	3	5
Erosion	PT156203	Widening	Bend at steep slope	3	1200	Forest	Forest	No		3	2	3
Erosion	PT171102	Widening	Bend at steep slope	3	700	Forest	Forest	No		3	2	3
Erosion	PT171103	Widening	Bend at steep slope	5	1000	Forest	Forest	No		3	3	3
Erosion	PT173105	Widening	Unknown	6	1500	Forest	Forest	No		3	4	3
Erosion	PT173112	Widening	Unknown	5	650	Forest	Forest	No		3	3	3
Erosion	PT177203	Widening	Bend at steep slope	5.5	800	Forest	Forest	No		3	3	3
Erosion	PT188103	Widening	Bend at steep slope	3	2800	Forest	Forest	No		3	2	4
Erosion	PT188104	Widening	Bend at steep slope	20	200	Forest	Forest	No		3	2	4
Erosion	PT189301	Widening	Land use change	4	500	Forest	Lawn	No		3	1	1
Erosion	PT192104	Widening	Bend at steep slope	15	200	Forest	Forest	No		3	4	4
Erosion	PT193102	Widening	Unknown	4	450	Shrubs/small trees	Shrubs/small trees	No		3	2	2
Erosion	PT204107	Widening	Bend at steep slope	3	1100	Forest	Forest	No		3	3	3
Erosion	PT208101	Widening	Unknown	3.5	4000	Forest	Forest	No		3	5	4
Erosion	PT209201	Headcutting	Unknown	3	700	Forest	Forest	No		3	3	4
Erosion	PT223101	Widening	Bend at steep slope	15	250	Forest	Forest	No		3	3	4
Erosion	PT236301	Widening	Unknown	8	1600	Forest	Forest	No		3	3	4

Erosion

Problem	Site	Type	Possible Cause	Height(ft)	Length(ft)	Landuseleft	Landuseright	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	PT240201	Widening	Bend at steep slope	4	1500	Forest	Forest	No		3	3	3
Erosion	PT243303	Widening	bend at stee slope	6	100	Forest	Forest	No		3	3	4
Erosion	PT254101	Widening	Bend at steep slope	3	3200	Forest	Forest	No		3	3	4
Erosion	PT255101	Widening	Bend at steep slope	3	7000	Forest	Forest	No		3	3	3
Erosion	PT107101	Widening	Bend at steep slope	3.5	100	Forest	Forest	No		4	3	3
Erosion	PT111104	Widening	Bend at steep slope	3	100	Forest	Forest	No		4	3	3
Erosion	PT133302	Downcutting	Unknown	3	300	Shrubs/small trees	Shrubs/small trees	No		4	3	5
Erosion	PT163203	Widening	Bend at steep slope	4	1500	Forest	Forest	No		4	3	4
Erosion	PT167201	Widening	Unknown	3	2000	Shrubs/small trees	Shrubs/small trees	No		4	2	3
Erosion	PT172102	Widening	Bend at steep slope	5	100	Pasture	Forest	No		4	3	3
Erosion	PT173101	Widening	Bend at steep slope	5	600	Forest	Forest	No		4	3	3
Erosion	PT179104	Widening	Unknown	3	100	Pasture	Forest	No		4	3	3
Erosion	PT180205	Widening	Unknown	3	2500	Forest	Forest	No		4	4	4
Erosion	PT184101	Widening	Unknown	2	1000	Forest	Forest	No		4	4	5
Erosion	PT198205	Widening	Bend at steep slope	2	600	Lawn	Forest	No		4	3	3
Erosion	PT202201	Widening	Unknown	3	600	Forest	Pasture	No		4	2	3
Erosion	PT205204	Widening	Bend at steep slope	4	25	Lawn	Lawn	No		4	3	4
Erosion	PT215201	Widening	Bend at steep slope	4	1200	Forest	Forest	No		4	3	4
Erosion	PT230103	Widening	Bend at steep slope	4	300	Shrubs/small trees	Forest	No		4	3	3
Erosion	PT244301	Widening	Unknown	8	800	Forest	Forest	No		4	2	3
Erosion	PT116304	Widening	Bend at steep slope	3	50	Forest	Lawn	No		5	2	1
Erosion	PT130102	Downcutting	Unknown	2	3500	Forest	Forest	No		5	1	2
Erosion	PT159201	Widening	Bend at steep slope	9	90	Forest	Forest	No		5	1	5
Erosion	PT159211	Widening	Land use change	3	1400	Lawn	Forest	No		5	1	1
Erosion	PT166201	Widening	Bend at steep slope	4	200	Forest	Forest	No		5	1	4
Erosion	PT196101	Headcutting	Road crossing	1	20	Forest	Forest	No		5	1	1
Erosion	PT204104	Widening	Bend at steep slope	2	150	Forest	Forest	No		5	3	3
Erosion	PT204106	Widening	Bend at steep slope	2	500	Forest	Forest	No		5	3	3
Erosion	PT243302	Widening	Bend at steep slope	15	35	Forest	Forest	No		5	1	4

