Poor House Run Hydrologic Assessment and Watershed Action Plan

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1.0 Introduction

The southern side of the town of Denton, Maryland, is transected by a tributary of the Choptank River called Poor House Run. It conveys stormwater from nearly 745 acres of mixed urban and commercial land use. As a result, the stream is incised and eroding the sub-base under 5th St. and Legion Road, a major intersection in Denton. Restoration of this stream will eliminate the stream as a source of sediment and turn it into a net pollutant sink. Addressing the stormwater within the watershed will also help alleviate flooding issues and help protect infrastructure. This plan provides hydrologic analysis of the stream, recommendations for stream restoration and stormwater infrastructure, as well as stormwater best management practices that can be installed within the watershed to better control runoff.

Figure 1. Poor House Run Watershed

1.1 Background

In 2017, the Town hired the engineering firm, George, Miles & Buhr, LLC (GMB), to conduct a preliminary study of stormwater issues in the town. The resulting Denton Stormwater Drainage Management Study documented five "subareas" as opportunities to reduce stormwater volume to mitigate the impacts of flooding in the town. The "subareas" are five projects that have associated infrastructure components and represent stormwater best management practices (BMPs). All practices are located on public land. The study did not address stormwater issues or BMP opportunities on privately owned land. The report did not address the condition of Poor House Run, how these five projects might reduce stormwater to the stream, or the impacts of the five projects on the stream. Finally, it did not address how to alleviate stormwater stress on Poor House Run.

This project broadens the scope of GMB stormwater study to assess the Poor House Run stream and its watershed and provide more best management practice opportunities, a thorough examination of stormwater issues associated with the stream and pipe infrastructure, and constructability analysis for stream restoration.

Identification of Causes and Sources of Impairment

Location and Description: Poor House Run is a non-tidal perennial stream located in the Choptank River (02060005) watershed, specifically the upper Choptank River, and is in the urban center of Denton, Maryland, in Caroline County. Poor House Run has a watershed of 744.5 acres that is heavily developed but still has some forested segments (Figure 2). The majority of the land cover falls into impervious or turf with the next largest category being forest. Most of the turf areas are either residential or vacant lots zoned for commercial use.

There are two main tributaries that meet just west of South 5th Avenue. One stream flows from the northeast, and the other flows from the southeast. The northeast tributary is mostly residential and forested, and the southeast tributary is predominantly commercial and includes the Denton wastewater treatment plant.

Table 2: Poor House Run Watershed Land Cover	
Land Cover	**Area (Acres)**
Impervious, Road	46.9
Impervious, Non-Road	122.1
Impervious with Tree Cover	5.9
Water	13.1
Tidal Wetlands	1.4
Floodplain Wetlands	15.2
Other Wetlands	68.3
Forest	115.9
Trees over Turf	40.8
Mixed Open	11.0
Turf	181.6
Cropland	85.0
Total	**744.5**

