MCPB
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Clarksburg Limited Master Plan for the Ten Mile Creek Watershed – Existing Conditions in Ten Mile Creek and Results of 1994 Master Plan Analysis

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Description

The County Council has asked the Planning Board to prepare an amendment to the 1994 Clarksburg Master Plan by October 2013. The focus is to determine how to best achieve the Plan's community-building goals for a portion of the Town Center District, while protecting Ten Mile Creek. Because of the compressed time schedule, staff has scheduled this meeting with the Planning Board to share the interim results of our analysis and feedback we have received from the community and stakeholders. This report focuses mainly on environmental issues with a summary of the process and existing conditions in Ten Mile Creek and the results of the initial analysis of the 1994 Plan. Staff seeks feedback from the Planning Board on additional analysis and the range of scenarios to test, given the resources and time available.

A transportation analysis is well underway with the regional study completed and the local area analysis has begun. Economic analyses have been discussed with the project consultants but have not been initiated because the current scenario has not yet modified the proposed 1994 land uses.
Analytical information contained in this report has been prepared by our environmental consultants:

- Biohabitats, a nationally-recognized firm specializing in watershed protection and habitat restoration
- Brown and Caldwell, an engineering firm with special expertise in environmental analysis and protection, and
- the Center for Watershed Protection, a clearinghouse for research on watershed protection with expertise in watershed impact analysis.

Substantial information and assistance was provided by the Montgomery County Department of Environmental Protection (DEP).

Summary

Outreach, schedule, process, feedback from stakeholders

The work undertaken by staff and consultant team has been guided by the following assumptions:

- The Planning Area is limited to the Ten-Mile Creek watershed
- The goal is to protect Clarksburg Town Center vision, while protecting water quality
- Consider development scenarios, impact avoidance, development guidelines and practices, mitigation and offsets to arrive at recommendations
- Land use or zoning changes outside this amendment will not be considered and this effort will not affect the progress of already approved development
- Decisions are to be based on science
- Public input is important

In order to complete this master plan amendment within a compressed timeframe the below schedule is being followed:

Meeting	When	Objective
Upcounty Citizens Advisory Board	October 22,2012	Overview of current Clarksburg Master Plan and status of various development projects
Community Workshop One	November 19, 2012	Introduce master plan amendment and process; identify issues and priorities
Community Workshop Two	February 25, 2013	Provide an overview of existing conditions and the 1994 Master Plan recommendations
Planning Board	March 14, 2013	Work Session to present and discuss preliminary concepts, tradeoffs and recommendations – seek Board direction
Planning Board	April 11, 2013	Present refined concepts – seek Board direction
Community Workshop Three	April 2013	Present final recommendations
Planning Board	May 9, 2013	Present Staff Draft and set public hearing
Planning Board	June 20, 2013	Public hearing – Staff Draft
Planning Board	July-September 2013	Work sessions to prepare Planning Board Draft
Planning Board	October 2013	Transmit Planning Board Draft to County

Both community workshops have been well attending, with over 200 participants. The initial workshop, held in November, included an interactive discussion concerning four topics that helped identify community priorities. However, some may be difficult to achieve completely given the limited scope of this effort and potentially conflicting goals. Nevertheless, they provided an overview of various perspectives, which the following summarizes:

Community Building

- Improve walkability
- Provide community facilities – but not in Ag Reserve
- Parkland and nature walks
- Smart development
- Plan development to maintain a rural agricultural nature
- Protect the historic district
- Provide promised core services in town center

Economy

- Lack of the basic needs, stores restaurants , employment
- Support additional development
- Ensure town center areas are economically viable
- Attract business
- Measured residential growth and home businesses
- Limit retail to town scale
- Shopping similar to Kentlands

Transportation

- Improve walkability
- No transit = no development
- Bicycle lanes on Clarksburg Rd.
- Access to Metro and MARC, by shuttle?
- East-west public transit
- Too auto dependent
- Protect public safety
- Sufficient flow of traffic

Environment

- Protect water quality, Ag Reserve and wildlife habitats
- Protect Ten Mile Creek and the lake
- Protect forest cover
- Lower ag nutrient loading
- Apply improved environmental technologies
- Balance development and environment
- Negotiate flexibility on locations

Existing Conditions in the Ten Mile Creek Watershed

In the 1994 Clarksburg Area Master Plan Ten Mile Creek was ranked as the planning area's most important watershed. It had the best quality or most extensive natural resources and the highest potential to be adversely affected by development. Ten Mile Creek was also found to have slightly more diverse and pollution-sensitive population of macroinvertebrates than Little Seneca.

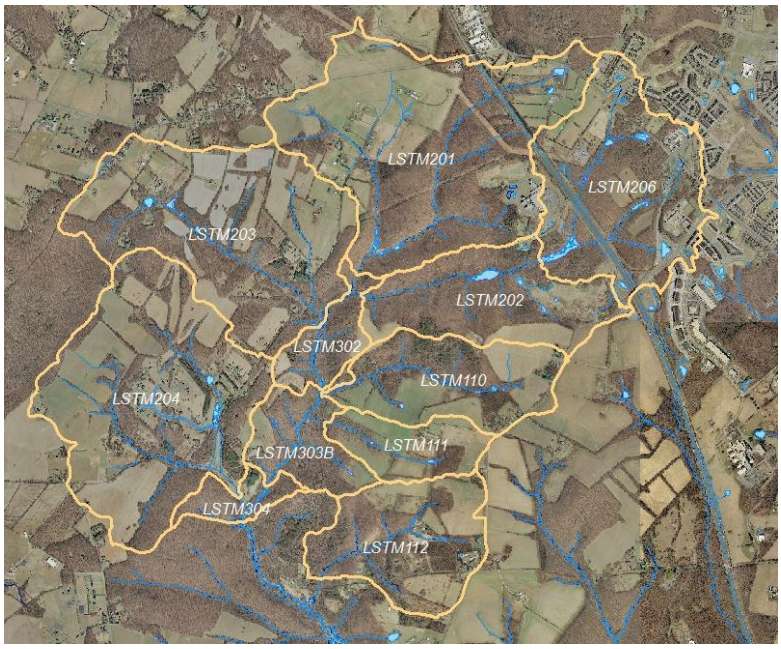
The Ten Mile Creek study area drains approximately 4.8 square miles or just over 3000 acres of primarily rural and forested lands in Montgomery County, flowing from its headwaters just north of Frederick Road to Little Seneca Lake. The watershed remains important today because it is a 'headwater' watershed where the majority of streams are small and spring fed. Ten Mile Creek is underlain by the Ijamsville geologic formation with bedrock that is predominately made up of schist and greenstone with very thin and rocky soils. Stream beds contain little silt and clays – the smaller particles are sands and gravels. The stream bed and surrounding land contains flat thin rocks of ancient sedimentary origin. This stream bed material is ideal to support a diverse bottom-dwelling macroinvertebrate community, such as stoneflies and other organisms.

Natural springs and seeps are abundant in the watershed. These springs and seeps supply the cold and clean groundwater necessary to maintain Ten Mile Creek water quality and support sensitive species of fish and aquatic animals. Portions of the Upper Little Seneca Creek and Ten Mile Creek watersheds have been shaped by geological forces unique to this part of the county. A fault line with many associated bedrock fractures runs through these and the adjacent Little Bennett watersheds. These rock fractures have dramatically influenced the abundance of springs and seeps and the form of the stream channel. The springs and seeps are found along fractures and fault areas with groundwater flowing through the cracks found along the fracture areas.

These headwater streams are very easily damaged through changes to the landscape resulting from earthmoving during the development process such as cutting, filling and permanent alterations to soils and land cover. Sensitive 'indicator' organisms that occur in few other areas within the county are found here. Ten Mile Creek was rated as being one of the highest quality streams in the County during the 1994 -1998 monitoring period (immediately after the 1994 Master Plan publication), although stream conditions have declined somewhat in parts of the watershed. With very little development occurring in the watershed since 1994, it is still considered a reference stream against which the scores of all other streams in the County are rated. As a sensitive and fragile watershed, Ten Mile Creek is part of a small group of high quality watersheds still remaining within the county. Similar watersheds would include many Patuxent River tributaries, Bennett Creek, and Little Bennett Creek.

Analysis of the Ten Mile Creek Watershed

This analysis evaluates the potential effects on the watershed resulting from the initiation of Stage 4 development of the 1994 Clarksburg Master Plan, focusing on the subwatersheds contributing to the free-flowing portion of Ten Mile Creek. These subwatersheds are referred to as the "study area." While these subwatersheds are unnamed, they are identified by the name of the monitoring station for each. The LSTM stands for Little Seneca Ten Mile and the number is the unique identifier. Those most affected by Stage 4 development are LSTM 201, 206, 202, 110, 111, and 112. (See adjacent map)



Existing conditions in the Ten Mile Creek were evaluated by reviewing GIS data and numerous reports and studies. The detailed draft report prepared by our consultants is attached. Key watershed characteristics are described below:

- Ten Mile Creek feeds into Little Seneca Lake, a supplemental source of drinking water in Montgomery County. The aquifer in the study area is designated as a Sole Source Aquifer per the United States Environmental Protection Agency's Sole Source Aquifer Program.
- Ten Mile Creek is considered a reference stream, serving as an example of the highest-quality waters in Montgomery County and used as a yardstick against which other streams are measured.
- Long-term monitoring of the stream habitat within the Ten Mile Creek watershed by DEP, including measurements of the physical habitat and sampling of biological communities, indicates an overall healthy biological condition.
- In-stream physical habitat conditions show slight signs of decline since 2007. While change is subtle over time, these conditions are indicative of a watershed that is sensitive and is responding to various stressors. The reason for the decline is mostly due to increased embeddedness (a measure of stream bottom quality), sedimentation, and decreased streambank vegetation. However, a proportional response in the overall biological condition has not been observed. Long-term monitoring data collected by DEP does generally indicate that the proportion of sensitive taxa, both fish and benthic macroinvertebrates, present within the watershed are declining while the tolerant species are increasing in both number and richness.
- Base flows are low in the summer months and the creek is susceptible to low flows from lack of rain.

- However, even in the driest years tributaries have continued to flow (although at sometimes much lower rates) and to provide cool, clean water as refuge for the stream biotic community due to the seeps and springs throughout the Ten Mile Creek study area. Many are in headwaters of tributaries within the Stage 4 area. These are necessary to maintain base flows in headwater streams.
- Wetlands are concentrated along Ten Mile Creek mainstem. These are predominantly forested wetlands and are groundwater-dominated.
- Beaver have developed a series of dams in the upper reaches of Ten Mile Creek which provide pools that act as refuges for fish, amphibians and reptiles during the drier summer months and habitat for wintering waterfowl and wildlife in the winter months.
- Bird surveys conducted in 2009 in the Clarksburg Stage 4 forest interior areas of Ten Mile Creek "observed or heard 12 migratory nesting forest interior bird species."
- Development in the overall watershed is low, and roughly half of the study area is forested. Imperviousness is approximately 4%, and the remaining land cover in the study area is predominantly a mix of non-forested pervious area; including pasture, cropland, and turf. The upper headwaters have the highest impervious cover due to the presence of the I-270, other roadways, the historic district, the school and the detention facility.
- LSTM202, LSTM201, and subwatersheds along the mainstem have the highest forested land cover.

Imperviousness and Forest Cover in the Ten Mile Creek Study Area

Subwatershed	Individual Subwatershed Imperviousness (%)	Contribution to Study Area Imperviousness (%)	Subwatershed Forest Cover (%)	Contribution to Study Area Forest Cover (%)
LSTM206	16.2%	48.9%	42%	11%
LSTM201	3.8%	19.0%	44%	19%
LSTM204	2.5%	11.0%	33%	13%
LSTM203	1.9%	7.6%	41%	14%
LSTM112	2.5%	4.7%	49%	8%
LSTM202	2.2%	4.5%	67%	12%
LSTM110	1.6%	2.7%	45%	7%
LSTM111	1.2%	1.0%	19%	1%
LSTM304	0.9%	0.4%	89%	3%
LSTM303B	0.1%	0.1%	77%	7%
LSTM302	0.1%	0.1%	83%	5%
Data source: DEP Impervious Cover, 2012; MCP Forest Cover, 2008 (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)				

- The forested cover along the main stem and through LSTM202 and LSTM201 is a major contiguous, ecological connection, linking Black Hill and Little Bennett Regional Parks. The

largest gap occurs northeast of I-270, which bisects the corridor to Little Bennett Regional Park. Forested areas within the study area are characterized as upland or bottomland hardwood forest. Upland hardwood forest is particularly prevalent in the western portion of study area. Bottomland hardwood forests are located along stream, floodplains and wetland areas within the watershed.

- Soils within the study area are generally rocky with a shallow to moderate depth to bedrock and steep slopes. Based on soil survey mapping 45 % slopes are the steepest found along the upland stream valley. Erodible soils are most prevalent in the western and southern part of the study area. The shallow bedrock, slopes, and erodible soils could pose general siting restrictions for foundations, septic systems, roads, basements, etc., as well as a challenge for erosion and sediment control during construction activities, and post-construction stormwater management.
- The limited available datasets and field observations suggest that the streams are very dynamic (i.e. they frequently move and deposit bed and bank materials). There is no evidence of widespread and significant channel degradation (i.e. chronic lowering of the channel bed with time), which is often observed in highly disturbed watersheds. Flood flows along many reaches of Ten Mile Creek still access the floodplain, sustaining important geomorphic and ecological processes. Streams in the region have been subjected to an extended history of changes in sediment supply and hydrology due to land use changes. Like many streams in the region, Ten Mile Creek has adjusted to these historic changes and continues to adjust to existing inputs of water and sediment.

Summary of 1994 Plan

The Ten Mile Creek watershed includes part of the Town Center District and all of the Ten Mile Creek Area in the 1994 Clarksburg Master Plan. The plan envisioned the **Town Center District** as a strong central focus for the entire master plan area, while also recognizing that a portion of the district was in the headwaters of Ten Mile Creek. The plan included reduced densities relative to the other parts of the Town Center District for parcels closest to the headwaters of Ten Mile Creek. Even with the density reduction, the proposed MXPD and PD-4 zoning can produce relatively high levels of imperviousness and most of the Ten Mile Creek area was placed in the last implementation stage to allow an evaluation of protection measures and consideration of additional water quality measures and land use actions.

West of I-270, the master plan provisions for the **Ten Mile Creek Area** recommended a balance of environmental concerns, housing needs and employment uses within a high-technology employment corridor. The provisions included:

- employment sites with development criteria to help address environmental concerns
- residential use (2-4 units per acre) for land west of MD 121 with a substantial amount of private conservation area and parkland
- rural residential (1 unit per 5 acres) between the mainstem of the creek and Shiloh Church Road, and
- the remaining area in the agricultural reserve (1 unit per 25 acres).

The R&D land in the Ten Mile Creek Area is limited to 15% imperviousness and with uses tightly clustered close to I-270. The residential area west of MD 121 is approximately 600 acres and is limited to a maximum of 900 units (plus MPDUs), with any units beyond the base density requiring the purchase of TDRs. The plan specifies that at least 70% must be single family dwellings with the stream buffers and a large amount of conservation area beyond those buffers being undeveloped and forested.

Analysis of potential impact of 1994 plan

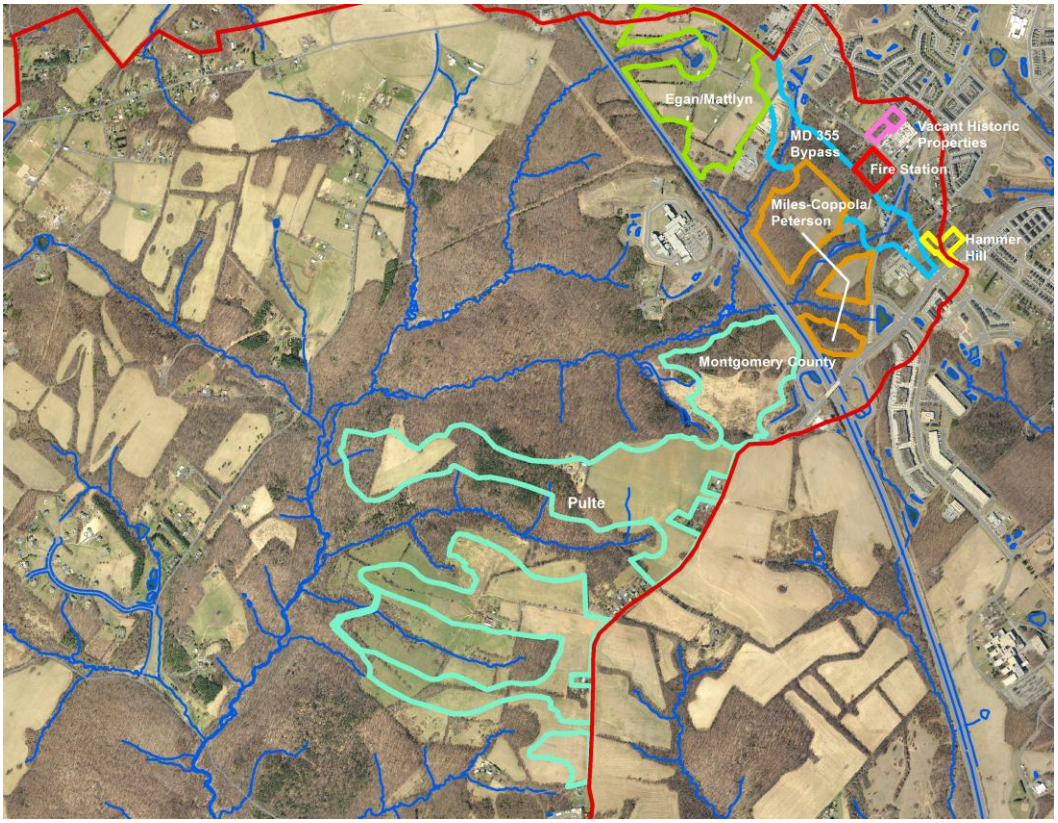
Four analyses were conducted for the buildout of the 1994 Clarksburg Master Plan in the Ten Mile Creek watershed:

- A Spatial Analysis that identifies the impacts to each of ten aspects of the physical and habitat features of the watershed including forests, wetlands, streams, etc.
- An analysis of the change in Impervious Surface in the watershed.
- A Hydrologic Analysis which determines the potential change to water flow characteristics.
- A Pollutant Loadings Analysis that projects the contributions of nitrogen, phosphorus and sediment to the stream.

The results of these analyses are summarized below and will be presented in more detail at the Planning Board meeting. For purposes of this analysis, the following development was assumed (see map for location of properties and limits of disturbed area):

Development Name	Land Use	Density	Imperviousness % of Disturbed Area	Acres of Disturbed Area	Property Acreage
Egan/Brookfield	Residential	4 units/ac	50.2%	61.34	100.06
Miles Coppola/Peterson	Office/Residential	50%office 50% res	60.0%	42.46	98.64
County Site	Office	Office	41.7%	45.72	124.77
Pulte	Residential	2 units/ac	33.0%	203.50	523.44
Fire Station	Institutional	NA	37.0%	4.08	4.08
Hammer Hill	Commercial	commercial	30.0%	2.93	2.93
Historic District Residential	Residential	2 units/ac	15.4%	2.41	2.41
355 Bypass	Roadway/Transitway	NA	30.4%	38.43	

Outlines of Disturbed Areas Used for Modeling



The projected limits of disturbance are approximately 412 acres, or 13.5% of the Ten Mile Creek study area. Development associated with the 1994 Master Plan will directly impact hydrology, water quality, and aquatic and upland habitats. It will indirectly impact stream geomorphology and biota.

Impact on Natural Resources

A Spatial Watershed Analysis of existing conditions within the Ten Mile Creek watershed was conducted to identify areas with high resource value that support watershed health. The table below shows the results of that analysis.

Attribute	Existing	Affected by 1994 Master Plan	% Affected
Study Area (acres)	3,046.2	412.0	14%
Stream Length (miles)	22.0	0.7	3%
Wetland Area (acres)	86.3	1.6	2%
Seeps, Springs & Seasonal Pools (#)	149.0	9.0	6%
Forest Cover (acres)	1,389.1	119.5	9%
Forest Interior Area (acres)	409.2	64.2	16%
Erodible Soils (acres)	230.6	1.0	0%
Areas with Slopes >15%	804.8	57.3	7%
Areas with Slopes >25%	183.0	5.6	3%

- Areas of high resource value within the watershed are generally concentrated near the streams, particularly the mainstem. Here wetlands, floodplains, forest, springs, seeps and the streams themselves provide critical watershed functions, such as rainfall capture and runoff reduction, pollutant filtering, nutrient cycling, overbank flow attenuation and reduction, and aquatic and upland habitat.
- Areas of high resource value are also associated with interior forest, largely concentrated along and east of the mainstem, west of I-270, extending onto the County and Pulte properties.
- The build-out of the 1994 Master Plan will significantly affect over 3500 linear feet of streams. The majority of these impacts (about half a mile) would be to small headwater tributaries east of I-270 as a result of construction of the MD355 Bypass. Construction of the 355 Bypass may also impact half an acre of wetlands and nine of the watershed's 149 springs, seeps and seasonal pools. Additional impacts would be from necessary stream crossings by projected sewer lines.
- Build-out of the 1994 Master Plan has the potential to impact up to 9% of the watershed's forest – about 119 acres out of 1,389 acres. The largest impacts are associated with the Pulte property, where potential impacts include 38 acres of forest cover. This is followed by the Miles Coppola property at 25 acres; the MD355 Bypass at 22 acres; and the County property at 22 acres.
- Build-out of the 1994 Master Plan would also result in the loss of over 60 acres of interior forest. About 18 of these acres may be directly impacted by development, namely on the County and Pulte properties. The remaining loss would be attributed to overall reduction in forest cover, reducing the size and buffer of contiguous forest.
- Removal of forest, especially interior forest, will reduce travel corridors for terrestrial and avian species such as amphibians and neotropical birds.
- Removal of forest, including interior forest, will create more forest "edges", which may make remaining forest more vulnerable to blow-down during windstorms, further compromising forest cover.
- Approximately 57 acres on lands with a slope greater than 15% would be affected by the 1994 Master Plan, with 6 of these acres on lands with a slope greater than 25%. These include the Pulte, County, and Miles Coppola properties, as well as the MD355 Bypass.
- The amount of topographic alteration, grading, soil removal and compaction, will likely affect the springs and seeps that receive groundwater from developed upland areas.

Imperviousness Analysis

All research to date and our experiences in Montgomery County indicate a strong correlation between imperviousness and stream conditions. This is not only due to impervious cover impacts alone, but also because higher imperviousness levels are strongly correlated with other impacts from development such as vegetation removal, altered topography, grading, soil removal and compaction, hydrologic changes, and pollutant inputs. Environmental Site Design (ESD) performance criteria address hydrologic impacts of development, and some pollutant impacts. There is no extensive or long-term experience with ESD, especially on a watershed-scale, and while it is expected to result in better conditions than traditional stormwater management, we cannot accurately predict the stream response. Research to date shows that stream degradation begins at very low levels of impervious cover, and that at 8-10%

imperviousness, streams are less likely to maintain high quality stream conditions. The following table shows the projected change in imperviousness by subwatershed. Cumulative imperviousness calculates, for each downstream watershed, the average of all imperviousness upstream divided by the total acreage upstream.

ID	WATERSHED AREA (ACRES)	EXISTING IMPERVIOUS (ACRES)	EXISTING CUMULATIVE IMPERVIOUSNESS	MASTER PLAN SCENARIO IMPERVIOUS (ACRES)	MASTER PLAN SCENARIO CUMULATIVE IMPERVIOUSNESS
LSTM201	611	23.09	3.8%	41.16	6.7%
LSTM111	104	1.26	1.2%	14.60	14.0%
LSTM112	228	5.80	2.5%	12.97	5.7%
LSTM206	370	59.74	16.1%	112.00	30.0%
LSTM202	243	5.45	10.6%	27.14	22.7%
LSTM302	77	0.09	5.4%	3.09	10.7%
LSTM110	211	3.34	1.6%	31.86	15.1%
LSTM303B	117	0.15	5.7%	2.15	10.8%
LSTM 304	49	0.44	4.3%	0.44	9.0%
LSTM 203	493	9.29	1.9%	9.29	1.9%
LSTM 204	544	13.12	2.4%	13.12	2.4%

Hydrology

One of the chief means by which development can impact a stream is hydrologic alteration. In the absence of stormwater controls, an increase in impervious cover can lead to higher peak streamflows and current velocities. This in turn can lead to increased erosion and sedimentation both on the land surface and within the stream system, and subsequent impacts to biota. One of the major goals of ESD is to maintain natural hydrology and prevent adverse hydrologic and hydraulic (H&H) impacts. A dynamic rainfall-runoff modeling package (XP-SWMM) was used to predict H&H impacts to Ten Mile Creek that would result from the buildout of the Clarksburg Master Plan (implemented with full ESD in accordance with State and County regulations). The model was set up to simulate a 1-year, 24-hour storm (2.6 inches) and a 2-year, 24-hour storm assuming (3.2 inches) and SCS Type II distribution. The "base conditions" model scenario represents the Ten Mile Creek study area under existing conditions, prior to development described in the Master Plan. The model simulated the effect of ESD practices on stormwater runoff under the Master Plan scenario, assuming that Montgomery County's minimum design standards will be met. The model scenario also assumes that construction activities will reduce the infiltration capacity of soil.

- The model predicted that a 1-year, 24-hour storm event would produce lower peak streamflows and velocities under the Master Plan post-development scenario in some subwatershed outlets as compared to the streamflows and velocities produced under the base scenario. This effect

was observed for subwatersheds that would have significant areas of existing agricultural and developed land uses converted to a new developed land use with ESD.

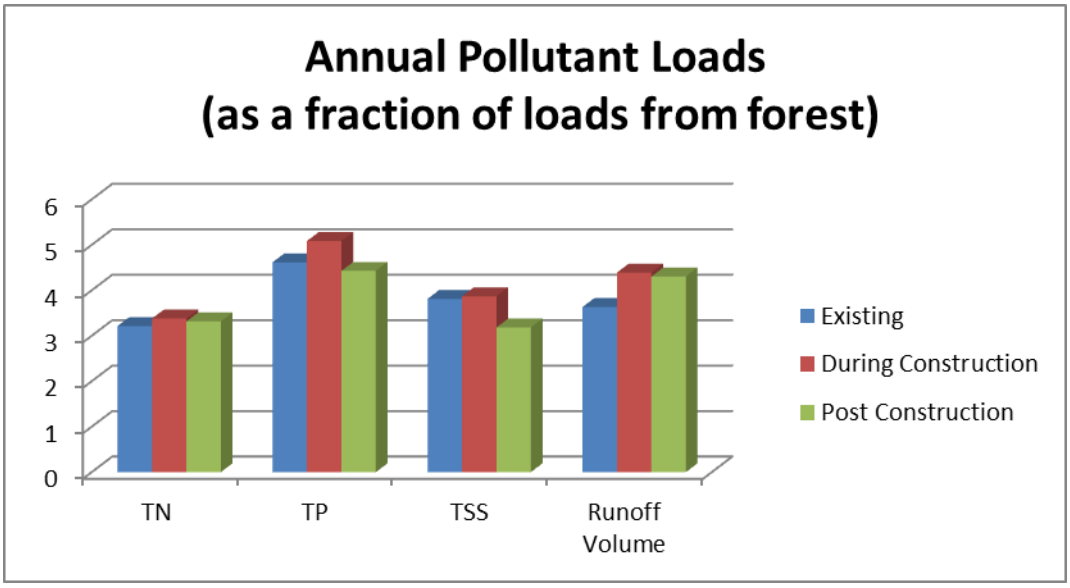
- In some subwatersheds that have very low stormwater runoff rates under existing conditions, the model predicted that peak streamflows and velocities under the Master Plan would increase, even with the implementation of ESD. This simulated effect was partly caused by soil compaction and the adherence to the minimum ESD design standards, which might cause ESD to fall short of the goal of representing runoff from "woods in good condition".
- The total stormwater runoff volume delivered to the stream system was predicted to be greater under the Master Plan post-development scenario than the total runoff generated in the base model scenario, and duration of elevated streamflow was predicted to be longer. This was the case even in most subwatersheds that were predicted to have lower peak streamflow after development, because the ESD practices were predicted to drain their stored water in the 24 hours following a storm peak.
- A separate model scenario was created with a performance safety factor to account for variations in BMP efficiency over the long term, when they may become clogged due to inadequate maintenance or other conditions. As expected, this scenario showed that poorly-draining ESD practices would greatly reduce their benefit.
- During storms that exceed ESD performance design criteria, ESD ceases to provide infiltration, and the benefits associated with it, allowing stormwater and pollutants to flow to the receiving streams. This aspect of ESD may become an even greater concern as climate change continues to alter the frequency and intensity of rainfall events.

In summary, development associated with the 1994 Master Plan is expected to have very different effects on different subwatersheds, largely dependent on the existing runoff characteristics and degree of planned development. Some areas could experience moderate increases in peak streamflow and velocities. Streamflow volume would increase, and the stream would likely experience longer, broader storm peaks as ESD practices drain.

Impact on Pollutant Loadings

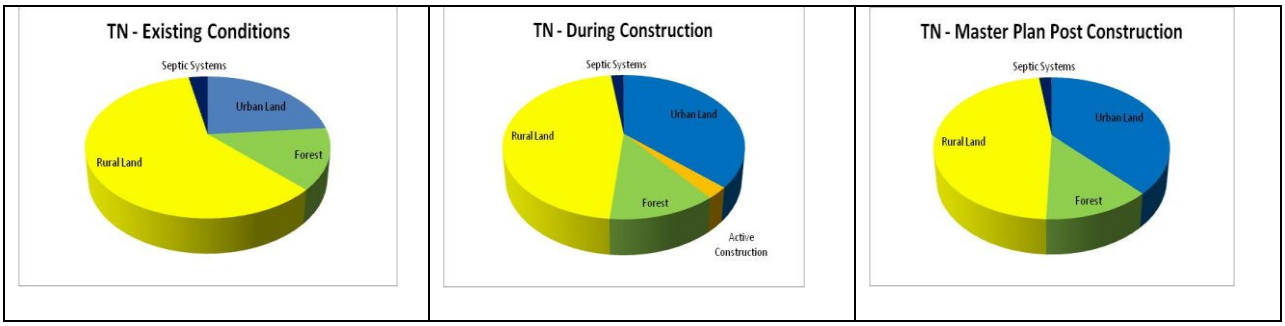
Water quality can also be adversely affected by land development, both during the development process, and in the post-developed condition. Annual pollutant loading was assessed using the Watershed Treatment Model, a simple spreadsheet model, for three scenarios. The "base conditions" scenario represents conditions as they are before implementation of the Master Plan. The "post construction" phase models 1994 Master Plan with the implementation of ESD. The "during construction" is similar to the post construction scenario, but assumes that construction occurs over ten construction seasons, so that 10% of the developable land is in active construction, rather than the built out condition, and additional fertilizer is being applied to establish new lawns. The water quality modeling also reflects conversion of 36 septic systems to sewer. Results include annual runoff volume, as well as annual runoff loads for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS). The model results do not account for channel erosion, which would likely increase in subwatersheds that have increased runoff volumes and peak discharges.

Watershed-wide, pollutant loads for Total Phosphorus and Total Suspended Solids increase slightly during construction, and decrease to slightly below pre-developed rates in the post-developed condition. Annual runoff volume as well as pollutant loads for Total Nitrogen, on the other hand, increase both during construction and in the post-developed state. The apparent decrease in TP and TSS can be explained by the agricultural uses dominant in much of the watershed. It is important to note, however, that this model does not calculate loads from channel erosion, which may increase as a result of increased stormwater runoff volumes and in-stream velocities.

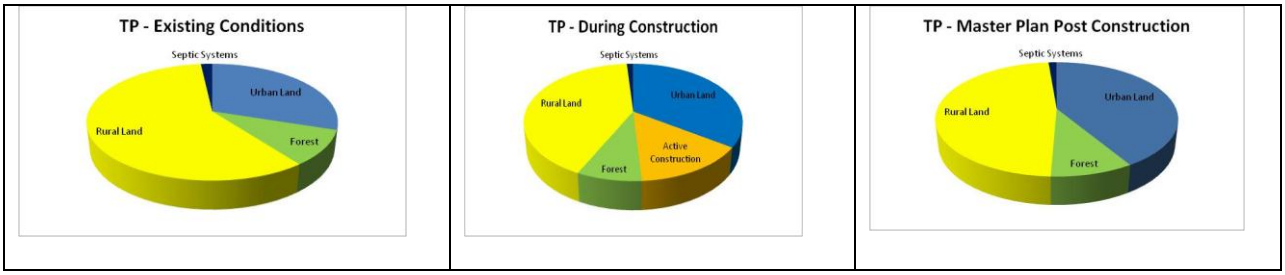


- By reducing shading and increasing the volume of streamflow, development is likely to alter (increase) stream temperature.
- By increasing the delivery and concentration of contaminants, development is likely to alter stream chemistry (e.g., concentrations of nutrients, chloride, iron, and magnesium).

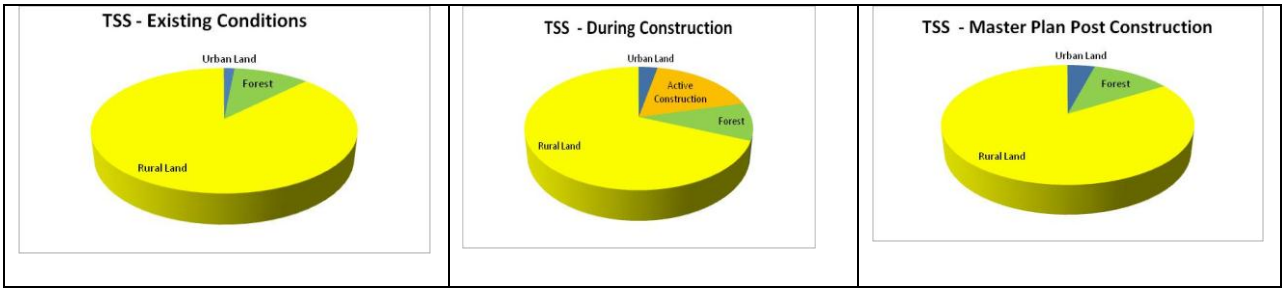
As development occurs, the sources of the modeled pollutants change. In the current conditions, rural land is the dominant source of all pollutants, but urban land becomes a more important source over time, and active construction is a significant source of sediment and phosphorus during the construction phase. In general, pollutants that have the greatest increase are those where urban land is a relatively high pollutant source. For example, runoff is generated primarily by urban land and increases significantly. This is somewhat true for TN, which shows a modest increase over all phases of development, and runoff volume, which shows a significant increase. By contrast, TSS actually decreases, and rural land is the dominant sediment source in all phases of development.



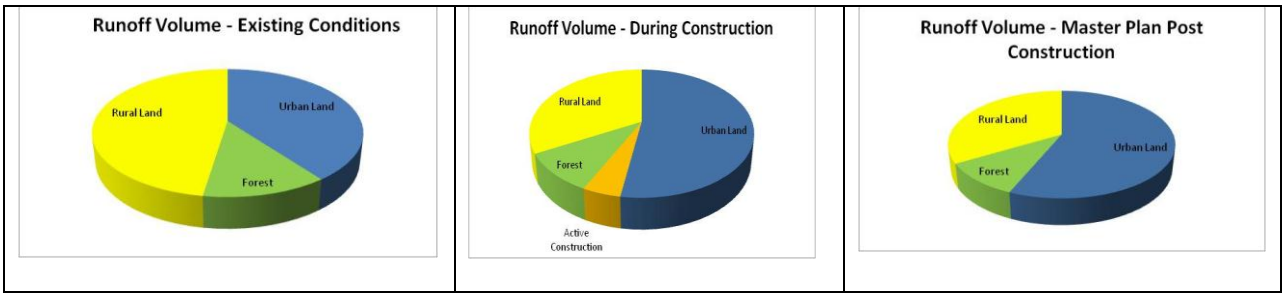
Total Nitrogen Sources: Current, During Construction and Post Construction



Total Phosphorus Sources: Current, During Construction and Post Construction



Total Suspended Solids: Current, During Construction and Post Construction



Sources of Runoff Volume: Current, During Construction and Post Construction

Overall Assessment

The effect of development under the 1994 Clarksburg Master Plan in the Ten Mile Creek watershed is expected to have the greatest effect in the upper sections of the watershed. The loss of significant amounts of stream length, forest cover and substantial acreage of interior forest are concerns that cannot be ignored. While the stream peak flows will probably not be affected (assuming full ESD treatment), the total runoff and duration of flow will be higher, threatening the stability of the stream

system with unpredictable results. The amount of nutrients flowing from the land may be somewhat reduced from the agricultural uses that currently occupy the land, however, nutrients generally do not affect local stream health, and are not currently affecting Ten Mile Creek. Most troubling are the predicted imperviousness levels, with all of the subwatersheds in the Stage 4 area predicted to surpass 10%, with the subwatershed encompassing most of the Town Center District portion of Ten Mile Creek surpassing 30%. Most of the streams in these subwatersheds would not likely maintain high quality conditions, and the Town Center District subwatershed is likely to be in poor condition and unable to support a healthy macroinvertebrate population, a key indicator of water quality.

Testing of Additional Scenarios

The staff will discuss potential additional scenarios for further analysis with the Planning Board on March 14, 2013.

Attachment

Draft Existing Conditions Report

Existing Conditions
in the Ten Mile Creek Study Area
In Support of the Limited Amendment to the Clarksburg Master Plan

DRAFT

Prepared for:
Maryland-National Capital Park & Planning Commission
Montgomery County Planning Department

Prepared by:

Biohabitats
Brown AND Caldwell
A Joint Venture

March 6, 2013

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LIST OF ACRONYMS

Best management practice (BMP)
IBI (index of biotic integrity)
Maryland Biological Stream Survey (MBSS)
Maryland Department of Natural Resources (MDNR)
Maryland Historical Trust (MHT)
Maryland-National Capital Park and Planning Commission (M-NCPPC)
Montgomery County Department of Environmental Protection (DEP)
Montgomery County Department of Permitting Services (DPS)
Research and development (R&D)
Sediment and erosion control (S&EC)
Special Protection Area (SPA)
Stormwater management (SWM)
Total maximum daily load (TMDL)
Transfer of development rights (TDRs)
United States Environmental Protection Agency (U.S. EPA)
USDA Natural Resources Conservation Service (NRCS)
Water quality limited segment (WQLS)

EXECUTIVE SUMMARY

The Ten Mile Creek watershed in northwestern Montgomery County is the focus of an environmental analysis study in support of the Limited Amendment to the Clarksburg Master Plan, being undertaken by the Maryland-National Capital Park and Planning Commission (M-NCPPC) Montgomery County Planning Department. This environmental analysis is being conducted for the Planning Department by Biohabitats and Brown and Caldwell, a Joint Venture, with support from the Center for Watershed Protection. It is being done in collaboration with Montgomery County Department of Environmental Protection (DEP) and Montgomery County Department of Permitting Services (DPS).

As the purpose of this study is to determine the baseline environmental conditions in order to evaluate potential watershed response to development within the Ten Mile Creek watershed, this report and future analyses will focus only on subwatersheds upstream of the existing USGS gage station and those that have the potential to be directly affected by development (Figure E.1). These subwatersheds are referred to as the Ten Mile Creek "study area." The Ten Mile Creek study area drains approximately 4.8 square miles of primarily rural and forested lands in Montgomery County, flowing from its headwaters just north of Frederick Road to Little Seneca Lake.

Existing conditions in the Ten Mile Creek were evaluated through review of GIS data and numerous reports and studies of the watershed. Key watershed characteristics are described below:

- Ten Mile Creek feeds into Little Seneca Lake, which serves as a reservoir providing additional flow to the Potomac River, a public raw water supply, during drought periods (Montgomery County Department of Park and Planning, 1994). The aquifer in the study area is designated as a Sole Source Aquifer per the United States Environmental Protection Agency's (U.S. EPA) Sole Source Aquifer Program (Greenhorne & O'Mara, Inc., 1992).

- Base flows are low in the summer months and the creek is susceptible to low flows from lack of rain. However, even in the driest years tributaries have continued to flow and to provide cool, clean water as refuge for the stream biotic community. Montgomery County DEP located seeps and springs throughout the Ten Mile Creek study area, the majority are in headwaters of tributaries to Ten Mile Creek. Both are necessary to maintain base flows in headwater streams (Montgomery County Department of Environmental Protection, 2013).

- Wetlands are concentrated along Ten Mile Creek mainstem. These are predominantly palustrine forested wetlands and are groundwater-dominated.

- Beaver have developed a series of dams in the upper reaches of Ten Mile Creek which provide pools that act as refuge for fish, amphibians and reptiles during the drier summer months and habitat for wintering waterfowl and wildlife in the winter months (Montgomery County Planning Department, 2009). In addition, "bird surveys in 2009 observed or heard 12 migratory nesting forest interior bird species in Stage 4 forest interior areas of Ten Mile Creek" (Montgomery County Planning Department, 2009).

- Development in the overall watershed is low, and roughly half of the study area is forested. Imperviousness is approximately 4%, and the remaining land cover in the study area is predominantly a mix of non-forested pervious area, including pasture, cropland, and turf. Ten Mile

Creek subwatersheds labeled LSTM206 and LSTM201 have the highest impervious cover and urban land uses.

- Subwatersheds LSTM202 and LSTM201, as well as, subwatersheds along the mainstem have the highest forested land cover. The forested cover along the mainstem and through LSTM202 and LSTM201 is a major contiguous hub linking hubs in Black Hill and Little Bennett Regional Parks by corridors. MDNR (2003) defines hubs as areas that consist of large contiguous tracts of forest land that are integral to the ecological health of the state and corridors as linear remnants of these vital habitats that form linkages among the hubs. The largest gap in forest cover occurs in northeast LSTM201, north of I-270 which bisects the corridor to Little Bennett Regional Park. Forested areas within the study area are characterized as upland or bottomland hardwood forest. Upland hardwood forest is particularly prevalent in the western portion of study area. Bottomland hardwood forests are located along stream, floodplains and wetland areas within the watershed.

- Soils within the study area were formed from weathered phyllite, a metamorphic rock, and are generally rocky with a shallow to moderate depth to bedrock and steep slopes. Based on soil survey mapping, 45 percent slopes are the steepest slopes found along the upland stream valley. The upland summits range from 3 to 8 percent slopes (Soil Survey Staff, 2013). Erodible soils were prevalent in subwatersheds LSTM203, LSTM204, LSTM202, and LSTM112. The shallow bedrock, slopes, and erodible soils could pose general siting restrictions for foundations, septic systems, roads, basements, etc., as well as a challenge for erosion and sediment control during construction activities, and post-construction stormwater management. In addition, disturbance to the shallow soils, as a result of grading associated with development, could also create negative impacts to local stream habitat and biology.

- Long-term and spatially comprehensive geomorphic monitoring data are not available for Ten Mile Creek. The limited available datasets and field observations suggest that the streams are very dynamic (i.e. streams frequently move and deposit material and adjust their shape). Evidence of widespread and significant channel degradation (i.e. chronic lowering of the channel bed with time), which is often observed in highly disturbed watersheds, is not evident in the Ten Mile Creek watershed. Flood flows along many reaches of Ten Mile Creek still access the floodplain, sustaining important geomorphic and ecological processes. Streams in the region have been subjected to an extended history of changes in sediment supply and hydrology due to land use changes. Like many streams in the region, Ten Mile Creek has adjusted in response to these historic changes, and continues to adjust to existing inputs of water and sediment.

- Long-term monitoring of the stream habitat within the Ten Mile Creek watershed by DEP, including measurement of the physical habitat and sampling of biological communities (fish, benthic macroinvertebrates, and herptofauna), indicates that the overall biological condition is in the good range (63-87) with an average score for all stations of 77. Two subwatersheds (LSTM110 and LSTM110) scored in the excellent range (>87) and two subwatersheds (LSTM112 and LSTM206) scored fair (41-63).

- In-stream physical habitat conditions (such as stream bed and bank conditions) show signs of decline since 2007. While the change is subtle over time, these conditions are indicative of a watershed that is sensitive and is responding to various stressors. Evidence of declining habitat conditions include increased embeddedness (the degree to which coarse bed material is choked by fine sediments), sedimentation, and decreased streambank vegetation. However a proportional

response in the overall biological condition has not been observed. Long-term monitoring data collected by DEP does generally indicate that the proportion of sensitive taxa, both fish and benthic macroinvertebrate, present within the watershed are declining while the tolerant individuals are increasing in both number and richness.

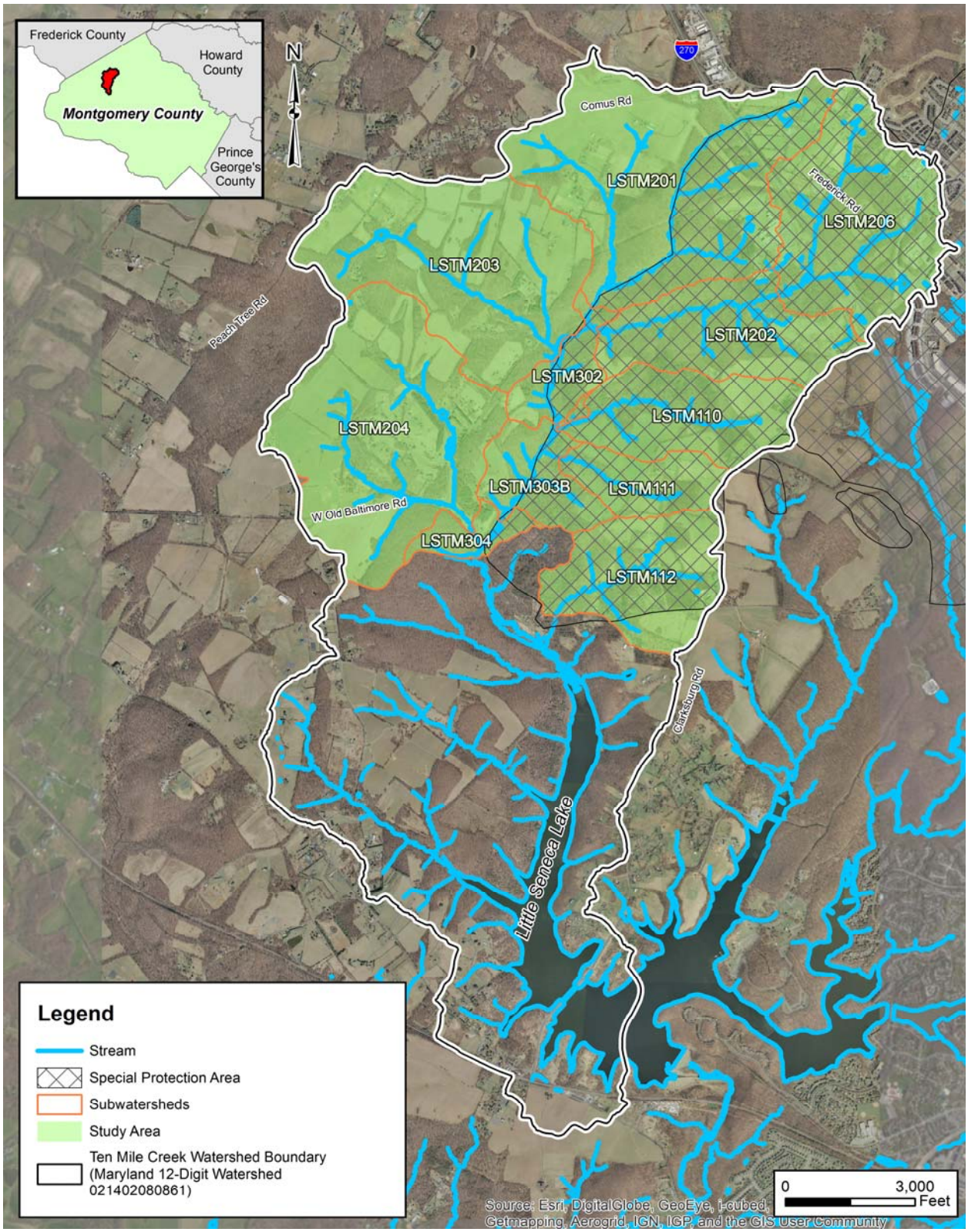

Figure E.1. Ten Mile Creek Watershed and Subwatersheds

1.0 INTRODUCTION

1.1 Introduction to the Existing Conditions Report

In response to a request by the Montgomery County Council, the Montgomery County Planning Department has asked the Planning Board to prepare a Limited Amendment to the Clarksburg Master Plan to determine how to achieve the Plan's community-building goals for the Town Center District, while protecting Ten Mile Creek. The amendment will include a comprehensive analysis of environmentally sensitive areas in the Ten Mile Creek watershed to determine ways to balance development potential and the community objectives specified in the 1994 plan with the need to protect water quality. This environmental analysis is being conducted for the Planning Department by Biohabitats and Brown and Caldwell, a Joint Venture, with support from the Center for Watershed Protection.

This report on existing conditions within the Ten Mile Creek watershed is the first product developed for this analysis. As the purpose of this study is to determine the baseline environmental conditions in order to evaluate potential watershed response to development within the Ten Mile Creek watershed, this report and future analyses will focus only on subwatersheds upstream of the existing USGS gage station and those that have the potential to be directly affected by development. These subwatersheds, displayed in Figure E.1, will be referred to as the Ten Mile Creek "study area." Sections 2, 3 and 4 provide more detailed information on the study area's land use and land cover, natural features, and community features.

A number of documents were reviewed while developing this baseline assessment; a complete listing of all Ten Mile Creek related documents obtained and reviewed is provided in Appendix A, along with a list of all GIS data sources used to create maps.

1.2 Introduction to the Ten Mile Creek Watershed

The Ten Mile Creek watershed (12-digit watershed code 021402080861) is located in the Clarksburg area of northwestern Montgomery County (Figure E.1). The drainage area of the ***study area*** within Ten Mile Creek – the focus of this report and future analyses – is approximately 3,046 acres (4.8 square miles) and drains into Little Seneca Lake reservoir (Figure 1.1), which flows into the Potomac River.

Ten Mile Creek originates just north of MD 335 (Frederick Road) and flows into Little Seneca Lake. Little Seneca Lake serves as a reservoir providing additional flow to the Potomac River, a public raw water supply, during drought periods (Montgomery County Department of Park and Planning, 1994). Little Seneca Lake, constructed from 1982 to 1985, has a surface area of 505 acres, a shoreline of 15.7 miles, and an average depth of 24.7 feet. The dam was constructed of earth and rock and rises 91 feet above the stream (Greenhorne & O'Mara, 1992). Ten Mile Creek and its tributaries are designated as a Use I-P stream – protection of water contact recreation, aquatic life and drinking water supply (Montgomery County Department of Park and Planning, 1994).

A portion of Ten Mile Creek study area, all land east of Ten Mile Creek mainstem and north of West Old Baltimore Road, is located within the Clarksburg Master Plan Special Protection Area (SPA). The SPA was developed as a result of the Clarksburg Area Master Plan, adopted in 1994, and also includes portions of Little Seneca Creek, Cabin Branch, and Wildcat Branch subwatersheds (Montgomery County Department of Environmental Protection, 2012). In addition, a portion of the watershed west of Ten Mile Creek is within the county-wide Agricultural Reserve. This is a result of the western portion of the watershed

being dominated by larger parcels and agriculture land uses (Montgomery County Department of Park and Planning, 1994). A basic profile of the study area is provided in Table 1.1. The study area within Ten Mile Creek includes 11 subwatersheds (Table 1.2 and Figure E.1).