Inadequate Buffers

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	LandUseLeft	LandUseRight	RecentlyestablishedLivestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	PT133301	Both	Both	0	0	1400	1400	Shrubs/small trees	Shrubs/small trees	No	No	1	3	1	2
Inadequate Buffer	PT158306	Both	Both	0	0	1000	1000	Lawn	Paved	No	No	1	5	1	2
Inadequate Buffer	PT159204	Both	Left	0	5	3100	1300	Golf Course	Golf Course	No	No	1	4	1	5
Inadequate Buffer	PT170201	Both	Both	0	0	6000	6000	Power Lines	Power Lines	No	No	1	3	3	3
Inadequate Buffer	PT174211	Both	Both	0	0	3000	3000	Shrubs/small trees	Shrubs/small trees	No	No	1	1	5	4
Inadequate Buffer	PT193201	Both	Both	0	0	2500	2500	Shrubs/small trees	Shrubs/small trees	No	No	1	3	1	3
Inadequate Buffer	PT258302	Both	Both	0	0	1500	1500	Pasture	Pasture	No	No	1	3	4	5
Inadequate Buffer	PT165101	Both	Neither	5	5	700	700	Pasture	Pasture	No	Cattle	2	3	3	3
Inadequate Buffer	PT172101	Left	Left	0	10	3550	250	Lawn	Shrubs/small trees	No	No	2	3	3	4
Inadequate Buffer	PT174103	Both	Both	5	5	1500	1500	Shrubs/small trees	Shrubs/small trees	No	No	2	4	3	5
Inadequate Buffer	PT121201	Left	Left	15		1600		Pasture	Forest	No	Cattle	3	2	5	5
Inadequate Buffer	PT156202	Both	Both	0	0	500	500	Power Lines	Power Lines	No	No	3	3	3	3
Inadequate Buffer	PT158301	Both	Both	20	30	1000	1000	Crop field	Crop field	No	Cattle	3	5	1	3
Inadequate Buffer	PT158302	Left	Both	0	0	1200	1000	Crop field	Crop field	No	No	3	3	2	3
Inadequate Buffer	PT163201	Both	Both	0	0	450	450	Power Lines	Power Lines	No	No	3	3	3	2
Inadequate Buffer	PT177202	Right	Neither		20		500	Forest	Pasture	No	No	3	2	3	3
Inadequate Buffer	PT180103	Both	Both	0	10	500	500	Crop field	Lawn	No	No	3	3	2	4
Inadequate Buffer	PT181107	Both	Both	0	0	400	300	Shrubs/small trees	Shrubs/small trees	No	No	3	1	2	5
Inadequate Buffer	PT181113	Both	Both	0	15	400	400	Shrubs/small trees	Shrubs/small trees	No	No	3	2	3	5
Inadequate Buffer	PT185102	Both	Both	0	10	200	1000	Power Lines	Power Lines	No	No	3	5	3	2
Inadequate Buffer	PT186101	Right	Right	100	0		600	Forest	Shrubs/small trees	No	No	3	3	3	4
Inadequate Buffer	PT186201	Both	Neither	10	10	900	900	Pasture	Pasture	No	No	3	3	3	3
Inadequate Buffer	PT187202	Both	Neither	10	10	1200	3000	Forest	Pasture	No	No	3	3	2	5
Inadequate Buffer	PT189303	Right	Neither		10		500	Forest	Lawn	No	No	3	1	1	4
Inadequate Buffer	PT200202	Right	Neither		0		1000	Pasture	Lawn	No	No	3	4	2	2
Inadequate Buffer	PT111102	Both	Both	0	0	700	700	Forest	Forest	No	No	4	3	3	2
Inadequate Buffer	PT116302	Left	Left	0		300		Lawn	Forest	No	No	4	2	1	3
Inadequate Buffer	PT116303	Right	Neither	5		295		Forest	Lawn	No	No	4	2	1	3
Inadequate Buffer	PT151302	Both	Neither	10	15	3600	4600	Shrubs/small trees	Shrubs/small trees	No	Cattle	4	4	5	5
Inadequate Buffer	PT156201	Both	Both	0	0	300	300	Shrubs/small trees	Lawn	No	No	4	1	1	1
Inadequate Buffer	PT172201	Right	Right		0		1000	Forest	Shrubs/small trees	No	No	4	3	3	3
Inadequate Buffer	PT172203	Right	Right		0		700	Forest	Shrubs/small trees	No	No	4	3	3	2