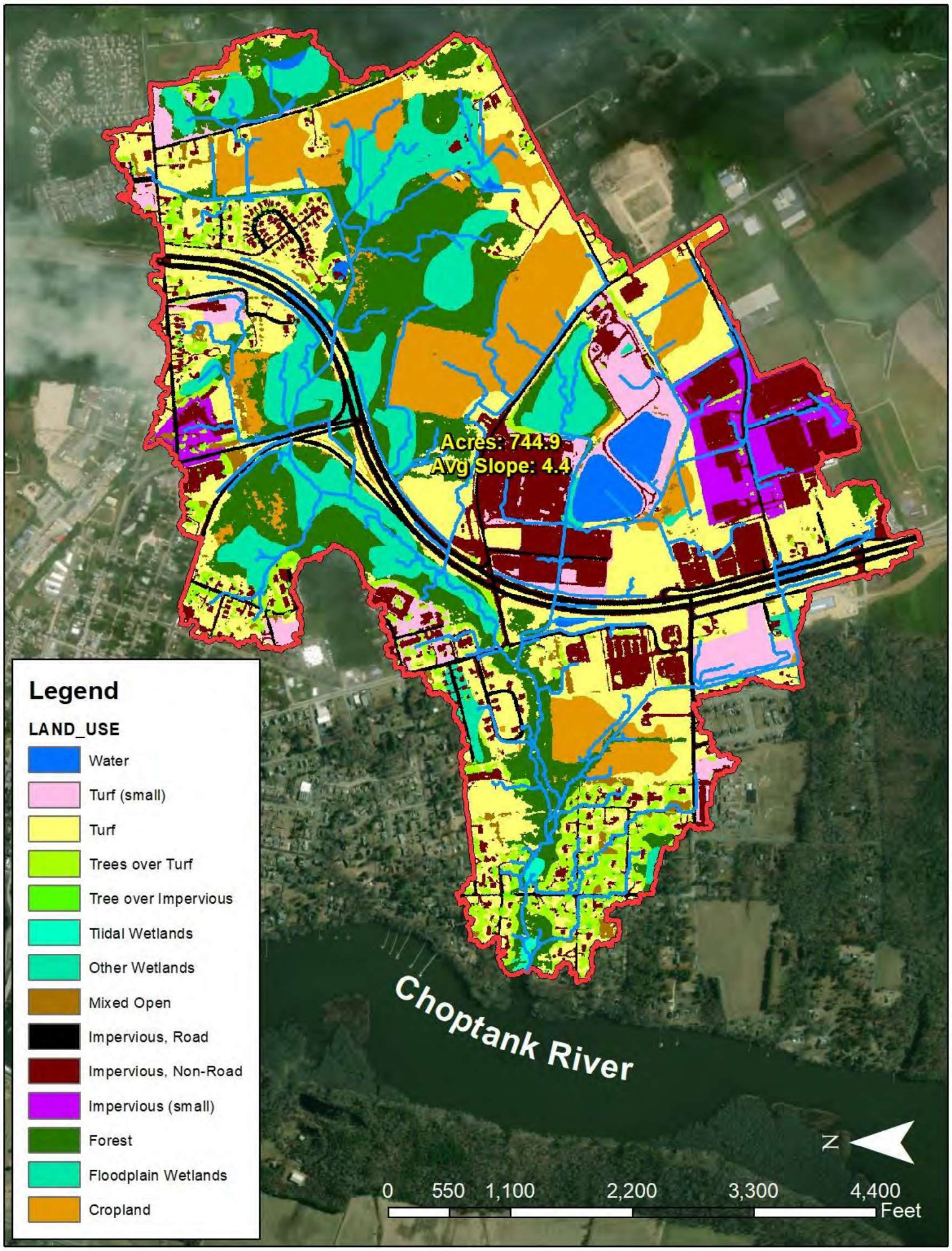

Figure 2. 2014 1-meter land use within the Poor House Run watershed. Land use data set created by Chesapeake Conservancy.

Causes and Sources of Pollution

Nonpoint Source Pollution and Sources: Poor House Run watershed is a primarily developed watershed that has a storm drain network to capture stormwater. This creates a complex situation where nonpoint source pollution can be concentrated into stormwater pipes and mixed with regulated point source discharges. In general, the nonpoint source pollution stems from either residential or urban land practices, including, but not limited to, lawn fertilizer application, road salt application, herbicide and pesticide application, hydrocarbons from road surfaces, detergents, and atmospheric deposition. There are a few agricultural fields that would contribute nutrient and sediment pollution, but the size and extent is minimal when compared to the urban nonpoint source load.

Point Source Pollution and Sources:
In 1972, a component of the Clean Water Act was established to control point source water pollution through a permitting system. Point sources are defined as any conveyance such as a pipe or a man-made ditch that eventually discharges directly into the surface water. Municipal, industrial, and other facilities must obtain a National Pollution Discharge Elimination (NPDES) permit if their discharges go directly to surface waters. Maryland Department of the Environment (MDE) issues NPDES permits in Maryland as a means of limiting the amount of pollution entering surface waters from industrial and municipal facilities. Poor House Run watershed has two NPDES permitted facilities, which are shown in the Table 5 below (EPA, 2017).

Table 5: NPDES Permitted Facilities in the Poor House Run			
Facility Name	**Address**	**Permit Type**	**Permit No.**
Denton WWTP	650 American Legion Rd	Minor, Permit Effective	MD0020494
Town of Denton Water Supply	650 American Legion Rd	Minor, Permit Admin Continued	MDG679417

2.0 Watershed Goal, Strategies and Recommendations

Poor House Run Hydrologic Assessment and Watershed Action Plan identifies specific restoration projects that support Caroline County's Urban WIP goals and provides guidance on stream restoration design for the main stem of Poor House Run.

2.1 Watershed Goal

The goal is to convey stormwater in a fashion that does not negatively impact Poor House Run and reduces the impacts of development on water quality.

2.2 Strategies

1. **Quantify the problem in terms of nutrient loads and stormwater volume.** Identify flow-paths and nutrient sources.
2. **Public-private partnerships.** Leverage the town's resources in collaboration with the skills and expertise from the diverse group of watershed partners.
3. **Implement stormwater retrofit practices wherever space and site conditions permit**. Urban runoff is best treated when stormwater is forced to absorb into the ground.
4. **Incorporate climate change adaptation strategies in project planning and implementation.** Impacts of climate change will affect how restoration practices perform into the future.

2.2 Recommendations

This section describes 8 recommendations for addressing stormwater and nutrient pollution coming from the Poor House Run watershed. Not listed in order of priority, these recommendations are a result of fieldwork findings. Stormwater and other urban retrofits are both beneficial and expensive when implemented individually, so multiple recommendations should be implemented simultaneously in order to effectively restore water quality. Combining these efforts with education and pollution prevention can lead to long-term behavioral change. Targeted outreach to homeowners and businesses can have a beneficial impact while additional funding can be secured for the costlier recommendations.

1. **Stormwater retrofitting demonstration projects**. Use existing stormwater projects, such as the bioretentions located at the Choptank Health facility, to show other watershed businesses/partners how attractive updated stormwater practices can be and to provide context to stormwater projects identified in this plan.
2. **Upgrading failed stormwater facilities and installing stormwater practices where they are lacking.** Many stormwater practices in the Poor House Run watershed are poorly maintained or completely lacking in the older commercial area along Engerman Ave. Improving or maintaining the current stormwater practices will to improve

stormwater quantity and quality. Adding new stormwater practices where they are missing will have dramatic positive impacts.

