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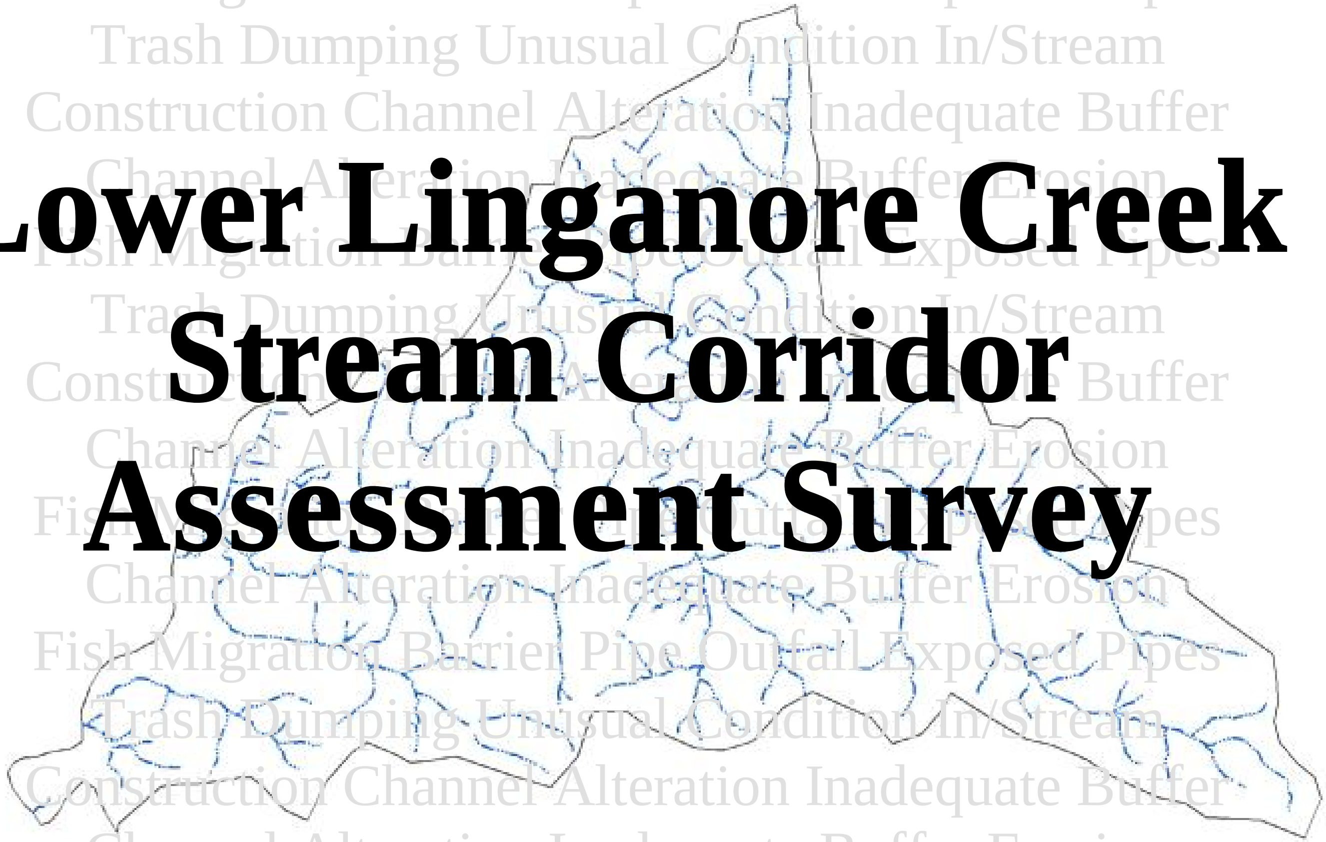

Lower Linganore Creek Stream Corridor Assessment Survey

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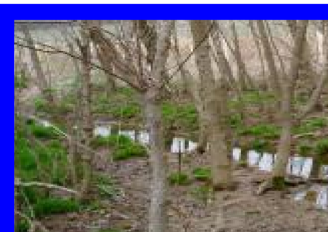
Watershed Assessment and Targeting Division
Watershed Services
Maryland Department of Natural Resources
June 2005



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A Message To Maryland Citizens

The Maryland Department of Natural Resources (DNR) seeks to preserve, protect and enhance the living resources of the state. Working in partnership with the citizens of Maryland, this worthwhile goal will become a reality. This publication provides information that will increase your understanding of how DNR strives to reach that goal through its many diverse programs.

C. Ronald Franks
Secretary

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www.dnr.maryland.gov
DNR Publication Number: 14-6212005-36

LOWER LINGANORE CREEK
STREAM CORRIDOR ASSESEMENT SURVEY
Frederick County, Maryland

PREPARED BY
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WATERSHED SERVICES UNIT
TECHNICAL AND PLANNING SERVICES
MARYLAND DEPARTMENT OF NATURAL RESOURCES
ANNAPOLIS, MARYLAND

FOR

FREDERICK COUNTY DIVISION OF PUBLIC WORKS
DEPARTMENT OF PROGRAM DEVELOPMENT AND MANAGEMENT
NATIONAL POLLUTANT DISCHARGE ELLIMINATION SYSTEM
FREDERICK, MARYLAND

2005

SUMMARY

The Linganore Creek watershed is located in the Lower Monocacy watershed, an 8-digit watershed in Frederick County, Maryland. It is divided into the Upper Linganore Creek and the Lower Linganore Creek watershed. According to Table 7-12 of the 2003 Frederick County Annual Report for NPDES Storm Sewer System Permit # MD0068357, the Lower Linganore Creek watershed encompasses approximately 23,894 acres. Frederick County Division of Public Works hired the Maryland Department of Natural Resources (DNR) to complete a Stream Corridor Assessment (SCA) survey of the stream network within the watershed. This assessment is necessary to complete the required tasks under the County's National Pollutant Discharge Elimination System (NPDES) storm sewer system permit under the Clean Water Act. The results of this survey will be used by Frederick County DPW to determine problem areas that could be fixed through community restoration, stormwater management (SWM) facility retrofits, and to reduce untreated impervious urban areas by 10 percent. The County plans to use the data to target areas where more involved stream restoration and stormwater management facility retrofit assessments are required.

Standing alone, the SCA survey is not a detailed scientific evaluation of the watershed. Instead, the SCA survey is designed to provide a rapid overview of the entire stream network to determine the location of potential environmental problems and to collect some basic habitat information about its streams. The value of the present survey is its help in placing individual stream problems into their watershed context and its potential use among resource managers and land-use planners to cooperatively and consistently prioritize future restoration work.

The Stream Corridor Assessment fieldwork consisted of walking approximately 94.61 miles, the majority of the mapped stream miles in Lower Linganore Creek. Fieldwork was completed in March 2004. The County sent out letters to landowners with stream frontage property describing the process and requesting permission to walk their land. The landowners were asked to return an enclosed postcard indicating if they granted permission for our teams to walk the streams through their property. Based on landowner response, survey teams did not have access to all streams.

Survey teams identified 114 potential environmental problems within the Lower Linganore Creek watershed. At the time of the survey, the most frequently observed environmental problem was inadequately forested buffers, reported at 63 sites or 30.61 miles along the left bank and 32.25 miles along the right bank of the streams. Other potential environmental problems recorded during the survey include: 20 erosion sites, 11 fish passage barrier sites, 7 pipe outfalls, 5 channel alterations, 3 trash dumping sites, 3 unusual conditions, 2 exposed pipes, and no in or near-stream construction sites. Additionally, the survey recorded descriptive information for 32 representative sites and 1 comment site.

In order to document each potential environmental problem, survey teams collected data, recorded the location, and took a photograph at each of these sites. As an aid to prioritizing future restoration work, field crews rated all problem sites on a scale of 1 to 5 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 necessary machinery. In addition, field teams collected descriptive information of both in- and near-stream habitat conditions at representative sites spaced at approximately ½- to 1-mile intervals along the stream.

The Maryland Department of Natural Resources (DNR) Watershed Services Unit developed the Stream Corridor Assessment Survey (SCA) as a watershed management tool. All of the problems identified as part of the SCA survey can be addressed through existing State or Local government programs. One of the main goals of the SCA survey is to compile a list of observable environmental problems in a watershed in order to target future restoration efforts. Once this list is compiled and distributed, county planners, resource managers, and others can initiate a dialog to cooperatively set the direction and goals for the watershed's management, and plan future restoration work at the most effective problem sites.

ACKNOWLEDGMENTS

Without the hard work and dedication of the National Civilian Community Corps, this survey would not have been possible. The crew chief during the survey was Stefanie Warner. The crewmembers were Sara Lander, Meuy Saechao, Nisa Karimi, Ali Nguyen, Micah Coach, Adam Malgren, Neal Schmidt, Emily “Danger” Scott-Texler, Dana Siebers, and Laura Hale.

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INTRODUCTION

The Lower Linganore Creek watershed is located within the Lower Monocacy watershed, an 8-digit watershed located in Frederick County, Maryland. Frederick County Division of Public Works hired the Maryland Department of Natural Resources to determine potential sites for stream restoration or stormwater management (SWM) facility retrofits. This assessment is required by the County's National Pollutant Discharge Elimination System (NPDES) storm sewer system permit under the Clean Water Act.

To provide specific information on the location of environmental problems and restoration opportunities within the watershed, teams performed a Stream Corridor Assessment (SCA) survey of Lower Linganore Creek in March 2004. Developed by DNR's Watershed Services Unit, the Stream Corridor Assessment survey is a watershed management tool used to identify environmental problems and help prioritize restoration opportunities on a watershed basis. As part of the survey, specially trained personnel walk the watershed's stream network and record information on a variety of environmental problems that can be easily observed within the stream corridor.

The Lower Linganore Creek watershed encompasses 23,894 acres (37.33 mi^2) of land and 107.4 miles of stream. The watershed lies approximately centered within the Lower Monocacy watershed (Figure 1). Of the land area surveyed, 27.2 percent is categorized as urban, with 1,710 acres, or 7.2 percent of the watershed, with impervious surfaces. All urban areas within the Lower Linganore Creek watershed have stormwater management (SWM). Figure 1 shows the geographic location of the watershed targeted in this survey. Figure 2 shows the Lower Linganore Creek watershed stream network. The 2002 land use of the Lower Linganore Creek watershed is shown in Figure 3.

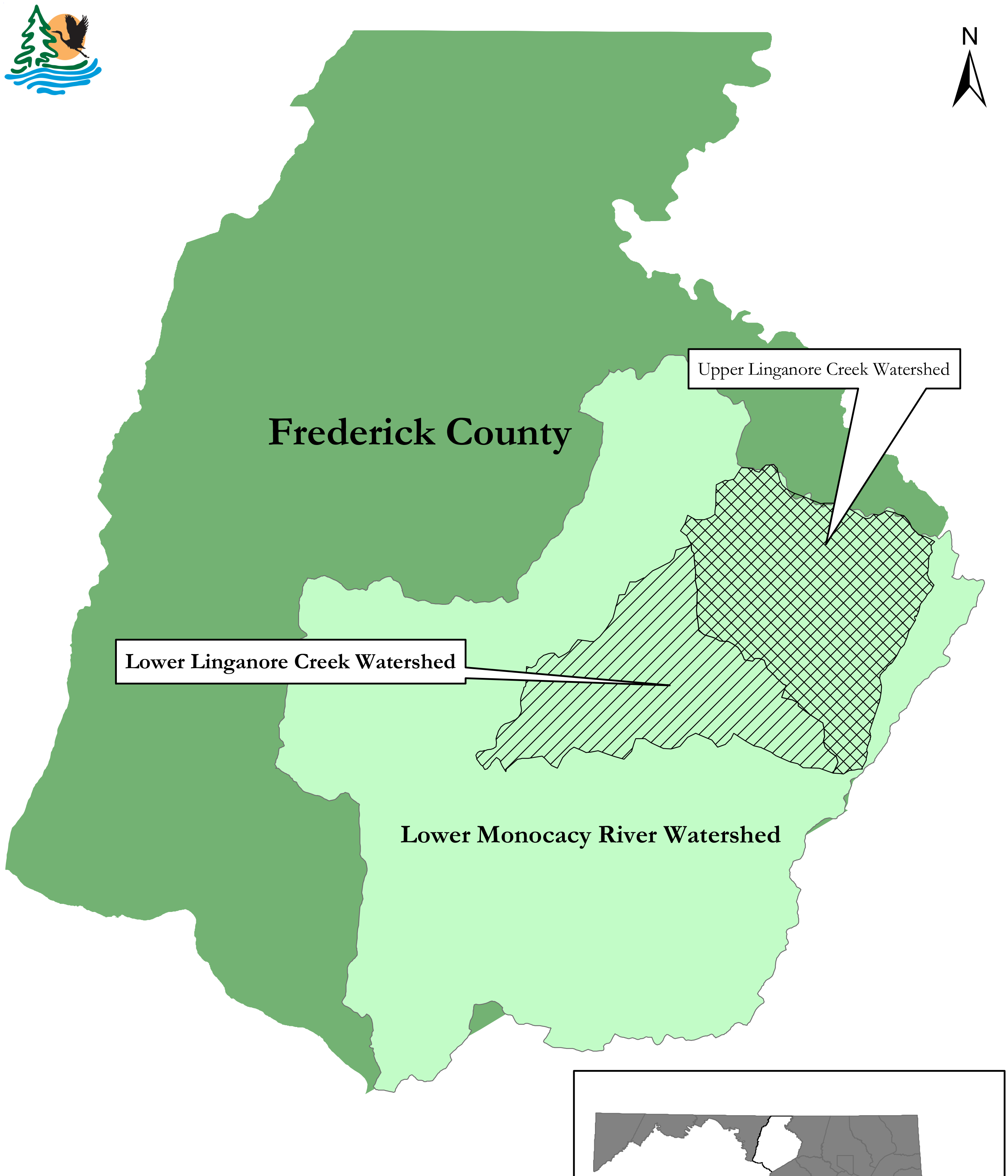
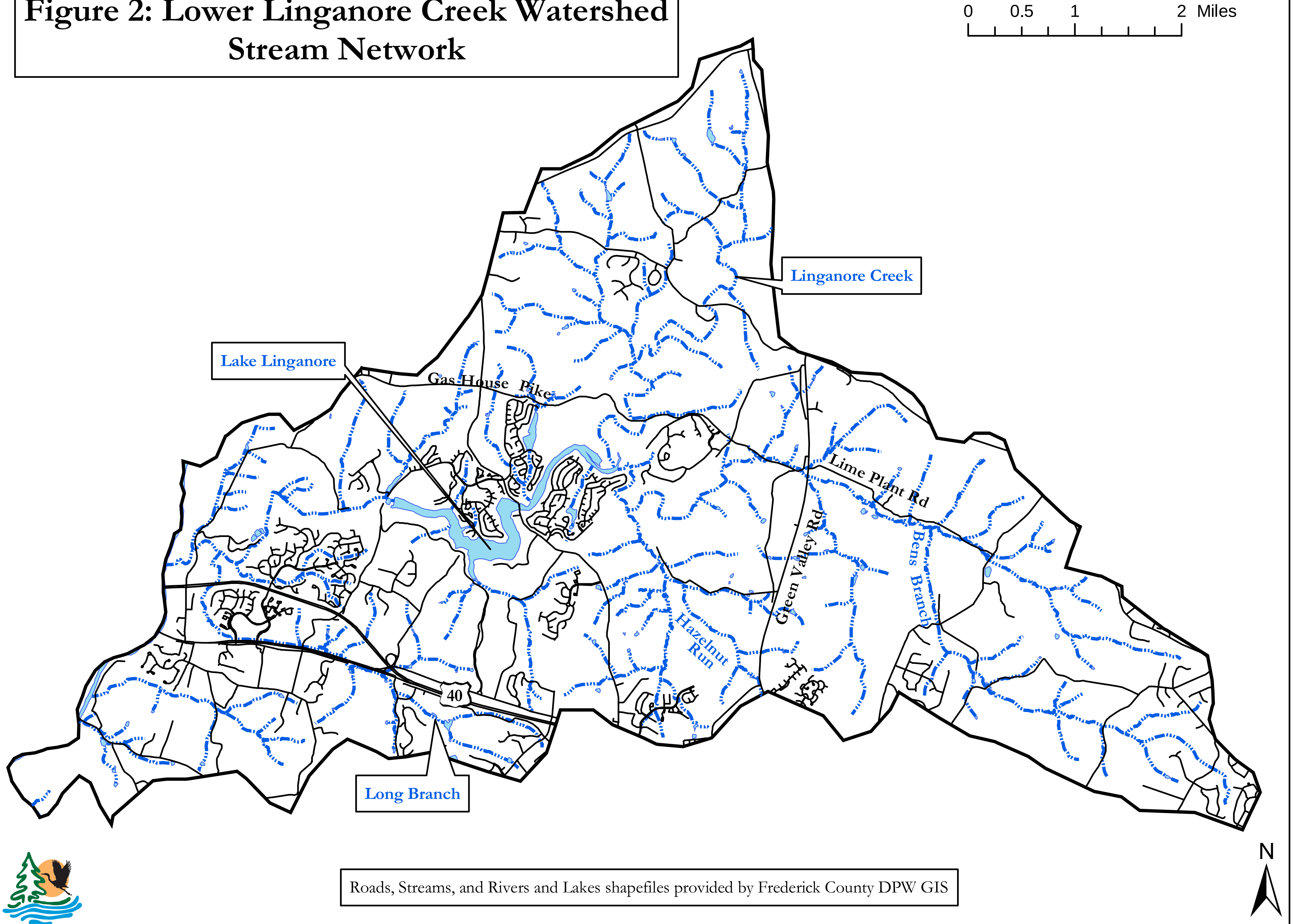