Table 1.1. Profile of the Current Ten Mile Creek Study Area

Area in Montgomery County	• 3,046 acres (4.8 square miles)
Stream Length	• Approximately 22 miles (including Ten Mile Creek and its tributaries)
Land Use	• 46% Forest • 38% Rural • 7% Low Density Residential
Land Cover	• 4% Impervious Cover • 46% Forest Cover • Remaining land cover predominantly a mix of non-forested pervious area, including pasture, cropland, and turf
Water Quality	• Use I-P Stream
Major Transportation Routes	• Dwight D. Eisenhower Memorial Highway (I-270) • Frederick Road (MD 355)
Significant Natural and Historical Features	• Rustic roads • Old Baltimore Road stream ford • Cemeteries • 1994 Clarksburg Master Plan Individual Sites (Clarksburg School, Moneysworth Farm, and Cephas Summers House) • 1994 Clarksburg Master Plan Historical District (Clarksburg Historical District)

Table 1.2. Ten Mile Creek Study Area Subwatersheds

Subwatershed	Within Special Protection Area (SPA)	Area (acres)	Area (square miles)	Percent of Study Area
LSTM110	Yes	211	0.3	7%
LSTM111	Yes	104	0.2	3%
LSTM112	Partial	228	0.4	7%
LSTM201	Partial	611	1.0	20%
LSTM202	Yes	243	0.4	8%
LSTM203	No	493	0.8	16%
LSTM204	No	544	0.8	18%
LSTM206	Yes	370	0.6	12%
LSTM302	Partial	77	0.1	3%
LSTM303B	Partial	117	0.2	4%
LSTM304	Partial	49	0.1	2%
TOTAL		**3,046**	**4.8**	**100%**

Source: (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)

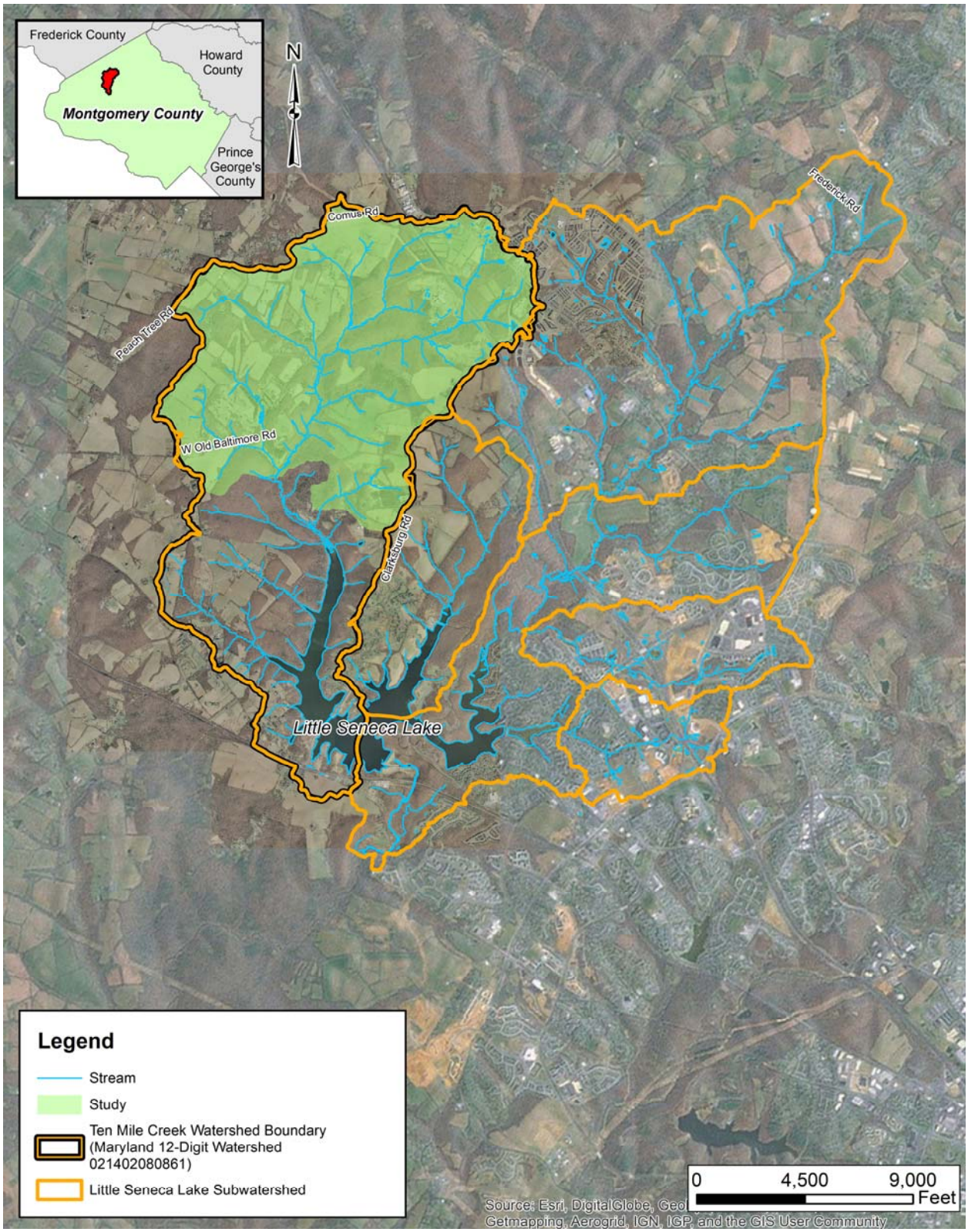

Figure 1.1. Little Seneca Lake Watershed

2.0 LAND USE AND LAND COVER

2.1 Existing Land Use

The principal land uses within the Ten Mile Creek study area include forest, rural, and low-density residential, as shown in Figure 2.1 and Table 2.1. The east side of the study area is within the Clarksburg SPA. The remainder is zoned Rural Density Transfer (RDT) and is not part of the SPA because the rural zoning precludes significant development of the area.

Table 2.1. Land Use in the Ten Mile Creek Study Area

Land Use	Area (acres)	Percent of Total
Forest	1,420	46%
Rural	1,145	38%
Low-density Residential	203	7%
Transportation	86	3%
Institutional	75	2%
Bare Ground	38	1%
Water & Wetlands	27	1%
Medium-density Residential	20	1%
Industrial	16	1%
Commercial	9	<1%
High-density Residential	7	<1%
TOTAL	**3,046**	**100%**

Data source: Maryland Department of Planning, 2007 (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)

Table 2.2 lists completed or active development projects according to the County's SPA Reports. As shown in the table, construction is currently underway or has been completed on several projects in the study area.

Table 2.2. Recent Development Activity in the Clarksburg Special Protection Area

Development	Subwatershed	Land Use	Status
Clarksburg Detention Facility	LSTM206, LSTM202, LSTM201 & LSTM106	34 acres, Jail	• Under Construction in 1998 • Construction Completed in 2002 • Stormwater Conversion in April 2003
Stringtown Road Extension	LSTM206	17 acres, Roadway	• Under Construction 2004 • Construction Completed in November 2006
Gateway Commons	LSTM206		• March 2008, <30% under construction • November 2008, 30 to 60% constructed • 2010, >60% completed, and 30 to 60% permanently stabilized
Gateway 270 Corporations	LSTM206		• Construction Completed in 2010

Data source: DEP SPA Reports, 1994-2010

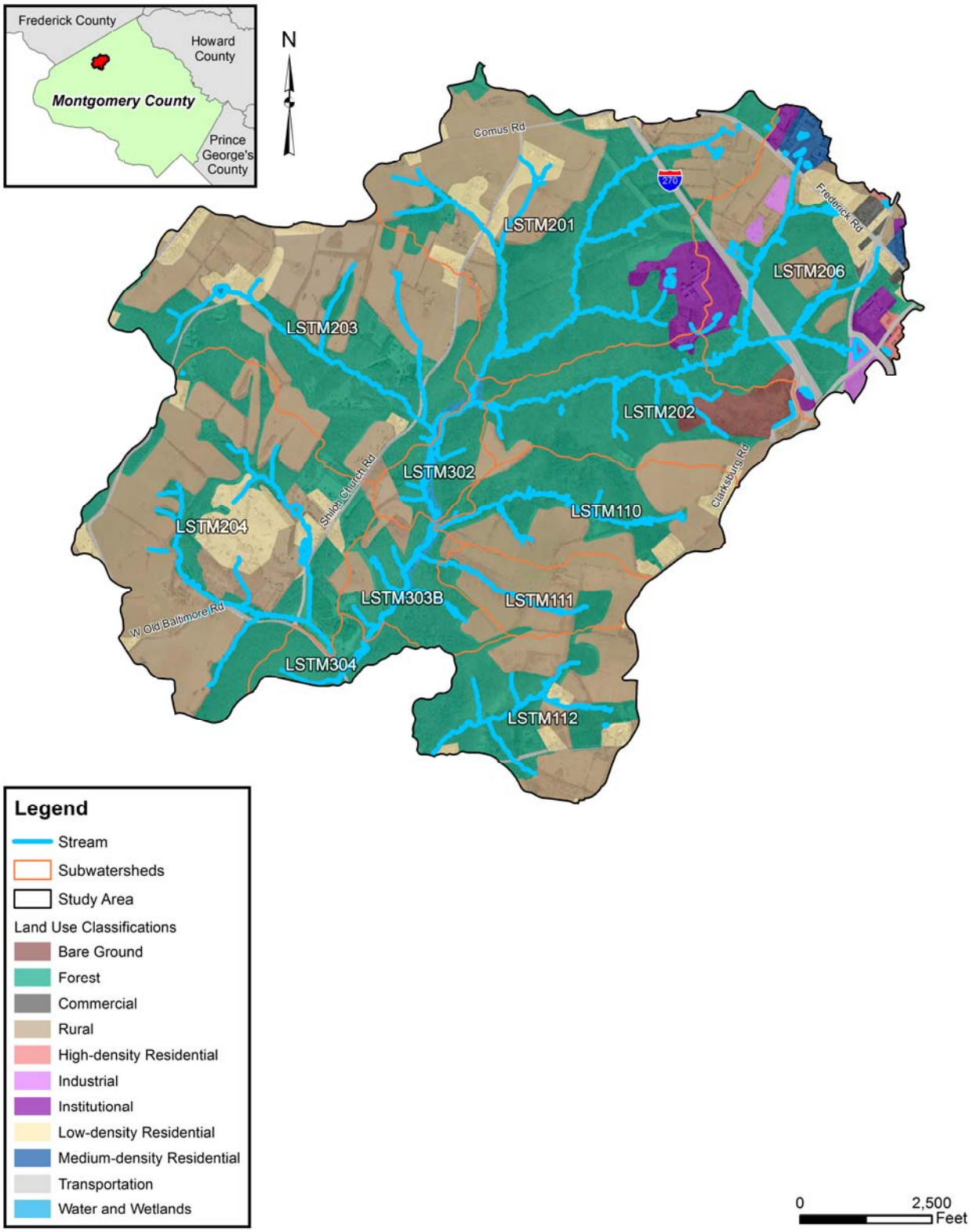

Figure 2.1. Land Use in the Ten Mile Creek Study Area

2.2 Land Cover

Forty-six percent of the Ten Mile Creek study area (Figure 2.2) is in forest cover, while only 4% is in impervious cover. Forest cover and imperviousness by subwatershed is displayed in Table 2.3. Remaining land cover in the study area is predominantly a mix of non-forested pervious area, including pasture, cropland, and turf.

Smaller subwatersheds along the mainstem of Ten Mile Creek have the highest percentage of forest cover, including LSTM304, LSTM303B, and LSTM302. The largest contributors to forest cover in the study area includes subwatersheds LSTM201, LSTM203, LSTM204, LSTM202 and LSTM206. More discussion on the study area's forest cover, including forest interior and habitat value, is provided in Section 3.9 of this report.

Subwatershed LSTM206 has the highest percentage of imperviousness at 16%. It is also the largest contributor of impervious cover to the study area at nearly 49% of the total impervious cover acreage, followed by subwatershed LSTM201 at 19%. Both subwatersheds include I-270 and developed areas east of the highway.

Table 2.3. Imperviousness and Forest Cover in the Ten Mile Creek Study Area

Subwatershed	Subwatershed Imperviousness (%)	Contribution to Study Area Imperviousness (%)	Subwatershed Forest Cover (%)	Contribution to Study Area Forest Cover (%)
LSTM206	16.2%	48.9%	42%	11%
LSTM201	3.8%	19.0%	44%	19%
LSTM204	2.5%	11.0%	33%	13%
LSTM203	1.9%	7.6%	41%	14%
LSTM112	2.5%	4.7%	49%	8%
LSTM202	2.2%	4.5%	67%	12%
LSTM110	1.6%	2.7%	45%	7%
LSTM111	1.2%	1.0%	19%	1%
LSTM304	0.9%	0.4%	89%	3%
LSTM303B	0.1%	0.1%	77%	7%
LSTM302	0.1%	0.1%	83%	5%

Data source: DEP Impervious Cover, 2012; MCP Forest Cover, 2008 (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)

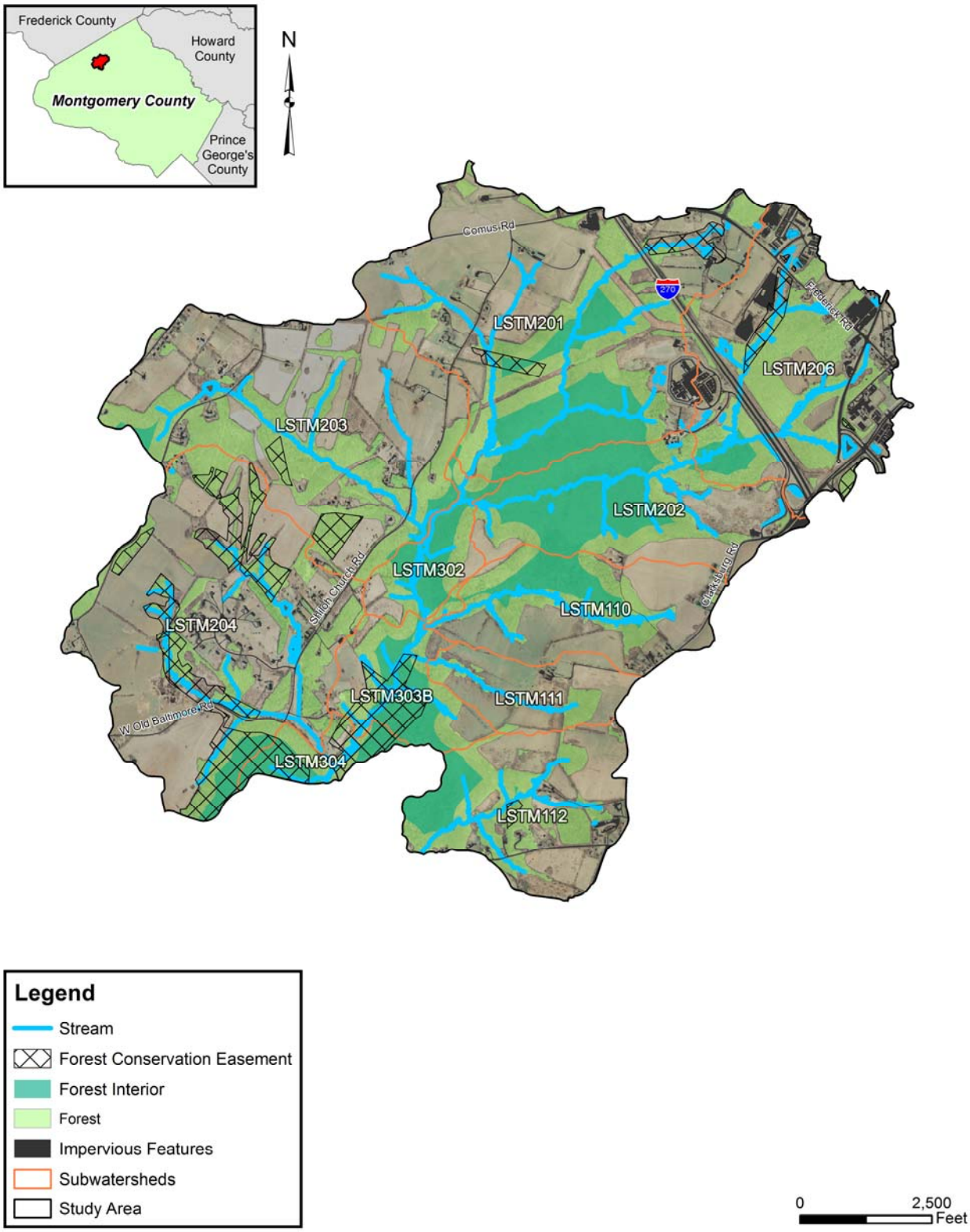

Figure 2.2. Land Cover in the Ten Mile Creek Study Area

2.3 Clarksburg Master Plan

The Ten Mile Creek watershed includes part of the Town Center District and all of the Ten Mile Creek Area in the 1994 Clarksburg Master Plan. The plan envisioned the Town Center District as a strong central focus for the entire master plan area, while also emphasizing the protection of Ten Mile Creek as a sensitive and fragile natural resource. The plan envisions land uses and densities that would result in relatively high levels of imperviousness. Most of the Ten Mile Creek area was placed in the last implementation stage to allow evaluation of protection measures and consideration of additional water quality measures and land use actions.

West of I-270, the master plan provisions for the Ten Mile Creek Area recommended a balance of environmental concerns, housing needs and employment uses in the high-technology employment corridor. The provisions included:

- employment sites with development criteria to help address environmental concerns,
- low density residential use for land west of MD 121,
- low density residential (2-4 units per acre) between the mainstem of the creek and Shiloh Church Road with a substantial area of private conservation area and parkland, and
- the remaining area in the watershed in rural residential (1 unit per 5 acres) and agricultural reserve.

The research and development (R&D) land in the Ten Mile Creek Area is limited to 15% imperviousness and with uses tightly clustered close to I-270. The residential area west of MD 121 is approximately 600 acres and is limited to a maximum of 900 units, with any units beyond the base density requiring the purchase of transfer of development rights (TDRs). The plan specifies that at least 70% must be single family dwellings, with the open space and conservation areas being undeveloped and forested.

3.0 NATURAL FEATURES

3.1 Climate

Table 3.1 shows the normal monthly temperature, precipitation and snowfall records from the nearest National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) weather station. This station is located in southwest Damascus, Maryland, but the data is representative of the general climate conditions in the Ten Mile Creek watershed. Overall, the average mean daily temperature is 54.5 degrees Fahrenheit (NCDC, 2010). The average monthly precipitation reaches a maximum of 5.15 inches in May and a minimum of 3.01 inches in February. The mean precipitation total is 43.9 inches and the mean snow total is 26.0 inches (National Climate Data Center, 2010). Montgomery County's growing season, the period between the last killing frost in the spring and the first in the fall, extends from approximately the beginning of April to the end of October. The growing season is approximated by median dates (e.g., 50 percent probability) of 28°F air temperatures based on WETS tables available from NRCS National Water and Climate Center (National Weather and Climate Center, 2002).

Table 3.1. Summary of Monthly Normals 1981-2010

Month	Daily Maximum (°F)	Daily Minimum (°F)	Mean (°F)	Mean Precipitation Totals (in.)	Mean Snow Totals (in.)
January	39.8	25.0	32.4	3.09	10.0
February	44.3	26.9	35.6	3.01	6.8
March	53.0	34.0	43.5	4.04	3.0
April	64.4	43.6	54.0	3.47	1.0
May	72.9	51.8	62.3	5.15	0.0
June	81.4	60.7	71.1	3.57	0.0
July	85.6	65.1	75.3	3.46	0.0
August	83.8	64.2	74.0	3.08	0.0
September	77.2	56.7	67.0	4.22	0.0
October	65.2	46.3	55.8	3.82	0.0
November	54.8	38.0	46.4	3.61	1.2
December	43.5	29.0	36.3	3.38	4.0
Total				**43.9**	**26.0**

Data source: Weather station Damascus 3 SW, MD US (National Climate Data Center, 2010).

3.2 Topography

The Ten Mile Creek watershed is within the Mt. Airy Upland District of the Piedmont Upland Section of the Piedmont Plateau Province (Reger & Cleaves, 2008). This section of the Piedmont physiographic province is characterized by gently rolling upland of low relief to very rolling and hilly topography, with some major streams incised into narrow, steep-sided valleys. Stream network patterns have been affected by joints in the bedrock and interactions of thin siltstones and quartzites that are oblique to the bedrock strike (Reger & Cleaves, 2008).

Within the Ten Mile Creek study area, ground elevations range from 390 to 680 feet above sea level (Figure 3.1). Based on soil survey mapping, 45 percent slopes are the steepest slopes found along the upland stream valley. The upland summits ranged from 3 to 8 percent (Soil Survey Staff, 2013).

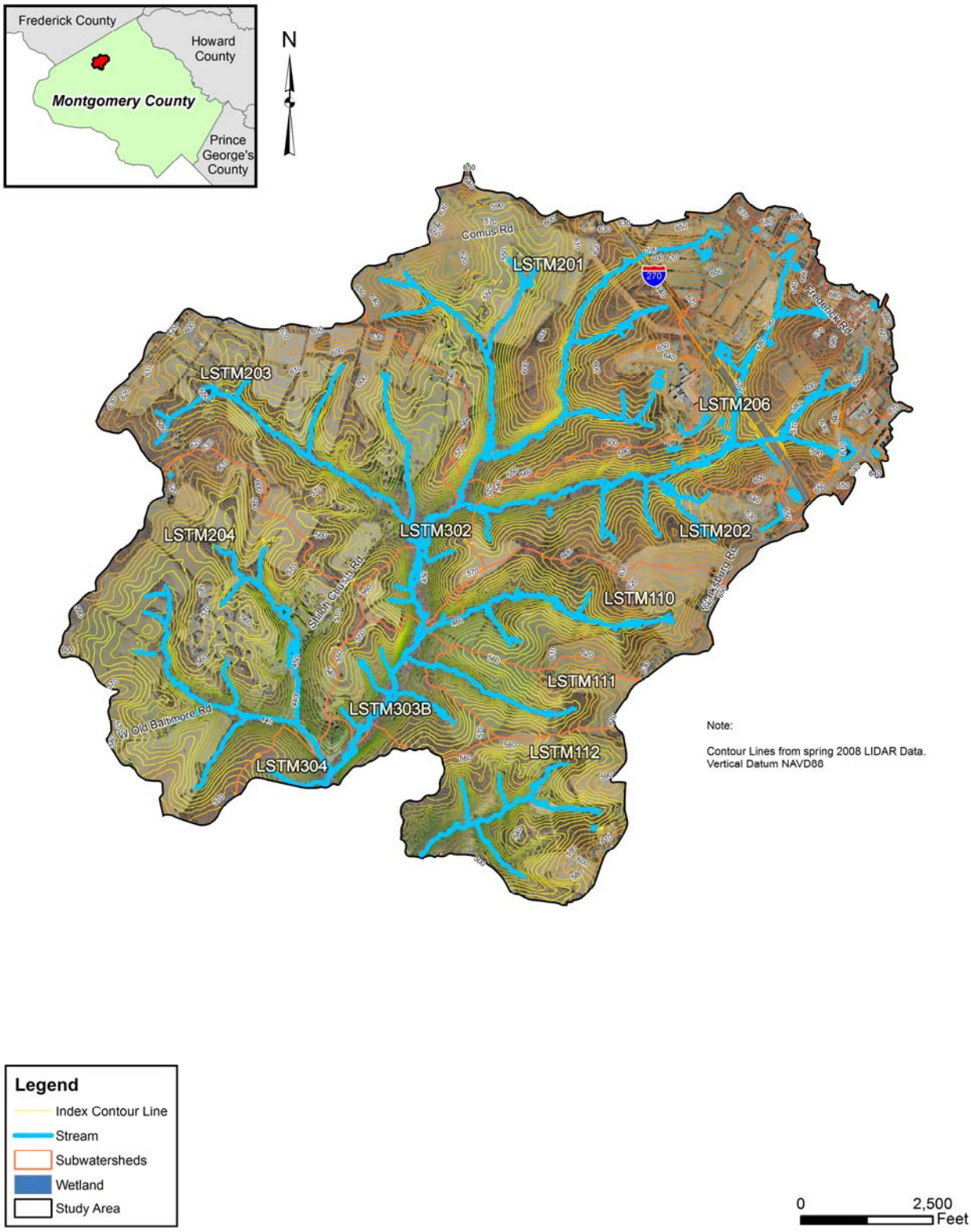

Figure 3.1. Ten Mile Creek Study Area Topography

3.3 Geology

Available GIS mapping shows one predominant bedrock lithology, phyllite, in the Ten Mile Creek study area. Phyllite is a metamorphosed rock (altered at depth by pressure and heat), intermediate in grade between a slate and mica schist. Additional mapping available online through the Maryland Geological Survey (1968) identifies the unit as the Ijamville Formation. The Ijamville Formation includes a suite of rocks that were originally sedimentary (a layered rock resulting from consolidation of sediment) and underwent alteration over time. Specific rock types identified by the Maryland Geological Survey (1968) include blue, green, or purple phyllite and phyllitic slate, with interbedded metasiltstone and metagraywacke and local pumiceous blebs. Lenses of quartz-rich rocks have also been observed in bedrock outcrops along streams in the Ten Mile Creek study area. The bedrock geology of Ten Mile Creek is typical of other nearby watersheds in Montgomery County, which are underlain by Western Piedmont metasedimentary rocks (sedimentary rocks altered by pressure and heat, Maryland Geological Survey [1968]). The phyllitic bedrock is associated with shallow soil formation in the Ten Mile Creek watershed.

3.4 Soils

According to USDA Natural Resources Conservation Service (NRCS) Soil Survey mapping, the study area within Ten Mile Creek is mapped with fifteen soil map units excluding water (Figure 3.2 and Table 3.2) (Soil Survey Staff, 2013). The soils map units mapped along nearly level ridge crests and side slopes of ridges formed in residuum (soil formed in place) weathered from phyllite and schist. The soil series composing these map units are either shallow to moderately deep with a restrictive layer of lithic (hard bedrock that is not able to be dug with hand tools) or paralithic (bedrock that can be dug with difficulty with hand tools) bedrock. Shallow soils have a restrictive layer ranging from 10 to 20 inches from the soil surface, while moderately deep soils have a restrictive layer ranging from 20 to 40 inches. The shallow and moderately deep soils are evidence that geology – phyllite – is more resistant to weathering and slower to form deep soils. In addition, these soil series are typically well drained, have steep slopes ranging from 15 to 45 percent slopes, and have rock fragments on the surface and throughout the soil profile. The soil map units mapped along Ten Mile Creek mainstem and its tributaries were formed in alluvium (soil deposited by flowing water) or colluvium (soil accumulated by the action of gravity). The soil series composing these map units are either poorly drained or moderately well drained and a few may experience flooding (Soil Survey Staff, 2013). A more detailed description of the soil map units and their soil series is provided in Appendix B.

The soils are able to support several vegetative habitats throughout the Ten Mile Creek study area including upland hardwood forests, bottomland hardwood forests, and palustrine forest wetlands, in addition to agricultural practices (i.e. pasture and crops) (Greenhorne & O'Mara, 1992; Montgomery County Department of Parks and Planning, 1994). The shallow depth to bedrock and steep slopes of the soils dominating the study area will be the most limiting factors to development (e.g., roads, excavation, etc.) and its associated erosion and sediment control.

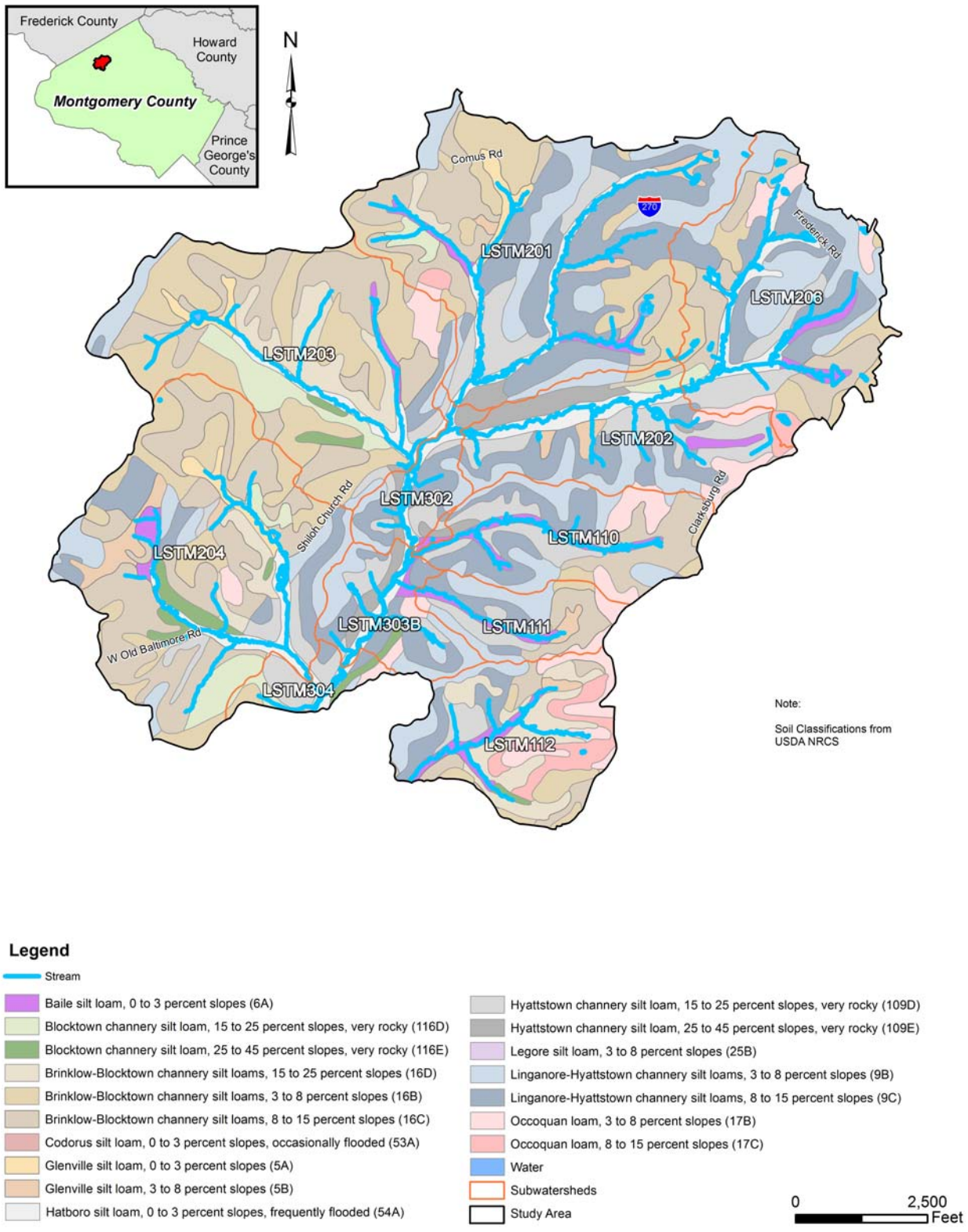

Figure 3.2. Ten Mile Creek Study Area Soils

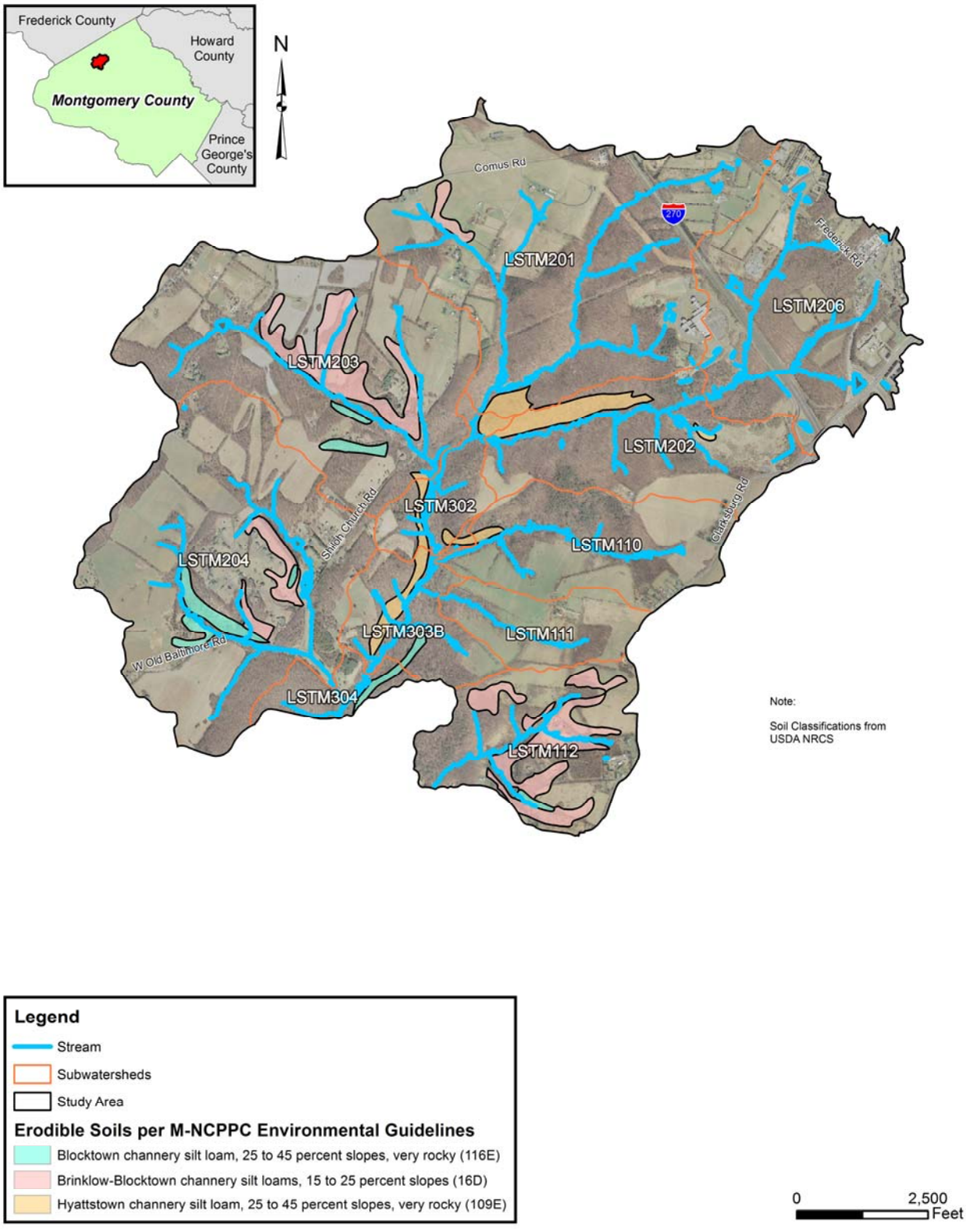

Figure 3.3. Ten Mile Creek Study Area Erodible Soils

Using the Planning Board's Environmental Guidelines list of erodible soils, the following soil map units were identified as erodible: Blocktown channery silt loam, 25 to 45 percent slopes, very rocky (116E); Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes (16D); and Hyattstown channery silt loam, 25 to 45 percent slopes, very rocky (109E) (Figure 3.3) (Montgomery County Department of Park and Planning, 2000; Montgomery County Planning Department, 2013). The shallow depth to bedrock, presence of rock fragments on the surface and within the soil profile, and steep slopes of these selected map units can contribute to the soils' susceptibility to erosion. These same three characteristics are observed in other soil map units within the study area such as Blocktown channery loam, 15 to 25 percent slopes (116D) and Hyattstown channery silt loam, 15 to 25 percent slopes (109D). .

Subwatersheds with the highest percentage of erodible soils within the study area are LSTM112, LSTM203, LSTM303B, and LSTM302 (Table 3.3) in decreasing order. These subwatersheds tend to have the highest concentration of erodible soils because each subwatershed's landscape is highly dissected by the Ten Mile Creek mainstem or its tributaries, contributing to the presence of steeper slopes – a contributing factor to erodibility. It is typical of a highly dissected landscape to have steeper slopes.

Hydrologic soil groups (HSGs) help define the amount of runoff and infiltration capacity of a drainage area and are categorized into four groups – A, B, C, and D. "Most of the groupings are based on the premise that soils found within a climatic region that are similar in depth to a restrictive layer or water table, transmission rate of water, texture, structure, and degree of swelling when saturated, will have similar runoff responses (Natural Resources Conservation Service, 2009)." The four HSGs are briefly defined as follows (Natural Resources Conservation Service, 2009):

- Group A: Soil with low runoff potential and high infiltration capacity.
- Group B: Soil with moderately low runoff potential and moderately high infiltration capacity.
- Group C: Soil with moderately runoff potential and moderate infiltration capacity.
- Group D: Soil with high runoff potential and low infiltration capacity.

The HSGs dictate the type of stormwater management strategy applicable for development in a particular area based on parameters such as infiltration. For example, infiltration practices are best suited for HSG A or B soils, whereas practices with underdrains or detention practices are more appropriate for HSG C or D soils (Maryland Department of the Environment and Center for Watershed Protection, 2009). Three– B, C, and D – are within the study area (Table 3.2). Since infiltration can vary from location to location, infiltration should be field tested prior to the start of any design.

Table 3.2. Soils in the Study Area within Ten Mile Creek Study Area

Soil Map Unit Name (Symbol)	Acres of Study Area	Percent of Study Area	Hydrologic Soil Group
Glenville silt loam, 0 to 3 percent slopes (5A)	38.2	1.3%	C
Glenville silt loam, 3 to 8 percent slopes (5B)	52.1	1.7%	C
Baile silt loam, 0 to 3 percent slopes (6A)	93.3	3.1%	D
Linganore-Hyattstown channery silt loams, 3 to 8 percent slopes (9B)	424.2	13.9%	B
Linganore-Hyattstown channery silt loams, 8 to 15 percent slopes (9C)	493.7	16.2%	B
Brinklow-Blocktown channery silt loams, 3 to 8 percent slopes (16B)	473.8	15.6%	B
Brinklow-Blocktown channery silt loams, 8 to 15 percent slopes (16C)	544.3	17.9%	B
Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes (16D)*	140.7	4.6%	B

Table 3.2. Soils in the Study Area within Ten Mile Creek Study Area

Soil Map Unit Name (Symbol)	Acres of Study Area	Percent of Study Area	Hydrologic Soil Group
Occoquan loam, 3 to 8 percent slopes (17B)	129.5	4.3%	B
Occoquan loam, 8 to 15 percent slopes (17C)	45.5	1.5%	B
Hatboro silt loam, 0 to 3 percent slopes, frequently flooded (54A)	169.5	5.6%	D
Hyattstown channery silt loam, 15 to 25 percent slopes, very rocky (109D)**	264.5	8.7%	C
Hyattstown channery silt loam, 25 to 45 percent slopes, very rocky (109E)*	55.4	1.8%	C
Blocktown channery silt loam, 15 to 25 percent slopes, very rocky (116D)**	84.7	2.8%	C
Blocktown channery silt loam, 25 to 45 percent slopes, very rocky (116E)*	34.4	1.1%	C
Water (W)	2.3	0.1%	-

*Identified as M-NCPPC's highly erodible soils.
**Identified as additional erodible soils of concern.

Data source: (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)

Table 3.3. Erodible Soils by Subwatershed

Subwatershed	Erodible Soils[1]	
	Acreage	% of Subwatershed
LSTM110	2.2	1.1%
LSTM111	-	-
LSTM112	61.5	27.0%
LSTM201	14.7	2.4%
LSTM202	22.5	9.3%
LSTM203	65.1	13.2%
LSTM204	36.2	6.7%
LSTM206	-	-
LSTM302	9.7	12.6%
LSTM303B	15.0	12.8%
LSTM304	3.6	7.4%

Source:
[1] Montgomery County Planning Department, 2013)

3.5 Hydrology

Streams

The Ten Mile Creek study area is comprised of nearly 22 miles of streams (Figure 3.4). There are several sources of information descriptive of the stream hydrology in the Ten Mile Creek study area. Available information and resources are briefly summarized below, and include a relatively new stream gage and results from a synoptic flow survey conducted by DEP. However, as is typical for a watershed of this size, there is no long-term, more comprehensive gage network or hydrologic dataset available.

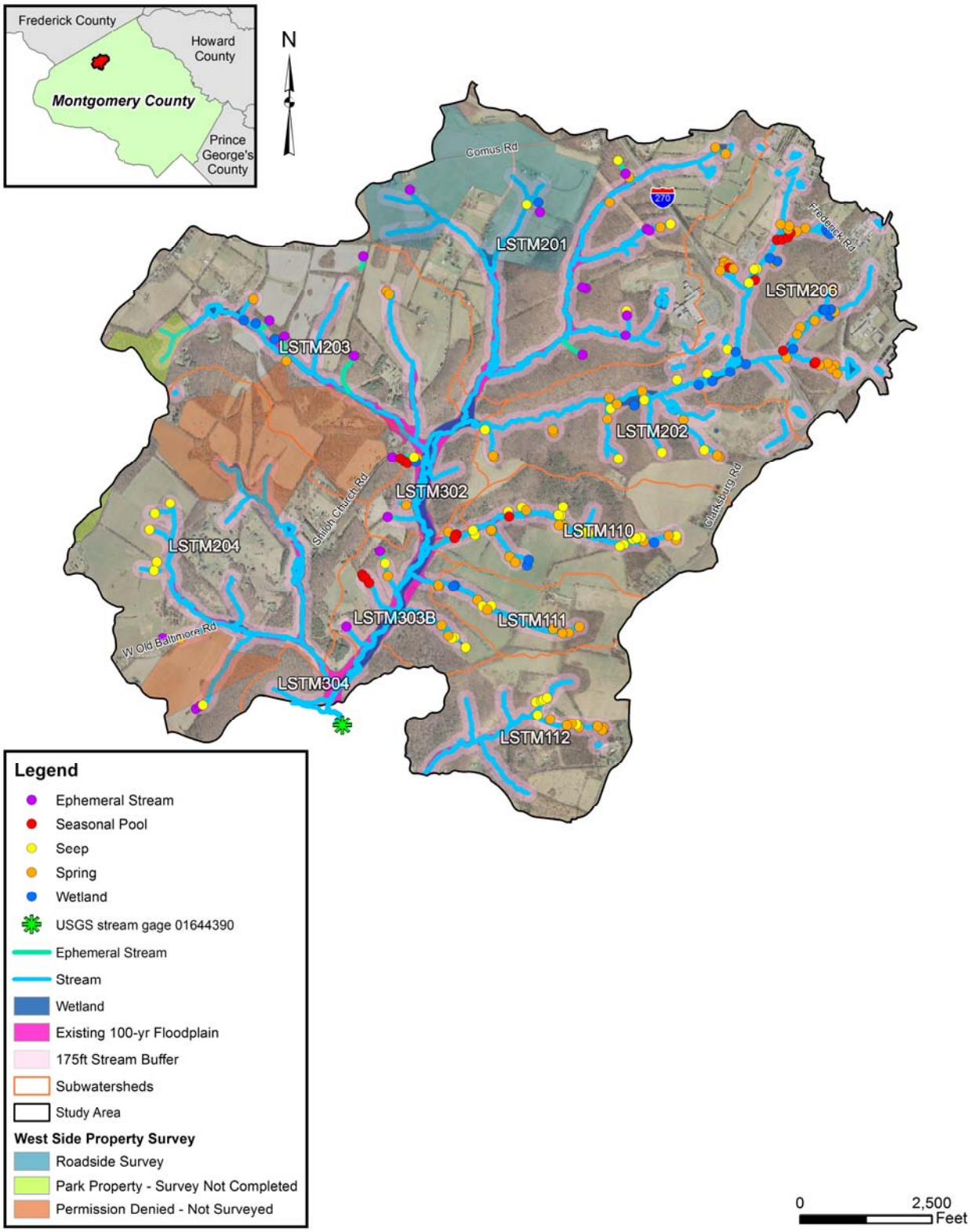

Figure 3.4. Key Hydrologic Features in the Ten Mile Creek Study Area

There is one gage (USGS gage 01644390) located on the left bank of Ten Mile Creek downstream from West Old Baltimore Road and approximately 0.3 mile upstream from Little Seneca Lake, just downstream of DEP monitoring station LSTM304 and the study area. The period of record is short and extends back only to October 2010. During the period of record, which includes two water years of data (the period between October 1st of one year and September 30th of the next), peak flows reached 2,180 cfs (February 2012, local storm) and 5,520 cfs (September 2011, Tropical Storm Lee) (United States Geologic Survey, 2013). Daily mean flows tend to fall between 0.5 and 2 cfs in the months of June through August and 2 to 10 cfs in the months of November through April (Appendix C). Better information about the magnitude and frequency of flows will be obtained as the period of record extends.

Montgomery County DEP has conducted "synoptic" flow measurements across the watershed during baseflow conditions. For each sample event, flow measurements are taken at 15 locations from headwaters to just above the reservoir on the same calendar day. The purpose is to broadly show the magnitude and relative contributions of subwatersheds to overall watershed baseflow hydrology at (approximately) the same time. The flow study was conducted three times in the summer (June and July) of 2009, and once in December 2012. Results are similar between sample events and years, with measured flows along headwaters streams less than 1 cfs, and mainstem flows reaching 1 cfs at approximately half of the full watershed area and exceeding 1 to 3 cfs at the downstream-most sample points (Appendix C).

As described in Section 1.2, the Ten Mile Creek watershed drains into Little Seneca Lake. Little Seneca Lake was created by the construction of a dam, which was completed in 1984, on Little Seneca Creek. Little Seneca Lake serves as a reservoir providing additional flow to the Potomac River, a public raw water supply, during drought periods, and also supports recreational activities (Montgomery County Department of Park and Planning, 1994). Based on available information reviewed, the reservoir does not affect the hydrology of Ten Mile Creek within the study area (i.e. via flow attenuation or backwater).

Wetlands

According to GIS data provided by Planning and DEP, the study area in Ten Mile Creek watershed has approximately 86 acres of wetlands (Figure 3.4; Table 3.4). This wetland acreage includes wetlands identified by County agencies, as well as wetlands identified during the 1997 Wetlands Study performed by C. Athanas, Ph.D. & Associates, Inc. and Dewberry & Davis (1997). The wetlands within the Ten Mile Creek study area are predominantly palustrine forested wetlands and are groundwater-dominated (Montgomery County Department of Park and Planning, 1994; Athanas & Dewberry & Davis, 1997). A palustrine forest wetland is defined as a nontidal wetland dominated by woody vegetation six meters or taller (Cowardin, Carter, Golet, & LaRoe, 1979).

The subwatersheds within the study area with the highest percentage of wetlands are LSTM302, LSTM303B, and LSTM304 (Table 3.4). All three subwatersheds are located along the Ten Mile Creek mainstem and contain a portion of the largest contiguous wetland area denoted by Planning and DEP GIS data (Figure 3.4) (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013).

Table 3.4. Wetland Coverage in Ten Mile Creek Study Area by Subwatershed

Subwatershed	Wetland Area (acres)	Percent of Subwatershed (%)
LSTM110	1.7	1%
LSTM111	0.5	1%
LSTM112	0.2	<1%
LSTM201	7.7	1%
LSTM202	5.3	2%
LSTM203	9.2	2%
LSTM204	2.6	<1%
LSTM206	12.9	3%
LSTM302	25.9	33%
LSTM303B	16.3	14%
LSTM304	4.0	8%
TOTAL	**86.3**	

Data source: (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013)

Springs and Seeps

Montgomery County DEP located 51 seeps and 78 springs throughout the Ten Mile Creek study area (Figure 3.4), mostly concentrated at the heads of tributaries and at the confluence of two streams. A seep is defined as a water feature exclusively fed by groundwater and does not typically flow, whereas a spring is a water feature fed by groundwater that flows intermittently or constantly (Montgomery County Department of Environmental Protection, 2012). Seeps and springs in the headwaters of tributaries to Ten Mile Creek are necessary to maintain base flows in headwater streams (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013). "These tributaries begin at springs such as the King Spring, Hancock Spring, and an unnamed spring along Frederick Road" near the intersection with Clarksburg Road. These springs have provided cool clean water for a long time as evidenced by the use of native rock by early settlers to protect the spring head. Trout and other sensitive aquatic species rely on this source of cool, clean water (Montgomery County Planning Department, 2009)." In general, there does not appear to be a correlation between the soil mapping unit and the presence of springs and seeps.

Groundwater

According to the Clarksburg Environmental & Water Resources Study (Greenhorne & O'Mara, Inc., 1992), the groundwater resources in Little Seneca Lake watershed, which contains Ten Mile Creek watershed, "are generally limited with respect to available yields. The majority of the existing wells produce only enough water for a single household and no municipal wells exist within the study area." The aquifer in the study area is designated as a Sole Source Aquifer per the U.S. EPA's Sole Source Aquifer Program (Greenhorne & O'Mara, Inc., 1992).

3.6 Stream Geomorphology

Geomorphology is the study of landforms, including hillslopes and rivers, and the processes that shape them. Geomorphic information can be used to evaluate why current landscapes look the way they do, and to predict future changes. The geomorphic study of rivers draws from field observations, historical information, and measurements of channel pattern and shape. Geomorphic study helps identify the

dominant processes active in a landscape. Along streams, this includes erosion and deposition of sediment along the bed and banks.

The general geomorphic history and fluvial processes active today in the study area are typical of the Maryland Piedmont physiographic region. Streams in the region reflect a complex legacy of historical land use practices, with three periods of differing hydrology and sediment supply, as summarized by Jacobson & Coleman (1986). Prior to colonization, floodplains were characterized by thin, fine overbank deposits. Following colonization in the period from 1730 to 1930, the morphology, or form, of streams and floodplains changed in response to greatly increased sediment supply and moderately increased discharges or stream flow. This resulted in thick, fine overbank sediment deposits on the floodplain and thin lateral accretion sands. After 1930, farm abandonment and the introduction of soil conservation practices slightly decreased water yield and substantially decreased sediment yield. Streams adjusted by reworking floodplain sediments, including removal of finer sediment and redeposition of coarsest sediment as a new, lower inset floodplain surface along a deeper, wider channel.

These types of observations demonstrate the role of watershed processes in the evolution of stream channels, as well as the relevance of geomorphic history in the explanation of appearance and behavior of streams. While this sequence of channel adjustment is broadly applicable to the Piedmont streams of Montgomery County, Ten Mile Creek is likely to have been subject to a similar cycle of inputs and adjustments in the historical past. In addition, streams in the Ten Mile Creek study area have been impacted by localized disturbances, both natural and man-made. Natural influences include vegetation (e.g., debris dams) and wildlife (e.g., beaver dam construction). Man-made or anthropogenic influences include stream straightening and channelization, channel crossings (e.g., fords, culverts at road crossings) and dam construction (e.g., mill ponds). A detailed inventory of these historical impacts is not available for the Ten Mile Creek watershed. However, there are known examples of these influences. Examples include current evidence of beaver activity in upper reaches of Ten Mile Creek (Montgomery County Planning Department, 2009; Figure 3.5), landowner accounts of small dams along the channel, and a long-term channel ford along West Old Baltimore Road.

There is little geomorphic data available documenting channel form change over time in the watershed. Montgomery County maintains a number of biological monitoring stations within the Ten Mile Creek watershed. At a majority of these stations, a monumented channel cross section was established as early as 1996. Resurvey of some these cross sections has occurred during some subsequent years (1997 and 1998 mostly; with a few resurveys in 1999, 2000, and 2006; and additional resurvey in 2013 where monuments could be found). Over this 16-year period, the degree of channel change varies considerably between sites. Data sets from stations with the most numerous resurveys (e.g., four years of survey or more) were reviewed to characterize the magnitude and rate of geomorphic adjustment at these stations. The stations reviewed are as follows:

- Station LSTM106 (inactive, tributary of LSTM201): This small tributary (<0.5 square mile drainage area) has maintained the most consistent channel shape, with only minor channel bed elevation changes.
- Station LSTM202 and LSTM206: Cross sections on these intermediate streams (0.5 - 1 square mile drainage area) show minor fluctuations in bed elevation. Sections with side or midchannel sediment bars, in which sediment is stored and remobilized during larger flow events, show the most fluctuations in channel bed shape and bank position.

- Station LSTM303B and LSTM304: These larger streams (>3 square mile drainage area) show the channel invert lowering about a foot across the complete survey record and some channel enlargement (i.e. an increase in cross-sectional area below the floodplain elevation).

Figure 3.5. Recent beaver activity along Ten Mile Creek near monitoring station LSTM206.

One may expect the potential for geomorphic adjustment (both short and long-term) to be greatest in the larger streams, with relatively greater cumulative changes in hydrology and sediment supply with increasing drainage area. Even so, it is difficult to definitively identify long-term trends in geomorphic adjustment relative to short-term fluctuations given limitations of the data set. A more extended monitoring record in conjunction with geomorphic mapping could be used to better evaluate this.

Observations made during field reconnaissance within the Ten Mile Creek watershed are consistent with available cross-sectional survey information. The tributaries and mainstem channel in the Ten Mile Creek watershed are active and respond to spatially variable conditions (e.g., debris, vegetation, beaver activity, cutoff channels). Bank erosion is apparent throughout the stream system, sometimes expressed along the outer edge of meander bends as nearly vertical banks three to four feet in height. Conversely, bed material is regularly mobilized and deposited in side and midchannel sediment bars, whose shape and elevation fluctuates in response to flood events. In most locations, the stream network is in contact with the adjacent floodplain, with recent sandy deposits and debris lines apparent along streamside trees. That floodplain connection effectively reduces the shear stresses or the force exerted by flowing water on the bed and bank within the main channel, and promotes maintenance of a bankfull channel geometry and thus floodplain connection, rather than downward bed incision. Figures 3.6 and 3.7 show two examples of typical stream conditions with increasing drainage area. While it is not possible to assess whether the stream system is in a true long-term geomorphic equilibrium based

on available data, there also is no clear evidence to suggest long-term chronic channel adjustment over the recent decadal time scale.

Figure 3.6. Example of channel dynamics along Ten Mile Creek near monitoring station LSTM206.

Figure 3.7. Channel conditions near USGS gage 01644390 downstream of monitoring station LSTM304.

The phyllitic material supplied to the channel tends to weather easily, breaking into small fragments, probably because of numerous planes of weakness, and forms particles that are platy in shape and observable on bars within Ten Mile Creek (Figure 3.8). More resistant quartz particles derived from veins in the bedrock tend to form larger, more rounded particles on the bed. Measurements taken by DEP in conjunction with channel cross sections between 1996 and 2006 demonstrate the grain-size distribution on channel bed material along representative riffles ranges in size from sand to very large cobble, with the majority in the coarse to very coarse gravel range. The limited amount of fine material (i.e. <2 mm which includes sand, silt, and clay) observed during sampling of these riffles is consistent with general field observations of relatively "clean" bed material dominated by gravels. Estimates of riffle embeddedness (the degree to which coarse bed material is choked by fine sediments) were made by DEP in conjunction with these same cross-sectional measurements to determine the percentage of a particle's surface surrounded by sand, silt or clay sediment in the stream bed. Estimates of embeddedness ranged between 12 and 43%, but were typically between 15 to 25%. Some disparity in the degree of embeddedness was observed between these estimates and those recorded in conjunction with DEP's biological monitoring reported in the following section. This disparity may be the result of a difference in sampling methodology and may indicate that riffle embeddedness reported above is lower than that of a 75-meter sampling reach, inclusive of riffles and pools, reported with the biological monitoring.