3. **Stream Restoration of Poor House Run.** There are sections of Poor House Run that are eroding and in poor condition. A stream restoration should be completed at the same time culverts are replaced along 5th Street. The ditch that cuts through the public parks is also down-cutting and eroding, and in need of stabilization. The stream restoration needs to be designed to be able to handle future land use changes while providing ecological uplift.
4. **Participate in local code and ordinance review**s. This would include focusing on erosion controls, rights-of-way, and site designs, that update local ordinances so they are conducive to implementing clean water projects. Also encouraging more street-tree plantings in the right-of-way, and providing stricter regulations for construction sites with bare soils and erosion possibilities.
5. **Implement restoration on public land whenever applicable.** By implementing projects on public land, the government demonstrates to watershed residents a new way of conducting business and managing stormwater runoff. Lead by example.
6. **Plan for increased rainfall amounts and intensity, and regional plant species migration due to changing climate patterns.** By planning for these expected changes, we will be able to implement projects that are more resilient to the effects of climate change. Rainfall is becoming more intense and more frequent, while we are also experiencing longer periods of drought-like conditions. These changes will have an effect on the size of our stormwater practices, as well as the plants that are used in green infrastructure projects.
7. **Monitor stream discharge and nutrient concentrations to track progress.** Conducting an on-going water quality monitoring program will allow us to track the health of Poor House Run. We will test the water for physical degradations, as well as chemical impairments, and test nutrient and bacteria levels from different areas throughout the stream and the surrounding watershed, thus allowing us to identify emerging pollution hot-spots.
8. **Outreach and education of residents on lawn care practices**. Administer a fertilizer outreach campaign with property owners and lawn care professionals. Educate them on the impacts of fertilizers and the alternative practices that are available.

3.0 Watershed Restoration Practices

This section provides an overview of the key recommended practices for restoring Poor House Run. Successful restoration requires collaboration between local, county and state government, watershed partners, businesses, and residents. Local and state governments are able to implement capital projects such as large-scale roadway stormwater retrofits, and change ordinances and municipal operations to encourage continued restoration. Watershed partners, businesses, and residents are encouraged to implement smaller scale projects and programs such as rain garden installations, lawn care education, outreach initiatives, and restoration of streams and wetlands. The variety of practices recommended in this plan are primarily urban stormwater retrofits, and are described in more detail below.

Impervious Surface Reduction – Impervious surfaces are land surfaces that repel rainwater and do not permit it to infiltrate (soak into) the ground. As urban development started occurring within the Cambridge Creek watershed, natural flow paths were paved over for roads, parking lots, and buildings, resulting in a stormwater sewer network that captures and transports runoff to the creek without the benefit of natural filtration through soil and plant roots.

Efforts to remove unnecessary or failing impervious surface areas are being undertaken all around the Chesapeake Bay watershed, and range in capacity from volunteer community groups to local government capital improvement projects. Prime areas for impervious surface removal include unused parking lots, deteriorated walkways, and other areas that can be used for green infrastructure stormwater management projects


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Figure 3. Depave, a non-profit from Seattle, WA, organizes volunteer groups to manually remove impervious surfaces.

Urban Forest Buffer – Forest buffers are used in urban areas where stormwater has the increased potential to travel and transport pollutants as surface runoff. Urban forest buffers refer to areas where collections of trees are planted to help buffer a local waterway from surface runoff, or a location that separates two or more densely paved areas. In general, urban tree canopy (UTC) provides an important stormwater management function, and can be a valuable tool in filtering and absorbing water, which would otherwise add stress to stormwater systems.

In this watershed, it is important to increase forest buffers in the southern portion of the watershed where there are large commercial lots and areas that are grass covered and mowed adjacent to the ditches.

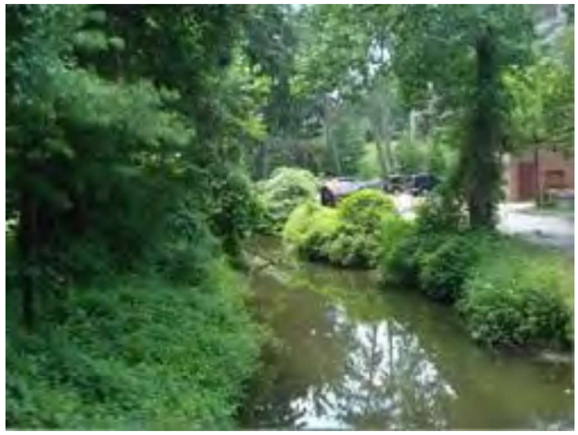

Figure 4. Forest buffer alongside an urban stream in New York.

Urban Tree Planting – Urban tree planting refers to city/town-scape, street tree plantings that are arranged throughout town's roadways and residential and business properties. This practice is different from urban forest buffers in that the plantings aren't necessarily buffering a waterway or large amounts of impervious surfaces. Urban tree plantings are considered the fillers in a town's urban tree canopy. In addition to providing stormwater management benefits, they also reduce the urban heat island effect, decrease heating and cooling costs, lower air temperature, reduce air pollution, increase property values, and provide wildlife benefits. The business park along Engerman Ave. would benefit from street trees.