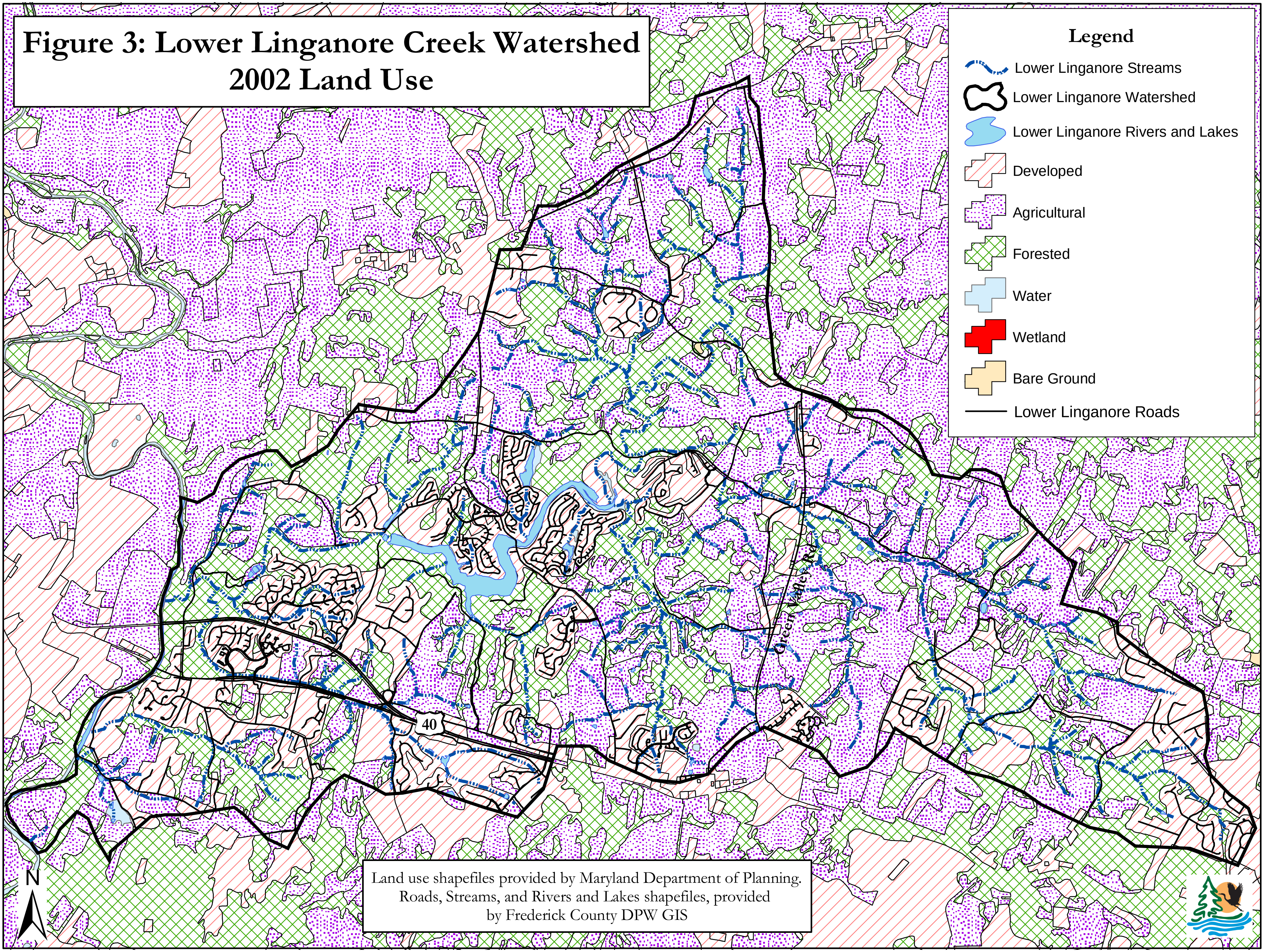
Figure 1: Lower Linganore Creek Watershed Frederick County, Maryland

Figure 2: Lower Linganore Creek Watershed Stream Network



Roads, Streams, and Rivers and Lakes shapefiles provided by Frederick County DPW GIS

Figure 3: Lower Linganore Creek Watershed 2002 Land Use



METHODS

Goals of the SCA Survey

To help identify some of the common problems that affect streams in a rapid and cost effective manner, 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 in order to make a preliminary determination of both the severity and correctability of each problem.

3. Sufficient data to prioritize restoration efforts.

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

The SCA survey provides a rapid method of examining and cataloguing the observable environmental problems within an entire drainage network to better target future monitoring, management and/or conservation efforts. This survey is not a detailed scientific survey, nor will it replace chemical and biological surveys in determining overall stream conditions and health. One advantage of the SCA survey over chemical and biological surveys is that the SCA survey can be done on a watershed basis both quickly and at relatively low cost.

Maryland's SCA survey is both a refinement and systematization of an old approach – the stream walk survey. Many of the common environmental problems affecting streams can be straightforward to identify by an individual walking along a stream. These include: excessive stream bank erosion, blockages to fish passage, stream segments without trees along their banks, or a sewage pipeline 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 Stream "Stream 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 in under 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 indicates that a potential environmental problem exists at a specific location, but it 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 use by trained professionals analyzing a very specific stream reach type, 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 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 National Civilian Community Corps (NCCC) has proven to be an ideal group to do this work in Maryland. The National Civilian Community Corps is part of the AmeriCorps Program, initiated to promote greater involvement of young volunteers in their communities and the environment. Volunteers with the NCCC are 17-25 years old and can have educational backgrounds ranging from high school to graduate degrees. With the proper training and supervision, NCCC 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 National Civilian Community Corps visit their website at http://www.americorps.org/nccc/index.html.

Prior to the start of the Lower Linganore SCA Survey, the members of the NCCC's Perry Point Crew 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 both favorable conditions for macroinvertebrates and fish and healthy riparian habitat. These reference sites for habitat condition 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 4-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 NCCC Crew received guidelines for taking photographs at all problem and reference sites.

Several weeks prior to the beginning of the survey, property owners along the stream reach received letters informing them of what the survey is and when it is scheduled to be conducted. Included with the letter is a postcard for the landowner to return giving permission for our crews to enter their property. This letter also provided a phone number to call if individuals had any questions regarding the stream walk. In addition, survey crews were not to cross fence lines or enter any areas that were marked "No Trespassing" unless they had specific permission from the property owner, based on conditions set forth by the State Annotated Code.

The NCCC crew conducted field surveys of the Lower Linganore Creek Watershed from March to April 2004. The survey teams walked a part of the watershed'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 passage 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 Rating System

The 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 rating system developed from an earlier survey that found 453 potential environmental problems along 96 miles of stream of 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, the severity of the erosion problem varied substantially among the sites and that the erosion problems at many sites were minor in severity. Based on this experience and its goal of helping to prioritize restoration work, the SCA survey rates the severity, correctability, and access of each problem site.

While the ratings are subjective, they have proven to be very valuable in providing a starting point for more detailed follow-up evaluations. Once the SCA survey is completed, the collected data can 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 plan future riparian buffer plantings, while the local fishery biologist can use the data on fish blockages to help target future fish passage projects. 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 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 watershed 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 <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 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 <u>moderate severity rating</u> 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 <u>minor severity rating</u> 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 a pipe outfall 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. These types of projects would usually not need any Federal, State or local government permits. It is a job that a small group of volunteers (10 people or less) could fix 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 would not be the type of project that volunteers would usually do alone, 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 indicates problems that would require a large expensive effort to correct. These projects would 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 has deeply incised several feet over a long distance (i.e., several thousand feet) or a fish blockage at a large dam.

The accessibility rating 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 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 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 where there are no roads or trails nearby.

Data Analysis and Presentation

Following the 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 labeled and organized the 182 photographs taken during the survey by site number and placed them in folders in both print and digital form. Members of the Department of Natural Resources' Watershed Services Unit incorporated the map location, recorded data, and digitized photographs into the ArcView GIS computer software. The GIS project is an electronic geodatabase 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 digital geographic datasets available for features within the watershed. A final copy of the ArcView files are given to the Frederick County Division of Public Works for their use in determining potential sites for stream restoration or stormwater management (SWM) facility retrofits.

RESULTS

The Stream Corridor Assessment identified a total of 114 problem sites, 32 representative sites and 1 comment site in the Lower Linganore Creek watershed. Problem sites include: 63 inadequate buffers, 20 erosion sites, 11 fish passage barriers, 7 pipe outfalls, 5 channel alterations, 3 trash dumping sites, and 3 unusual conditions. Table 1 presents a summary of survey results and 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 X and Y coordinates. When working with maps, information in this format is useful to determine what problems are present along a specific stream reach. In Appendix B, the data is presented by problem type and lists more detailed descriptive data about each problem. Presenting the data by problem type allows the reader to see which problems the field crews rated as most severe or easiest to fix within each category and provides other details about the problem or surrounding area.

Table 1: Summary of results from Lower Linganore Creek SCA Survey

Potential Identified Problem	Number of Problems	Estimated Length	Very Severe	Severe	Moderate	Low Severity	Minor	Unknown
Channel Alteration	5	N/A	0	0	2	1	2	0
Erosion Site	20	67,316 feet (12.75 miles)	0	4	7	7	2	0
Exposed Pipe	2	N/A	0	0	1	1	0	0
Fish Barrier	11	N/A	0	5	3	2	1	0
Inadequate Buffer	63	Left bank 161,635 feet (30.61 miles) Right bank: 170,258 feet (32.25 miles)	0	9	17	28	9	0
Pipe Outfall	7	N/A	0	1	2	3	1	0
Trash Dumping	3	N/A	0	0	1	2	0	0
Unusual Condition	3	N/A	0	0	2	1	0	0
Total	**114**		**0**	**19**	**35**	**45**	**15**	**0**
Representative Sites	32							
Comments	1							

Inadequate Buffers

Forests are the historically occurring ecosystem around Maryland streams and are very important for maintaining stream health. 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 slows 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, terrestrial plant material falling into the stream can be the primary source of plant food for stream life. Tree leaves can 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 and benthic habitat. Maintaining healthy streams is important in reducing the nutrient and sediment loadings to the

Chesapeake Bay. Because of the importance of forest stream buffers, the state of Maryland has set a goal of recreating 1,200 miles of forest stream buffers by the year 2010.

While there is no single minimum standard for how wide a stream buffer should be in Maryland, for the purposes of this study a buffer is considered inadequate if it is less than 50 feet wide, measured from the edge of the stream. The severity of inadequate 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.

The survey crew identified 63 inadequate buffers sites (Figures 4b-4e) and provided an estimate of the length of the inadequate stream buffer at all sites (Appendix B). Based on the collected data, there are approximately 161,635 feet (30.61 miles) of inadequate buffers on the left bank and 170,258 feet (32.25 miles) on the right bank of the streams (Table 2). Field teams found inadequate buffers ranging in length from 383 feet to 14,415 feet (2.73 miles). Severity ratings varied from severe to minor with the greatest number of sites given a low severity rating (Figure 4a). Inadequate buffer sites are distributed throughout the watershed, with approximately 32.35 percent of the left bank and 34.09 percent of the right bank inadequately buffered.

Of those sites ranked as severe, five of the nine sites have zero feet of buffer on both the left and right stream banks. The land uses noted for the severe sites on the left bank are: 4 pasture, 2 lawn, 1 forest, and 1 golf course. On the right bank, the land uses are as follows: 5 pasture, 2 lawn, and 1 golf course. None of the severe sites were noted as having a recently established buffer. However, three other sites were noted as having recently established buffers: 0916202, 0916203, and 1512402.

As survey crews evaluate buffer sites, they are asked to consider wetland potential and livestock access to the stream. In the case of wetland potential, the rating is based on slope, bank height, and current conditions. A rating of one is given to a site that has low slope, low bank height, and might already have saturated soils. The crews gave only 11 of the 63 sites a rating of one indicating good wetland potential (0603202, 0609201, 0705201, 0808201, 0916202, 0916203, 1116201, 1307201, 1515201, 1911201). It is recommended that these sites be further investigated for the potential of wetland restoration projects. In the case of livestock access to the streams, the survey crews observed 14 occasions (10 sites with cattle and 4 sites with horses) where it was apparent that livestock had access to the stream. The sites where cattle have access are 0705201, 0708201, 0814101, 0814102, 1019402, 1213101, 1217402, 1511401, 1515201, and 1913201 and the sites where horses have access are 0605201, 1207302, 1510402, and 1516101.

Wetlands and livestock access are two important areas to consider for restoration as they both greatly affect the amount of nutrients reaching the stream. Wetlands help to slow the flow of water and act as a sponge, absorbing excess nutrients from the water, while livestock access can have negative effects on the stream. Cattle and horses can cause additional erosion by compromising the stability of the banks at crossing points and thus increasing sediment levels. Nutrient and bacteria levels can also rise due to the increased possibility of animal feces entering the water. It is recommended that sites that could benefit from livestock fencing and sites that may be suitable to restore wetlands be further investigated.

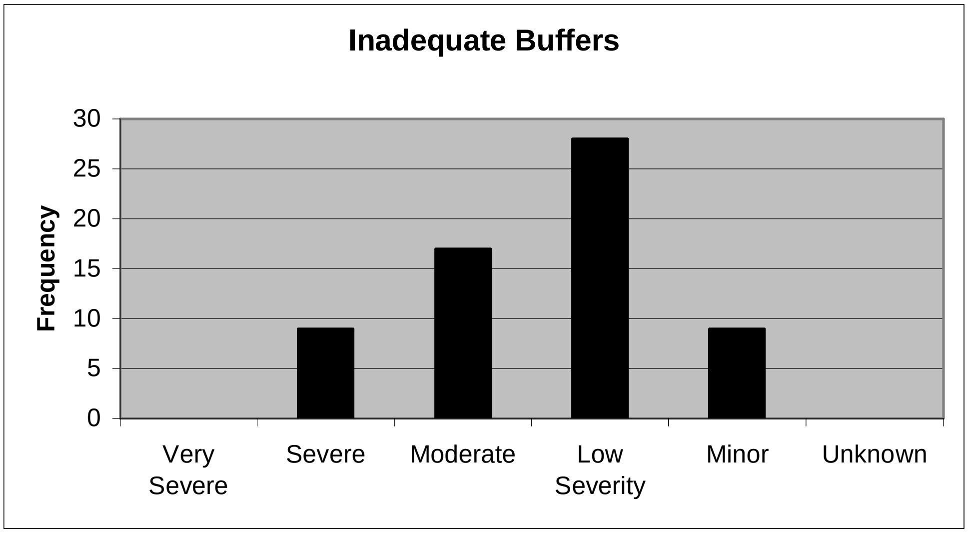


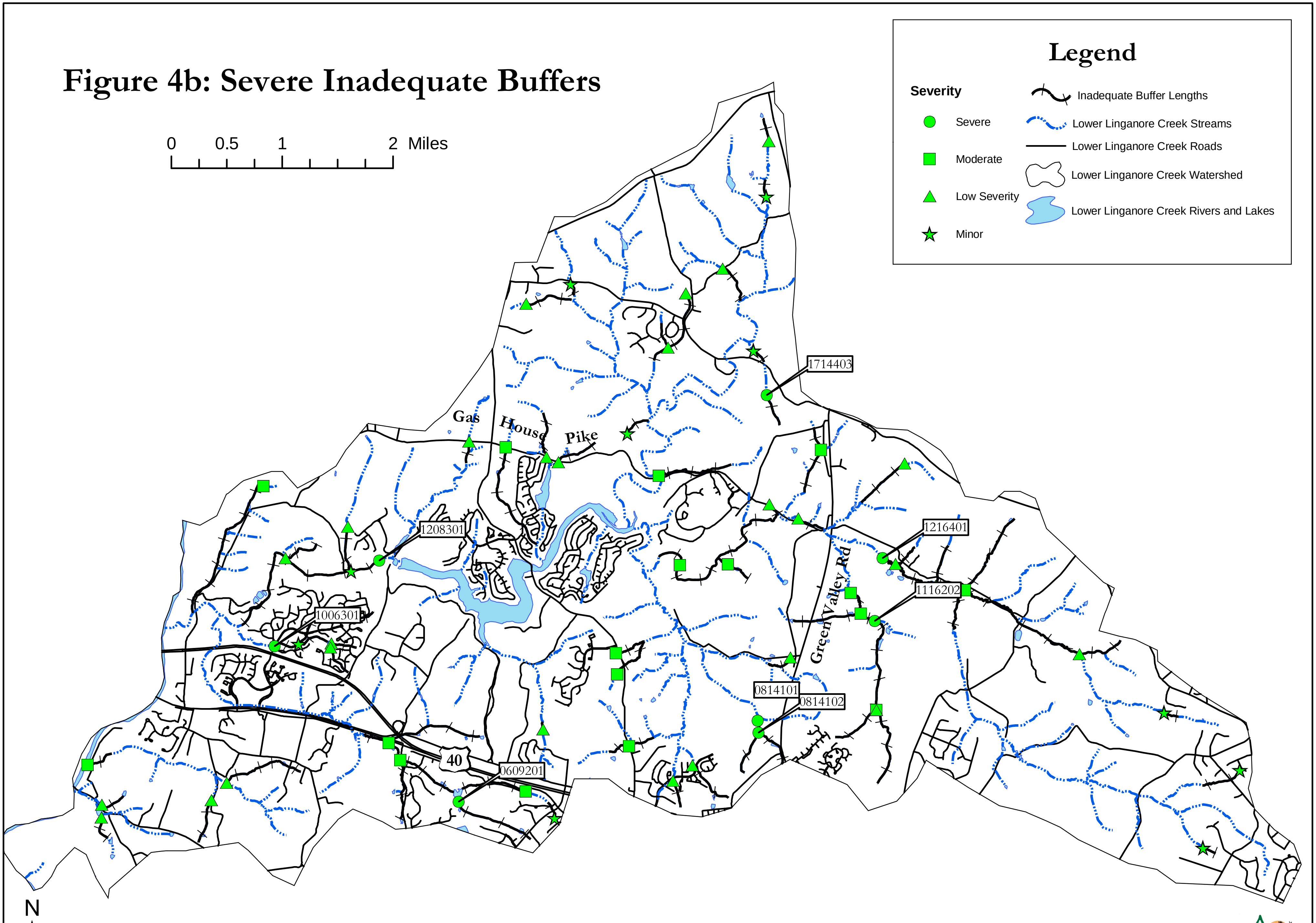
Figure 4a: Histograph showing the frequency of severity ratings given to inadequate buffer sites during the Lower Linganore Creek SCA survey