Figure 3.8. Example of bar deposits along Ten Mile Creek near monitoring station LSTM202.

3.7 Water Quality

All tributaries of Ten Mile Creek are designated by the State of Maryland as Use I-P streams (water contact recreation, protection of aquatic life, and public water supply) and are part of Little Seneca Lake, which serves as a reservoir providing additional flow to the Potomac River, a public raw water supply, during drought periods (Montgomery County Department of Park and Planning, 1994). Table 3.5 below lists the State standards for Use I-P streams. Ten Mile Creek was one of the last streams in Montgomery County to support brook trout (*Salvelinus fontinalis*), a highly sensitive native species requiring clean and cold water to survive (Montgomery County Department of Environmental Protection, 2004). In 2007, State and County fisheries biologists discovered three adult a non-native, more tolerant species of trout, brown trout (*Salmo trutta*), some distance above the West Old Baltimore Road ford (Montgomery County Department of Environmental Protection, 2009). These trout represented different age classes and did not appear to be hatchery raised. The trout were weighed, measured and returned to the creek. Fisheries biologists returned and conducted a wider survey of the creek but did not find additional trout. It is not known for certain if the three adults found are naturally occurring to Ten Mile Creek or not, but no signs of fish stocking, such as fin erosion, were observed. Regardless of the origin of the trout, the fact that the trout species were surviving in Ten Mile Creek are indicative of its excellent water quality. Brown trout were again found in 2008 and 2009 (Montgomery County Department of Environmental Protection, 2012).

Table 3.5. State Water Quality Standards for Use I-P Streams

Parameter	Standard
Maximum Total Fecal Coliform	200 log mean per 100 mL
Minimum Dissolved Oxygen	5 mg/L
Maximum Temperature	32° Celsius or Ambient, whichever is greater
pH	6.5 to 8.5
Maximum Turbidity	150 NTU
Maximum Monthly Average Turbidity	50 NTU

Data Source: DEP SPA Report, 2012

Water quality monitoring has been performed in Ten Mile Creek associated with three separate efforts: (1) DEP's Countywide Biological Stream Monitoring Program; (2) the Clarksburg Special Protection Area monitoring program; and (3) MDE and WSSC water quality data associated with Little Seneca Lake.

Countywide Biological Stream Monitoring Data

Data from the biological stream monitoring is limited to single point measurements during non-storm flow conditions, according to the station locations shown in Figure 3.9. Biological field collection of benthic macroinvertebrates is conducted during the spring index period (March 15 to April 30). Fish are collected in the summer index period (June 1 through the middle of October). More information on biological monitoring is provided in Section 2.8. During both sampling events, a multi-parameter probe is placed in the stream's laminar flow to measure water temperature, pH, dissolved oxygen, percent saturation, and conductivity. Air temperature and time of day is also recorded at all stations. Thus, the biological stream monitoring data is only representative of spring and summer conditions during non-storm flow conditions. Data collection has occurred for selected subwatersheds between 1995-2012, with an average of 17 samples per subwatershed.

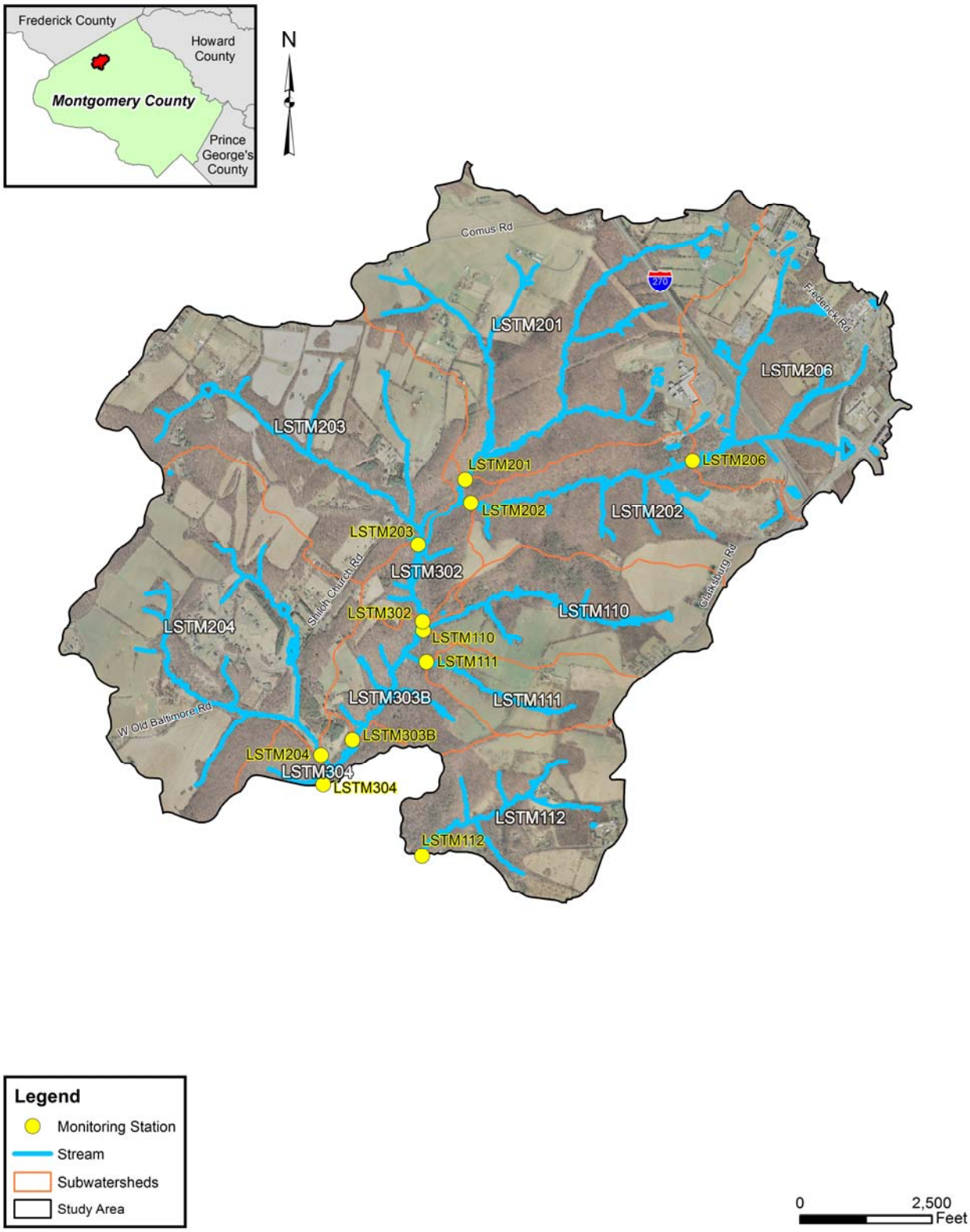

Figure 3.9. Habitat, Biological, and Geomorphic Stream Monitoring Sites in the Ten Mile Creek Study Area

Water temperature is an important measure of stream health, and has a standard maximum of 32 degrees Celsius for Use I-P streams. Higher temperatures can cause stress in aquatic biota. Figure 3.10 shows the water temperature readings across all of the Ten Mile Creek subwatersheds, which are all statistically similar with a median of 16 degrees Celsius. No readings were higher than 26 degrees Celsius during the biological stream surveys.

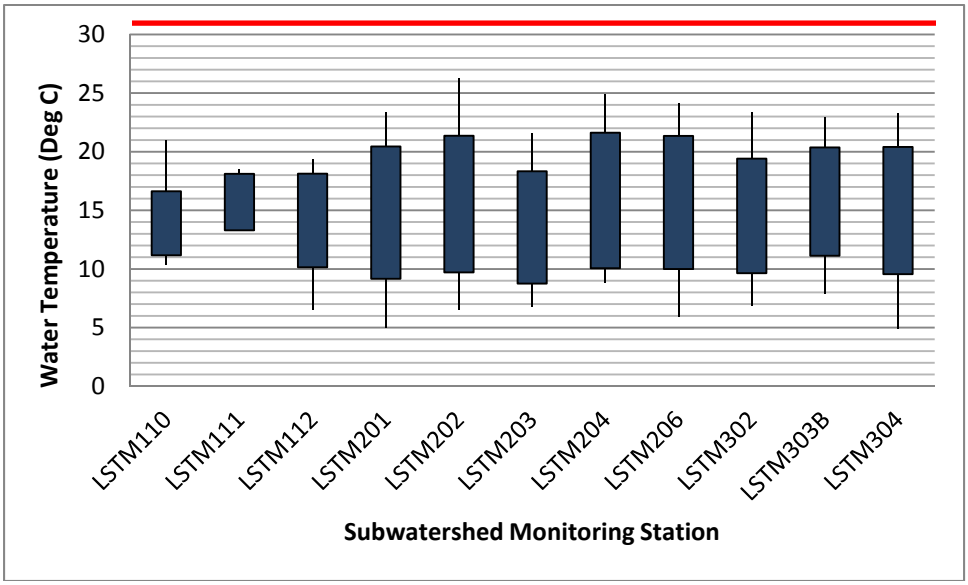

Figure 3.10. 90% Confidence Interval, Maximum, and Minimum Water Temperature Values for Ten Mile Creek Biological Stream Monitoring Stations. The red line indicates the State Standard for Maximum Temperature in Use I-P Streams (32 deg C).

In general, the optimal pH range for aquatic life is between 6.5 and 8.5 (EIFAC 1968 and U.S. EPA 1976). While many aquatic species can tolerate pH levels well outside this optimal range, water pH influences the solubility of metals and other pollutants that, if present, are toxic to aquatic life (EIFAC 1968 and U.S. EPA 1976). For the Ten Mile Creek subwatersheds, one subwatershed has consistently measured lower than the State Standard of 6.5: LSTM111. Several other subwatersheds, LSTM110, LSTM112, LSTM201, LSTM202, and LSTM303B, all have at least one reading below the State Standard (Figure 3.11). Similar conditions were observed in the 1992 Clarksburg Environmental & Water Resources Study, where it was noted that the, "low buffering capacity of Seneca Creek's [including Ten Mile Creek's] soft waters leads to large fluctuations in the pH in the stream. The pH levels vary by as much as 6 orders of magnitude..." (Greenhorne & O'Mara, Inc., 1992). The Biological Stream Monitoring data suggest differences in the headwater streams, LSTM110 and LSTM111, from the mainstem streams LSTM203, LSTM204, and LSTM206. The primary land uses within the subwatersheds LSTM110 and LSTM111 are cropland and pasture, with a lack of a continuous riparian buffer apparent (Figures 2.1 and 2.2). There are no stormwater management facilities in these subwatersheds (Figure 4.2).

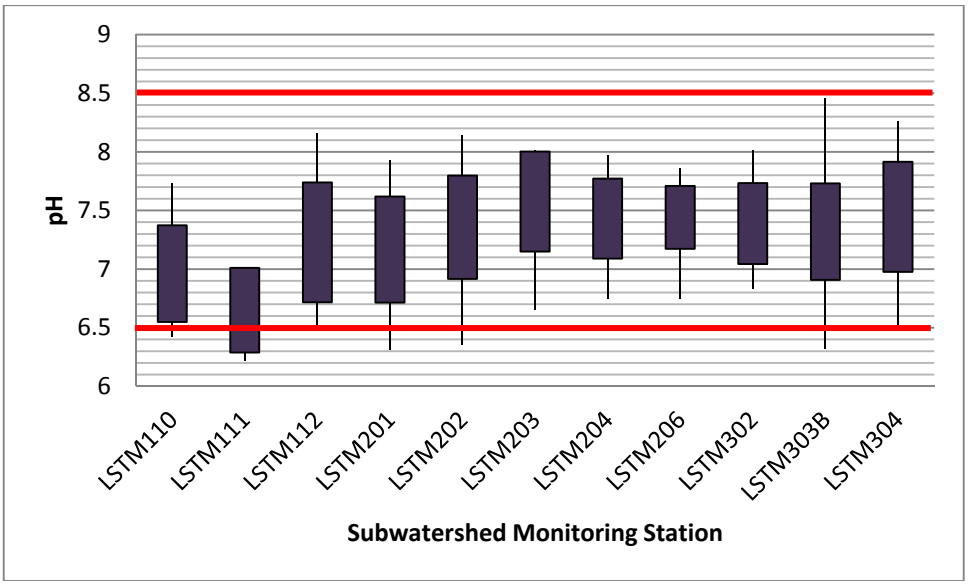

Figure 3.11. 90% Confidence Interval, Maximum, and Minimum for pH Values for Ten Mile Creek Biological Stream Monitoring Stations. The red lines indicate the State Standard for Maximum (8.5) and Minimum (6.5) pH in Use I-P Streams.

Dissolved oxygen is necessary for aerobic respiration of aquatic life. From the biological stream monitoring data, dissolved oxygen in the Ten Mile Creek subwatersheds have remained above the State standard of 5 mg/L. No single subwatershed appears significantly different, with an average of 9.3 mg/L (Figure 3.12).

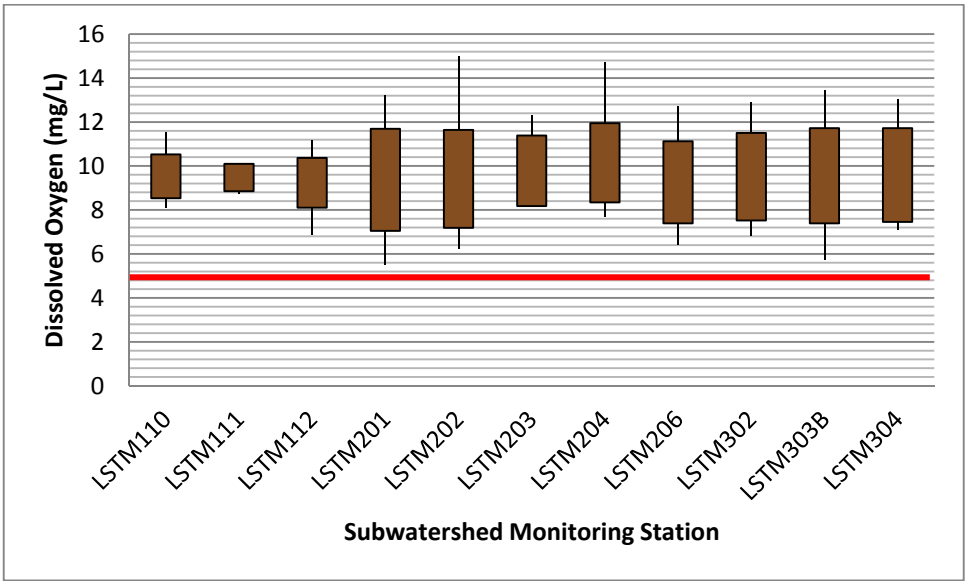

Figure 3.12. 90% Confidence Interval, Maximum, and Minimum Dissolved Oxygen Values for Ten Mile Creek Biological Stream Monitoring Stations. The red line indicates the State Standard for Minimum Dissolved Oxygen in Use I-P Streams (5 mg/L).

The percent saturation of dissolved oxygen in the water is an indirect measure of the biological oxygen demand. Saturation below 100% indicates a greater rate of aerobic respiration than can be equilibrated with the atmosphere. Saturation above 100% indicates generation of oxygen within the water column,

such as through photosynthesis of algae. There are no standards for percent saturation, but the Ten Mile Creek subwatersheds are all statistically similar with an average of 90% saturation (Figure 3.13).

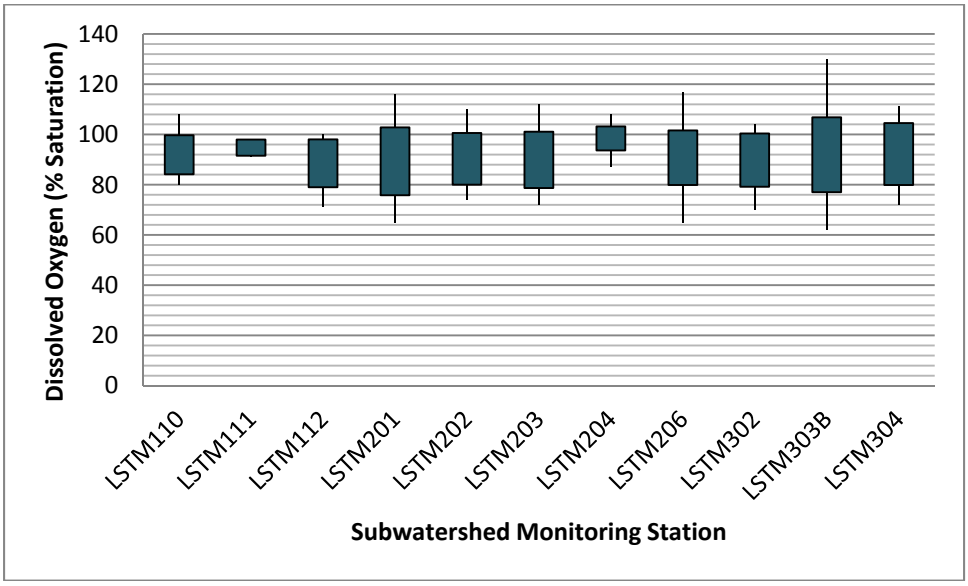

Figure 3.13. 90% Confidence Interval, Maximum, and Minimum for Percent Saturation of Dissolved Oxygen Values for Ten Mile Creek Biological Stream Monitoring Stations.

Conductivity values are related to the type and concentration of inorganic ions in the water column. Examples of these inorganic constituents include chloride, carbonate, nitrate, sulfate, and phosphate anions as well as sodium, calcium, magnesium, iron, and aluminum cations. Elevated conductivity is commonly associated with development and urbanization upstream in the watershed and often attributed to runoff from roadways (U.S. EPA, 2010). However, there are currently no water quality standards for conductivity, and a threshold for biological impairment has not been clearly defined for this parameter. Two subwatersheds have shown a significantly higher conductivity reading in the watershed: LSTM202 and LSTM206. LSTM203 has had some high readings, but overall is not significantly different from the rest of the watershed (Figure 3.14). LSTM206 has the most development and highest level of impervious cover (16%) in the watershed (Figures 2.1 and 2.2). The principal urban land uses include transportation (I-270), residential, institutional (Clarksburg Detention Center), and some commercial, all scattered throughout the subwatershed. LSTM206 also has the most stormwater management facilities of all the subwatersheds (Figure 4.2). LSTM202 is mostly forested and has a much lower level of development than LSTM206. However, LSTM206 directly feeds into LSTM202, which could account for the higher conductivity readings.

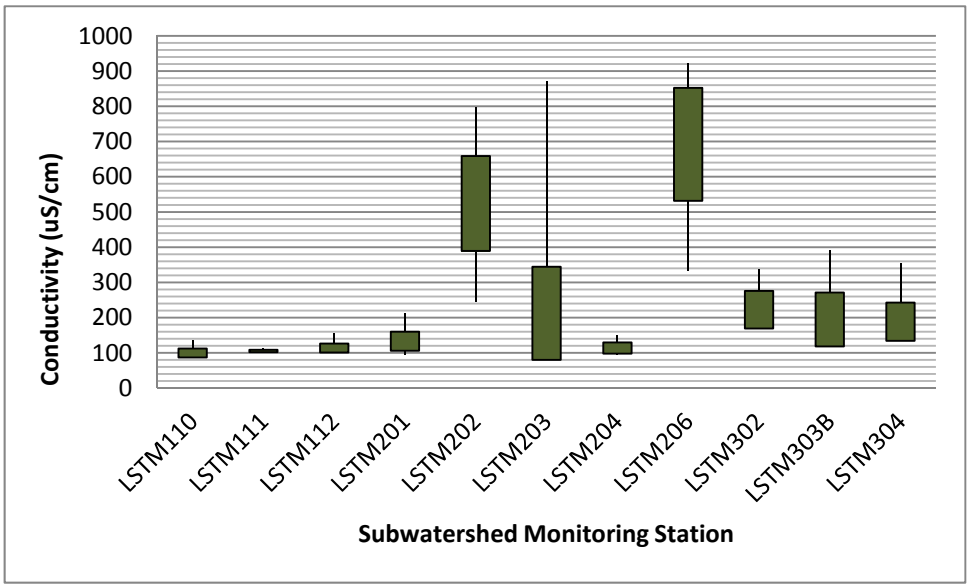

Figure 3.14. 90% Confidence Interval, Maximum, and Minimum for Conductivity Values for Ten Mile Creek Biological Stream Monitoring Stations

Special Protection Area Water Quality Monitoring

The Clarksburg SPA monitoring fulfills the requirements in Montgomery County Code, Section 19-67(d) for "the effectiveness of best management practices and the observed impact of development on the biological integrity of streams in special protection areas," (Montgomery County Department of Environmental Protection, 2012). The best management practices (BMPs) monitored for effectiveness were predominantly structural facilities such as sediment and erosion control (S&EC) basins that were monitored during construction, and stormwater management (SWM) facilities that were monitored after construction activity was completed.

The County SPA Reports provide information on year-to-year stream conditions for Ten Mile Creek on a station by station basis. Due to the decline in biological stream conditions in an eastern tributary of Ten Mile Creek (mostly east of I-270, subwatershed LSTM206) during development, an investigation was made into possible reasons for the decline (as reported in the 2006 SPA Annual Report). High conductivity readings were found throughout the drainage area to the station. No specific cause for the high conductivity readings could be identified, but the sensitivity of Ten Mile Creek to change is apparent (Montgomery County Department of Environmental Protection, 2008).

Monitoring was required during construction of the Clarksburg Detention Center, located on the west side of I-270 just north of the Rt. 121 interchange in subwatersheds LSTM206 and LSTM201. During construction, monitoring occurred from 1997-2003. Three groundwater wells were monitored to determine nutrients and water table elevation. During the late 1970's, a parcel of land near the Detention Center property was used for WSSC sewage sludge disposal (Montgomery County Department of Environmental Protection, 2010). Sludge contains high concentrations of nutrients. Much of the sludge was removed from the area that was to be disturbed during the beginning phase of construction.

Results of the groundwater monitoring showed the concentration of total phosphorus (TP) from all three wells remained low, except for samples obtained on 4/2/98 and 8/17/99, which could have been related to land disturbance and removal of the buried sewage sludge. Since 8/17/99 TP concentrations

have remained relatively low. Concentrations did increase slightly at all three wells on 9/17/02. Nitrate concentrations were consistently higher in one of the wells downstream of construction, with values as much as three times above the EPA drinking water standard of 10.0 mg/l. Presumably, the sewage sludge, which was not removed from the area immediately surrounding this well, is the cause of high nitrate concentration. Nitrate concentrations in the other two wells went down during the period of study, from 7.2 mg/l on 11/24/97 to 0.18 mg/l on 9/17/02 in one well, and from 5.25 mg/l on 11/24/97 to 0.83 mg/l on 9/17/02 in the other. The decrease in nitrate concentrations in these two wells is likely due to removal of sewage sludge from the site (Montgomery County Department of Environmental Protection, 2003).

The County SPA Reports also provide information on stream temperature monitoring. The station records vary according to development in the watershed, in order to evaluate conditions immediately downstream. Temperature monitoring conducted in Ten Mile Creek indicated that the water temperatures were found to stay below the Maryland Use Class I-P criteria limit. Anomalies, such as in late August 1998 when station LSTM202 began to show large daily temperature ranges, were attributed to the pool in which the temperature logger was deployed getting low enough to expose the logger to air temperatures. Results from LSTM303B in 2003 show mean water temperature was higher than any other area in the Clarksburg SPA. This is likely due to differences in stream channel characteristics between Ten Mile Creek and Little Seneca Creek. In Ten Mile Creek the stream channel tends to be wide and shallow. This allows the stream to warm up more as there is greater exposure to warm ambient air temperatures. In contrast, results from LSTM112 in 2003 show water temperature was cooler than most other areas in the Clarksburg SPA. This was the first year data was collected from this fairly large tributary to Ten Mile Creek (Montgomery County Department of Environmental Protection, 2004).

Seneca Lake Water Quality Monitoring

MDE and WSSC have performed water quality monitoring within the Seneca Creek watershed basin in order to assess impairments in Little Seneca Lake and monitor the lake as an important source of drinking water in Montgomery County. The Lake was identified on Maryland's 1998 list of water quality limited segments (WQLSs) as being impaired by nutrients. An analysis of recent monitoring data (2001) shows that the criteria associated with nutrients are being met, and the designated use in Little Seneca Lake is supported (Maryland Department of the Environment, 2006). This analysis supports the conclusion that a total maximum daily load (TMDL) for nutrients is not necessary to achieve water quality in this case. A TMDL is used to determine the maximum amount of a pollutant a waterbody can receive without violating water quality standards for the waterbody's designated use. The report was used to support the nutrient listing change for Little Seneca Lake from Category 5 ("waterbodies impaired by one or more pollutants and requiring a TMDL") to Category 2 ("surface waters that are meeting some standards and have insufficient information to determine attainment of other standards") when MDE proposed the revision of Maryland's 303(d) list for public review. Urban development is occurring in portions of the Little Seneca Lake watershed, and is expected to increase in the future. It is expected that over time, the character of the watershed may change as a consequence of land conversion and development. Although the waters of Little Seneca Lake do not presently display signs of eutrophication, the State reserves the right to require future controls in the Little Seneca Lake watershed if evidence suggests nutrients from the basin are contributing to water quality problems.

3.8 Aquatic Habitat and Biology

Since 1994, the Montgomery County DEP has established and regularly monitored physical habitat and biological communities at 11 permanent sampling stations within the Ten Mile Creek Watershed as part of the Clarksburg Special Protection Area monitoring program (Figure 3.9). At each station DEP field crews assess the physical structure and condition of habitat and sample the benthic macroinvertebrate, fish and salamander communities.

Various metrics describing the composition and ecology of these biological communities can be combined into a multi-metric Index of Biotic Integrity (IBI) to represent the quality of a particular stream ecosystem (Karr, 1981). These various IBI metrics can then be compared to those of known regional reference sites to predict the probable stream condition (Hughes, Larsen, & Omernik, 1986). The DEP has developed IBIs for both fish and macroinvertebrates that reference the least impacted streams in the County to determine the stream condition (Montgomery County Department of Environmental Protection, 2009). Additionally, these biological data can be compared with the statewide IBI developed by the Maryland Biological Stream Survey (MBSS), which stratified by ecological region and statistically validated to ensure discrimination efficiency, reduce redundancy, and improve accuracy (Southerland et al., 2005).

The following sections outline the sampling methodologies and summarize the biological conditions and observed trends over the 19 years of data provided by DEP. Observed trends were not rigorously tested, but derived from observations in the data and determining simple linear regressions and associated correlation coefficients (R^2). A more detailed discussion of the individual metrics for each of the indices and a summary table of available data and IBI scores for the respective sampling efforts are presented in Appendix D.

Benthic Macroinvertebrates

The benthic macroinvertebrate communities were assessed by DEP staff during spring index periods of the respective sampling years in accordance with the Maryland Biological Stream Survey (MBSS) methods (Kayzak, 2001). The DEP Benthic IBI evaluates 8 metrics, which are summed to describe the overall health of the benthic macroinvertebrate community.

The 2012 Benthic IBI scores for each subwatershed are shown in Figure 3.15. The average of the 1994 – 2012 composite Benthic IBI scores for each subwatershed are shown in Figure 3.16.The overall ranges of Benthic IBI scores, as shown in Figure 3.17, indicate that the benthic macroinvertebrate community within the Ten Mile Creek drainage is in generally good condition. Applying the MBSS Benthic IBI to this data set corroborates this conclusion. Both Benthic IBIs do rank LSTM206 one condition class lower (e.g. fair versus good) than the other stations. Over the 15 years Station LSTM206 was monitored, eight years scored Fair, five years scored Good and two years scored Poor. The lowest scores occurred between 2005 and 2008 with some recovery after 2008, but no long-term trends of further degradation or recovery were interpreted from the data. This is conclusion is supported by the time series data for all stations shown in Figure 3.18.

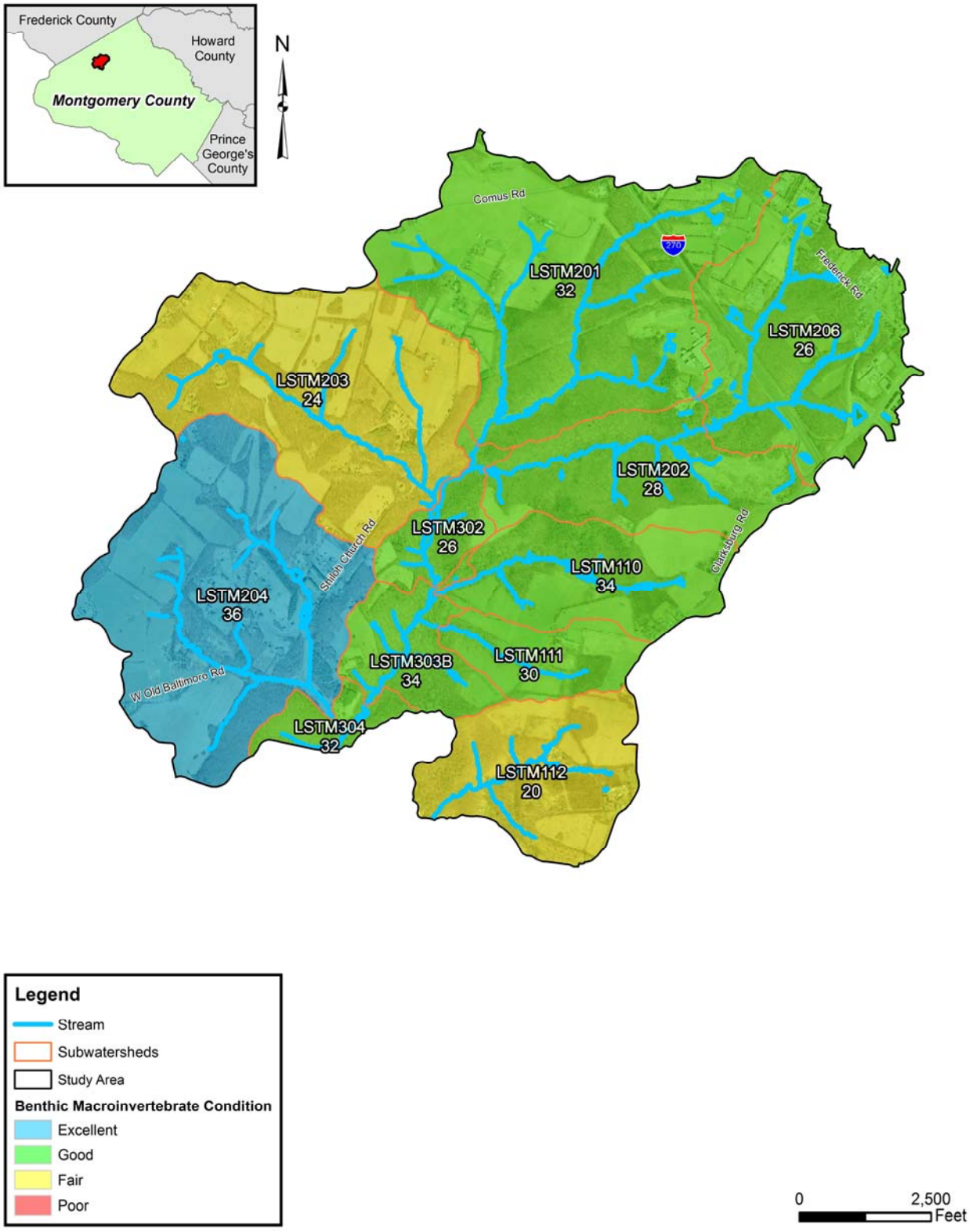

Figure 3.15. 2012 subwatershed benthic IBI rating.

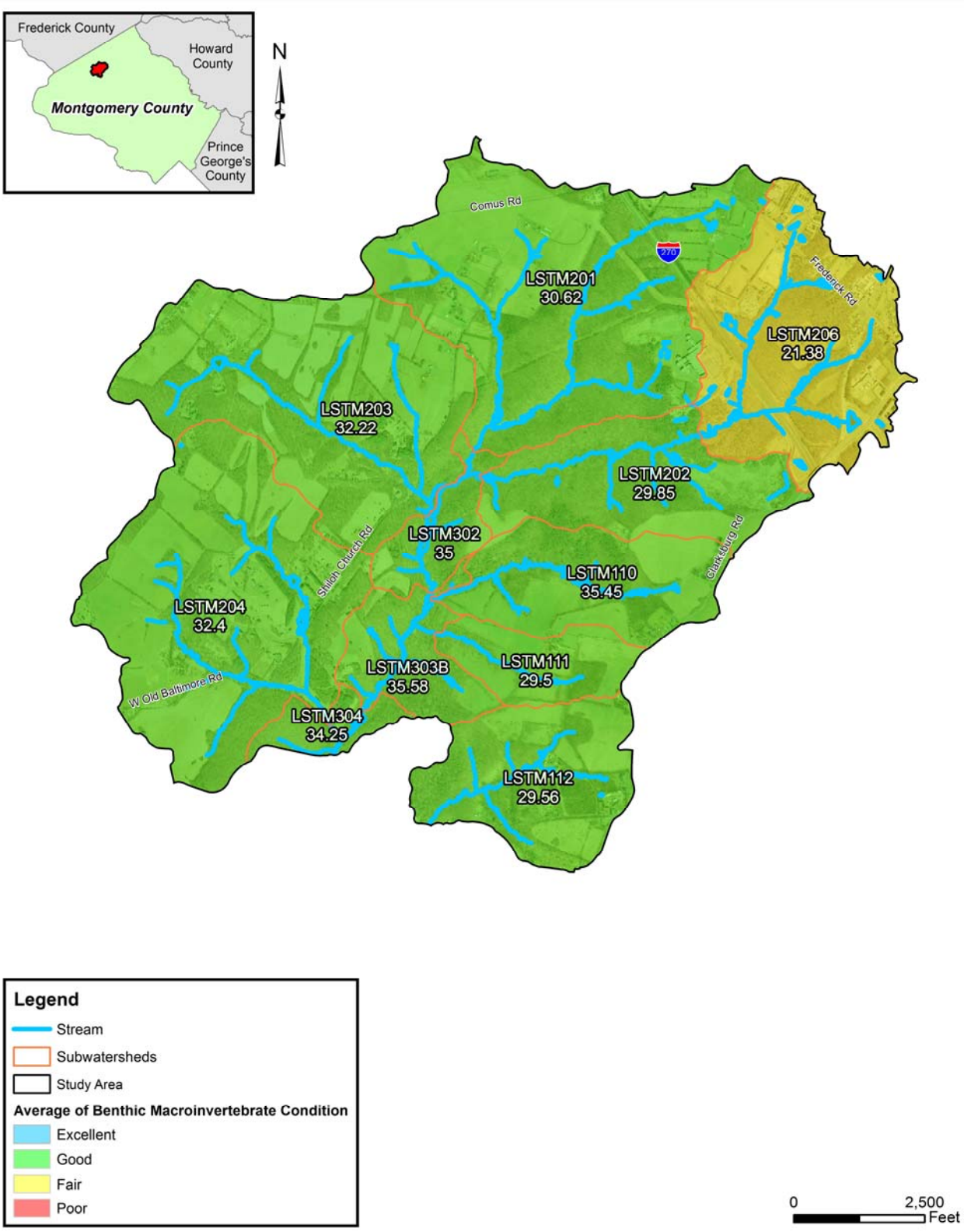

Figure 3.16. Average subwatershed benthic IBI rating (1994-2012).

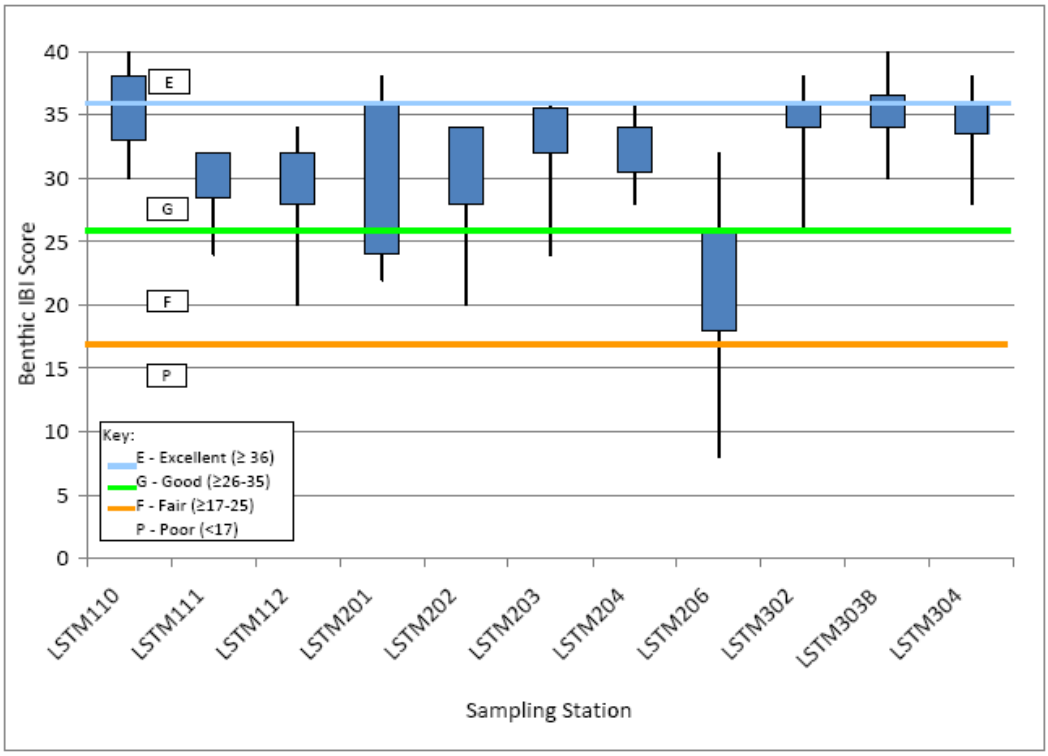

Figure 3.17. Ranges of composite Benthic IBI scores among the permanent sampling stations (1994-2012).

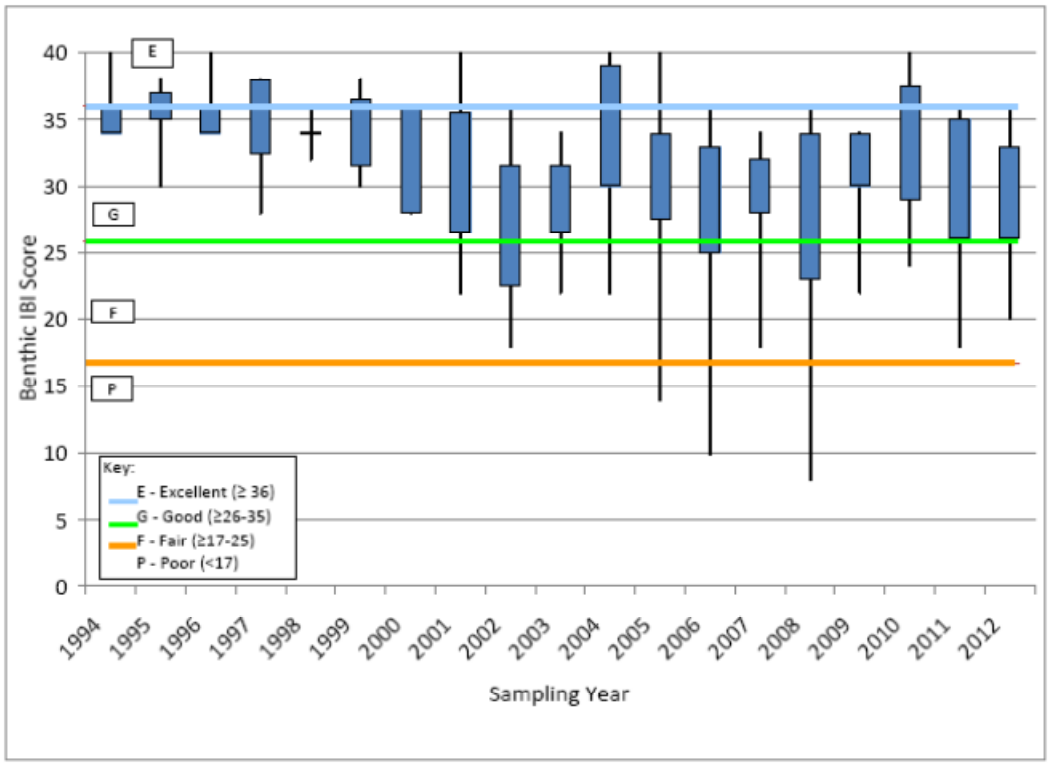

Figure 3.18. Variability among Benthic IBI scores at all sampling stations over time.

A number of observations related to the individual metrics time series data are discussed in Appendix D. Other than minor shifts in the benthic macroinvertebrate community structure, the community appears to be stable. The rates of change associated with any observed trends are generally slow and only likely to influence the overall Benthic IBI score over period of decades, if natural recovery does not occur. These trends indicate the tendency toward degradation if stressor levels are increased.

Habitat

Habitat was assessed by DEP staff using the qualitative rapid habitat assessment protocol described by Barbour and Stribling (Gibson, 1991). This method relies on visual inspection to assign numerical scores that represent the condition of each of ten habitat parameters. The 2012 habitat scores for each subwatershed are shown in Figure 3.19. Figure 3.20 shows the average of the 1994 – 2012 composite habitat scores for each subwatershed. A summary of the composite habitat scores at each station and over time is presented in Figures 3.21 and 3.22 respectively. These data indicate that the habitats of Ten Mile Creek are minimally to partially degraded (excellent/good) and generally score in the suboptimal range in individual parameters (Figure 3.21). Overall most stations scored within one standard deviation of the mean overall habitat score, with the exception of Station LSTM204. The deviation in Station LSTM204 can be attributed to poor scores for the riparian buffer parameter, which consequently dropped the overall score but not the overall condition category for the habitat score. These conclusions are corroborated by the MBSS Physical Habitat Index (Paul et al., 2003).

While most habitat parameters consistently scored in the good range, individual parameters related to sediment deposition and bank erosion scored marginal and likely influence the overall score. Embeddedness scores indicate that the preferred substrates (for most benthic organisms these are gravel, cobble and boulder) are choked with fine sediments surrounding 50-75% of the coarse grains and filling the interstitial voids. Additionally, sediment deposition scores reflect an intrusion of newly deposited fine sediments (gravel, sand and silt) occupying 30-50% of the bottom habitat. Marginal scores in bank erosion indicate a likely source of these fine sediments. The bank erosion scores indicate that 30-60% of the sample reach shows signs of erosion; however, the severity of this erosion was categorized as only minimal to moderate. Low suboptimal to marginal scores in the bank vegetation could also be attributed to the eroding banks.

As would be expected with a progressive problem like bank erosion, most of the stations show declining trends in the overall habitat score over time; however, the magnitude of the decline is only 1 to 2 total points/year in the overall score when the entire data set is analyzed (Figure 3.22). This trend may indicate that the watershed is stressed; however, several decades may elapse before the overall habitat condition degrades from suboptimal to marginal, which is also an adequate timeframe for the stream conditions to naturally recover or stabilize. Visual inspection of plots of the parameters versus time, which were not isolated and evaluated independently, indicate that the overall declining trend may be more severe in recent years (after 2005), but the significance of this was not tested (Figure 3.22).

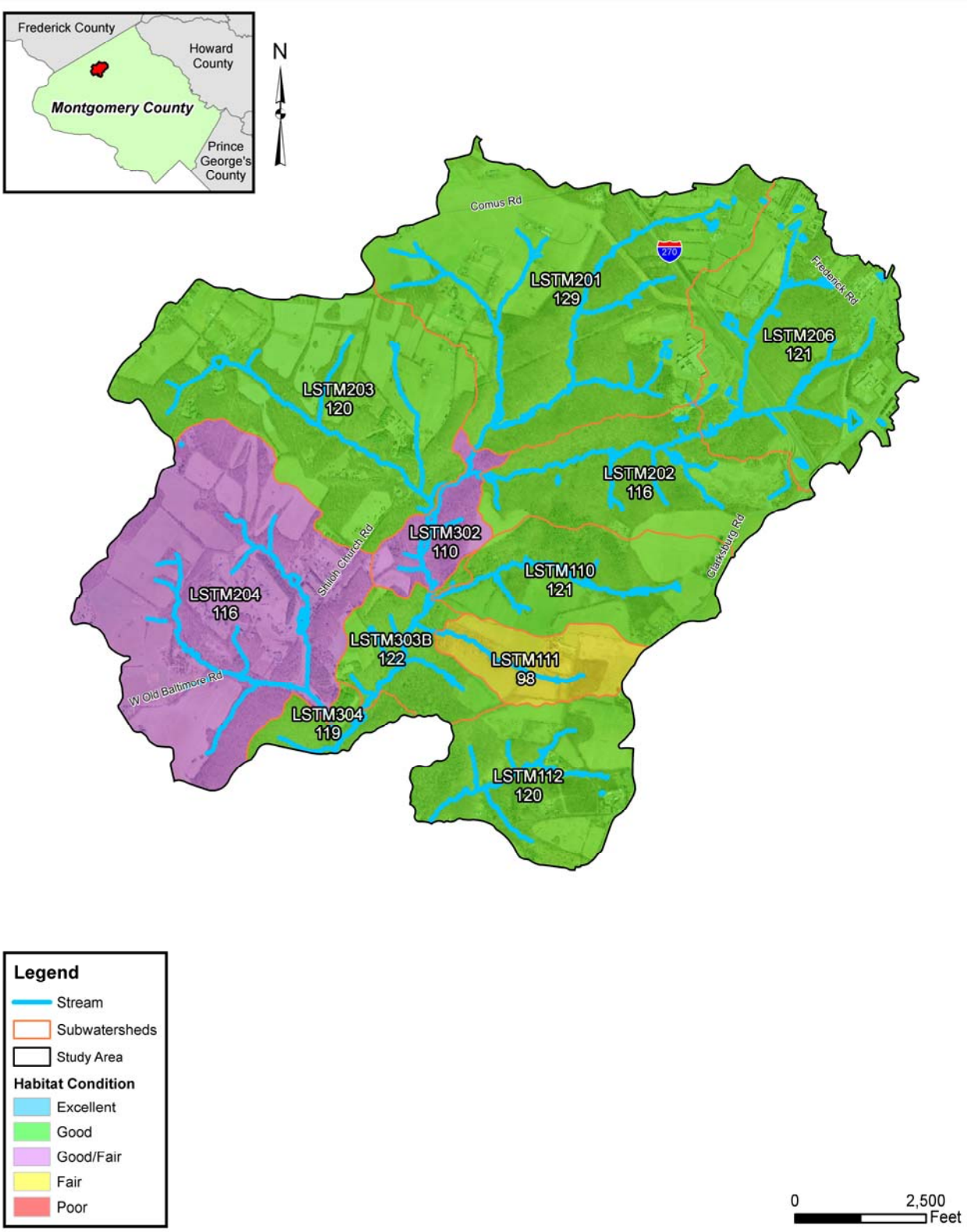

Figure 3.19. 2012 subwatershed habitat condition rating.

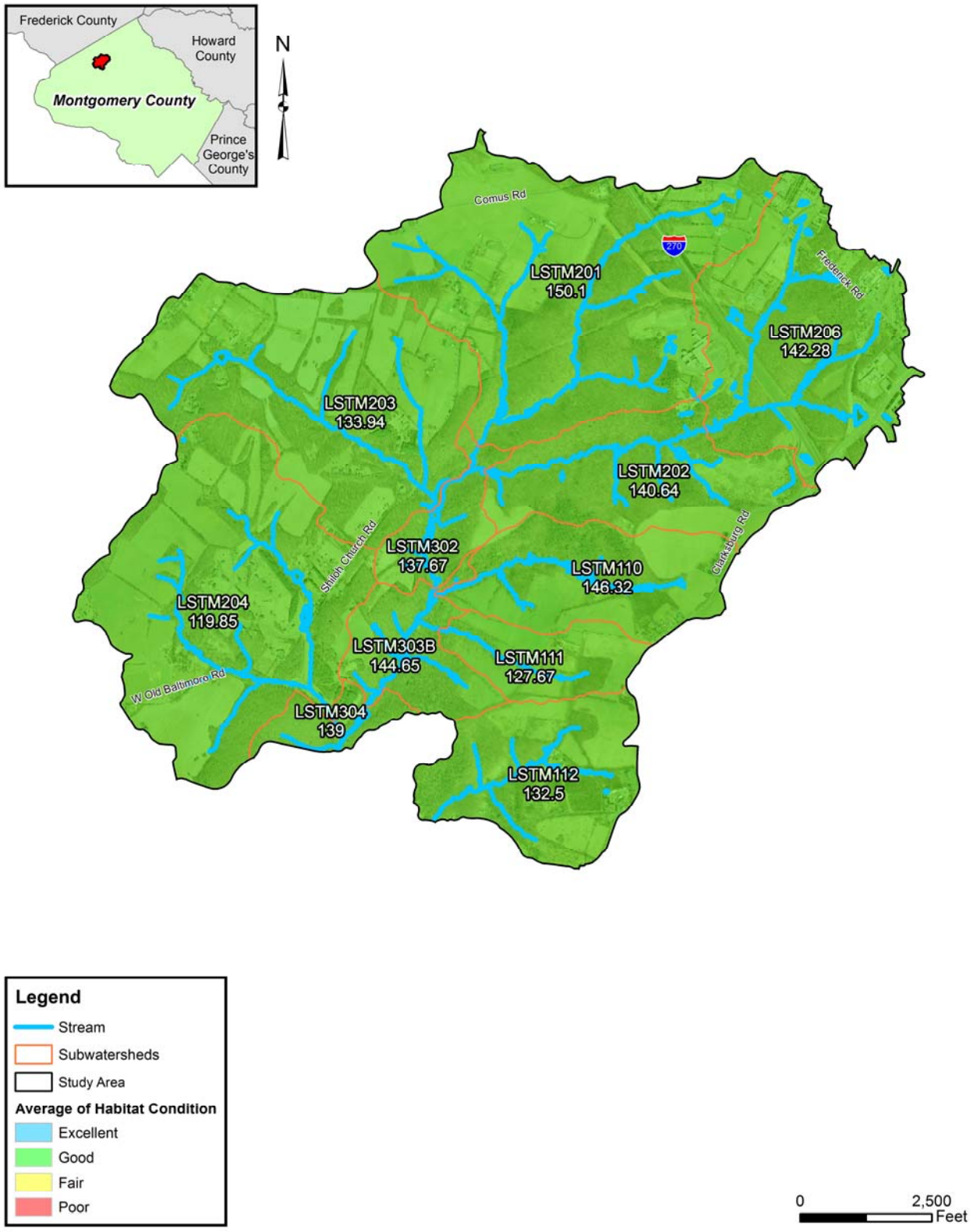

Figure 3.20. Average subwatershed habitat condition rating (1994-2012).

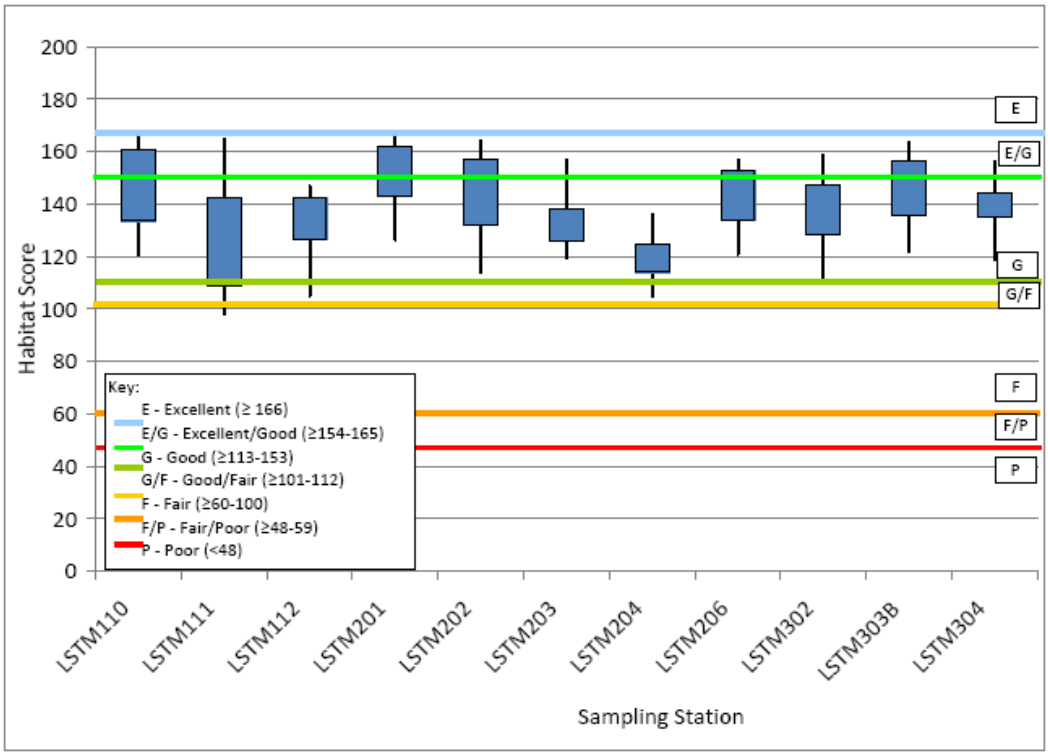

Figure 3.21. Ranges of composite habitat scores among the permanent sampling stations (1994-2012).