Figure 5. Street trees along an urban center.

Urban Grass Buffer – Similar to urban forest buffers, grass buffers act as a filter that captures and absorbs runoff. Urban grass buffers include a diverse mixture of warm and cold season grasses that are allowed to grow tall, while their roots grow deep into the soil. Urban grass buffers should be maintained and cut once or twice a season in order to keep out undesired and invasive plants, but the area should not be maintained as often as typical residential lawn.

Figure 6. Urban grass buffer example showing tall grasses buffering a paved area.

New and Retrofitted Bioretentions – Bioretentions are stormwater treatment facilities that capture and temporarily store runoff. Once it enters the BMP area, the water is slowly released and passed through a filter bed of sand, organic matter and soil, often referred to as a bioretention mix. Depending on the design, the filtered runoff may continue to filter into the groundwater, or may be returned to the stormwater conveyance system via an underdrain. The treatment areas are typically planted with native grasses and plants that help to filter out any pollutants, as well as provide aesthetic and habitat benefits to the practice. Native pollinator plants are often used to attract butterflies and other beneficial pollinator species.


Figure 7. Bioretention project at a local church in Easton, MD

Bioswale – A bioswale is a landscape BMP that is designed to remove nutrients and sediment while transporting rainwater. A bioswale typically consists of a soil medium that includes sand, organic matter like compost and soil, native vegetation, sloped banks, and sometimes riprap. Depending on the landscape, bioswales can be meandering or straight, and the amount of time that water stays within the channel is maximized up for 24 hours to allow for sufficient nutrient and sediment removal.

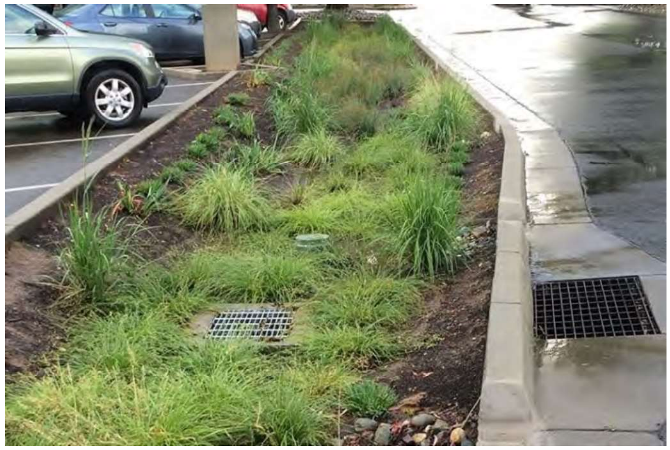

Figure 8. A bioswale on the campus of California State University

Vegetated Open Channels – This practice is similar to a bioswale in that it is used to remove nutrients and sediment as water is transported through a channel. Unlike bioswales, vegetated open channels do not necessarily include the same soil medium that consists of organic matter and sand, but they do include native vegetation and sloped banks, and sometimes riprap as needed. Vegetated open channels are a less expensive alternative retrofit option than a bioswale, and can be very effective given the amount of insufficiently vegetated open channels throughout the Poor House Run watershed.

Figure 9. Example of vegetated open swale in Maryland.

Stream Restoration – Stream restorations can take on many different forms based on stream geometry and local topography. In areas where there are steep banks with steep stream slopes, a practice called regenerative stormwater conveyance (RSC), also known as a coastal plain outfall, or regenerative step pool storm conveyance. A RSC is a series of riffles, pools, and weirs that use surface pools and a subsurface sand seepage filter to reduce storm flows and infiltrate as much water as possible into shallow groundwater. RSCs are designed to safely convey stormwater from concentrated flow points (culvert, stream, or ditch) to a receiving waterbody while mitigating erosion and providing some degree of water quality improvement. They are implemented in steep topographies that are incised and present erosion issues that cannot be addressed using typical stream restoration techniques. Natural channel design is another stream restoration technique that reconfigures the stream to have better connectivity to the floodplain and uses techniques to help stabilize the stream channel using local wood materials or stone. Natural channel design is used when the existing topography allows for an incised channel to be economically reconnected to the floodplain and when the topography is less steep.

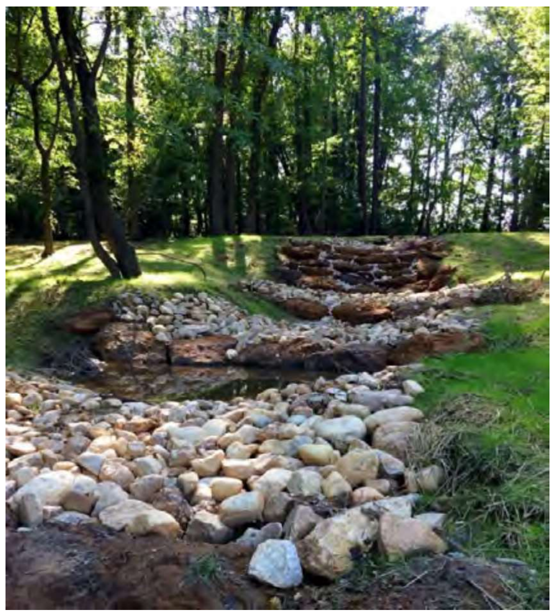

Figure 10. Example of a regenerative stormwater conveyance (RSC) in Wye Mills, Maryland.