Table 2: Summary of Inadequate Buffer Lengths and Widths by Severity Rating

Severity	Number of Sites	Affected Length (Left)	Affected Length (Right)	Mean Length (Left)	Mean Length (Right)	Mean Width (Left)	Mean Width (Right)	Minimum Width	Maximum Width
		Miles		Feet					
Very Severe	0	0	0	0	0	0	0	0	0
Severe	9	7.08	9.68	4154.11	5677.44	1.11	2	0	8
Moderate	17	12.2	11.47	3789.71	3562.71	4.76	2.41	0	40
Low Severity	28	9.68	9.38	1825.21	1769.29	5.86	3.86	0	30
Minor	9	1.65	1.72	968.56	1007.22	8.89	14.56	0	30

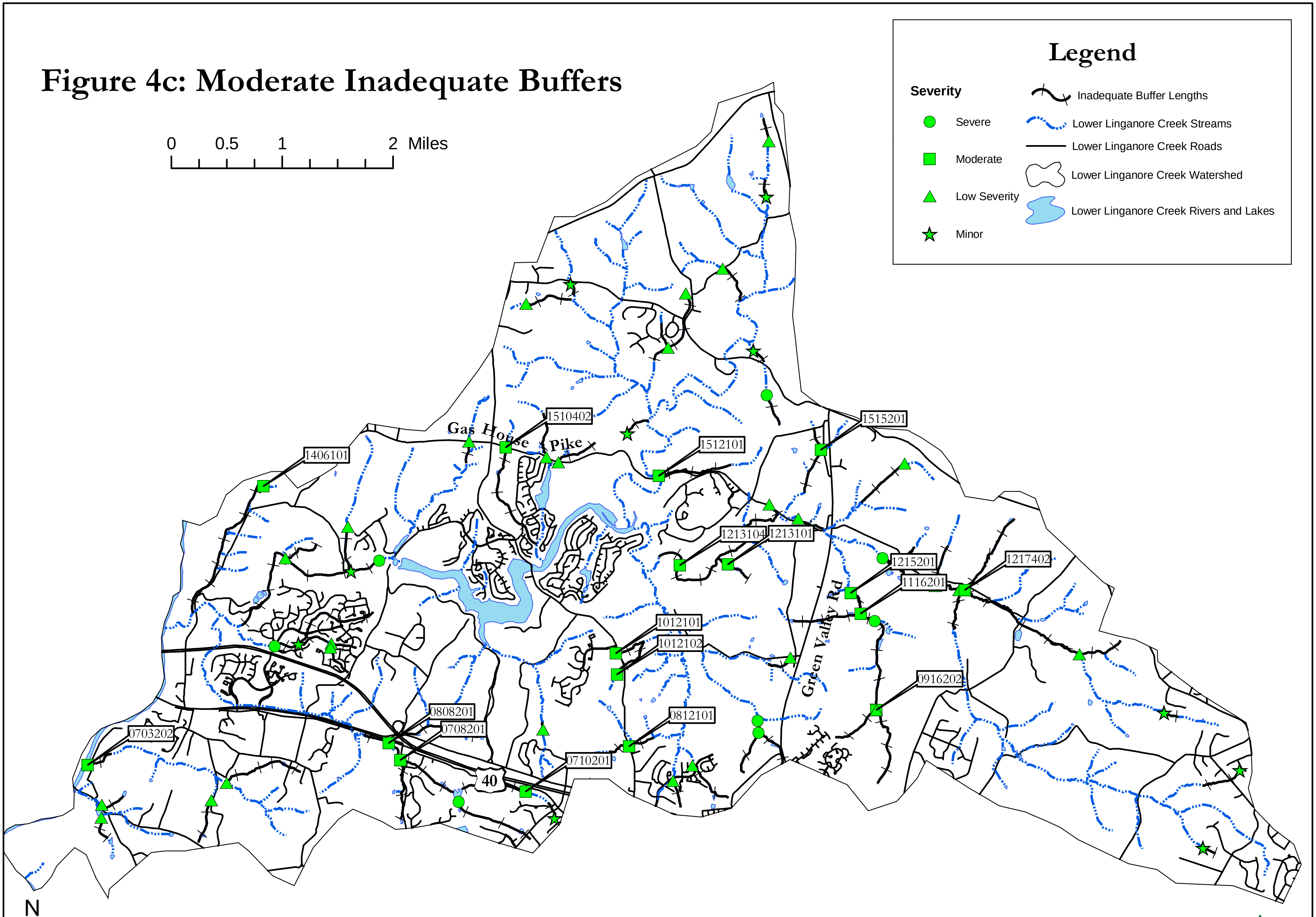
Total	**63**	**30.61**	**32.25**

Figure 4b: Severe Inadequate Buffers



Streams, Roads, and Rivers and Lakes shapeflles provided by Frederick County DPW GIS

Figure 4c: Moderate Inadequate Buffers



Streams, Roads, and Rivers and Lakes shapeflles provided by Frederick County DPW GIS

Figure 4d: Low Severity Inadequate Buffers

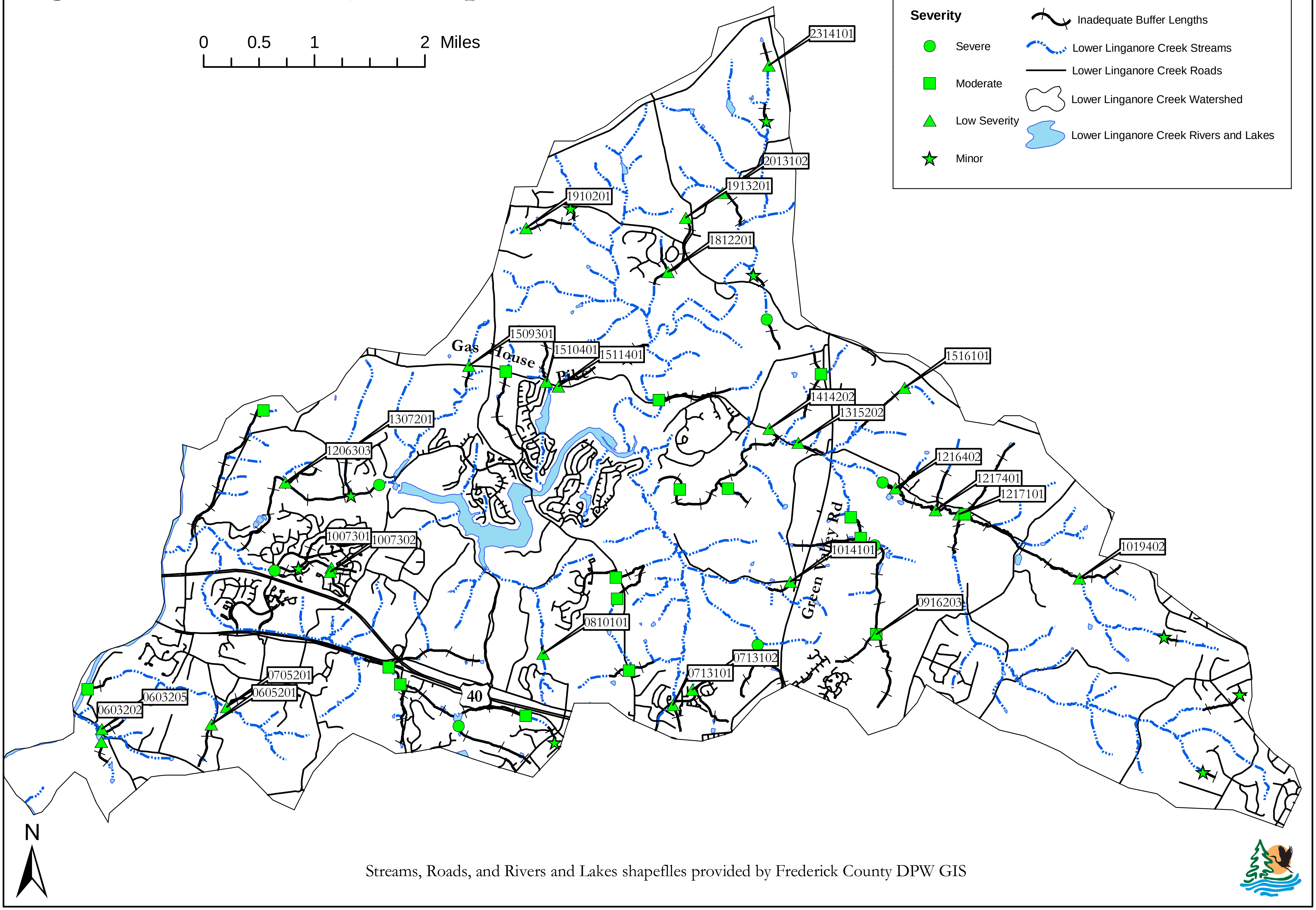


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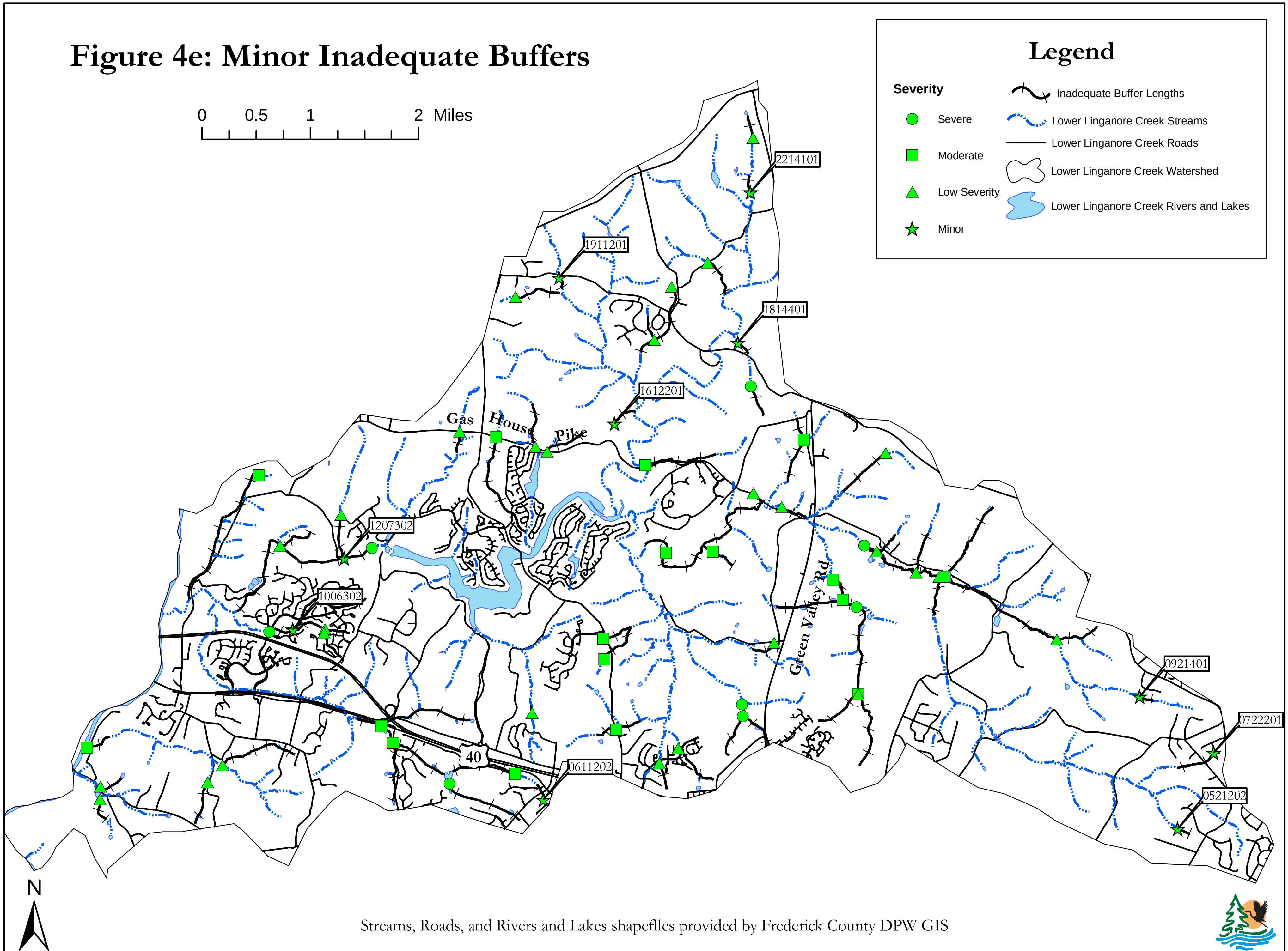
Figure 4e: Minor Inadequate Buffers



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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 the 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 20 eroding stream banks with a total length of 67,316 feet (12.75 miles). Erosion sites noted by the survey crews are congregated primarily in the eastern part of the Lower Linganore Creek watershed. Based on the land use, soil type and gradient within the watershed, levels of erosion vary. According to the Frederick County Annual Report, the Lower Linganore Creek watershed has a total urban impervious area equaling 1,174 acres (7.2% of the watershed). Though it is likely that these impervious surfaces are contributing to erosion levels, the contribution is probably small. Figure 3 shows that the much of the watershed is agricultural in land use. These areas tend to have minimal forest buffering; an increase in forest buffers could help reduce the rate at which water runoff enters the stream channel.

The severity and location of erosion sites in the Lower Linganore Creek watershed are shown in Figure 5b. Severity ratings ranged from minor to severe. The frequency of the severity ratings is shown in Figure 5a.

In addition, survey crews are asked to evaluate whether there is a threat to infrastructure due to the erosion. Crews cited only one instance where this was the case, and the threatened infrastructure is listed as a baseball diamond.