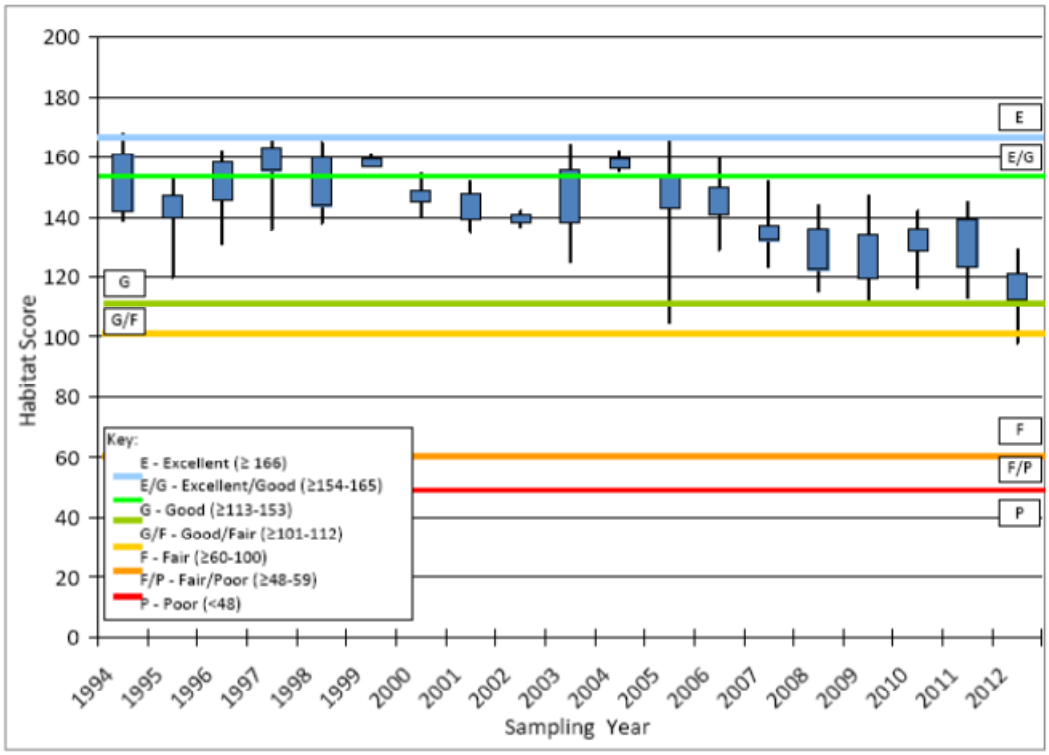

Figure 3.22. Variability among habitat scores at all sampling stations over time.

Fish

Fish communities were assessed by DEP staff during summer index periods of the respective sampling years in accordance with the Maryland Biological Stream Survey (MBSS) methods (Kayzak, 2001). The DEP Fish IBI evaluates 9 metrics which are averaged into an overall IBI score indicating the health of the fish community. Comparisons of these data to the statewide data sets developed by MBSS could not be used to corroborate these data because one or more of the metrics for this comparison was not readily available in the data provided.

The DEP Fish IBI indicates that overall the fish community within the Ten Mile Creek drainage is in good condition. Figure 3.23 shows the 2012 Fish IBI scores for each subwatershed, and Figure 3.24 shows the average of the 1994 – 2012 composite Fish IBI scores for each subwatershed. As shown in Figure 3.25, Station 206 and the third order or mainstem stations (LSTM 302, LSTM303B and LSTM304) scored lower than the second order stations. The lower scores in the third order stations could be due in part to how the Fish IBI is stratified based on stream order. The lower score in LSTM206, however, is likely more related to the watershed condition, since it is scored in the same way as the other stations. As discussed in previous sections, subwatershed LSTM206 contains the highest percent impervious cover and urban land uses, which could explain the lower overall score in the Fish IBI.

The one notable outlier in the data set is Station LSTM112, which was only sampled in 2007 and scored poor. Station LSTM112, is a first-order tributary and due to their watershed position, size and flow characteristics first-order tributaries typically lack the abundance and diversity necessary to be scored accurately by an IBI (Southerland et al. 2005).

Review of the time series data shown in Figure 3.26 indicates some of the variability in the sampling data over time. This variability is likely attributed to number of stations sampled between sample years 2000 and 2006. During this period, only LSTM206, LSTM303B and LSTM304, which generally scored lower in the fish IBI on average, were regularly sampled. Regimented sampling of all eight sampling stations for fish did not begin until sample year 2007. This more regimented sampling could explain the apparent recovery and/or stabilizing of the Fish IBI scores shown in Figure 3.26 post 2007.

A review of the time series data for the individual metrics comprising the DEP's Fish IBI is presented in Appendix D. While the time series data indicate some shifts in the overall community structure, the total fish diversity appears to be stable, as indicated by the composite Fish IBI shown in Figure 3.26.

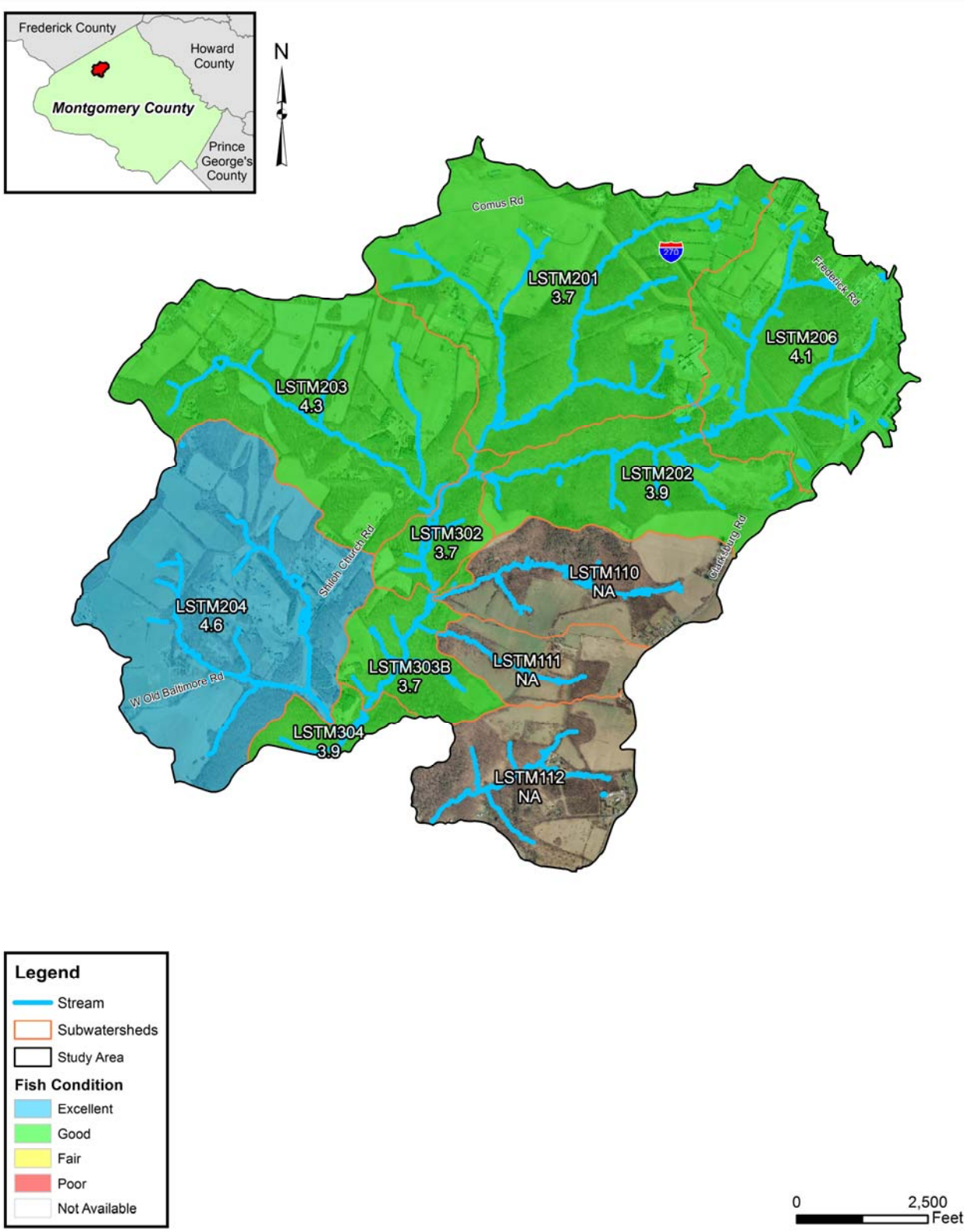

Figure 3.23. 2012 subwatershed fish IBI rating.

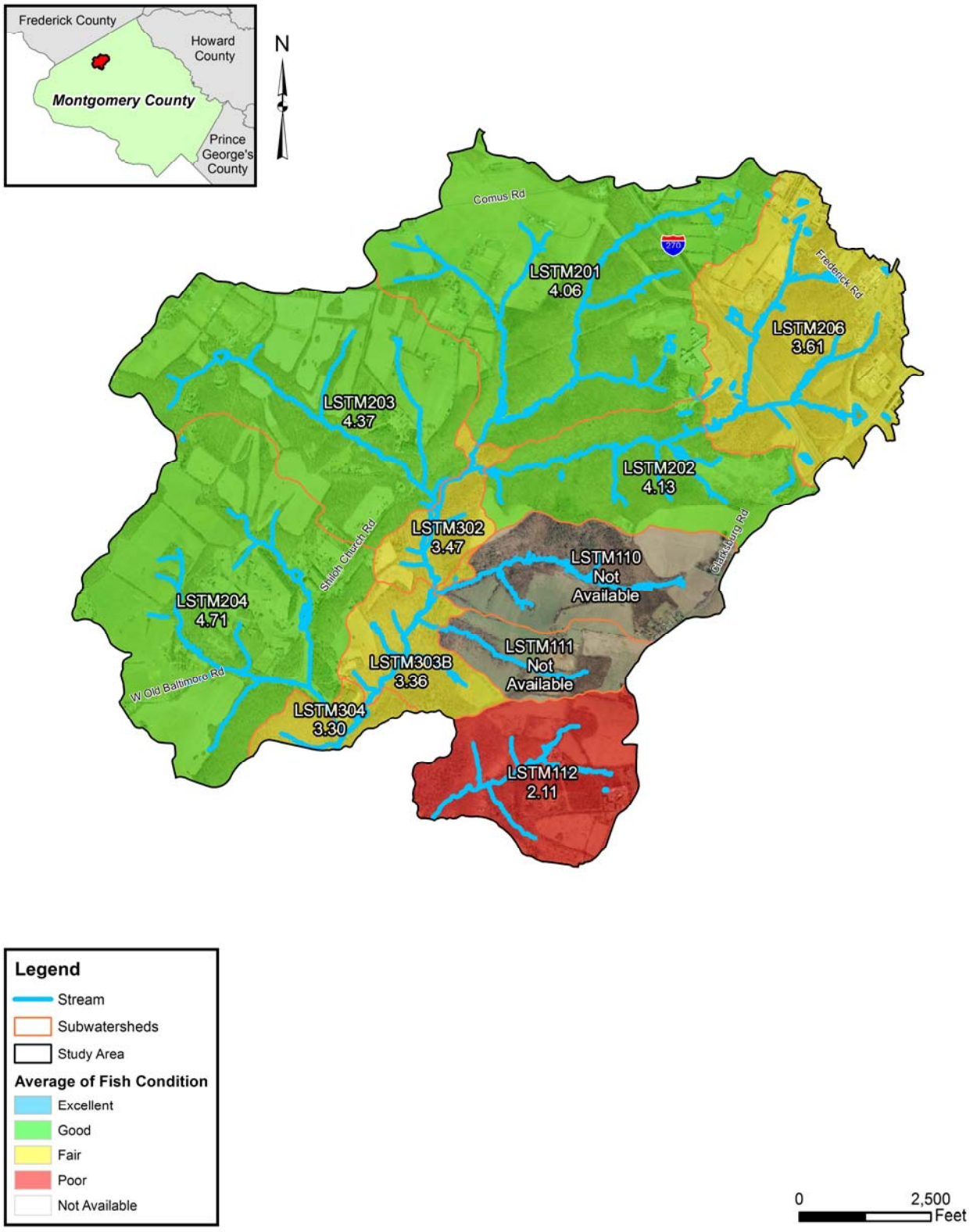

Figure 3.24. Average subwatershed fish IBI rating (1994-2012).

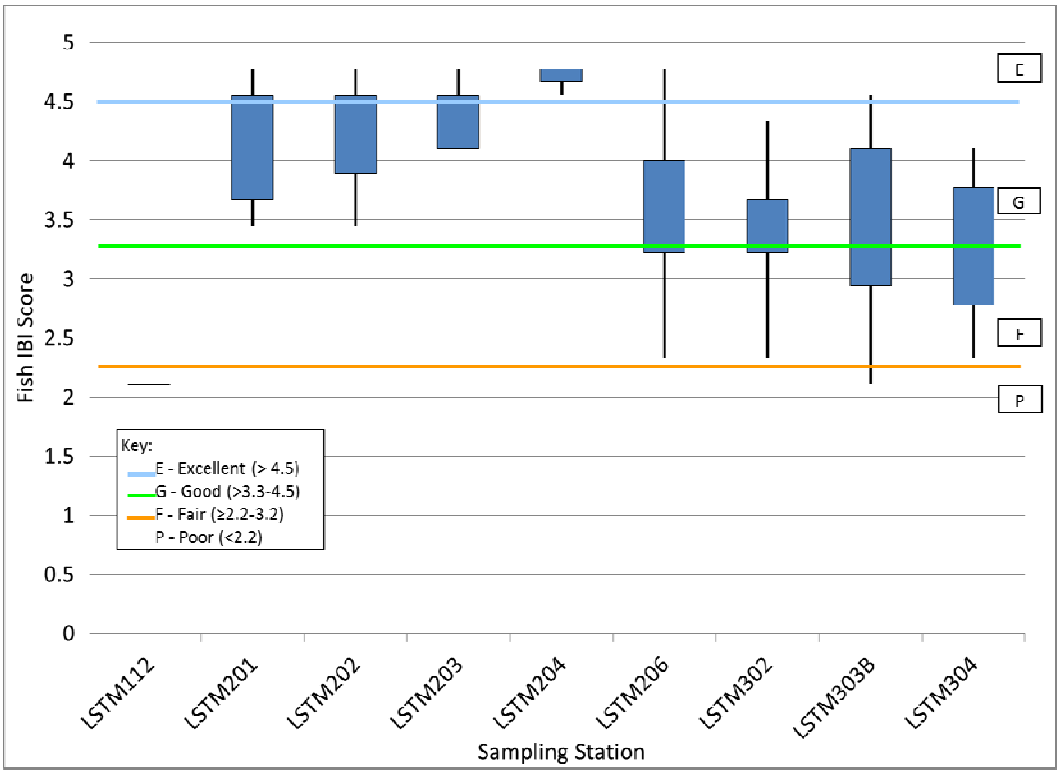

Figure 3.25. Ranges of composite Fish IBI scores among the permanent sampling stations (1994-2012).

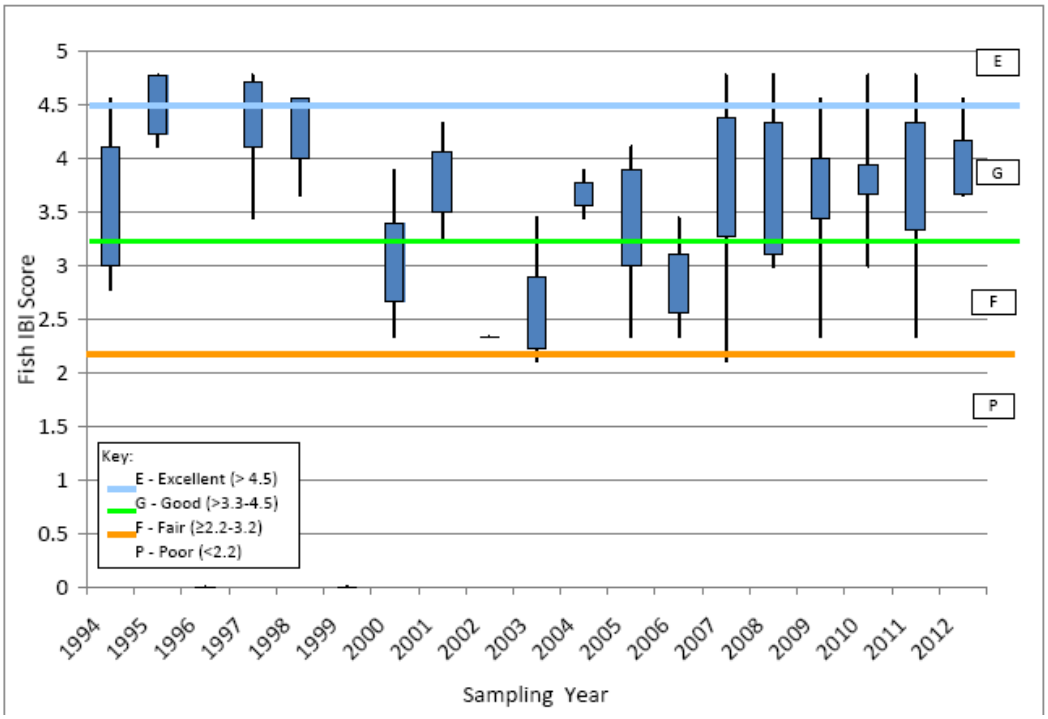

Figure 3.26. Variability among Fish IBI scores at all sampling stations over time.

Herptofauna

Reptile and amphibian, collectively called herptofauna, communities have been assessed by DEP since 2008. MBSS data suggest that herptofauna are sensitive to various environmental stressors including urbanization (Boward, Kayzak, Stranko, Hurd, & Prochaska, 1999). Consequently, Southerland et al. (2004) proposed a provisional Stream Salamander IBI to describe stream salamander communities relative to watershed condition; however, this IBI has not been able to effectively classify reference sites (Southerland and Rogers 2010). Southerland and Rogers (2010) attributed this to differences in sampling methodologies among sites and the number of reference sites where salamanders were not found. For these reasons, a formal stream salamander IBI is not available for comparison, but the presence or absence of herptofauna can still be indicative of watershed condition.

Within the Ten Mile Creek Watershed, a total of 22 herptofauna species were observed, which is indicative of less developed watersheds (Boward et al., 1999). A summary table of observed herptofauna is presented in Appendix D. Of the observed species, the slimy salamander (*Plethedon guttinosis*), a terrestrial/riparian species, found at station LSTM201 would be considered intolerant to degraded conditions. The slimy salamander preferred habitat is mature hardwood forest, and the slimy salamander along with most amphibians are sensitive to forest clearing and land use conversion (Petranka, 1998). Six of the species would be characterized as tolerant and the remaining 15 species would be considered sensitive. One or more of these sensitive species were observed at 10 of the 11 sample sites. The majority of these sensitive species require forested habitat (Stranko et al., 2010 and Petranka, 1998), and while many of these species are common, their distribution within the state is limited to relatively rural watersheds with low to moderate impervious cover between 3% and 25% (Boward et al., 1999). LSTM111 was the only site where sensitive species were absent, but two tolerant species were observed. The lack of sensitive species in this LSTM111 is likely related to the limited amount of preferred habitat (riparian forest) within the subwatershed and adjacent to the sampling station.

The presence of diverse community of herptofauna including a number of sensitive species is indicative a watershed that contains abundant and contiguous habitat. The large tracts of interior forest, springs, seeps, seasonal pools, and clean water within the watershed are necessary to support this community. Conservation and enhancement of contiguous blocks of preferred habitat, particularly riparian corridors, would be the primary management strategy for maintaining a diverse and healthy community of herptofauna (Petranka, 1998).

Biological Condition

The overall biological condition of the subwatersheds is determined by averaging the percent maximum IBI scores for the fish and benthic macroinvertebrates at each station (Keith Van Ness, personal communication, February 12, 2013). The 2012 biological conditions scores for each subwatershed are shown in Figure 3.27, and the average of the 1994 – 2012 biological condition scores for each subwatershed is presented in Figure 3.28. This index indicates that the overall biological condition of the Ten Mile Creek Watershed is good, as shown in Figure 3.29.

Time series data shown in Figure 3.30 indicates that the biological condition of the Ten Mile Creek sampling stations generally maintains a good classification, but shows a slight decline from high end of the good to the middle of the range, as observed in the Benthic IBI data. The biological condition is variable between sample years 2000 and 2006 when sampling was only performed at a limited number of stations, as discussed in the Fish section. The overall biological condition then stabilizes after 2007 as previously discussed.

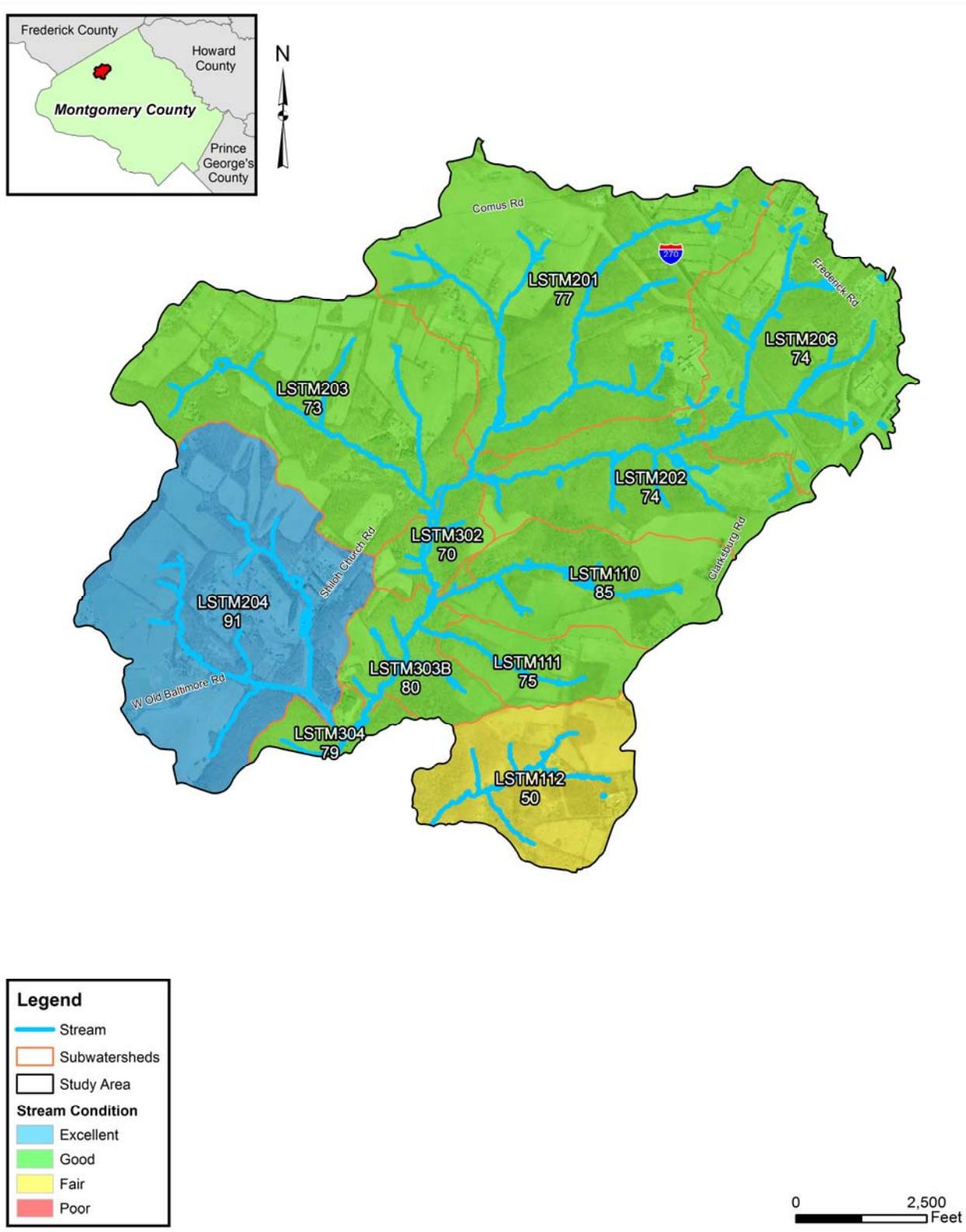

Figure 3.27. 2012 subwatershed biological condition rating.

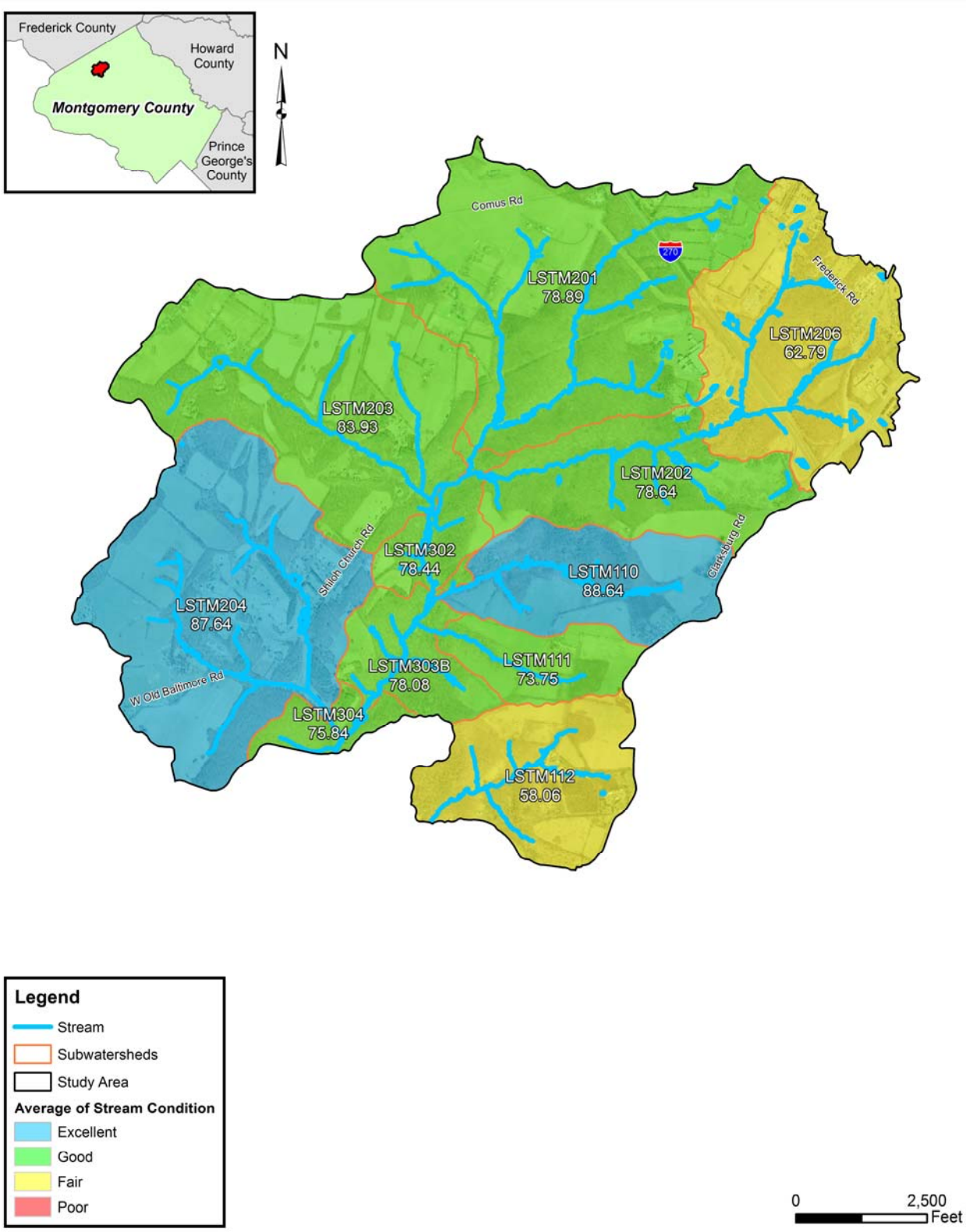

Figure 3.28. Average subwatershed biological condition rating (1994-2012).

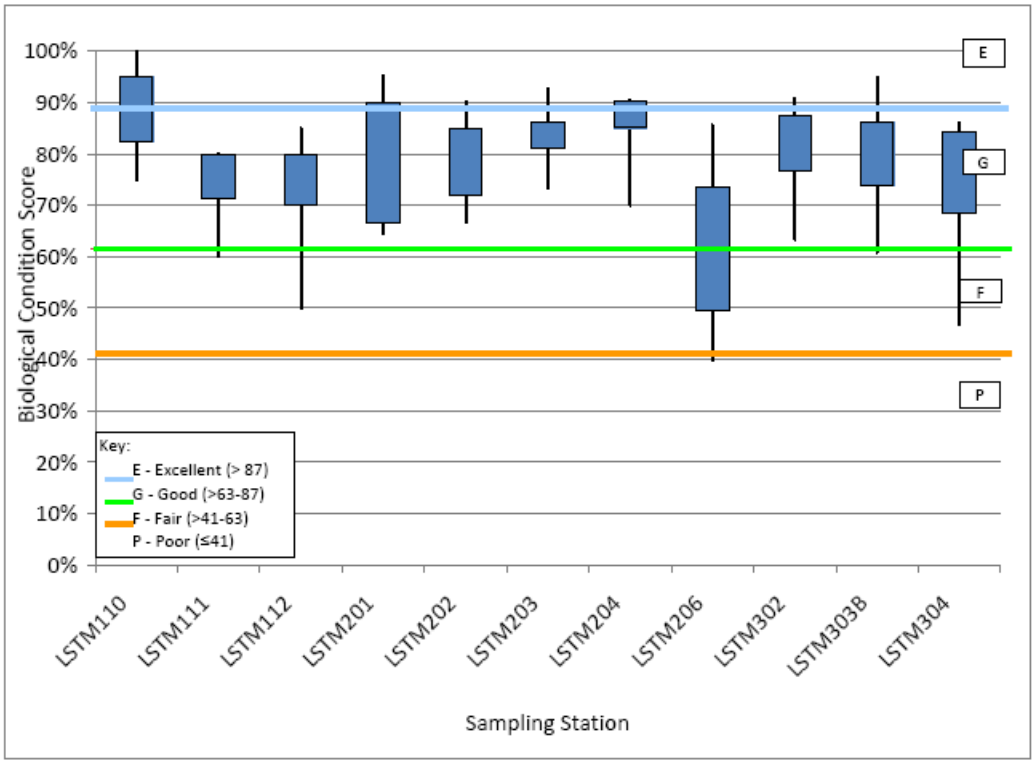

Figure 3.29. Ranges of composite Biological Condition scores among the permanent sampling stations (1994-2012).

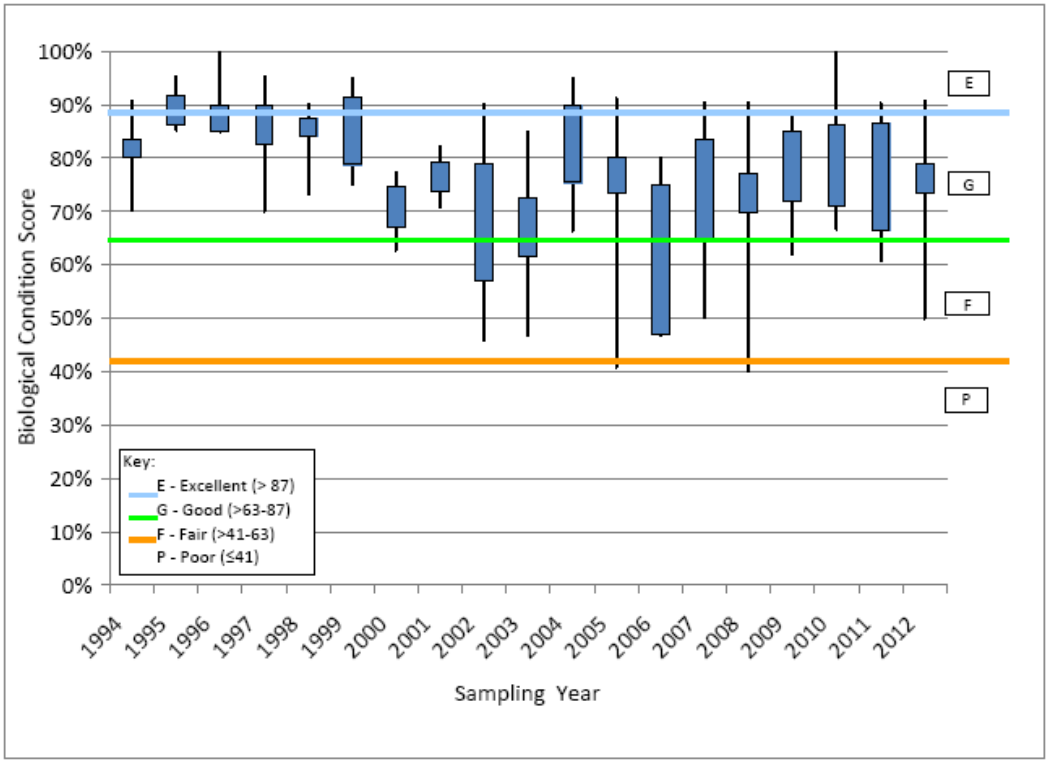

Figure 3.30. Variability among biological condition scores at all sampling stations over time.

3.9 Upland Habitat and Biology

Forest Cover

Typically in those undeveloped areas not in agriculture, the vegetation in the Ten Mile Creek study area is characterized as an upland or bottomland hardwood forest. The upland hardwood forest is particularly prevalent in the western portion of study area. It is described as a mature forest with abundant groundcover and a nearly complete canopy in upland and on hillslope landscape positions. Tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), and hickory (*Carya sp.*) are the dominant canopy trees (Greenhorne & O'Mara, 1992). Bottomland hardwood forests are located along stream, floodplains and wetland areas within the watershed. The canopy coverage of the bottomland forests is dominated by red maple, American sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), Green ash (*Fraxinus pennsylvanica*), tulip tree, hickory, black locust (*Robinia pseudoacacia*), black gum (*Nyssa sylvatica*), black cherry (*Prunus serotina*), and black walnut (*Juglans nigra*) in the overstory tree canopy. While concentrated in the western portion of the watershed, agricultural fields and pasture are found throughout the watershed (Greenhorne & O'Mara, 1992).

Montgomery County DEP recently mapped forest interior within the Ten Mile Creek watershed based on the following conditions: 1) a forest at least 50 acres in size with 10 or more acres of interior forest habitat or a forest greater than 300 feet from the nearest forest edge, or 2) a riparian forest with an average minimum width of 300 feet and at least 50 acres in size. These forest interiors that can support forest interior dwelling birds species (FIDS) that require large forest areas to breed and maintain viable populations (Jones, McCann, & McConville, 2000). See Figure 2.2 for the extent of forest interior in the Ten Mile Creek study area.

In addition MDNR has performed a statewide analysis of hubs and corridors "that are large and intact enough to provide a full range of environmental functions" (MDNR 2003). MDNR (2003) defines hubs as areas that consist of large contiguous tracts of forest land that are integral to the ecological health of the state and corridors as linear remnants of these vital habitats that form linkages among the hubs. As shown in Figures 3.31 and 3.32, the large tract of forest central to the Ten Mile Creek Watershed has been designated as a hub by MDNR. This figure also shows an important corridor extending north to Little Bennett Regional Park and south to Black Hills Regional Park, both MNDR designated hubs. Being in such proximity, these hubs each function to enhance the integrity and biodiversity of the adjacent habitats as a more contiguous unit. The crucial gaps documented in this resource are located at the northeastern tip of the subwatershed LSTM201 and at the boundary between LSTM302 and LSTM303B. The primary land use within these gaps is currently documented as bare ground and agriculture.

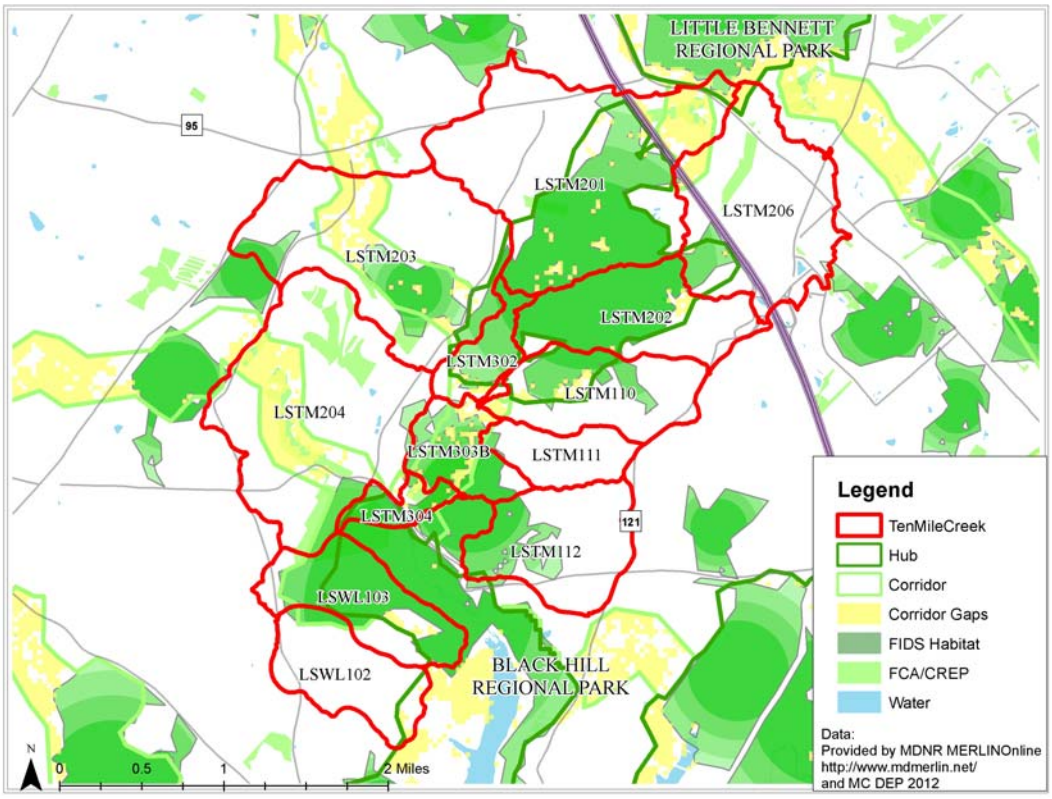

Figure 3.31. Overview of MDNR's hubs and corridors and forest connectivity data within the project area.

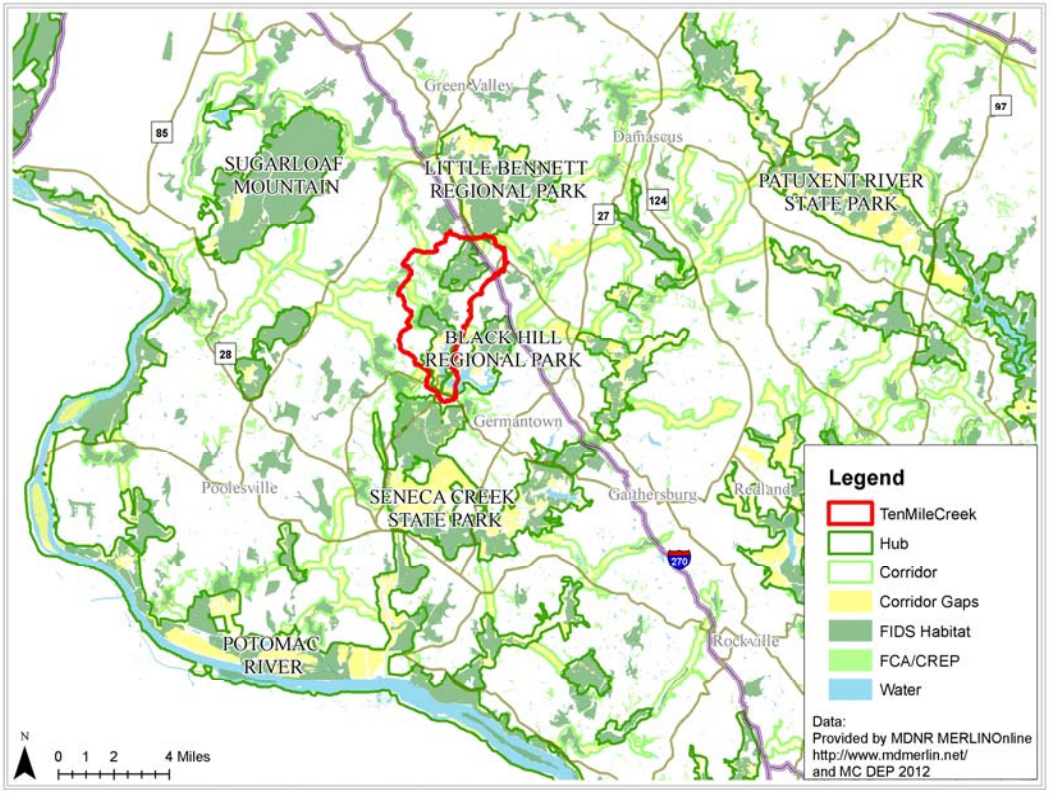

Figure 3.32. Regional overview of MDNR's hubs and corridors and forest connectivity data.

Wildlife

In the upper reaches of Ten Mile Creek beaver have developed a series of dams which provide deep, cool pools that act as refuge for fish, amphibians and reptiles during the drier summer months and habitat for wintering waterfowl and area wildlife in the winter months (Montgomery County Planning Department, 2009). In addition, "bird surveys in 2009 observed or heard 12 migratory nesting forest interior bird species in Stage 4 forest interior areas of Ten Mile Creek" (Montgomery County Planning Department, 2009).

Table 3.6 lists the wildlife documented in various habitats during an ecological field survey throughout the Clarksburg Planning Area by Greenhorne & O'Mara, Inc. (1992).

Table 3.6. Wildlife Documented in the Clarksburg Planning Area During the Clarksburg Environmental & Water Resources Study

Mammals throughout the Clarksburg Planning Area	
Whitetail deer (*Odocoileus virginianus*)	Eastern mole (*Scalopus aquaticus*)
Raccoon (*Procyon lotor*)	Woodchuck (*Marmota monax*)
Gray squirrel (*Sciurus carolinensis*)	Eastern chipmunk (*Tamias striatus*)
Red fox (*Vulpes vulpes*)	
Birds in Upland Hardwood Forest	
Downy woodpecker (*Picoides pubescens*)	Scarlet tanager (*Piranga olivacea*)
Red-bellied woodpecker (*Melanerpes carolinus*)	White-breasted nuthatch (*Sitta carolinensis*)
Tufted titmouse (*Parus bicolor*)	Whippoorwill (*Caprimulgus vociferous*)
Kentucky warbler (*Oporornis formosus*)	Eastern towhee (*Pipilo erythrophthalmus*)
Northern parula (*Parula americana*)	Red-tailed hawk (*Buteo jamaicensis*)
Northern cardinal (*Cardinalis cardinalis*)	Great crested flycatcher (*Myiarchus crinitus*)
Ovenbird (*Seiurus aurocapillus*)	
Birds in Bottomland Hardwood Forest	
Eastern wood pewee (*Contopus virens*)	Gray catbird (*Dumetella carolinensis*)
Carolina chickadee (*Poecile carolinensis*)	Red-eyed vireo (*Vireo olivaceus*)
Carolina wren (*Thryothorus ludoyicianus*)	American robin (*Turdus migratorius*)
Wood thrush (*Hylocichia mustelina*)	Barred owl (*Strix varia*)
Birds along Forest Edges and Open Areas	
Common yellowthroat (*Geothlypis trichas*)	Barn swallow (*Hirundo rustica*)
Red-winged blackbird (*Agelaius phoeniceus*)	American crow (*Corvus brachyrhynchos*)
Indigo bunting (*Passerina cyanea*)	Turkey vulture (*Cathartes aura*)
Northern flicker (*Colaptes auratus*)	American goldfinch (*Carduelis tristis*)
Herptile Species in Bottomland Hardwood Forests (Associated with streams, floodplains, and wetalnds)	
Pickerel frog (*Rana palustris*)	Ringneck snake (*Diadophis punctatus*)
American toad (*Bufo americanus*)	Eastern box turtle (*Terrapene carolina*)
Two-lined salamander (*Eurycea bislineata*)	Treefrog (*Hyla sp.*)

Source: (Greenhorne & O'Mara, Inc., 1992)

In addition, the Audubon Naturalist Society has observed or seen evidence of the following wildlife during sampling efforts in Ten Mile Creek watershed: salamanders, fish, frogs, deer, beavers,

woodpeckers, owls, songbirds, Great Blue herons, hawks, and vultures (Audubon Naturalist Society, 2012).

3.10 Rare, Threatened, and Endangered Species

A species information request letter regarding information on state rare, threatened and/or endangered plant and animal species within or near the Ten Mile Creek watershed was sent to MDNR Wildlife and Heritage Service in January 2013. As of the date of this report, a response letter was not yet received. According to the United States Fish and Wildlife Service (USFWS) Chesapeake Bay Field Office website, the watershed is located on a United States Geologic Survey (USGS) Topographic map designated "where no federally proposed or listed endangered or threatened species are known to occur." For this reason, an online certification letter is adequate for fulfilling the species information request to the USFWS (Appendix E). In addition, no endangered flora or fauna were identified during a 1990 environmental inventory conducted by Greenhorne & O'Mara, Inc. for Montgomery County Planning Department of M-NCPPC (Greenhorne & O'Mara, 1992).

4.0 COMMUNITY FEATURES

4.1 Historical Context

A letter requesting historic and archeological properties information within Ten Mile Creek watershed was sent to Maryland Historical Trust (MHT) in January 2013 (Appendix F). A MHT review letter dated February 8, 2013, (Appendix F) concluded there are "literally dozens of historical properties" and "several known archeological sites (both prehistoric and historic) as well as a number of archeologically sensitive areas likely to contain significant sites that have not yet been identified (Maryland Historical Trust, 2013)". The known historical features to note within Ten Mile Creek watershed include three rustic roads, West Old Baltimore Road ford crossing, cemeteries, Clarksburg School, Moneysworth Farm, Cephas Summers House, Clarksburg Historical District, and Tenmile Creek Valley Historical District (Figure 4.1).

The Rustic Road Program was enacted by Montgomery County to preserve historic and scenic roadways characteristics of the county's agricultural and rural origins. There are two categories of rustic roads – rustic road and exceptionally rustic road. The difference is that exceptional rustic roads "contribute significantly to the natural, agricultural, or historic characteristic of the County", "have unusual features found on few other roads", and "would be more negatively affected by improvements or modifications…than most other roads in the Rustic Road Program" (Montgomery County Department of Park and Planning, 1994). Three roads in the watershed are included in this program. Small portions of Peach Tree Road and Slidell Road within the watershed are classified as rustic roads. West Old Baltimore Road, that bisects the watershed from Clarksburg Road (MD 121) to Slidell Road, is classified as an exceptional rustic road (Montgomery County Planning Department, 2004).

A unique characteristic of West Old Baltimore Road is a ford crossing, a natural shallow point in the stream that can be crossed by vehicle or people, through Ten Mile Creek mainstem. This is one of a few fords remaining in Montgomery County.

Two historical cemeteries are located in Ten Mile Creek – one in the northeast and the other in the northwest – Clarksburg Methodist Church Cemetery and Thompson Family Cemetery. Clarksburg Methodist Church Cemetery is associated with the Clarksburg Methodist Church, established in 1788. Some of the slate grave markers are dated late 18th to early 19th century. The cemetery is located on Spire Street in the Clarksburg Historic District. Thompson Family Cemetery, circa 1873, is located west of Slidell Road just south of Comus Road (Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013).

According to the 1994 Clarksburg Master Plan, the Master Plan for Historic Preservation has five individual sites and three Master Plan historical districts within the Clarksburg Study Area. Three individual sites – Clarksburg School, Moneysworth Farm, and Cephas Summers House – and Clarksburg Historic District are located entirely or partially within Ten Mile Creek watershed. Several additional historical resources, mostly houses and outbuildings within Ten Mile Creek watershed identified in the 1994 Master Plan that were being reviewed in conjunction with the Master Plan effort, received negative recommendations from the Historical Preservation Commission and the Master Plan (Montgomery County Department of Park and Planning, 1994).

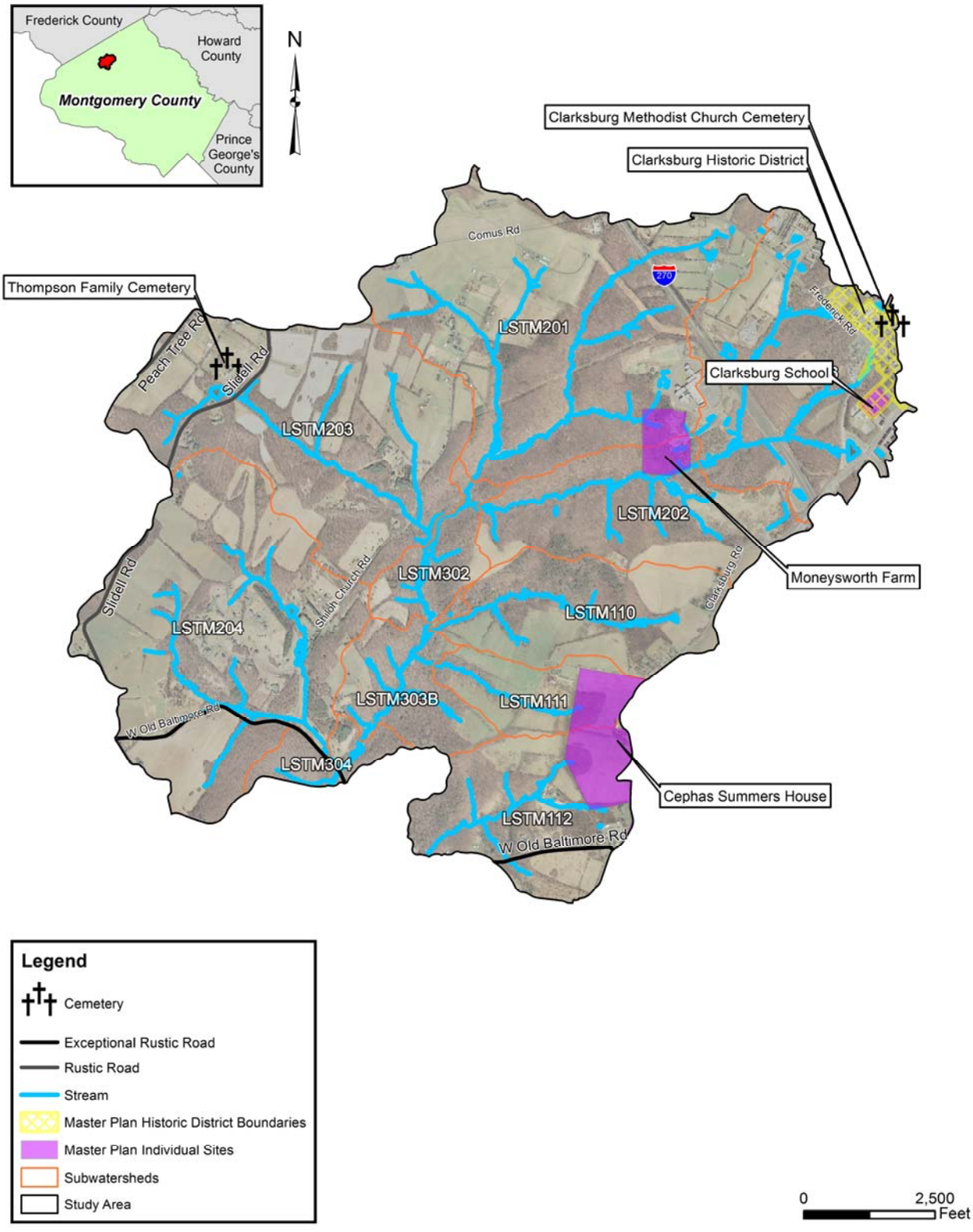

Figure 4.1. Historic and Cultural Sites

The National Register listed Clarksburg School, a two-room schoolhouse built in 1909, as located within the Clarksburg Historical District (Maryland Historical Trust, 2013; Montgomery County Department of Park and Planning, 1994). Moneysworth Farm, a MHT easement property, is located south of Frederick Road (MD 355) on the grounds of the Montgomery County Correctional Facility (Maryland Historical Trust, 2013; Montgomery County Department of Park and Planning, 1994). The Moneysworth Farm is a farmstead in which the original part of the house was built in 1783 with logs. Cephas Summers House, dating from the second quarter of the 19th century, is one of the earliest farmhouses in the Clarksburg area. The farmhouse, located west of Clarksburg Road, is an example of Greek Revival-style architecture (Montgomery County Department of Park and Planning, 1994; Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013).