4.0 Potential Projects

4.1 Project Identification

Potential project sites were initially identified through geographical information system (GIS) desktop analysis using land use, soils, and topography data. This GIS analysis provides an understanding of surface water flow paths, existing stormwater features, and areas that could fit additional best management practices. Five field visits were conducted to walk the watershed and catalog opportunities for retrofit or BMP implementation. This data was collected using computer tablets and saved, including pictures, on an online database. Once all the field work was completed, the GIS information was combined with the data collected in the field to provide a more complete understanding of project type and feasibility. All the potential projects are identified in Appendix A. Two concept level plans were also created for the stream restoration and a stormwater pond retrofit that is on town property.

4.2 Calculating Load Reductions

Once projects were identified and recorded in each section, the FieldDoc calculator was used to estimate nutrient and sediment load reductions.[1] FieldDoc is a standardized method for project reporting and calculating nutrient and sediment reductions in accordance with the latest version of the Chesapeake Bay Watershed Model. Reductions were determined based on the type of BMP that was being proposed, and the size of the drainage area that the project is treating. Estimated nutrient and sediment reductions for each project can be found in the Appendix B.

4.3 Funding Strategy

To best prepare the Town of Denton and watershed partners for implementing the projects and strategies identified in this plan, Appendix C provides a list of funding sources that have historically supported similar efforts. By identifying the funder, the purpose, the funding limit, and the date of the last RFP for each grant program, partners can plan accordingly.

The Poor House Run Hydrologic Assessment and Watershed Action Plan was designed to provide all of the project information necessary to seek design and implementation funding for the projects identified. Each project page found in the Appendix B includes enough detail to be considered a fact sheet for that specific project. It was designed this way so project partners can simply include the project fact sheet with their grant application and provide general context to take projects to the design phase.

For the design of smaller urban best management projects, it is best to bundle projects to make the projects more desirable to the funding agency. Bundling projects demonstrates that efforts are watershed wide and will provide larger stormwater and water quality improvements than a singular project. Traditional funding sources for design of urban BMPs are National Fish and Wildlife Foundation (NFWF) Small Watershed Grant (SWG) and various Chesapeake Bay Trust (CBT) grant opportunities. Construction for these projects can also occur through the NFWF SWG or NFWF Innovative Nutrient and Sediment Reduction (INSR) grants.

Stream restoration project design can be funded through the CBT Watershed Assistance Grant Program (WAGP) with construction funding through the Maryland Department of Natural Resources Chesapeake and Atlantic Coastal Bays Trust Fund.

[1] To review the FieldDoc user guide please visit: http://www.nfwf.org/chesapeake/Documents/FieldDoc-User-Guide.pdf

5.0 Hydrologic Study

5.1 Stream Hydrology

<u>Catchment analysis</u>
The catchment to Poor House Run and longest flow paths were defined using ArcGIS Pro version 2.9.2 based on 2014 USGS CMGP Lidar data.

The entire catchment area was subdivided into four sub-basins, representing three main inflows to the stream and the area adjacent to the main stream corridor.

Figure 11. Sub-basins within the Poor House Run watershed that were used for the hydrologic analysis

Longest flowpaths were used as a trial time of concentration flowpath, and locations of change of flow type were estimated.

The extents of sub-basins were ground truthed and the DEM and sub-basins were modified as necessary to reflect actual conditions.

Curve numbers were developed for existing and future conditions. Existing conditions were based on Chesapeake Conservancy land cover data from 2013-2014. Future conditions were based on Chesapeake Conservancy land cover data, edited to reflect future land use patterns based on the town comprehensive plan. (Exhibits of land cover showing curve number).

<u>Time of Concentration (TC) Survey</u>
A separate TC flow path survey was performed to accurately establish a TC for each sub catchment.

Flow type was ascertained along with estimated roughness, flow depth, channel geometry and bed slope. Real time kinematic (RTK) survey equipment was used to confirm bed slope where possible. Light detection and ranging (LIDAR) imagery was used where RTK was not possible.

<u>Catchment routing</u>

Catchment routing was as shown below. Any stormwater ponds inside the subcatchments were not included in the analysis because: 1. they didn't appear to be in very good condition and unlikely to be functioning correctly; and 2. their contributory area is minimal in comparison to the entire watershed, and therefore unlikely to greatly impact the results of this analysis. Autodesk Storm and Sanitary analysis v. 13.4.133.0 was used to perform the analysis using SCS TR-55 methodology. The Poor House Run river valley was modeled as a reach, using cross sectional data estimated from LIDAR.