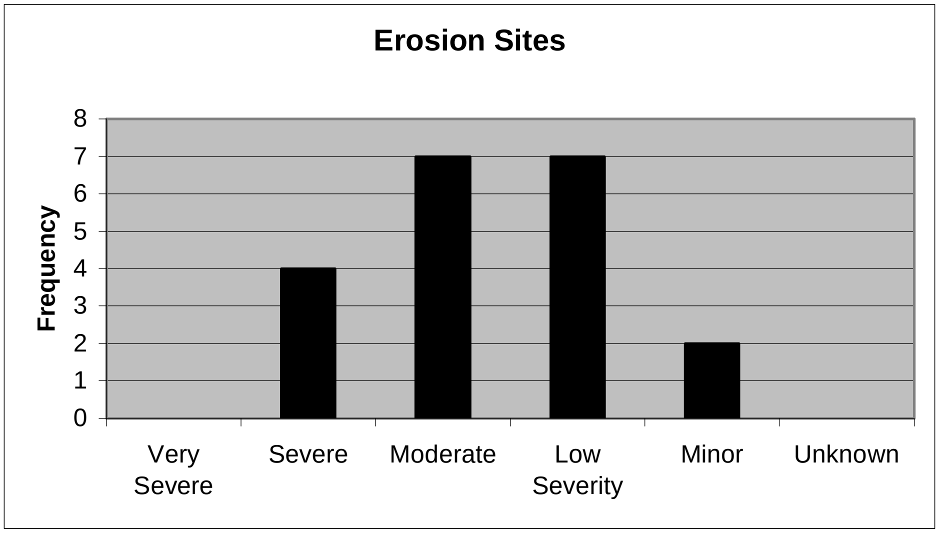
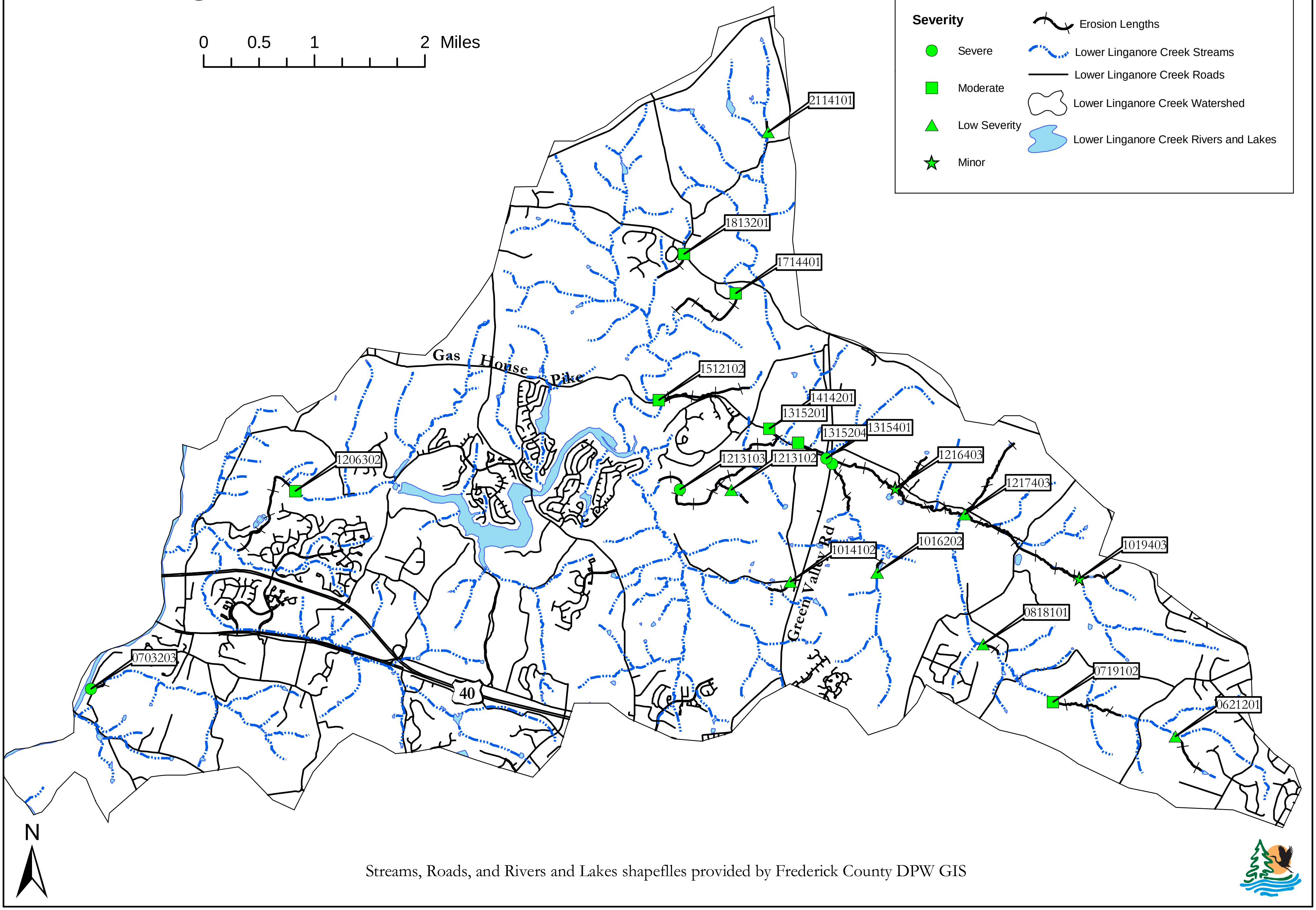


Figure 5a: Histograph showing the frequency of severity ratings given to erosion sites during the Lower Linganore Creek SCA survey.

Figure 5b: Erosion Sites



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Fish Passage Barriers

Fish passage barriers include anything in the stream that significantly interferes with the free, upstream movement of fish. Unobstructed upstream movement is important for resident fish species, many of which travel both up and down stream during different parts of their life cycles. 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. Ironically, barriers can also isolate species in a beneficial manner to prevent predation.

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 if the stream water over or under it is too high, shallow, or fast for fish to swim through. First, a vertical water drop such as a dam can be too high for fish to jump. A vertical drop as little as 6 inches may cause a fish passage problem for some resident fish species. 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 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 speed.

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 resident fish to migrate for spawning and providing a source of fish species for tributaries in the event of a disturbance. Restoration planning includes targeting barriers for removal that isolate entire tributaries, those that isolate significant portions of the upper tributary, and those that isolate quality fish habitat. The best restoration sites also are far from other existing fish barriers. However, in some cases, the optimal situation is to allow a barrier to remain because it is protecting upstream native species from downstream predators.

The Lower Linganore Creek SCA survey found 11 fish passage barriers. The locations of fish blockages are shown in Figure 6b. The fish barriers found in the Lower Linganore Creek watershed are due to road crossings (5), channelized stream beds (2), a debris dam (1), a dam (1), an exposed pipe (1), and a dam/channelized stream bed (1). Figure 6a shows that severity ratings varied from severe to minor with 5 sites listed as severe. These sites were 0719103, 1011101, 1016203, 1310403, and 1410402. Four of the eleven sites were observed to be too shallow with the remainder of the sites marked as too high. Total structures blocking full movement of fish were observed at seven sites while partial barriers allowing some flow were found in three cases. One site was noted as being a temporary barrier.

In all cases, areas should be assessed for viable fish habitat before restoration work begins, giving preference to sites with the most potential habitat area created.

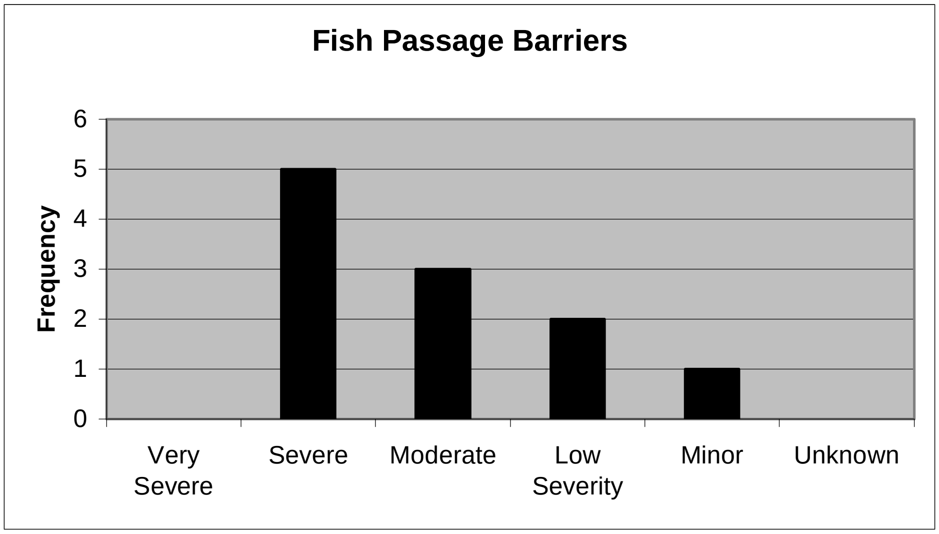
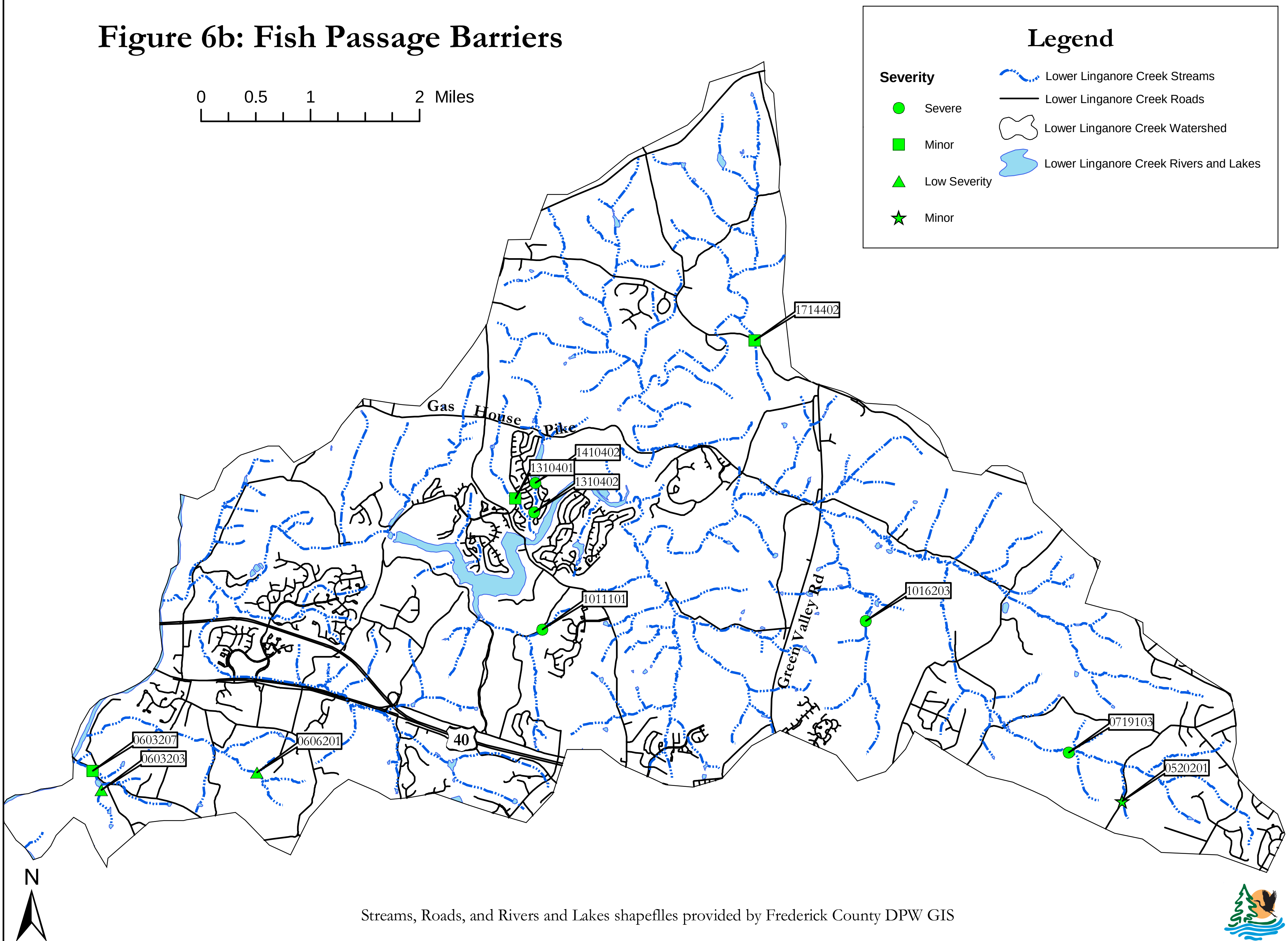


Figure 6a: Histograph showing the frequency of severity ratings given to fish passage barrier sites during the Lower Linganore Creek SCA survey

Figure 6b: Fish Passage Barriers



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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 7 pipe outfalls (Figure 7a). The locations of pipe outfalls are shown in Figure 7b.

Five of the seven pipe outfalls observed during the survey were recorded as having a discharge. Of these, three had a clear discharge and no odor associated with it at the time of the survey (Appendix B). Site 0521201 was recorded as having a green discharge and no odor, and site 0703201 was recorded as having an oily medium brown discharge. Five of the pipe outfalls were recorded as being stormwater pipes. Those that were not marked as stormwater were either for an unknown use (1107301) or agricultural use (0521201). In these cases, it is recommended that further investigation be performed to determine the type of outfall. It is also recommended that the pipes with a colored discharge be reported to the Environmental Compliance Section for further investigation of the source of discharge.

No immediate follow up actions were taken by the survey crew as part of this study to determine the source of the color or smell coming from the pipe. In some cases, coloration or smell from a storm drainpipe may be a sporadic occurrence. No estimates of the amount of fluid released from the pipes were made.

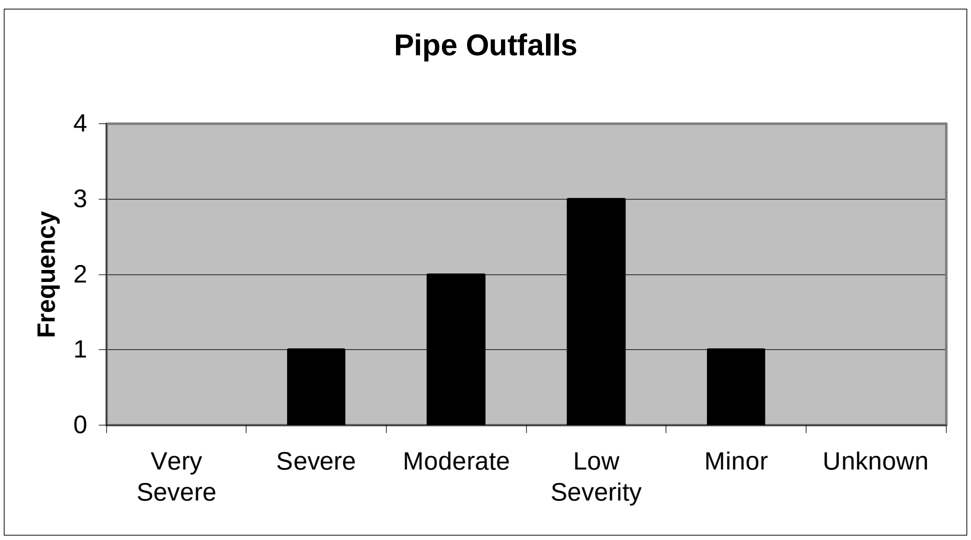
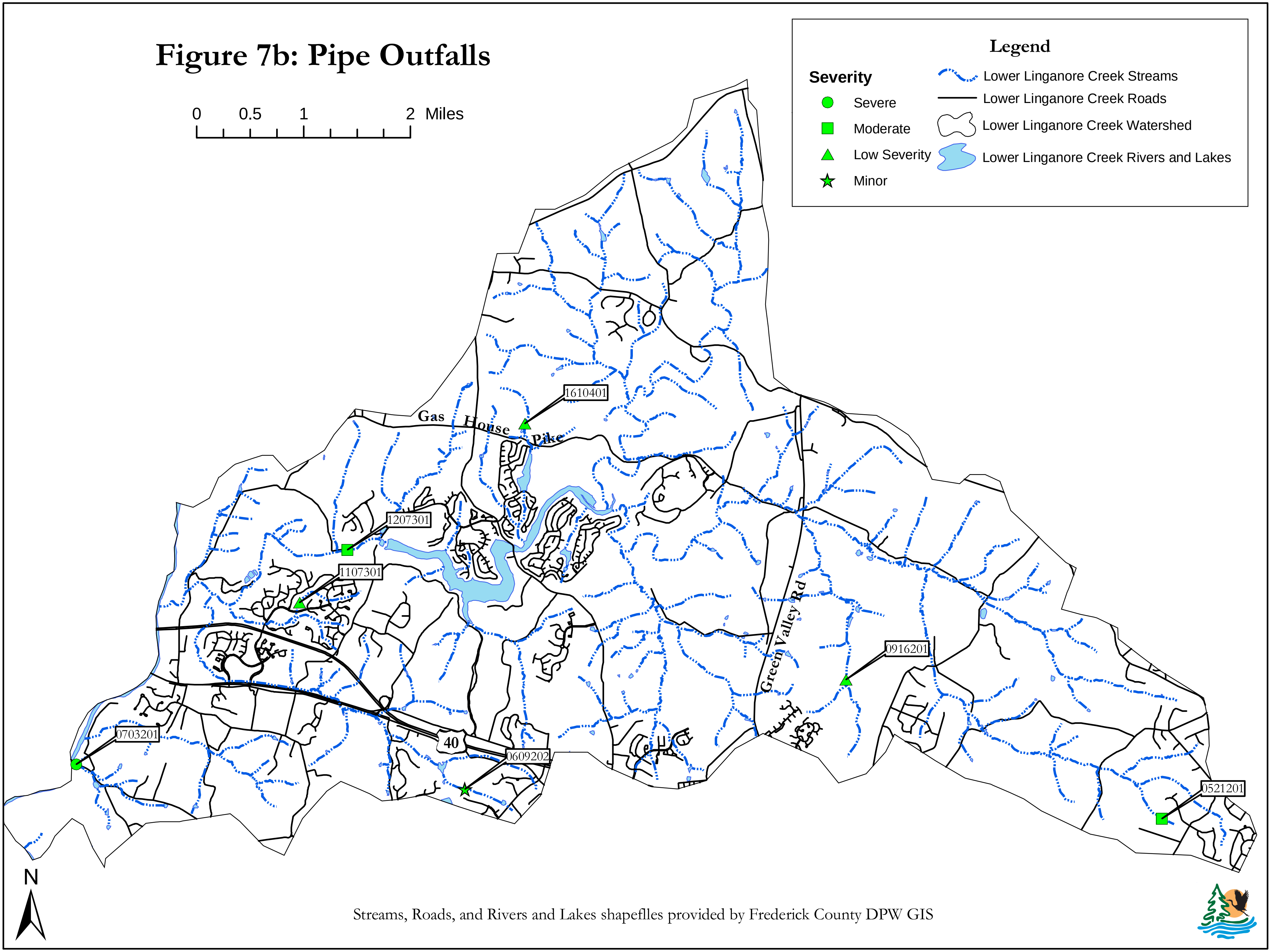


Figure 7a: Histograph showing the frequency of severity ratings given to pipe outfall sites during the Lower Linganore Creek SCA survey

Figure 7b: Pipe Outfalls



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Channel Alterations

Channel alterations 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 and 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. However, if human alterations to the channel were performed in an effort to protect the channel, this may indicate a stormwater problem upstream/upland from the site. It is recommended that Frederick County DPW investigate such situations. 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 streams sections have been significantly altered, it is not possible to tell by walking the stream corridor precisely where this was done.

