Little Creek Environmental Action Plan
(LEAP)

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Mission Statement

The Little Creek watershed is home to upwards of 8,000 permanent residents as well as several acres of fresh and saltwater wetlands. It has been estimated that the area of historic wetlands in this and neighboring watersheds has been reduced by as much as 21% in recent years due to coastal development as well as the conversion of these valuable sites to agricultural fields. Furthermore, wetlands in this region have been surveyed and based on field observations gathered, these wetlands received an overall grade of a C+ (Delaware Watersheds, n.d.). This preliminary observation shows that the wetland regimes in the region are not functioning at their full potential which provides LEAP and the population of the Little Creek watershed with the opportunity to become stewards of the Little River and help to improve wetland habitat in the area.

LEAP's mission will be to improve wildlife habitat and water quality in the Little Creek watershed to meet water quality standards (WQS) for primary contact recreational/fishable levels by the year 2025.

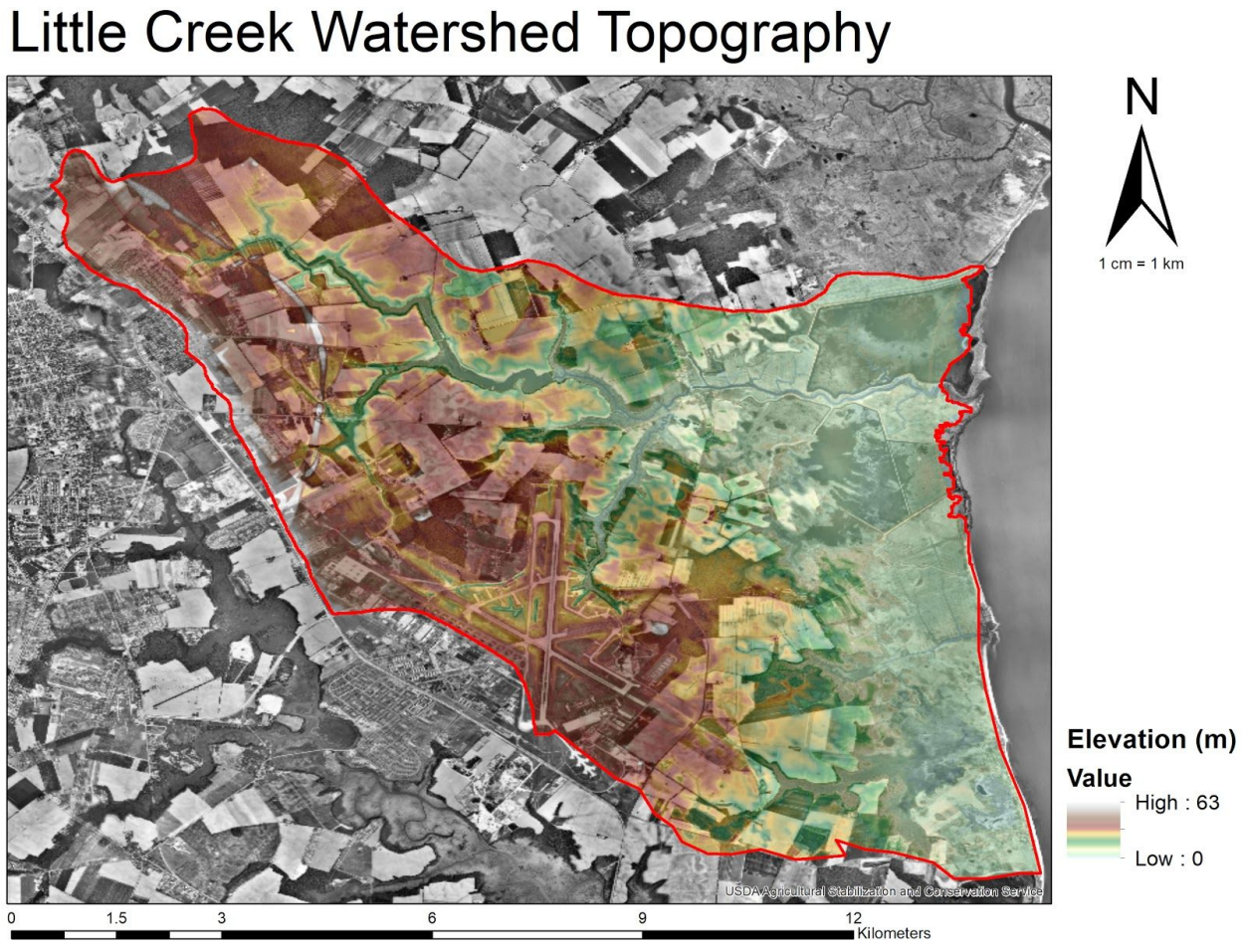

Figure 1: Little Creek Watershed topography and elevation (MASL)

