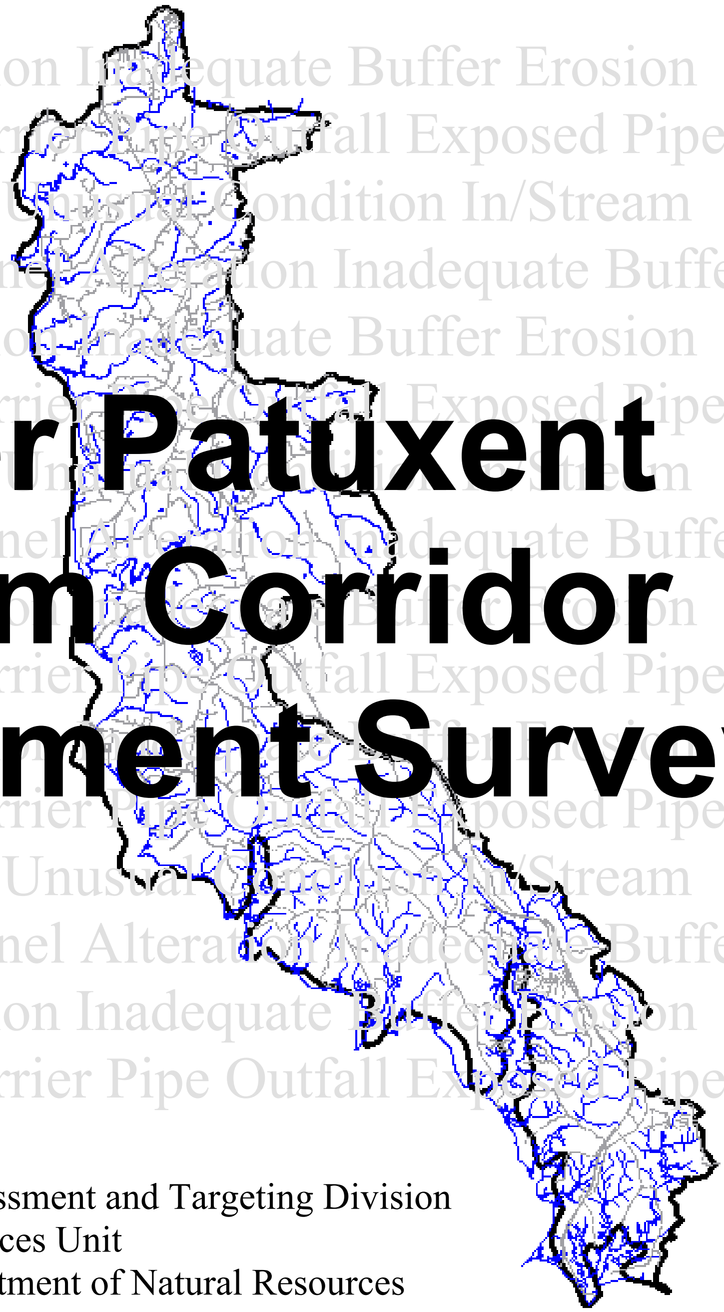

Lower Patuxent Stream Corridor Assessment Survey

Watershed Assessment and Targeting Division
Watershed Services Unit
Maryland Department of Natural Resources
April 2004

Robert L. Ehrlich, Jr.
Governor

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W.P. Jensen
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Maryland Department of Natural Resources
Tawes State Office Building
580 Taylor Avenue
Annapolis, Maryland 21401

Toll free in Maryland: 1-(877) 620-8DNR (ext. 8796)
Out of state call: 410-260-8796
www.dnr.state.md.us

LOWER PATUXENT STREAM CORRIDOR ASSESSMENT SURVEY

BY

Robin Pellicano & Ken Yetman
Watershed Assessment and Targeting Division
Watershed Services Unit
Maryland Department of Natural Resources

Financial Assistance provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration (NOAA). A report of the Maryland Coastal Zone Management Program, Department of Natural Resources pursuant to NOAA Award No. NA1702337.

SUMMARY

The Lower Patuxent watershed encompasses over 209,276 acres ($327mi^2$) of land. Approximately 47% of the land in the watershed is in Calvert County, Maryland, 30% in St. Mary's County, Maryland, 14% in Charles County, Maryland, and 1% in Anne Arundel County, Maryland. This survey focuses only on the area lying within Calvert County**.** The Maryland Department of Natural Resources and Calvert County has formed a partnership to develop a Watershed Restoration Action Strategy (WRAS) for the Lower Patuxent Watershed. As part of the WRAS development process, a Stream Corridor Assessment (SCA) survey was performed on the sub-watersheds: Hall Creek, Island Creek, and Back & Mill Creeks. The survey began in March 2003 and was completed by October 2003.

The SCA survey was developed by the Watershed Assessment and Targeting Division of the Maryland Department of Natural Resources to provide a rapid examination of the stream network in a watershed. The survey is done using specially trained field teams that walked the entire stream network and note the location of a variety of potential environmental problems. As part of the survey, field teams also collected some basic information about stream habitat conditions at regular intervals. This survey is not intended to be a detailed scientific evaluation, and the data collected about any specific problem is limited. Instead, the survey is designed to give an overview of the condition of the stream system so that future restoration efforts can be better targeted.

Approximately 130 miles of streams were surveyed, and 101 potential environmental problems were identified. The most common environmental concern seen during the SCA survey was erosion, which was reported at 39 sites. Other potential environmental problems identified during the survey include: 22 fish barriers, 13 inadequate buffers, 11 pipe outfalls, 11 trash dumping sites, and 5 channel alterations sites.

At each site, data was collected about the problem, its location noted on field maps, and photographs taken to document existing conditions. To aid in prioritizing future restoration work, field crews rated all problem sites on a scale of 1 to 5 in three categories. They were: 1) the severity of the problem, 2) how correctable the specific problem was, and 3) how accessible the site was. Field teams also collected information on both in and near stream habitat conditions at 73 representative sites that were spaced at approximately ½ to ¾ mile intervals along the streams.

The SCA survey was specifically developed as a watershed management tool. One of the main goals of the SCA survey is to compile a list of observable environmental problems so that future restoration efforts can be better targeted. It is hoped that once a list of environmental problems has been compiled, a dialog can be initiated among resource managers on the goals and targets of future environmental restoration efforts in the Lower Patuxent Watershed. It is important to note that all of the problems identified as part of the Lower Patuxent Stream Corridor Assessment survey can be addressed through existing State or Local government programs. The value of the present survey is that it can help to place the problems in a watershed context and can be used by a variety of resource managers to plan future restoration work. Results of the present survey have been given to the Lower Patuxent WRAS committee,

which is developing a Watershed Restoration Action Strategy for the Lower Patuxent. Information on the Lower Patuxent Watershed Action Strategy can be found on DNR's website (www.dnr.maryland.gov/watersheds/wras).

ACKNOWLEDGEMENTS

Without the hard work of the Southern Maryland Crew of the Maryland Conservation Corps, this survey would not have been possible. The crew chief during the survey was Dawn Letts. The crewmembers were Sara Ashton, Sabrina Burt, Ryan Galligan, Natalie Gienger, Damion Somerville, and Thomas Somerville.

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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 Lower Patuxent Watershed. The watershed encompasses approximately 207,276 acres in the Coastal Plain of Maryland. A map showing the location of the Lower Patuxent Watershed is presented in Figure 1. Approximately 47% of the land in the watershed is in Calvert County, Maryland, 30% in St. Mary's County, Maryland, 14% in Charles County, Maryland, and 1% in Anne Arundel County, Maryland (Shanks, 200**3**). In response to the findings of the Maryland Clean Water Action Plan, the Maryland Department of Natural Resources has formed a partnership with Calvert County to work together to assess and improve environmental conditions in the Lower Patuxent watershed. The main goals of this partnership are to develop and implement a Watershed Restoration Action Strategy (WRAS) for the Lower Patuxent watershed.

The first step in developing a Restoration Action Strategy for the Lower Patuxent Watershed is to do an overall assessment of the condition of the watershed and the streams within it. This initial step is being accomplished using three approaches. First, a watershed characterization was done that compiles and analyzes existing water quality, land use, and living resources data about the Lower Patuxent watershed (Shanks, 2003). Second, a synoptic water quality survey, as well as surveys of the fish and macro invertebrate communities at selected stations throughout the Lower Patuxent Watershed were done to provide information on the present condition of aquatic resources in the watershed (Primrose, 2003). While both these approaches provide good overall information on environmental conditions within the Lower Patuxent watershed, for the most part, information on the causes or location of specific environmental problems is limited. To provide specific information on the present location of environmental problems and restoration opportunities, a Stream Corridor Assessment (SCA) survey of the Lower Patuxent Watershed was also done.

The Stream Corridor Assessment survey has been developed by DNR's Watershed Assessment and Targeting Division as a watershed management tool to identify environmental problems and help prioritize restoration opportunities on a watershed basis. As part of the survey, members of the Watershed Assessment and Targeting Division along with specially trained personnel walk the watershed's entire stream network and record information on a variety of environmental problems that can be easily observed within the stream corridor.

The Lower Patuxent watershed in Calvert County contains 97,647 acres of land. Approximately 25% (23,441 acres) of the land in the watershed is categorized as agricultural land, 48% (46,243 acres) of land is forested and 25% (23,423 acres) is designated as developed (Shanks, 200**3**). Due to funding and time limitations, the SCA survey was done in several sub-watersheds. The sub-watersheds were chosen by the WRAS committee and included Hall Creek, Island Creek, and Back and Mill Creeks in Calvert County, Maryland. The targeted area encompasses 19,276 acres (30 mi^2) of land. Hall Creek contains 9,885 acres, Island Creek contains 3,376 acres, and Back and Mill Creeks contain 6,015 acres. There are approximately 121 miles of stream within the three sub-watersheds. Survey teams walked all 121 miles over a

7-month period from March to October 2003. A digital orthophoto map of Lower Patuxent watershed is shown in Figure 2. Figure 3 shows the same watershed boundary superimposed on a seven and ½ minute USGS topographic quadrangle maps. Figure 4 shows the survey's sub-watershed boundaries.

As mentioned earlier, the Maryland Department of Natural Resources is working with Calvert County to develop a Watershed Restoration Action Strategy (WRAS) of the Lower Patuxent Watershed. As part of this process, data collected during the SCA survey will be used to help define present environmental conditions, as well as possible restoration opportunities in the watershed. This information, combined with the watershed characterization, synoptic water quality surveys, recent biological surveys and other local knowledge of the watershed, will be used to develop a Watershed Restoration Action Strategy for the Lower Patuxent. The Watershed Restoration Action Strategy, in turn, will help guide future restoration efforts with the ultimate goals of restoring the area's natural resources and meeting State water quality standards. Additional information on the Maryland Watershed Restoration Action Strategy can be found on the Department's web site at www.dnr.maryland.gov/watersheds/wras.