In the Lower Linganore Creek watershed, survey crews found 5 areas where the stream channel had been recognizably altered. Locations of channel alteration sites are shown in Figure 8b. Channel alterations were clustered primarily in the southwestern portion of the watershed. The channel alterations were approximately 181 feet in total length. Three sites were made of rip rap, 1 concrete, 1 a railroad crossing, and 1 an earth channel. Severity ratings varied from minor to moderate (Figure 8a).

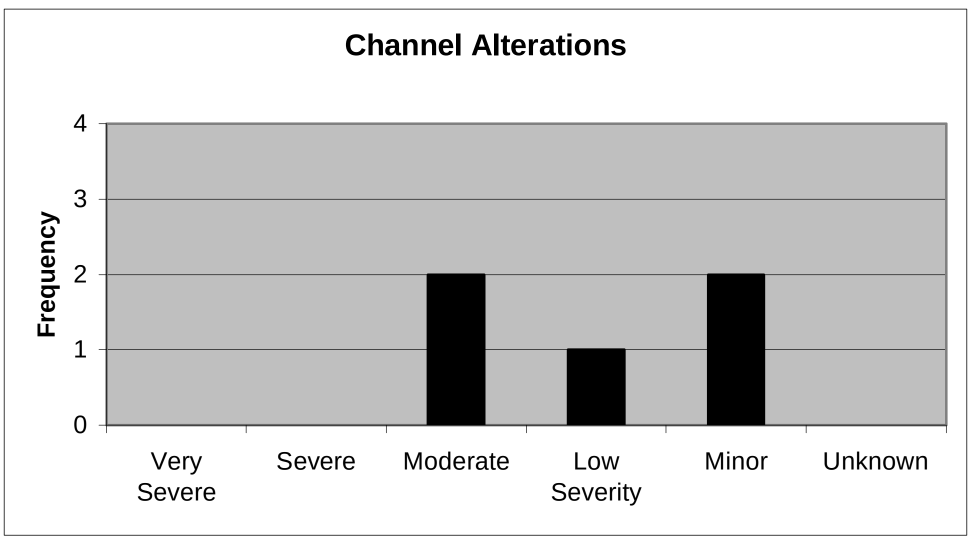


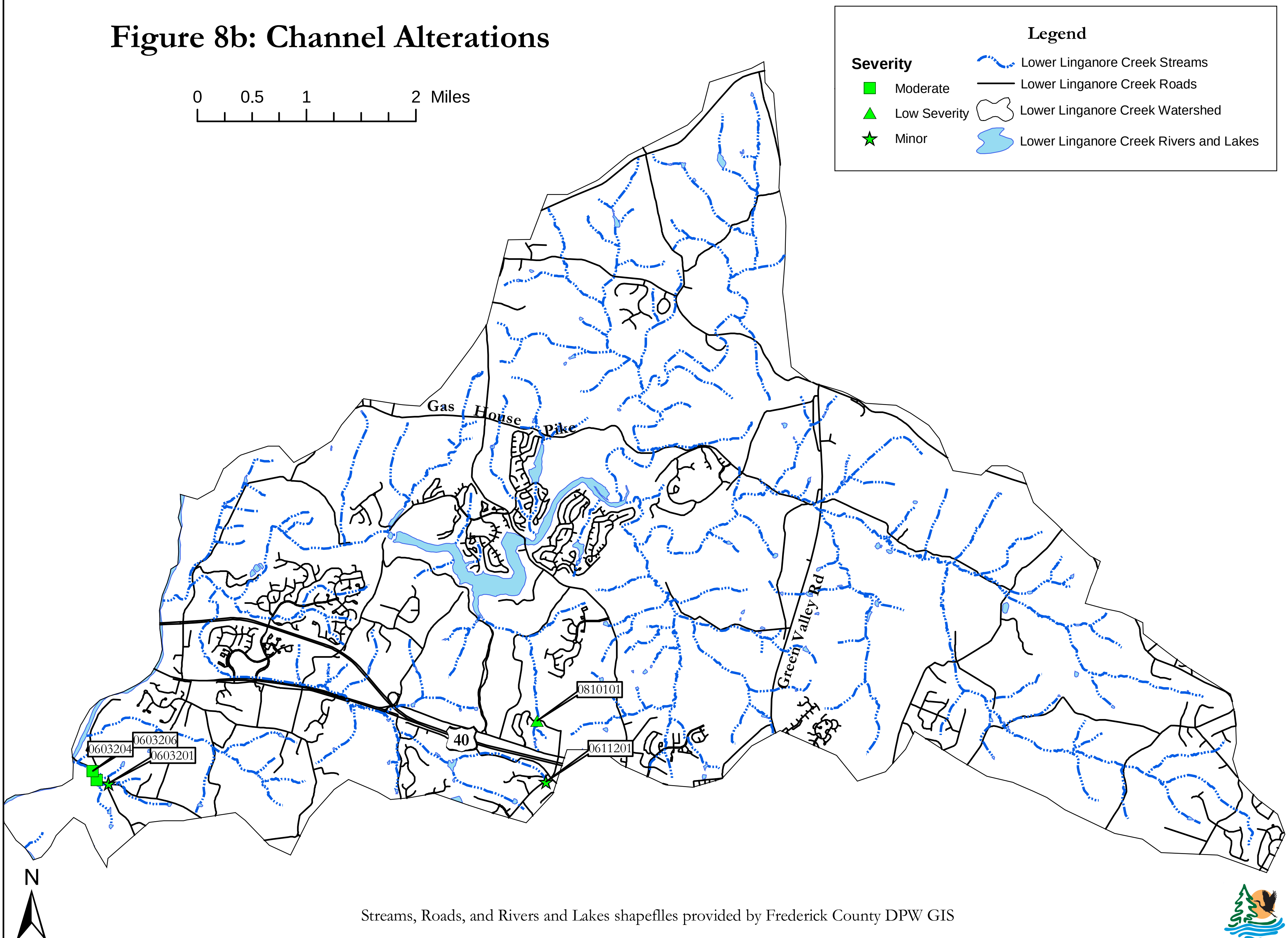
Figure 8a: Histograph showing the frequency of severity ratings given to channel alteration sites during the Lower Linganore Creek SCA survey

The severity of channel alterations is based on both the channel type and the length of the site. The presence of hardened stream banks using concrete or rock for a total length of over a thousand feet increases the severity of a site. This is due to the greater habitat potential of earth channels, which can easily develop and support vegetation, stream sinuosity, and refuge areas for wildlife within the channel bed than areas with a hardened stream channel.

In addition to channel type and site length, the potential fish and wildlife habitat available within the channel was a factor in evaluating severity. Sites that showed signs of forming bends, having natural banks, or supporting forest or wetland vegetation over a considerable length of the total site ranked as less severe than those sites without these characteristics. Four of the 5 sites were reported to have perennial flow, 4 were reported to have sedimentation along the bottom of the streambed, and 2 had vegetation growing in the channel (Appendix B).

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

Figure 8b: Channel Alterations



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Trash Dumping

Trash dumping sites are places where large amounts of trash are 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 ratings are based on size, contents of trash, and potential impact on the stream.

Survey crews found a total of 3 trash dumping sites dispersed throughout the Lower Linganore Creek watershed (Figure 9b). This is a low number of sites compared to other watersheds previously surveyed throughout Maryland. In terms of severity, the six sites are ranked as moderate (1) and low severity (2), as shown in Figure 9a. The sites contained residential waste (1), agricultural (1), and industrial waste (1). All sites were found on private land and only one was considered suitable for a volunteer clean up project.

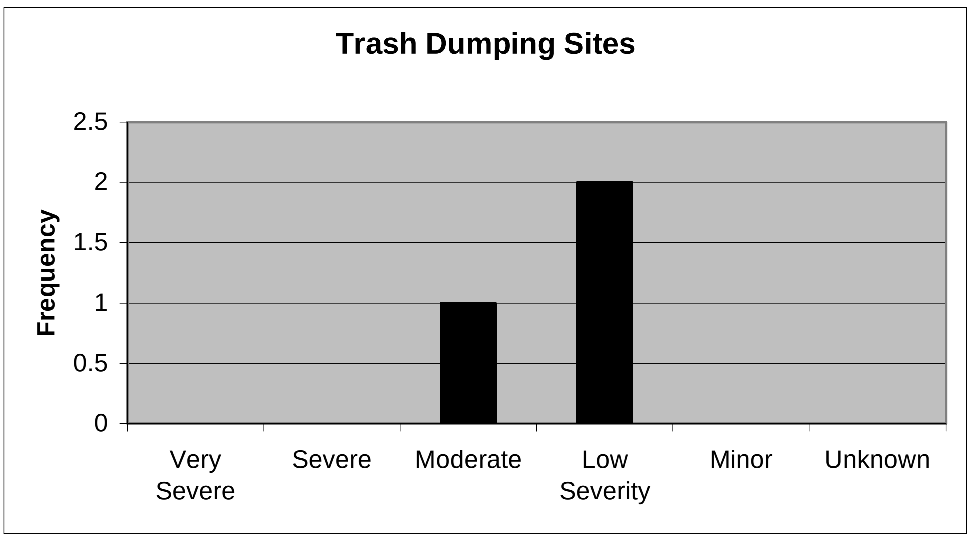
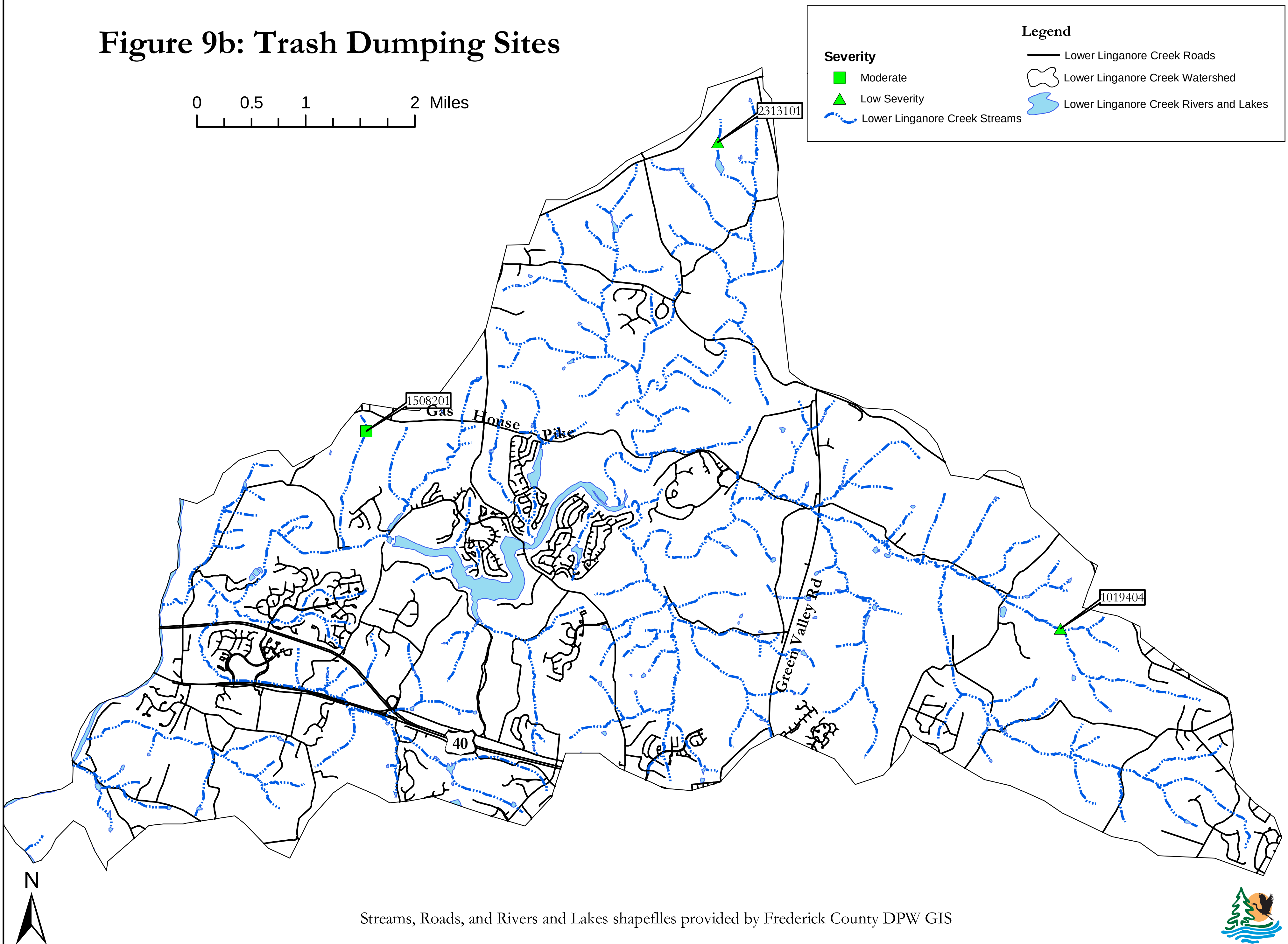


Figure 9a: Histograph showing frequency of severity ratings given to trash dumping sites in the Lower Linganore Creek SCA survey.

Figure 9b: Trash Dumping Sites



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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 crews identified 3 unusual conditions and 1 comment site throughout the Lower Linganore Creek watershed. The conditions and comments noted vary from red flock to excessive algae to pipe outfalls along a golf course. It is recommended that unusual conditions be further investigated to determine cause and potential correctability (Figure 10b).

Only sites marked as unusual conditions are given a severity rating. The frequency and ratings of these can be seen in Figure 10a.