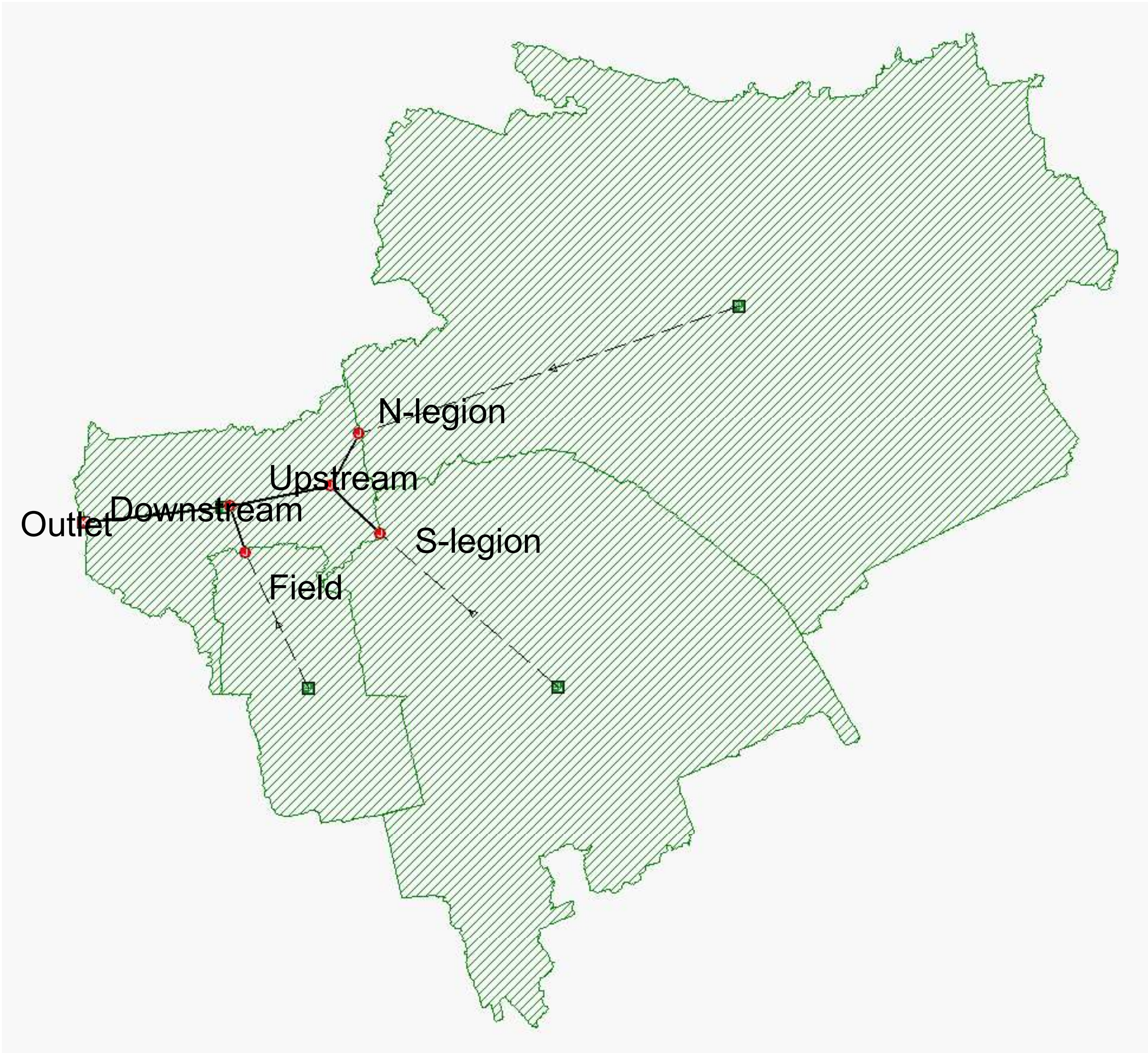

Figure 12. Storm and Sanitary (SSA) routing diagram.

Results

Peak flows are given for the nodes shown in the figure above for both existing and future buildout conditions. Additional SSA reports are available in the Appendix D.

EXISTING LAND COVER						
RETURN PERIOD - YEARS	DOWNSTREAM - CFS	FIELD - CFS	N-LEGION - CFS	S-LEGION - CFS	UPSTREAM - CFS	OUTLET - CFS
2	37	3	20	25	34	38
5	72	8	40	53	67	75
10	104	13	55	77	94	112
25	134	17	71	100	120	147
50	173	23	89	128	152	191
100	215	30	108	158	187	239

FUTURE LAND COVER						
RETURN PERIOD - YEARS	DOWNSTREAM - CFS	FIELD - CFS	N-LEGION - CFS	S-LEGION - CFS	UPSTREAM - CFS	OUTLET - CFS
2	69	10	42	42	64	70
5	117	19	68	78	106	123
10	157	26	89	107	140	168
25	197	32	107	134	172	213
50	243	40	129	166	207	265
100	291	48	151	198	246	320