Lower Patuxent Watershed
Calvert County, Maryland

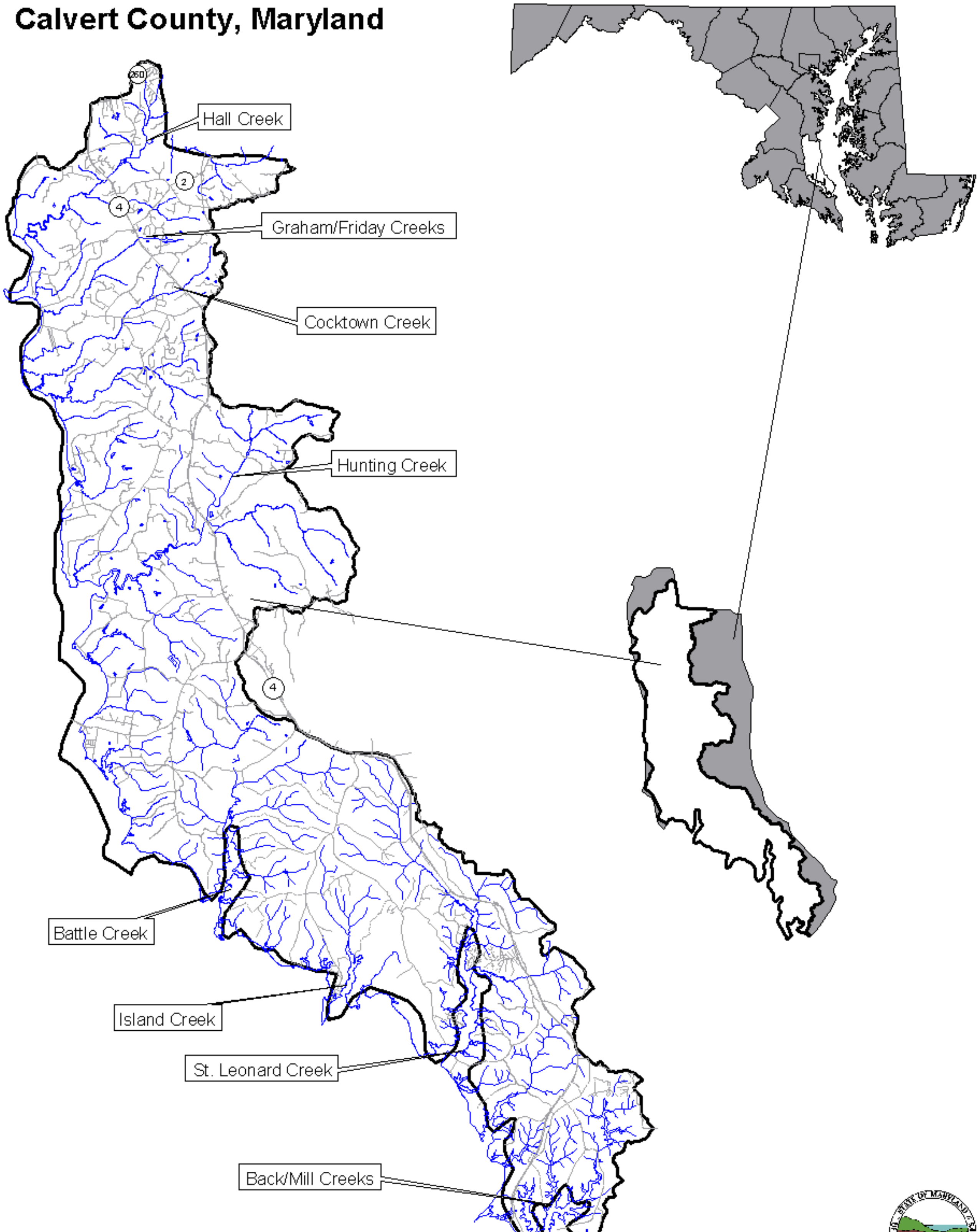

Figure 1: Map showing the location of the Lower Patuxent Watershed

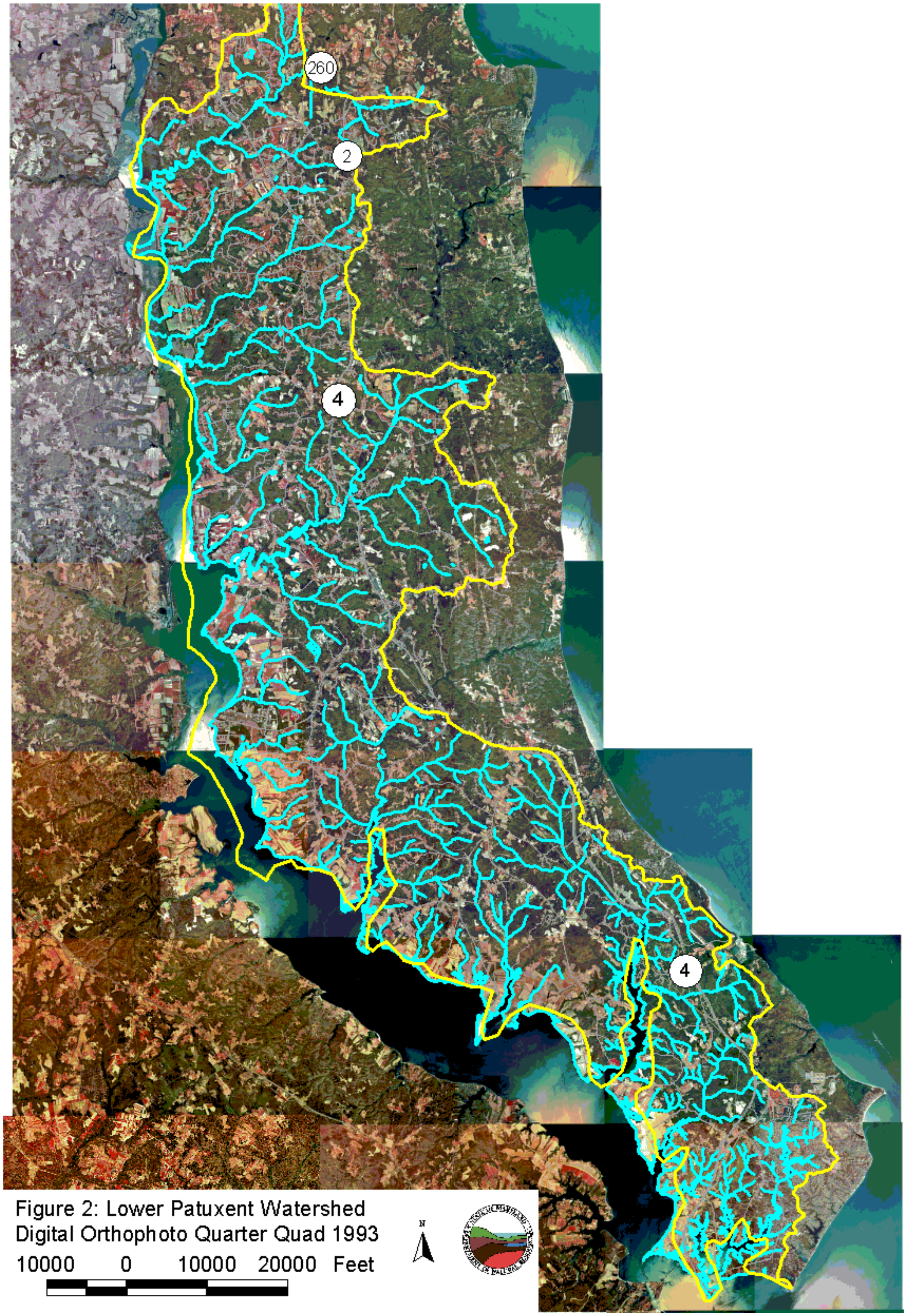

Figure 2: Lower Patuxent Watershed
Digital Orthophoto Quarter Quad 1993

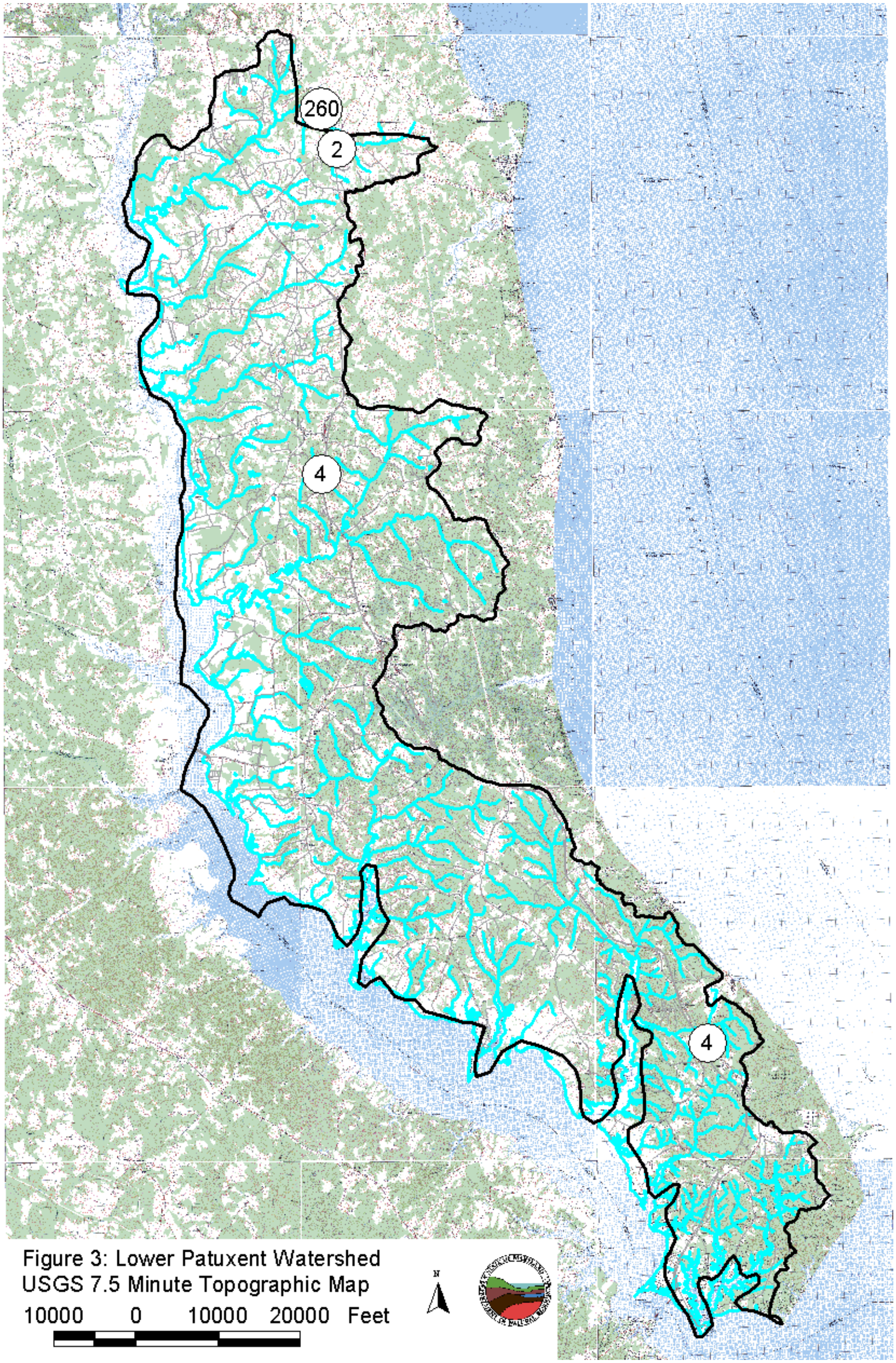

Figure 3: Lower Patuxent Watershed
USGS 7.5 Minute Topographic Map

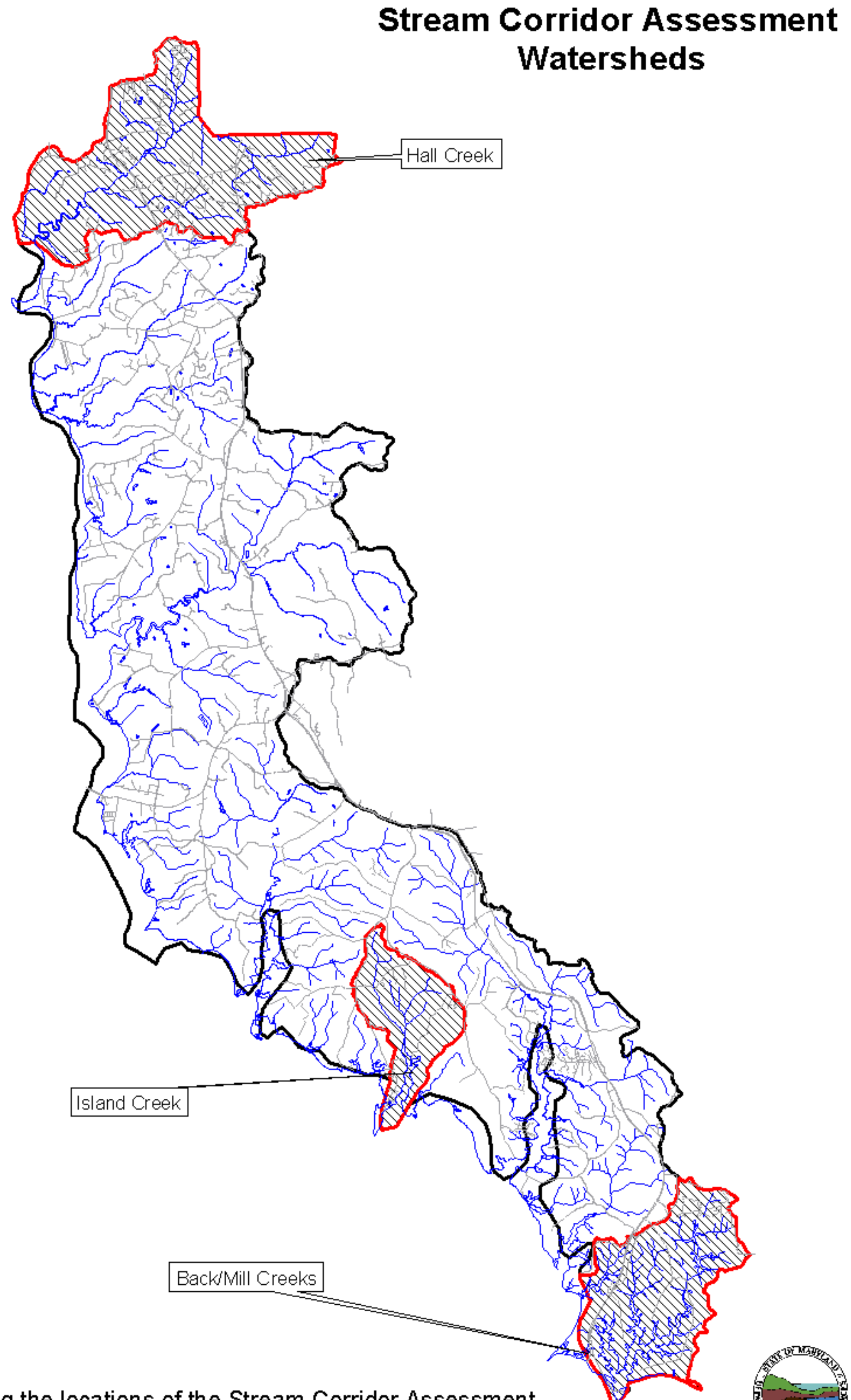

Figure 4: Map showing the locations of the Stream Corridor Assessment Sub- Watersheds in the Lower Patuxent Watershed

METHODS

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

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

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

3. Sufficient information so that restoration efforts can be prioritized.

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

It is important to note that the SCA survey is not intended to be a detailed scientific survey, nor will it replace the more traditional chemical and biological surveys. Instead, the SCA survey provides a rapid method of examining an entire drainage network so that future monitoring, management and/or conservation efforts can be better targeted. One advantage of the SCA survey over chemical and biological surveys is that the SCA survey can be done on a watershed basis both quickly and at a relatively low cost. A copy of the survey protocols is available on DNR web site at www.dnr.maryland.gov/streams/stream_corridor.html.

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

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

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

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

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

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

Several weeks prior to the beginning of the survey, letters were sent out to individuals who own land along the stream. The letter was used to inform property owners that the survey was being done and asked for their permission for survey crews to cross their properties. Landowners were asked to indicate on an enclosed postcard whether or not the survey crew had their permission to survey the stream on their land. The letter also gave property owners a phone number to call if they did want more information about the survey. In addition, as part of their training survey crews were instructed not to cross fence lines or enter any areas that are marked "No Trespassing" unless they have specific permission from the property owner.

Field surveys of the Lower Patuxent watershed began in March 2002, and over the next several months the survey teams walked the stream's drainage network collecting information on potential environmental problems. Potential environmental problems commonly identified during the SCA Survey include: channelized stream sections, inadequate stream buffers, fish migration blockages, excessive bank erosion, near stream construction, trash dumping sites, unusual conditions, pipe outfalls. In addition, the survey records information on the location of potential wetlands creation sites and collects data on the general condition of in-stream and riparian habitats.

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

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

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

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

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

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

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

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

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

* A moderate correctability rating of 3 is given to sites that may require a small piece of equipment, such as a backhoe, and some planning to correct the problem. This would not be the type of project that volunteers would usually do by themselves, although volunteers could assist in some aspects of the project, such as final landscaping. This type of project would usually require a week or more to complete. The project may require some local, State or Federal government notification or permits, however, environmental disturbance would be small and approval should be easy to obtain.

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

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

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

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

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

Following the completion of the survey, information from the field data sheets were entered into a Microsoft Access database and verified by the field teams. In addition, the 247 photographs were taken during the survey were labeled and organized by site number in a binder. The photographs were also digitized using a flat bed scanner and placed on a photo CD so they can be distributed to interested parties. Finally, all data collected during the survey was incorporated into an ArcView Geographic Information System (GIS). A final copy of the ArcView files was given to the Calvert County Planning Department for their use in developing a Watershed Action Strategy for the Lower Patuxent.

RESULTS

The Stream Corridor Assessment survey of the Lower Patuxent sub-watersheds started in March 2003, and field data collection was completed by October 2003. An overall summary of survey results is presented in Table 1, while Table 2 summarizes the data by major stream segments. All data collected during the survey is presented in Appendices A and B. Appendix A provides a listing of information by problem number along with its location, using Maryland State Plane northing and easting coordinates. The coordinates are meters. Information in this format is useful when working with maps showing the location of problem sites to determine what problems may be present along a specific stream reach. In Appendix B, the data is presented by problem type, with more detailed information about each problem. Presenting the data by problem type allows the reader to see which problems the field crews rated the most severe or easiest to fix within each category.

Table 1. Summary of results from Western Branch SCA Survey.

Potential Problems Identified	Number	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor
Erosion Site	39	59,640 feet (11.3miles)	1	1	20	9	8
Fish Barriers	22	N/A	-	-	5	4	13
Inadequate Buffers	13	3,100 feet (0.59miles)	-	-	2	4	7
Pipe Outfalls	11	N\A	-	-	6	-	5
Trash Dumping	11	N\A	-	1	5	4	1
Channel Alterations	5	767 feet (0.14miles)	-	-	1	1	3
TOTAL	101		1	2	39	22	37
Representative Sites	73						

Table 2 Summary of results by major stream segments.

Stream Segment	Channel Alteration	Erosion	Fish Barrier	Inadequate Buffer	Pipe Outfall	Representative Sites	Trash Dumping	Total
Hall Creek	3	20	8	4	7	49	5	96
Island Creek	1	14	7	2		16	3	43
Back/Mill Creeks	1	5	7	7	4	8	3	35

Erosion Sites

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

In this survey, unstable eroding streams are defined as areas where the stream banks are almost vertical and the roots from the vegetation along the stream's banks are unable to hold the soil onto banks. Unstable eroding stream banks were reported at 39 sites. The locations of bank erosion sites are shown in Figures 5b, 5c, and 5d, while the frequency of severity ratings is shown in Figure 5a. It is important to note that the SCA survey is only a visual survey of the stream network. While survey teams are asked to comment whether they believed the stream was down-cutting, widening, or headcutting at a specific site, the only way to really know the full significance of the erosion processes at a specific site is to do more detailed monitoring over time.

Erosion sites were spread throughout the sub-watersheds that were surveyed with 20 reported erosion sites in Hall Creek, 14 being reported in Island Creek, and 5 in Back and Mill Creeks. The lengths of the erosion sites reported ranged from 20 ft to 13,000 ft with heights ranging from 1ft to 15 ft. The most frequently reported causes for erosion were: land use changes upstream (3), bend at steep slope (12), road crossing (3), channel alteration upstream (4), pipe outfalls (2), and causes unknown (14).

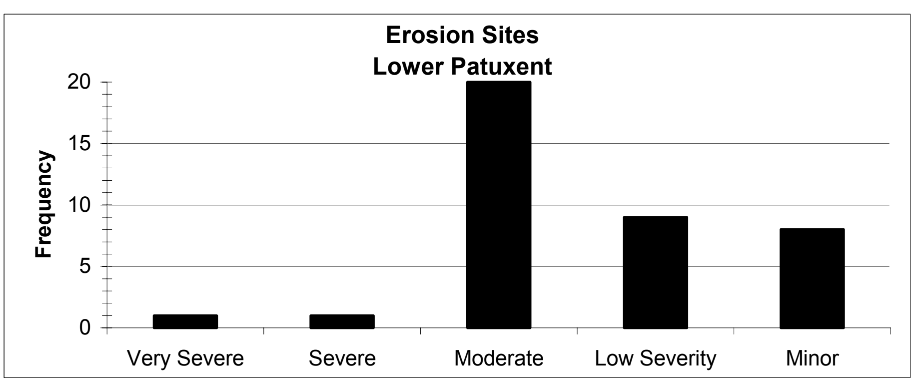

Figure 5a: Histograph showing the frequency of severity ratings given to stream bank erosion sites during the Lower Patuxent SCA Survey.

Hall Creek

Hall Creek contains 20 erosion sites as identified by this survey. One of these erosion sites was given a very severe rating. At site 371201, the survey crew reported that the stream appeared to be downcutting causing severe erosion. The average height of the banks was 7 ft. and the erosion problems ran for approximately 13,000 ft. with forest on both sides of stream

Island Creek

Island Creek contains 14 erosion sites as identified by this survey. All of the sites received moderate to minor severity rankings. The sites ranged in length from 20 ft. to 2,400 ft., and in height from 1 ft. to 5 ft. These sites were mainly in the headwaters of the sub-watershed and were found mostly in forest areas (12 sites).

Back and Mill Creek

Five erosion sites were identified in the Back and Mill Creek sub-watershed. All of the sites received moderate to minor severity rankings. The sites ranged in length from 50 ft. to 700 ft., and in height from 2 ft. to 3 ft. These sites were evenly spread out in the sub-watershed and were found mostly in forest areas (4 sites). At site 231001, the erosion threatens a house and deck. The location of these sites can be found on figure 5d.