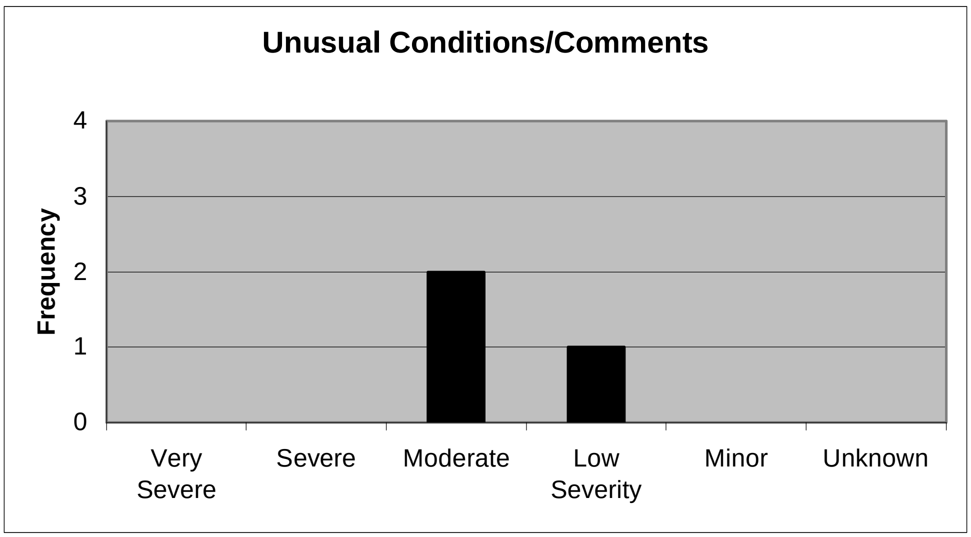
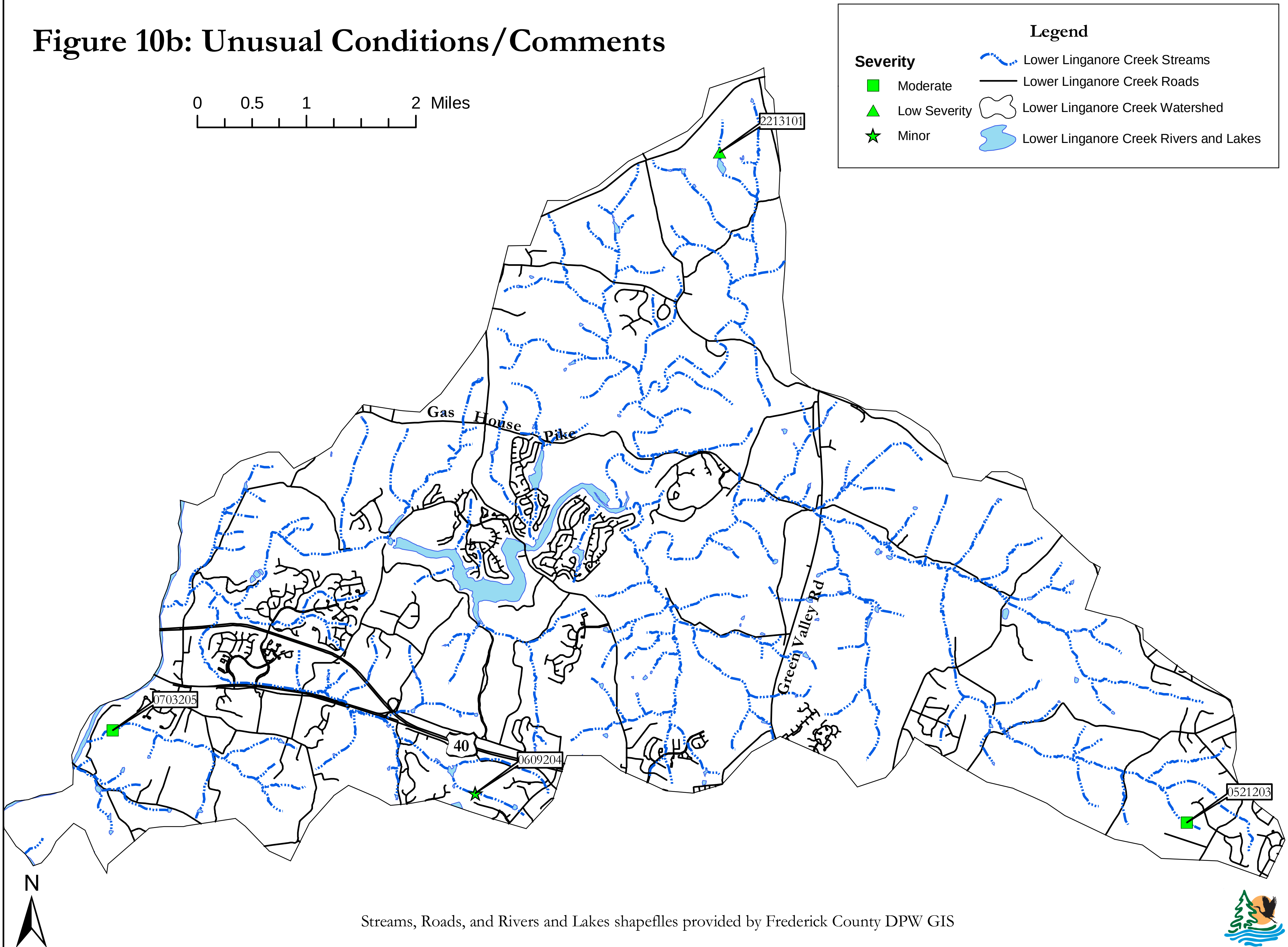


Figure 10a: Histograph of the frequency of severity ratings given to unusual condition sites in the Lower Linganore Creek SCA survey.

Figure 10b: Unusual Conditions/Comments



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Exposed Pipes

Any pipes that are 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, where only the open end of the pipe is 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 two exposed pipes during the survey with a moderate or low severity rating (Figure 11a). Figure 11b shows the locations of the exposed pipes cited within the Lower Linganore Creek watershed. One of the pipes was exposed above the stream and the second pipe was exposed within the stream. Site 0719101 was recorded as having a clear odorless discharge at the time of the survey. Its diameter was estimated to be four inches, while the other pipe had a diameter of 14 inches. One of the pipes was made of corrugated metal and the other pipe was made of plastic. In one case, survey crews were unable to determine the purpose of the pipe (Appendix B).

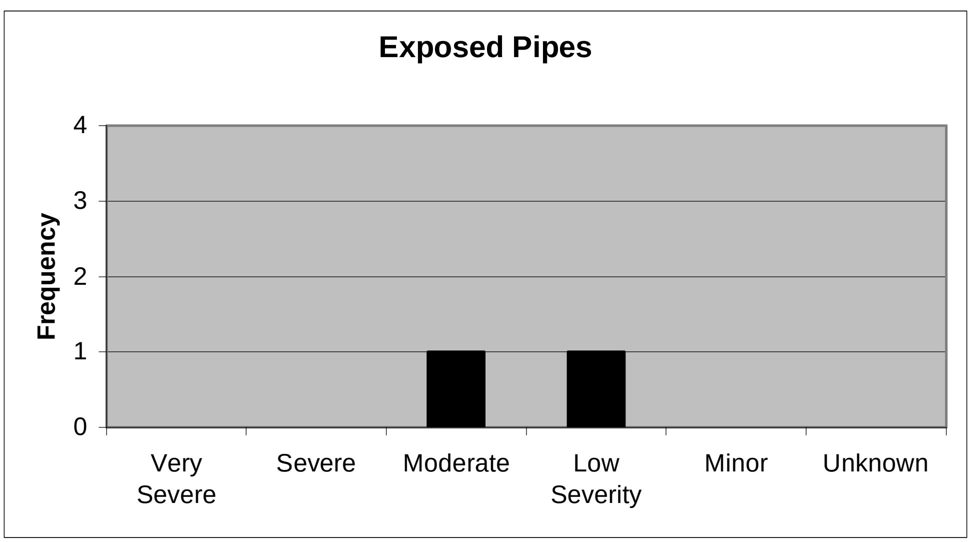
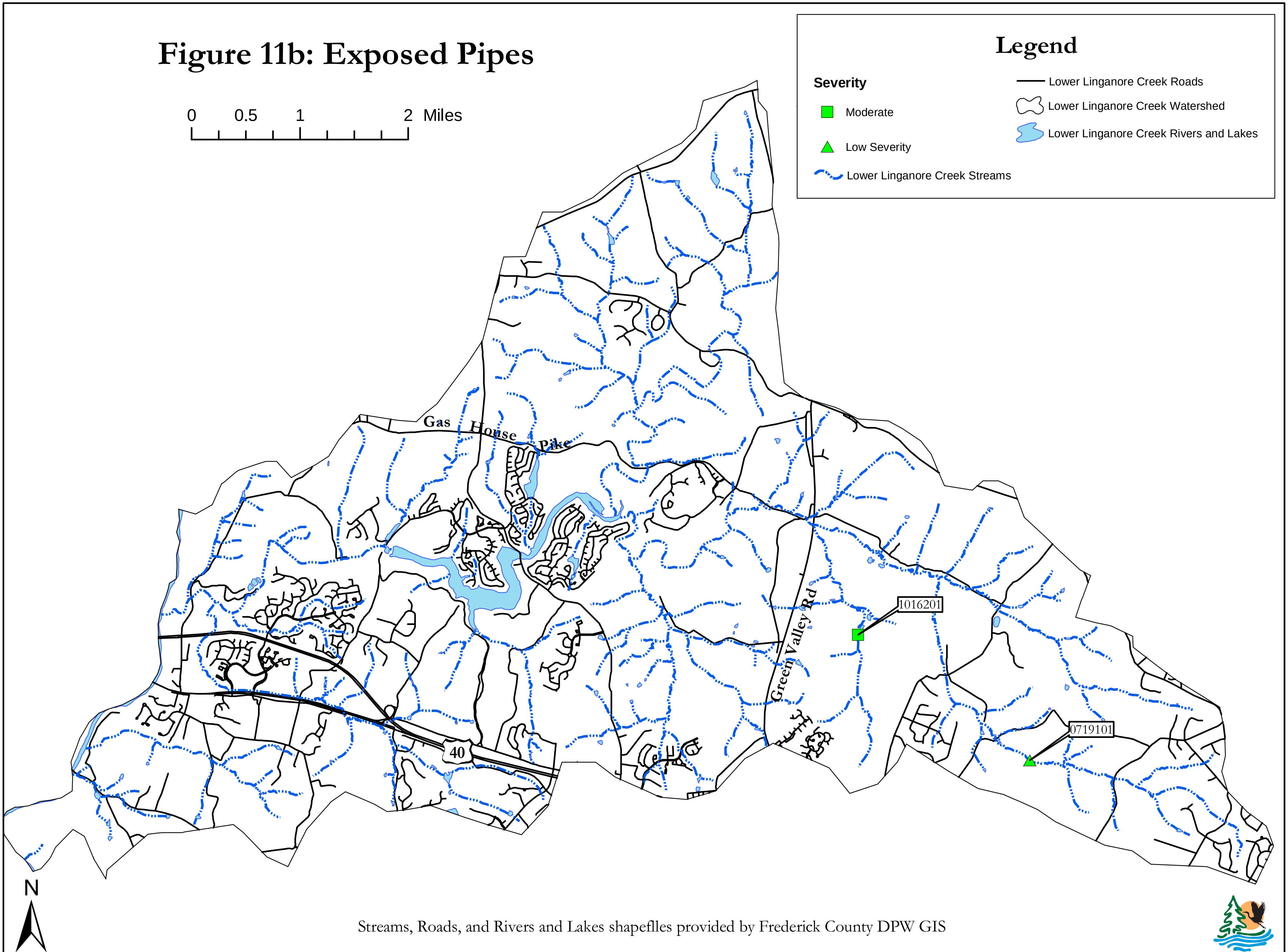


Figure 11a: Histograph showing the severity rating given to exposed pipe sites during the Lower Linganore Creek SCA survey.

Figure 11b: Exposed Pipes



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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

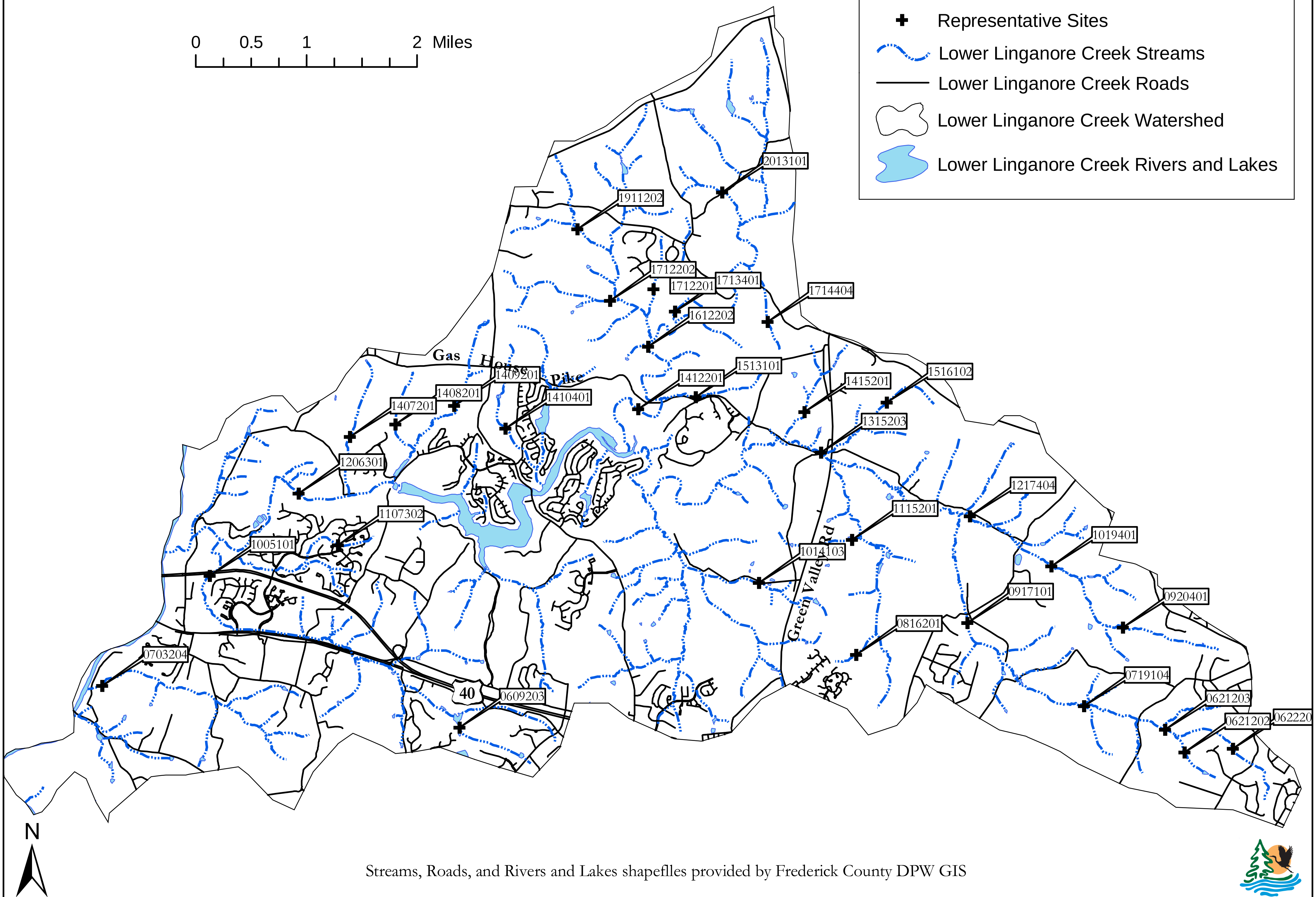
Under each category, field crews base a rating of optimal, suboptimal, marginal or poor on established grading criteria developed to reflect ideal wildlife habitat for rocky bottom streams. In addition to the habitat ratings, teams collect data on the stream's wetted width and pool depths at both runs 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 ½- to one-mile intervals along the stream. Survey crews evaluated 32 representative sites in the Lower Linganore Creek watershed. Locations of representative sites are shown in Figure 12, and data collected for all categories are listed in Appendix B.

Since representative sites provide an overall assessment of the in-stream and riparian habitat, they can be used to target areas for restoration. No sites were given poor ratings in all categories. However, Frederick County DPW can suggest further investigation of areas given poor ratings in multiple categories such as bank vegetation, bank condition, and riparian vegetation. Sites with poor ratings in the above categories include 0703204, 1019401, 1217404, and 1516102.

In addition, if there are areas already identified for targeted restoration, the representative sites can be used to provide additional habitat information. Representative sites can be used to identify areas of the stream corridor where the in-stream and riparian corridors are pristine and should thus be targeted with preservation. There is one site that given optimal ratings across the board (0621203), and there are quite a few that have a combination of optimal and suboptimal ratings such as sites 1206301, 1407201 and 1412201. These areas could possibly be targeted for preservation with minimal amounts of restoration. It is suggested the representative sites listed in Appendices A and B be used to assist in restoration and preservation targeting.

Figure 12: Representative Sites



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DISCUSSION

The results of the Lower Linganore Creek SCA survey, list, summarize, and show the location of the observable environmental problems along the stream corridor network in this watershed. Each potential problem site has a corresponding rating for severity, correctability, and access and a photograph of the site. The data from this survey 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 dialog 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.

During the SCA survey, the most frequently observed potential problem sites were inadequately forested buffers, reported at 63 sites (or 30.61 miles of stream on the left bank and 32.25 miles of stream on the right bank), and erosion sites, reported at 20 sites (or 12.75 miles of stream). Other potential environmental problems recorded during the survey included: 11 fish passage barriers, 7 pipe outfalls, 5 channel alterations, 3 trash dumping sites, 3 unusual conditions, 2 exposed pipes, 1 comment site and no in- or near-stream construction sites (Table 1). Additionally, crews recorded descriptive habitat condition data at 32 representative sites.

Inadequately forested buffers were the most common observed problem within the Lower Linganore Creek watershed. Erosion sites were the second most common observed problem within Lower Linganore Creek. In most cases, erosion sites were found either immediately downstream from an inadequate buffer site or in conjunction with an inadequate buffer site. The occurrence is most likely due to increased flow rates of water and scour from stream banks and the streambed through the stream channel. When there are no trees and shrubs to slow the water as it runs off of the landscape, it enters the stream channel at an accelerated rate. The stream channel compensates by widening and deepening to increase its carrying capacity and adjust for the additional water.

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 further targeted to restore areas where rare or threatened species, gaps in continuous forest or the state's Green Infrastructure, or quality fish and wildlife habitat are found. In addition, sites can be prioritized for restoration based on their location in headwater areas, areas of specific local interest, or sites where the surrounding land use is particularly suited to restoration projects.