Inadequate Buffers

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	LandUseLeft	LandUseRight	RecentlyestablishedLivestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	PT179105	Both	Right	10	10	200	200	Pasture	Forest	No	Horses	4	3	3	4
Inadequate Buffer	PT193101	Both	Both	0	0	400	400	Shrubs/small trees	Shrubs/small trees	No	No	4	3	2	4
Inadequate Buffer	PT198203	Both	Both	5	5	150	150	Lawn	Lawn	No	No	4	2	1	2
Inadequate Buffer	PT204101	Left	Left	15		400		Lawn	Forest	No	No	4	2	1	3
Inadequate Buffer	PT230104	Left	Neither	10		2000		Forest	Forest	No	No	4	2	3	3
Inadequate Buffer	PT240101	Right	Right		10		700	Forest	Pasture	No	No	4	3	3	4
Inadequate Buffer	PT163202	Left	Neither	20		450		Power Lines	Forest	No	No	5	2	4	3
Inadequate Buffer	PT177207	Right	Right		0		150	Forest	Lawn	No	No	5	1	1	4
Inadequate Buffer	PT231102	Right	Right		5		50	Forest	Pasture	No	No	5	1	3	4

Pipe Outfalls

Problem	Site	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	PT145303	Stormwater	Earth channel	Left bank		8	Yes	Clear	None	3	3	2
Pipe Outfall	PT145305	Stormwater	Concrete pipe	Left bank	24		Yes	Clear	None	3	5	2
Pipe Outfall	PT159203	Golf Course drainage	Concrete pipe	Left bank	12		Yes	Clear	None	3	1	1
Pipe Outfall	PT167203	Pond overflow	Corrugated metal	Left bank	24		Yes	Clear	None	3	3	1
Pipe Outfall	PT174205	Stormwater	Corrugated metal	Right bank	24	1	Yes	Clear	None	3	3	1
Pipe Outfall	PT174209	Stormwater	Corrugated metal	Right bank	36		Yes	Clear	None	3	3	1
Pipe Outfall	PT177204	Spring	Smooth metal pipe	Left bank	2		Yes	Clear	None	3	3	3
Pipe Outfall	PT181101	Waste water treatment facility	Smooth metal pipe	Right bank	18		Yes	Clear	Soapy	3	2	4
Pipe Outfall	PT189305	Stormwater	Corrugated metal	Right bank	30		Yes	Clear	None	3	3	1
Pipe Outfall	PT224201	Pond overflow	Corrugated metal	Right bank	24		Yes	Clear	None	3	3	2
Pipe Outfall	PT174201	Stormwater	Plastic	Left bank	6		No			4	1	1
Pipe Outfall	PT174202	Stormwater	Plastic	Left bank	6		No			4	1	1
Pipe Outfall	PT147302	Stormwater	Corrugated metal	Right bank	36		No			5	1	1
Pipe Outfall	PT159205	Golf Course drainage	Plastic	Left bank	6		No			5	2	1
Pipe Outfall	PT159209	Golf Course drainage	Plastic	Left bank	6		No			5	1	1
Pipe Outfall	PT174208	Stormwater	Earth channel	Left bank		2	No			5	3	1
Pipe Outfall	PT177205	Unknown	Plastic	Left bank	2		No			5	1	3
Pipe Outfall	PT177206	Stormwater	Concrete pipe	Left bank	10		No			5	1	3
Pipe Outfall	PT180203	Stormwater	Plastic	Right bank	24		No			5	1	4
Pipe Outfall	PT189304	Stormwater	Concrete pipe	Left bank	24		No			5	1	1
Pipe Outfall	PT191303	Stormwater	Plastic	Left bank	4		No			5	2	3