Erosion Sites

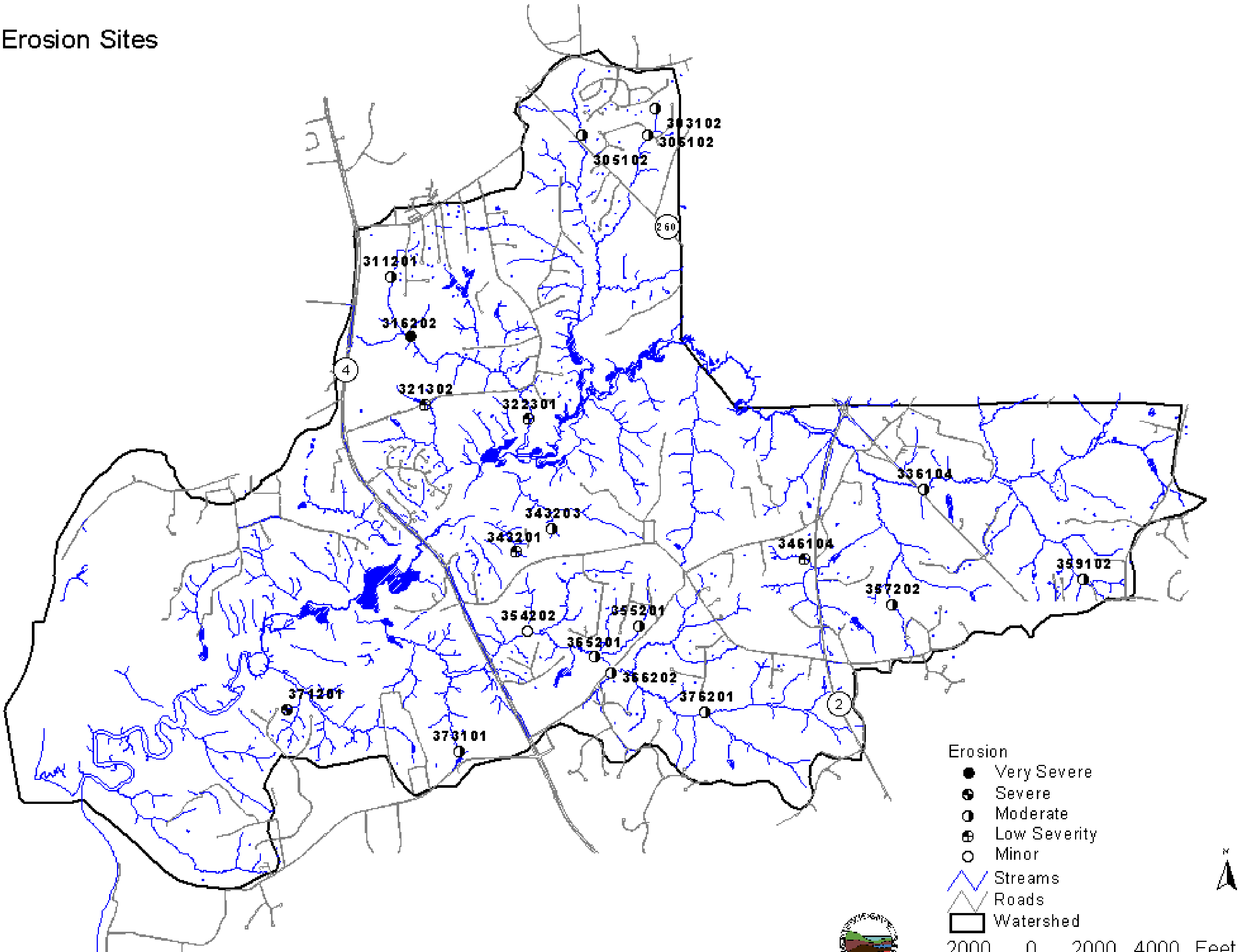

Figure 5b: Map showing the locations of the Erosion sites in Hall Creek

Erosion

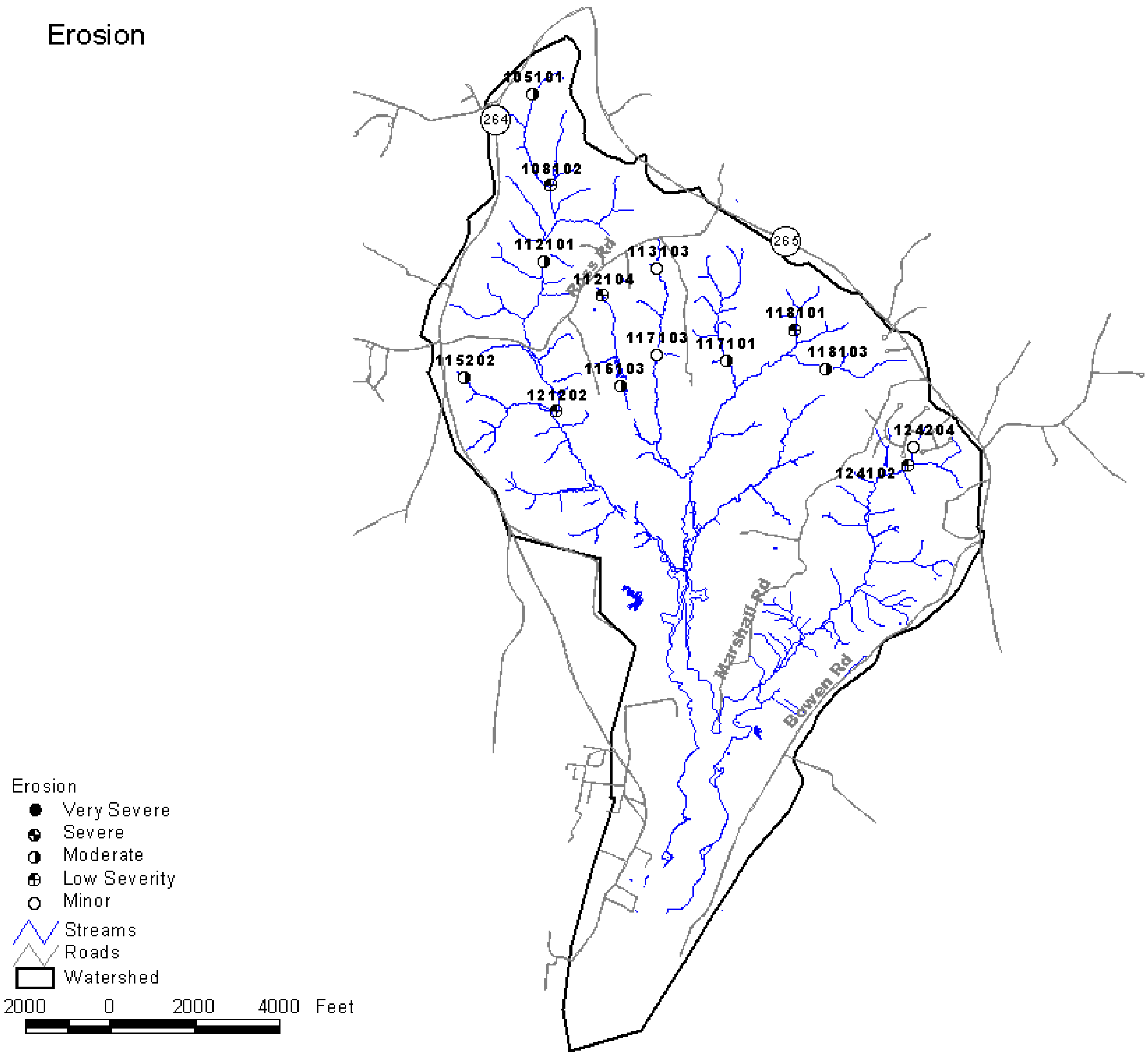

Figure 5c: Map showing the locations of the Erosion sites in Island Creek

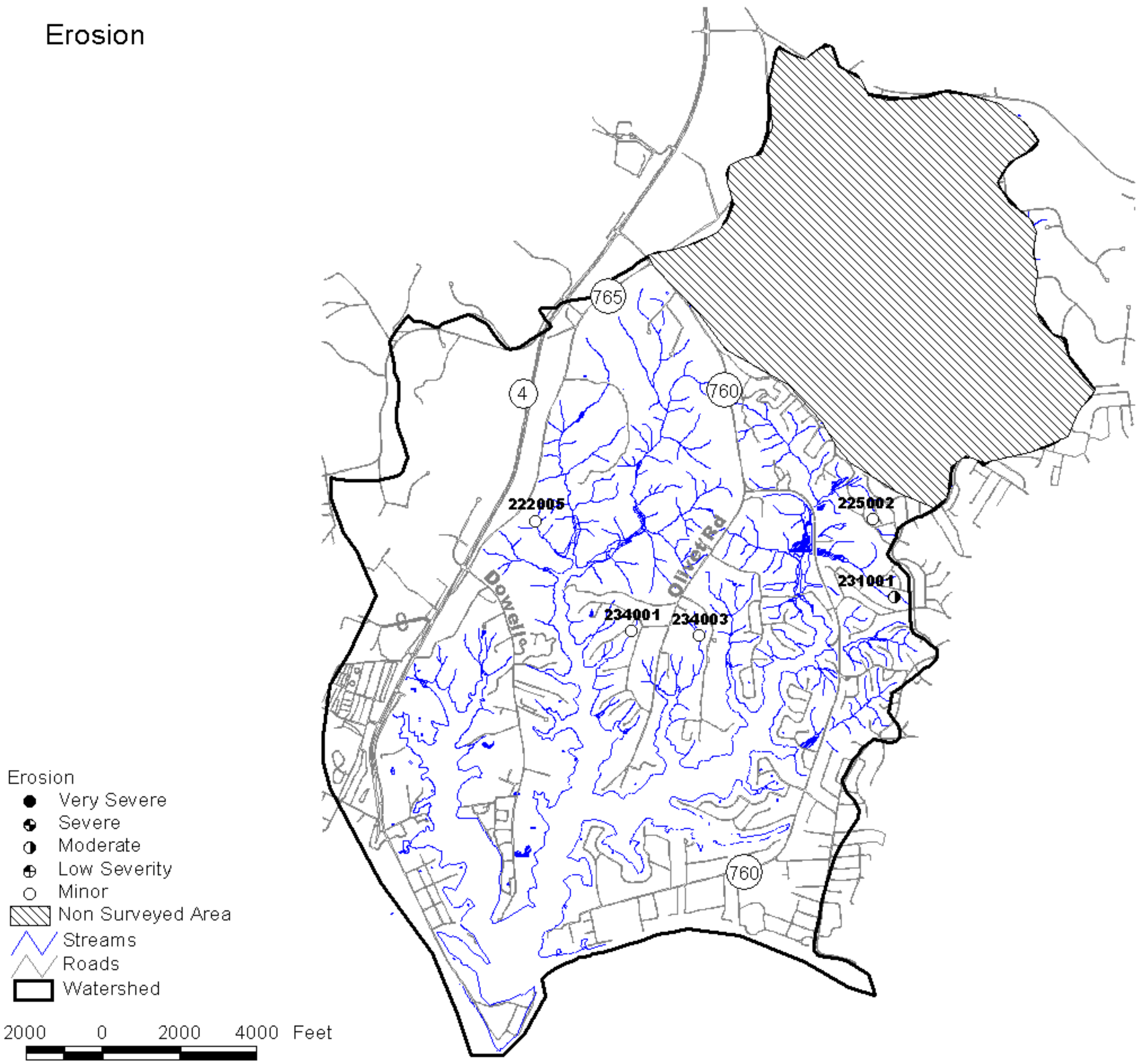

Figure 5d: Map showing the locations of the Erosion sites in Back/Mill Creek (Solomon's Harbor)

Fish Migration Barriers

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

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

Survey crews identified 22 fish migration barriers during the survey. Eight fish barriers were found in Hall Creek, 7 were reported in Island Creek, and 7 in Back and Mill Creeks. The locations of fish migration blockages are shown in Figure 6b, 6c, and 6d. At all but two sites, the survey crews reported that there was a water drop that was too high for some fish to move upstream. Road crossings were cited as one of the main types of fish barrier and were reported at 6 sites. Other causes of fish barriers in the watershed were an old road crossing (1), beaver dams (2), natural falls (6), debris dams (3), in-stream ponds (3), and dams (1). The majority (17 of 22 sites) of the fish migration blockages were characterized as being total fish migration barriers, blocking the whole width of the stream with a permanent structure. Temporary structures blocking full movement of fish were cited at 5 sites.

Most of the fish migration barriers were given moderate to minor ratings (Figure 6a). Severity ratings were based on position in the watershed, as well as the type and height/depth of the barrier. Several barriers received moderate severity ratings. One such site is at site 225001, there is an instream pond with approximately 25 foot drop with another 5 foot drop after the road crossing. Migratory fish such as white perch and herring have been found to spawn in some areas of the Lower Patuxent. White perch in particular have been found spawning in the stream just south of the pond in Mill Creek. (Mower J. and M. McGinty. 2002)

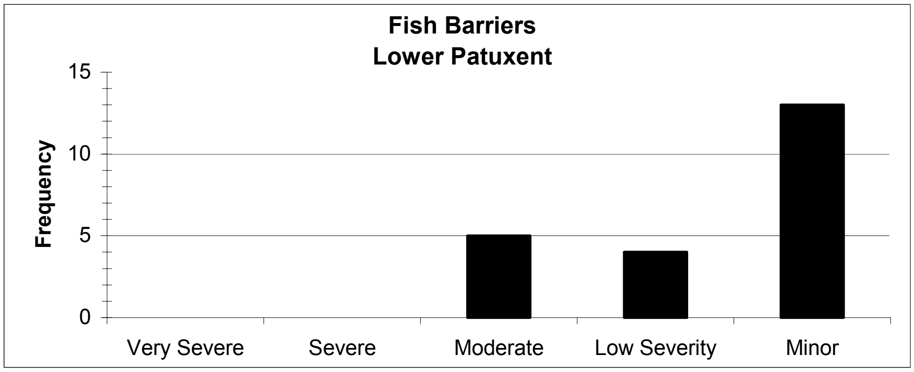

Figure 6a: Histograph showing the frequency of severity ratings given to fish barriers seen during the Lower Patuxent SCA Survey.

Fish Barriers

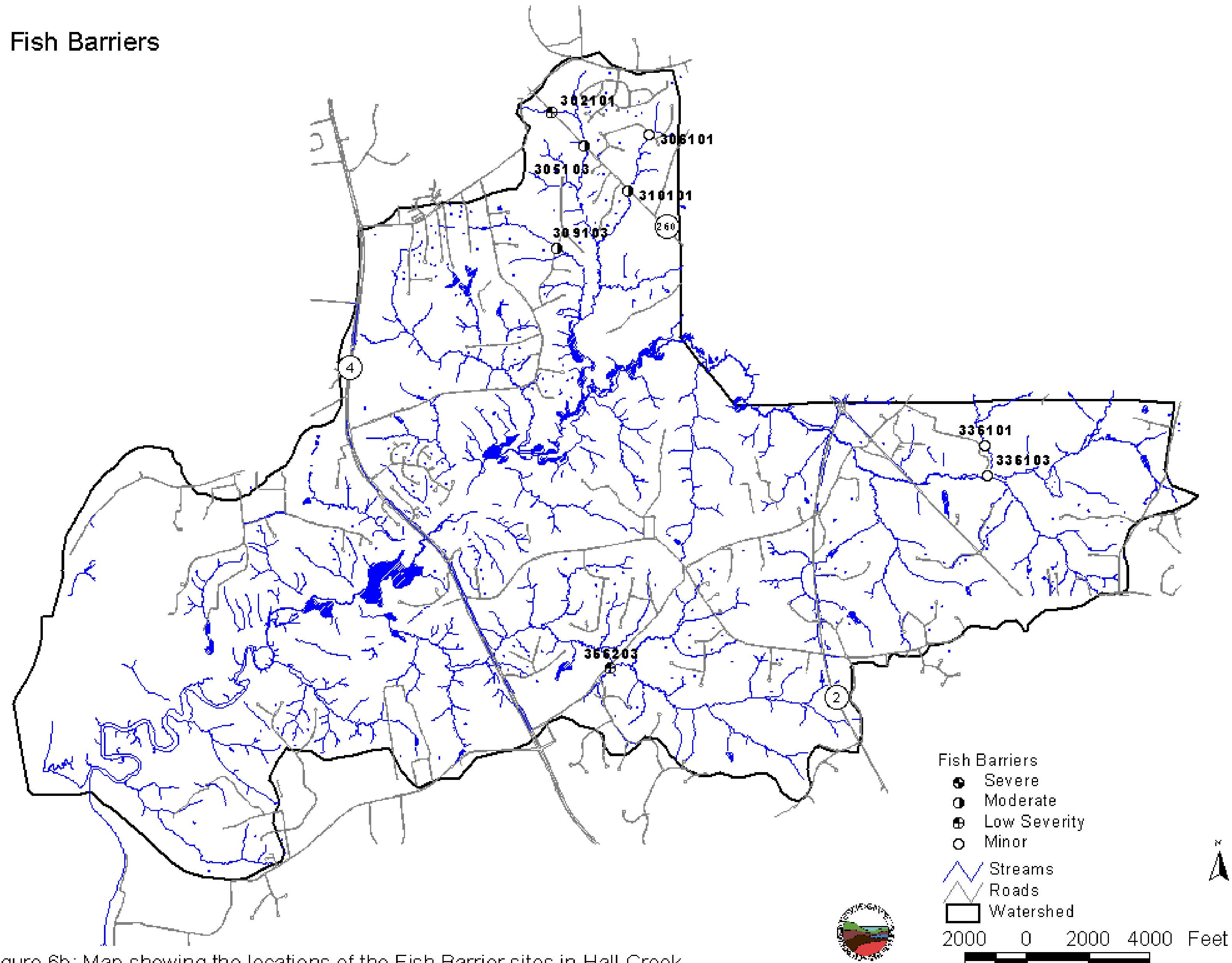

Figure 6b: Map showing the locations of the Fish Barrier sites in Hall Creek

Fish Barriers

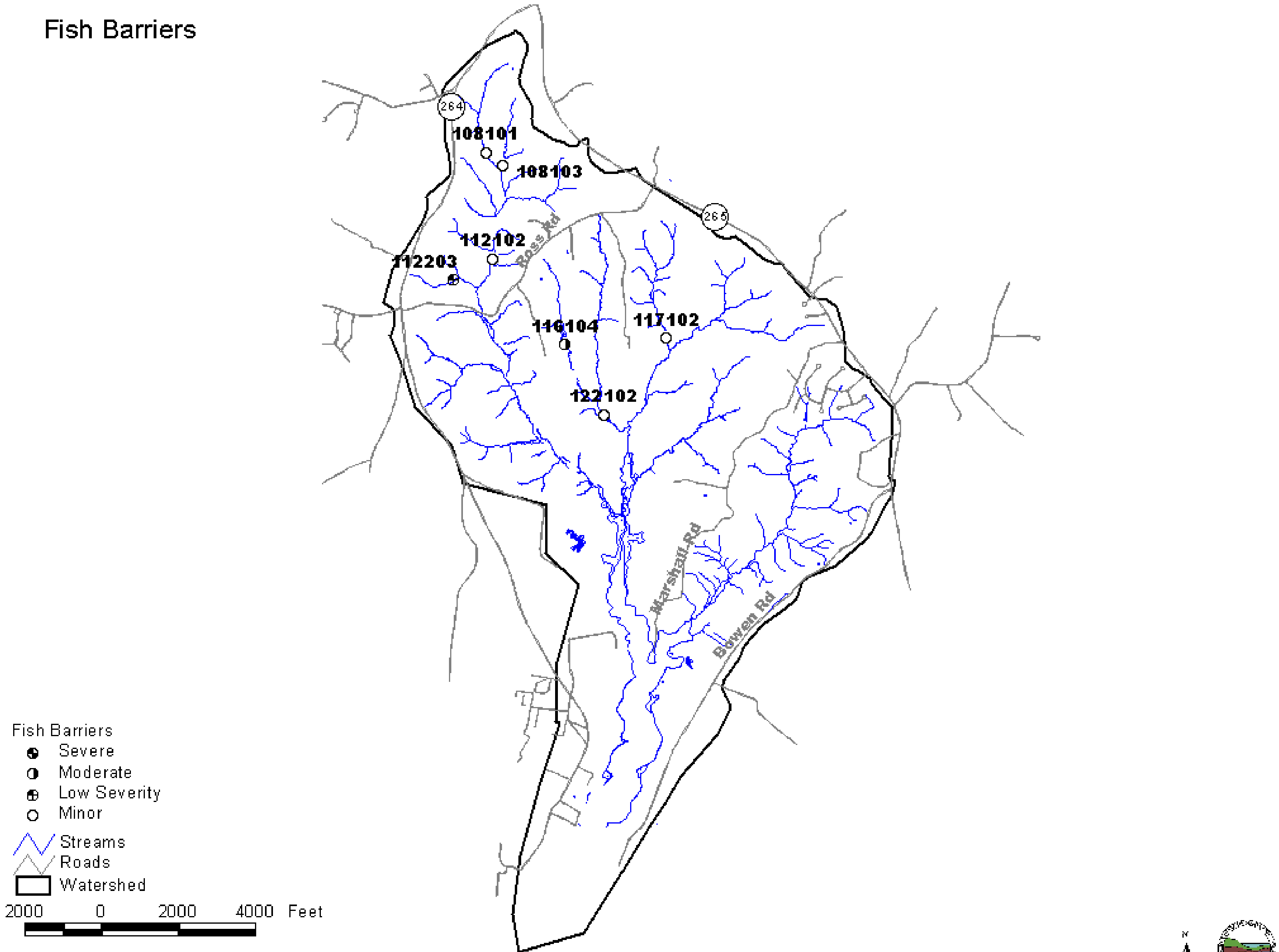

Figure 6c: Map showing the locations of the Fish Barrier sites in Island Creek

Fish Barriers

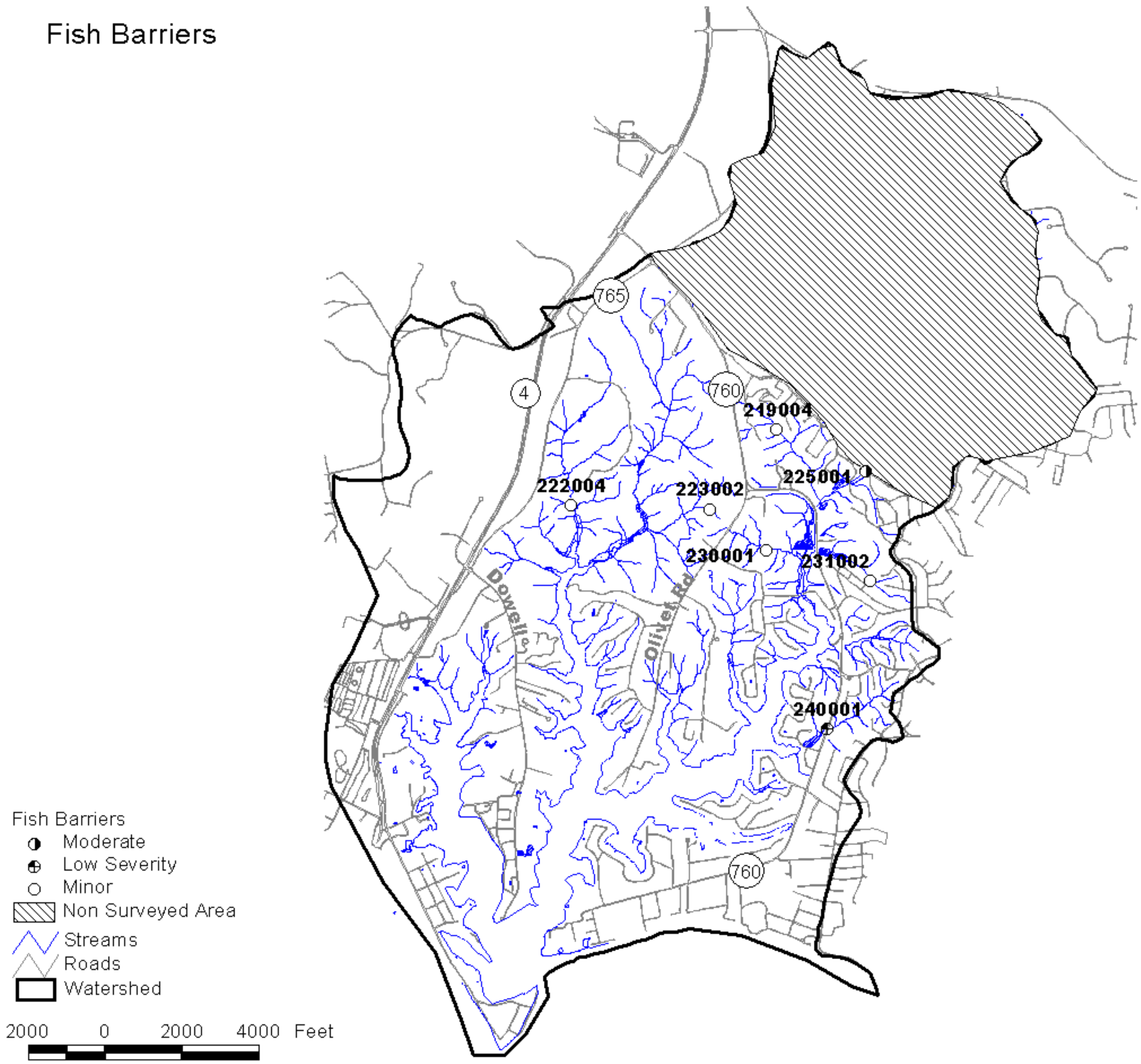

Figure 6d: Map showing the locations of the Fish Barrier sites in Back/Mill Creek (Solomon's Harbor)

Inadequate Buffers

Forested stream buffers are very important for maintaining healthy Maryland streams. They help shade the stream to prevent excessive solar heating and their roots stabilize the streams banks. Forest buffers also help remove nutrients, sediment and other pollutants from runoff, and the leaves from trees are a major component of the stream's food web.