The Maryland Department of Natural Resources (DNR) Watershed Restoration Division developed the Stream Corridor Assessment Survey (SCA) as a watershed management tool. The value of the present survey is its help in placing individual stream problems into their watershed context and its potential common use among resource managers and land-use planners to cooperatively and consistently prioritize future restoration work. Results of the present survey will be given to Frederick County DPW in order to initiate a dialog to cooperatively set the direction and goals for the watershed's management and more effectively plan future restoration work for specific problem sites within the watershed.

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Appendix A

Listing of sites by site number

Location	Problem	Severity	Correctability	Access	X Coordinates	Y Coordinates	Stream
0520201	Fish Barrier	5	4	1	382637.59436	190338.78468	Lower Linganore
0521201	Pipe Outfall	3	4	4	383603.65375	190100.15220	Lower Linganore
0521202	Inadequate Buffer	5	5	5	383604.16721	190099.84195	Lower Linganore
0521203	Unusual Condition/Comment	3	4	4	383588.42344	190110.72002	Lower Linganore
0603201	Channel Alteration	5	5	1	367720.14240	190600.81808	Lower Linganore
0603202	Inadequate Buffer	4	4	2	367595.95623	190536.65938	Lower Linganore
0603203	Fish Barrier	4	5	1	367612.05758	190501.57582	Lower Linganore
0603204	Channel Alteration	3	3	2	367548.71466	190653.73859	Lower Linganore
0603205	Inadequate Buffer	4	5	4	367603.63731	190723.84801	Lower Linganore
0603206	Channel Alteration	3	3	1	367488.14737	190786.42149	Lower Linganore
0603207	Fish Barrier	3	2	1	367488.39950	190786.18953	Lower Linganore
0605201	Inadequate Buffer	4	4	4	369193.70296	190788.26068	Lower Linganore
0606201	Fish Barrier	4	5	5	369903.92271	190758.39784	Lower Linganore
0609201	Inadequate Buffer	2	2	4	372788.04899	190767.63215	Lower Linganore
0609202	Pipe Outfall	5	5	4	373116.41035	190545.97149	Lower Linganore
0609203	Representative Site				372798.20039	190743.16565	Lower Linganore
0609204	Unusual Condition/Comment		1	1	373120.51916	190544.23182	Lower Linganore
0611201	Channel Alteration	5	3	1	374159.27430	190628.43259	Lower Linganore
0611202	Inadequate Buffer	5	4	1	374183.14584	190528.69169	Lower Linganore
0621201	Erosion Site	4	5	5	383200.87173	190614.15178	Lower Linganore
0621202	Representative Site				383332.80461	190379.77557	Lower Linganore
0621203	Representative Site				383052.22792	190711.02912	Lower Linganore
0622201	Representative Site				384039.80844	190437.86855	Lower Linganore
0703201	Pipe Outfall	2	5	1	367271.03640	190917.77224	Lower Linganore
0703202	Inadequate Buffer	3	2	1	367400.46347	191302.76511	Lower Linganore
0703203	Erosion Site	2	1	1	367447.40653	191308.56513	Lower Linganore
0703204	Representative Site				367609.38559	191347.57976	Lower Linganore
0703205	Unusual Condition/Comment	3	4	4	367783.73743	191468.95834	Lower Linganore
0705201	Inadequate Buffer	4	5	5	369418.53137	191044.16583	Lower Linganore
0708201	Inadequate Buffer	3	3	2	371943.53084	191370.14037	Lower Linganore
0710201	Inadequate Buffer	3	5	1	373759.35421	190914.21799	Lower Linganore
0713101	Inadequate Buffer	4	2	1	375903.03926	191074.84512	Lower Linganore
0713102	Inadequate Buffer	4	2	2	376182.33426	191293.20133	Lower Linganore
0719101	Exposed Pipe	4	3	2	381409.36347	191123.55729	Lower Linganore
0719102	Erosion Site	3	2	2	381425.71617	191114.48474	Lower Linganore
0719103	Fish Barrier	2	1	3	381851.55290	191052.62594	Lower Linganore
0719104	Representative Site				381874.30022	191050.93480	Lower Linganore
0722201	Inadequate Buffer	5	1	1	384142.32220	191226.89546	Lower Linganore
0808201	Inadequate Buffer	3	4	3	371771.99293	191620.79927	Lower Linganore
0810101	Channel Alteration	4	2	1	374028.12178	191521.09415	Lower Linganore
0810101	Inadequate Buffer	4	2	2	374016.49460	191814.90374	Lower Linganore
0812101	Inadequate Buffer	3	3	1	375261.83663	191570.99268	Lower Linganore
0814101	Inadequate Buffer	2	4	4	377132.27542	191940.77892	Lower Linganore
0814102	Inadequate Buffer	2	3	4	377147.91442	191769.32158	Lower Linganore
0816201	Representative Site				378560.52878	191799.96333	Lower Linganore
0818101	Erosion Site	4	3	2	380410.79090	191955.94694	Lower Linganore
0916201	Pipe Outfall	4	3	4	378852.29004	192192.25641	Lower Linganore
0916202	Inadequate Buffer	3	2	4	378859.95607	192098.62693	Lower Linganore
0916203	Inadequate Buffer	4	2	4	378859.58237	192099.60695	Lower Linganore
0917101	Representative Site				380180.95189	192264.70711	Lower Linganore
0920401	Representative Site				382439.16166	192193.01791	Lower Linganore
0921401	Inadequate Buffer	5	3	3	383041.50580	192061.96567	Lower Linganore
1005101	Representative Site				369170.47971	192948.22654	Lower Linganore
1006301	Inadequate Buffer	2	3	2	370111.45781	193026.79788	Lower Linganore

Location	Problem	Severity	Correctability	Access	X Coordinates	Y Coordinates	Stream
1006302	Inadequate Buffer	5	2	2	370462.74063	193062.18936	Lower Linganore
1007301	Inadequate Buffer	4	2	2	370937.22232	193064.70529	Lower Linganore
1007302	Inadequate Buffer	4	3	2	370927.77888	193009.52019	Lower Linganore
1011101	Fish Barrier	2	3	1	374105.89277	192862.77657	Lower Linganore
1012101	Inadequate Buffer	3	3	1	375071.53074	192920.80328	Lower Linganore
1012102	Inadequate Buffer	3	3	1	375090.33895	192615.39387	Lower Linganore
1014101	Inadequate Buffer	4	3	4	377607.70653	192861.66065	Lower Linganore
1014102	Erosion Site	4	3	4	377607.54510	192861.07525	Lower Linganore
1014103	Representative Site				377153.48464	192843.55662	Lower Linganore
1016201	Exposed Pipe	3	4	4	378865.65037	192986.33875	Lower Linganore
1016202	Erosion Site	4	3	4	378867.92703	192992.85002	Lower Linganore
1016203	Fish Barrier	2	4	4	378865.55723	192986.00194	Lower Linganore
1019401	Representative Site				381397.86387	193087.80005	Lower Linganore
1019402	Inadequate Buffer	4	3	3	381806.50764	192909.20064	Lower Linganore
1019403	Erosion Site	5	3	3	381806.40842	192909.48860	Lower Linganore
1019404	Trash Dumping	4	2	4	381763.63949	192935.74932	Lower Linganore
1107301	Pipe Outfall	4	2	2	370631.63485	193347.24004	Lower Linganore
1107302	Representative Site				371031.80882	193391.80517	Lower Linganore
1115201	Representative Site				378502.02019	193471.05437	Lower Linganore
1116201	Inadequate Buffer	3	4	3	378629.93964	193501.25969	Lower Linganore
1116202	Inadequate Buffer	2	4	4	378836.23280	193392.29153	Lower Linganore
1206301	Representative Site				370462.77359	194145.32215	Lower Linganore
1206302	Erosion Site	3	4	3	370416.74315	194181.47244	Lower Linganore
1206303	Inadequate Buffer	4	2	4	370273.23388	194302.97559	Lower Linganore
1207301	Pipe Outfall	3	4	2	371354.78463	194140.07019	Lower Linganore
1207302	Inadequate Buffer	5	2	1	371227.81996	194116.79681	Lower Linganore
1208301	Inadequate Buffer	2	4	4	371637.51159	194271.24700	Lower Linganore
1213101	Inadequate Buffer	3	2	2	376700.86805	194213.08729	Lower Linganore
1213102	Erosion Site	4	3	2	376749.04156	194196.34554	Lower Linganore
1213103	Erosion Site	2	3	1	376005.83841	194201.18899	Lower Linganore
1213104	Inadequate Buffer	3	3	1	376006.19016	194200.50788	Lower Linganore
1215201	Inadequate Buffer	3	2	4	378482.40222	193799.25610	Lower Linganore
1216401	Inadequate Buffer	2	4	3	378947.94243	194303.02840	Lower Linganore
1216402	Inadequate Buffer	4	2	2	379133.14888	194217.99397	Lower Linganore
1216403	Erosion Site	5	3	3	379132.72142	194218.31498	Lower Linganore
1217101	Inadequate Buffer	4	3	2	380061.52398	193842.65348	Lower Linganore
1217401	Inadequate Buffer	4	3	2	379719.39379	193901.46643	Lower Linganore
1217402	Inadequate Buffer	3	4	2	380144.81746	193839.96659	Lower Linganore
1217403	Erosion Site	4	3	2	380144.28717	193839.80425	Lower Linganore
1217404	Representative Site				380216.70163	193809.90945	Lower Linganore
1307201	Inadequate Buffer	4	2	4	371178.00031	194763.54564	Lower Linganore
1310401	Fish Barrier	3	4	1	373709.24860	194790.79729	Lower Linganore
1310402	Fish Barrier	2	2	2	373986.82758	194588.76550	Lower Linganore
1315201	Erosion Site	3	3	3	377724.43802	194883.51052	Lower Linganore
1315202	Inadequate Buffer	4	3	3	377724.45207	194883.32635	Lower Linganore
1315203	Representative Site				378052.79664	194739.24094	Lower Linganore
1315204	Erosion Site	2	4	2	378216.88982	194576.05737	Lower Linganore
1315401	Erosion Site	2	5	4	378132.46618	194655.27072	Lower Linganore
1406101	Inadequate Buffer	3	2	1	369951.75724	195348.92222	Lower Linganore
1407201	Representative Site				371210.08086	194963.11704	Lower Linganore
1408201	Representative Site				371870.64487	195149.08695	Lower Linganore
1409201	Representative Site				372721.10612	195413.70225	Lower Linganore
1410401	Representative Site				373466.95202	195086.31774	Lower Linganore
1410402	Fish Barrier	2	5	4	374001.93371	195018.07008	Lower Linganore

Location	Problem	Severity	Correctability	Access	X Coordinates	Y Coordinates	Stream
1412201	Representative Site				375396.79753	195366.93303	Lower Linganore
1414201	Erosion Site	3	2	3	377299.62782	195084.75342	Lower Linganore
1414202	Inadequate Buffer	4	3	3	377300.25851	195084.81738	Lower Linganore
1415201	Representative Site				377814.02749	195323.85613	Lower Linganore
1508201	Trash Dumping	3	4	4	371527.42920	195849.71832	Lower Linganore
1509301	Inadequate Buffer	4	1	2	372936.34504	196000.94629	Lower Linganore
1510401	Inadequate Buffer	4	2	3	374063.66215	195769.27524	Lower Linganore
1510402	Inadequate Buffer	3	4	3	373476.10378	195914.93452	Lower Linganore
1511401	Inadequate Buffer	4	2	2	374235.78036	195701.05291	Lower Linganore
1512101	Inadequate Buffer	3	4	1	375697.84732	195502.05606	Lower Linganore
1512102	Erosion Site	3	2	4	375697.54875	195502.10698	Lower Linganore
1513101	Representative Site				376231.38187	195544.85994	Lower Linganore
1515201	Inadequate Buffer	3	3	3	378050.38907	195877.62153	Lower Linganore
1516101	Inadequate Buffer	4	4	4	379267.17506	195681.76729	Lower Linganore
1516102	Representative Site				379007.22227	195462.23235	Lower Linganore
1610401	Pipe Outfall	4	2	3	374018.76432	196044.06874	Lower Linganore
1612201	Inadequate Buffer	5	5	5	375238.92373	196117.53979	Lower Linganore
1612202	Representative Site				375539.09665	196276.22578	Lower Linganore
1712201	Representative Site				375621.72424	197110.31781	Lower Linganore
1712202	Representative Site				374985.26847	196941.71286	Lower Linganore
1713401	Representative Site				375929.90282	196785.39039	Lower Linganore
1714401	Erosion Site	3	3	2	376814.72035	197052.47573	Lower Linganore
1714402	Fish Barrier	3	2	1	377228.86804	197116.03581	Lower Linganore
1714403	Inadequate Buffer	2	4	3	377264.43164	196674.42242	Lower Linganore
1714404	Representative Site				377277.62581	196635.76746	Lower Linganore
1812201	Inadequate Buffer	4	5	5	375828.16504	197361.47688	Lower Linganore
1813201	Erosion Site	3	4	5	376062.23832	197624.82678	Lower Linganore
1814401	Inadequate Buffer	5	2	4	377071.89909	197324.31983	Lower Linganore
1910201	Inadequate Buffer	4	5	5	373764.96958	197999.29271	Lower Linganore
1911201	Inadequate Buffer	5	5	2	374415.57052	198285.89071	Lower Linganore
1911202	Representative Site				374514.06789	197981.25727	Lower Linganore
1913201	Inadequate Buffer	4	5	5	376089.70543	198152.39741	Lower Linganore
2013101	Representative Site				376615.48850	198519.45320	Lower Linganore
2013102	Inadequate Buffer	4	2	1	376624.43891	198512.85742	Lower Linganore
2114101	Erosion Site	4	3	3	377282.12078	199393.49644	Lower Linganore
2213101	Unusual Condition/Comment	4	3	2	376711.45927	199969.99579	Lower Linganore
2214101	Inadequate Buffer	5	1	3	377261.30164	199555.72793	Lower Linganore
2313101	Trash Dumping	4	2	2	376710.10471	200117.70547	Lower Linganore
2314101	Inadequate Buffer	4	3	2	377295.57600	200363.04450	Lower Linganore

Appendix B

Listing of sites by problem category

Inadequately Forested Buffers

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings. For wetland rating 1=best wetland potential, 5=worst wetland potential

Problem	Location	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right (ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock Access	Severity	Correctability	Access	Wetland
Inadequate Buffer	0609201	Both	Both	0	0	9678	9678	Golf Course	Golf Course	No	No	2	2	4	1
Inadequate Buffer	0814101	Both	Both	0	0	2831	2831	Pasture	Pasture	No	Cattle	2	4	4	2
Inadequate Buffer	0814102	Both	Both	0	0	2145	2145	Pasture	Pasture	No	Cattle	2	3	4	2
Inadequate Buffer	1006301	Both	Neither	5	5	5930	5930	Lawn	Lawn	No	No	2	3	2	3
Inadequate Buffer	1116202	Both	Both	0	0	4797	4797	Lawn	Lawn	No	No	2	4	4	1
Inadequate Buffer	1208301	Right	Neither		8		9695	Forest	Pasture	No	No	2	4	4	5
Inadequate Buffer	1216401	Both	Both	0	0	10400	14415	Pasture	Pasture	No	No	2	4	3	2
Inadequate Buffer	1714403	Both	Both	5	5	1606	1606	Pasture	Pasture	No	No	2	4	3	4
Inadequate Buffer	1512101	Left	Left	40	0	3869	0	Shrubs	Forest	No	No	3	4	1	3
Inadequate Buffer	0703202	Both	Both	3	3	1348	1348	Other	Other	No	No	3	2	1	2
Inadequate Buffer	0708201	Both	Both	0	0	3182	3182	Pasture	Pasture	No	Cattle	3	3	2	2
Inadequate Buffer	0710201	Both	Neither	20	20	3221	3221	Shrubs	Shrubs	No	No	3	5	1	2
Inadequate Buffer	0808201	Both	Both	10	10	4707	4707	Shrubs	Shrubs	No	No	3	4	3	1
Inadequate Buffer	0812101	Both	Both	0	0	2468	2468	Pasture	Pasture	No	No	3	3	1	3
Inadequate Buffer	0916202	Both	Both	0	0	4082	4082	Crop field	Crop field	Yes	No	3	2	4	1
Inadequate Buffer	1012101	Both	Both	0	0	1572	1572	Pasture	Pasture	No	No	3	3	1	3
Inadequate Buffer	1012102	Both	Both	0	0	2311	2311	Pasture	Pasture	No	No	3	3	1	4
Inadequate Buffer	1116201	Both	Both	0	0	3302	3302	Pasture	Pasture	No	No	3	4	3	1
Inadequate Buffer	1213101	Both	Both	0	0	1843	1843	Pasture	Pasture	No	Cattle	3	2	2	5
Inadequate Buffer	1213104	Both	Both	0	0	9130	9130	Pasture	Pasture	No	No	3	3	1	5
Inadequate Buffer	1215201	Both	Both	0	0	2272	2272	Crop field	Crop field	No	No	3	2	4	2
Inadequate Buffer	1217402	Both	Both	0	0	4477	4477	Pasture	Pasture	No	Yes	3	4	2	2
Inadequate Buffer	1406101	Both	Both	0	0	7608	7608	Lawn	Lawn	No	No	3	2	1	5
Inadequate Buffer	1510402	Both	Both	8	8	5633	5633	Crop Field	Pasture	Yes	Horses	3	4	3	3
Inadequate Buffer	1515201	Both	Both	0	0	3400	3400	Pasture	Pasture	No	Cattle	3	3	3	1
Inadequate Buffer	0603202	Both	Both	0	1	1255	1255	Crop field	Paved	No	No	4	4	2	1
Inadequate Buffer	0603205	Both	Neither	15	5	1328	1328	Crop field	Shrubs & small trees	No	No	4	5	4	2
Inadequate Buffer	0605201	Both	Neither	5	5	2167	2167	Crop field	Pasture	No	Horses	4	4	4	4
Inadequate Buffer	0705201	Both	Both	5	5	4005	4005	Crop field	Pasture	No	Cattle	4	5	5	1
Inadequate Buffer	0713101	Both	Both	0	0	1358	1358	Paved	Shrubs	No	No	4	2	1	5
Inadequate Buffer	0713102	Both	Both	0	0	2655	2655	Shrubs & Small trees	Shrubs & Small trees	No	No	4	2	2	3