The National Register-eligible Clarksburg Historical District, located along Frederick Road (MD 355) in the northern part of Ten Mile Creek watershed, has residential and commercial buildings from the early 19th to early 20th century including the Clarksburg School (Maryland Historical Trust, 2013; Montgomery County Department of Park and Planning, 1994; Montgomery County Planning Department & Montgomery County Department of Environmental Protection, 2013). The Tenmile Creek Stream Valley Historical District is located between Route 121 and West Old Baltimore Road (Maryland Historical Trust, 1979). According to Maryland State archives compiled 1978-1979, the area contains potentially significant archeological sites (i.e. prehistoric Indian culture) and settlements of the eighteenth century (e.g., tobacco planters, a mill site include a pond, race, and house, a boarding house, etc.) (Maryland Historical Trust, 1979).

4.2 Existing Infrastructure

Utilities

Utilities are limited within the Ten Mile Creek study area. The County Correctional Facility pumps sewage to Gateway Center Drive. A few properties in the Historic District have access to sewer service via sewers in the Little Seneca watershed, some adjacent to the town center and a few west of Route 355 (Montgomery County Planning Department, 2009). The majority of residents within Ten Mile Creek watershed are on well water and septic systems.

Stormwater Management

Montgomery County has historically been very proactive in requiring stormwater management of developers, thus the existing development areas in Ten Mile Creek are largely controlled by best management practices (BMPs). Due to the various development periods, these BMPs vary according to their approval date and what was considered “state-of-the-practice” at the time of construction. Twenty BMPs are located in three of the Ten Mile Creek subwatersheds- LSTM201, LSTM206, and LSTM204 (Table 4.1 and Figure 4.2). In all, these BMPs service fifteen drainage areas, which are grouped in the Table. Eighteen are listed in the Montgomery County DEP urban stormwater BMP database. The urban stormwater BMP database maintained by DEP is generally used for the County to track BMPs within their jurisdiction for maintenance. Generally, there is a lag period between construction of a BMP, a period where the BMP is maintained by a developer or property owner, and when that BMP becomes County responsibility. At least two BMPs are currently not listed in the urban stormwater BMP database: a pond at the Clarksburg Detention Center, and a pond at the Stringtown Road Extension. These were added to Table 4.1 based on data from the SPA reports.

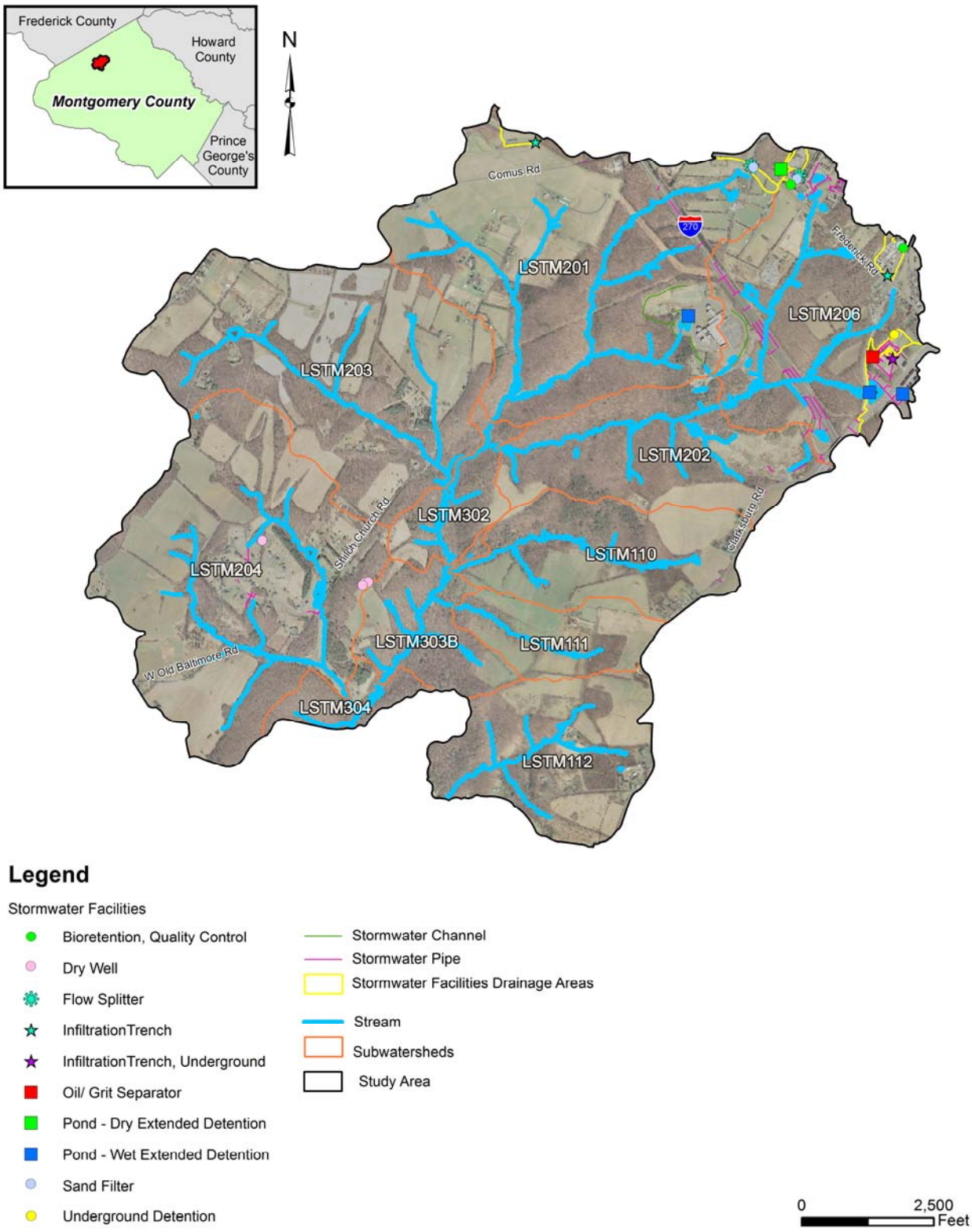

Figure 4.2. Existing Stormwater Infrastructure in the Ten Mile Creek Study Area

Table 4.1. Existing Stormwater Management Features in the Ten Mile Creek study area

Subwatershed	Structure Type	Approval Date	Drainage Area (acres)	Land Use
LSTM201	Flow Splitter to Sand Filter	2002	14.6	Route 355 Roadway
LSTM201	Infiltration Trench	2000	3.9	Garden of Remembrance Cemetery Roadway
LSTM201	Flow Splitter to Dry Pond w/ Extended Detention	1979	3.7	Little Bennett Regional Park Parking
LSTM201	Wet Pond w/ Extended Detention[1]	2002	35	Clarksburg Detention Facility (Institutional)
LSTM206	Flow Splitter to Sand Filter	1979	3.2	Little Bennett Regional Park Parking
LSTM206	Bioretention	2007	1.1	Woodcrest Phase 5 Medium-Density Residential
LSTM206	Infiltration Trench	1995	6.1	Clarksburg Nursery (Commercial)
LSTM206	Bioretention	2003	0.9	Clarksburg Ridge High-Density Residential
LSTM206	Sand Filter	2003	0.6	Clarksburg Ridge High-Density Residential
LSTM206	Wet Pond w/ Extended Detention	1989	34.5	Gateway 270 Corporate Park
LSTM206	Oil/grit Separator to Underground Detention	1992	3.8	Clarksburg Elementary School
LSTM206	Underground Infiltration trench	1974	0.3	Clarksburg Elementary School
LSTM206	Erosion & Sediment Control Pond, to be converted to a Wet Pond[2]	2012	12.9	Stringtown Road Extension & Gateway Commons
LSTM204	Dry Well	2007	0.09	Huffman Property Single Residence
LSTM204	Dry Well	2008	0.03	Branch Hill Single Residence

Source: DEP Urban Stormwater BMP Database, except for
1 Montgomery County Department of Environmental Protection, 2003
2 Montgomery County Department of Environmental Protection, 2012

The northern headwater area of Ten Mile Creek (subwatershed LSTM201) receives runoff from part of the Clarksburg Detention Center, Route 355, the Garden of Remembrance Cemetery, and the Little Bennett Regional Park. In some cases, a flow splitter is used to route first-flush events to infiltration practices, as is the case for the Route 355 and Little Bennett Regional Park facilities. The flow splitter at the Little Bennett Regional Park actually divides flow between the LSTM201 and LSTM206 subwatersheds. The pond at the Clarksburg Detention Center was re-constructed after construction of the jail, but was not listed in the DEP Urban Stormwater BMP database (Montgomery County Department of Environmental Protection, 2003). The stream has been impacted by the crossing and piped drainage associated with I-270. Sections of the Clarksburg Correctional Facility have also been channelized to improve drainage.

The eastern headwater area of Ten Mile Creek (subwatershed LSTM206) receives runoff from the new Stringtown Road widening west of Route 355, some commercial development in the I-270 Gateway Center area, portions of the Town Center development, a part of Gateway Commons, as well as runoff from portions of I-270. This subwatershed contains the highest density of stream crossings, piped drainage, and stormwater management facilities. Construction on the Stringtown Road Extension has been completed since November 2006, but the Sediment Basin BMP will not be converted to SWM until construction is completed at Gateway Commons, since the two properties both drain to this basin. The basin treats 12.9 acres of runoff from Stringtown Road Extension and Gateway Commons. It then discharges to an existing off-site stormwater management pond to the west of Gateway Center Drive (Montgomery County Department of Environmental Protection, 2012).

The western tributary area of Ten Mile Creek (subwatershed LSTM204) contains some low density residential development. Two of these private homes, Branch Hill and Huffman, have dry wells to manage runoff from their properties. Some limited piped drainage occurs associated with the residential development.

5.0 CONCLUSION

As presented in the preceding sections, the Ten Mile Creek study area exhibits many environmental characteristics that reflect overall healthy watershed conditions. Subwatershed characteristics within the study area are summarized in Table 5.1. Where conditions show indications of impairment, these tend to be associated with subwatersheds where development already exists.

In the next phases of planning analysis and development scenario testing, it will be important to assess potential impacts to key environmental features throughout the watershed. Spatial analysis overlaying development scenarios with key environmental features such as soils, slopes, wetlands, hydrology, and forest cover (supplemented by water quality and hydrologic modeling) will inform the Clarksburg Master Plan Limited Amendment process.

Table 5.1. Summary of Key Subwatershed Attributes

Subwatershed	Within SPA	Area (square miles)	Percent of Study Area	Contribution to Study Area's:					2012 Benthic IBI Rating
				Imperviousness	Forest Cover	Forest Interior	Wetlands	Erodible Soils	
LSTM110	Yes	0.3	7%	3%	7%	8%	2%	6%	Good
LSTM111	Yes	0.2	3%	1%	1%	0%	1%	3%	Good
LSTM206	Yes	0.6	12%	49%	11%	3%	15%	6%	Good
LSTM112	Partial	0.4	7%	5%	8%	6%	0%	13%	Fair
LSTM201	Partial	1.0	20%	19%	19%	25%	9%	11%	Good
LSTM202	Yes	0.4	8%	4%	12%	26%	6%	13%	Good
LSTM302	Partial	0.1	3%	0%	5%	9%	30%	4%	Good
LSTM303B	Partial	0.2	4%	0%	7%	10%	19%	5%	Good
LSTM203	No	0.8	16%	8%	14%	2%	11%	18%	Fair
LSTM204	No	0.8	18%	11%	13%	4%	3%	15%	Excellent
LSTM304	Partial	0.1	2%	0%	3%	7%	5%	5%	Good
TOTAL		**4.8**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	

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APPENDIX A. BIBLIOGRAPHY FOR THE TEN MILE CREEK WATERSHED ENVIRONMENTAL ANALYSIS FOR THE CLARKSBURG MASTER PLAN LIMITED AMENDMENT

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Category	**Data Sources**
Overall Figure Data	**Study Area**. FinalData_ToUse_BC.gdb\Subwatersheds_StudyArea. Created from Original_Data\mp_boundary_one\mp_boundary_one.shp based on direction from Montgomery Co. DEP, Feb 8, 2013.
Overall Figure Data	**Ten Mile Creek Boundary**. Original_Data\DEP\TenMileCreek_OCT2012.gdb\TMC
Overall Figure Data	**Subwatersheds**. FinalData_ToUse_BC.gdb\Station_DA_BCupdated. Created from Original_Data\DEP\TenMileCreek_OCT2012.gdb\ STATION_DA based on direction from Montgomery Co. DEP, Feb 8, 2013.
Overall Figure Data	**Streams**. FinalData_ToUse_BC.gdb\TMC_HYDRO_FINAL. Created from Original_Data\TenMileCreek_HYDRO_FINAL.gdb\TMC_HYDRO_FINAL to correct ephemeral streams, add one missing stream and create centerlines for streams having duplicate lines.
Individual Maps	
2012 Benthic Macroinvertebrate Conditions	Created from DEP data summaries compiled by Biohabitats Mar 6, 2013.
2012 Fish Conditions	Created from DEP data summaries compiled by Biohabitats Mar 6, 2013.
2012 Habitat Condition	Created from DEP data summaries compiled by Biohabitats Mar 6, 2013.
2012 Stream Condition	Created from DEP data summaries compiled by Biohabitats Mar 6, 2013.
Average of Benthic Macroinvertebrate Conditions	Created from DEP data summaries compiled by Biohabitats Feb 13, 2013.
Average of Fish Conditions	Created from DEP data summaries compiled by Biohabitats Feb 13, 2013.
Average of Habitat Condition	Created from DEP data summaries compiled by Biohabitats Feb 13, 2013.
Average of Stream Condition	Created from DEP data summaries compiled by Biohabitats Feb 13, 2013.
Erodible Soils	**Erodible Soils.** Data\Erodible_Soil_Clip_MUNAMEdesc.shp. Created from Original_Data\MNCPPC\Clarksburg Data.mdb\Erodible_soils96 and NRCS data.
Habitat, Biological, and Geomorphic Stream Monitoring Sites	**Monitoring Stations.** Original_Data\Biohab_Jan2013\BIOHABIT_JAN_2013.gdb\station (Inactive stations LSTM106, LSTM301, LSTM303A, LSTM10 and LS3638212 not shown)
Historic and Cultural Sites	**Cemeteries**. Original_Data\MNCPPC\Clarksburg Data.mdb\Historic Preservation\GISADMIN_Montco_Cem_2007
Historic and Cultural Sites	**Rustic Roads.** Original_Data\Data Transfer 010813.mdb\Rustic_Roads

Historic and Cultural Sites	**Master Plan Historic District Boundary**. Original_Data\MNCPPC\Clarksburg Data.mdb\Historic Preservation\GISADMIN_mp_historic_district_bound
Historic and Cultural Sites	**Master Plan Individual Sites**. Original_Data\MNCPPC\Clarksburg Data.mdb\Historic Preservation\ GISADMIN_mp_individual_sites
Key Hydrologic Features	**USGS Stream Gage**. Data\RiverGauge_Projected83.shp from: http://waterdata.usgs.gov/md/nwis/nwismap/?site_no=01644390&agency_cd=USGS
Key Hydrologic Features	**Hydrologic Feature Points (West Side**). Manipulated_Data-ZN\WestSide_TMC_Feat_Pnt.shp. Created from Original_Data\TenMileCreek_West_NRI.gdb\TenMileCreek_West_NRI\TMC_FEAT_PNT by removing duplicate ephemeral streams)
Key Hydrologic Features	**Hydrologic Feature Points (East Side).** Original_Data\DEP\12-05-12 MNCPPC & Biohab - Ten Mile Mapping Data\DATA\New Feature Reference & Field Points\FeaturePoints.shp (Features grouped into springs, seeps, pools, wetlands in symbology)
Key Hydrologic Features	**Wetlands.** FinalData_ToUse_BC.gdb\Wetlands_combined. Created from DEP\12-05-12 MNCPPC & Biohab - Ten Mile Mapping Data- Existing Wetlands97Update, New_TenMile_Wetlands_06-03-09, and Original_Data\TenMileCreek_HYDRO_FINAL.gdb\TMC_HYDRO_FINAL
Key Hydrologic Features	**Existing 100-yr Floodplain.** Original_Data\MNCPPC\Clarksburg Data.mdb\ GISADMIN_floodplains_county
Land Use	**2007 Land Use Classifications**. LandcoverNew_02152013.gdb\ Landcover2007_updatedBC_Clipped. Created from Original_Data\ Clarksburg Data.mdb\GISADMIN_MC_Landcover_byShed, modified based on direction from M-NCPPC.
Landcover	**Forest Conservation Easement**. Original_Data\MNCPPC\Clarksburg Data.mdb\GISADMIN_forest_conservation_easements
Landcover	**Impervious Features**. Original_Data\Latest Impervious Layer.gdb\ Imperviousness_012213
Landcover	**Forest**. Original_Data\MNCPPC\Clarksburg Data.mdb\ GISADMIN_forest_2008
Landcover	**Forest Interior**. Original_Data\DEP\12-05-12 MNCPPC & Biohab - Ten Mile Mapping Data\DATA\Existing Forest Cover & Interior Forest\TenMile_Forest_Interior_05-15-09
Ten Mile Creek Watershed	**Special Protection Areas**. Original_Data\MNCPPC\Clarksburg Data.mdb\GISADMIN_special_protection_areas
Soils	**Soil Classification Layer**. Original_Data\MNCPPC\Clarksburg Data.mdb\GISADMIN_soils
Existing Stormwater Facilities	**Stormwater Facilities**. Original_Data\DEP\TenMileCreek_OCT2012.gdb\ TMC\TMC_SWFAC and Montgomery Co. DEP BMP information.

Existing Stormwater Facilities	**Stormwater Facilities Drainage Areas**. Original_Data\DEP\TenMileCreek _OCT2012.gdb\TMC\TMC_SWFAC_DA
Existing Stormwater Facilities	**Storm Channel (County)**. Original_Data\Biohab_Jan2013\BIOHABIT_ JAN_2013.gdb\StormDrain\County_CH
Existing Stormwater Facilities	**Storm Channel (DPS).** Original_Data\Biohab_Jan2013\BIOHABIT _JAN_2013.gdb\StormDrain\DPS_CH
Existing Stormwater Facilities	**Storm Pipe (State).** Original_Data\Biohab_Jan2013\BIOHABIT_ JAN_2013.gdb\StormDrain\State_P
Existing Stormwater Facilities	**Storm Pipe (County).** Original_Data\Biohab_Jan2013\BIOHABIT _JAN_2013.gdb\StormDrain\County_P
Existing Stormwater Facilities	**Storm Pipe (DPS).** Original_Data\Biohab_Jan2013\BIOHABIT_ JAN_2013.gdb\StormDrain\DPS_P
Topography	**Index Contour Line.** Original_Data\MNCPPC\Clarksburg Data.mdb\contours2ft
Subwatershed Imperviousness	Color coding provided by Biohabitats Feb 28, 2013 based on Impervious Features in Original_Data\Latest Impervious Layer.gdb\ Imperviousness_012213
Little Seneca Lake Drainage Area	**Drainage Areas**. Original_Data\Seneca Lake Subwatershed\Seneca Lake Subwatershed.shp and Original_Data\DEP\TenMileCreek_OCT2012.gdb \TMC
Spatial Data Analyses	
Data Analysis: Land Use Analysis	**Forest 2008**. Original_Data\MNCPPC\Clarksburg Data.mdb\ GISADMIN_forest_2008
Data Analysis: Land Use Analysis	**Impervious Features**. Original_Data\Latest Impervious Layer.gdb\ Imperviousness_012213
Data Analysis: Land Use Analysis	**Erodible Soils.** Data\Erodible_Soil_Clip_MUNAMEdesc.shp. Created from Original_Data\MNCPPC\Clarksburg Data.mdb\Erodible_soils96 and NRCS data.
Data Analysis: Land Use Analysis	**Soils.** FinalData_ToUse_BC.gdb\Soils_Clipped. Created from MNCPPC\Clarksburg Data.mdb - GISADMIN_soils_1996 soils survey and NRCS data.
Data Analysis: Land Use Analysis	**Subwatersheds**. FinalData_ToUse_BC.gdb\Station_DA_BCupdated. Created from Original_Data\DEP\TenMileCreek_OCT2012.gdb\ STATION_DA
Data Analysis: Land Use Analysis	**Land Use.** LandcoverNew_02152013.gdb\Landcover2007_updatedBC _Clipped. Created from Original_Data\ Clarksburg Data.mdb\GISADMIN _MC_Landcover_byShed, modified based on direction from M-NCPPC.
Data Analysis: Stream Analysis	**Streams**. FinalData_ToUse_BC.gdb\TMC_HYDRO_FINAL. Created from Original_Data\TenMileCreek_HYDRO_FINAL.gdb\TMC_HYDRO_FINAL to correct ephemeral streams, add one missing stream and create centerlines for streams having duplicate lines.
Data Analysis: Stream	**Subwatersheds**. FinalData_ToUse_BC.gdb\Station_DA_BCupdated.

Analysis	Created from Original_Data\DEP\TenMileCreek_OCT2012.gdb\ STATION_DA
Data Analysis: Stream Analysis	**Monitoring Stations**. Original_Data\Biohab_Jan2013\BIOHABIT _JAN_2013.gdb\station
Data Analysis: Hydrologic Feature Count	**Hydrologic Feature Points (West Side).** Manipulated_Data-ZN\WestSide_TMC_Feat_Pnt.shp. Created from Original_Data\TenMileCreek_West_NRI.gdb\TenMileCreek_West_NRI\TMC_FEAT_PNT by removing duplicate ephemeral streams)
Data Analysis: Hydrologic Feature Count	**Hydrologic Feature Points (East Side).** Original_Data\DEP\12-05-12 MNCPPC & Biohab - Ten Mile Mapping Data\DATA\New Feature Reference & Field Points\FeaturePoints.shp (Features grouped into springs, seeps, pools, wetlands in symbology)

APPENDIX B. DETAILED SOIL MAP UNIT DESCRIPTION

Detailed Soil Map Units Descriptions

According to USDA Natural Resources Conservation Service (NRCS) Soil Survey mapping, the study area within Ten Mile Creek, approximately 3,050 acres of land, is mapped with fifteen soil map units excluding water (Soil Survey Staff, 2013). The dominant soil map units include Brinklow-Blocktown channery silt loams, 8 to 15 percent slopes (16C), Linganore-Hyattstown channery silt loams, 8 to 15 percent slopes (9C), Brinklow-Blocktown channery silt loams, 3 to 8 percent slopes (16B), and Linganore-Hyattstown channery silt loams, 3 to 8 percent slopes (9B) at 17.9%, 16.2%, 15.6%, and 13.9% of the study area, respectively.

Linganore and Hyattstown soil series making up the 9B and 9C map units are well drained soils on nearly level ridge crests and side slopes of ridges and dissected landscapes. Both soil series formed in residuum, or in place, weathered from phyllite. Linganore is moderately deep with a restrictive layer of paralithic bedrock ranging from 20 to 40 inches from the soil surface, while Hyattstown is shallow with a restrictive layer of paralithic bedrock ranging from 10 to 20 inches from the soil surface. Paralithic implies the bedrock at that depth can be dug with difficulty with hand tools. Both map units also have a channery silt loam surface texture. This indicates the surface soil has more than 15 percent channers or thin, flat rock fragments in the soil surface layer or topsoil. The particle-size class, or the grain size classification, of both series is loamy-skeletal meaning the soil has 35 percent of more rock fragments by volume throughout the soil profile (Soil Survey Staff, 2013).

Brinklow and Blocktown soil series making up the 16B and 16C map units are well drained soils on ridges and side slopes of dissected landscapes. While both soil series formed in residuum weathered from phyllite and schist, Brinklow also formed in soil creep matierals, or soil that has moved slowly down-slope. Brinklow is moderately deep with a restrictive layer of lithic bedrock ranging from 20 to 40 inches from the soil surface, while Blocktown is shallow with a restrictive layer of paralithic bedrock ranging from 10 to 20 inches from the soil surface. Lithic refers to hard bedrock that is not able to be dug with hand tools. Similar to map units 9B and 9C, 16B and 16C have a channery silt loam surface texture indicating the surface soil has more than 15 percent channers in the topsoil. Blocktown soil series' particle-size class, or the grain size classification, is loamy-skeletal (Soil Survey Staff, 2013).

In general, Ten Mile Creek mainstem and its tributaries were mapped using the soil maps units Glenville silt loam, 0 to 3 percent slopes (5A), Glenville silt loam, 3 to 8 percent slopes (5B), Baile silt loam, 0 to 3 percent slopes (6A), and Hatboro silt loam, 0 to 3 percent slopes, frequently flooded (54A). The soil map unit 54A was mapped along Ten Mile Creek mainstem and its tributaries with existing floodplains. Soil map unit 6A was mapped along tributaries with narrow floodplains bounded by steep slopes and soil map units 5A and 5B were mapped in the tributary headwaters. These soils map units mapped along the stream are either poorly drained or moderately well drained and formed in alluvium, soil deposited by flowing water, or colluvium, soil accumulated by the action of gravity (Soil Survey Staff, 2013).

APPENDIX C. HYDROLOGY: USGS DAILY MEAN FLOWS & MONTGOMERY COUNTY DEP'S TEN MILE CREEK SYNOPTIC FLOW

Appendix C. Hydrology - USGS Daily Mean Flows

USGS 01644390 TEN MILE CREEK NEAR BOYDS, MD

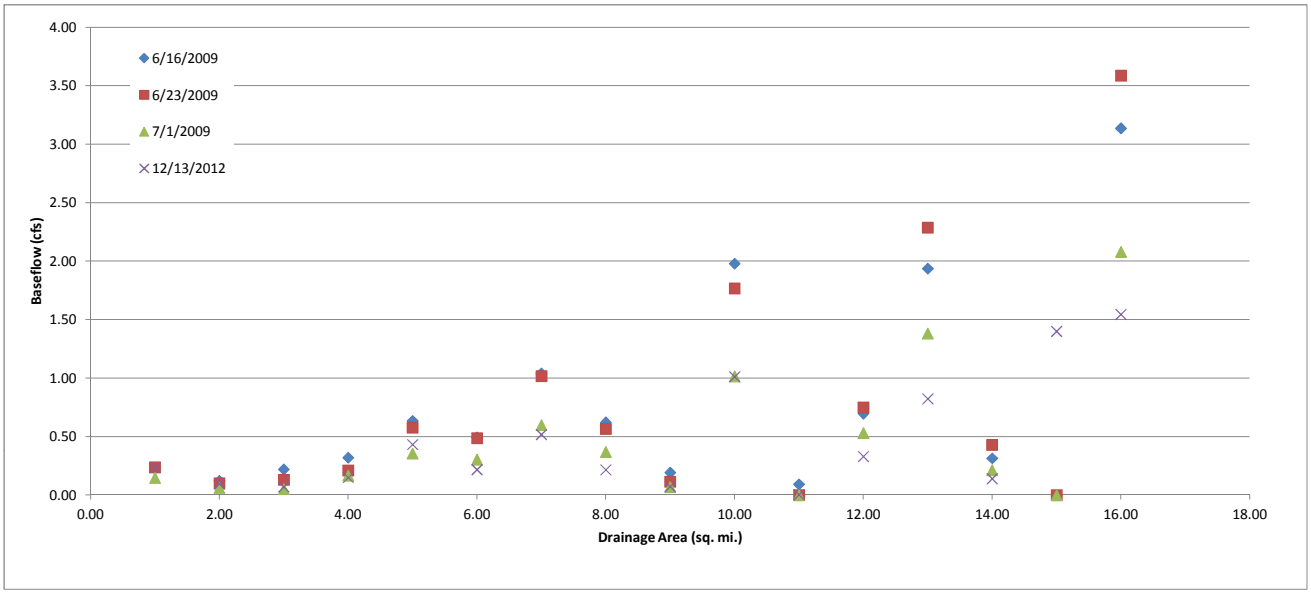
Time Series: Daily Statistics

00060, Discharge, cubic feet per second,

Mean of daily mean values for each day for 2 - 2 years of record in, cfs (Calculation Period 2010-10-01 -> 2012-09-30)

Day of month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.8	2.9	18	4	5.4	28	0.81	0.62	0.64	16	4.2	10
2	3.7	9.3	7.4	3.5	4.9	9.9	0.77	0.48	0.7	11	3.7	5.2
3	3.4	5.5	8.6	3.2	4.5	3.3	1.3	0.48	3.4	4.5	3.4	4
4	3.1	4	5.8	3	6.8	2.6	0.95	0.47	1.1	4.5	5.6	3.6
5	3.3	4.3	4.9	5.9	4.5	2.3	0.8	0.42	13	3.2	4	3.4
6	3.2	5.6	58	3.9	4	2	0.72	0.57	21	2.7	3.1	3.7
7	3	5.3	21	3.4	3.8	1.8	0.68	1.5	18	2.5	2.8	36
8	2.8	5.1	8.2	3.9	3.5	1.7	2	0.77	348	2.2	2.7	16
9	2.7	4.1	6.5	4.1	3.5	1.5	6.1	2.1	11	2.1	2.6	7
10	2.7	3.5	49	3.5	3.3	1.4	1	3	7.3	2	2.6	5.5
11	2.9	3.7	18	3.4	2.7	1.4	1.5	0.79	4.7	2	2.5	4.9
12	13	3.3	8.2	16	2.6	1.6	1.3	0.56	4.1	2.3	2.4	5.4
13	7.4	3	6.4	14	2.6	1.5	1.2	0.52	3.7	59	2.3	5.2
14	5.1	5.5	5.6	5.9	4.9	1.5	0.94	13	6.2	26	2.3	4.2
15	4.2	4.2	5	4.7	13	1.2	0.77	3.7	6.2	7.6	2.3	4
16	3.4	4	6.7	37	7	1.2	0.71	0.87	3.4	4.9	6	3.6
17	3.6	4	4.8	16	4.7	1.5	0.66	0.63	2.9	4.2	5.8	3.5
18	3.6	3.6	4.4	7.5	5.4	1.6	0.6	0.64	3.8	3.7	3.3	3.3
19	3.5	3.3	4.1	7.6	4.8	1.2	3.7	1.6	3.1	9.9	2.8	3.2
20	3.5	3	4.1	6.4	4	1.4	2	1.7	2.5	7.2	2.5	3
21	3.4	3	4.4	5.2	3.9	1.1	1.2	1.1	2.3	3.9	2.8	3.2
22	3	3.2	4	6.4	3.3	1.1	0.89	0.74	2.2	3.3	18	4
23	3.2	3	4	7.4	3.7	1	0.71	0.61	4.1	3	32	24
24	3.7	3	5.5	15	3.4	0.94	0.76	0.6	3	2.8	6.5	5.4
25	3	12	4.7	9.2	2.9	0.88	1.1	0.69	2.3	2.7	4.8	4.5
26	3	4.7	3.9	5.9	2.4	0.82	0.78	1.6	2.3	2.7	4.2	4
27	3.9	3.8	3.5	7.5	2.4	0.85	0.62	1.5	2.4	9.6	4	10
28	3.3	4.7	3.4	20	2.7	0.78	0.58	5.3	3.2	3.2	3.7	6.5
29	3	134	3.3	8.1	2.6	0.79	0.53	1.1	2.6	6.8	7.4	4.6
30	3		3.3	5.8	2.8	1.3	0.48	0.78	2.2	8.2	4.9	4.2
31	2.9		3.5		2		0.63	0.65		5.3		4
Average:	3.8	8.9	9.6	8.2	4.1	2.6	1.2	1.6	16.4	7.4	5.2	6.7

Appendix C. Hydrology - Montgomery County DEP's Ten Mile Creek Synoptic Flow										
	2009 Date			2012 Date	CUMUL Drainage Area (SF)	CUMUL Drainage Area (sq mi)	COMMENTS	Sample Point	Latitude	Longitude
Sample Point	6/16/2009	6/23/2009	7/1/2009	12/13/2012						
1	0.23	0.24	0.15	0.23	175.3	0.27	West Fork- above LSTM206	1	39.23483	77.28985
2	0.12	0.10	0.06	0.10	168.7	0.26	East Fork- above LSTM206	2	39.23604	77.29008
3	0.22	0.13	0.05	0.07	310.5	0.49	East Fork- above LSTM201	3	39.23486	77.30431
4	0.32	0.21	0.17	0.15	275.0	0.43	West Fork- above LSTM201	4	39.23515	77.30636
5	0.63	0.58	0.36	0.43	616.7	0.96	LSTM202	5	39.23181	77.3079
6	0.49	0.49	0.30	0.22	614.5	0.96	LSTM201	6	39.23255	77.3081
7	1.04	1.02	0.60	0.52	1242.4	1.94	Below confluence of LSTM201 and 202	7	39.23042	77.31016
8	0.62	0.57	0.37	0.22	482.7	0.75	LSTM203	8	39.23014	77.31046
9	0.19	0.12	0.07	0.07	203.9	0.32	LSTM110	9	39.22593	77.3083
10	1.98	1.77	1.01	1.01	2015.2	3.15	LSTM302 (below LSTM110)	10	39.2244	77.31127
11	0.09	-	-	0.00	105.2	0.16	LSTM111	11	39.22371	77.31147
12	0.70	0.75	0.53	0.33	543.8	0.85	LSTM204	12	39.21837	77.31731
13	1.94	2.29	1.38	0.82	2241.2	3.50	LSTM303B	13	39.21847	77.31602
14	0.31	0.43	0.21	0.14	243.9	0.38	LSTM112	14	39.21164	77.31152
-	-	-	-	1.4	-	-	USGS Gage	15	39.21043	77.31069
15	3.14	3.59	2.08	1.55	3195.0	4.99	Below bridge			
15a	3.32	2.96	-	1.33	-	-	Below bridge- close loop			



APPENDIX D. AQUATIC HABITAT AND BIOLOGY

Appendix D Aquatic Habitat and Biology

The following sections outline the sampling methodologies and summarize the individual metrics, narrative IBI scores and trends over the 19 years of data provided by DEP. A summary table of available data and IBI scores for the respective sampling efforts are presented in this Appendix.

1.0 Habitat

Habitat was assessed by DEP staff using the qualitative rapid habitat assessment protocol described by Barbour and Stribling (Gibson, 1991). This method scores the condition of each of ten habitat parameters from 0 to 20 according to the criteria in Table D-1.The individual scores are summed to provide the composite habitat score which assigned a condition score (Excellent to Poor) according to the criteria in Table D-1a The habitat parameters include the following:

- Instream cover
- Epifaunal substrate
- Embeddedness
- Channel alteration
- Sediment deposition
- Riffle frequency
- Channel flow status
- Bank vegetation
- Bank stability
- Riparian buffer

Table D-1. Habitat assessment scoring criteria

Condition category	Score
Optimal	20-16
Suboptimal	15-11
Marginal	10-6
Poor	5-0

Source: Barbour and Stribling (Gibson, 1991)

Table D-1a. Cumulative habitat assessment scoring criteria

Condition category	Score
Excellent	≥ 166
Excellent/Good	≥154-165
Good	≥113-153
Good/Fair	≥101-112
Fair	≥60-100
Fair/Poor	≥48-59
Poor	<48

Source: Keith Van Ness, personal communication, January 10, 2013.

Since 2005, DEP has been supplementing these habitat data with the MBSS spring and summer habitat assessments forms (MDNR 2010 and previous versions) to be comparable to statewide datasets. These supplemental data include the following:

Appendix D
Habitat

- Severity and extent of bank erosion
- Composition of bars and substrate
- Exotic plant
- Adjacent land use
- Stream character
- Riparian vegetation type
- Number of woody debris

The MBSS raw habitat scores are converted to scaled metrics and averaged for an overall PHI score for each site as described by Paul et al. (2003). Table D-2 presents the MBSS habitat scoring criteria.

Table D-2. MBSS Habitat assessment scoring criteria

PHI Score	Narrative Rating
81.0 – 100.0	Minimally Degraded
66.0 – 80.9	Partially Degraded
51.0 – 65.9	Degraded
0.0 – 50.9	Severely Degraded

Source: Barbour and Stribling (Gibson, 1991)

The following tables the present the available habitat assessment data at each station for the respective sampling year.

	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Avg.
2005	NA	NA	NA	NA	NA	85	NA	76	76	**79**
2006	NA	NA	NA	NA	NA	NA	NA	NA	79	**79**
2007	93	93	96	90	35	87	83	80	NA	**82**
2008	NA	83	77	79	35	84	70	79	NA	**73**
2009	NA	85	80	86	42	87	77	84	NA	**77**
2010	NA	81	84	84	41	87	77	86	79	**77**
2011	NA	89	81	87	46	85	NA	85	68	**77**
2012	NA	84	81	77	34	73	69	77	75	**71**
Avg.	**93**	**86**	**83**	**84**	**39**	**84**	**75**	**81**	**75**	**77**
R-square	*NA*	*0.14*	*0.22*	*0.22*	*0.07*	***0.30***	***0.37***	*0.22*	*0.22*	***0.38***
Slope	*NA*	*-0.01*	*-0.02*	*-0.01*	*0.01*	*-0.01*	*-0.02*	*0.01*	*-0.01*	*-0.01*
N	*1.00*	*6.00*	*6.00*	*6.00*	*6.00*	*7.00*	*5.00*	*7.00*	*5.00*	*8.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Instream cover

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	16.00	8.00	NA	NA	NA	13.00	13.00	13.00	**12.60**
1995	NA	NA	NA	15.50	13.50	13.00	11.00	NA	14.33	13.50	13.00	**13.40**
1996	17.00	NA	NA	15.00	16.00	14.00	8.00	NA	16.00	13.00	13.00	**14.00**
1997	15.50	NA	NA	13.33	14.33	NA	12.00	15.00	16.67	15.33	16.33	**14.81**
1998	15.00	NA	NA	14.00	12.00	NA	NA	14.00	NA	13.50	15.00	**13.92**
1999	NA	NA	NA	13.00	15.00	NA	NA	16.00	NA	15.00	NA	**14.75**
2000	NA	NA	NA	NA	NA	NA	NA	15.00	14.00	13.00	13.50	**13.88**
2001	NA	NA	NA	NA	NA	NA	NA	17.00	NA	14.00	NA	**15.50**
2002	NA	NA	NA	NA	NA	NA	NA	15.00	NA	13.00	NA	**14.00**
2003	15.00	NA	NA	15.00	16.00	12.00	10.00	13.50	15.50	13.50	13.00	**13.72**
2004	8.00	NA	NA	NA	NA	NA	NA	15.50	NA	15.50	NA	**13.00**
2005	NA	16.00	8.00	NA	NA	NA	NA	13.00	NA	14.00	15.00	**13.20**
2006	6.00	NA	11.00	NA	NA	NA	NA	15.00	NA	16.00	13.00	**12.20**
2007	13.00	NA	10.50	13.00	12.00	11.00	8.50	13.00	12.00	14.00	NA	**11.89**
2008	NA	NA	8.00	16.50	13.50	13.00	11.50	14.50	16.50	15.50	NA	**13.63**
2009	9.00	NA	8.00	15.00	12.00	12.50	11.00	14.50	11.00	17.00	NA	**12.22**
2010	12.00	NA	14.00	14.00	14.00	12.00	9.00	15.00	14.50	15.50	11.50	**13.15**
2011	11.00	8.00	11.00	14.50	14.50	10.50	11.00	13.50	17.00	16.50	13.50	**12.82**
2012	8.00	4.00	8.00	11.50	9.50	11.50	8.00	13.50	10.50	14.00	14.00	**10.23**
Average	**11.77**	**9.33**	**9.81**	**14.33**	**13.10**	**12.17**	**10.00**	**14.56**	**14.25**	**14.46**	**13.65**	**13.31**
R-square	***0.49***	***0.96***	*0.02*	*0.09*	*0.00*	***0.49***	*0.03*	*0.20*	*0.07*	***0.36***	*0.04*	***0.34***
Slope	*-0.44*	*-1.58*	*0.13*	*-0.06*	*-0.02*	*-0.12*	*-0.04*	*-0.10*	*-0.08*	*0.14*	*-0.04*	*-0.12*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

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DEP Habitat Scores for Individual Metrics

Epibenthic substrate

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	16.00	11.00	NA	NA	NA	11.00	11.00	16.00	**13.00**
1995	NA	NA	NA	15.00	14.00	15.50	14.00	NA	16.67	14.50	13.00	**14.67**
1996	14.00	NA	NA	17.00	16.00	16.00	18.00	NA	14.00	13.00	15.00	**15.38**
1997	17.00	NA	NA	15.33	18.00	NA	19.00	17.00	13.33	15.00	16.00	**16.33**
1998	17.00	NA	NA	15.00	12.00	NA	NA	13.00	NA	14.50	11.00	**13.75**
1999	NA	NA	NA	14.00	14.00	NA	NA	15.00	NA	14.00	NA	**14.25**
2000	NA	NA	NA	NA	NA	NA	NA	12.00	13.00	10.50	10.50	**11.50**
2001	NA	NA	NA	NA	NA	NA	NA	12.00	NA	7.00	NA	**9.50**
2002	NA	NA	NA	NA	NA	NA	NA	13.00	NA	13.00	NA	**13.00**
2003	16.00	NA	NA	12.00	14.00	12.00	17.00	16.50	14.00	15.50	14.00	**14.56**
2004	18.00	NA	NA	NA	NA	NA	NA	11.00	NA	14.50	NA	**14.50**
2005	NA	16.00	7.00	NA	NA	NA	NA	12.50	NA	12.50	12.00	**12.00**
2006	14.00	NA	15.00	NA	NA	NA	NA	15.00	NA	15.00	12.00	**14.20**
2007	16.00	NA	14.00	16.00	13.00	19.00	17.00	14.00	16.50	15.00	NA	**15.61**
2008	NA	NA	16.00	17.00	15.00	15.00	14.00	16.00	12.00	13.00	NA	**14.75**
2009	12.00	NA	17.00	11.00	10.00	17.50	14.50	16.00	13.00	14.50	NA	**13.94**
2010	14.00	NA	16.00	15.00	15.00	16.50	17.00	17.50	16.50	14.50	14.50	**15.65**
2011	16.00	16.00	16.00	16.00	11.00	14.50	15.50	13.00	15.00	15.50	14.00	**14.77**
2012	10.00	11.00	12.00	11.50	13.50	11.50	15.50	12.00	11.00	14.50	13.00	**12.32**
Average	**14.91**	**14.33**	**14.13**	**14.68**	**13.58**	**15.28**	**16.15**	**14.09**	**13.83**	**13.53**	**13.42**	**13.88**
R-square	*0.27*	***0.37***	*0.18*	*0.11*	*0.06*	*0.01*	*0.12*	*0.00*	*0.00*	*0.11*	*0.03*	*0.00*
Slope	*-0.22*	*-0.47*	*0.56*	*-0.10*	*-0.08*	*-0.04*	*-0.09*	*0.03*	*0.01*	*0.12*	*-0.05*	*0.01*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Embeddedness

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	17.00	16.00	NA	NA	NA	20.00	16.00	10.00	**15.80**
1995	NA	NA	NA	13.50	15.00	14.00	12.00	NA	12.00	13.00	11.67	**13.02**
1996	12.00	NA	NA	16.00	14.00	14.00	15.00	NA	13.00	13.00	11.00	**13.50**
1997	15.00	NA	NA	16.33	17.67	NA	17.00	16.50	15.33	15.67	16.33	**16.23**
1998	15.00	NA	NA	16.00	14.50	NA	NA	14.00	NA	14.00	14.00	**14.58**
1999	NA	NA	NA	16.00	16.00	NA	NA	16.00	NA	14.00	NA	**15.50**
2000	NA	NA	NA	NA	NA	NA	NA	16.00	15.00	14.50	14.00	**14.88**
2001	NA	NA	NA	NA	NA	NA	NA	13.00	NA	16.00	NA	**14.50**
2002	NA	NA	NA	NA	NA	NA	NA	13.00	NA	17.00	NA	**15.00**
2003	15.00	NA	NA	13.00	18.00	14.50	15.00	13.50	15.00	15.50	18.00	**15.28**
2004	13.00	NA	NA	NA	NA	NA	NA	15.00	NA	16.00	NA	**14.67**
2005	NA	15.00	8.00	NA	NA	NA	NA	15.00	NA	16.50	17.00	**14.30**
2006	17.00	NA	11.00	NA	NA	NA	NA	15.00	NA	17.00	16.00	**15.20**
2007	11.00	NA	13.00	14.00	12.00	12.00	14.00	12.00	15.00	15.00	NA	**13.11**
2008	NA	NA	13.00	12.50	10.50	11.50	10.50	11.00	11.00	10.50	NA	**11.31**
2009	12.00	NA	14.00	6.00	10.00	12.00	10.50	9.50	10.50	12.50	NA	**10.78**
2010	7.00	NA	14.00	11.50	11.50	9.50	12.50	10.50	9.50	12.00	11.50	**10.95**
2011	10.00	12.00	8.00	9.00	10.50	14.00	12.50	14.50	8.00	11.50	11.00	**11.00**
2012	8.00	6.00	11.00	11.00	7.50	10.00	11.00	11.50	8.00	9.50	8.00	**9.23**
Average	**12.27**	**11.00**	**11.50**	**13.22**	**13.32**	**12.39**	**13.00**	**13.50**	**12.69**	**14.17**	**13.21**	**13.62**
R-square	***0.40***	***0.70***	*0.01*	***0.64***	***0.66***	***0.43***	***0.37***	***0.44***	***0.57***	*0.21*	*0.02*	***0.54***
Slope	*-0.34*	*-1.01*	*0.12*	*-0.39*	*-0.39*	*-0.19*	*-0.20*	*-0.30*	*-0.39*	*-0.18*	*-0.06*	*-0.27*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Channel Alterations

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	17.00	17.00	NA	NA	NA	18.00	16.00	15.00	**16.60**
1995	NA	NA	NA	16.50	18.00	19.00	15.33	NA	17.33	17.50	16.67	**17.19**
1996	19.00	NA	NA	18.00	17.00	18.00	19.00	NA	18.00	18.00	18.00	**18.13**
1997	19.00	NA	NA	18.33	19.00	NA	19.00	19.00	18.67	19.00	17.00	**18.63**
1998	18.00	NA	NA	18.00	19.00	NA	NA	18.50	NA	18.50	17.00	**18.17**
1999	NA	NA	NA	19.00	18.00	NA	NA	18.00	NA	18.00	NA	**18.25**
2000	NA	NA	NA	NA	NA	NA	NA	18.00	17.50	17.00	18.00	**17.63**
2001	NA	NA	NA	NA	NA	NA	NA	18.00	NA	18.00	NA	**18.00**
2002	NA	NA	NA	NA	NA	NA	NA	18.50	NA	17.00	NA	**17.75**
2003	18.00	NA	NA	16.00	19.00	16.00	14.00	16.50	17.00	16.50	18.00	**16.78**
2004	20.00	NA	NA	NA	NA	NA	NA	18.00	NA	18.00	NA	**18.67**
2005	NA	18.00	13.00	NA	NA	NA	NA	16.50	NA	17.00	18.00	**16.50**
2006	18.00	NA	17.00	NA	NA	NA	NA	17.00	NA	18.00	18.00	**17.60**
2007	19.00	NA	18.00	19.00	19.00	18.00	17.00	19.00	17.00	18.00	NA	**18.22**
2008	NA	NA	18.00	18.00	16.00	17.00	17.50	18.50	17.50	18.50	NA	**17.63**
2009	19.00	NA	18.00	17.50	16.50	19.00	16.50	18.00	16.50	18.00	NA	**17.67**
2010	18.00	NA	17.00	18.50	17.00	18.00	18.00	17.00	17.00	18.50	18.00	**17.70**
2011	19.00	18.00	19.00	17.50	18.50	17.50	18.50	19.00	18.00	18.00	18.00	**18.27**
2012	18.00	16.00	18.00	18.00	17.00	18.50	18.00	17.50	16.00	17.50	17.50	**17.45**
Average	**18.64**	**17.33**	**17.25**	**17.79**	**17.77**	**17.89**	**17.28**	**17.94**	**17.38**	**17.74**	**17.43**	**17.73**
R-square	*0.02*	***0.37***	***0.45***	*0.05*	*0.06*	*0.01*	*0.01*	*0.03*	***0.38***	*0.05*	***0.36***	*0.00*
Slope	*-0.02*	*-0.19*	*0.50*	*0.03*	*-0.04*	*-0.01*	*0.03*	*-0.03*	*-0.07*	*0.03*	*0.08*	*0.00*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Sediment Deposition

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	16.00	11.00	NA	NA	NA	16.00	17.00	14.00	**14.80**
1995	NA	NA	NA	11.00	11.50	12.00	11.67	NA	12.67	10.50	9.67	**11.29**
1996	13.00	NA	NA	14.00	12.00	13.00	11.00	NA	13.00	13.00	13.00	**12.75**
1997	14.50	NA	NA	14.67	13.67	NA	15.00	13.50	15.33	13.67	13.67	**14.25**
1998	14.00	NA	NA	15.00	11.00	NA	NA	12.50	NA	9.50	10.00	**12.00**
1999	NA	NA	NA	15.00	12.00	NA	NA	14.00	NA	12.00	NA	**13.25**
2000	NA	NA	NA	NA	NA	NA	NA	15.50	13.50	13.50	12.00	**13.63**
2001	NA	NA	NA	NA	NA	NA	NA	17.00	NA	16.00	NA	**16.50**
2002	NA	NA	NA	NA	NA	NA	NA	11.00	NA	16.00	NA	**13.50**
2003	16.00	NA	NA	15.00	15.00	15.00	15.00	11.50	15.00	15.50	15.00	**14.78**
2004	13.00	NA	NA	NA	NA	NA	NA	15.00	NA	15.50	NA	**14.50**
2005	NA	17.00	8.00	NA	NA	NA	NA	15.50	NA	16.00	15.00	**14.30**
2006	15.00	NA	9.00	NA	NA	NA	NA	15.00	NA	14.00	10.00	**12.60**
2007	8.00	NA	10.50	15.00	10.00	9.00	12.00	12.00	11.50	10.00	NA	**10.89**
2008	NA	NA	14.00	13.00	11.00	10.00	14.50	11.00	8.00	9.00	NA	**11.31**
2009	11.00	NA	12.00	11.00	8.00	10.50	7.00	11.50	8.00	10.00	NA	**9.89**
2010	7.00	NA	10.00	13.00	12.50	9.50	10.00	10.00	10.50	8.00	9.50	**10.00**
2011	6.00	8.00	12.00	14.50	10.50	9.00	8.50	15.50	6.00	8.50	6.50	**9.55**
2012	12.00	6.00	7.00	12.00	9.50	9.00	8.50	7.00	7.50	10.50	7.00	**8.73**
Average	**11.77**	**10.33**	**10.31**	**13.78**	**11.36**	**10.78**	**11.32**	**12.97**	**11.42**	**12.54**	**11.28**	**12.55**
R-square	***0.40***	***1.00***	*0.00*	*0.13*	*0.17*	***0.52***	*0.26*	*0.19*	***0.72***	*0.22*	***0.32***	***0.38***
Slope	*-0.37*	*-1.55*	*0.05*	*-0.09*	*-0.11*	*-0.24*	*-0.22*	*-0.24*	*-0.42*	*-0.25*	*-0.26*	*-0.23*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Riffle frequency

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	13.00	11.00	NA	NA	NA	20.00	16.00	16.00	**15.20**
1995	NA	NA	NA	15.00	13.50	16.50	15.67	NA	17.00	16.00	15.33	**15.57**
1996	18.00	NA	NA	14.00	17.00	16.00	19.00	NA	18.00	14.00	18.00	**16.75**
1997	18.50	NA	NA	16.00	17.33	NA	18.00	17.00	17.00	16.67	17.00	**17.19**
1998	17.00	NA	NA	17.00	15.50	NA	NA	16.50	NA	16.00	12.00	**15.67**
1999	NA	NA	NA	15.00	15.00	NA	NA	17.00	NA	15.00	NA	**15.50**
2000	NA	NA	NA	NA	NA	NA	NA	17.50	15.00	14.50	14.00	**15.25**
2001	NA	NA	NA	NA	NA	NA	NA	18.00	NA	8.00	NA	**13.00**
2002	NA	NA	NA	NA	NA	NA	NA	15.50	NA	11.00	NA	**13.25**
2003	18.00	NA	NA	15.00	17.00	15.50	16.00	16.50	14.50	15.00	16.00	**15.94**
2004	18.00	NA	NA	NA	NA	NA	NA	17.00	NA	17.00	NA	**17.33**
2005	NA	18.00	8.00	NA	NA	NA	NA	15.00	NA	16.00	16.00	**14.60**
2006	15.00	NA	18.00	NA	NA	NA	NA	15.00	NA	17.00	16.00	**16.20**
2007	15.00	NA	16.50	18.00	13.00	16.00	18.00	17.00	16.00	14.50	NA	**16.00**
2008	NA	NA	17.00	17.00	12.50	15.00	15.00	18.50	13.00	13.00	NA	**15.13**
2009	16.00	NA	17.00	18.00	14.00	14.00	17.00	17.50	15.00	15.50	NA	**16.00**
2010	18.00	NA	19.00	17.50	18.00	16.50	17.00	19.00	15.50	14.50	15.00	**17.00**
2011	17.00	17.00	17.00	18.50	17.50	15.50	16.50	17.00	19.00	15.50	9.00	**16.32**
2012	18.00	19.00	17.00	17.00	14.50	14.50	17.00	17.50	14.00	15.00	17.00	**16.41**
Average	**17.14**	**18.00**	**16.19**	**16.23**	**15.06**	**15.50**	**16.92**	**16.97**	**16.17**	**14.75**	**15.11**	**15.70**
R-square	*0.09*	*0.02*	***0.32***	***0.67***	*0.02*	*0.28*	*0.06*	*0.06*	*0.27*	*0.00*	*0.08*	*0.03*
Slope	*-0.07*	*0.03*	*0.78*	*0.21*	*0.05*	*-0.07*	*-0.05*	*0.06*	*-0.16*	*-0.01*	*-0.11*	*0.04*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Channel flow characteristics