While there is no single minimum standard for how wide a forested stream buffer should be in Maryland, for the purposes of this study a forest buffer is generally considered inadequate if it is less than 50 ft. wide, measured from the edge of the stream's banks. Inadequate buffers were the third most frequently reported problem. Survey crews reported inadequate stream buffers at 13 sites in the Lower Patuxent watershed survey. The locations of the inadequate buffer sites are shown in Figure 7b, 7c, and 7d.

As part of the data collected by the field crews, a rough estimate of the length of the inadequate stream buffer at each site was made. Based on this data, there is an estimated 3,100 ft. (0.59 miles) of inadequately buffered stream banks in the sub-watersheds. This accounts for only 0.4% of the total stream miles that were surveyed by the field crews. The length of inadequate buffers ranged from 50 feet to 500 feet. At 5 sites, the field crew reported that there was an inadequate buffer on both sides of the stream, while at an additional 8 sites trees were inadequate on only one side of the stream. The most commonly reported land uses along these inadequately buffered banks was lawn (8 sites). Only one site had livestock present. All sites received severity ratings of moderate to minor (Figure 7a).

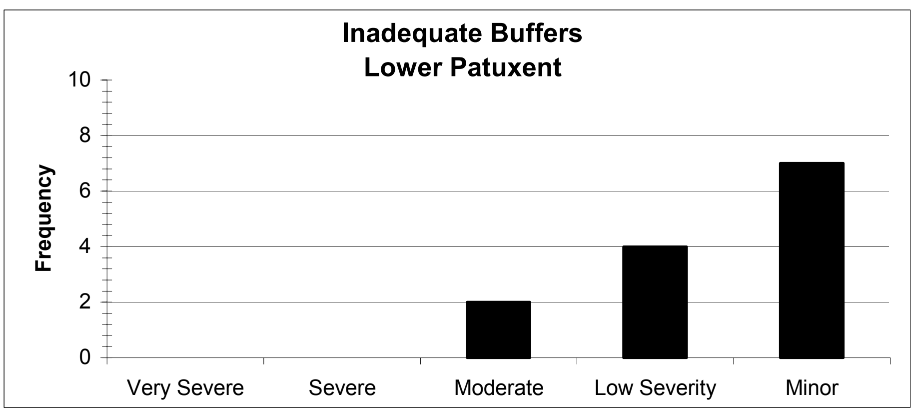

Figure 7a: Histograph showing the frequency of severity ratings given to inadequate buffers during the Lower Patuxent SCA Survey.

Inadequate Buffers

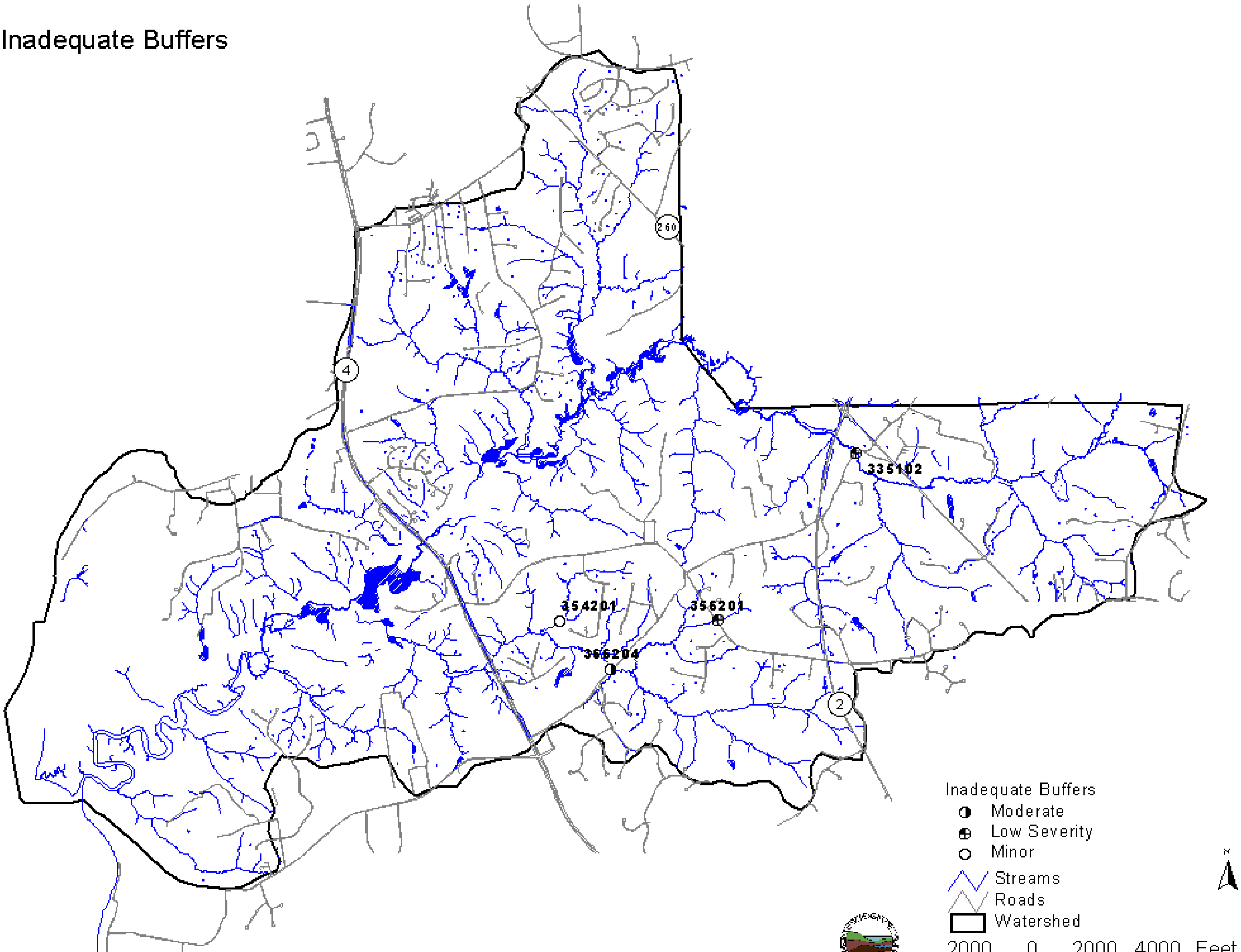

Figure 7b: Map showing the locations of the Inadequate Buffer sites in Hall Creek

Inadequate Buffers

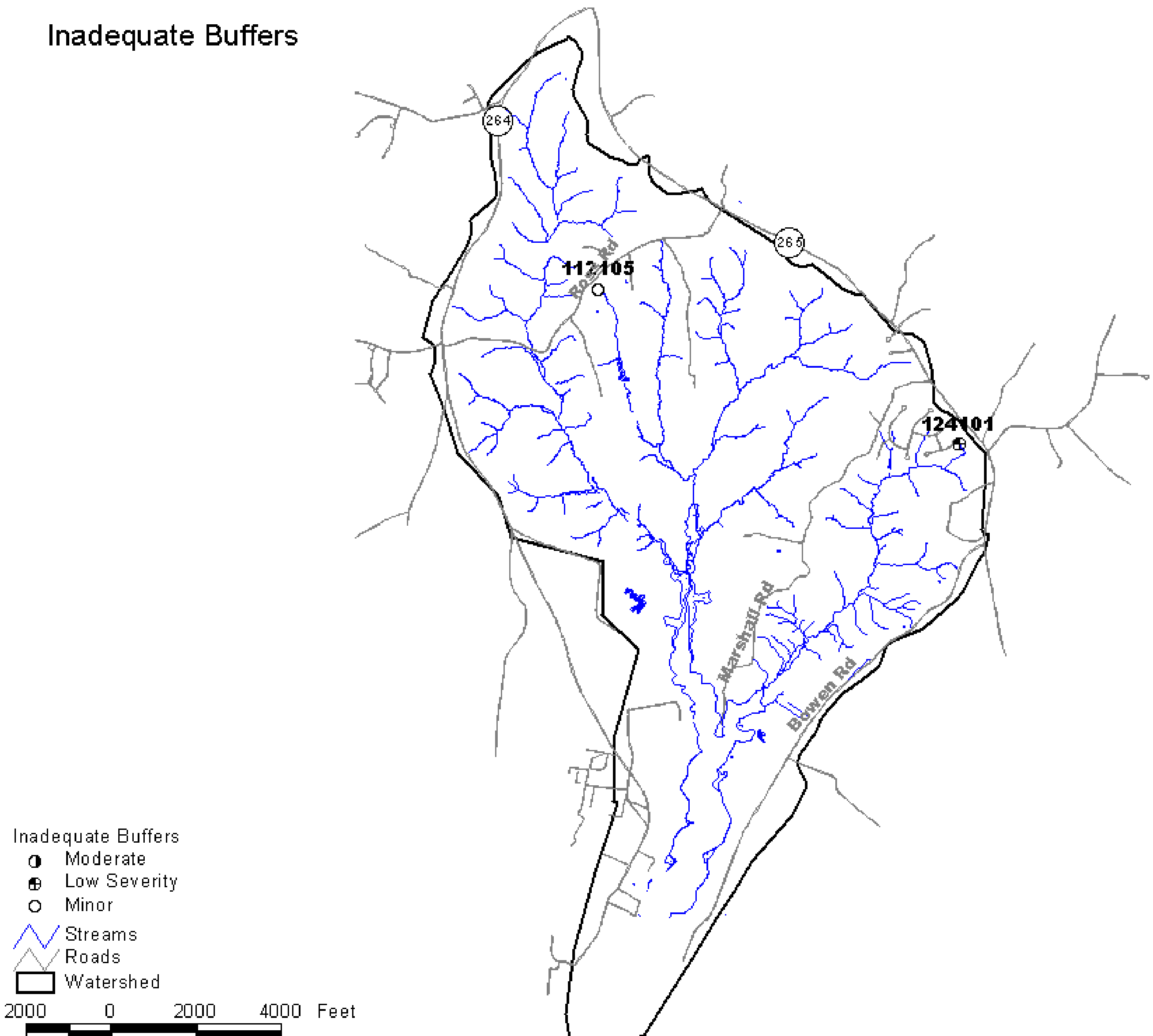

Figure 7c: Map showing the locations of the Inadequate Buffer sites in Island Creek

Inadequate Buffers

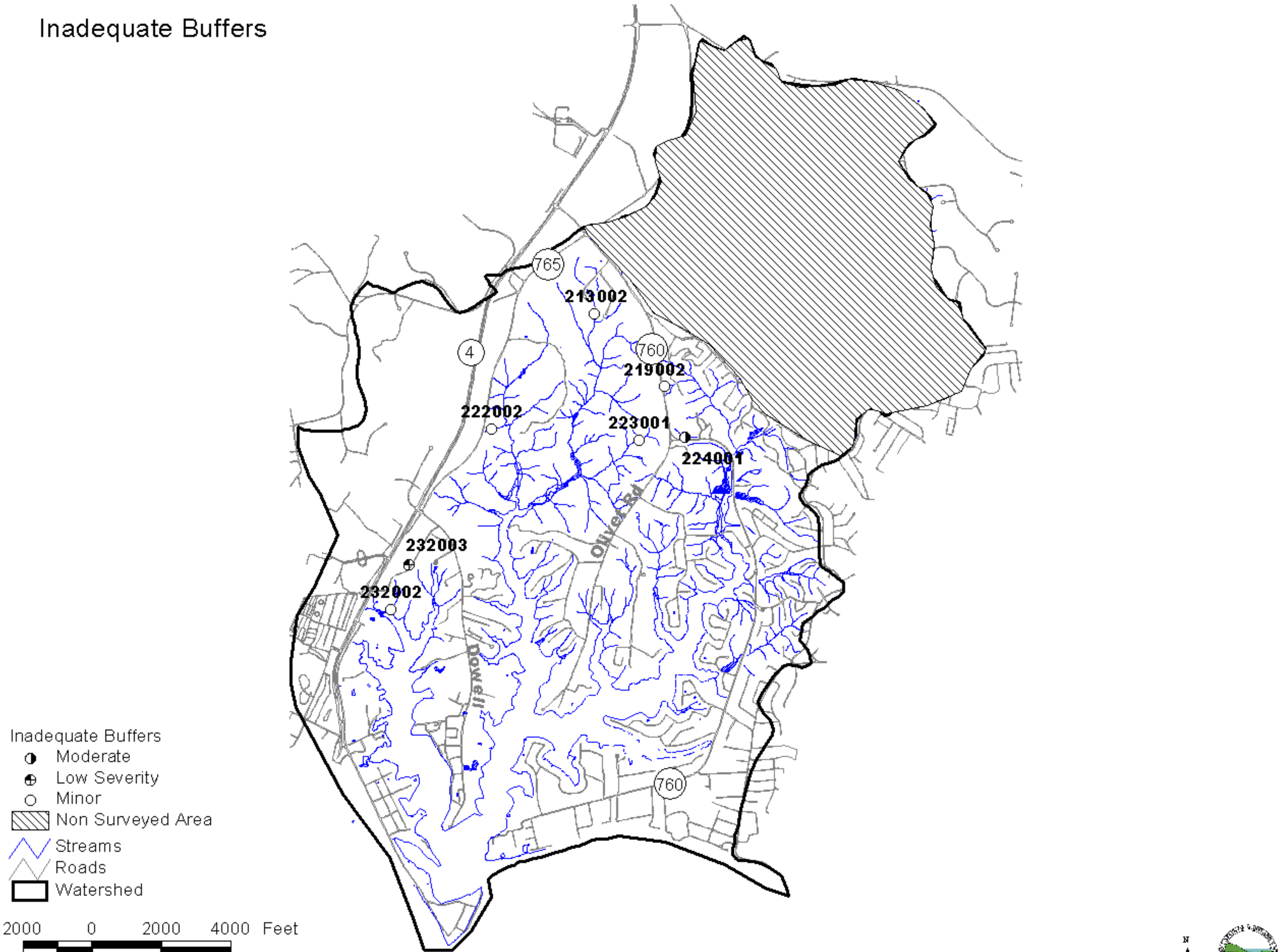

Figure 7d: Map showing the locations of the Inadaequate Buffer sites in Back/Mill Creek (Solomon's Harbor)

Pipe Outfalls

Pipe outfalls include any pipes or small man made channels that discharge into the stream through the stream corridor. Pipe outfalls are considered 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. One hundred and twenty five pipe outfalls were identified during the Lower Patuxent survey. The location of these pipes can be seen in Figures 8b and 8c.

Thirty-six percent (4) of the pipe outfalls observed in the survey had a discharge coming out of them. Of these, only 1 had an odor or coloration associated with the outfall (Appendix B). The remaining discharges were reported as having a clear discharge with no odor. The most frequently reported type of outfall was stormwater at 9 sites. There were no estimates of the amount of fluid discharging from the pipes. No immediate follow up actions were taken as part of this study to determine the source of color or odor discharging from the pipes. In some cases, coloration or smell from a storm drainpipe may be a sporadic occurrence.

Severity ratings for pipe outfalls were given based on outfall type, discharge, and type of discharge. In the Lower Patuxent SCA Survey, 6 pipe outfalls were given moderate ratings, along with 5 minor sites (Figure 8a).

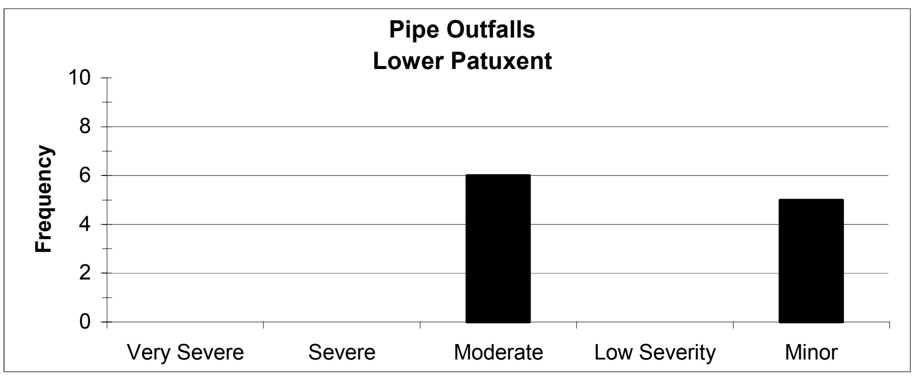

Figure 8a: Histograph showing the frequency of severity ratings given to Pipe outfall sites during the Lower Patuxent SCA survey.