Unusual Conditions

Problem	Site	Describe	Description	Potential Cause	Severity	Correctability	Access
Unusual condition	PT165102		Stream blockage/ disturbance causing alternation. Stream diverts into cow pasture out of stream bed.		2	3	3
Unusual condition	PT126302	Excessive algae	Stream bottom covered in algae		3	3	2
Unusual condition	PT159202	Piped Stream			3	3	2
Unusual condition	PT159206	Excessive algae	1200 ft of algae		3	5	1
Unusual condition	PT159212	Piped Stream			3	3	1
Unusual condition	PT174204	Excessive algae	Brown muck covering stream bottom		3	3	1
Unusual condition	PT177208	Excessive algae			3	3	1
Unusual condition	PT179101		Large numbers of trees down over stream		3	4	3
Unusual condition	PT186102		Large numbers of trees down over stream		3	3	3
Unusual condition	PT188105	Water color/clarity	Excessive mud from tributary		3	4	3
Unusual condition	PT189302	Excessive algae	Algae covers bottom of stream	Next to town houses	3	4	1
Unusual condition	PT189306	Piped Stream			3	3	1
Unusual condition	PT202202	Excessive algae	Green Algae covers stream bottom		3	2	3
Unusual condition	PT206202		Concrete Pipe (3ft diameter, 15-20 ft long) in stream. Creating a fish barrier. Pipe is not connected to anything. Stream water runs through debris in pipe.		3	1	5
Unusual condition	PT208102	Excessive algae	Algae covers bottom of stream		3	3	3
Unusual condition	PT102101	Water color/clarity	Unable to see bottom of stream - water is dark brown. Frothy white scum on surface. Little visible stream flow.	unknown	5	3	1

Unusual Conditions

Problem	Site	Describe	Description	Potential Cause	Severity	Correctability	Access
Unusual condition	PT173108		Large numbers of trees down over stream		5	3	1
Unusual condition	PT179103	Excessive algae	Excessive Algae covering stream bottom and floating on surface	Near by horse farm	5	3	3
Unusual condition	PT204105		Stream stops flowing on the ground surface and reappears 6 ft downstream at lower level		5	3	3
Comment	PT116301		Lot of vegetation growing under water				
Comment	PT172202		Many large trees down across stream for 1500 ft.				3
Comment	PT181106		Erosion causing pipe to collapse				
Comment	PT191301	Algae	Intermittent but substantial presence of algae				
Comment	PT192101	Fish ladder w/ fast flow	Fish ladder may have too fast of flow to allow fish passage				
Comment	PT205209		Small tributary feeding into right side of stream				
Comment	PT206203		Small tributary feeding into right side of stream				

Channel Alterations

Problem	Site	Type	BottomWidth (in)	Length (ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	LengthAbove(ft)	LengthBelow(ft)	Severity	Correctability	Access
Channel Alteration	PT200201	Wooden on one side	300	1000	Yes	No	No	No			4	4	2
Channel Alteration	PT112201	Gabion	24	100	Yes	No	Yes	Both	40	60	5	3	1
Channel Alteration	PT145302	Rip-rap	240	70	Yes	Yes	Yes	No			5	3	2
Channel Alteration	PT159207	Wooden on left side	36	35	Yes	No	No	No			5	1	1
Channel Alteration	PT159208	Wooden on left side	36	25	Yes	No	No	No			5	1	1
Channel Alteration	PT159210	Wooden on left side	36	25	Yes	No	No	No			5	1	1

Exposed Pipes

Problem	Site	Location of Pipe	Type	Diameter(in)	Length(ft)	Purpose	Discharge	Color	Odor	Severity	Correctability	Access
Exposed Pipe	PT158202	Across bottom of stream	Plastic	8	6	Unknown	No			3	3	1
Exposed Pipe	PT181102	Above stream	Smooth metal	14	30	Unknown	No			3	4	1
Exposed Pipe	PT205201	Along Stream	Concrete	36	2.5	Unknown	No			3	3	1
Exposed Pipe	PT205202	Along Stream	Concrete	36	2.5	Unknown	No			3	3	1
Exposed Pipe	PT145304	Exposed Manhole	Concrete	72	8	Unknown	No			4	2	2
Exposed Pipe	PT181103	Across bottom of stream	Plastic	16	4	Unknown	No			4	3	3

Trash Dumping

Problem	Site	Type	Truckloads	Extent	Volunteer Project?	Owner Type	Owner Name	Severity	Correctability	Access
Trash Dumping	PT192103	Vehicles, trailer	4	Single site	No	Private		3	3	4
Trash Dumping	PT174101	Construction	2	Large area	Yes	Private		5	1	2