Background

The Little Creek watershed is a small watershed which drains approximately 23 square miles in eastern Kent County directly to the Delaware Bay. The mainstem of Little River is five miles long and flows east through the town of Little Creek. The lower three miles of the Little River mainstem is characterized as saline wetland habitat. In the 23-mile drainage area, the dominant land uses are primarily agricultural, with some urban and forested/wetland regimes. Approximately 43% of the little creek watershed is agricultural while 19% is urban and 32% is characterized as forested or wetland.

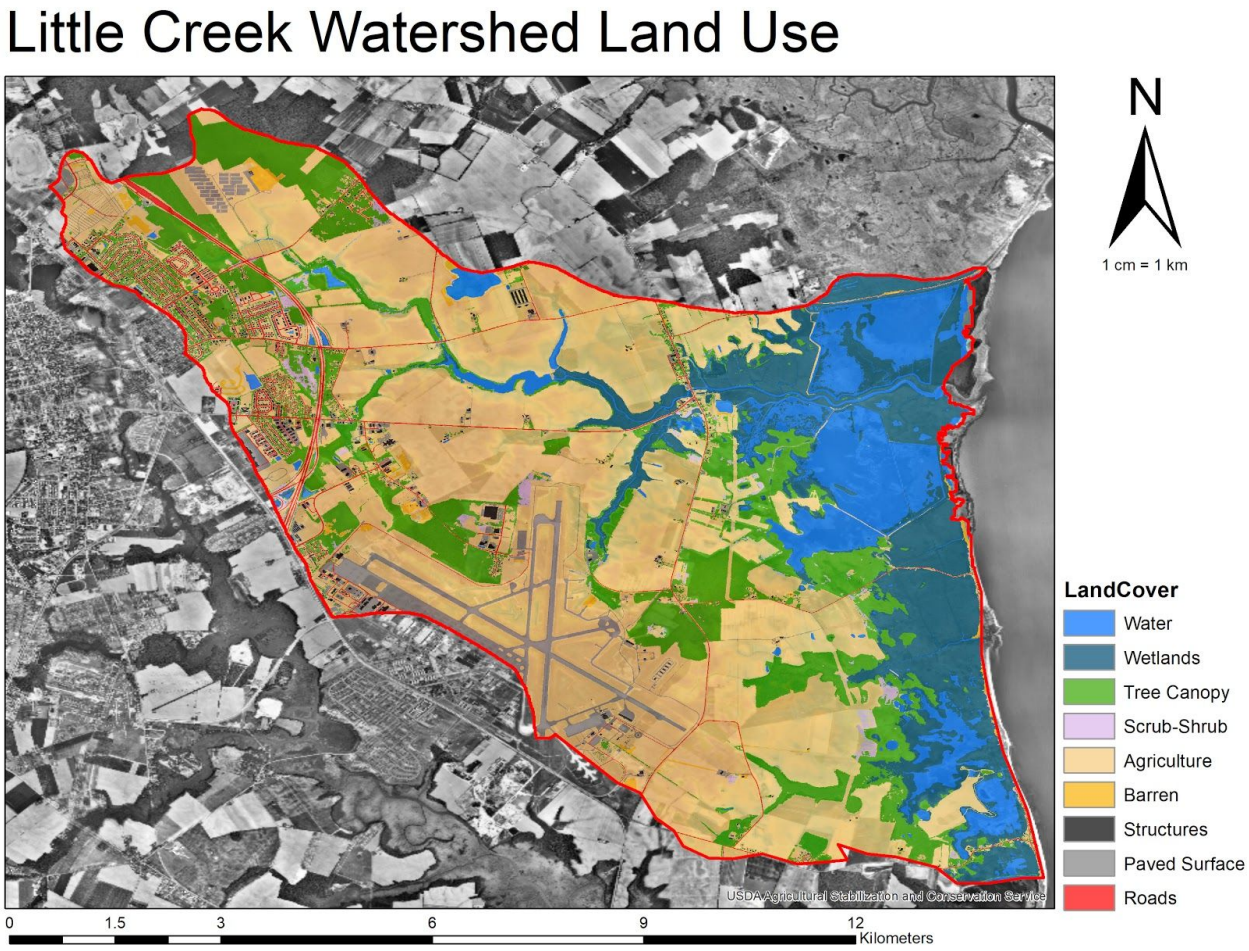

Figure 2: Land Use Designations in the Little Creek Watershed. Data was gathered from The USDA Agricultural Stabilization and Conservation Service, Chesapeake Conservancy and Shippensburg University.