Pipe Outfalls

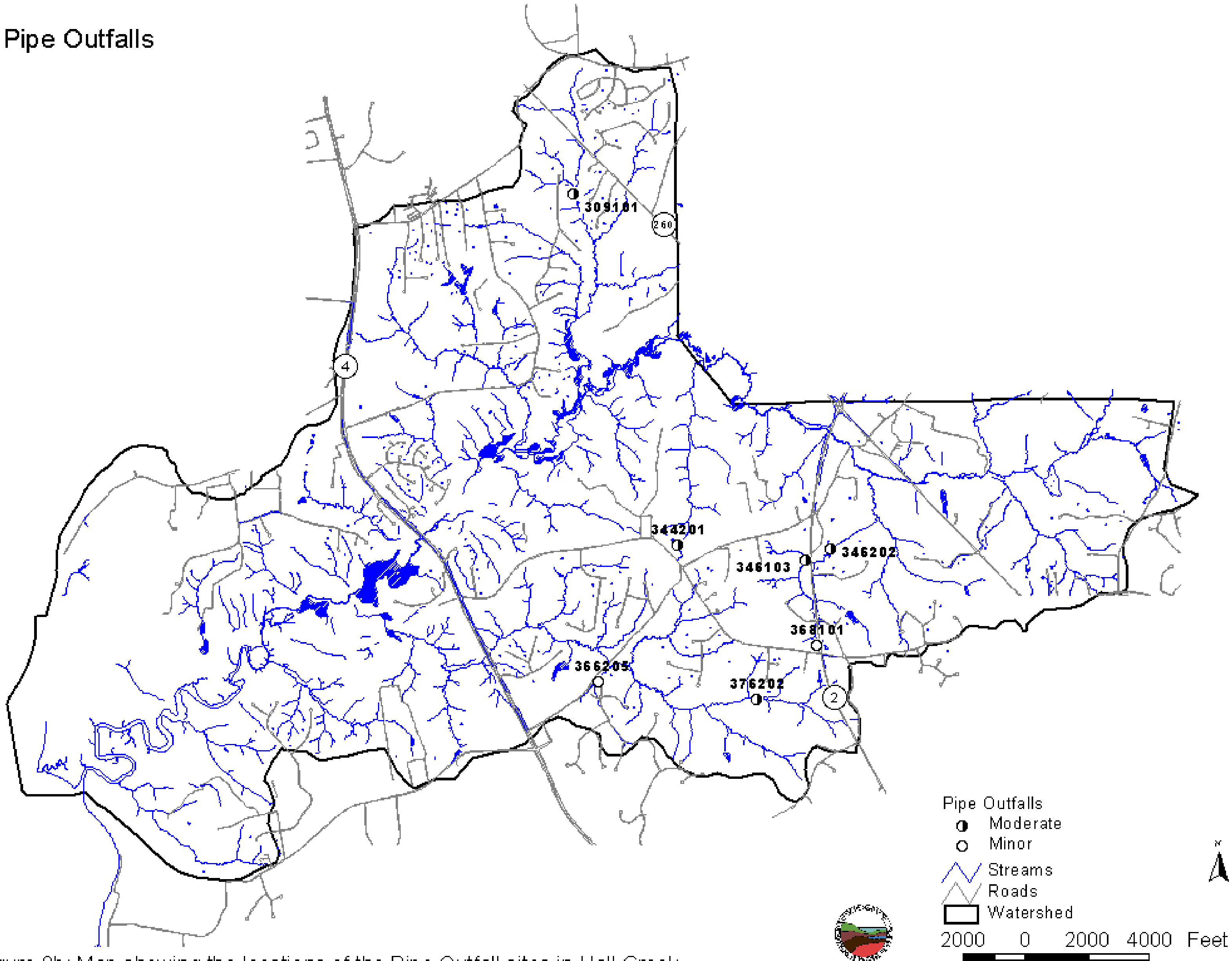

Figure 8b: Map showing the locations of the Pipe Outfall sites in Hall Creek

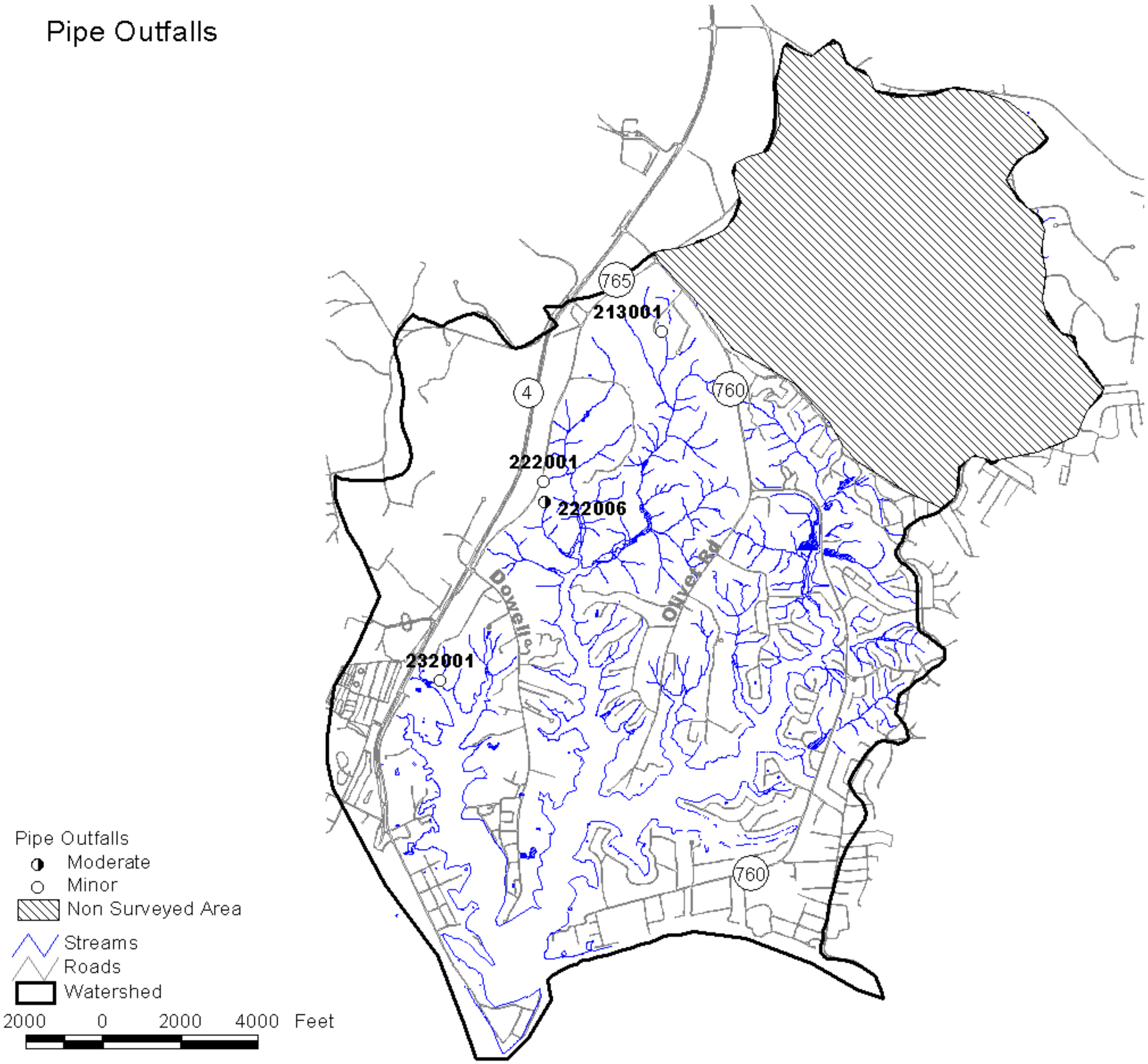

Figure 8c: Map showing the locations of the Pipe Outfall sites in Back/Mill Creek (Solomon's Harbor)

Trash Dumping

Trash dumping data sheets record information on places where large amounts of trash have been dumped inside the stream corridor, or to note places where trash tends to accumulate. The field survey crew found 11 sites where there was excessive trash, and these locations are shown in Figures 9b, 9c, and 9d. The sites were given severity ratings based on size, contents of trash, and potential impact on the stream. Severity ratings for trash dumping sites throughout the surveyed Lower Patuxent sub-watersheds can be found in Figure 9a. Most sites found were ranked as moderate to minor trash dumping sites. Field crews indicated that 15 of the sites might be good volunteer clean up opportunities.

The trash dumping sites range in size from 1 truckload to 7 dumptruck loads. Single site trash dumping sites were recorded at 8 sites, while large area dumping sites were recorded at 3 locations. Types of trash sites found include: residential (7), floatables (1), vehicles (2), and mixed (1). Nine trash dumping sites were found on private land. Site 219005 was the only site to be given a severe rating. An estimated 7 dumptruck loads of cars, appliances, and large amounts of glass were found next to the stream. This site can be found in Mill Creek and was given a severe rating because it is unknown if the vehicles are leaking any substances or if there is any other hazardous substance coming from the other trash present at the site.

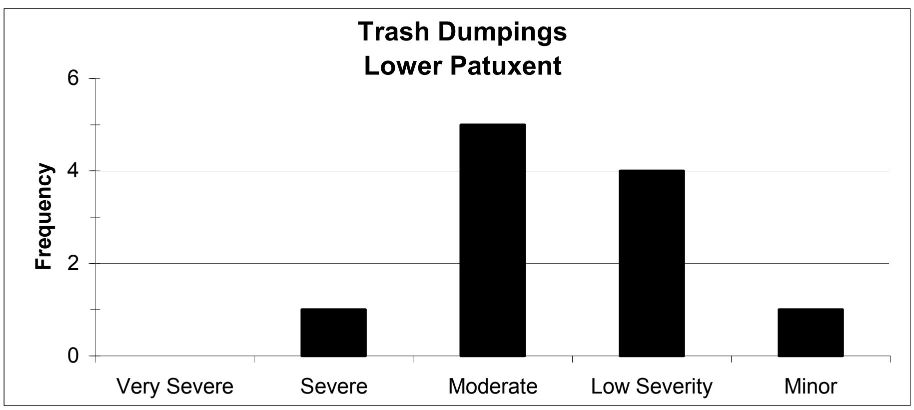

Figure 9a: Histograph showing the frequency of severity ratings given to trash dumping sites seen during the Lower Patuxent SCA survey

Trash Dumping

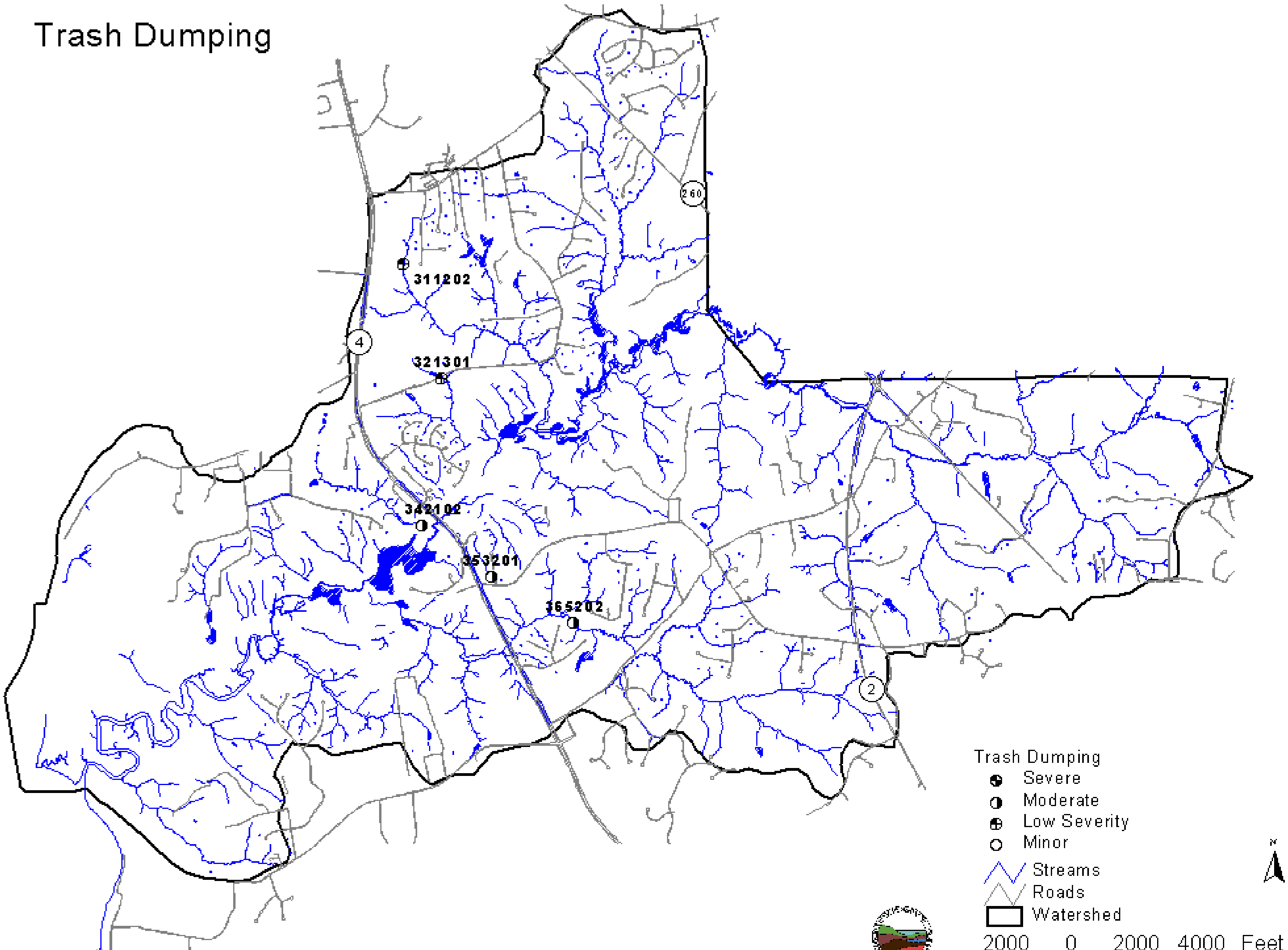

Figure 9b: Map showing the locations of the Trash Dumping sites in Hall Creek

Trash Dumping

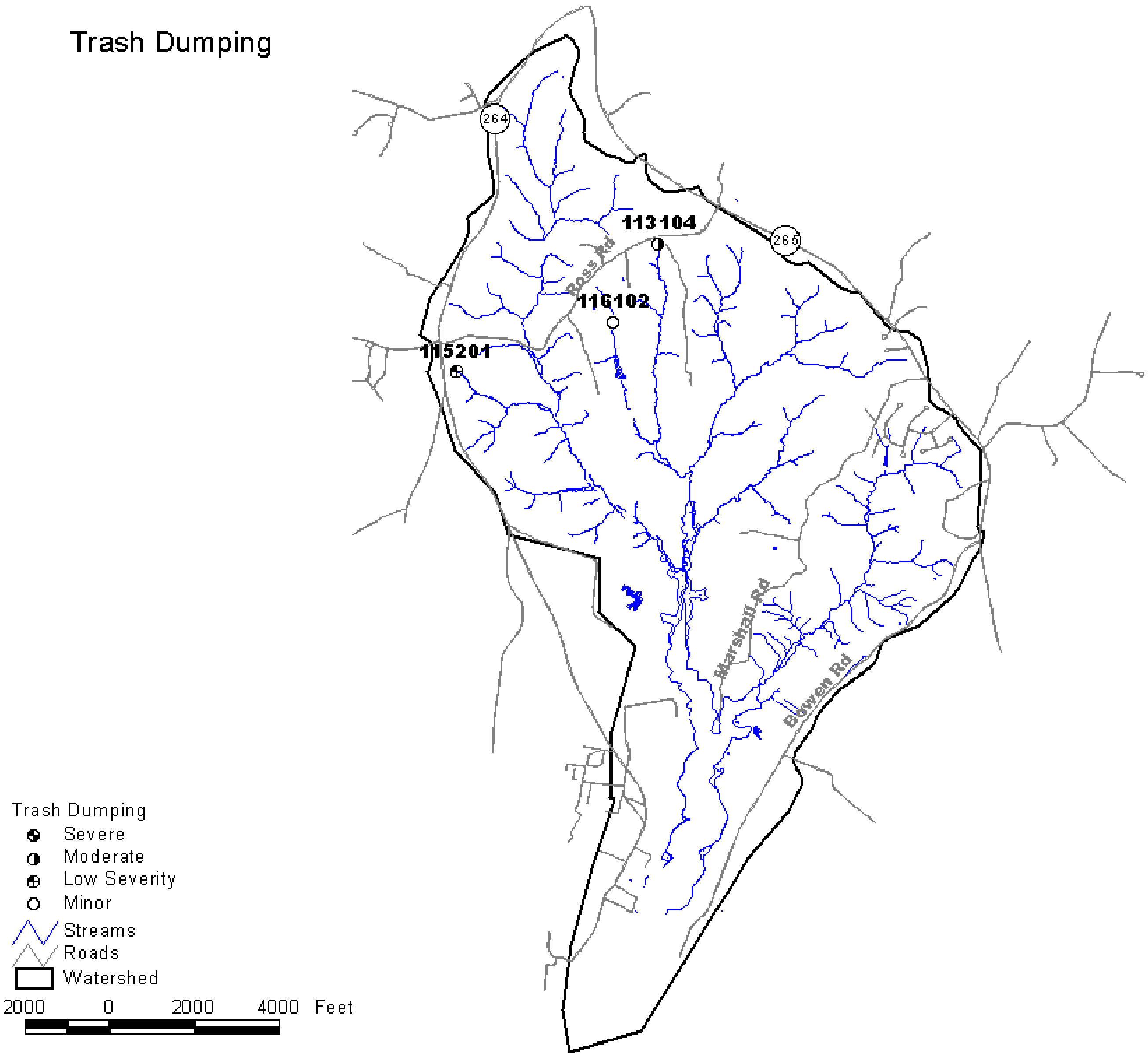

Figure 9c: Map showing the locations of the Trash Dumping sites in Island Creek

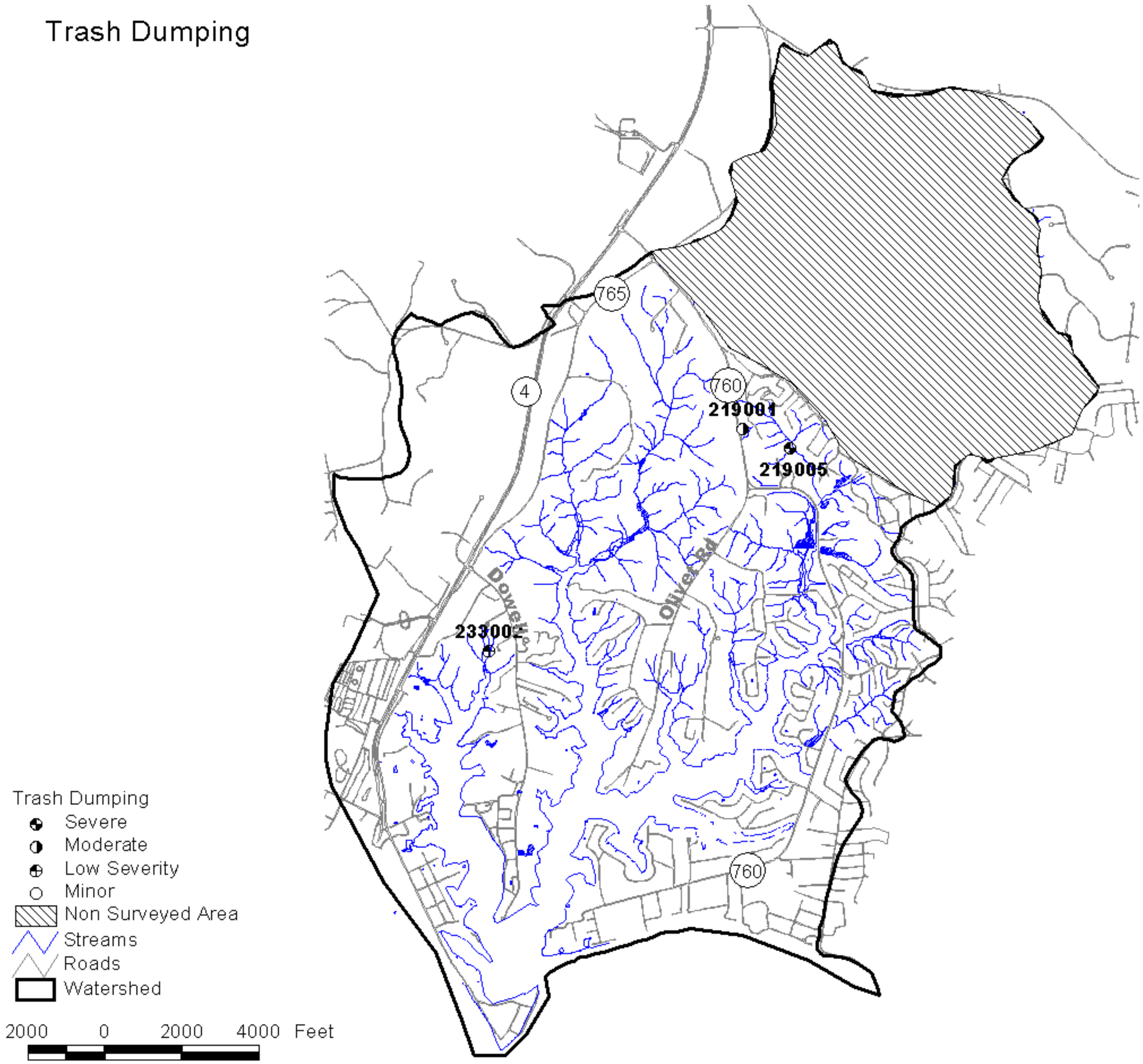

Figure 9d: Map showing the locations of the Trash Dumping sites in Back/Mill Creek (Solomon's Harbor)

Channel Alterations

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

In the 3 surveyed sub-watersheds of the Lower Patuxent watershed, survey crews found 5 areas where the stream channel had been recognizably altered. Locations of channel alteration sites are shown in Figure 10b, 10c, and 10d. The total length of stream affected by channelization was estimated to be 767 ft, or about 0.14 miles. The sites were concrete channels (1), earth channels (2), rip-rap (1), and a man made pond (1). All of the sites in the Lower Patuxent watershed were given moderate to low severity ratings (Figure 10a). The lengths of stream present at channel alteration sites varied from 7 ft. to 400 ft. Perennial flow was reported at 4 sites, and sediment deposition was reported at 3 sites. Vegetation was found in the channel at 1 site. Road crossings are attributed to 2 channel alteration sites in the surveyed areas of the Lower Patuxent watershed.