Problem	Location	Sides	Unshaded	Width Left (ft)	Width Right (ft)	Length Left (ft)	Length Right (ft)	Land Use Left	Land Use Right	Recently Established Buffer	Livestock Access	Severity	Correctability	Access	Wetland
Inadequate Buffer	0810101	Both	Both	1	0	383	383	Pasture	Pasture	No	No	4	2	2	4
Inadequate Buffer	0916203	Both	Both	0	0	2528	2528	Crop field	Crop field	Yes	No	4	2	4	1
Inadequate Buffer	1007301	Both	Neither	10	10	1247	1247	Lawn	Lawn	No	No	4	2	2	3
Inadequate Buffer	1007302	Both	Neither	30	20	1594	1594	Lawn	Lawn	No	No	4	3	2	4
Inadequate Buffer	1014101	Both	Both	0	0	1404	1404	Shrubs	Multiflora Rose	No	No	4	3	4	3
Inadequate Buffer	1019402	Both	Both	0	0	2280	2280	Pasture	Pasture	No	Cattle	4	3	3	2
Inadequate Buffer	1206303	Both	Neither	10	5	1889	1889	Crop field	Pasture	No	No	4	2	4	2
Inadequate Buffer	1216402	Both	Both	0	0	1406	1406	Pasture	Pasture	No	No	4	2	2	3
Inadequate Buffer	1217101	Both	Both	0	0	2225	2225	Pasture	Pasture	No	No	4	3	2	2
Inadequate Buffer	1217401	Both	Both	0	0	2046	2046	Pasture	Pasture	No	No	4	3	2	3
Inadequate Buffer	1307201	Right	Right	50	2		1502	Forest	Lawn	No	No	4	2	4	1
Inadequate Buffer	1315202	Both	Both	0	0	1346	1346	Lawn	Lawn	No	No	4	3	3	2
Inadequate Buffer	1414202	Both	Both	0	0	895	895	Pasture	Pasture	No	No	4	3	3	2
Inadequate Buffer	1509301	Both	Both	0	5	1076	1076	Pasture	Pasture	No	No	4	1	2	3
Inadequate Buffer	1510401	Both	Both	8	8	2360	2360	Pasture	Pasture	No	Cattle	4	2	3	4
Inadequate Buffer	1511401	Both	Neither	7	7	2073	2073	Pasture	Pasture	No	No	4	2	2	3
Inadequate Buffer	1516101	Both	Both	0	0	2828	2828	Pasture	Pasture	No	Horses	4	4	4	2
Inadequate Buffer	1812201	Left	Neither	15	25	1265	1265	Lawn	Forest	No	No	4	5	5	2
Inadequate Buffer	1910201	Both	Both	0	0	2339	2339	Pasture	Pasture	No	No	4	5	5	2
Inadequate Buffer	1913201	Both	Both	5	5	4068	1000	Pasture	Pasture	No	Cattle	4	5	5	3
Inadequate Buffer	2013102	Both	Both	3	5	1973	1973	Pasture	Pasture	No	No	4	2	1	4
Inadequate Buffer	2314101	Both	Both	0	0	1113	1113	Pasture	Pasture	No	No	4	3	2	5
Inadequate Buffer	0521202	Both	Both	0	0	661	661	Pasture	Pasture	No	No	5	5	5	2
Inadequate Buffer	0611202	Both	Neither	30	30	849	849	Lawn	Lawn	No	No	5	4	1	2
Inadequate Buffer	0722201	Both	Both	5	5	2140	2140	Pasture	Pasture	No	No	5	1	1	3
Inadequate Buffer	0921401	Both	Both	25	25	723	723	Shrubs & small trees	Shrubs & small trees	No	No	5	3	3	4
Inadequate Buffer	1006302	Both	Neither	10	5	1588	1588	Lawn	Pasture	No	No	5	2	2	2
Inadequate Buffer	1207302	Both	Both	0	0	766	766	Pasture	FARM	No	Horses	5	2	1	3
Inadequate Buffer	1612201	Left	Both	10	50	1274		Lawn	Forest	No	No	5	5	5	3
Inadequate Buffer	1814401	Right	Neither		20		761	Forest	Pasture	No	No	5	2	4	5
Inadequate Buffer	1911201	Both	Both	0	0	716	716	Lawn	Lawn	No	No	5	5	2	1
Inadequate Buffer	2214101	Right	Right		1		861	Forest	Pasture	No	No	5	1	3	4

Erosion Sites

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings.

Problem	Location	Type	Possible Cause	Length (ft)	Height (ft)	Land use left	Land use right	Infrastructure Threatened?	Describe	Severity	Correctability	Access
Erosion Site	0621201	Downcutting	Flooding	2146	9	Forest	Forest	No		4	5	5
Erosion Site	0703203	Downcutting	Baseball Fields	741	7	Baseball Fields	Baseball Fields	Yes	Baseball Diamonds	2	1	1
Erosion Site	0719102	Widening	Inadequate Buffer	3754	3	Lawn	Shrubs & Small Trees	No		3	2	2
Erosion Site	0818101	Widening	Other	920	4	Forest	Forest	No		4	3	2
Erosion Site	1014102	Widening	Land Use Change Upstream	1409	4	Shrubs	Shrubs	No		4	3	4
Erosion Site	1016202	Downcutting	Livestock	703	5	Pasture	Lawn	No		4	3	4
Erosion Site	1019403	Widening	Livestock	2039	2	Pasture	Pasture	No		5	3	3
Erosion Site	1206302	Widening	Unknown	5593	5	Forest	Crop field	No		3	4	3
Erosion Site	1213102	Widening	Inadequate Buffer	1876	4	Pasture	Pasture	No		4	3	2
Erosion Site	1213103	Widening	Inadequate Buffer	6533	5	Pasture	Pasture	No		2	3	1
Erosion Site	1216403	Widening	Bend at steep slope	2422	2	Pasture	Pasture	No		5	3	3
Erosion Site	1217403	Widening	Bend at steep slope	4430	2	Pasture	Pasture	No		4	3	2
Erosion Site	1315201	Downcutting	Land use change upstream	1376	6	Lawn	Lawn	No		3	3	3
Erosion Site	1315204	Downcutting	Land use change upstream	2690	6	Forest	Forest	No		2	4	2
Erosion Site	1315401	Widening	Land use change upstream	15793	4	Forest	Forest	No		2	5	4
Erosion Site	1414201	Downcutting	Land use change upstream	3434	6	Pasture	Pasture	No		3	2	3
Erosion Site	1512102		Bend at steep slope	4786	3	Shrubs	Shrubs	No		3	2	4
Erosion Site	1714401	Widening	Land Use Change Upstream	4344	3	Forest	Forest	No		3	3	2
Erosion Site	1813201	Downcutting	Land use change upstream	1783	13	Shrubs & Small Trees	Lawn	No		3	4	5
Erosion Site	2114101	Widening	Unknown	544	6	Forest	Multiflora Rose	No		4	3	3

Fish Passage Barriers

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Problem	Location	Blockage	Type	Reason	Drop (In)	Depth (In)	Severity	Correctability	Access
Fish Barrier	0520201	Total	Road crossing	Too shallow		0.5	5	4	1
Fish Barrier	0603203	Partial	Road crossing	Too high	1		4	5	1
Fish Barrier	0603207	Partial	Channelized	Too shallow		0.5	3	2	1
Fish Barrier	0606201	Total	Road crossing	Too shallow		0.5	4	5	5
Fish Barrier	0719103	Temporary	Debris dam	Too shallow		0	2	1	3
Fish Barrier	1011101	Total	Dam	Too high	48		2	3	1
Fish Barrier	1016203	Total	Exposed Pipe	Too high	60		2	4	4
Fish Barrier	1310401	Partial	Road crossing	Too high	34		3	4	1
Fish Barrier	1310402	Total	Channelized	Too high	14		2	2	2
Fish Barrier	1410402	Total	Dam/Channelized	Too high	55		2	5	4
Fish Barrier	1714402	Total	Road crossing	Too high	20		3	2	1

Pipe Outfalls

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Problem	Location	Outfall Type	Pipe Type	Location of Pipe	Diameter (in)	Channel Width	Discharge	Color	Odor	Severity	Correctability	Access
Pipe Outfall	0521201	Agricultural	Corrugated Metal	Head of stream	16	50	Yes	Green	None	3	4	4
Pipe Outfall	0609202	Stormwater	Plastic	Right bank	5		No			5	5	4
Pipe Outfall	0703201	Stormwater	Corrugated Metal	Head of stream	6		Yes	Medium Brown	Oily	2	5	1
Pipe Outfall	0916201	Stormwater	Plastic	Left bank	5		Yes	Clear	None	4	3	4
Pipe Outfall	1107301	Unknown	Smooth Metal Pipe	Right bank	24		No			4	2	2
Pipe Outfall	1207301	Stormwater	Corrugated Plastic	Other	28	50	Yes	Clear	None	3	4	2
Pipe Outfall	1610401	Stormwater	Plastic	Right bank	6		Yes	Clear	None	4	2	3

Channel Alterations

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Problem	Location	Type	Bottom Width (in)	Length (ft)	Perennial Flow	Sedimentation	Veg in Channel	Road Crossing	Length Above (ft)	Length Below (ft)	Severity	Correctability	Access
Channel Alteration	0603201	Rip-rap	4	65	Yes	Yes	No	No			5	5	1
Channel Alteration	0603204	Rip-rap	1	30	No	Yes	Yes	No			3	3	2
Channel Alteration	0603206	Concrete	1	35	Yes	No	No	No			3	3	1
Channel Alteration	0611201	Railroad		21	Yes	Yes	Yes	Below			5	3	1
Channel Alteration	0810101	Earth Channel	4	30	Yes	Yes	No	Above			4	2	1

Trash Dumping Sites

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Problem	Location	Type	Truckloads	Other measure	Extent	Volunteer Project?	Owner Type	Severity	Correctability	Access
Trash Dumping	1019404	Farm	7		Single Site	Yes	Private	4	2	4
Trash Dumping	1508201	Residential	8		Large Area	No	Private	3	4	4
Trash Dumping	2313101	Industrial	5		Single Site	No	Private	4	2	2

Unusual Conditions/Comments

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Identified Problem	Location	Type	Describe	Description	Potential Cause	Severity	Correctability	Access
Unusual Condition/Comment	0521203	Unusual Condition	Excessive Algae		Not enough flow from pond, head of stream in cow pasture	3	4	4
Unusual Condition/Comment	0609204	Comment		Pipe outfalls occur periodically throughout the golf course	Drainage		1	1
Unusual Condition/Comment	0703205	Unusual Condition	Red Flock	Red flock, stationary, no odor but looks disgusting	Lack of flow, swampy area, lots of tribs/stream	3	4	4
Unusual Condition/Comment	2213101	Unusual Condition	Decay	Hole in channel under road crossing	Rust/Erosion	4	3	2

Exposed Pipe

Note: Please see the Methods Section-Overall Rating System (page 9) for discussion of severity, correctability, and access ratings

Problem	Location	Location of Pipe	Type	Diameter (in)	Length (ft)	Purpose	Discharge	Color	Odor	Severity	Correctability	Access
Exposed Pipe	0719101	Above stream	Plastic	4	12	Water supply	Yes	Clear	None	4	3	2
Exposed Pipe	1016201	Exposed half in stream	Corrugated metal	14	12	Unknown	No			3	4	4

Representative Sites A

Problem	Location	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Representative Site	0609203	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal	Suboptimal	Poor
Representative Site	0621202	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal
Representative Site	0621203	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	0622201	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	0703204	Suboptimal	Marginal	Marginal	Suboptimal	Marginal	Suboptimal	Marginal	Poor	Poor	Marginal
Representative Site	0719104	Marginal	Suboptimal	Suboptimal	Optimal	Marginal	Optimal	Optimal	Suboptimal	Marginal	Optimal
Representative Site	0816201	Marginal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Marginal	Suboptimal	Suboptimal	Marginal
Representative Site	0917101	Suboptimal	Marginal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	0920401	Suboptimal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal
Representative Site	1005101	Marginal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal	Suboptimal
Representative Site	1014103	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal
Representative Site	1019401	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Optimal	Optimal	Poor	Poor	Poor
Representative Site	1107302	Marginal	Marginal	Suboptimal	Optimal	Suboptimal	Poor	Suboptimal	Marginal	Marginal	Optimal
Representative Site	1115201	Marginal	Suboptimal	Suboptimal	Optimal	Optimal	Marginal	Marginal	Marginal	Marginal	Poor
Representative Site	1206301	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
Representative Site	1217404	Optimal	Suboptimal	Marginal	Optimal	Marginal	Suboptimal	Suboptimal	Poor	Poor	Poor
Representative Site	1315203	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Marginal	Marginal	Marginal
Representative Site	1407201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal
Representative Site	1408201	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal
Representative Site	1409201	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	1410401	Suboptimal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
Representative Site	1412201	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	1415201	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Marginal	Marginal	Marginal
Representative Site	1513101	Optimal	Marginal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Marginal	Marginal
Representative Site	1516102	Suboptimal	Suboptimal	Poor	Optimal	Suboptimal	Marginal	Optimal	Marginal	Poor	Poor
Representative Site	1612202	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Optimal
Representative Site	1712201	Suboptimal	Marginal	Marginal	Optimal	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal
Representative Site	1712202	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal

Problem	Location	Substrate	Embeddedness	Shelter for Fish	Channel Alteration	Sediment Deposition	Velocity/Depth	Flow	Vegetation	Bank Condition	Riparian Vegetation
Representative Site	1713401	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal
Representative Site	1714404	Suboptimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Marginal	Suboptimal
Representative Site	1911202	Suboptimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal
Representative Site	2013101	Marginal	Poor	Suboptimal	Optimal	Poor	Marginal	Optimal	Optimal	Suboptimal	Optimal

Representative Sites B

Problem	Location	Width Riffle	Width Run	Width Pool	Depth Riffle	Depth Run	Depth Pool	Bottom Type
Representative Site	0609203	14	22	36	3	4	5	Cobble
Representative Site	0621202	15	23	30	5	8	20	Cobble
Representative Site	0621203	16	25	35	6	10	28	Cobble
Representative Site	0622201	16	21	30	3	5	10	Gravel
Representative Site	0703204	13	20	25	4	9	13	Cobble
Representative Site	0719104	84	60	24	1	3	4	Gravel
Representative Site	0816201		18			2		Silt
Representative Site	0917101	48	30	24	1	5	9	Gravel
Representative Site	0920401	30	36	60	4	7	13	Cobble
Representative Site	1005101	120	48	24	1	3	5	Silt
Representative Site	1014103	2	2	4	2	3	4	
Representative Site	1019401	60	144	188	2	3	30	Cobble
Representative Site	1107302	12	8	24	2	4	6	Gravel
Representative Site	1115201		12			3		GRASS
Representative Site	1206301	120	180	120	24	36	36	
Representative Site	1217404	24	28	38	4	7	14	Cobble
Representative Site	1315203	84	72	96	4	6	7	
Representative Site	1407201	15	25	38	4	10	38	Cobble
Representative Site	1408201	8	17	20	3	4	14	Cobble
Representative Site	1409201	17	22	39	4	10	32	Cobble
Representative Site	1410401	26	14	36	2	7	14	Cobble
Representative Site	1412201	216	264	360	36	36	144	Cobble
Representative Site	1415201	72	24	36	2	4	6	Cobble
Representative Site	1513101	40	36	36	3	6	10	
Representative Site	1516102	24	30	38	3	6	24	
Representative Site	1612202	120	192	3600	24	48	96	Cobble
Representative Site	1712201	10	15	19	2	3	5	Gravel
Representative Site	1712202	25	40	56	5	9	22	Gravel
Representative Site	1713401	108	240	295	3	24	36	Cobble
Representative Site	1714404	32	14	8	3	5	5	Gravel
Representative Site	1911202	20	23	26	6	8	10	Cobble
Representative Site	2013101	36	24	12	1	3	4	Silts