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	18.00	16.00	NA	NA	NA	8.00	18.00	14.00	**14.80**
1995	NA	NA	NA	16.00	11.50	8.50	17.00	NA	12.00	12.50	13.33	**12.98**
1996	19.00	NA	NA	18.00	15.00	15.00	19.00	NA	9.00	18.00	13.00	**15.75**
1997	15.50	NA	NA	15.67	14.67	NA	16.00	12.00	12.33	14.00	13.67	**14.23**
1998	17.00	NA	NA	15.00	12.00	NA	NA	12.50	NA	13.50	14.00	**14.00**
1999	NA	NA	NA	15.00	13.00	NA	NA	14.00	NA	16.00	NA	**14.50**
2000	NA	NA	NA	NA	NA	NA	NA	14.00	10.00	12.50	14.50	**12.75**
2001	NA	NA	NA	NA	NA	NA	NA	13.00	NA	6.00	NA	**9.50**
2002	NA	NA	NA	NA	NA	NA	NA	14.50	NA	12.00	NA	**13.25**
2003	15.00	NA	NA	12.00	15.00	11.00	14.00	14.00	13.00	14.00	15.00	**13.67**
2004	16.00	NA	NA	NA	NA	NA	NA	15.50	NA	15.50	NA	**15.67**
2005	NA	13.00	13.00	NA	NA	NA	NA	12.50	NA	14.50	11.00	**12.80**
2006	13.00	NA	11.00	NA	NA	NA	NA	13.00	NA	15.00	11.00	**12.60**
2007	9.00	NA	13.00	13.00	10.00	12.00	12.50	14.00	8.50	12.00	NA	**11.56**
2008	NA	NA	15.00	10.00	9.50	9.50	11.00	11.00	8.50	9.00	NA	**10.44**
2009	14.00	NA	15.00	8.50	9.50	8.00	14.00	8.50	8.00	9.00	NA	**10.50**
2010	9.00	NA	13.00	10.50	8.50	9.00	15.00	8.00	8.50	8.00	11.00	**10.05**
2011	18.00	9.00	12.00	12.50	12.00	9.50	12.50	13.50	13.00	10.50	10.00	**12.05**
2012	11.00	6.00	8.00	9.00	9.00	8.50	10.50	10.00	7.50	8.50	7.50	**8.68**
Average	**14.23**	**9.33**	**12.50**	**13.32**	**11.97**	**10.11**	**14.15**	**12.50**	**9.86**	**12.55**	**12.33**	**12.62**
R-square	***0.34***	***0.91***	*0.15*	***0.83***	***0.59***	*0.25*	***0.69***	*0.26*	*0.06*	***0.38***	***0.65***	***0.49***
Slope	*-0.35*	*-0.88*	*-0.36*	*-0.44*	*-0.30*	*-0.18*	*-0.34*	*-0.23*	*-0.08*	*-0.37*	*-0.28*	*-0.26*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Left bank vegetation

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	9.00	8.00	NA	NA	NA	4.00	9.00	8.00	**7.60**
1995	NA	NA	NA	9.00	8.00	6.00	4.33	NA	7.00	7.50	7.67	**7.07**
1996	7.00	NA	NA	8.00	8.00	9.00	4.00	NA	6.00	7.00	4.00	**6.63**
1997	8.50	NA	NA	8.67	7.33	NA	4.00	7.00	8.67	9.00	7.33	**7.56**
1998	8.00	NA	NA	9.00	6.00	NA	NA	7.00	NA	7.50	8.00	**7.58**
1999	NA	NA	NA	9.00	9.00	NA	NA	7.00	NA	9.00	NA	**8.50**
2000	NA	NA	NA	NA	NA	NA	NA	7.00	8.50	8.50	8.50	**8.13**
2001	NA	NA	NA	NA	NA	NA	NA	5.00	NA	8.00	NA	**6.50**
2002	NA	NA	NA	NA	NA	NA	NA	6.50	NA	6.00	NA	**6.25**
2003	7.00	NA	NA	7.00	8.00	5.50	6.00	4.50	7.00	6.00	8.00	**6.56**
2004	8.00	NA	NA	NA	NA	NA	NA	8.00	NA	8.00	NA	**8.00**
2005	NA	9.00	7.00	NA	NA	NA	NA	6.50	NA	7.50	8.00	**7.60**
2006	9.00	NA	6.00	NA	NA	NA	NA	5.00	NA	8.00	8.00	**7.20**
2007	5.00	NA	6.00	7.00	6.00	5.00	4.50	4.00	5.00	6.00	NA	**5.39**
2008	NA	NA	6.00	5.00	5.50	5.50	4.50	4.50	5.50	5.00	NA	**5.19**
2009	6.00	NA	7.00	5.50	4.00	5.50	4.50	5.50	4.50	4.00	NA	**5.17**
2010	5.00	NA	5.00	5.50	5.00	5.50	3.00	4.00	4.50	5.00	6.00	**4.85**
2011	5.00	4.00	5.00	4.50	4.00	4.50	3.00	3.50	9.00	4.50	5.00	**4.73**
2012	5.00	3.00	5.00	5.50	3.50	4.50	2.50	4.50	3.00	3.50	3.50	**3.95**
Average	**6.68**	**5.33**	**5.88**	**7.13**	**6.33**	**5.67**	**4.03**	**5.59**	**6.06**	**6.79**	**6.83**	**6.55**
R-square	***0.49***	***1.00***	***0.54***	***0.88***	***0.74***	***0.57***	*0.17*	***0.53***	*0.08*	***0.64***	*0.20*	***0.57***
Slope	*-0.19*	*-0.85*	*-0.25*	*-0.24*	*-0.24*	*-0.16*	*-0.06*	*-0.21*	*-0.08*	*-0.25*	*-0.12*	*-0.18*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Right bank vegetation

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	9.00	8.00	NA	NA	NA	4.00	9.00	7.00	**7.40**
1995	NA	NA	NA	8.00	8.00	5.00	4.33	NA	7.00	7.50	5.67	**6.50**
1996	7.00	NA	NA	8.00	10.00	7.00	4.00	NA	6.00	7.00	7.00	**7.00**
1997	8.50	NA	NA	9.00	7.67	NA	4.00	7.00	8.00	9.00	6.00	**7.40**
1998	8.00	NA	NA	9.00	7.00	NA	NA	8.00	NA	8.00	6.00	**7.67**
1999	NA	NA	NA	9.00	9.00	NA	NA	7.00	NA	9.00	NA	**8.50**
2000	NA	NA	NA	NA	NA	NA	NA	7.50	8.00	8.50	5.50	**7.38**
2001	NA	NA	NA	NA	NA	NA	NA	7.00	NA	8.00	NA	**7.50**
2002	NA	NA	NA	NA	NA	NA	NA	6.50	NA	6.00	NA	**6.25**
2003	7.00	NA	NA	5.00	9.00	5.50	6.00	5.00	7.00	6.00	8.00	**6.50**
2004	8.00	NA	NA	NA	NA	NA	NA	8.00	NA	8.00	NA	**8.00**
2005	NA	9.00	7.00	NA	NA	NA	NA	6.50	NA	7.50	6.00	**7.20**
2006	9.00	NA	6.00	NA	NA	NA	NA	5.00	NA	8.00	8.00	**7.20**
2007	5.00	NA	5.50	6.00	7.00	5.00	4.50	5.00	4.00	5.00	NA	**5.22**
2008	NA	NA	7.00	5.00	5.50	4.50	4.50	4.00	6.00	5.00	NA	**5.19**
2009	5.00	NA	6.00	5.50	5.00	6.00	4.00	4.00	6.00	5.50	NA	**5.22**
2010	6.00	NA	5.00	5.50	5.50	4.50	3.50	3.50	5.00	5.00	4.00	**4.75**
2011	4.00	4.00	5.00	5.50	5.00	3.50	3.50	5.00	9.00	4.50	4.00	**4.82**
2012	4.00	3.00	4.00	4.50	5.00	4.00	4.00	3.50	3.50	3.50	4.00	**3.91**
Average	**6.50**	**5.33**	**5.69**	**6.85**	**7.05**	**5.00**	**4.23**	**5.78**	**6.13**	**6.84**	**5.93**	**6.51**
R-square	***0.53***	***1.00***	***0.65***	***0.80***	***0.67***	***0.43***	*0.05*	***0.72***	*0.03*	***0.65***	*0.29*	***0.57***
Slope	*-0.23*	*-0.85*	*-0.34*	*-0.24*	*-0.21*	*-0.11*	*-0.03*	*-0.28*	*-0.04*	*-0.25*	*-0.12*	*-0.17*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Left bank stability

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	8.00	5.00	NA	NA	NA	4.00	8.00	8.00	**6.60**
1995	NA	NA	NA	7.50	6.00	7.00	6.33	NA	6.00	6.50	7.00	**6.62**
1996	8.00	NA	NA	8.00	8.00	7.00	6.00	NA	7.00	9.00	4.00	**7.13**
1997	8.00	NA	NA	8.33	6.67	NA	5.00	6.00	7.67	8.67	7.67	**7.25**
1998	8.00	NA	NA	8.00	6.00	NA	NA	6.50	NA	8.00	8.00	**7.42**
1999	NA	NA	NA	8.00	7.00	NA	NA	6.00	NA	9.00	NA	**7.50**
2000	NA	NA	NA	NA	NA	NA	NA	6.00	6.00	8.00	8.50	**7.13**
2001	NA	NA	NA	NA	NA	NA	NA	5.00	NA	9.00	NA	**7.00**
2002	NA	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2003	8.00	NA	NA	7.00	6.00	6.50	4.00	3.50	6.50	7.00	7.00	**6.17**
2004	9.00	NA	NA	NA	NA	NA	NA	6.50	NA	7.50	NA	**7.67**
2005	NA	7.00	7.00	NA	NA	NA	NA	5.50	NA	7.00	8.00	**6.90**
2006	8.00	NA	6.00	NA	NA	NA	NA	4.00	NA	7.00	8.00	**6.60**
2007	6.00	NA	8.50	6.00	5.00	7.00	5.00	4.00	6.00	7.00	NA	**6.06**
2008	NA	NA	7.00	6.00	3.50	5.50	4.00	4.00	1.50	5.50	NA	**4.63**
2009	8.00	NA	9.00	5.00	3.00	6.50	4.00	3.50	4.00	4.00	NA	**5.22**
2010	6.00	NA	7.00	5.00	6.50	5.50	4.00	3.50	6.00	6.00	6.50	**5.60**
2011	6.00	3.00	8.00	5.50	4.00	5.00	4.00	4.50	7.00	7.50	4.00	**5.32**
2012	5.00	3.00	6.00	6.00	4.00	4.50	3.00	3.00	5.00	4.00	3.50	**4.27**
Average	**7.27**	**4.33**	**7.31**	**6.79**	**5.44**	**6.06**	**4.53**	**4.78**	**5.56**	**7.04**	**6.68**	**6.32**
R-square	***0.46***	***0.98***	*0.00*	***0.85***	***0.42***	***0.59***	***0.76***	***0.62***	*0.06*	***0.42***	*0.20*	***0.49***
Slope	*-0.15*	*-0.60*	*0.01*	*-0.17*	*-0.14*	*-0.12*	*-0.14*	*-0.19*	*-0.06*	*-0.18*	*-0.13*	*-0.13*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Right bank stability

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	9.00	9.00	NA	NA	NA	4.00	9.00	4.00	**7.00**
1995	NA	NA	NA	7.00	7.50	6.00	6.33	NA	6.67	8.00	5.33	**6.69**
1996	8.00	NA	NA	6.00	9.00	8.00	6.00	NA	7.00	6.00	6.00	**7.00**
1997	8.00	NA	NA	8.00	7.33	NA	5.00	6.00	6.33	8.67	5.00	**6.79**
1998	8.00	NA	NA	8.00	7.50	NA	NA	7.50	NA	7.50	4.00	**7.08**
1999	NA	NA	NA	8.00	9.00	NA	NA	8.00	NA	9.00	NA	**8.50**
2000	NA	NA	NA	NA	NA	NA	NA	6.50	7.00	8.00	4.50	**6.50**
2001	NA	NA	NA	NA	NA	NA	NA	7.00	NA	9.00	NA	**8.00**
2002	NA	NA	NA	NA	NA	NA	NA	4.50	NA	5.00	NA	**4.75**
2003	8.00	NA	NA	7.00	7.00	6.50	4.00	4.50	6.50	7.00	7.00	**6.39**
2004	8.00	NA	NA	NA	NA	NA	NA	6.50	NA	8.00	NA	**7.50**
2005	NA	7.00	7.00	NA	NA	NA	NA	5.50	NA	7.00	5.00	**6.30**
2006	8.00	NA	7.00	NA	NA	NA	NA	4.00	NA	7.00	6.00	**6.40**
2007	7.00	NA	5.50	7.00	7.00	6.00	5.50	6.00	5.00	6.00	NA	**6.11**
2008	NA	NA	6.00	6.00	5.50	4.00	4.50	6.00	2.50	5.50	NA	**5.00**
2009	6.00	NA	7.00	5.50	7.00	6.00	4.50	6.50	6.00	4.50	NA	**5.89**
2010	7.00	NA	5.00	6.00	7.00	5.00	4.50	5.50	6.00	6.50	5.00	**5.75**
2011	6.00	3.00	6.00	6.50	7.50	4.50	5.00	6.50	6.00	7.00	7.50	**5.95**
2012	6.00	3.00	6.00	5.00	6.50	5.00	4.50	4.50	5.50	4.50	7.00	**5.23**
Average	**7.27**	**4.33**	**6.19**	**6.85**	**7.45**	**5.67**	**4.98**	**5.94**	**5.71**	**7.01**	**5.53**	**6.47**
R-square	***0.67***	***0.98***	*0.23*	***0.54***	***0.46***	***0.53***	***0.43***	*0.16*	*0.06*	***0.41***	***0.38***	***0.34***
Slope	*-0.13*	*-0.60*	*-0.15*	*-0.13*	*-0.10*	*-0.14*	*-0.07*	*-0.10*	*-0.05*	*-0.17*	*0.11*	*-0.10*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Left bank riparian buffer

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	10.00	9.00	NA	NA	NA	10.00	10.00	9.00	**9.60**
1995	NA	NA	NA	10.00	9.50	10.00	1.00	NA	9.67	10.00	9.33	**8.50**
1996	7.00	NA	NA	10.00	9.00	10.00	1.00	NA	10.00	10.00	10.00	**8.38**
1997	9.50	NA	NA	9.67	9.67	NA	1.00	10.00	9.67	10.00	8.67	**8.52**
1998	10.00	NA	NA	10.00	10.00	NA	NA	9.50	NA	9.50	10.00	**9.83**
1999	NA	NA	NA	10.00	10.00	NA	NA	10.00	NA	10.00	NA	**10.00**
2000	NA	NA	NA	NA	NA	NA	NA	10.00	9.50	9.50	7.50	**9.13**
2001	NA	NA	NA	NA	NA	NA	NA	10.00	NA	7.00	NA	**8.50**
2002	NA	NA	NA	NA	NA	NA	NA	9.50	NA	9.00	NA	**9.25**
2003	10.00	NA	NA	10.00	10.00	9.00	2.00	8.50	9.50	9.00	8.00	**8.44**
2004	9.00	NA	NA	NA	NA	NA	NA	10.00	NA	10.00	NA	**9.67**
2005	NA	10.00	6.00	NA	NA	NA	NA	9.50	NA	9.50	6.00	**8.20**
2006	9.00	NA	6.00	NA	NA	NA	NA	9.00	NA	10.00	8.00	**8.40**
2007	9.00	NA	8.00	9.00	9.00	7.00	3.00	6.00	9.00	8.00	NA	**7.56**
2008	NA	NA	7.00	9.00	7.00	8.00	2.00	7.50	9.50	8.00	NA	**7.25**
2009	8.00	NA	8.00	8.50	6.50	8.00	3.00	8.50	8.00	9.00	NA	**7.50**
2010	6.00	NA	8.00	9.00	8.50	8.50	1.50	8.50	8.50	9.00	8.50	**7.60**
2011	9.00	9.00	8.00	9.00	8.50	9.00	1.50	9.00	9.00	8.50	8.50	**8.09**
2012	7.00	9.00	9.00	9.00	7.50	9.00	1.50	9.00	9.00	9.00	8.00	**7.91**
Average	**8.50**	**9.33**	**7.50**	**9.47**	**8.78**	**8.72**	**1.75**	**9.03**	**9.28**	**9.21**	**8.46**	**8.54**
R-square	*0.15*	***0.98***	***0.76***	***0.78***	***0.46***	***0.39***	*0.28*	***0.30***	***0.63***	*0.24*	*0.24*	***0.43***
Slope	*-0.09*	*-0.15*	*0.38*	*-0.07*	*-0.12*	*-0.10*	*0.06*	*-0.13*	*-0.07*	*-0.07*	*-0.08*	*-0.10*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

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Appendix D

DEP Habitat Scores for Individual Metrics

Right bank riparian buffer

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	10.00	10.00	NA	NA	NA	10.00	9.00	9.00	**9.60**
1995	NA	NA	NA	10.00	10.00	10.00	1.00	NA	10.00	9.00	9.33	**8.48**
1996	9.00	NA	NA	10.00	10.00	10.00	1.00	NA	10.00	7.00	10.00	**8.38**
1997	10.00	NA	NA	10.00	10.00	NA	1.00	10.00	9.67	8.67	9.33	**8.58**
1998	10.00	NA	NA	10.00	10.00	NA	NA	9.50	NA	7.50	9.00	**9.33**
1999	NA	NA	NA	10.00	10.00	NA	NA	9.00	NA	9.00	NA	**9.50**
2000	NA	NA	NA	NA	NA	NA	NA	9.50	10.00	8.50	9.50	**9.38**
2001	NA	NA	NA	NA	NA	NA	NA	10.00	NA	9.00	NA	**9.50**
2002	NA	NA	NA	NA	NA	NA	NA	9.50	NA	7.00	NA	**8.25**
2003	10.00	NA	NA	10.00	10.00	9.00	2.00	8.50	9.50	7.50	9.00	**8.39**
2004	9.00	NA	NA	NA	NA	NA	NA	9.50	NA	8.50	NA	**9.00**
2005	NA	10.00	6.00	NA	NA	NA	NA	9.50	NA	9.00	9.00	**8.70**
2006	9.00	NA	6.00	NA	NA	NA	NA	9.00	NA	8.00	10.00	**8.40**
2007	9.00	NA	9.00	9.00	9.00	8.00	2.00	7.00	8.00	6.50	NA	**7.50**
2008	NA	NA	9.00	9.00	8.00	6.50	2.00	7.50	9.00	6.50	NA	**7.19**
2009	9.00	NA	9.00	9.50	8.50	8.50	2.00	7.00	9.00	7.50	NA	**7.78**
2010	10.00	NA	9.00	9.50	9.00	8.50	1.50	7.00	9.00	8.00	8.00	**7.95**
2011	9.00	9.00	9.00	9.50	9.00	9.00	1.50	8.00	9.00	8.50	8.50	**8.18**
2012	9.00	9.00	9.00	9.00	9.00	9.00	1.00	7.50	9.00	8.00	9.00	**8.05**
Average	**9.36**	**9.33**	**8.25**	**9.65**	**9.42**	**8.72**	**1.50**	**8.63**	**9.35**	**8.04**	**9.14**	**8.53**
R-square	*0.15*	***0.98***	***0.57***	***0.68***	***0.69***	***0.34***	*0.24*	***0.66***	***0.64***	*0.10*	*0.24*	***0.43***
Slope	*-0.03*	*-0.15*	*0.43*	*-0.05*	*-0.09*	*-0.10*	*0.03*	*-0.19*	*-0.07*	*-0.05*	*-0.04*	*-0.08*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Habitat Scores for Individual Metrics

Composite

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	168.00	139.00	NA	NA	NA	142.00	161.00	143.00	**150.60**
1995	NA	NA	NA	154.00	146.00	142.50	120.00	NA	148.33	146.00	137.00	**141.98**
1996	158.00	NA	NA	162.00	161.00	157.00	131.00	NA	147.00	148.00	142.00	**150.75**
1997	167.50	NA	NA	163.33	163.33	NA	136.00	156.00	158.67	163.33	154.00	**157.77**
1998	165.00	NA	NA	164.00	142.50	NA	NA	149.00	NA	147.50	138.00	**151.00**
1999	NA	NA	NA	161.00	157.00	NA	NA	157.00	NA	159.00	NA	**158.50**
2000	NA	NA	NA	NA	NA	NA	NA	154.50	147.00	146.50	140.50	**147.13**
2001	NA	NA	NA	NA	NA	NA	NA	152.00	NA	135.00	NA	**143.50**
2002	NA	NA	NA	NA	NA	NA	NA	142.00	NA	137.00	NA	**139.50**
2003	163.00	NA	NA	144.00	164.00	138.00	125.00	136.50	150.00	148.00	156.00	**147.17**
2004	157.00	NA	NA	NA	NA	NA	NA	155.50	NA	162.00	NA	**158.17**
2005	NA	165.00	105.00	NA	NA	NA	NA	143.00	NA	154.00	146.00	**142.60**
2006	150.00	NA	129.00	NA	NA	NA	NA	141.00	NA	160.00	144.00	**144.80**
2007	132.00	NA	138.00	152.00	132.00	135.00	123.50	133.00	133.50	137.00	NA	**135.11**
2008	NA	NA	143.00	144.00	123.00	125.00	115.50	134.00	120.50	124.00	NA	**128.63**
2009	135.00	NA	147.00	126.50	114.00	134.00	112.50	130.50	119.50	131.00	NA	**127.78**
2010	125.00	NA	142.00	140.50	138.00	128.50	116.50	129.00	131.00	130.50	129.00	**131.00**
2011	136.00	120.00	136.00	143.00	132.50	126.00	113.50	142.50	145.00	136.50	119.50	**131.86**
2012	121.00	98.00	120.00	129.00	116.00	119.50	105.00	121.00	109.50	122.00	119.00	**116.36**
Average	**146.32**	**127.67**	**132.50**	**150.10**	**140.64**	**133.94**	**119.85**	**142.28**	**137.67**	**144.65**	**139.00**	**142.33**
R-square	***0.79***	***0.96***	*0.11*	***0.76***	***0.49***	***0.78***	***0.63***	***0.68***	***0.51***	***0.41***	***0.37***	***0.60***
Slope	*-2.63*	*-8.85*	*1.86*	*-1.75*	*-1.79*	*-1.57*	*-1.12*	*-1.92*	*-1.57*	*-1.48*	*-1.09*	*-1.58*
N	*11.00*	*3.00*	*8.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*12.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

2.0 Fish

Fish communities were assessed by DEP staff during summer index periods with the respective sampling years in accordance with the Maryland Biological Stream Survey (MBSS) methods (Kayzak, 2001). The DEP Fish IBI evaluates 9 metrics, which include the following:

- Total number of species
- Total number of riffle benthic insectivore individuals
- Total number of minnow species (*cyprinidae*)
- Total number of intolerant species
- Proportion of tolerant individuals
- Proportion of individuals as omnivores/generalists
- Proportion of individuals as pioneering species
- Total number of individuals (excluding tolerant species)
- Proportion of individuals with disease/anomalies

Each of these metrics is assigned a metric score of 1, 3, or 5 depending on the calculated value, stream order, and presence/absence of Channery Silt Loam and the average of the metric scores is reported according to the following criteria in Table D-3:

Table D-3. Fish IBI scoring criteria

Condition category	Score
Excellent	>4.5
Good	3.4-4.5
Fair	2.3-3.3
Poor	≤2.2

Source: Keith Van Ness, personal communication, January 10, 2013.

The MBSS has also developed and tested a Fish IBI which could be used to corroborate the DEP Fish IBI and provide a comparison to the statewide data sets; however, one or more of the metrics for this comparison was not readily available in the data provided.

Overall the fish community within the Ten Mile Creek drainage, as indicated by its Fish IBI scores, is in good condition. The DEP Fish IBI accounts for some of this natural variability by adjusting the scoring criteria based on stream order. These adjustments do tend to influence the overall Fish IBI scores for the third-order streams, but not the narrative rating, in this data set. Specifically the calculated values for the number of minnow species and number of intolerant species were similar among third-order sites and second-order sites immediately upstream, but the assigned metric dropped to the lower category in the assigned score.

In interpreting the Fish IBI data, one factor that is unlikely to improve naturally is the number of intolerant species. Only Blue Ridge sculpin (*Cottus caeruleomentum*) and an occasional brown trout (*Salmo trutta*) are present within the watershed. Due to the presence of the Little Seneca Lake, it is unlikely that recruitment of new intolerant species will occur. This results in consistent marginal scores of 3 and 1 for the second- and third-order streams respectively.

Similarly, the number of minnow species is stable and shows no recruitment, which is likely related to the presence of physical barrier to fish migration posed by the Little Seneca Lake Dam and impoundment. The consequence of this is a consistently marginal ranking of 3 for third-order stations and an excellent rating for the second-order stations.

Analysis of trends in the Fish IBI metrics over time indicated the following:

- The total number of individuals showed significant declines between the mid-1990s and when sampling resumed in 2007. This appears to have stabilized, but these stations presently declined from an excellent to a good rating.
- The frequency of riffle benthic insectivores in the second-order tributaries show moderate declines in the raw data, but the respective metric values are stable. These declines could be related to an increase in sediment supply and embeddedness documented in habitat assessment.
- Proportion of omnivores/generalist in the samples strong to slight increasing trends (~1%/year) in raw metrics, which are dampened in the scaled metric. These species are likely competing with the riffle benthic insectivores, which have shown some decline.
- Proportion of pioneer species show slight increasing trends (~1%/year), at most stations, which are also likely competing with the riffle benthic insectivores.
- The raw numbers of tolerant individuals are showing slight signs of increasing (≤1%/year), however this is not reflected in the assigned value. Some stations, particularly the second-order stations are showing an increase in the proportion that are negatively influencing the IBI score.
- The proportion of individuals with disease/anomalies has remained low and no trends were observed.

Other observations of note include:

- LSTM206 consistently scored lower than other second-order stations on all metrics except for the proportion of individuals with disease/anomalies, which improves its overall score.
- LSTM204 scored the lowest on the habitat ratings, but was the only station to consistently score excellent in the Fish IBI.

While the trend analysis indicates some shifts in the overall community structure, the total fish diversity appears to be stable. The second-order tributaries, particularly LSTM201, show the strongest declining trends. The strength of the trend appears to be correlated to the watershed position, with the smaller drainages expressing stronger trends, and independent of habitat condition. Since the abundance and diversity of fishes in a drainage is correlated to the stream size, the fish community in the smaller channels is more sensitive to watershed stressors, which may explain the declining trends.

The following tables the present the available habitat assessment data at each station for the respective sampling year.

Appendix D

Fish Individual Raw Metrics

Number of intolerant species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		1	1				1	1	1	**1.00**
1995		1	1	1	1		1	1	1	**1.00**
1997		1	1			1	1	1	1	**1.00**
1998			1			1		1	1	**1.00**
2000						1	1	1	1	**1.00**
2001						1		1		**1.00**
2002						1				**1.00**
2003						1	1	1	1	**1.00**
2004						1		1		**1.00**
2005						1		1	1	**1.00**
2006						1		1	1	**1.00**
2007	0	1	1	1	1	1	1	2		**1.00**
2008		1	1	1	1	1	1	1		**1.00**
2009		1	1	1	1	1	1	2		**1.14**
2010		1	1	1	1	1	1	1	1	**1.00**
2011		1	1	1	1	1		1	1	**1.00**
2012		1	1	1	1	1	1	1	1	**1.00**
Average	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.13**	**1.00**	**1.01**
R-square	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.08*	*NA*	***0.06***
Slope	*NA*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.02*	*0.00*	***0.00***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Number of minnow species (Cyprinidae)

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	4				6	4	6	**5.00**
1995		5	4	4	4		5	4	6	**4.57**
1997		3	3			4	4	5	4	**3.83**
1998			3			5		5	5	**4.50**
2000						3	6	5	3	**4.25**
2001						3		3		**3.00**
2002						3				**3.00**
2003						3	6	6	3	**4.50**
2004						3		4		**3.50**
2005						3		5	4	**4.00**
2006						3		4	3	**3.33**
2007	3	4	4	5	4	5	6	4		**4.38**
2008		3	4	5	4	3	4	6		**4.14**
2009		4	4	5	5	4	5	5		**4.57**
2010		5	4	5	4	4	7	4	5	**4.75**
2011		5	4	4	5	5		4	4	**4.43**
2012		5	5	5	4	4	6	5	5	**4.88**
Average	**3.00**	**4.33**	**3.90**	**4.71**	**4.29**	**3.67**	**5.50**	**4.56**	**4.36**	**4.15**
R-square	*NA*	*0.00*	*0.33*	*0.28*	*0.09*	*0.04*	*0.05*	*0.01*	*0.09*	***0.01***
Slope	*NA*	*0.01*	*0.05*	*0.04*	*0.03*	*0.04*	*0.03*	*0.02*	*-0.05*	***0.01***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Number of riffle benthic insectivorous individuals

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		37	34				105	48	39	**52.60**
1995		86	124	175	151		273	109	91	**144.14**
1997		105	69			95	114	132	173	**114.67**
1998			120			115		187	190	**153.00**
2000						38	79	11	27	**38.75**
2001						95		82		**88.50**
2002						10				**10.00**
2003						17	55	12	27	**27.75**
2004						42		129		**85.50**
2005						7		104	77	**62.67**
2006						17		64	23	**34.67**
2007	2	22	16	155	174	6	170	191		**92.00**
2008		31	38	145	184	32	53	63		**78.00**
2009		41	18	64	123	47	64	113		**67.14**
2010		39	35	146	261	69	154	51	108	**107.88**
2011		35	20	74	78	37		20	57	**45.86**
2012		23	38	67	501	47	154	164	158	**144.00**
Average	**2.00**	**46.56**	**51.20**	**118.00**	**210.29**	**44.93**	**122.10**	**92.50**	**88.18**	**79.24**
R-square	*NA*	*0.46*	*0.46*	*0.46*	*0.11*	*0.17*	*0.05*	*0.00*	*0.00*	***0.01***
Slope	*NA*	*-2.71*	*-3.80*	*-5.62*	*8.03*	*-3.06*	*-2.20*	*-0.12*	*-0.27*	***-0.72***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Proportion of individuals as omnivores/generalists

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		57	70				50	36	46	**51.80**
1995		61	46	47	60		40	46	44	**49.14**
1997		61	53			27	40	41	39	**43.50**
1998			49			57		46	56	**52.00**
2000						69	68	81	63	**70.25**
2001						58		52		**55.00**
2002						82				**82.00**
2003						72	64	83	58	**69.25**
2004						59		51		**55.00**
2005						85		40	50	**58.33**
2006						68		60	68	**65.33**
2007	99	75	66	58	56	84	57	45		**67.50**
2008		69	59	64	43	82	61	53		**61.57**
2009		72	74	71	51	80	67	68		**69.00**
2010		75	72	64	54	76	67	74	45	**65.88**
2011		78	71	57	54	74		84	66	**69.14**
2012		80	78	64	59	62	63	59	49	**64.25**
Average	**99.00**	**69.78**	**63.80**	**60.71**	**53.86**	**69.00**	**57.70**	**57.44**	**53.09**	**61.70**
R-square	*NA*	*0.92*	*0.50*	*0.58*	*0.10*	*0.31*	*0.53*	*0.24*	*0.13*	***0.32***
Slope	*NA*	*1.09*	*1.11*	*1.01*	*-0.32*	*1.81*	*1.19*	*1.38*	*0.53*	***0.98***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Proportion of individuals as pioneering species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		33	65				41	15	5	**31.80**
1995		43	43	35	36		26	24	8	**30.71**
1997		47	51			24	28	22	10	**30.33**
1998			48			55		27	40	**42.50**
2000						65	58	63	15	**50.25**
2001						57		30		**43.50**
2002						81				**81.00**
2003						70	55	70	39	**58.50**
2004						59		32		**45.50**
2005						85		27	25	**45.67**
2006						66		28	32	**42.00**
2007	99	67	58	55	31	80	46	25		**57.63**
2008		64	54	57	33	82	52	29		**53.00**
2009		69	69	67	36	80	65	53		**62.71**
2010		68	67	64	28	76	48	53	30	**54.25**
2011		72	65	48	41	73		52	38	**55.57**
2012		70	61	50	55	55	54	48	32	**53.13**
Average	**99.00**	**59.22**	**58.10**	**53.71**	**37.14**	**67.20**	**47.30**	**37.38**	**24.91**	**49.30**
R-square	*NA*	*0.96*	*0.36*	*0.43*	*0.08*	*0.29*	*0.45*	*0.22*	*0.47*	***0.33***
Slope	*NA*	*1.92*	*0.73*	*1.23*	*0.43*	*1.81*	*1.27*	*1.33*	*1.38*	***1.30***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Proportion of tolerant individuals

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		61	68				48	45	52	**54.80**
1995		50	44	36	37		31	33	24	**36.43**
1997		56	53			24	34	27	19	**35.50**
1998			49			56		39	47	**47.75**
2000						65	60	66	50	**60.25**
2001						57		31		**44.00**
2002						82				**82.00**
2003						72	64	75	49	**65.00**
2004						59		39		**49.00**
2005						85		28	28	**47.00**
2006						68		44	57	**56.33**
2007	99	67	60	57	55	83	55	31		**63.38**
2008		65	54	62	35	82	58	43		**57.00**
2009		69	69	69	38	80	68	59		**64.57**
2010		68	67	64	46	76	59	64	39	**60.38**
2011		72	68	57	44	73		71	57	**63.14**
2012		70	62	59	56	61	57	51	38	**56.75**
Average	**99.00**	**64.22**	**59.40**	**57.71**	**44.43**	**68.20**	**53.40**	**46.63**	**41.82**	**55.49**
R-square	*NA*	*0.80*	*0.30*	*0.74*	*0.19*	*0.33*	*0.50*	*0.16*	*0.07*	***0.22***
Slope	*NA*	*0.89*	*0.68*	*1.57*	*0.65*	*1.93*	*1.30*	*1.11*	*0.53*	***0.96***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Proportion with disease/anomalies

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		0.5	0				1.2	9.1	13.1	**4.78**
1995		0	0	0	0		0.4	0	0.5	**0.13**
1997		0.4	0			0.7	0	0.4	0.4	**0.32**
1998			1.5			0		0.2	2.7	**1.10**
2000						0	1.6	4.2	4.6	**2.60**
2001						0		0		**0.00**
2002						0				**0.00**
2003						0	1.8	1.7	0	**0.88**
2004						0		0		**0.00**
2005						0		0	0	**0.00**
2006						0		0	1.3	**0.43**
2007	1.8	3.6	2.4	2.8	0.1	2.1	1.7	0		**1.81**
2008		0	0.3	1.7	0	0.3	0.6	0.3		**0.46**
2009		0.4	4.3	1.9	3	0.3	9.3	3.6		**3.26**
2010		3	1	0.2	0	2.1	1.9	0.9	0.5	**1.20**
2011		0	0	0	0	0		0	4.3	**0.61**
2012		0	2.7	0.8	0.1	0	0.2	1.1	0.9	**0.73**
Average	**1.80**	**0.88**	**1.22**	**1.06**	**0.46**	**0.37**	**1.87**	**1.34**	**2.57**	**1.08**
R-square	*NA*	*0.04*	*0.24*	*0.03*	*0.02*	*0.06*	*0.11*	*0.13*	*0.15*	***0.03***
Slope	*NA*	*0.04*	*0.10*	*0.04*	*0.03*	*0.04*	*0.13*	*-0.15*	*-0.23*	***-0.04***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Total number of fish species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		14	9				12	12	15	**12.40**
1995		13	11	11	10		12	13	12	**11.71**
1997		11	8			9	11	12	10	**10.17**
1998			7			9		12	15	**10.75**
2000						8	12	11	12	**10.75**
2001						7		8		**7.50**
2002						7				**7.00**
2003						11	14	12	11	**12.00**
2004						7		12		**9.50**
2005						7		12	10	**9.67**
2006						7		9	7	**7.67**
2007	4	8	11	12	9	10	13	13		**10.00**
2008		8	11	13	10	6	10	14		**10.29**
2009		9	10	11	11	8	13	13		**10.71**
2010		10	9	12	12	8	16	10	12	**11.13**
2011		11	11	12	14	9		12	13	**11.71**
2012		9	10	10	12	12	13	13	12	**11.38**
Average	**4.00**	**10.33**	**9.70**	**11.57**	**11.14**	**8.33**	**12.60**	**11.75**	**11.73**	**10.25**
R-square	*NA*	*0.61*	*0.20*	*0.00*	*0.28*	*0.03*	*0.17*	*0.01*	*0.08*	***0.00***
Slope	*NA*	*-0.23*	*0.09*	*0.01*	*0.15*	*0.06*	*0.10*	*0.02*	*-0.10*	***-0.01***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Raw Metrics

Total number of individuals (ex tolerant sp.)

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		163	118				169	61	96	**121.40**
1995		296	344	265	207		370	181	156	**259.86**
1997		238	79			108	136	171	217	**158.17**
1998			137			144		252	239	**193.00**
2000						49	130	40	55	**68.50**
2001						123		110		**116.50**
2002						41				**41.00**
2003						42	103	30	53	**57.00**
2004						56		146		**101.00**
2005						13		137	110	**86.67**
2006						52		103	33	**62.67**
2007	3	63	99	217	420	55	320	227		**175.50**
2008		62	131	269	348	53	137	178		**168.29**
2009		72	85	100	244	69	116	196		**126.00**
2010		74	69	165	353	90	210	114	133	**151.00**
2011		72	59	100	131	63		58	88	**81.57**
2012		53	100	98	750	104	211	229	211	**219.50**
Average	**3.00**	**121.44**	**122.10**	**173.43**	**350.43**	**70.80**	**190.20**	**139.56**	**126.45**	**128.68**
R-square	*NA*	*0.79*	*0.30*	*0.48*	*0.14*	*0.06*	*0.01*	*0.01*	*0.02*	***0.01***
Slope	*NA*	*-10.96*	*-6.24*	*-9.34*	*13.32*	*-1.88*	*-1.54*	*1.47*	*-1.58*	***-1.07***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Number of intolerant species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		3	3				1	1	1	**1.80**
1995		3	3	3	3		1	1	1	**2.14**
1997		3	3			3	1	1	1	**2.00**
1998			3			3		1	1	**2.00**
2000						3	1	1	1	**1.50**
2001						3		1		**2.00**
2002						3				**3.00**
2003						3	1	1	1	**1.50**
2004						3		1		**2.00**
2005						3		1	1	**1.67**
2006						3		1	1	**1.67**
2007	1	3	3	3	3	3	1	3		**2.50**
2008		3	3	3	3	3	1	1		**2.43**
2009		3	3	3	3	3	1	3		**2.71**
2010		3	3	3	3	3	1	1	1	**2.25**
2011		3	3	3	3	3		1	1	**2.43**
2012		3	3	3	3	3	1	1	1	**2.25**
Average	**1.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**1.00**	**1.25**	**1.00**	**2.11**
R-square	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.08*	*NA*	***0.14***
Slope	*NA*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.03*	*0.00*	***0.03***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Number of minnow species (Cyprinidae)

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	5				3	3	3	**3.80**
1995		5	5	5	5		3	3	3	**4.14**
1997		5	5			5	3	3	3	**4.00**
1998			5			5		3	3	**4.00**
2000						5	3	3	1	**3.00**
2001						5		1		**3.00**
2002						5				**5.00**
2003						5	3	3	1	**3.00**
2004						5		3		**4.00**
2005						5		3	3	**3.67**
2006						5		3	1	**3.00**
2007	5	5	5	5	5	5	3	3		**4.50**
2008		5	5	5	5	5	3	3		**4.43**
2009		5	5	5	5	5	3	3		**4.43**
2010		5	5	5	5	5	5	3	3	**4.50**
2011		5	5	5	5	5		3	3	**4.43**
2012		5	5	5	5	5	3	3	3	**4.25**
Average	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**3.20**	**2.88**	**2.45**	**3.95**
R-square	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.12*	*0.02*	*0.00*	***0.10***
Slope	*NA*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.03*	*0.01*	*0.00*	***0.04***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Number of riffle benthic insectivorous individuals

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	5				5	3	1	**3.80**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	5	5	5	**5.00**
1998			5			5		5	5	**5.00**
2000						5	3	1	1	**2.50**
2001						5		5		**5.00**
2002						1				**1.00**
2003						3	3	1	1	**2.00**
2004						5		5		**5.00**
2005						1		5	3	**3.00**
2006						3		3	1	**2.33**
2007	1	3	3	5	5	1	5	5		**3.50**
2008		5	5	5	5	5	3	3		**4.43**
2009		5	3	5	5	5	3	5		**4.43**
2010		5	5	5	5	5	5	3	5	**4.75**
2011		5	3	5	5	5		1	3	**3.86**
2012		3	5	5	5	5	5	5	5	**4.75**
Average	**1.00**	**4.56**	**4.40**	**5.00**	**5.00**	**3.93**	**4.20**	**3.75**	**3.18**	**3.84**
R-square	*NA*	*0.14*	*0.22*	*NA*	*NA*	*0.00*	*0.04*	*0.01*	*0.01*	***0.00***
Slope	*NA*	*-0.04*	*-0.06*	*0.00*	*0.00*	*0.01*	*-0.03*	*-0.03*	*0.03*	***0.00***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Proportion of individuals as omnivores/generalists

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	3				5	5	5	**4.60**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	5	5	5	**5.00**
1998			5			5		5	3	**4.50**
2000						3	3	1	3	**2.50**
2001						5		3		**4.00**
2002						1				**1.00**
2003						3	3	1	3	**2.50**
2004						5		3		**4.00**
2005						1		5	5	**3.67**
2006						3		3	3	**3.00**
2007	1	3	3	5	5	1	3	5		**3.25**
2008		3	5	3	5	1	3	3		**3.29**
2009		3	3	3	5	3	3	3		**3.29**
2010		3	3	3	5	3	3	3	5	**3.50**
2011		3	3	5	5	3		1	3	**3.29**
2012		3	3	3	5	3	3	3	5	**3.50**
Average	**1.00**	**3.67**	**3.80**	**3.86**	**5.00**	**3.00**	**3.60**	**3.38**	**4.09**	**3.52**
R-square	*NA*	*0.95*	*0.30*	*0.25*	*NA*	*0.20*	*0.72*	*0.20*	*0.01*	***0.18***
Slope	*NA*	*-0.13*	*-0.08*	*-0.09*	*0.00*	*-0.14*	*-0.12*	*-0.12*	*-0.02*	***-0.08***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Proportion of individuals as pioneering species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	3				3	5	5	**4.20**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	3	5	5	**4.67**
1998			5			3		5	3	**4.00**
2000						3	3	3	5	**3.50**
2001						3		3		**3.00**
2002						1				**1.00**
2003						3	3	1	3	**2.50**
2004						3		3		**3.00**
2005						1		5	5	**3.67**
2006						3		3	3	**3.00**
2007	1	3	3	3	5	1	3	5		**3.00**
2008		3	3	3	5	1	3	3		**3.00**
2009		3	3	3	5	1	1	3		**2.71**
2010		3	3	3	5	3	3	3	3	**3.25**
2011		3	3	5	5	3		3	3	**3.57**
2012		3	3	5	3	3	3	3	3	**3.25**
Average	**1.00**	**3.67**	**3.60**	**3.86**	**4.71**	**2.47**	**3.00**	**3.63**	**3.91**	**3.31**
R-square	*NA*	*0.95*	*0.51*	*0.05*	*0.12*	*0.14*	*0.25*	*0.25*	*0.46*	***0.21***
Slope	*NA*	*-0.13*	*-0.10*	*-0.04*	*-0.05*	*-0.09*	*-0.07*	*-0.10*	*-0.11*	***-0.07***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Proportion of tolerant individuals

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		3	3				3	3	3	**3.00**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	3	5	5	**4.67**
1998			5			5		3	3	**4.00**
2000						3	3	3	3	**3.00**
2001						5		5		**5.00**
2002						1				**1.00**
2003						3	3	1	3	**2.50**
2004						3		3		**3.00**
2005						1		5	5	**3.67**
2006						3		3	3	**3.00**
2007	1	3	3	5	5	1	3	5		**3.25**
2008		3	5	3	5	1	3	3		**3.29**
2009		3	3	3	5	1	1	3		**2.71**
2010		3	3	3	5	3	3	3	3	**3.25**
2011		3	3	5	5	3		1	3	**3.29**
2012		3	3	3	5	3	3	3	3	**3.25**
Average	**1.00**	**3.44**	**3.80**	**3.86**	**5.00**	**2.73**	**3.00**	**3.38**	**3.55**	**3.35**
R-square	*NA*	*0.47*	*0.30*	*0.25*	*NA*	*0.27*	*0.25*	*0.13*	*0.14*	***0.11***
Slope	*NA*	*-0.08*	*-0.08*	*-0.09*	*0.00*	*-0.16*	*-0.07*	*-0.08*	*-0.05*	***-0.06***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Proportion with disease/anomalies

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	5				5	1	1	**3.40**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	5	5	5	**5.00**
1998			5			5		5	5	**5.00**
2000						5	5	5	5	**5.00**
2001						5		5		**5.00**
2002						5				**5.00**
2003						5	5	5	5	**5.00**
2004						5		5		**5.00**
2005						5		5	5	**5.00**
2006						5		5	5	**5.00**
2007	5	3	5	3	5	5	5	5		**4.50**
2008		5	5	5	5	5	5	5		**5.00**
2009		5	3	5	3	5	1	5		**3.86**
2010		3	5	5	5	5	5	5	5	**4.75**
2011		5	5	5	5	5		5	5	**5.00**
2012		5	3	5	5	5	5	5	5	**4.75**
Average	**5.00**	**4.56**	**4.60**	**4.71**	**4.71**	**5.00**	**4.60**	**4.75**	**4.64**	**4.78**
R-square	*NA*	*0.08*	*0.22*	*0.00*	*0.01*	*NA*	*0.09*	*0.20*	*0.20*	***0.01***
Slope	*NA*	*-0.04*	*-0.06*	*0.00*	*-0.02*	*0.00*	*-0.06*	*0.08*	*0.08*	***0.01***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Total number of fish species

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	5				5	5	5	**5.00**
1995		5	5	5	5		5	5	5	**5.00**
1997		5	5			5	3	5	3	**4.33**
1998			3			5		5	5	**4.50**
2000						5	5	3	5	**4.50**
2001						3		3		**3.00**
2002						3				**3.00**
2003						5	5	5	3	**4.50**
2004						3		5		**4.00**
2005						3		5	3	**3.67**
2006						3		3	3	**3.00**
2007	3	5	5	5	5	5	5	5		**4.75**
2008		5	5	5	5	3	3	5		**4.43**
2009		5	5	5	5	5	5	5		**5.00**
2010		5	5	5	5	5	5	3	5	**4.75**
2011		5	5	5	5	5		5	5	**5.00**
2012		5	5	5	5	5	5	5	5	**5.00**
Average	**3.00**	**5.00**	**4.80**	**5.00**	**5.00**	**4.20**	**4.60**	**4.50**	**4.27**	**4.32**
R-square	*NA*	*NA*	*0.09*	*NA*	*NA*	*0.01*	*0.01*	*0.00*	*0.00*	***0.01***
Slope	*NA*	*0.00*	*0.03*	*0.00*	*0.00*	*0.02*	*0.01*	*-0.01*	*0.00*	***0.01***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Total number of individuals (ex tolerant sp.)

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		5	5				3	1	1	**3.00**
1995		5	5	5	5		5	3	3	**4.43**
1997		5	3			5	3	3	5	**4.00**
1998			5			5		5	5	**5.00**
2000						3	3	1	1	**2.00**
2001						5		3		**4.00**
2002						1				**1.00**
2003						1	1	1	1	**1.00**
2004						3		3		**3.00**
2005						1		3	3	**2.33**
2006						3		1	1	**1.67**
2007	1	3	5	5	5	3	5	5		**4.00**
2008		3	5	5	5	3	3	3		**3.86**
2009		3	3	5	5	3	3	3		**3.57**
2010		3	3	5	5	3	5	3	3	**3.75**
2011		3	3	5	5	3		1	1	**3.00**
2012		3	5	5	5	5	5	5	5	**4.75**
Average	**1.00**	**3.67**	**4.20**	**5.00**	**5.00**	**3.13**	**3.60**	**2.75**	**2.64**	**3.20**
R-square	*NA*	*0.95*	*0.10*	*NA*	*NA*	*0.02*	*0.07*	*0.03*	*0.00*	***0.00***
Slope	*NA*	*-0.13*	*-0.05*	*0.00*	*0.00*	*-0.04*	*0.05*	*0.04*	*-0.01*	***0.00***
N	*1*	*9*	*10*	*7*	*7*	*15*	*10*	*16*	*11*	***17***

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Fish Individual Scaled Metrics

Composite

Sample Year	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994		4.56	4.11				3.67	3.00	2.78	**3.00**
1995		4.78	4.78	4.78	4.78		4.33	4.11	4.11	**4.43**
1997		4.78	4.56			4.78	3.44	4.11	4.11	**4.00**
1998			4.56			4.56		4.11	3.67	**5.00**
2000						3.89	3.22	2.33	2.78	**2.00**
2001						4.33		3.22		**4.00**
2002						2.33				**1.00**
2003						3.44		2.11	2.33	**1.00**
2004						3.89		3.44		**3.00**
2005						2.33		4.11	3.67	**2.33**
2006						3.44		2.78	2.33	**1.67**
2007	2.11	3.44	3.89	4.33	4.78	2.78	3.67	4.56		**4.00**
2008		3.89	4.56	4.11	4.78	3.00	3.00	3.22		**3.86**
2009		3.89	3.44	4.11	4.56	3.44	2.33	3.67		**3.57**
2010		3.67	3.89	4.11	4.78	3.89	3.89	3.00	3.67	**3.75**
2011		3.89	3.67	4.78	4.78	3.89		2.33	3.00	**3.00**
2012		3.67	3.89	4.33	4.56	4.11	3.67	3.67	3.89	**4.75**
Average	2.11	4.06	4.13	4.37	4.71	3.61	3.47	3.36	3.30	**3.20**
R-square	NA	**0.81**	**0.48**	0.23	0.13	0.08	0.13	0.02	0.01	**0.00**
Slope	NA	-0.06	-0.04	-0.03	-0.01	-0.05	-0.03	-0.02	-0.01	**0.00**

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

3.0 Benthic Macroinvertebrates

The benthic macroinvertebrate communities were assessed by DEP staff during spring index periods with the respective sampling years in accordance with the Maryland Biological Stream Survey (MBSS) methods (Kayzak, 2001). The DEP Benthic IBI evaluates 8 metrics, which include the following:

- Taxa Richness
- Biotic Index
- Proportion of Dominant Taxa
- Proportion of Ephemeropera, Plecoptera, and Tricoptera (EPT) Individuals
- Proportion of Hydropsyche & Cheumatopsyche
- Proportion of Shredders
- Ratio of Scrapers
- Total Number of EPT Taxa

Each of these metrics is assigned a metric score of 1, 3, or 5 depending on the calculated value, stream order, and presence/absence of Channery Silt Loam and the sum of the metric scores is reported according to the following criteria in Table D-4:

Table D-4. Benthic IBI scoring criteria

Condition category	Score
Excellent	≥36
Good	26-35
Fair	17-25
Poor	<17

Source: Keith Van Ness, personal communication, January 10, 2013.

The overall Benthic IBI scores indicate that the benthic macroinvertebrate community within the Ten Mile Creek drainage is in generally good condition. A similar condition is gained using the MBSS scoring criteria (Southerland et al. 2006), which references a statewide dataset stratified by ecoregion.

Observations in the benthic macroinvertebrate community data over time include:

- Data from the 2003 sample year includes consistently low scores.
- The percent scrapers scored relatively low with declining trends at some stations.
- Overall the first-order streams scored poor in metrics where third-order streams scored fair.
- Overall the number of taxa appears to be increasing.
- The number of Ephemeroptera show some declining trends most pronounced at stations LSTM201 and LSTM206. Trends persist in both the number of individuals and diversity of taxa.
- The first-order streams score fair to good on percent intolerant while second-order score poor to fair, and data from third-order stations were inconsistent. There is some indication that the scores are declining over time.
- The number of taxa is increasing in first-order channels and somewhat consistent to slightly declining in higher order channels.
- The number of EPT weakly declined at stations LSTM110, 201, and 202

Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

- Station LSTM201 shows an overall declining trend in most metrics

Other than minor shifts in the benthic macroinvertebrate community structure, the community appears to be stable. The rates of change associated with any observed trends are generally slow and only likely to influence the overall Benthic IBI score over period of decades if natural recovery does not occur. These trends indicate the tendency toward degradation if stressor levels are increased.

Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Biotic Index

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	4.18	4.29	NA	NA	NA	3.01	3.55	4.09	**3.82**
1995	NA	NA	NA	3.56	3.78	5.76	3.98	NA	3.74	3.38	3.72	**3.99**
1996	3.22	NA	NA	3.46	3.89	4.41	4.22	NA	2.84	3.00	3.83	**3.61**
1997	3.58	NA	NA	3.70	3.78	NA	5.04	5.21	4.19	3.84	3.89	**4.15**
1998	3.70	NA	NA	3.20	3.12	NA	NA	3.31	NA	3.81	NA	**3.43**
1999	NA	NA	NA	4.72	3.67	NA	NA	5.64	NA	4.17	NA	**4.55**
2000	NA	NA	NA	NA	NA	NA	NA	6.27	3.54	4.29	4.72	**4.71**
2001	NA	NA	NA	NA	NA	NA	NA	6.10	NA	3.41	NA	**4.76**
2002	NA	NA	NA	NA	NA	NA	NA	6.42	NA	4.82	NA	**5.62**
2003	3.01	3.74	3.16	3.48	5.00	4.00	5.87	5.98	3.82	3.91	NA	**4.20**
2004	3.10	NA	NA	NA	NA	NA	NA	6.10	NA	3.04	NA	**4.08**
2005	NA	3.13	3.19	NA	NA	NA	NA	6.60	NA	3.77	NA	**4.17**
2006	4.97	NA	4.55	NA	NA	NA	NA	6.70	NA	3.77	NA	**5.00**
2007	3.41	NA	4.90	5.63	5.92	4.57	4.47	6.48	4.75	5.32	NA	**5.05**
2008	NA	NA	3.56	5.34	6.55	3.42	4.19	7.12	3.80	4.50	NA	**4.81**
2009	3.64	NA	5.01	5.16	4.82	4.01	3.96	5.40	5.80	4.23	NA	**4.67**
2010	3.08	NA	4.18	5.45	4.26	3.59	4.02	5.60	4.45	3.75	4.93	**4.33**
2011	2.94	3.50	4.04	5.16	5.10	3.97	4.85	6.18	4.04	4.10	4.96	**4.44**
2012	4.82	5.43	6.65	4.60	5.46	5.94	3.53	5.46	5.44	5.50	5.46	**5.30**
Average	**3.59**	**3.95**	**4.36**	**4.43**	**4.59**	**4.41**	**4.41**	**5.91**	**4.12**	**4.01**	**4.45**	**4.46**
R-square	*0.04*	***0.36***	***0.44***	***0.58***	***0.49***	*0.08*	*0.06*	*0.12*	***0.52***	*0.28*	***0.85***	***0.31***
Slope	*0.02*	*0.14*	*0.25*	*0.10*	*0.10*	*-0.04*	*-0.03*	*0.06*	*0.09*	*0.06*	*0.08*	*0.06*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Proportion of Dominant Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	20.00	18.00	NA	NA	NA	12.00	13.00	15.00	**15.60**
1995	NA	NA	NA	20.50	43.00	29.00	32.00	NA	31.00	25.50	29.50	**30.07**
1996	21.00	NA	NA	27.00	12.00	23.00	22.00	NA	22.00	37.00	20.00	**23.00**
1997	22.00	NA	NA	32.00	33.00	NA	41.00	44.00	32.00	33.00	44.00	**35.13**
1998	52.00	NA	NA	49.00	45.00	NA	NA	80.00	NA	55.00	NA	**56.20**
1999	NA	NA	NA	40.00	52.00	NA	NA	60.00	NA	44.00	NA	**49.00**
2000	NA	NA	NA	NA	NA	NA	NA	67.00	28.00	35.00	46.00	**44.00**
2001	NA	NA	NA	NA	NA	NA	NA	78.00	NA	36.00	NA	**57.00**
2002	NA	NA	NA	NA	NA	NA	NA	81.00	NA	35.00	NA	**58.00**
2003	71.00	69.00	78.00	38.00	45.00	43.00	60.00	69.00	64.00	67.00	NA	**60.40**
2004	38.00	NA	NA	NA	NA	NA	NA	58.00	NA	37.00	NA	**44.33**
2005	NA	37.00	45.00	NA	NA	NA	NA	83.00	NA	30.00	NA	**48.75**
2006	31.00	NA	46.00	NA	NA	NA	NA	88.00	NA	33.00	NA	**49.50**
2007	44.00	NA	47.00	57.00	56.00	43.00	26.00	79.00	36.00	50.00	NA	**48.67**
2008	NA	NA	65.00	44.00	84.00	37.00	30.00	93.00	56.00	36.00	NA	**55.63**
2009	55.00	NA	37.00	43.00	23.00	43.00	49.00	37.00	68.00	46.00	NA	**44.56**
2010	31.00	NA	39.00	49.00	50.00	29.00	45.00	56.00	37.00	70.00	33.00	**43.90**
2011	36.00	73.00	59.00	48.00	40.00	25.00	39.00	57.00	48.00	53.00	36.00	**46.73**
2012	43.00	44.00	87.00	38.00	44.00	62.00	23.00	52.00	49.00	43.00	51.00	**48.73**
Average	**40.36**	**55.75**	**55.89**	**38.88**	**41.92**	**37.11**	**36.70**	**67.63**	**40.25**	**40.97**	**34.31**	**45.22**
R-square	*0.05*	*0.00*	*0.01*	***0.50***	*0.18*	*0.22*	*0.01*	*0.02*	***0.49***	*0.26*	*0.30*	*0.26*
Slope	*0.55*	*-0.09*	*0.46*	*1.19*	*1.16*	*0.91*	*0.17*	*-0.46*	*1.75*	*1.25*	*0.88*	*1.08*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Proportion of EPT Individuals

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	59.00	32.00	NA	NA	NA	51.00	58.00	43.00	**48.60**
1995	NA	NA	NA	63.00	57.00	41.00	84.00	NA	35.00	49.50	62.50	**56.00**
1996	62.00	NA	NA	53.00	26.00	42.00	52.00	NA	44.00	37.00	44.00	**45.00**
1997	79.00	NA	NA	71.00	68.00	NA	34.00	38.00	55.00	72.00	75.00	**61.50**
1998	69.00	NA	NA	80.00	83.00	NA	NA	90.00	NA	65.00	NA	**77.40**
1999	NA	NA	NA	46.00	71.00	NA	NA	27.00	NA	66.00	NA	**52.50**
2000	NA	NA	NA	NA	NA	NA	NA	13.00	45.00	58.00	49.00	**41.25**
2001	NA	NA	NA	NA	NA	NA	NA	18.00	NA	70.00	NA	**44.00**
2002	NA	NA	NA	NA	NA	NA	NA	11.00	NA	44.00	NA	**27.50**
2003	88.00	76.00	90.00	59.00	39.00	72.00	34.00	19.00	73.00	74.00	NA	**62.40**
2004	76.00	NA	NA	NA	NA	NA	NA	15.00	NA	69.00	NA	**53.33**
2005	NA	70.00	89.00	NA	NA	NA	NA	6.00	NA	65.00	NA	**57.50**
2006	49.00	NA	40.00	NA	NA	NA	NA	4.00	NA	52.00	NA	**36.25**
2007	78.00	NA	44.00	20.00	24.00	47.00	64.00	10.00	46.00	31.00	NA	**40.44**
2008	NA	NA	83.00	30.00	10.00	75.00	76.00	0.00	75.00	61.00	NA	**51.25**
2009	77.00	NA	39.00	41.00	60.00	63.00	76.00	39.00	29.00	65.00	NA	**54.33**
2010	80.00	NA	67.00	20.00	67.00	64.00	77.00	30.00	62.00	80.00	57.00	**60.40**
2011	81.00	84.00	66.00	25.00	24.00	45.00	45.00	10.00	65.00	60.00	37.00	**49.27**
2012	46.00	37.00	6.00	41.00	36.00	21.00	68.00	30.00	28.00	36.00	35.00	**34.91**
Average	**71.36**	**66.75**	**58.22**	**46.77**	**45.92**	**52.22**	**61.00**	**22.50**	**50.67**	**58.55**	**50.31**	**50.20**
R-square	*0.01*	*0.20*	***0.34***	***0.61***	*0.09*	*0.01*	*0.06*	*0.12*	*0.01*	*0.00*	*0.20*	*0.05*
Slope	*-0.19*	*-2.10*	*-5.63*	*-2.27*	*-1.00*	*0.20*	*0.68*	*-1.59*	*0.24*	*-0.03*	*-0.78*	*-0.44*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Proportion of Hydropsyche & Cheumatopsyche

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	9.00	21.00	NA	NA	NA	32.00	17.00	41.00	**24.00**
1995	NA	NA	NA	5.50	2.50	4.00	37.50	NA	4.00	9.00	7.00	**9.93**
1996	0.00	NA	NA	2.00	2.00	2.00	18.00	NA	5.00	0.00	28.00	**7.13**
1997	1.00	NA	NA	5.00	4.00	NA	1.00	5.00	3.00	8.00	13.00	**5.00**
1998	0.00	NA	NA	0.00	0.00	NA	NA	0.00	NA	0.00	NA	**0.00**
1999	NA	NA	NA	1.00	0.00	NA	NA	8.00	NA	0.00	NA	**2.25**
2000	NA	NA	NA	NA	NA	NA	NA	0.00	0.00	1.00	0.00	**0.25**
2001	NA	NA	NA	NA	NA	NA	NA	8.00	NA	2.00	NA	**5.00**
2002	NA	NA	NA	NA	NA	NA	NA	18.00	NA	0.00	NA	**9.00**
2003	0.00	0.00	0.00	0.00	0.00	1.00	15.00	10.00	0.00	0.00	NA	**2.60**
2004	1.00	NA	NA	NA	NA	NA	NA	10.00	NA	0.00	NA	**3.67**
2005	NA	1.00	0.00	NA	NA	NA	NA	17.00	NA	1.00	NA	**4.75**
2006	0.00	NA	0.00	NA	NA	NA	NA	20.00	NA	0.00	NA	**5.00**
2007	0.00	NA	1.00	3.00	3.00	1.00	16.00	32.00	0.00	3.00	NA	**6.56**
2008	NA	NA	0.00	24.00	0.00	0.00	33.00	60.00	0.00	0.00	NA	**14.63**
2009	0.00	NA	0.00	10.00	5.00	0.00	11.00	19.00	4.00	6.00	NA	**6.11**
2010	0.00	NA	0.00	6.00	2.00	2.00	18.00	19.00	9.00	1.00	13.00	**7.00**
2011	0.00	0.00	0.00	3.00	11.00	0.00	3.00	43.00	3.00	0.00	9.00	**6.55**
2012	3.00	2.00	0.00	3.00	2.00	2.00	2.00	6.00	0.00	2.00	17.00	**3.55**
Average	**0.45**	**0.75**	**0.11**	**5.50**	**4.04**	**1.33**	**15.45**	**17.19**	**5.00**	**2.63**	**16.00**	**6.47**
R-square	*0.06*	*0.20*	*0.01*	*0.05*	*0.03*	***0.39***	*0.11*	***0.34***	*0.19*	*0.21*	*0.12*	*0.04*
Slope	*0.04*	*0.10*	*-0.01*	*0.21*	*-0.16*	*-0.13*	*-0.64*	*1.97*	*-0.58*	*-0.36*	*-0.57*	*-0.19*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Proportion of Shredders

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	7.66	12.15	NA	NA	NA	9.66	19.69	16.82	**13.20**
1995	NA	NA	NA	12.66	27.43	16.15	6.25	NA	16.53	16.74	42.59	**19.76**
1996	30.62	NA	NA	31.00	9.24	21.90	12.68	NA	13.43	12.50	10.98	**17.79**
1997	23.90	NA	NA	35.50	35.41	NA	19.63	27.67	28.38	33.95	44.44	**31.11**
1998	57.14	NA	NA	54.63	47.06	NA	NA	80.17	NA	57.67	NA	**59.33**
1999	NA	NA	NA	23.46	56.14	NA	NA	15.10	NA	52.52	NA	**36.81**
2000	NA	NA	NA	NA	NA	NA	NA	8.08	17.41	35.63	33.65	**23.69**
2001	NA	NA	NA	NA	NA	NA	NA	7.75	NA	37.96	NA	**22.86**
2002	NA	NA	NA	NA	NA	NA	NA	6.00	NA	18.90	NA	**12.45**
2003	75.34	73.98	79.10	57.14	36.27	45.24	13.45	9.82	63.50	67.27	NA	**52.11**
2004	21.37	NA	NA	NA	NA	NA	NA	7.80	NA	18.03	NA	**15.73**
2005	NA	21.74	48.12	NA	NA	NA	NA	3.92	NA	32.28	NA	**26.52**
2006	30.10	NA	27.52	NA	NA	NA	NA	0.84	NA	19.27	NA	**19.43**
2007	56.15	NA	32.58	10.07	17.65	27.14	24.20	3.66	32.82	11.76	NA	**24.00**
2008	NA	NA	66.00	10.00	4.76	46.72	29.52	1.18	58.65	35.51	NA	**31.54**
2009	62.91	NA	26.98	10.95	19.08	44.78	50.79	2.99	17.77	46.43	NA	**31.41**
2010	45.88	NA	44.41	11.84	53.67	32.79	46.06	21.13	43.08	71.36	34.34	**40.46**
2011	43.62	74.75	61.35	5.56	16.52	28.93	27.85	2.86	48.77	53.06	27.33	**35.51**
2012	27.33	22.48	4.62	30.54	25.56	10.84	22.42	24.07	13.91	21.82	13.97	**19.78**
Average	**43.12**	**48.24**	**43.41**	**23.15**	**27.76**	**30.50**	**25.29**	**13.94**	**30.33**	**34.86**	**28.02**	**28.08**
R-square	*0.01*	*0.03*	*0.24*	*0.08*	*0.01*	*0.05*	***0.49***	*0.16*	*0.20*	*0.06*	*0.02*	*0.01*
Slope	*0.38*	*-1.24*	*-3.86*	*-0.75*	*-0.22*	*0.48*	*1.51*	*-1.66*	*1.24*	*0.81*	*-0.24*	*0.27*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Ratio of Scrapers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	48.00	76.00	NA	NA	NA	54.00	53.00	42.00	**54.60**
1995	NA	NA	NA	64.50	61.50	53.00	27.00	NA	16.00	73.50	65.00	**51.50**
1996	69.00	NA	NA	54.00	83.00	55.00	48.00	NA	25.00	12.00	32.00	**47.25**
1997	80.00	NA	NA	57.00	53.00	NA	6.00	6.00	15.00	23.00	10.00	**31.25**
1998	98.00	NA	NA	77.00	84.00	NA	NA	84.00	NA	89.00	NA	**86.40**
1999	NA	NA	NA	68.00	91.00	NA	NA	57.00	NA	58.00	NA	**68.50**
2000	NA	NA	NA	NA	NA	NA	NA	71.00	68.00	60.00	3.00	**50.50**
2001	NA	NA	NA	NA	NA	NA	NA	20.00	NA	81.00	NA	**50.50**
2002	NA	NA	NA	NA	NA	NA	NA	0.00	NA	73.00	NA	**36.50**
2003	0.00	20.00	0.00	0.00	43.00	57.00	47.00	12.00	14.00	20.00	NA	**21.30**
2004	69.00	NA	NA	NA	NA	NA	NA	12.00	NA	12.00	NA	**31.00**
2005	NA	4.00	32.00	NA	NA	NA	NA	0.00	NA	55.00	NA	**22.75**
2006	75.00	NA	91.00	NA	NA	NA	NA	0.00	NA	32.00	NA	**49.50**
2007	60.00	NA	25.00	13.00	29.00	59.00	29.00	10.00	68.00	53.00	NA	**38.44**
2008	NA	NA	0.00	12.00	20.00	86.00	28.00	0.00	100.00	43.00	NA	**36.13**
2009	54.00	NA	33.00	18.00	14.00	85.00	45.00	17.00	67.00	37.00	NA	**41.11**
2010	75.00	NA	20.00	9.00	5.00	34.00	24.00	4.00	18.00	6.00	17.00	**21.20**
2011	86.00	67.00	17.00	18.00	16.00	16.00	48.00	11.00	45.00	5.00	29.00	**32.55**
2012	55.00	11.00	0.00	5.00	16.00	16.00	26.00	3.00	3.00	4.00	23.00	**14.73**
Average	**65.55**	**25.50**	**24.22**	**34.12**	**45.50**	**51.22**	**32.80**	**19.19**	**41.08**	**41.55**	**27.63**	**41.35**
R-square	*0.02*	*0.18*	*0.05*	***0.69***	***0.81***	*0.07*	*0.03*	***0.33***	*0.03*	*0.25*	*0.13*	***0.36***
Slope	*-0.60*	*2.70*	*-2.25*	*-3.42*	*-4.15*	*-1.10*	*0.34*	*-3.24*	*0.71*	*-2.45*	*-0.91*	*-1.88*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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DEP Benthic Macroinvertebrate Raw Metric Scores

Taxa Richness

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	36.00	26.00	NA	NA	NA	27.00	30.00	24.00	**28.60**
1995	NA	NA	NA	27.50	20.50	27.00	21.00	NA	26.00	29.00	19.50	**24.36**
1996	26.00	NA	NA	31.00	28.00	28.00	29.00	NA	30.00	27.00	27.00	**28.25**
1997	30.00	NA	NA	37.00	22.00	NA	22.00	26.00	26.00	21.00	21.00	**25.63**
1998	30.00	NA	NA	21.00	21.00	NA	NA	13.00	NA	19.00	NA	**20.80**
1999	NA	NA	NA	34.00	22.00	NA	NA	25.00	NA	21.00	NA	**25.50**
2000	NA	NA	NA	NA	NA	NA	NA	19.00	20.00	23.00	14.00	**19.00**
2001	NA	NA	NA	NA	NA	NA	NA	14.00	NA	24.00	NA	**19.00**
2002	NA	NA	NA	NA	NA	NA	NA	12.00	NA	24.00	NA	**18.00**
2003	14.00	9.00	12.00	7.00	12.00	18.00	17.00	16.00	13.00	12.00	NA	**13.00**
2004	21.00	NA	NA	NA	NA	NA	NA	19.00	NA	22.00	NA	**20.67**
2005	NA	13.00	17.00	NA	NA	NA	NA	10.00	NA	21.00	NA	**15.25**
2006	21.00	NA	14.00	NA	NA	NA	NA	10.00	NA	16.00	NA	**15.25**
2007	20.00	NA	16.00	17.00	23.00	22.00	35.00	21.00	23.00	25.00	NA	**22.44**
2008	NA	NA	16.00	18.00	15.00	18.00	33.00	5.00	18.00	16.00	NA	**17.38**
2009	23.00	NA	29.00	25.00	17.00	19.00	27.00	21.00	18.00	18.00	NA	**21.89**
2010	32.00	NA	23.00	20.00	19.00	35.00	35.00	21.00	22.00	16.00	21.00	**24.40**
2011	21.00	23.00	27.00	18.00	16.00	19.00	22.00	20.00	28.00	16.00	31.00	**21.91**
2012	28.00	23.00	17.00	23.00	24.00	18.00	26.00	16.00	19.00	23.00	26.00	**22.09**
Average	**24.18**	**17.00**	**19.00**	**24.19**	**20.42**	**22.67**	**26.70**	**16.75**	**22.50**	**21.21**	**22.94**	**21.23**
R-square	*0.02*	***0.99***	***0.40***	***0.37***	*0.22*	*0.12*	*0.14*	*0.02*	*0.21*	***0.35***	*0.14*	*0.15*
Slope	*-0.15*	*1.60*	*1.28*	*-0.78*	*-0.32*	*-0.33*	*0.36*	*-0.19*	*-0.34*	*-0.51*	*0.25*	*-0.30*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Raw Metric Scores

Total Number of EPT Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	0.00	0.00	208.84	203.44	0.00	0.00	0.00	202.67	210.24	198.91	**102.41**
1995	0.00	0.00	0.00	213.21	226.20	190.91	223.23	0.00	147.27	222.11	240.31	**133.02**
1996	225.84	0.00	0.00	218.46	178.13	193.31	201.90	0.00	160.27	142.50	178.81	**136.29**
1997	259.48	0.00	0.00	261.20	230.19	0.00	141.67	163.88	177.57	206.79	223.33	**151.28**
1998	324.84	0.00	0.00	293.83	294.18	0.00	0.00	356.48	0.00	297.48	0.00	**142.44**
1999	0.00	0.00	0.00	239.18	303.81	0.00	0.00	208.74	0.00	260.69	0.00	**92.04**
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	192.35	196.95	226.92	157.37	**70.33**
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	161.85	0.00	267.37	0.00	**39.02**
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	140.42	0.00	213.72	0.00	**32.19**
2003	259.35	255.72	271.26	168.62	185.27	250.24	203.32	148.80	238.32	252.18	0.00	**203.01**
2004	242.47	0.00	0.00	0.00	0.00	0.00	0.00	134.90	0.00	174.07	0.00	**50.13**
2005	0.00	157.87	245.31	0.00	0.00	0.00	0.00	131.52	0.00	223.05	0.00	**68.89**
2006	222.07	0.00	230.07	0.00	0.00	0.00	0.00	132.54	0.00	166.04	0.00	**68.25**
2007	273.56	0.00	181.48	133.70	168.57	217.71	220.67	169.14	222.57	194.08	0.00	**161.95**
2008	0.00	0.00	244.56	149.34	147.31	277.14	251.71	166.30	324.45	207.01	0.00	**160.71**
2009	286.55	0.00	182.99	167.11	151.90	270.79	276.75	151.39	222.57	231.66	0.00	**176.52**
2010	287.96	0.00	211.59	132.29	211.93	221.38	270.08	164.73	209.53	259.11	193.27	**196.53**
2011	281.56	334.25	247.39	132.72	136.62	146.90	202.70	158.04	254.81	201.16	189.29	**207.77**
2012	227.15	159.91	129.27	160.14	165.02	143.78	185.95	144.53	131.35	149.32	187.43	**162.17**
Average	**160.60**	**47.78**	**102.31**	**130.45**	**136.98**	**100.64**	**114.63**	**143.45**	**130.96**	**216.08**	**82.56**	**123.94**
R-square	*0.10*	*0.19*	***0.58***	*0.11*	*0.06*	*0.19*	*0.18*	*0.08*	*0.06*	*0.04*	*0.05*	*0.14*
Slope	*7.90*	*7.77*	*15.53*	*-5.95*	*-4.51*	*8.81*	*8.66*	*4.01*	*4.83*	*-1.37*	*-3.90*	*3.77*
N	*18.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Biotic Index

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	3.00	3.00	NA	NA	NA	5.00	5.00	3.00	**3.80**
1995	NA	NA	NA	4.00	4.00	3.00	3.00	NA	5.00	4.00	4.00	**3.86**
1996	5.00	NA	NA	3.00	3.00	3.00	3.00	NA	5.00	5.00	5.00	**4.00**
1997	3.00	NA	NA	3.00	3.00	NA	3.00	3.00	3.00	3.00	3.00	**3.00**
1998	3.00	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**4.60**
1999	NA	NA	NA	3.00	3.00	NA	NA	3.00	NA	3.00	NA	**3.00**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	5.00	3.00	3.00	**3.50**
2001	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2002	NA	NA	NA	NA	NA	NA	NA	3.00	NA	3.00	NA	**3.00**
2003	5.00	3.00	5.00	3.00	3.00	3.00	3.00	3.00	5.00	3.00	NA	**3.60**
2004	5.00	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.33**
2005	NA	5.00	5.00	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.50**
2006	3.00	NA	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2007	3.00	NA	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	NA	**3.00**
2008	NA	NA	3.00	3.00	3.00	3.00	3.00	1.00	5.00	3.00	NA	**3.00**
2009	3.00	NA	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	NA	**3.00**
2010	5.00	NA	3.00	3.00	3.00	3.00	3.00	3.00	3.00	5.00	3.00	**3.40**
2011	5.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.18**
2012	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.00**
Average	**3.91**	**3.50**	**3.44**	**3.23**	**3.23**	**3.00**	**3.00**	**2.88**	**4.00**	**3.89**	**3.38**	**3.51**
R-square	*0.00*	*0.17*	***0.56***	*0.14*	*0.14*	*NA*	*NA*	*0.13*	***0.41***	*0.08*	*0.21*	*0.18*
Slope	*0.00*	*-0.09*	*-0.23*	*-0.03*	*-0.03*	*0.00*	*0.00*	*-0.07*	*-0.10*	*-0.05*	*-0.04*	*-0.04*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Proportion of Dominant Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	5.00	**5.00**
1995	NA	NA	NA	5.00	4.00	5.00	4.00	NA	5.00	5.00	5.00	**4.71**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1997	5.00	NA	NA	5.00	5.00	NA	3.00	3.00	5.00	5.00	5.00	**4.50**
1998	3.00	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**2.60**
1999	NA	NA	NA	5.00	3.00	NA	NA	3.00	NA	5.00	NA	**4.00**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	5.00	5.00	5.00	**4.50**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2003	3.00	3.00	1.00	5.00	3.00	3.00	3.00	3.00	3.00	3.00	NA	**3.00**
2004	5.00	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.33**
2005	NA	5.00	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.50**
2006	5.00	NA	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.50**
2007	3.00	NA	3.00	3.00	3.00	3.00	5.00	1.00	5.00	3.00	NA	**3.22**
2008	NA	NA	3.00	3.00	1.00	5.00	5.00	1.00	3.00	5.00	NA	**3.25**
2009	3.00	NA	5.00	3.00	5.00	3.00	3.00	5.00	3.00	5.00	NA	**3.89**
2010	5.00	NA	5.00	3.00	3.00	5.00	3.00	3.00	5.00	3.00	5.00	**4.00**
2011	5.00	1.00	3.00	3.00	5.00	5.00	5.00	3.00	3.00	3.00	5.00	**3.73**
2012	3.00	3.00	1.00	5.00	3.00	3.00	5.00	3.00	3.00	5.00	3.00	**3.36**
Average	**4.09**	**3.00**	**3.00**	**4.08**	**3.69**	**4.11**	**4.10**	**2.25**	**4.17**	**4.47**	**4.75**	**3.79**
R-square	*0.03*	***0.31***	*0.06*	***0.36***	*0.11*	*0.10*	*0.03*	*0.04*	***0.44***	*0.09*	*0.28*	*0.21*
Slope	*-0.03*	*-0.20*	*0.12*	*-0.09*	*-0.06*	*-0.05*	*0.03*	*0.05*	*-0.10*	*-0.05*	*-0.05*	*-0.06*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Proportion of EPT Individuals

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	3.00	NA	NA	NA	5.00	5.00	3.00	**4.20**
1995	NA	NA	NA	5.00	4.00	3.00	5.00	NA	3.00	4.00	5.00	**4.14**
1996	5.00	NA	NA	3.00	1.00	3.00	3.00	NA	3.00	3.00	3.00	**3.00**
1997	5.00	NA	NA	5.00	5.00	NA	3.00	3.00	5.00	5.00	5.00	**4.50**
1998	5.00	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
1999	NA	NA	NA	3.00	5.00	NA	NA	1.00	NA	5.00	NA	**3.50**
2000	NA	NA	NA	NA	NA	NA	NA	1.00	3.00	5.00	3.00	**3.00**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.00**
2003	5.00	5.00	5.00	5.00	3.00	5.00	3.00	1.00	5.00	5.00	NA	**4.20**
2004	5.00	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.67**
2005	NA	5.00	5.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**4.00**
2006	3.00	NA	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2007	5.00	NA	3.00	1.00	1.00	3.00	5.00	1.00	3.00	3.00	NA	**2.78**
2008	NA	NA	5.00	3.00	1.00	5.00	5.00	1.00	5.00	5.00	NA	**3.75**
2009	5.00	NA	3.00	3.00	5.00	5.00	5.00	3.00	3.00	5.00	NA	**4.11**
2010	5.00	NA	5.00	1.00	5.00	5.00	5.00	3.00	5.00	5.00	5.00	**4.40**
2011	5.00	5.00	5.00	1.00	1.00	3.00	3.00	1.00	5.00	5.00	3.00	**3.36**
2012	3.00	3.00	1.00	3.00	3.00	1.00	5.00	3.00	3.00	3.00	3.00	**2.82**
Average	**4.64**	**4.50**	**3.89**	**3.31**	**3.23**	**3.67**	**4.20**	**1.75**	**4.00**	**4.53**	**3.75**	**3.60**
R-square	*0.13*	***0.41***	*0.15*	***0.53***	*0.05*	*0.00*	*0.16*	*0.00*	*0.00*	*0.00*	*0.02*	*0.05*
Slope	*-0.05*	*-0.14*	*-0.19*	*-0.17*	*-0.06*	*0.01*	*0.06*	*-0.02*	*0.01*	*0.00*	*-0.02*	*-0.03*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Proportion of Hydropsyche & Cheumatopsyche

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	3.00	3.00	NA	NA	NA	3.00	5.00	3.00	**3.40**
1995	NA	NA	NA	5.00	5.00	5.00	3.00	NA	5.00	5.00	5.00	**4.71**
1996	5.00	NA	NA	5.00	5.00	5.00	3.00	NA	5.00	5.00	3.00	**4.50**
1997	5.00	NA	NA	5.00	5.00	NA	5.00	5.00	5.00	5.00	5.00	**5.00**
1998	5.00	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
1999	NA	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
2000	NA	NA	NA	NA	NA	NA	NA	5.00	5.00	5.00	5.00	**5.00**
2001	NA	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2002	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2003	5.00	5.00	5.00	5.00	5.00	5.00	3.00	3.00	5.00	5.00	NA	**4.60**
2004	5.00	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.33**
2005	NA	5.00	5.00	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.50**
2006	5.00	NA	5.00	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.50**
2007	5.00	NA	5.00	5.00	5.00	5.00	3.00	3.00	5.00	5.00	NA	**4.56**
2008	NA	NA	5.00	3.00	5.00	5.00	3.00	1.00	5.00	5.00	NA	**4.00**
2009	5.00	NA	5.00	3.00	5.00	5.00	3.00	3.00	5.00	5.00	NA	**4.33**
2010	5.00	NA	5.00	5.00	5.00	5.00	3.00	3.00	5.00	5.00	5.00	**4.60**
2011	5.00	5.00	5.00	5.00	3.00	5.00	5.00	3.00	5.00	5.00	5.00	**4.64**
2012	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	**5.00**
Average	**5.00**	**5.00**	**5.00**	**4.54**	**4.69**	**5.00**	**3.60**	**3.63**	**4.83**	**5.00**	**4.50**	**4.56**
R-square	*NA*	*NA*	*NA*	*0.00*	*0.00*	*NA*	*0.04*	*0.30*	*0.19*	*NA*	*0.30*	*0.00*
Slope	*0.00*	*0.00*	*0.00*	*-0.01*	*0.00*	*0.00*	*0.03*	*-0.14*	*0.04*	*0.00*	*0.07*	*0.00*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Proportion of Shredders

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	3.00	5.00	5.00	**4.60**
1995	NA	NA	NA	5.00	5.00	5.00	4.00	NA	5.00	4.00	5.00	**4.71**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	3.00	3.00	3.00	**4.25**
1997	5.00	NA	NA	5.00	5.00	NA	5.00	5.00	5.00	5.00	5.00	**5.00**
1998	5.00	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
1999	NA	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
2000	NA	NA	NA	NA	NA	NA	NA	5.00	5.00	5.00	5.00	**5.00**
2001	NA	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2002	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2003	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA	**5.00**
2004	5.00	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2005	NA	5.00	5.00	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.50**
2006	5.00	NA	5.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**4.00**
2007	5.00	NA	5.00	5.00	5.00	5.00	5.00	3.00	5.00	3.00	NA	**4.56**
2008	NA	NA	5.00	5.00	3.00	5.00	5.00	1.00	5.00	5.00	NA	**4.25**
2009	5.00	NA	5.00	5.00	5.00	5.00	5.00	1.00	5.00	5.00	NA	**4.56**
2010	5.00	NA	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	**5.00**
2011	5.00	5.00	5.00	3.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	**4.45**
2012	5.00	5.00	3.00	5.00	5.00	5.00	5.00	5.00	3.00	5.00	3.00	**4.45**
Average	**5.00**	**5.00**	**4.78**	**4.85**	**4.85**	**5.00**	**4.90**	**3.63**	**4.50**	**4.74**	**4.50**	**4.65**
R-square	*NA*	*NA*	*0.28*	*0.13*	*0.05*	*NA*	*0.28*	*0.27*	*0.06*	*0.04*	*0.03*	*0.07*
Slope	*0.00*	*0.00*	*-0.12*	*-0.03*	*-0.02*	*0.00*	*0.03*	*-0.19*	*0.03*	*0.02*	*-0.02*	*-0.02*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Ratio of Scrapers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	5.00	**5.00**
1995	NA	NA	NA	4.00	4.00	5.00	3.00	NA	5.00	5.00	5.00	**4.43**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1997	5.00	NA	NA	5.00	5.00	NA	1.00	1.00	5.00	5.00	5.00	**4.00**
1998	5.00	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
1999	NA	NA	NA	5.00	5.00	NA	NA	5.00	NA	5.00	NA	**5.00**
2000	NA	NA	NA	NA	NA	NA	NA	5.00	5.00	5.00	1.00	**4.00**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2003	1.00	1.00	1.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	NA	**3.00**
2004	5.00	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.67**
2005	NA	1.00	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**2.50**
2006	5.00	NA	5.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**4.00**
2007	5.00	NA	3.00	1.00	3.00	5.00	3.00	1.00	5.00	5.00	NA	**3.44**
2008	NA	NA	1.00	1.00	1.00	5.00	3.00	1.00	5.00	5.00	NA	**2.75**
2009	5.00	NA	3.00	1.00	1.00	5.00	5.00	1.00	5.00	5.00	NA	**3.44**
2010	5.00	NA	1.00	1.00	1.00	3.00	3.00	1.00	5.00	3.00	5.00	**2.80**
2011	5.00	5.00	1.00	1.00	1.00	1.00	5.00	1.00	5.00	3.00	5.00	**3.00**
2012	5.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	3.00	5.00	**2.09**
Average	**4.64**	**2.00**	**2.11**	**2.77**	**3.23**	**3.89**	**3.60**	**1.75**	**4.67**	**4.68**	**4.50**	**3.64**
R-square	*0.01*	*0.24*	*0.14*	***0.84***	***0.82***	***0.38***	*0.04*	***0.33***	*0.16*	***0.40***	*0.01*	***0.63***
Slope	*0.02*	*0.22*	*-0.19*	*-0.27*	*-0.26*	*-0.17*	*0.04*	*-0.19*	*-0.07*	*-0.08*	*0.02*	*-0.13*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Taxa Richness

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	5.00	**5.00**
1995	NA	NA	NA	5.00	4.00	5.00	4.00	NA	5.00	5.00	4.00	**4.57**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1997	5.00	NA	NA	5.00	3.00	NA	3.00	5.00	5.00	5.00	5.00	**4.50**
1998	5.00	NA	NA	3.00	3.00	NA	NA	3.00	NA	3.00	NA	**3.40**
1999	NA	NA	NA	5.00	3.00	NA	NA	5.00	NA	5.00	NA	**4.50**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	3.00	5.00	3.00	**3.50**
2001	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2002	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2003	3.00	1.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00	NA	**2.60**
2004	3.00	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**3.67**
2005	NA	3.00	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2006	3.00	NA	3.00	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.50**
2007	3.00	NA	3.00	3.00	5.00	3.00	5.00	3.00	5.00	5.00	NA	**3.89**
2008	NA	NA	3.00	3.00	3.00	3.00	5.00	1.00	3.00	3.00	NA	**3.00**
2009	5.00	NA	5.00	5.00	3.00	3.00	5.00	3.00	3.00	3.00	NA	**3.89**
2010	5.00	NA	5.00	3.00	3.00	5.00	5.00	3.00	5.00	3.00	5.00	**4.20**
2011	3.00	5.00	5.00	3.00	3.00	3.00	3.00	3.00	5.00	3.00	5.00	**3.73**
2012	5.00	5.00	3.00	5.00	5.00	3.00	5.00	3.00	3.00	5.00	5.00	**4.27**
Average	**4.09**	**3.50**	**3.67**	**3.92**	**3.69**	**3.67**	**4.30**	**2.88**	**4.17**	**4.26**	**4.63**	**3.85**
R-square	*0.05*	***0.93***	*0.29*	*0.13*	*0.03*	***0.40***	*0.09*	*0.20*	*0.14*	*0.23*	*0.07*	*0.19*
Slope	*-0.04*	*0.42*	*0.18*	*-0.07*	*-0.03*	*-0.10*	*0.04*	*-0.11*	*-0.06*	*-0.08*	*0.03*	*-0.06*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Total Number of EPT Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	36.00	34.00	NA	NA	NA	36.00	40.00	34.00	**36.00**
1995	NA	NA	NA	38.00	34.00	36.00	30.00	NA	38.00	36.00	36.00	**35.43**
1996	40.00	NA	NA	36.00	34.00	36.00	34.00	NA	36.00	36.00	34.00	**35.75**
1997	38.00	NA	NA	38.00	34.00	NA	28.00	28.00	38.00	36.00	36.00	**34.50**
1998	36.00	NA	NA	34.00	34.00	NA	NA	32.00	NA	34.00	NA	**34.00**
1999	NA	NA	NA	36.00	32.00	NA	NA	30.00	NA	38.00	NA	**34.00**
2000	NA	NA	NA	NA	NA	NA	NA	28.00	36.00	36.00	28.00	**32.00**
2001	NA	NA	NA	NA	NA	NA	NA	22.00	NA	40.00	NA	**31.00**
2002	NA	NA	NA	NA	NA	NA	NA	18.00	NA	36.00	NA	**27.00**
2003	30.00	24.00	28.00	26.00	28.00	32.00	28.00	22.00	34.00	32.00	NA	**28.40**
2004	38.00	NA	NA	NA	NA	NA	NA	22.00	NA	40.00	NA	**33.33**
2005	NA	32.00	32.00	NA	NA	NA	NA	14.00	NA	40.00	NA	**29.50**
2006	32.00	NA	30.00	NA	NA	NA	NA	10.00	NA	36.00	NA	**27.00**
2007	32.00	NA	28.00	24.00	28.00	32.00	34.00	18.00	34.00	32.00	NA	**29.11**
2008	NA	NA	28.00	24.00	20.00	34.00	34.00	8.00	36.00	34.00	NA	**27.25**
2009	34.00	NA	34.00	28.00	30.00	32.00	34.00	22.00	32.00	34.00	NA	**31.11**
2010	40.00	NA	34.00	24.00	28.00	36.00	32.00	24.00	38.00	32.00	38.00	**32.60**
2011	36.00	32.00	32.00	22.00	24.00	28.00	34.00	18.00	36.00	30.00	36.00	**29.82**
2012	34.00	30.00	20.00	32.00	28.00	24.00	36.00	26.00	26.00	34.00	32.00	**29.27**
Average	**35.45**	**29.50**	**29.56**	**30.62**	**29.85**	**32.22**	**32.40**	**21.38**	**35.00**	**35.58**	**34.25**	**31.43**
R-square	*0.09*	***0.34***	*0.03*	***0.69***	***0.64***	***0.41***	***0.37***	*0.24*	*0.27*	*0.28*	*0.01*	***0.48***
Slope	*-0.17*	*0.50*	*-0.24*	*-0.75*	*-0.53*	*-0.41*	*0.26*	*-0.70*	*-0.26*	*-0.28*	*0.04*	*-0.37*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

DEP Benthic Macroinvertebrate Scaled Metric Scores

Composite

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	36.00	34.00	NA	NA	NA	36.00	40.00	34.00	**36.00**
1995	NA	NA	NA	38.00	34.00	36.00	30.00	NA	38.00	36.00	36.00	**35.43**
1996	40.00	NA	NA	36.00	34.00	36.00	34.00	NA	36.00	36.00	34.00	**35.75**
1997	38.00	NA	NA	38.00	34.00	NA	28.00	28.00	38.00	36.00	36.00	**34.50**
1998	36.00	NA	NA	34.00	34.00	NA	NA	32.00	NA	34.00	NA	**34.00**
1999	NA	NA	NA	36.00	32.00	NA	NA	30.00	NA	38.00	NA	**34.00**
2000	NA	NA	NA	NA	NA	NA	NA	28.00	36.00	36.00	28.00	**32.00**
2001	NA	NA	NA	NA	NA	NA	NA	22.00	NA	40.00	NA	**31.00**
2002	NA	NA	NA	NA	NA	NA	NA	18.00	NA	36.00	NA	**27.00**
2003	30.00	24.00	28.00	26.00	28.00	32.00	28.00	22.00	34.00	32.00	NA	**28.40**
2004	38.00	NA	NA	NA	NA	NA	NA	22.00	NA	40.00	NA	**33.33**
2005	NA	32.00	32.00	NA	NA	NA	NA	14.00	NA	40.00	NA	**29.50**
2006	32.00	NA	30.00	NA	NA	NA	NA	10.00	NA	36.00	NA	**27.00**
2007	32.00	NA	28.00	24.00	28.00	32.00	34.00	18.00	34.00	32.00	NA	**29.11**
2008	NA	NA	28.00	24.00	20.00	34.00	34.00	8.00	36.00	34.00	NA	**27.25**
2009	34.00	NA	34.00	28.00	30.00	32.00	34.00	22.00	32.00	34.00	NA	**31.11**
2010	40.00	NA	34.00	24.00	28.00	36.00	32.00	24.00	38.00	32.00	38.00	**32.60**
2011	36.00	32.00	32.00	22.00	24.00	28.00	34.00	18.00	36.00	30.00	36.00	**29.82**
2012	34.00	30.00	20.00	32.00	28.00	24.00	36.00	26.00	26.00	34.00	32.00	**29.27**
Average	**35.45**	**29.50**	**29.56**	**30.62**	**29.85**	**32.22**	**32.40**	**21.38**	**35.00**	**35.58**	**34.25**	**31.43**
R-square	*0.09*	***0.34***	*0.03*	***0.69***	***0.64***	***0.41***	***0.37***	*0.24*	*0.27*	*0.28*	*0.01*	***0.48***
Slope	*-0.17*	*0.50*	*-0.24*	*-0.75*	*-0.53*	*-0.41*	*0.26*	*-0.70*	*-0.26*	*-0.28*	*0.04*	*-0.37*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

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Appendix D
MBSS Benthic Macroinvertebrate Raw Metric Scores

Number Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	36.00	26.00	NA	NA	NA	27.00	30.00	24.00	**28.60**
1996	NA	NA	NA	55.00	41.00	27.00	42.00	NA	26.00	58.00	39.00	**41.14**
1997	27.00	NA	NA	31.00	29.00	29.00	30.00	NA	30.00	27.00	28.00	**28.88**
1998	31.00	NA	NA	38.00	22.00	NA	22.00	26.00	26.00	21.00	21.00	**25.88**
1999	30.00	NA	NA	21.00	21.00	NA	NA	13.00	NA	19.00	NA	**20.80**
2000	NA	NA	NA	34.00	22.00	NA	NA	25.00	NA	21.00	NA	**25.50**
2001	NA	NA	NA	NA	NA	NA	NA	19.00	20.00	23.00	14.00	**19.00**
2002	NA	NA	NA	NA	NA	NA	NA	14.00	NA	24.00	NA	**19.00**
2003	NA	NA	NA	NA	NA	NA	NA	15.00	NA	27.00	NA	**21.00**
2004	15.00	10.00	16.00	10.00	16.00	22.00	21.00	20.00	16.00	16.00	NA	**16.20**
2005	23.00	NA	NA	NA	NA	NA	NA	22.00	NA	27.00	NA	**24.00**
2006	NA	16.00	19.00	NA	NA	NA	NA	13.00	NA	25.00	NA	**18.25**
2007	24.00	NA	17.00	NA	NA	NA	NA	12.00	NA	19.00	NA	**18.00**
2008	24.00	NA	19.00	21.00	27.00	26.00	39.00	24.00	27.00	29.00	NA	**26.22**
2009	NA	NA	19.00	21.00	18.00	21.00	37.00	9.00	21.00	19.00	NA	**20.63**
2010	26.00	NA	31.00	29.00	21.00	22.00	31.00	24.00	22.00	21.00	NA	**25.22**
2011	35.00	NA	26.00	23.00	22.00	39.00	39.00	25.00	26.00	20.00	24.00	**27.90**
2012	24.00	26.00	30.00	22.00	19.00	24.00	26.00	24.00	34.00	20.00	35.00	**25.82**
Average	**25.90**	**17.33**	**22.13**	**28.42**	**23.67**	**26.25**	**31.89**	**19.00**	**25.00**	**24.78**	**26.43**	**24.00**
R-square	*0.01*	***0.98***	***0.71***	***0.37***	*0.28*	*0.00*	*0.01*	*0.01*	*0.00*	*0.21*	*0.01*	*0.11*
Slope	*-0.09*	*1.92*	*1.88*	*-1.09*	*-0.54*	*-0.02*	*0.13*	*0.11*	*-0.01*	*-0.78*	*0.10*	*-0.36*
N	*10.00*	*3.00*	*8.00*	*12.00*	*12.00*	*8.00*	*9.00*	*15.00*	*11.00*	*18.00*	*7.00*	*18.00*

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Appendix D

MBSS Benthic Macroinvertebrate Raw Metric Scores

 # EPT

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	25.00	14.00	NA	NA	NA	14.00	16.00	13.00	**16.40**
1996	NA	NA	NA	32.00	21.00	15.00	23.00	NA	15.00	31.00	21.00	**22.57**
1997	14.00	NA	NA	17.00	14.00	17.00	16.00	NA	18.00	14.00	13.00	**15.38**
1998	20.00	NA	NA	21.00	11.00	NA	13.00	12.00	14.00	12.00	12.00	**14.38**
1999	15.00	NA	NA	9.00	11.00	NA	NA	6.00	NA	8.00	NA	**9.80**
2000	NA	NA	NA	22.00	8.00	NA	NA	11.00	NA	15.00	NA	**14.00**
2001	NA	NA	NA	NA	NA	NA	NA	8.00	15.00	10.00	6.00	**9.75**
2002	NA	NA	NA	NA	NA	NA	NA	10.00	NA	13.00	NA	**11.50**
2003	NA	NA	NA	NA	NA	NA	NA	6.00	NA	14.00	NA	**10.00**
2004	8.00	4.00	9.00	4.00	5.00	10.00	11.00	7.00	7.00	8.00	NA	**7.30**
2005	13.00	NA	NA	NA	NA	NA	NA	7.00	NA	13.00	NA	**11.00**
2006	NA	8.00	11.00	NA	NA	NA	NA	5.00	NA	15.00	NA	**9.75**
2007	11.00	NA	7.00	NA	NA	NA	NA	3.00	NA	10.00	NA	**7.75**
2008	12.00	NA	11.00	8.00	10.00	14.00	22.00	7.00	12.00	15.00	NA	**12.33**
2009	NA	NA	11.00	6.00	7.00	11.00	18.00	NA	13.00	11.00	NA	**11.00**
2010	11.00	NA	13.00	15.00	10.00	12.00	15.00	10.00	14.00	9.00	NA	**12.11**
2011	21.00	NA	14.00	11.00	11.00	21.00	21.00	8.00	14.00	11.00	13.00	**14.50**
2012	11.00	9.00	13.00	10.00	8.00	10.00	13.00	8.00	13.00	10.00	15.00	**10.91**
Average	**13.60**	**7.00**	**11.13**	**15.00**	**10.83**	**13.75**	**16.89**	**7.71**	**13.55**	**13.06**	**13.29**	**12.25**
R-square	*0.05*	***0.67***	***0.58***	***0.47***	***0.34***	*0.04*	*0.00*	*0.08*	*0.12*	*0.21*	*0.01*	*0.24*
Slope	*-0.17*	*0.52*	*0.65*	*-0.91*	*-0.38*	*-0.13*	*-0.02*	*-0.15*	*-0.14*	*-0.44*	*-0.05*	*-0.33*
N	*10.00*	*3.00*	*8.00*	*12.00*	*12.00*	*8.00*	*9.00*	*14.00*	*11.00*	*18.00*	*7.00*	*18.00*

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Appendix D

MBSS Benthic Macroinvertebrate Raw Metric Scores

 # Ephemeroptera

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	6.00	3.00	NA	NA	NA	2.00	4.00	4.00	**3.80**
1996	NA	NA	NA	7.00	1.00	4.00	9.00	NA	4.00	8.00	5.00	**5.43**
1997	6.00	NA	NA	6.00	2.00	7.00	6.00	NA	8.00	6.00	2.00	**5.38**
1998	8.00	NA	NA	6.00	3.00	NA	6.00	3.00	3.00	5.00	3.00	**4.63**
1999	7.00	NA	NA	3.00	4.00	NA	NA	1.00	NA	3.00	NA	**3.60**
2000	NA	NA	NA	10.00	3.00	NA	NA	3.00	NA	5.00	NA	**5.25**
2001	NA	NA	NA	NA	NA	NA	NA	2.00	4.00	4.00	3.00	**3.25**
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.00	NA	**6.00**
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.00	NA	**6.00**
2004	4.00	2.00	5.00	1.00	2.00	4.00	4.00	NA	4.00	5.00	NA	**3.44**
2005	4.00	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.33**
2006	NA	2.00	4.00	NA	NA	NA	NA	NA	NA	7.00	NA	**4.33**
2007	5.00	NA	3.00	NA	NA	NA	NA	NA	NA	4.00	NA	**4.00**
2008	6.00	NA	5.00	3.00	1.00	6.00	11.00	1.00	5.00	6.00	NA	**4.89**
2009	NA	NA	5.00	2.00	2.00	5.00	8.00	NA	7.00	5.00	NA	**4.86**
2010	4.00	NA	4.00	4.00	NA	8.00	6.00	1.00	6.00	1.00	NA	**4.25**
2011	9.00	NA	4.00	3.00	2.00	7.00	10.00	1.00	8.00	3.00	6.00	**5.30**
2012	3.00	4.00	4.00	1.00	1.00	4.00	5.00	NA	8.00	5.00	5.00	**4.00**
Average	**5.60**	**2.67**	**4.25**	**4.33**	**2.18**	**5.63**	**7.22**	**1.63**	**5.36**	**4.89**	**4.00**	**4.54**
R-square	*0.11*	*0.94*	*0.04*	*0.45*	*0.24*	*0.03*	*0.01*	*0.48*	*0.42*	*0.10*	*0.37*	*0.01*
Slope	*-0.12*	*0.27*	*-0.06*	*-0.28*	*-0.07*	*0.05*	*0.05*	*-0.12*	*0.21*	*-0.09*	*0.12*	*-0.01*
N	*10.00*	*3.00*	*8.00*	*12.00*	*11.00*	*8.00*	*9.00*	*8.00*	*11.00*	*18.00*	*7.00*	*18.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

MBSS Benthic Macroinvertebrate Raw Metric Scores

% Intollerant

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	0.51	0.39	NA	NA	NA	0.50	0.37	0.34	**0.42**
1996	NA	NA	NA	0.61	0.45	0.64	0.20	NA	0.65	0.62	0.37	**0.51**
1997	0.64	NA	NA	0.71	0.38	0.64	0.32	NA	0.75	0.75	0.50	**0.59**
1998	0.74	NA	NA	0.69	0.70	NA	0.33	0.40	0.55	0.64	0.65	**0.59**
1999	0.73	NA	NA	0.80	0.86	NA	NA	0.89	NA	0.66	NA	**0.79**
2000	NA	NA	NA	0.46	0.75	NA	NA	0.30	NA	0.56	NA	**0.52**
2001	NA	NA	NA	NA	NA	NA	NA	0.20	0.70	0.55	0.48	**0.48**
2002	NA	NA	NA	NA	NA	NA	NA	0.17	NA	0.78	NA	**0.48**
2003	NA	NA	NA	NA	NA	NA	NA	0.17	NA	0.50	NA	**0.34**
2004	0.90	0.81	0.92	0.60	0.49	0.71	0.33	0.25	0.72	0.76	NA	**0.65**
2005	0.69	NA	NA	NA	NA	NA	NA	0.20	NA	0.67	NA	**0.52**
2006	NA	0.66	0.80	NA	NA	NA	NA	0.13	NA	0.73	NA	**0.58**
2007	0.58	NA	0.55	NA	NA	NA	NA	0.03	NA	0.70	NA	**0.46**
2008	0.82	NA	0.47	0.19	0.38	0.57	0.47	0.15	0.55	0.50	NA	**0.46**
2009	NA	NA	0.81	0.30	0.12	0.77	0.41	0.09	0.75	0.45	NA	**0.46**
2010	0.77	NA	0.47	0.25	0.41	0.80	0.59	0.20	0.32	0.65	NA	**0.50**
2011	0.79	NA	0.65	0.26	0.68	0.69	0.53	0.37	0.52	0.79	0.39	**0.57**
2012	0.85	0.89	0.72	0.33	0.49	0.71	0.35	0.30	0.73	0.65	0.42	**0.59**
Average	**0.75**	**0.79**	**0.67**	**0.48**	**0.51**	**0.69**	**0.39**	**0.26**	**0.61**	**0.63**	**0.45**	**0.53**
R-square	*0.16*	***0.38***	*0.16*	***0.66***	*0.05*	*0.21*	***0.56***	*0.17*	*0.02*	*0.04*	*0.02*	*0.00*
Slope	*0.01*	*0.02*	*-0.03*	*-0.03*	*-0.01*	*0.01*	*0.01*	*-0.02*	*0.00*	*0.00*	*0.00*	*0.00*
N	*10.00*	*3.00*	*8.00*	*12.00*	*12.00*	*8.00*	*9.00*	*15.00*	*11.00*	*18.00*	*7.00*	*18.00*