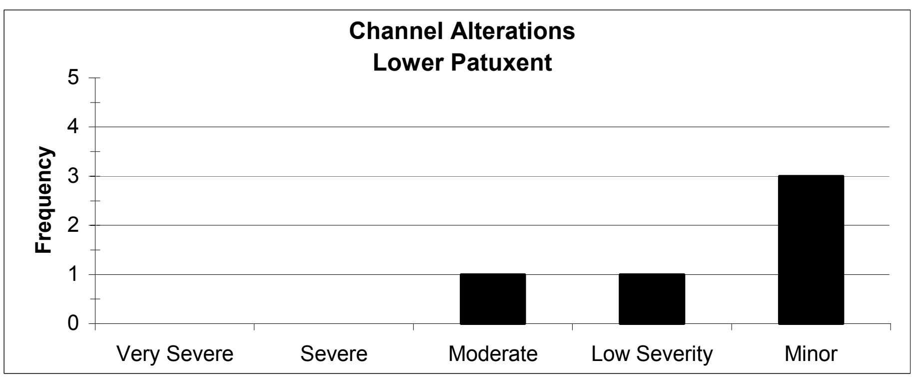

Figure 10a: Histograph showing the frequency of severity ratings given to channel alteration sites during the Lower Patuxent SCA Survey.

Channel Alteration

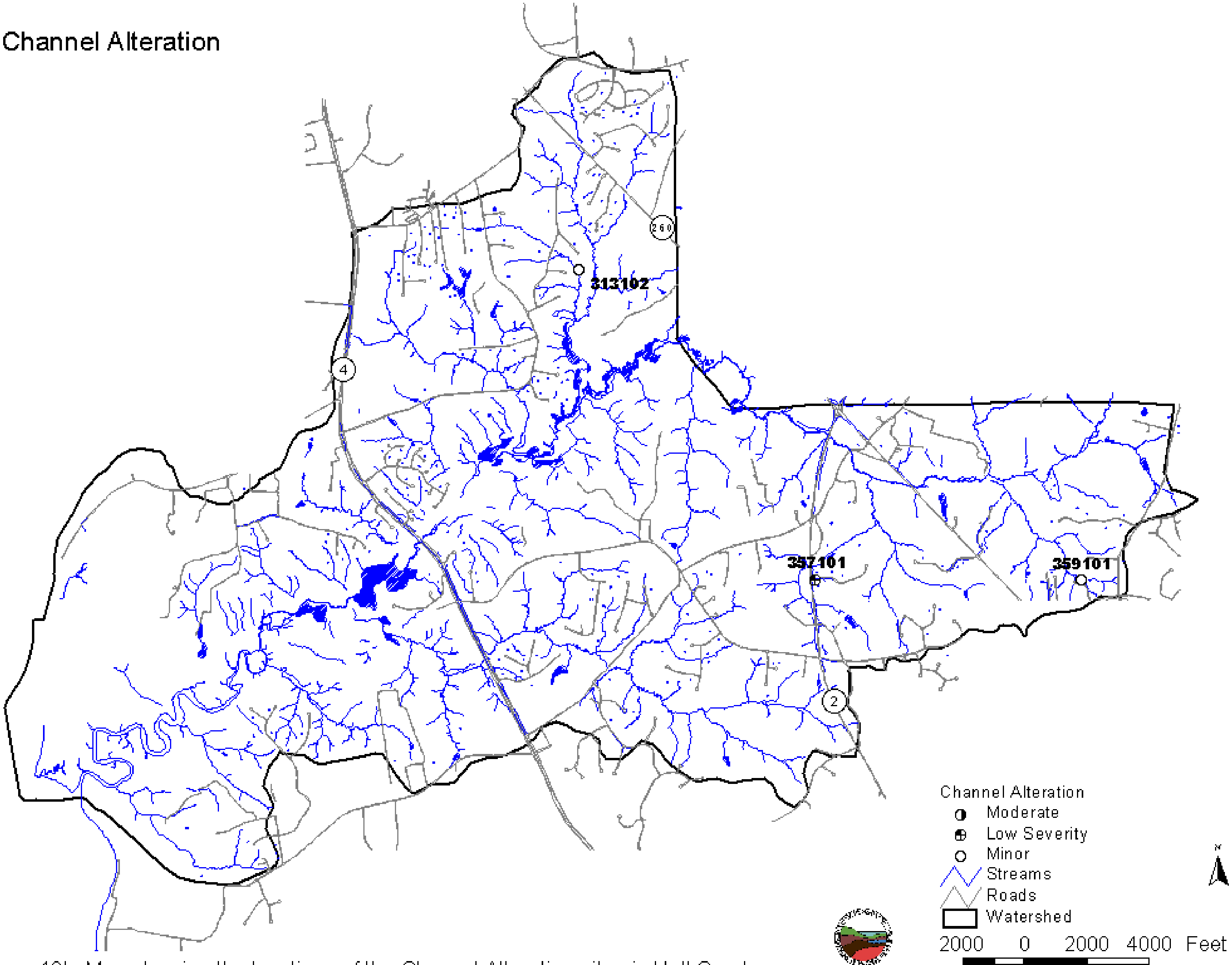

Figure 10b: Map showing the locations of the Channel Alteration sites in Hall Creek

Channel Alteration

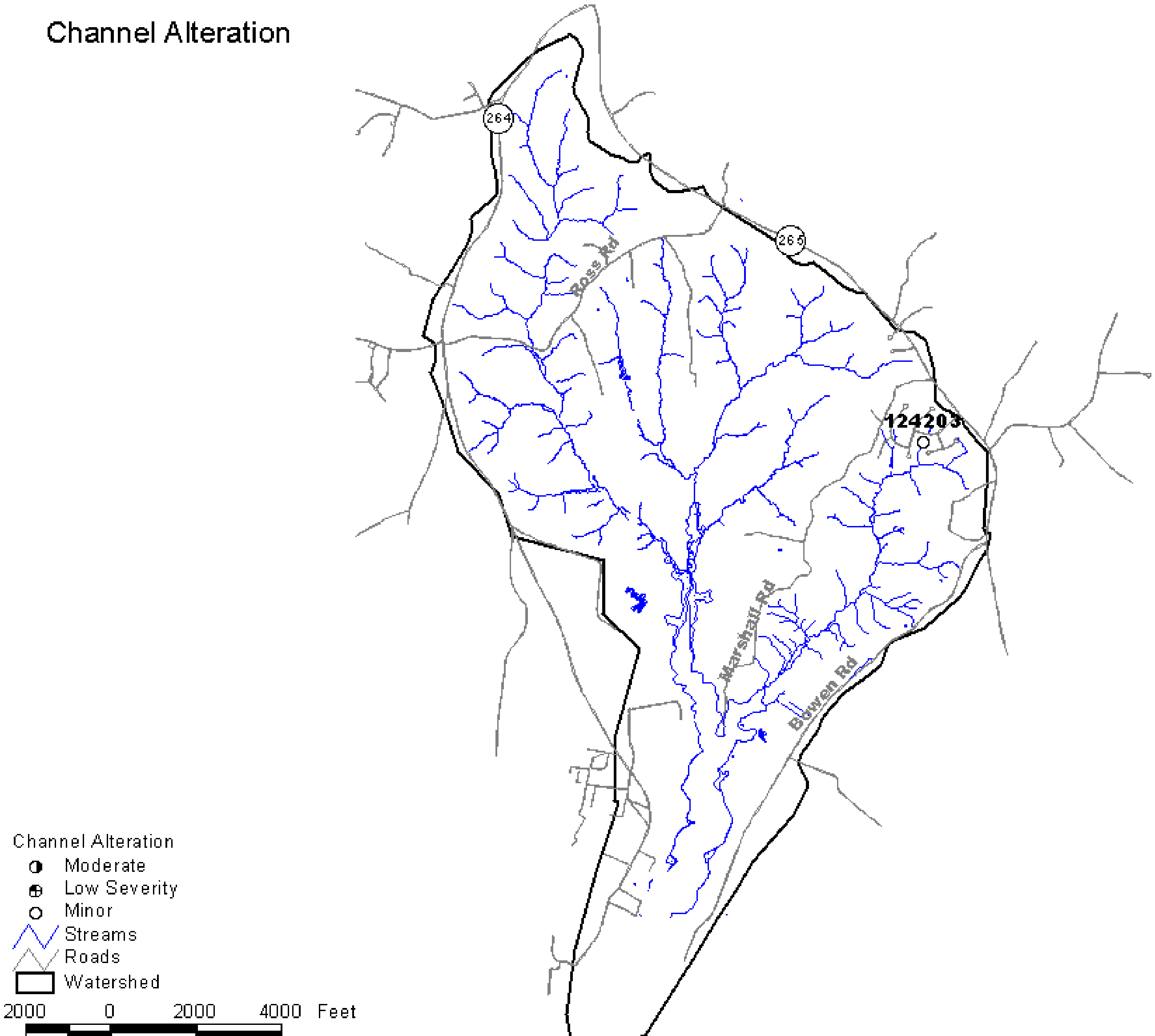

Figure 10c: Map showing the locations of the Channel Alteration sites in Island Creek

Channel Alteration

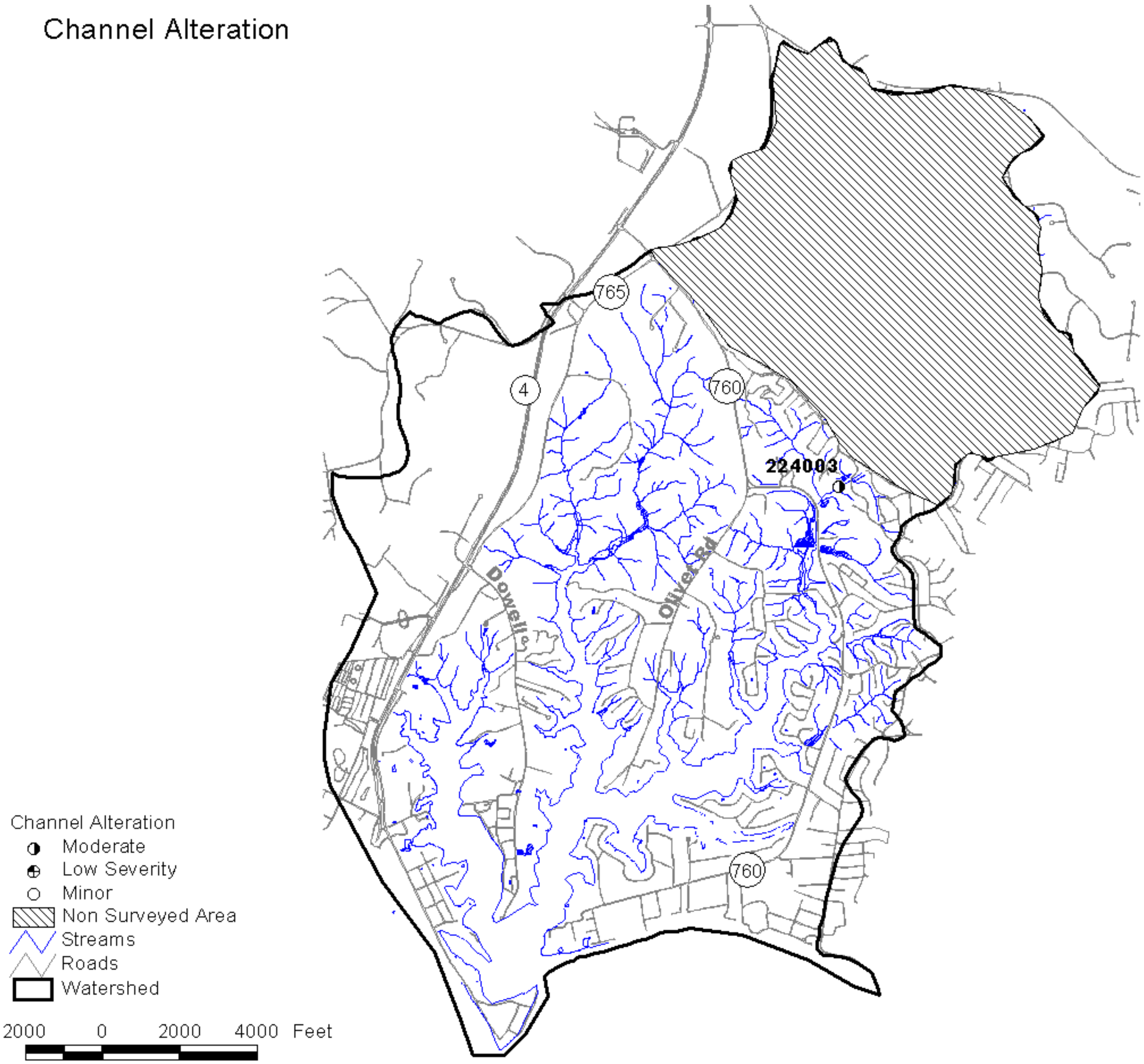

Figure 10d: Map showing the locations of the Channel Alteration sites in Back/Mill Creek (Solomon's Harbor)

Representative Sites

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

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

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

Representative site evaluations were done at approximately ½ mile intervals along the stream. Seventy-three representative data sheets were filled out during this survey. Locations of representative sites are shown in Figures 11a, 11b, and 11c, and the data is presented in Appendix B.

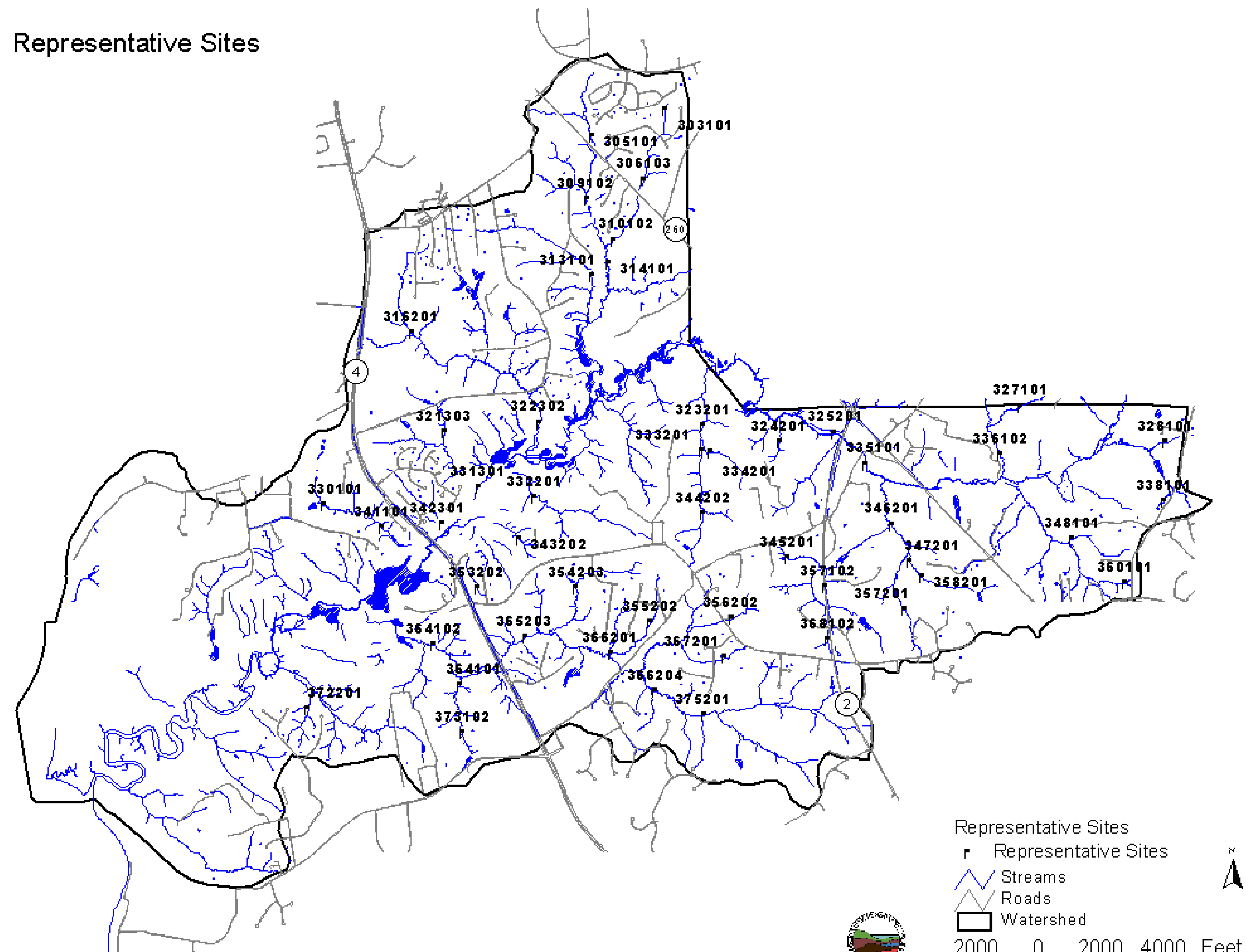

Figure 11b: Map showing the locations of the Representive sites in Hall Creek

Representative Sites

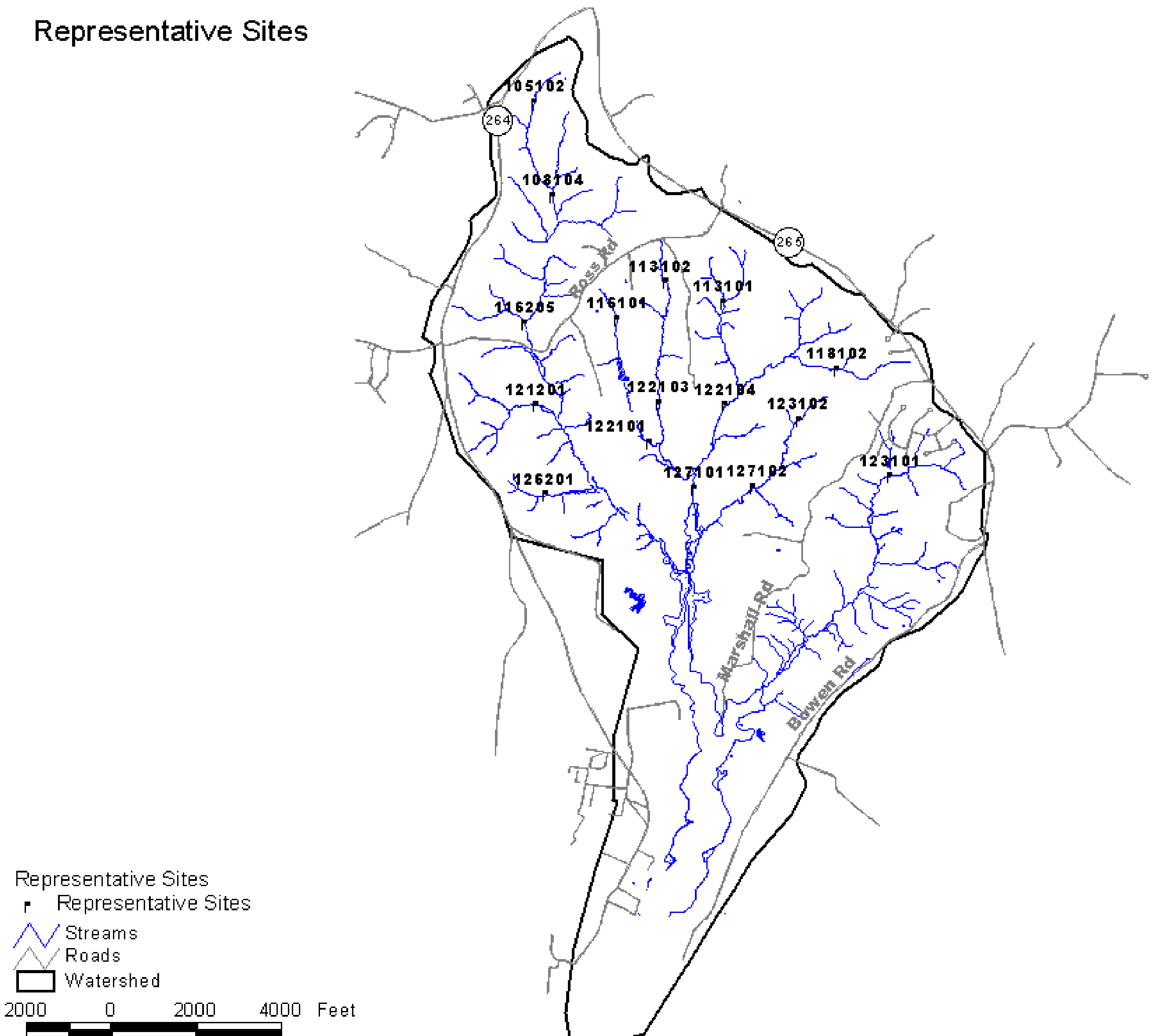

Figure 11c: Map showing the locations of the Representative sites in Island Creek