5.2 Culvert analysis

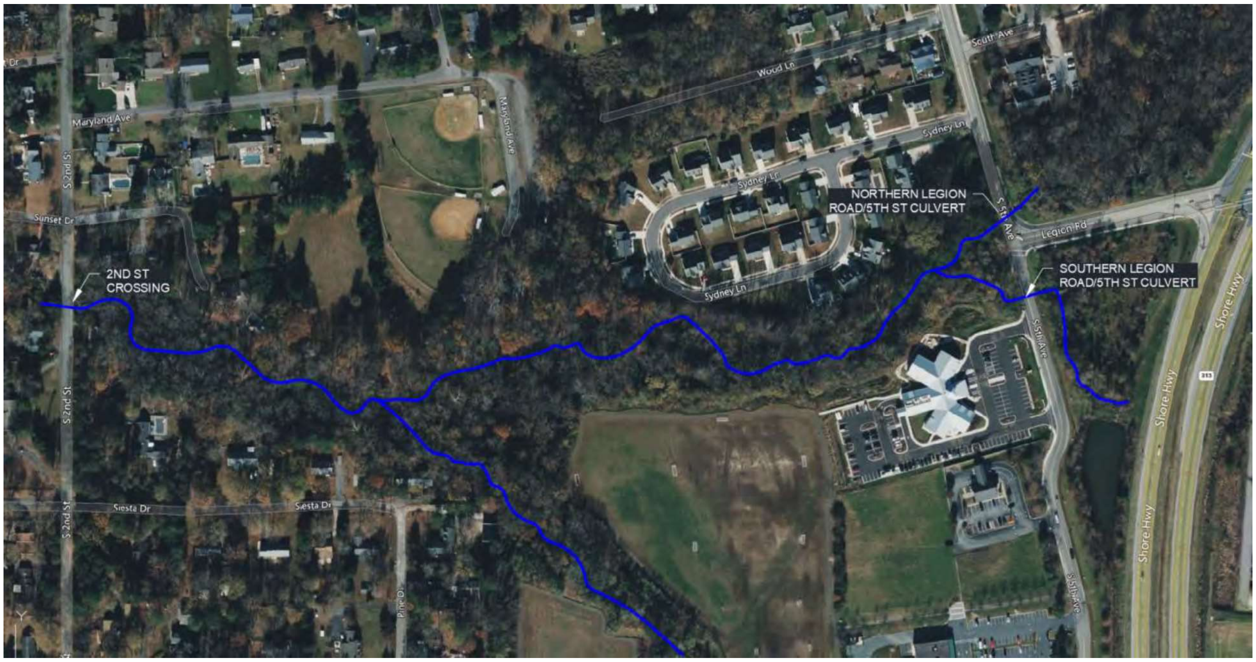

Figure 13. Culvert locations along Poor House Run

<u>Existing conditions survey</u>
RTK and Total Station survey equipment were used to survey existing culvert infrastructure on 5th Street/Legion Road and 2nd Street. Culvert invert elevations and sizes were taken along with roadway elevations and downstream streambed geometry.

<u>Existing and future flow data</u>
Existing and future peak flow data was provided as part of the hydrologic study. See above.

<u>Analysis</u>
Analysis was performed using HY8 version 7.70.1.0 from FHA. All analysis was performed for the 2-, 5-, 10-, 25-, 50- and 100-year return periods.

Existing conditions analysis was performed for all culverts using existing flows and geometries.

Future conditions analysis was performed on the existing southern 5th Street/Legion Road culverts and the existing 2nd Street culverts to check their performance against possible future runoff conditions. Tidal impacts were not considered for the 2nd Street culverts. For the southern Legion Road culvert, downstream bed elevation was assumed to be returned to the bottom of the culvert to approximate future conditions, post stream restoration.

Future conditions analysis was performed on a number of different, common scenarios for the northern 5th Street/Legion Road culvert. Bed elevations were assumed to be coincident with the bottom elevation of the culverts to approximate the restored condition of the stream. It was assumed that a number of utility crossings would constrain vertical clearance for culvert replacement, thus a 24" height option was included in the analysis that would pass the minimum storm.

Note: lowering the culvert elevation to avoid utilities could detrimentally impact any future stream restoration, and should be avoided during culvert replacement.

Required return periods
5th Street is classified as a major collector, and thus future crossing should be designed to convey a minimum of a 25-year storm per 2009 Maryland State Highway Administration Drainage Manual Design Guidelines.

B. Flood Frequency

The flood frequency used to design or review culverts shall be based on:

- The roadway classification,
- The level of risk associated with failure of the crossing, increasing backwater, or redirection of the floodwaters,
- Location of mapped floodplains and
- An economic assessment or analysis to justify the flood frequencies greater or lesser than the minimum flood frequencies listed below.

AASHTO Classification	***Highway Needs Inventory Classification***	***Flood Frequency***
Expressways	***I. Principal Arterials***	***100 year storm***
Arterials	***II Intermediate Arterial***	***50 year storm***
	III Minor Arterials	***50 year storm***
Collectors	***IV Major Collectors***	***25 year storm***
	V Minor Collector	***25 year storm***
Local Roads & Entrances	***VI Local Streets***	***10 year storm***
Ramps		***Higher classification of the intersecting road***

- Regardless of the design flood frequency, culverts requiring a permit for "Construction on Non-Tidal Waters and Floodplains" shall be analyzed using the ultimate discharge for the 100 year storm. The ultimate discharge is that discharge which would occur if the watershed was fully developed in accordance with existing zoning.