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MBSS Benthic Macroinvertebrate Raw Metric Scores

% Tanytarsini

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2003	NA	NA	NA	NA	NA	NA	NA	0.09	NA	0.10	NA	**0.10**
2004	0.01	NA	NA	NA	0.01	0.01	0.04	0.01	0.01	0.01	NA	**0.01**
2005	NA	NA	NA	NA	NA	NA	NA	0.02	NA	0.01	NA	**0.01**
2006	NA	NA	NA	NA	NA	NA	NA	0.05	NA	0.03	NA	**0.04**
2007	0.03	NA	0.14	NA	NA	NA	NA	0.11	NA	0.06	NA	**0.08**
2008	0.05	NA	0.16	0.11	0.10	0.06	0.05	0.24	0.07	0.01	NA	**0.10**
2009	NA	NA	0.04	0.06	0.02	0.03	0.02	0.02	0.01	0.09	NA	**0.04**
2010	0.05	NA	0.14	0.08	0.05	0.09	0.03	0.05	0.17	0.04	NA	**0.08**
2011	0.05	NA	0.14	0.06	0.05	0.05	0.02	0.08	0.11	0.01	NA	**0.06**
2012	0.02	NA	0.01	0.08	0.03	0.04	0.03	0.09	0.01	0.05	0.01	**0.04**
Average	**0.03**	**NA**	**0.11**	**0.08**	**0.04**	**0.05**	**0.03**	**0.08**	**0.06**	**0.04**	**0.01**	**0.06**
R-square	*0.16*	*NA*	*0.25*	*0.22*	*0.02*	*0.29*	***0.33***	*0.03*	*0.11*	*0.01*	*NA*	*0.00*
Slope	*0.00*	*NA*	*-0.02*	*-0.01*	*0.00*	*0.01*	*0.00*	*0.00*	*0.01*	*0.00*	*NA*	*0.00*
N	*6.00*	*0.00*	*6.00*	*5.00*	*6.00*	*6.00*	*6.00*	*10.00*	*6.00*	*10.00*	*1.00*	*10.00*

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MBSS Benthic Macroinvertebrate Raw Metric Scores

% Scrapers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	15%	30%	NA	NA	NA	32%	25%	19%	**0.24**
1996	NA	NA	NA	16%	6%	5%	20%	NA	6%	21%	19%	**0.13**
1997	11%	NA	NA	18%	31%	13%	21%	NA	6%	5%	18%	**0.15**
1998	13%	NA	NA	15%	14%	NA	2%	1%	3%	4%	1%	**0.06**
1999	17%	NA	NA	24%	11%	NA	NA	9%	NA	14%	NA	**0.15**
2000	NA	NA	NA	10%	14%	NA	NA	4%	NA	3%	NA	**0.08**
2001	NA	NA	NA	NA	NA	NA	NA	8%	31%	8%	0%	**0.12**
2002	NA	NA	NA	NA	NA	NA	NA	2%	NA	15%	NA	**0.09**
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	15%	NA	**0.15**
2004	NA	1%	NA	NA	6%	14%	7%	2%	1%	1%	NA	**0.04**
2005	8%	NA	NA	NA	NA	NA	NA	2%	NA	5%	NA	**0.05**
2006	NA	2%	6%	NA	NA	NA	NA	NA	NA	15%	NA	**0.08**
2007	3%	NA	9%	NA	NA	NA	NA	NA	NA	10%	NA	**0.07**
2008	2%	NA	3%	3%	4%	5%	7%	1%	10%	8%	NA	**0.05**
2009	NA	NA	NA	3%	1%	9%	13%	NA	10%	3%	NA	**0.06**
2010	5%	NA	4%	6%	5%	17%	13%	7%	3%	8%	NA	**0.08**
2011	4%	NA	2%	3%	1%	7%	8%	1%	2%	0%	2%	**0.03**
2012	12%	3%	2%	7%	6%	5%	9%	4%	8%	1%	7%	**0.06**
Average	**0.08**	**0.02**	**0.04**	**0.11**	**0.11**	**0.09**	**0.11**	**0.04**	**0.10**	**0.09**	**0.10**	**0.09**
R-square	***0.40***	***0.93***	***0.54***	***0.70***	***0.53***	*0.01*	*0.14*	*0.05*	*0.15*	***0.30***	***0.33***	***0.53***
Slope	*-0.01*	*0.00*	*-0.01*	*-0.01*	*-0.01*	*0.00*	*0.00*	*0.00*	*-0.01*	*-0.01*	*-0.01*	*-0.01*
N	*9.00*	*3.00*	*6.00*	*11.00*	*12.00*	*8.00*	*9.00*	*11.00*	*11.00*	*18.00*	*7.00*	*18.00*

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MBSS Benthic Macroinvertebrate Raw Metric Scores

% Swimmers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	0.21	0.01	NA	NA	NA	0.01	0.03	0.02	**0.06**
1996	NA	NA	NA	0.15	0.00	0.15	0.04	NA	0.02	0.04	0.02	**0.06**
1997	0.11	NA	NA	0.10	0.01	0.12	0.05	NA	0.13	0.07	NA	**0.09**
1998	0.31	NA	NA	0.13	0.09	NA	0.06	0.04	0.13	0.15	0.09	**0.12**
1999	0.06	NA	NA	0.06	0.09	NA	NA	0.01	NA	0.02	NA	**0.05**
2000	NA	NA	NA	0.10	0.11	NA	NA	0.02	NA	0.11	NA	**0.08**
2001	NA	NA	NA	NA	NA	NA	NA	0.02	0.04	0.11	0.05	**0.06**
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.08	NA	**0.08**
2003	NA	NA	NA	NA	NA	NA	NA	0.01	NA	0.08	NA	**0.04**
2004	0.08	0.03	0.08	0.01	0.02	0.13	0.09	NA	0.07	0.05	NA	**0.06**
2005	0.46	NA	NA	NA	NA	NA	NA	0.02	NA	0.09	NA	**0.19**
2006	NA	0.07	0.26	NA	NA	NA	NA	NA	NA	0.16	NA	**0.16**
2007	0.14	NA	0.11	NA	NA	NA	NA	NA	NA	0.07	NA	**0.11**
2008	0.18	NA	0.06	0.01	0.02	0.12	0.08	0.00	0.08	0.07	NA	**0.07**
2009	NA	NA	0.09	0.01	0.02	0.19	0.06	NA	0.08	0.09	NA	**0.08**
2010	0.07	NA	0.05	0.01	0.01	0.08	0.04	NA	0.04	0.01	NA	**0.04**
2011	0.23	NA	0.13	0.01	0.01	0.14	0.05	0.01	0.09	0.03	0.14	**0.08**
2012	0.18	0.06	0.02	0.01	NA	0.07	0.03	NA	0.06	0.02	0.01	**0.05**
Average	**0.18**	**0.05**	**0.10**	**0.07**	**0.03**	**0.12**	**0.06**	**0.02**	**0.07**	**0.07**	**0.05**	**0.08**
R-square	*0.00*	*0.27*	*0.20*	***0.80***	*0.07*	*0.10*	*0.01*	***0.45***	*0.01*	*0.03*	*0.13*	*0.00*
Slope	*0.00*	*0.00*	*-0.01*	*-0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
N	*10.00*	*3.00*	*8.00*	*12.00*	*11.00*	*8.00*	*9.00*	*8.00*	*11.00*	*18.00*	*6.00*	*18.00*

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Appendix D

MBSS Benthic Macroinvertebrate Raw Metric Scores

%Diptera

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1995	NA	NA	NA	0.25	0.35	NA	NA	NA	0.28	0.21	0.23	**0.26**
1996	NA	NA	NA	0.18	0.33	0.25	0.07	NA	0.63	0.14	0.21	**0.26**
1997	0.22	NA	NA	0.24	0.33	0.42	0.32	NA	0.49	0.56	0.43	**0.37**
1998	0.03	NA	NA	0.16	0.25	NA	0.65	0.59	0.41	0.23	0.20	**0.32**
1999	0.15	NA	NA	0.06	0.05	NA	NA	0.08	NA	0.16	NA	**0.10**
2000	NA	NA	NA	0.43	0.14	NA	NA	0.68	NA	0.31	NA	**0.39**
2001	NA	NA	NA	NA	NA	NA	NA	0.74	0.24	0.34	0.49	**0.45**
2002	NA	NA	NA	NA	NA	NA	NA	0.82	NA	0.18	NA	**0.50**
2003	NA	NA	NA	NA	NA	NA	NA	0.88	NA	0.42	NA	**0.65**
2004	0.11	0.23	0.10	0.41	0.55	0.26	0.63	0.79	0.26	0.26	NA	**0.36**
2005	0.16	NA	NA	NA	NA	NA	NA	0.77	NA	0.25	NA	**0.39**
2006	NA	0.29	0.08	NA	NA	NA	NA	0.93	NA	0.27	NA	**0.39**
2007	0.34	NA	0.48	NA	NA	NA	NA	0.94	NA	0.36	NA	**0.53**
2008	0.19	NA	0.56	0.78	0.65	0.47	0.32	0.86	0.44	0.61	NA	**0.54**
2009	NA	NA	0.13	0.59	0.87	0.15	0.14	0.95	0.18	0.36	NA	**0.42**
2010	0.17	NA	0.54	0.54	0.38	0.25	0.16	0.55	0.69	0.27	NA	**0.39**
2011	0.15	NA	0.31	0.78	0.31	0.27	0.16	0.68	0.35	0.19	0.41	**0.36**
2012	0.17	0.11	0.28	0.74	0.71	0.52	0.46	0.84	0.31	0.39	0.52	**0.46**
Average	**0.17**	**0.21**	**0.31**	**0.43**	**0.41**	**0.32**	**0.32**	**0.74**	**0.39**	**0.30**	**0.36**	**0.40**
R-square	*0.08*	***0.75***	*0.12*	***0.80***	***0.37***	*0.00*	*0.03*	*0.19*	*0.02*	*0.05*	***0.46***	*0.21*
Slope	*0.00*	*-0.02*	*0.03*	*0.04*	*0.02*	*0.00*	*-0.01*	*0.02*	*0.00*	*0.01*	*0.01*	*0.01*
N	*10.00*	*3.00*	*8.00*	*12.00*	*12.00*	*8.00*	*9.00*	*15.00*	*11.00*	*18.00*	*7.00*	*18.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Number Taxa

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	5.00	**5.00**
1995	NA	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1997	5.00	NA	NA	5.00	3.00	NA	3.00	5.00	5.00	3.00	3.00	**4.00**
1998	5.00	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**3.00**
1999	NA	NA	NA	5.00	3.00	NA	NA	5.00	NA	3.00	NA	**4.00**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	3.00	3.00	1.00	**2.50**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**4.00**
2003	3.00	1.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00	NA	**2.60**
2004	3.00	NA	NA	NA	NA	NA	NA	3.00	NA	5.00	NA	**3.67**
2005	NA	3.00	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2006	5.00	NA	3.00	NA	NA	NA	NA	1.00	NA	3.00	NA	**3.00**
2007	5.00	NA	3.00	3.00	5.00	5.00	5.00	5.00	5.00	5.00	NA	**4.56**
2008	NA	NA	3.00	3.00	3.00	3.00	5.00	1.00	3.00	3.00	NA	**3.00**
2009	5.00	NA	5.00	5.00	3.00	3.00	5.00	5.00	3.00	3.00	NA	**4.11**
2010	5.00	NA	5.00	3.00	3.00	5.00	5.00	5.00	5.00	3.00	5.00	**4.40**
2011	5.00	5.00	5.00	3.00	3.00	5.00	5.00	5.00	5.00	3.00	5.00	**4.45**
2012	5.00	5.00	3.00	5.00	5.00	5.00	5.00	3.00	5.00	5.00	5.00	**4.64**
Average	**4.64**	**3.50**	**3.67**	**3.92**	**3.77**	**4.33**	**4.60**	**3.13**	**4.33**	**3.95**	**4.25**	**3.84**
R-square	*0.01*	***0.93***	*0.29*	*0.13*	*0.07*	*0.01*	*0.15*	*0.03*	*0.03*	*0.04*	*0.05*	*0.01*
Slope	*0.02*	*0.42*	*0.18*	*-0.07*	*-0.04*	*-0.02*	*0.05*	*0.06*	*-0.02*	*-0.04*	*0.04*	*-0.01*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

 # EPT

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	3.00	**4.60**
1995	NA	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**5.00**
1996	5.00	NA	NA	5.00	5.00	5.00	5.00	NA	5.00	5.00	3.00	**4.75**
1997	5.00	NA	NA	5.00	3.00	NA	3.00	3.00	5.00	3.00	3.00	**3.75**
1998	5.00	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**3.00**
1999	NA	NA	NA	5.00	3.00	NA	NA	3.00	NA	5.00	NA	**4.00**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	5.00	3.00	1.00	**3.00**
2001	NA	NA	NA	NA	NA	NA	NA	3.00	NA	3.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2003	3.00	1.00	3.00	1.00	1.00	3.00	3.00	1.00	1.00	3.00	NA	**2.00**
2004	3.00	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.33**
2005	NA	3.00	3.00	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2006	3.00	NA	1.00	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.00**
2007	3.00	NA	3.00	3.00	3.00	5.00	5.00	1.00	3.00	5.00	NA	**3.44**
2008	NA	NA	3.00	1.00	1.00	3.00	5.00	NA	3.00	3.00	NA	**2.71**
2009	3.00	NA	3.00	5.00	3.00	3.00	5.00	3.00	5.00	3.00	NA	**3.67**
2010	5.00	NA	5.00	3.00	3.00	5.00	5.00	3.00	5.00	3.00	3.00	**4.00**
2011	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	5.00	**3.18**
2012	5.00	5.00	3.00	5.00	3.00	3.00	5.00	3.00	5.00	5.00	5.00	**4.27**
Average	**3.91**	**3.00**	**3.00**	**3.77**	**3.15**	**3.89**	**4.40**	**2.07**	**4.17**	**3.84**	**3.50**	**3.41**
R-square	*0.14*	***0.69***	*0.12*	*0.15*	***0.32***	***0.30***	*0.01*	*0.02*	*0.08*	*0.07*	*0.14*	*0.12*
Slope	*-0.07*	*0.31*	*0.12*	*-0.09*	*-0.11*	*-0.09*	*0.02*	*0.03*	*-0.06*	*-0.05*	*0.07*	*-0.05*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*15.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

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Ephemeroptera

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	3.00	NA	NA	NA	1.00	3.00	3.00	**3.00**
1995	NA	NA	NA	5.00	1.00	3.00	5.00	NA	3.00	5.00	5.00	**3.86**
1996	5.00	NA	NA	5.00	1.00	5.00	5.00	NA	5.00	5.00	1.00	**4.00**
1997	5.00	NA	NA	5.00	3.00	NA	5.00	3.00	3.00	5.00	3.00	**4.00**
1998	5.00	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**3.00**
1999	NA	NA	NA	5.00	3.00	NA	NA	3.00	NA	5.00	NA	**4.00**
2000	NA	NA	NA	NA	NA	NA	NA	1.00	3.00	3.00	3.00	**2.50**
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.00	NA	**5.00**
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.00	NA	**5.00**
2003	3.00	1.00	5.00	1.00	1.00	3.00	3.00	NA	3.00	5.00	NA	**2.78**
2004	3.00	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2005	NA	1.00	3.00	NA	NA	NA	NA	NA	NA	5.00	NA	**3.00**
2006	5.00	NA	3.00	NA	NA	NA	NA	NA	NA	3.00	NA	**3.67**
2007	5.00	NA	5.00	3.00	1.00	5.00	5.00	1.00	5.00	5.00	NA	**3.89**
2008	NA	NA	5.00	1.00	1.00	5.00	5.00	NA	5.00	5.00	NA	**3.86**
2009	3.00	NA	3.00	3.00	NA	5.00	5.00	1.00	5.00	1.00	NA	**3.25**
2010	5.00	NA	3.00	3.00	1.00	5.00	5.00	1.00	5.00	3.00	5.00	**3.60**
2011	3.00	3.00	3.00	1.00	1.00	3.00	5.00	NA	5.00	5.00	5.00	**3.40**
2012	5.00	3.00	1.00	5.00	3.00	5.00	5.00	1.00	5.00	3.00	5.00	**3.73**
Average	**4.27**	**2.00**	**3.44**	**3.46**	**1.83**	**4.33**	**4.80**	**1.44**	**4.00**	**4.16**	**3.75**	**3.61**
R-square	*0.07*	***0.96***	***0.39***	***0.32***	*0.11*	*0.10*	*0.01*	***0.36***	***0.57***	*0.05*	***0.42***	*0.00*
Slope	*-0.05*	*0.26*	*-0.28*	*-0.14*	*-0.05*	*0.05*	*0.01*	*-0.09*	*0.15*	*-0.05*	*0.12*	*-0.01*
N	*11.00*	*4.00*	*9.00*	*13.00*	*12.00*	*9.00*	*10.00*	*9.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

% Intollerant

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	3.00	3.00	NA	NA	NA	3.00	1.00	1.00	**2.20**
1995	NA	NA	NA	3.00	3.00	3.00	1.00	NA	3.00	3.00	1.00	**2.43**
1996	3.00	NA	NA	3.00	1.00	3.00	1.00	NA	3.00	3.00	3.00	**2.50**
1997	3.00	NA	NA	3.00	3.00	NA	1.00	3.00	3.00	3.00	3.00	**2.75**
1998	3.00	NA	NA		5.00	NA	NA	5.00	NA	3.00	NA	**4.00**
1999	NA	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**2.50**
2000	NA	NA	NA	NA	NA	NA	NA	1.00	3.00	3.00	3.00	**2.50**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.00**
2003	5.00	5.00	5.00	3.00	3.00	3.00	1.00	1.00	3.00	3.00	NA	**3.20**
2004	3.00	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.33**
2005	NA	3.00	5.00	NA	NA	NA	NA	1.00	NA	3.00	NA	**3.00**
2006	3.00	NA	3.00	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.50**
2007	5.00	NA	3.00	1.00	3.00	3.00	3.00	1.00	3.00	3.00	NA	**2.78**
2008	NA	NA	5.00	1.00	1.00	3.00	3.00	1.00	3.00	3.00	NA	**2.50**
2009	3.00	NA	3.00	1.00	3.00		3.00	1.00	1.00	3.00	NA	**2.25**
2010		NA	3.00	1.00	3.00	3.00	3.00	1.00	3.00		3.00	**2.50**
2011	5.00	5.00	3.00	1.00	3.00	3.00	1.00	1.00	3.00	3.00	3.00	**2.82**
2012	3.00	3.00	1.00	3.00	3.00	1.00	3.00	1.00	1.00	1.00	1.00	**1.91**
Average	**3.60**	**4.00**	**3.44**	**2.17**	**2.85**	**2.75**	**2.00**	**1.38**	**2.67**	**2.78**	**2.25**	**2.56**
R-square	*0.10*	*0.04*	***0.57***	***0.52***	*0.01*	*0.17*	***0.50***	*0.28*	*0.23*	*0.00*	*0.03*	*0.02*
Slope	*0.05*	*-0.05*	*-0.34*	*-0.11*	*-0.01*	*-0.04*	*0.11*	*-0.12*	*-0.06*	*0.00*	*0.02*	*-0.01*
N	*10.00*	*4.00*	*9.00*	*12.00*	*13.00*	*8.00*	*10.00*	*16.00*	*12.00*	*18.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

% Tanytarsini

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2002	NA	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2003	3.00	NA	NA	NA	3.00	3.00	5.00	3.00	3.00	3.00	NA	**3.29**
2004	NA	NA	NA	NA	NA	NA	NA	3.00	NA	3.00	NA	**3.00**
2005	NA	NA	NA	NA	NA	NA	NA	5.00	NA	3.00	NA	**4.00**
2006	3.00	NA	5.00	NA	NA	NA	NA	5.00	NA	5.00	NA	**4.50**
2007	5.00	NA	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	NA	**4.78**
2008	NA	NA	5.00	5.00	3.00	3.00	3.00	3.00	3.00	5.00	NA	**3.75**
2009	5.00	NA	5.00	5.00	5.00	5.00	3.00	5.00	5.00	5.00	NA	**4.78**
2010	5.00	NA	5.00	5.00	5.00	5.00	3.00	5.00	5.00	3.00	NA	**4.56**
2011	3.00	NA	3.00	5.00	3.00	3.00	3.00	5.00	3.00	5.00	5.00	**3.80**
2012	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	**3.00**
Average	**3.86**	**3.00**	**4.43**	**4.67**	**3.86**	**3.86**	**3.57**	**4.27**	**3.86**	**3.91**	**4.00**	**4.04**
R-square	*0.01*	*NA*	***0.63***	***0.43***	*0.00*	*0.00*	***0.66***	*0.00*	*0.00*	*0.00*	***1.00***	*0.01*
Slope	*0.04*	*NA*	*-0.36*	*-0.29*	*0.01*	*0.01*	*-0.27*	*0.02*	*0.01*	*0.02*	*-2.00*	*-0.02*
N	*7.00*	*1.00*	*7.00*	*6.00*	*7.00*	*7.00*	*7.00*	*11.00*	*7.00*	*11.00*	*2.00*	*11.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

% Scrapers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	5.00	NA	NA	NA	5.00	5.00	5.00	**5.00**
1995	NA	NA	NA	5.00	3.00	3.00	5.00	NA	3.00	5.00	5.00	**4.14**
1996	3.00	NA	NA	5.00	5.00	5.00	5.00	NA	3.00	3.00	5.00	**4.25**
1997		NA	NA	5.00	5.00	NA	1.00	1.00	1.00	3.00	1.00	**2.43**
1998	5.00	NA	NA	5.00	3.00	NA	NA	3.00	NA	5.00	NA	**4.20**
1999	NA	NA	NA	3.00	5.00	NA	NA	3.00	NA	3.00	NA	**3.50**
2000	NA	NA	NA	NA	NA	NA	NA	3.00	5.00	3.00	1.00	**3.00**
2001	NA	NA	NA	NA	NA	NA	NA	1.00	NA	5.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.00	NA	**5.00**
2003	NA	1.00	NA	NA	3.00	5.00	3.00	1.00	1.00	1.00	NA	**2.14**
2004	3.00	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.33**
2005	NA	1.00	3.00	NA	NA	NA	NA	NA	NA	5.00	NA	**3.00**
2006	1.00	NA	3.00	NA	NA	NA	NA	NA	NA	3.00	NA	**2.33**
2007	1.00	NA	1.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	NA	**2.33**
2008	NA	NA	NA	1.00	1.00	3.00	5.00	NA	3.00	1.00	NA	**2.33**
2009	3.00	NA	3.00	3.00	3.00	5.00		3.00	3.00	3.00	NA	**3.25**
2010	3.00	NA	1.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	**1.60**
2011		3.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00	1.00	3.00	**2.60**
2012	3.00	1.00	NA	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	**1.40**
Average	**2.75**	**1.50**	**2.00**	**3.33**	**3.15**	**3.44**	**3.44**	**1.83**	**2.67**	**3.11**	**2.75**	**3.04**
R-square	*0.15*	*0.24*	***0.38***	***0.75***	***0.59***	*0.21*	*0.03*	*0.02*	*0.15*	***0.43***	***0.35***	***0.52***
Slope	*-0.09*	*0.11*	*-0.29*	*-0.21*	*-0.17*	*-0.10*	*-0.04*	*-0.03*	*-0.08*	*-0.18*	*-0.15*	*-0.14*
N	*8.00*	*4.00*	*6.00*	*12.00*	*13.00*	*9.00*	*9.00*	*12.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

% Swimmers

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	5.00	1.00	NA	NA	NA	1.00	3.00	1.00	**2.20**
1995	NA	NA	NA	3.00	1.00	3.00	3.00	NA	1.00	3.00	1.00	**2.14**
1996	3.00	NA	NA	3.00	1.00	3.00	3.00	NA	3.00	3.00	NA	**2.71**
1997	5.00	NA	NA	3.00	3.00	NA	3.00	3.00	3.00	3.00	3.00	**3.25**
1998	3.00	NA	NA	3.00	3.00	NA	NA	1.00	NA	1.00	NA	**2.20**
1999	NA	NA	NA	3.00	3.00	NA	NA	1.00	NA	3.00	NA	**2.50**
2000	NA	NA	NA	NA	NA	NA	NA	1.00	3.00	3.00	3.00	**2.50**
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**2.00**
2003	3.00	3.00	3.00	1.00	1.00	3.00	3.00	NA	3.00	3.00	NA	**2.56**
2004	5.00	NA	NA	NA	NA	NA	NA	1.00	NA	3.00	NA	**3.00**
2005	NA	3.00	5.00	NA	NA	NA	NA	NA	NA	3.00	NA	**3.67**
2006	3.00	NA	3.00	NA	NA	NA	NA	NA	NA	3.00	NA	**3.00**
2007		NA	3.00	1.00	1.00	3.00	3.00	1.00	3.00	3.00	NA	**2.25**
2008	NA	NA	3.00	1.00	1.00	5.00	3.00	NA	3.00	3.00	NA	**2.71**
2009	3.00	NA	3.00	1.00	1.00	3.00	3.00	NA	3.00	1.00	NA	**2.25**
2010	5.00	NA	3.00	1.00	1.00	3.00	3.00	1.00	3.00	1.00	3.00	**2.40**
2011	5.00	3.00	1.00	1.00	NA	3.00	3.00	NA	3.00	1.00	1.00	**2.33**
2012	3.00	3.00	1.00	1.00	1.00	3.00	3.00	1.00	3.00	3.00	1.00	**2.09**
Average	**3.80**	**3.00**	**2.78**	**2.08**	**1.50**	**3.22**	**3.00**	**1.22**	**2.67**	**2.58**	**1.86**	**2.57**
R-square	*0.02*	*NA*	***0.51***	***0.81***	*0.16*	*0.02*	*NA*	*0.19*	***0.38***	*0.14*	*0.00*	*0.00*
Slope	*0.02*	*0.00*	*-0.29*	*-0.18*	*-0.06*	*0.01*	*0.00*	*-0.05*	*0.07*	*-0.06*	*-0.01*	*0.00*
N	*10.00*	*4.00*	*9.00*	*13.00*	*12.00*	*9.00*	*10.00*	*9.00*	*12.00*	*19.00*	*7.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

%Diptera

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	1.00	5.00	NA	NA	NA	5.00	1.00	1.00	**2.60**
1995	NA	NA	NA	1.00	5.00	1.00	1.00	NA	5.00	1.00	1.00	**2.14**
1996	1.00	NA	NA	1.00	5.00	5.00	5.00	NA	5.00	5.00	5.00	**4.00**
1997	1.00	NA	NA	1.00	1.00	NA	5.00	5.00	5.00	1.00	1.00	**2.50**
1998	1.00	NA	NA	1.00	1.00	NA	NA	1.00	NA	1.00	NA	**1.00**
1999	NA	NA	NA	5.00	1.00	NA	NA	5.00	NA	5.00	NA	**4.00**
2000	NA	NA	NA	NA	NA	NA	NA	5.00	1.00	5.00	5.00	**4.00**
2001	NA	NA	NA	NA	NA	NA	NA	5.00	NA	1.00	NA	**3.00**
2002	NA	NA	NA	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2003	1.00	1.00	1.00	5.00	5.00	1.00	5.00	5.00	5.00	5.00	NA	**3.40**
2004	1.00	NA	NA	NA	NA	NA	NA	5.00	NA	1.00	NA	**2.33**
2005	NA	5.00	1.00	NA	NA	NA	NA	5.00	NA	5.00	NA	**4.00**
2006	5.00	NA	5.00	NA	NA	NA	NA	5.00	NA	5.00	NA	**5.00**
2007	1.00	NA	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA	**4.56**
2008	NA	NA	1.00	5.00	5.00	1.00	1.00	5.00	1.00	5.00	NA	**3.00**
2009	1.00	NA	5.00	5.00	5.00	1.00	1.00	5.00	5.00	5.00	NA	**3.67**
2010	1.00	NA	5.00	5.00	5.00	5.00	1.00	5.00	5.00	1.00	5.00	**3.80**
2011	1.00	1.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	**4.27**
2012	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	**5.00**
Average	**1.73**	**3.00**	**3.67**	**3.46**	**4.08**	**3.22**	**3.40**	**4.75**	**4.33**	**3.53**	**3.50**	**3.54**
R-square	*0.13*	*0.04*	***0.43***	***0.73***	*0.18*	*0.08*	*0.01*	*0.13*	*0.00*	*0.19*	***0.49***	*0.28*
Slope	*0.10*	*0.10*	*0.45*	*0.26*	*0.11*	*0.10*	*-0.03*	*0.08*	*-0.01*	*0.15*	*0.19*	*0.10*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

Appendix D

Composite

	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	4.14	3.86	NA	NA	NA	3.57	3.29	2.71	**3.51**
1995	NA	NA	NA	3.86	3.29	3.29	3.57	NA	3.57	3.86	3.29	**3.53**
1996	3.57	NA	NA	3.86	3.29	4.43	4.14	NA	4.14	4.14	3.67	**3.90**
1997	4.00	NA	NA	3.86	3.00	NA	3.00	3.29	3.57	3.00	2.43	**3.27**
1998	3.86	NA	NA	3.00	3.00	NA	NA	1.86	NA	2.71	NA	**2.89**
1999	NA	NA	NA	4.14	3.00	NA	NA	3.00	NA	3.86	NA	**3.50**
2000	NA	NA	NA	NA	NA	NA	NA	2.43	3.29	3.29	2.43	**2.86**
2001	NA	NA	NA	NA	NA	NA	NA	2.20	NA	3.57	NA	**2.89**
2002	NA	NA	NA	NA	NA	NA	NA	2.67	NA	4.50	NA	**3.58**
2003	3.00	1.86	3.33	2.00	2.50	3.00	3.25	2.33	2.75	3.25	NA	**2.73**
2004	3.00	NA	NA	NA	NA	NA	NA	2.00	NA	3.25	NA	**2.75**
2005	NA	2.71	3.29	NA	NA	NA	NA	2.60	NA	4.25	NA	**3.21**
2006	3.50	NA	3.25	NA	NA	NA	NA	2.60	NA	3.50	NA	**3.21**
2007	3.57	NA	3.50	3.00	3.25	4.25	4.25	2.50	4.00	4.00	NA	**3.59**
2008	NA	NA	3.57	2.25	2.00	3.25	3.75	2.50	3.00	3.50	NA	**2.98**
2009	3.25	NA	3.75	3.50	3.29	3.57	3.57	3.29	3.75	3.00	NA	**3.44**
2010	4.14	NA	3.75	2.75	2.75	4.25	3.50	2.75	4.00	2.14	3.57	**3.36**
2011	3.86	3.57	3.00	3.00	3.00	3.50	3.75	3.67	4.00	3.50	4.00	**3.53**
2012	3.86	3.25	2.43	3.35	3.02	3.36	3.93	2.13	3.40	3.11	3.06	**3.17**
Average	**3.60**	**2.85**	**3.32**	**3.28**	**3.02**	**3.66**	**3.67**	**2.61**	**3.59**	**3.46**	**3.14**	**3.26**
R-square	*0.01*	***0.84***	*0.11*	***0.33***	*0.20*	*0.01*	*0.06*	*0.04*	*0.00*	*0.05*	*0.21*	*0.01*
Slope	*0.00*	*0.16*	*-0.05*	*-0.06*	*-0.03*	*-0.01*	*0.01*	*0.02*	*0.00*	*-0.02*	*0.03*	*-0.01*
N	*11.00*	*4.00*	*9.00*	*13.00*	*13.00*	*9.00*	*10.00*	*16.00*	*12.00*	*19.00*	*8.00*	*19.00*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

4.0 Herptofauna

Table 4-5. DEP Herptofauna Presence Data

Species	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304
American Bull Frog	●				●				●	●	●
Common Ribbonsnake			●						●		
Eastern American Toad			●			●	●	●	●	●	
Eastern Box Turtle			●						●		
Eastern Gartersnake			●		●						
Eastern Red-backed Salamander	●	●	●	●	●	●	●	●	●	●	●
Eastern Snapping Turtle									●		
Fowler's Toad				●	●					●	
Grey Tree Frog	●								●		
Long-tailed Salamander				●						●	
Northern Dusky Salamander	●		●	●	●	●		●	●	●	
Northern Green Frog	●	●	●	●	●	●	●	●	●	●	
Northern Red Salamander	●				●		●				
Northern Red-bellied Turtle							●				
Northern Ring-necked Snake										●	
Northern Slimy Salamander					●						
Northern Two-lined Salamander	●		●	●	●	●	●	●	●	●	●
Northern Watersnake			●				●		●	●	
Pickerel Frog			●	●	●	●	●	●	●	●	●
Queen Snake							●				
Spotted Salamander	●										
Wood Frog	●				●	●		●	●		●

Key:
Bold-Italics name indicates species most sensitive to urbanization. **Bold name** indicates species moderately sensitive to urbanization. Plain text name indicates species insensitive to urbanization. Source: Boward et al. 1999

5.0 Biological Condition

The overall biological condition is the average of the percent of the maximum value for the fish and benthic macroinvertabrate IBIs (Keith Van Ness, personal communication, February 12, 2013). These data are qualified according to the following criteria presented in TableD-6. The individual biological condition scores are presented in the Table D-7

Table D-6. Fish IBI scoring criteria

Condition category	Score
Excellent	>87
Good	>63-87
Fair	>41-63
Poor	≤41

Source: Keith Van Ness, personal communication, February 11, 2013.

Appendix D

Table D-7. Biological Condition Scores

Sample Year	LSTM110	LSTM111	LSTM112	LSTM201	LSTM202	LSTM203	LSTM204	LSTM206	LSTM302	LSTM303B	LSTM304	Average
1994	NA	NA	NA	0.91	0.84	NA	NA	NA	0.82	0.80	0.70	**0.81**
1995	NA	NA	NA	0.95	0.90	0.93	0.85	NA	0.91	0.86	0.86	**0.90**
1996	1.00	NA	NA	0.90	0.85	0.90	0.85	NA	0.90	0.90	0.85	**0.89**
1997	0.95	NA	NA	0.95	0.88	NA	0.70	0.83	0.82	0.86	0.86	**0.86**
1998	0.90	NA	NA	0.85	0.88	NA	NA	0.86	NA	0.84	0.73	**0.84**
1999	NA	NA	NA	0.90	0.80	NA	NA	0.75	NA	0.95	NA	**0.85**
2000	NA	NA	NA	NA	NA	NA	NA	0.74	0.77	0.68	0.63	**0.71**
2001	NA	NA	NA	NA	NA	NA	NA	0.71	NA	0.82	NA	**0.77**
2002	NA	NA	NA	NA	NA	NA	NA	0.46	NA	0.90	NA	**0.68**
2003	0.75	0.60	0.70	0.65	0.70	0.80	0.70	0.62	0.85	0.61	0.47	**0.68**
2004	0.95	NA	NA	NA	NA	NA	NA	0.66	NA	0.84	NA	**0.82**
2005	NA	0.80	0.80	NA	NA	NA	NA	0.41	NA	0.91	0.73	**0.73**
2006	0.80	NA	0.75	NA	NA	NA	NA	0.47	NA	0.73	0.47	**0.64**
2007	0.80	NA	0.56	0.64	0.74	0.83	0.90	0.50	0.79	0.86	NA	**0.74**
2008	NA	NA	0.70	0.69	0.71	0.84	0.90	0.40	0.75	0.75	NA	**0.72**
2009	0.85	NA	0.85	0.74	0.72	0.81	0.88	0.62	0.63	0.79	NA	**0.77**
2010	1.00	NA	0.85	0.67	0.74	0.86	0.88	0.69	0.86	0.70	0.84	**0.81**
2011	0.90	0.80	0.80	0.66	0.67	0.83	0.90	0.61	0.90	0.61	0.75	**0.77**
2012	0.85	0.75	0.50	0.77	0.74	0.73	0.91	0.74	0.69	0.79	0.79	**0.75**
Average	**0.89**	**0.74**	**0.72**	**0.79**	**0.78**	**0.84**	**0.85**	**0.63**	**0.81**	**0.80**	**0.72**	**0.77**
R-square	*0.09*	*0.34*	*0.01*	*0.71*	*0.76*	*0.57*	*0.32*	*0.19*	*0.19*	*0.20*	*0.02*	*0.27*
Slope	*0.00*	*0.01*	*0.00*	*-0.02*	*-0.01*	*-0.01*	*0.01*	*-0.01*	*-0.01*	*-0.01*	*0.00*	*-0.01*
N	*11*	*4*	*9*	*13*	*13*	*9*	*10*	*16*	*12*	*19*	*12*	*19*

Note: NA within the data table indicates that data was not available for the respective station for that sample year. NA associated with the calculated parameters below the data table indicates that a value could not be computed because either no variation in the data was observed over time or an insufficient number of observations were recorded to compute a value.

APPENDIX E. RARE, THREATENED, AND ENDANGERED SPECIES INFORMATION REQUEST LETTERS

2081 Clipper Park Road
Baltimore, MD 21211
Tel 410.554.0156
Fax 410.554.0168
www.biohabitats.com

January 23, 2013

Lori A. Byrne
Environmental Review Coordinator
MD DNR - Wildlife and Heritage Service
Tawes State Office Building
580 Taylor Ave.
Annapolis, MD 21401

RE: Montgomery County, Ten Mile Creek Watershed
Species Information Request

Dear Ms. Byrne:

Biohabitats, Inc. is requesting any information you may have regarding state rare, threatened and/or endangered plant or animal species within or near Ten Mile Creek watershed in Montgomery County.

The site encompasses Ten Mile Creek watershed located in northern Montgomery County (ADC Map #12, B-H, 1-9 and Map #4, B-K, 9-13). Brown and Caldwell/Biohabitats, a Joint Venture, are contracted by Maryland - National Capital Park and Planning Commission (M-NCPPC) Montgomery County Planning Department to provide data and environmental analysis of Ten Mile Creek watershed. This analysis is in support of the Planning Department undertaking a Limited Amendment to the Clarksburg Master Plan focusing on the Ten Mile Creek area in response to a request by the County Council in October 2012. Rare, threatened and endangered species is one piece of information being collected to assess the existing conditions of the watershed.

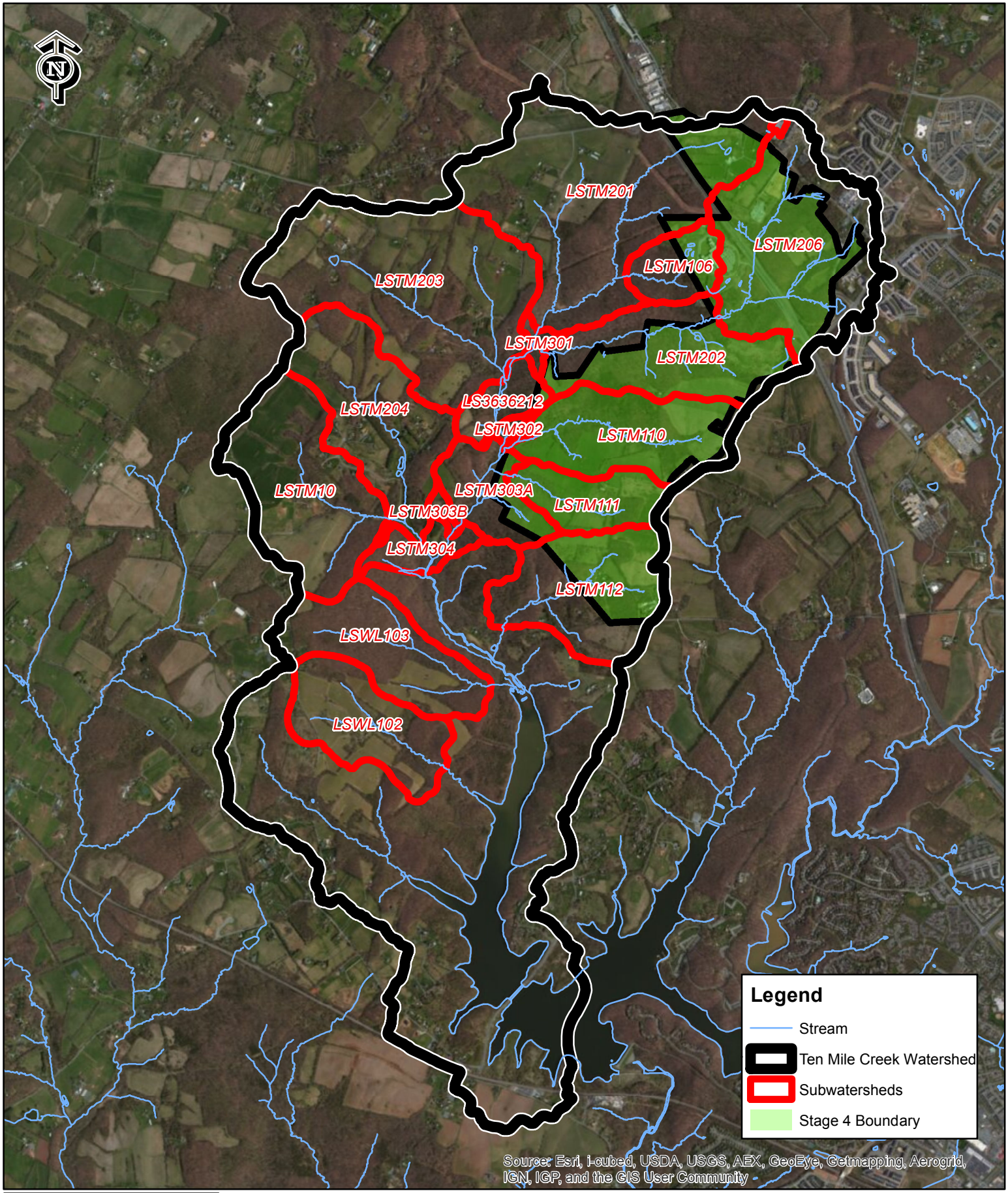
Please find the enclosed vicinity map showing the watershed location. Feel free to call me at 410-554-0156 should you have any questions. Thank you for your time and attention.

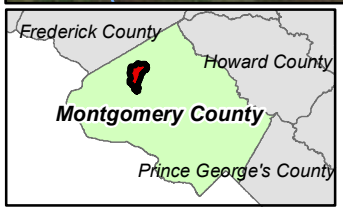
Sincerely,
BIOHABITATS, INC.

_____

Sarah Roberts
Environmental Scientist

Enclosure: Map of the Ten Mile Creek watershed





Ten Mile Creek

Map of Watershed

0 3,000 6,000 Feet

1 inch = 3,000 feet

United States Department of the Interior
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
410/573 4575

Online Certification Letter

Today's date: January 22, 2013

Project: Clarksburg Master Plan Limited Amendment for the Ten Mile Creek Watershed

Dear Applicant for online certification:

Thank you for choosing to use the U.S. Fish and Wildlife Service Chesapeake Bay Field Office online list request certification resource. This letter confirms that you have reviewed the conditions in which this online service can be used. On our website (http://www.fws.gov/chesapeakebay/EndSppWeb/ELEMENTS/listreq.html) are the USGS topographic map areas where no federally proposed or listed endangered or threatened species are known to occur in Maryland, Washington, D.C. and Delaware.

You have indicated that your project is located on the following USGS topographic map(s)

Germantown, Montgomery County

Based on this information and in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), we certify that except for occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist within the project area. Therefore, no Biological Assessment or further section 7 consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to federally protected threatened or endangered species under our jurisdiction. For additional information on threatened or endangered species in Maryland, you should contact the Maryland Wildlife and Heritage Division at (410) 260-8540. For information in Delaware you should contact the Delaware Natural Heritage and Endangered Species Program, at (302) 653-2880. For information in the District of Columbia, you should contact the National Park Service at (202) 535-1739.

The U.S. Fish and Wildlife Service also works with other Federal agencies and states to minimize loss of wetlands, reduce impacts to fish and migratory birds, including bald eagles,

and restore habitat for wildlife. Information on these conservation issues and how development projects can avoid affecting these resources can be found on our website (www.fws.gov/chesapeakebay)

We appreciate the opportunity to provide information relative to fish and wildlife issues, and thank you for your interest in these resources. If you have any questions or need further assistance, please contact Chesapeake Bay Field Office Threatened and Endangered Species program at (410) 573-4527.

Sincerely,

Genevieve LaRouche
Field Supervisor

APPENDIX F. HISTORIC AND ARCHEOLOGICAL PROPERTIES INFORMATION REQUEST LETTERS

Biohabitats
Incorporated

2081 Clipper Park Road
Baltimore, MD 21211
Tel 410.554.0156
Fax 410.554.0168
www.biohabitats.com

January 23, 2013

Ms. Elizabeth Cole, Administrator
Project Review and Compliance - Maryland Historical Trust
100 Community Place
Crownsville, MD 21032

RE: Montgomery County, Ten Mile Creek Watershed
Historic Properties Information Request

Dear Ms. Cole:

The purpose of this letter is to obtain information or assistance with any relevant historic and archeological properties information in Ten Mile Creek watershed in Montgomery County, Maryland (see enclosed map for location). Specifically, we would like to know whether or not the Maryland Historical Trust's database includes any of the following for the project vicinity:

- Inventoried historic properties,
- National Register listed properties,
- Prior archeological or architectural research conducted in the project vicinity,
- An informed assessment of the watershed's potential for containing historic properties that have not yet been identified.

The site encompasses Ten Mile Creek watershed located in northern Montgomery County (ADC Map #12, B-H, 1-9 and Map #4, B-K, 9-13). The watershed is located on the Georgetown quadrangle 7.5-minute USGS Topo Map. Brown and Caldwell/Biohabitats, a Joint Venture, are contracted by Maryland - National Capital Park and Planning Commission (M-NCPPC) Montgomery County Planning Department to provide data and environmental analysis of Ten Mile Creek watershed. This analysis is in support of the Planning Department undertaking a Limited Amendment to the Clarksburg Master Plan focusing on the Ten Mile Creek area in response to a request by the County Council in October 2012. Historical and archeological properties are one piece of information being collected to assess the existing conditions of the watershed.

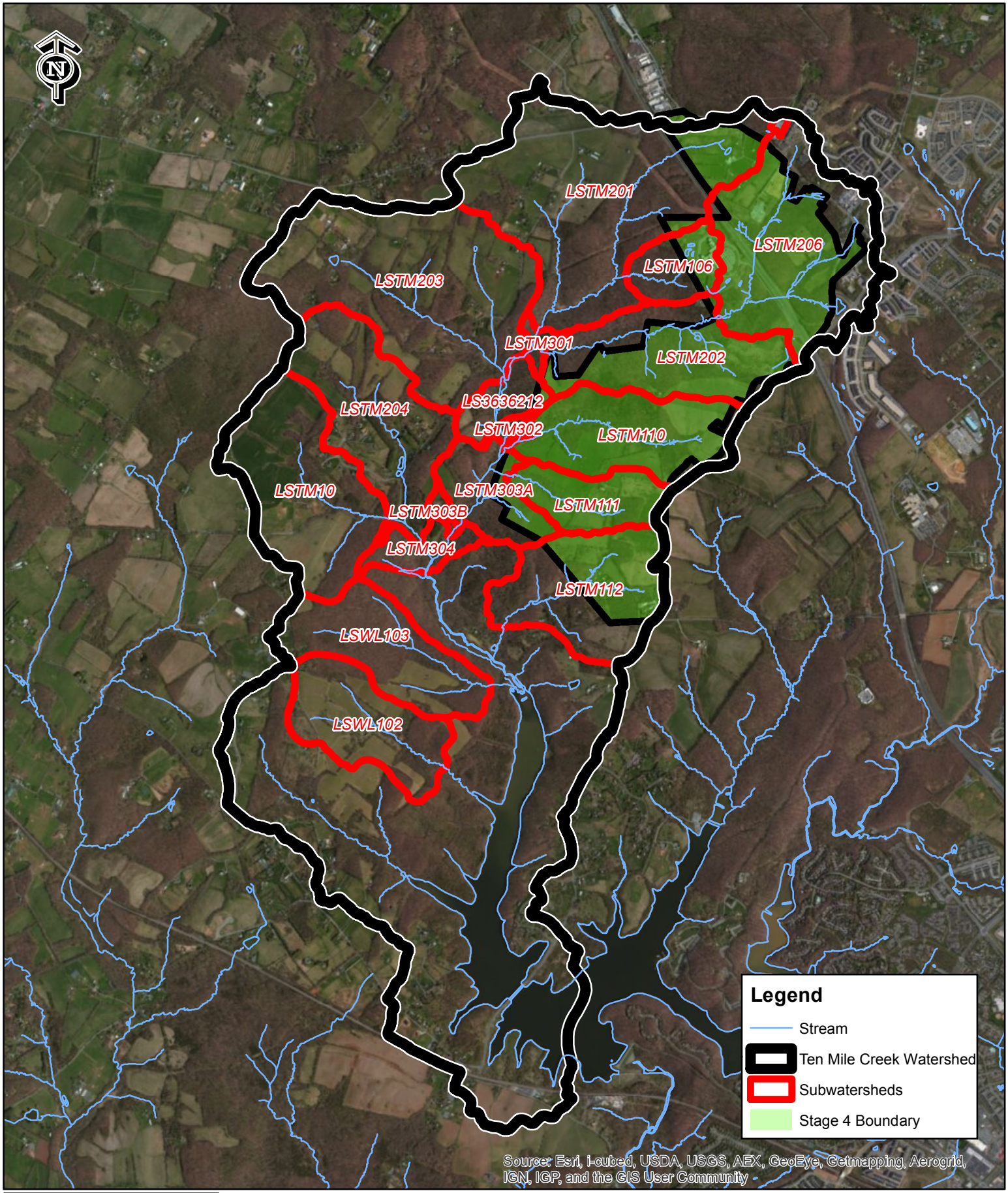
Please find the enclosed vicinity map showing the watershed location. Feel free to call me at 410-554-0156 should you have any questions. Thank you for your time and attention.

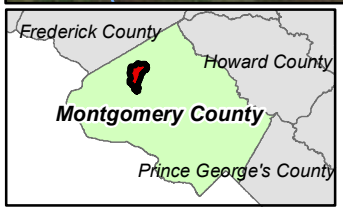
Sincerely,
BIOHABITATS, INC.

_____

Sarah Roberts
Environmental Scientist

Enclosure: Map of the Ten Mile Creek watershed





Ten Mile Creek

Map of Watershed

0 3,000 6,000 Feet

1 inch = 3,000 feet

Maryland Department of Planning
Maryland Historical Trust

Martin O'Malley
Governor

Anthony G. Brown
Lt. Governor

Richard Eberhart Hall
Secretary

Matthew J. Power
Deputy Secretary

February 8, 2013

Ms. Sarah Roberts
Biohabitats, Inc.
2081 Clipper Park Road
Baltimore, MD 21211

Re: MHT Review of Ten Mile Creek Watershed Study Area, Montgomery County

Dear Ms. Roberts:

In response to your January 24, 2013 request for information, the Maryland Historical Trust (MHT) has reviewed the above-referenced study area to assess potential effects on historic properties in accordance with Section 106 of the National Historic Preservation Act and the Maryland Historical Trust Act, §§ 5A-325 and 5A-326 of the State Finance and Procurement Article. Below are our preliminary comments and recommendations regarding the presence of historic properties within the Ten Mile Creek Watershed study area.

MHT files indicate that literally dozens of historic properties (including a number of archeological resources and an MHT easement property) are located within the broad study area boundaries illustrated in the project submittal. These properties include (but certainly are not limited to) the National Register-eligible historic district of Clarksburg, the National Register listed Clarksburg School (a two-room schoolhouse built in 1909), the Tenmile Creek Stream Valley Historic District, and the MHT easement property known as Moneysworth Farm. The study area also contains several known archeological sites (both prehistoric and historic) as well as a number of archeologically sensitive areas that are likely to contain significant sites that have not yet been identified.

Given the extensive nature of the watershed study area, we are unable to provide a complete inventory of the known historic properties or an assessment of areas having a moderate to high potential for containing resources that have not yet been identified. We are therefore recommending that the Maryland-National Capital Park and Planning Commission (M-NCPPC) send their qualified cultural resources staff or a cultural resources consultant to the MHT Library to conduct the necessary research and obtain all available information on the historic properties located within the proposed study area. Our library is open to the public on Tuesdays, Wednesdays, and Thursdays by appointment only. To make an appointment, please contact Mary Louise de Sarran at 410-514-7655.

A list of preservation consultants can be found on our website at www.marylandhistoricaltrust.net. If you have any questions or require additional information, please do not hesitate to contact me (for archeology) at 410-514-7638 or Jonathan Sager (for the historic built environment) at 410-514-7636.

Sincerely,

Dixie Henry

Dr. Dixie L. Henry
Preservation Officer
Maryland Historical Trust

DLH/201300327
cc: Scott Whipple (Montgomery County)