Representative Sites

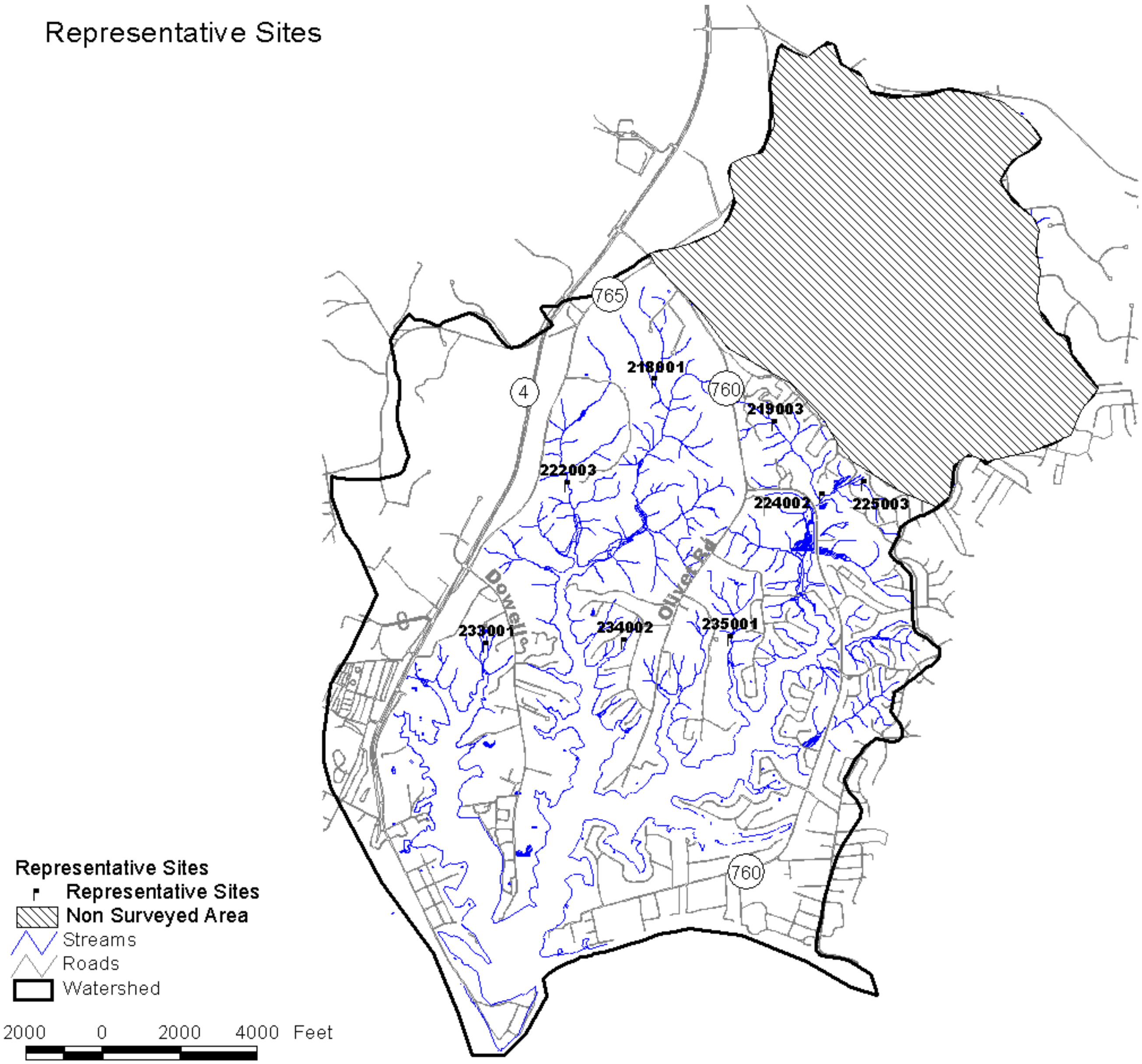

Figure 11d: Map showing the locations of the Representative sites in Back/Mill Creek (Solomon's Harbor)

DISCUSSION

One of the main objectives of the Lower Patuxent Stream Corridor Assessment survey was to walk the stream network quickly and identify potential environmental problems in or along the edge of the streams. The survey was completed in October 2003, and over 130 miles of stream were walked. During the SCA survey, 101 potential environmental problems were identified. The most common environmental concern seen during the SCA survey was erosion, which was reported at 39 sites. Other potential environmental problems identified during the survey include: 22 fish barriers, 13 inadequate buffers, 11 pipe outfalls, 11 trash dumping sites, and 5 channel alterations sites. Seventy-three representative sites also were recorded.

Erosion sites were the most common problems observed in the three surveyed sub-watersheds. These sites typically ran through forested areas. Some of the more minor erosion problems, especially in areas that also had inadequate, may be cured with buffer plantings. Some of the more severe erosion problems, however, will probably require more costly engineering solutions both to stabilize the stream's banks and to control upstream runoff, which ultimately is causing the stream to become unstable.

As mentioned earlier, the Maryland Department of Natural Resources has formed a partnership with Calvert County to develop a Watershed Restoration Action Strategy (WRAS) for the Lower Patuxent watershed. Results from this survey will be combined with other information about the area to help establish priorities for the types and location of restoration projects that will be pursued in the watershed in the future. Information on the Lower Patuxent Watershed Action Strategy can be found on DNR's website (www.dnr.maryland.gov/watersheds/wras).

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Appendix A

Listing of sites by site number

Appendix A- Lower Patuxent

Location	Problem	Severity	Correctability	Access	Northing	Easting	Stream
105101	Erosion	3	3	3	88748.47375	438981.75895	Island Creek
105102	Representative Site				88685.22489	438972.02836	Island Creek
108101	Fish Barrier	5	3	3	88193.82988	438987.84057	Island Creek
108102	Erosion	4	3	5	88086.79334	439117.98727	Island Creek
108103	Fish Barrier	5	3	5	88094.09129	439122.85257	Island Creek
108104	Representative Site				88013.81388	439103.39138	Island Creek
112101	Erosion	3	4	5	87543.09639	439064.46900	Island Creek
112102	Fish Barrier	5	2	5	87353.34980	439046.22414	Island Creek
112104	Erosion	4	3	3	87293.74991	439484.10088	Island Creek
112105	Inadequate Buffer	5	3	2	87354.56612	439433.01526	Island Creek
112203	Fish Barrier	4	4	1	87183.06440	438732.41247	Island Creek
113101	Representative Site				87249.96223	440319.71567	Island Creek
113102	Representative Site				87397.13747	439903.73276	Island Creek
113103	Erosion	5	1	5	87495.65974	439878.18995	Island Creek
113104	Trash Dumping	3	4	2	87663.51249	439887.92054	Island Creek
115201	Trash Dumping	4	3	3	86743.97133	438438.06200	Island Creek
115202	Erosion	3	3	3	86706.26528	438489.14762	Island Creek
116101	Representative Site				87129.54613	439568.02726	Island Creek
116102	Trash Dumping	5	1	3	87105.21964	439561.94564	Island Creek
116103	Erosion	3	2	2	86651.53068	439616.68023	Island Creek
116104	Fish Barrier	3	4	3	86674.64084	439617.89655	Island Creek
116205	Representative Site				87096.70537	438907.56317	Island Creek
117101	Erosion	3	3	5	86830.33035	440362.28702	Island Creek
117102	Fish Barrier	5	3	5	86726.94279	440404.85837	Island Creek
117103	Erosion	5	2	5	86871.68538	439870.89200	Island Creek
118101	Erosion	4	3	5	87046.83608	440857.33100	Island Creek
118102	Representative Site				86769.51414	441131.00396	Island Creek
118103	Erosion	3	4	5	86769.51414	441083.56732	Island Creek
121201	Representative Site				86511.65339	438982.97528	Island Creek
121202	Erosion	4	4	5	86463.00042	439158.12597	Island Creek
122101	Representative Site				86246.49470	439800.34520	Island Creek
122102	Fish Barrier	5	3	5	86117.56432	439914.67968	Island Creek
122103	Representative Site				86525.03296	439862.37773	Island Creek
122104	Representative Site				86509.22074	440331.87891	Island Creek
123101	Representative Site				86000.79719	441509.28082	Island Creek
123102	Representative Site				86405.83318	440854.89835	Island Creek
124101	Inadequate Buffer	4	3	3	86240.41307	442009.19010	Island Creek
124102	Erosion	4	3	3	86068.91135	441673.48460	Island Creek
124203	Channel Alteration	5	1	1	86247.71102	441736.73346	Island Creek
124204	Erosion	5	3	4	86207.57232	441714.83962	Island Creek
126201	Representative Site				85868.21784	439048.65679	Island Creek
127101	Representative Site				85915.65449	440109.29156	Island Creek
127102	Representative Site				85926.60141	440531.35609	Island Creek
213001	Pipe Outfall	5	1	1	77919.69117	448868.90690	Mill Creek
213002	Inadequate Buffer	5	1	2	77771.71060	448906.95904	Mill Creek
218001	Representative Site				77513.03005	448846.95153	Mill Creek
219001	Trash Dumping	3	2	1	77138.30373	449518.94547	Mill Creek
219002	Inadequate Buffer	5	1	1	77137.01563	449508.64063	Mill Creek
219003	Representative Site				77178.23500	449781.71896	Mill Creek
219004	Fish Barrier	5	1	3	77152.47289	449798.46433	Mill Creek

Appendix A- Lower Patuxent

Location	Problem	Severity	Correctability	Access	Northing	Easting	Stream
219005	Trash Dumping	2	4	4	76990.17162	449891.20792	Mill Creek
222001	Pipe Outfall	5	1	1	76742.85539	447939.72831	Mill Creek
222002	Inadequate Buffer	5	1	1	76771.19371	448004.13358	Mill Creek
222003	Representative Site				76697.77170	448158.70622	Mill Creek
222004	Fish Barrier	5	1	3	76550.92769	448180.60401	Mill Creek
222005	Erosion	5	1	2	76437.57442	447919.11863	Mill Creek
222006	Pipe Outfall	3	3	1	76575.40170	447955.18558	Mill Creek
223001	Inadequate Buffer	5	2	1	76672.00960	449288.37461	Mill Creek
223002	Fish Barrier	5	4	1	76526.45369	449266.47682	Mill Creek
224001	Inadequate Buffer	3	3	1	76692.61928	449692.83969	Mill Creek
224002	Representative Site				76607.60433	450153.98141	Mill Creek
224003	Channel Alteration	3	3	1	76681.02633	450273.77521	Mill Creek
225001	Fish Barrier	3	5	1	76821.42982	450497.90554	Mill Creek
225002	Erosion	5	3	2	76453.03169	450575.19186	Mill Creek
225003	Representative Site				76704.21223	450482.44827	Mill Creek
230001	Fish Barrier	5	1	3	76207.00357	449717.31370	Mill Creek
231001	Erosion	3	1	1	75846.33407	450738.78124	Mill Creek
231002	Fish Barrier	5	1	4	75966.12786	450532.68438	Mill Creek
232001	Pipe Outfall	5	1	2	75189.40034	447126.93384	Back Creek
232002	Inadequate Buffer	5	2	2	75198.41708	447120.49331	Back Creek
232003	Inadequate Buffer	4	2	2	75592.57731	447282.79458	Back Creek
233001	Representative Site				75443.15709	447522.38218	Back Creek
233002	Trash Dumping	4	1	2	75401.93772	447528.82270	Back Creek
234001	Erosion	5	2	3	75573.25573	448672.66026	Mill Creek
234002	Representative Site				75468.91920	448605.67878	Mill Creek
234003	Erosion	5	1	2	75539.76499	449203.35966	Mill Creek
235001	Representative Site				75492.10510	449428.77810	Mill Creek
240001	Fish Barrier	4	4	1	74796.52821	450197.77699	Mill Creek
302101	Fish Barrier	4	4	3	119957.26842	431535.97229	Hall Creek
303101	Representative Site				119996.49812	432545.12266	Hall Creek
303102	Erosion	3	3	1	119984.32339	432543.76991	Hall Creek
305101	Representative Site				119739.47591	431829.51871	Hall Creek
305102	Erosion	3	3	3	119719.18468	431826.81321	Hall Creek
305103	Fish Barrier	3	5	1	119627.41433	431847.01644	Hall Creek
306101	Fish Barrier	5	3	1	119740.77648	432481.45801	Hall Creek
306102	Erosion	3	4	1	119724.59568	432468.01600	Hall Creek
306103	Representative Site				119310.65464	432335.44664	Hall Creek
309101	Pipe Outfall	3	2	1	119141.82815	431766.85672	Hall Creek
309102	Representative Site				119119.95145	431775.36432	Hall Creek
309103	Fish Barrier	3	4	1	118622.67810	431580.35775	Hall Creek
310101	Fish Barrier	3	5	1	119184.36619	432274.88246	Hall Creek
310102	Representative Site				118722.52461	432042.74630	Hall Creek
311201	Erosion	3	3	3	118351.83597	429987.55124	Hall Creek
311202	Trash Dumping	4	5	4	118176.82231	429959.59767	Hall Creek
313101	Representative Site				118372.49730	431833.70221	Hall Creek
313102	Channel Alteration	5	3	1	118428.40444	431834.91758	Hall Creek
314101	Representative Site				118492.81919	431986.83916	Hall Creek
316201	Representative Site				117815.97794	430082.91990	Hall Creek
316202	Erosion	1	4	5	117754.95410	430168.61295	Hall Creek
321301	Trash Dumping	4	3	1	117112.25623	430320.52336	Hall Creek

Appendix A- Lower Patuxent

Location	Problem	Severity	Correctability	Access	Northing	Easting	Stream
321302	Erosion	4	4	1	117114.85298	430321.82174	Hall Creek
321303	Representative Site				116848.68518	430401.02289	Hall Creek
322301	Erosion	4	3	5	116972.03123	431328.06589	Hall Creek
322302	Representative Site				116942.16850	431324.17075	Hall Creek
323201	Representative Site				116913.60415	432906.89543	Hall Creek
324201	Representative Site				116748.70995	433652.16529	Hall Creek
325201	Representative Site				116843.49166	434189.69442	Hall Creek
327101	Representative Site				117101.86919	436003.53066	Hall Creek
328101	Representative Site				116755.20185	437414.86923	Hall Creek
330101	Representative Site				116156.64888	429227.28778	Hall Creek
331301	Representative Site				116321.54308	430733.40806	Hall Creek
332201	Representative Site				116225.46299	431278.72747	Hall Creek
333201	Representative Site				116664.31528	432897.80677	Hall Creek
334201	Representative Site				116651.33149	432977.00792	Hall Creek
335101	Representative Site				116546.16274	434494.81362	Hall Creek
335102	Inadequate Buffer	4	4	1	116649.40740	434477.18381	Hall Creek
336101	Fish Barrier	5	1	4	116683.79097	435778.91099	Hall Creek
336102	Representative Site				116626.66227	435811.37048	Hall Creek
336103	Fish Barrier	5	1	5	116398.14747	435798.38669	Hall Creek
336104	Erosion	3	3	1	116305.96252	435145.30177	Hall Creek
338101	Representative Site				116185.21323	437400.58705	Hall Creek
341101	Representative Site				115933.32759	429792.08288	Hall Creek
342102	Trash Dumping	3	2	4	115749.29431	430141.49125	Hall Creek
342301	Representative Site				115968.09531	430383.13411	Hall Creek
343201	Erosion	4	3	2	115695.19517	431201.83455	Hall Creek
343202	Representative Site				115827.43753	431128.50015	Hall Creek
343203	Erosion	3	3	2	115926.01820	431551.67570	Hall Creek
344201	Pipe Outfall	3	3	2	115716.83483	432791.14729	Hall Creek
344202	Representative Site				116070.28259	432914.97423	Hall Creek
345201	Representative Site				115641.09602	433734.87688	Hall Creek
346103	Pipe Outfall	3	4	1	115572.57043	434040.23651	Hall Creek
346104	Erosion	4	2	2	115627.87178	433990.94618	Hall Creek
346201	Representative Site				115962.08430	434751.94086	Hall Creek
346202	Pipe Outfall	3	1	1	115672.35330	434283.08158	Hall Creek
347201	Representative Site				115602.62551	434927.46254	Hall Creek
348101	Representative Site				115821.42651	436510.76427	Hall Creek
353201	Trash Dumping	3	3	1	115278.88521	430781.78858	Hall Creek
353202	Representative Site				115340.71911	430718.66647	Hall Creek
354201	Inadequate Buffer	5	1	1	115026.39679	431624.27545	Hall Creek
354202	Erosion	5	3	4	114925.91671	431318.97057	Hall Creek
354203	Representative Site				115339.43091	431687.39756	Hall Creek
355201	Erosion	3	3	4	114981.30958	432376.58789	Hall Creek
355202	Representative Site				115007.07370	432392.04636	Hall Creek
356201	Inadequate Buffer	4	3	1	115031.54962	433139.20598	Hall Creek
356202	Representative Site				115043.14347	433188.15781	Hall Creek
357101	Channel Alteration	4	3	1	115412.85866	434140.14222	Hall Creek
357102	Representative Site				115354.88938	434105.36065	Hall Creek
357201	Representative Site				115135.89432	434876.99618	Hall Creek
357202	Erosion	3	4	1	115187.42257	434834.48538	Hall Creek
358201	Representative Site				115451.50485	435039.31017	Hall Creek

Appendix A- Lower Patuxent

Location	Problem	Severity	Correctability	Access	Northing	Easting	Stream
359101	Channel Alteration	5	1	1	115408.99404	436738.45418	Hall Creek
359102	Erosion	3	5	1	115437.33458	436690.79055	Hall Creek
360101	Representative Site				115393.53557	437016.70673	Hall Creek
364101	Representative Site				114402.90498	430548.62325	Hall Creek
364102	Representative Site				114788.07864	430301.28765	Hall Creek
365201	Erosion	3	3	3	114679.86932	431947.61521	Hall Creek
365202	Trash Dumping	3	3	3	114840.89510	431546.98308	Hall Creek
365203	Representative Site				114867.94743	431187.57354	Hall Creek
366201	Representative Site				114708.20985	432017.17835	Hall Creek
366202	Erosion	3	3	3	114521.41995	432116.37023	Hall Creek
366203	Fish Barrier	4	3	1	114503.44968	432104.54216	Hall Creek
366204	Inadequate Buffer	3	3	2	114558.84255	432101.96574	Hall Creek
366204	Representative Site				114333.34184	432443.57461	Hall Creek
366205	Pipe Outfall	5	1	1	114382.29368	432018.46656	Hall Creek
367201	Representative Site				114663.12264	433116.01826	Hall Creek
368101	Pipe Outfall	5	1	1	114729.95916	434147.78848	Hall Creek
368102	Representative Site				114842.18330	434127.26016	Hall Creek
371201	Erosion	2	5	5	114165.87503	428987.31730	Hall Creek
372201	Representative Site				114165.87503	429073.62712	Hall Creek
373101	Erosion	3	3	3	113767.81931	430651.67975	Hall Creek
373102	Representative Site				113931.42150	430578.25199	Hall Creek
375201	Representative Site				114105.32934	432917.63451	Hall Creek
376201	Erosion	3	4	5	114143.97553	433012.96177	Hall Creek
376202	Pipe Outfall	3	3	3	114210.96225	433556.58480	Hall Creek