Figure 14: Flood frequency used to design roadway culverts

Results

Tables of results are shown below. 2nd street and the South 5th street/Legion road culverts are adequate for existing and future land use. Recommended replacement sizes for North 5th street/Legion Road are highlighted below.

2nd Street analysis

Culvert pipe	Downstream bed elevation	Flow condition	Overtopping flow
Ex Double	Existing elevation at culvert invert	Existing land use	100yr < 428.20 cfs
Ex Double	Existing elevation at culvert invert	Future land use	100yr < 428.20 cfs

South 5th Street/Legion analysis

Culvert pipe	Downstream bed elevation	Flow condition	Overtopping flow
Ex Double 3' dia RCP	Existing elevation below culvert	Existing land use	100yr < 195.24 cfs
Ex Double 3' dia RCP	Culvert invert	Future land use	50yr < 195.24 cfs < 100yr

Northern 5th Street/Legion analysis

Culvert pipe	Downstream bed elevation	Flow condition	Overtopping flow
Existing 24" CMP	Existing elevation below culvert invert	Existing land use	2yr < 27.27 cfs < 5yr
2' x 3' box culvert	Culvert invert	Future land use	5yr < 88.44 cfs < 10yr
2' x 4' box culvert	Culvert invert	Future land use	25yr < 120.94 cfs <50yr
Double 2' dia RCP	Culvert invert	Future land use	5yr < 88.13 cfs <10yr
Double 2.5' dia RCP	Culvert invert	Future land use	50yr < 140.44 cfs < 100 yr
Double 3' dia RCP	Culvert invert	Future land use	100yr < 198.42 cfs

5.3 Stream Restoration Constructability

The constructability analysis for the stream restoration was completed by Resource Restoration Group. Resource Restoration Group visited the site twice to assess construction feasibility, keying on project phasing, utilities, topography, equipment access, staging, stream flow, resource impacts, and design methods. The plan is broken down into four phases based on access and staging of materials. The entire constructability analysis can be found in Appendix E.The main points from the plan were:

1. The stream restoration should be completed at the same time of the culvert replacement at 5th Street because it provides greater accessibility options and reduces traffic issues.
2. The best access to Poor House Run is through the northeast side of the Choptank Community Health complex and Food Lion parking lot, and across the Town Park.
3. The Choptank Community Health complex and the Town Park provide the best staging areas for equipment and materials.

Figure 15. An example from the constructability analysis of access and staging areas near the Choptank Health complex

6.0 Monitoring and Reporting Progress

Monitoring this Action Plan will help the Town of Denton and watershed partners evaluate if the plan is effective at achieving its outcomes, or if modifications to the restoration strategy (inputs, outputs and outcomes) need to be made in order to maximize results. The outcomes used to measure progress include the following:

Completing the construction of roadway and culvert improvements and stream restoration, and implementing stormwater BMPs throughout the watershed.	
Short-term Milestones (<2 years)	1. Complete full design of Phase 1A of the stream restoration and roadway and culvert improvements, and complete partial design of the other phases of the stream restoration. 2. Engage private landowners and secure permission to access the project site. 3. Apply for implementation funding for Phase 1A of the stream restoration and roadway and culvert improvements.
Mid-term Milestones (<5 years)	1. Complete construction of Phase 1A of the stream restoration and roadway and culvert improvements, 2. Securing funding to complete full design of remaining phases of the stream restoration and apply for implementation funds. 3. Secure design funds for a package of stormwater BMPs throughout the watershed.
Long-term Milestones (5 years or longer)	1. Complete construction of the remaining phases of the stream restoration. 2. Secure implementation funding for a package of stormwater BMPs throughout the watershed. 3. Achieve water quality improvements by reducing nitrogen, phosphorus and suspended sediments entering the Choptank River.*

Completing maintenance on existing BMPs and establishing a maintenance plan for major stormwater BMPs throughout the Town of Denton.	
Short-term Milestones (<2 years)	1. Complete necessary maintenance on the stormwater facility on town property adjacent to the town's wastewater treatment facility. 2. Coordinate a team of town employees on developing a maintenance plan for town-owned stormwater BMPs.
Mid-term Milestones (<5 years)	1. Develop and implement a maintenance plan for town-owned stormwater BMPs
Long-term Milestones (5 years or longer)	1. Well maintained stormwater BMPs that achieve maximum nutrient and sediment reductions while adequately storing stormwater in order to reduce peak flow in Poor House Run.

Adopting policies (codes and ordinances) that are protective against increased stormwater flows associated with future land use.	
Short-term Milestones (<2 years)	1. Evaluate existing policies that regulate the volume and treatment of stormwater associated with land use and development. 2. Identify new policies and amendments to existing policies that will better capture and store stormwater.
Mid-term Milestones (<5 years)	1. Adopt and implement policy changes.
Long-term Milestones (5 years or longer)	1. Achieve increased volume and treatment capacity of stormwater from the private and public sectors within the Town of Denton and the Poor House Run watershed.

*The stormwater BMPs identified throughout the watershed have been entered into the FieldDoc tool to estimate nutrient reduction associated with each practice and the sum of all load reductions representations when the Action Plan is completed. FieldDoc will be used to monitor and report progress in meeting the long-term milestone of achieving nutrient and sediment reductions.

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