The wetland regimes within the Little Creek watershed themselves have not been abundantly surveyed, however an abundance of wetlands surveyed in the Leipsic River watershed immediately to the north are reported to be impaired with overall grades of a C+. The most common threats to the health of these wetland environments is believed to be forest harvesting, invasive plant species, excavation, filling ditching, and the development of agriculture in and around these wetland habitats.

According to the TMDLs established for the Little Creek Watershed, 40% reductions in phosphorus and nitrogen must be met, as well as 75% reductions in bacterial loads (LC Comprehensive Plan, 2016). There are several designated uses for segments of the Little Creek watershed. These include primary and secondary recreation, fishing, aquatic and wildlife habitat as well as industrial water supply and agricultural water supply in upstream lengths of the mainstem (freshwater).

The Little Creek Watershed has two contaminant sites currently under investigation or currently being remediated. These include the Dover Air Force Base with a hazard ranking score of 35.89 and the Wildcat Landfill, located along the watershed's southern border with a hazard ranking score of 30.61. Both sites pose risks of releasing potentially hazardous waste substances into the surrounding environment with substantial risk to ground and surface waters. The substances of concern have been broadly classified as volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls, and metals.

The Little Creek watershed is home to a five mile stretch of stream, accessible to fishing and boating. Many people rely on the recreational opportunities provided by the Little Creek and are believed to have a stake in the wellbeing and health of the watershed. As well as basic access to fishing in the channel, there are two state-owned areas which provide the Little Creek population of 8,269 with access to water-based recreational activities. These include the Little Creek Wildlife Area and the Port Mahon boat ramp.

History

The Town of Little Creek was established as a commercial shipping hub for the city of Dover and was very productive in the 1800's with a thriving oyster and canning industry. The success of the oyster industry in Little Creek began to fade by the start of the 20th century, leaving few economic opportunities in the town (History of Little Creek, n.d.).

The entire little creek watershed is underlain by structureless/finely laminated organic rich silty clays. To the east of the little creek watershed these deposits are largely marsh deposits, high in organics with a dark grey-black color and silty texture. Inland to the west of the little creek

watershed lies the Scotts Corners formation which is described as a heterogenous, light grey-brown gravelly sand rich deposit. The soils which developed over these deposits consist predominantly of silt loams including the: Broadkill-Appoquimink complex; Transquaking and Mispillion Soils; Carmichael Loam; Hurlock Sandy Loam and Kentuck Mucky Silt Loam. Historically these soils have been generated by a process of tidal inundation by means of sea level rise, and the conversion of forested regimes to shrublands and marshes as the ocean inundated inland regimes. This naturally occurring cycle of gradation has led to the development of the many rich soils prevalent to the region. This natural process appears to be no longer taking place as modern levels of sea level rise occur too quickly for this natural soil progression to continue.

Policies and Mandates in Place

The Little Creek watershed is within the Delaware River Basin and abides by all policies and mandates adopted and imposed by the Delaware River Basin Commission (DRBC). Section 1.5.1 of the Water Code for the Delaware River Basin, which quotes the Delaware River Basin Compact, states that "The commission shall develop and effectuate plans, policies and projects relating to the water resources of the basin". The Water Code details numerous policies on water, watersheds, surrounding environments, and the safety of the public within the basin. For more information or details, see the Delaware River Basin Compact and Water Code for the Delaware River Basin.

The Little River flows through multiple jurisdictions from Dover, through the Town of Little Creek, through the Little Creek Wildlife Area and into the Delaware Bay. With the watershed comprising the outskirts of Delaware's capital city, a wildlife protection area, and the small Town of Little Creek, the opinions and actions ultimately taken affect several different stakeholders. With help from the University of Delaware's Sustainable Coastal Communities Initiative and several partners, including Mayor Glenn Gauvry, the Little Creek Town Council, the Delaware Department of Transportation (DelDOT) and the Delaware Department of Natural Resources and Environmental Control (DNREC), the "Town of Little Creek Working Waterfronts Initiative" was finalized in 2015 to preserve the maritime community of Little Creek, while protecting the watershed it is located within.