Appendix B

Listing of sites by problem category

Erosion- Lower Patuxent

Problem	Site	Type	Possible Cause	Length(ft)	Height(ft)	Landuseleft	Landuseright	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	316202	Downcutting	Below channelization	13000	6.5	Forest	Forest	No		1	4	5
Erosion	371201	Downcutting	Land use change upstream	3000	10	Forest	Forest	No		2	5	5
Erosion	105101	Downcutting	Unknown	2400	3	Forest	Forest	No		3	3	3
Erosion	112101	Downcutting	Unknown	600	3	Forest	Forest	No		3	4	5
Erosion	115202	Widening	Unknown	600	5	crop field	Forest	No		3	3	3
Erosion	116103	Widening	Below Pond	800	3.5	Shrubs/Small Trees	Shrubs/Small Trees	No		3	2	2
Erosion	117101	Widening	Bend at steep slope	1000	3	Forest	Forest	No		3	3	5
Erosion	118103	Widening	Unknown	1000	5.5	Forest	Forest	No		3	4	5
Erosion	231001	Widening	Land use change upstream	700	3	Lawn	Shrubs & Small Trees	Yes	House/Deck	3	1	1
Erosion	303102	Widening	Bend at steep slope	400	5	Forest	Forest	No		3	3	1
Erosion	305102	Widening	Below roadcrossing	2100	4	Forest	Paved	No		3	3	3
Erosion	306102	Widening	Unknown	1800	3	Forest	Crop field	No		3	4	1
Erosion	311201	Widening	Bend at steep slope	2250	3	Forest	Forest	No		3	3	3
Erosion	336104	Widening	Below roadcrossing	1200	4.5	Pasture	Paved	No		3	3	1
Erosion	343203	Downcutting	Bend at steep slope	2700	5	Forest	Forest	No		3	3	2
Erosion	355201	Widening	Bend at steep slope	1200	4.5	Forest	Forest	No		3	3	4
Erosion	357202	Downcutting	Bend at steep slope	2000	5	Forest	Forest	No		3	4	1
Erosion	359102	Headcutting	Below channelization	1750	3	Paved	Lawn	No		3	5	1
Erosion	365201	Widening	Bend at steep slope	4600	4	Forest	Forest	No		3	3	3
Erosion	366202	Widening	Pipe outfall	5800	4	Forest	Forest	No		3	3	3
Erosion	373101	Widening	Bend at steep slope	2400	4	Forest	Forest	No		3	3	3
Erosion	376201	Unknown	Unknown	2600	6.5	Forest	Forest	No		3	4	5
Erosion	108102	Headcutting	Unknown	200	3.5	Forest	Forest	No		4	3	5
Erosion	112104	Widening	Unknown	170	1	Shrubs/Small Trees	Shrubs/Small Trees	No		4	3	3
Erosion	118101	Downcutting	Bend at steep slope	700	2	Forest	Forest	No		4	3	5
Erosion	121202	Widening	Unknown	500	3	Forest	Forest	No		4	4	5
Erosion	124102	Widening	Bend at steep slope	600	4	Forest	Forest	No		4	3	3
Erosion	321302	Downcutting	Below roadcrossing	100	15	Forest	Forest	No		4	4	1
Erosion	322301	Downcutting	Bend at steep slope	50	8	Forest	Forest	No		4	3	5
Erosion	343201	Downcutting	Below channelization	500	4	Forest	Forest	No		4	3	2
Erosion	346104	Widening	Pipe Outfall	1600	2	Forest	Forest	No		4	2	2

Erosion- Lower Patuxent

Problem	Site	Type	Possible Cause	Length(ft)	Height(ft)	Landuseleft	Landuseright	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion	113103	Headcutting	Unknown	50	4	Forest	Forest	No		5	1	5
Erosion	117103	Widening	Unknown	150	3	Forest	Forest	No		5	2	5
Erosion	124204	Downcutting	Below channelization	20	4.5	Forest	Forest	No		5	3	4
Erosion	222005	Downcutting	Land use change upstream	400	2	Forest	Forest	No		5	1	2
Erosion	225002	Downcutting	Unknown	50	2	Forest	Forest	No		5	3	2
Erosion	234001	Headcutting	Unknown	100	2	Forest	Forest	No		5	2	3
Erosion	234003	Downcutting	Unknown	150	2	Forest	Forest	No		5	1	2
Erosion	354202	Widening	Bend at steep slope	400	5	Forest	Forest	No		5	3	4

Fish Barriers-Lower Patuxent

Problem	Site	Blockage	Type	Reason	Drop(In)	Depth(In)	Severity	Correctability	Access
Fish Barrier	116104	Total	Instream pond	Too high	12		3	4	3
Fish Barrier	225001	Total	Instream pond	Too high	300		3	5	1
Fish Barrier	305103	Total	Road Crossing	Too high	24		3	5	1
Fish Barrier	309103	Total	Road Crossing	Too high	6		3	4	1
Fish Barrier	310101	Total	Road Crossing	Too shallow/fast		0.25	3	5	1
Fish Barrier	112203	Total	Dam	Too high	48		4	4	1
Fish Barrier	240001	Total	Road crossing	Too shallow		1	4	4	1
Fish Barrier	302101	Total	Road Crossing	Too high	36		4	4	3
Fish Barrier	366203	Total	Old Crossing	Too High	36		4	3	1
Fish Barrier	108101	Total	Natural falls	Too high	48		5	3	3
Fish Barrier	108103	Total	Natural falls	Too high	60		5	3	5
Fish Barrier	112102	Total	Natural falls	Too high	12		5	2	5
Fish Barrier	117102	Total	Natural falls	Too high	18		5	3	5
Fish Barrier	122102	Total	Natural falls	Too high	12		5	3	5
Fish Barrier	219004	Temporary	Debris dam	Too high	10		5	1	3
Fish Barrier	222004	Temporary	Debris dam	Too high	8		5	1	3
Fish Barrier	223002	Total	Instream pond	Too high	18		5	4	1
Fish Barrier	230001	Total	Natural falls	Too high	18		5	1	3
Fish Barrier	231002	Temporary	Debris dam	Too high	10		5	1	4
Fish Barrier	306101	Total	Road Crossing	Too High	36		5	3	1
Fish Barrier	336101	Temporary	Beaver dam	Too high	24		5	1	4
Fish Barrier	336103	Temporary	Beaver dam	Too high	16		5	1	5

Inadequate Buffers-Lower Patuxent

Problem	Site	Sides	Unshaded	WidthLeft(ft)	WidthRight(ft)	LengthLeft(ft)	LengthRight(ft)	LandUseLeft	LandUseRight	Recentlyestablished	Livestock	Severity	Correctability	Access	Wetland
Inadequate Buffer	224001	Right	Neither		0		400	Lawn	Paved	No	No	3	3	1	4
Inadequate Buffer	366204	Left	Neither	0		400		Lawn	Forest	No	No	3	3	2	4
Inadequate Buffer	124101	Right	Right		0		200	Forest	lawn	No	No	4	3	3	2
Inadequate Buffer	232003	Both	Both	0	5	500	500	Lawn	Lawn	No	No	4	2	2	1
Inadequate Buffer	335102	Right	Right		0		200	Forest	Paved	No	No	4	4	1	4
Inadequate Buffer	356201	Both	Both	0	0	250	250	Lawn	Lawn	No	No	4	3	1	1
Inadequate Buffer	112105	Both	Neither	30	30	200	200	Cropfield	Pasture	No	Horses	5	3	2	4
Inadequate Buffer	213002	Left	Neither	20		100		Shrubs/Small Trees	Shrubs/Small Trees	No	No	5	1	2	3
Inadequate Buffer	219002	Right	Neither		20		300	Forest	Shrubs/Small Trees	No	No	5	1	1	4
Inadequate Buffer	222002	Right	Both		0		100	Forest	Paved	No	No	5	1	1	2
Inadequate Buffer	223001	Both	Both	0	0	300	300	Lawn	Lawn	No	No	5	2	1	3
Inadequate Buffer	232002	Both	Neither	0	5	100	100	Lawn	Lawn	No	No	5	2	2	1
Inadequate Buffer	354201	Right	Both		0		50	Forest	Lawn	No	No	5	1	1	5

Pipe Outfalls- Lower Patuxent

Problem	Site	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	222006	Stormwater	Corrugated Metal	Head of stream	24		Yes	Clear	None	3	3	1
Pipe Outfall	309101	Stormwater	Plastic	Left bank	5		Yes	Yellow brown	None	3	2	1
Pipe Outfall	344201	Stormwater	Corrugated metal	Left bank	8		Yes	Clear	None	3	3	2
Pipe Outfall	346103	Stormwater	Corrugated metal	Head of stream	18		No			3	4	1
Pipe Outfall	346202	Pond outflow	Plastic	Right bank	4		No			3	1	1
Pipe Outfall	376202	Unknown	Plastic	Right bank	10		Yes	Clear	None	3	3	3
Pipe Outfall	213001	Stormwater	Rip rap chsnnel	Right bank		2	No			5	1	1
Pipe Outfall	222001	Stormwater	Corrugated Metal	Head of stream	18		No			5	1	1
Pipe Outfall	232001	Stormwater	Concrete Pipe	Left bank	18		No			5	1	2
Pipe Outfall	366205	Stormwater	Concrete channel	Right bank		3	No			5	1	1
Pipe Outfall	368101	Stormwater	Concrete channel	Head of stream		2	No			5	1	1

Trash Dumping- Lower Patuxent

Problem	Site	Type	Truckloads	Other measure	Extent	Volunteer Project?	Owner Type	Owner Name	Severity	Correctability	Access
Trash Dumping	219005	Mixed/Cars		7 dumptrucks	Single Single	No	Private		2	4	4
Trash Dumping	113104	Vehicles		3 Dump truck	Single Site	Yes	Private		3	4	2
Trash Dumping	219001	Residential	15		Large Area	No	Private		3	2	1
Trash Dumping	342102	Mixed Residential	7		Single Site	Yes	Private		3	2	4
Trash Dumping	353201	Residential/Construction	5		Large Area	Yes	Unknown		3	3	1
Trash Dumping	365202	Residential	10		Single Site	Yes	Private		3	3	3
Trash Dumping	115201	Mixed	3		Single Site	Yes	Private		4	3	3
Trash Dumping	233002	Residential	3		Large Area	Yes	Private		4	1	2
Trash Dumping	311202	Residential	2		Single Site	Yes	Private		4	5	4
Trash Dumping	321301	Residential	2		Single Site	Yes	Public	Along WARD RD	4	3	1
Trash Dumping	116102	Flotables	1		Single Site	Yes	Private		5	1	3

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	224003	Earth channel	360	300	Yes	No	No	No			3	3	1
Channel Alteration	357101	Rip-rap	12	400	No	No	Yes	No			4	3	1
Channel Alteration	124203	Manmade pond	60	7	Yes	Yes	No	No			5	1	1
Channel Alteration	313102	Concrete channel	36	30	Yes	Yes	No	Above	25		5	3	1
Channel Alteration	359101	Earth channel	12	30	Yes	Yes	No	Above	30		5	1	1

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Back Creek											
Representative Site	233001	Poor	Poor	Suboptimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Hall Creek											
Representative Site	303101	Poor	Poor	Poor	Suboptimal	Marginal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	305101	Poor	Poor	Marginal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	306103	Poor	Poor	Poor	Optimal	Marginal	Marginal	Optimal	Optimal	Suboptimal	Suboptimal
Representative Site	309102	Poor	Poor	Poor	Optimal	Poor	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	310102	Poor	Marginal	Poor	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	313101	Poor	Poor	Poor	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	314101	Poor	Poor	Poor	Optimal	Marginal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	316201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Marginal	Optimal
Representative Site	321303	Suboptimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Marginal	Optimal
Representative Site	322302	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Marginal	Marginal	Suboptimal
Representative Site	323201	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Optimal	Suboptimal	Marginal	Marginal	Optimal
Representative Site	324201	Poor	Marginal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Poor	Poor	Optimal
Representative Site	325201	Marginal	Suboptimal	Marginal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	327101	Poor	Poor	Poor	Optimal	Marginal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	328101	Poor	Poor	Poor	Suboptimal	Marginal	Poor	Marginal	Optimal	Optimal	Optimal
Representative Site	330101	Poor	Poor	Poor	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	331301	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Marginal	Marginal	Suboptimal
Representative Site	332201	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	333201	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal	Marginal	Marginal	Suboptimal
Representative Site	334201	Poor	Suboptimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal
Representative Site	335101	Poor	Poor	Marginal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	336102	Poor	Marginal	Marginal	Optimal	Marginal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	338101	Poor	Poor	Poor	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	341101	Poor	Poor	Poor	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	342301	Poor	Marginal	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Optimal
Representative Site	343202	Marginal	Marginal	Marginal	Optimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal	Suboptimal
Representative Site	344202	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Marginal	Suboptimal	Suboptimal
Representative Site	345201	Marginal	Optimal	Marginal	Suboptimal	Optimal	Optimal	Optimal	Marginal	Marginal	Optimal
Representative Site	346201	Poor	Poor	Poor	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	347201	Poor	Poor	Poor	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Representative Site	348101	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	353202	Marginal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal
Representative Site	354203	Optimal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	355202	Suboptimal	Suboptimal	Marginal	Optimal	Marginal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	356202	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal
Representative Site	357102	Poor	Poor	Poor	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	357201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal
Representative Site	358201	Poor	Poor	Poor	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	360101	Poor	Poor	Poor	Optimal	Marginal	Marginal	Marginal	Optimal	Optimal	Optimal
Representative Site	364101	Poor	Poor	Poor	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	364102	Poor	Poor	Poor	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	365203	Suboptimal	Poor	Marginal	Optimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	366201	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	366204	Suboptimal	Poor	Marginal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	367201	Poor	Poor	Poor	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	368102	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	372201	Suboptimal	Marginal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Marginal	Marginal
Representative Site	373102	Poor	Poor	Poor	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	375201	Optimal	Poor	Marginal	Optimal	Marginal	Marginal	Suboptimal	Suboptimal	Suboptimal	Optimal
Island Creek											
Representative Site	105102	Poor	Poor	Poor	Optimal	Optimal	Poor	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	108104	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	113101	Marginal	Suboptimal	Optimal	Optimal	Optimal	Poor	Suboptimal	Optimal	Optimal	Optimal
Representative Site	113102	Poor	Poor	Poor	Optimal	Suboptimal	Poor	Optimal	Optimal	Poor	Optimal
Representative Site	116101	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	116205	Marginal	Optimal	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	118102	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	121201	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	122101	Poor	Poor	Poor	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	122103	Poor	Poor	Poor	Optimal	Optimal	Poor	Optimal	Optimal	Optimal	Optimal
Representative Site	122104	Poor	Poor	Poor	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	123101	Marginal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	123102	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal

Representative Sites A

Problem	Site	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Representative Site	126201	Poor	Poor	Poor	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	127101	Poor	Poor	Poor	Optimal	Optimal	Poor	Optimal	Optimal	Suboptimal	Optimal
Representative Site	127102	Poor	Poor	Poor	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Mill Creek											
Representative Site	218001	Poor	Marginal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	219003	Poor	Poor	Optimal	Optimal	Marginal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
Representative Site	222003	Poor	Poor	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	224002	Poor	Poor	Optimal	Optimal	Optimal	Poor	Optimal	Optimal	Optimal	Optimal
Representative Site	225003	Poor	Poor	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	234002	Poor	Poor	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal
Representative Site	235001	Poor	Poor	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Optimal

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Back Creek								
Representative Site	233001	18	20	24	2	4	10	Sands
Hall Creek								
Representative Site	303101	5	15	4	1	2	4	Sands
Representative Site	305101	12	24	3	1	3	4	Sands
Representative Site	306103	6	11	3	2	3	5	Sands
Representative Site	309102	7	20	5	2	3	2	bedrock
Representative Site	310102	3	20	7	1	3	4	Sands
Representative Site	313101	3	10	3	2	4	3	Sands
Representative Site	314101	7	10	7	3	3	4	Sands
Representative Site	316201	48	36	42	4	3	4	Sands
Representative Site	321303	18	20	12	16	16	12	Sands
Representative Site	322302	36	36	40				Sands
Representative Site	323201	36	8	24				Sands
Representative Site	324201	48	36	24				Sands
Representative Site	325201	18	12	12	12	8	6	Sands
Representative Site	327101	2	8	2	0.5	0.5	0.5	Sands
Representative Site	328101		3	5		0.5	0.5	Sands
Representative Site	330101	10	12	5	1	2	3	Sands
Representative Site	331301	60	48	40				Sands
Representative Site	332201	20	24	24				cobble
Representative Site	333201	36	29	30				Sands
Representative Site	334201	24	18	12				Sands
Representative Site	335101	5	30	7	2	4	5	Sands
Representative Site	336102	22	10	10	5	5	7	Sands
Representative Site	338101	5	5	5	3	3	3	Sands
Representative Site	341101	12	20		2	2		Sands
Representative Site	342301	14	10		2	8		Sands
Representative Site	343202	12	14	10				Sands
Representative Site	344202	36	40	32				Sands
Representative Site	345201	24	18	16				Sands
Representative Site	346201	16	20	12	2	2	5	Sands
Representative Site	347201	8	10	6	3	3	4	Sands
Representative Site	348101		36			3		Sands

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Representative Site	353202	12	14	16				Sands
Representative Site	354203	8	38	24	2	3	5	Clay
Representative Site	355202	3	26		0.5	2		Sands
Representative Site	356202	8	6	7	6	6	5	Sands
Representative Site	357102	6	8	7	1	1	1	Sands
Representative Site	357201	12	6	8				Sands
Representative Site	358201		24		6			Sands
Representative Site	360101	2	4	2	0.5	1	1	Sands
Representative Site	364101	5	24	8	2	2	4	Sands
Representative Site	364102	10	50	8	4	4	8	Sands
Representative Site	365203	48	28	36	1	3	6	Clay
Representative Site	366201	3	0		0.5	1		Silts
Representative Site	366204	36	30	24	1	2	6	Sands
Representative Site	367201	5	10		1	1		Sands
Representative Site	368102	4	12		0.5	0.5		Clay
Representative Site	372201	5	8	7				Sands
Representative Site	373102	7	24	10	1	1	3	Sands
Representative Site	375201	30	24	24	1	2	6	Sands
Island Creek								
Representative Site	105102	36			3			Sands
Representative Site	108104		40			6		Sands
Representative Site	113101	18	4	12	2	2	3	Silts
Representative Site	113102	82	82		2	4		Sands
Representative Site	116101	70			2			Sands
Representative Site	116205	24	10	6				Sands
Representative Site	118102	20	20	20	3	4	6	Sands
Representative Site	121201		24			4		Sands
Representative Site	122101	15	20	24	4	5	6	Sands
Representative Site	122103		12			3		Sands
Representative Site	122104	28	36	36	4	4	6	sands`
Representative Site	123101	24	24	12	1	3	6	Sands
Representative Site	123102	4	15	4	1	1	2	Sands
Representative Site	126201		24			2		Sands
Representative Site	127101		24			4		Sands
Representative Site	127102	15	24	12	2	2	4	Sands

Representative Sites B

Problem	Site	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Mill Creek								
Representative Site	218001	20	20	24	2	3	6	Sands
Representative Site	219003	20	20	30	2	3	6	Sands
Representative Site	222003		60	70		3	6	Sands
Representative Site	224002			70			5	Sands
Representative Site	225003	12	18	24	1	2	3	Sands
Representative Site	234002	12	24	30	1	4	8	Sands
Representative Site	235001		12			2		Sands