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Goose Creek											
Representative Site	PT243301	Suboptimal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT258301	Poor	Poor	Marginal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Marginal
Hoghole Run											
Representative Site	PT156204	Optimal	Marginal	Optimal	Optimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Optimal
Representative Site	PT177102	Suboptimal	Marginal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Marginal	Marginal	Optimal
Representative Site	PT177201	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Marginal
Representative Site	PT185101	Suboptimal	Marginal	Suboptimal	Optimal	Marginal	Optimal	Optimal	Optimal	Marginal	Optimal
Representative Site	PT191302	Suboptimal	Marginal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal
Jennie Run											
Representative Site	PT152301	Optimal	Optimal	Marginal	Optimal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal
Port Tobacco River											
Representative Site	PT116306	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	PT128203	Marginal	Poor	Marginal	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT139301	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT145301	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	PT158201	Marginal	Marginal	Poor	Suboptimal	Marginal	Marginal	Optimal	Suboptimal	Marginal	Poor
Representative Site	PT158305	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Marginal
Representative Site	PT171101	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Optimal
Representative Site	PT179102	Marginal	Marginal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal	Poor	Marginal	Marginal
Representative Site	PT186103	Marginal	Marginal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Poor	Suboptimal	Marginal
Unnamed Trib 1											
Representative Site	PT205207	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT213202	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal
Unnamed Trib 2											
Representative Site	PT211101	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT228101	Marginal	Poor	Marginal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Unnamed Trib 3											
Representative Site	PT254102	Suboptimal	Marginal	Marginal	Optimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal
Unnamed Trib 4											
Representative Site	PT187203	Suboptimal	Marginal	Marginal	Optimal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal
Representative Site	PT188102	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Marginal	Marginal	Optimal
Representative Site	PT189101	Optimal	Marginal	Optimal	Optimal	Marginal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	PT202204	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Unnamed Trib 5											
Representative Site	PT173104	Optimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	PT180102	Optimal	Suboptimal	Optimal	Optimal	Marginal	Suboptimal	Optimal	Marginal	Marginal	Optimal
Representative Site	PT180201	Poor	Poor	Marginal	Optimal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Poor
Representative Site	PT180206	Optimal	Suboptimal	Optimal	Optimal	Marginal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	PT181105	Optimal	Poor	Marginal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Suboptimal	Poor
Wills Branch											
Representative Site	PT215101	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Optimal
Representative Site	PT230105	Poor	Poor	Marginal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Suboptimal	Marginal
Representative Site	PT231101	Optimal	Marginal	Suboptimal	Optimal	Marginal	Optimal	Optimal	Optimal	Marginal	Optimal
Representative Site	PT247102	Optimal	Optimal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Marginal	Optimal

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Goose Creek								
Representative Site	PT243301	48	36	30	3	3	12	Gravel
Representative Site	PT258301	44	36	18	8	6	10	Silts
Hoghole Run								
Representative Site	PT156204	36	48	48	2	3	6	Gravel
Representative Site	PT177102	60	10		1	6		Cobble
Representative Site	PT177201	70	85	120	3	24	36	Gravel
Representative Site	PT185101	36	120	144	4	8	48	Cobble
Representative Site	PT191302	24	24	30	1	2	4	Gravel
Jennie Run								
Representative Site	PT152301	40	36	60	3	6	36	Gravel
Port Tobacco River								
Representative Site	PT116306	30	55	30	4	7	20	Gravel
Representative Site	PT128203		180	60		30	40	Sands
Representative Site	PT139301	240	180	20	12	24	36	Gravel
Representative Site	PT145301	48	36	24	5	6	18	Cobble
Representative Site	PT158201	36	48	24	30	42	12	Sands
Representative Site	PT158305	96	96	36	3	24	24	Cobble
Representative Site	PT171101	24	30	24	2	3	6	Gravel
Representative Site	PT179102		148	60		12	36	Sands
Representative Site	PT186103	66	72	60	6	10	24	Gravel
Unnamed Trib 1								
Representative Site	PT205207	30	72	36	3	7	10	Gravel
Representative Site	PT213202	84	84	36	4	6	12	Gravel
Unnamed Trib 2								
Representative Site	PT211101	36	48	36	3	5	24	Gravel
Representative Site	PT228101		72	30		5	48	Sands
Unnamed Trib 3								
Representative Site	PT254102	30	40	40	1	1	12	Gravel
Unnamed Trib 4								
Representative Site	PT187203	60	66	36	3	6	12	Sands
Representative Site	PT188102	96	72	60	3	8	24	Gravel
Representative Site	PT189101	36	36	48	3	10	28	Gravel
Representative Site	PT202204	36	36	48	2	5	12	Gravel

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Unnamed Trib 5								
Representative Site	PT173104	24	36	72	24	48	18	Gravel
Representative Site	PT180102	36	72		5	10		Gravel
Representative Site	PT180201		60	96		8	12	Sands
Representative Site	PT180206	120	72	60	2	4	12	Gravel
Representative Site	PT181105	48	48	180	5	2	18	Sands
Wills Branch								
Representative Site	PT215101	60	60		4	5		Gravel
Representative Site	PT230105			120			24	Silts
Representative Site	PT231101	36	80	55	6	10	18	Gravel
Representative Site	PT247102	42	50	30	4	4	8	Gravel