The Working Waterfronts Initiative (WWI) has several goals for the waterfront communities it develops strategies for. These include assessing the prevailing socio-economic conditions of Delaware's working waterfronts, analyzing the impacts of the prevailing environmental conditions on the socio-economic structure of the study sites, identifying business infrastructure needs, and developing a set of guidelines and/or recommendations for establishing viable waterfront communities. This initiative polls people in the Little Creek community to learn what

they believe should be done in the area and combines that with data collected to make conclusions about what should, or should not, be done for the community and surrounding areas. This project concluded that the residents of the town want to revitalize the waterfront and the watershed to reconnect to the small town, maritime heritage, and rural nature the town was built around. Little Creek hopes to "Restore and maintain the river so that it becomes usable to town residents," per the town's comprehensive plan that was adopted in 2016.

Having these goals clearly defined in the WWI for Little Creek, it can now be compared to the "Little River Watershed Proposed TMDLs," finalized in August 2006. This was completed while abiding by the Federal Clean Water Act, enforced by DNREC. DNREC contracted an outside modeling firm to analyze the water from Little Creek and create models to determine the TMDLs. Also, the "State of Delaware Surface Water Quality Standards (Amended July 11th, 2004)" details water quality standards (WQS) for multiple nutrients. The following shows what nutrient levels are to be met according to DNREC:

Table 1: Freshwater and Marine Water Water Quality Standards for Little Creek Specified by DNREC

Nutrient	**WQS - Freshwater**	**WQS - Marine Waters**
Dissolved Oxygen (DO)	Daily average of not less than 5.5 mg/L (minimum of 4 mg/L)	Daily average of not less than 5 mg/L (minimum of 4 mg/L)
Enterococcus - Single Sample Value (cannot be exceeded)	185 colonies/100mL (col/100mL)	104 col/100mL
Enterococcus - Monthly Geometric Mean	100 col/100mL	35 col/100mL
Total Nitrogen (TN)	3.0 mg/L	3.0 mg/L
Total Phosphorus (TP)	0.2 mg/L	0.2 mg/L

Governance Structure to Implement

The Little Creek watershed has the umbrella governing structure of the Delaware River Basin Commission, which governs watersheds in New York, New Jersey, Pennsylvania and Delaware. However, with this large governing organization, there is no true smaller organization that can directly govern the Little Creek watershed. The Leipsic River watershed is located just north of

the Little creek watershed, and there are several sources that include the Little Creek watershed in the Leipsic watershed plans. The WWI is present, as well as the TMDL guidelines set forth by DNREC that govern certain standards that must be followed. Therefore, with all of this in mind, there should be a governance structure whose sole responsibility is the Little Creek watershed.

The new governance structure that would be set in place would consist of members that know the area well, such as residents of the town of Little Creek or residents who fall within the watershed boundary and in the Eastern part of Dover. These members will oversee policy in the Little Creek watershed, the water quality standards that need to be met, and ensure no pollutants impact the river itself or the areas that flow into the creek. Through this, the structure will also have one member assigned either by or to it that is part of the National Wildlife Refuge that will ensure not only preservation of Little Creek, but also ensure that the Little Creek Wildlife Area is being protected by this commission. The members here will mandate local businesses and residents to ensure safe water conditions for the conditions that want to be met, whether it be drinkable, swimmable, or fishable water quality standards. One member of the committee would be responsible, as a liaison, to report to and from the Delaware River Basin Commission about actions that need to take place in this watershed or to report any abnormalities that occur. With this new structure, the health of the watershed, the community, and Little Creek will be prioritized and governed with an appropriate system.

Problems and Goals

Table 2: A Summary of the Little Creek Watershed's Three Major Challenges.

Problem	**Description**	**Causes**
P1. Wetland sedimentation and habitat degradation	At the mouth of the Little Creek Watershed, high value saline wetland is being degraded due to increased sedimentation	Extensive upstream agricultural operations and one dam are contributing to accelerated rates of erosion and deposition and reducing flow rates necessary to flush out the tidal wetland
P2. Nutrient loading concentrations and abundant bacterial runoff	A 40% reduction in Phosphorus and Nitrogen levels and a 75% reduction in enterococcus bacteria is required in order to meet proposed TMDL requirements to meet criteria for a "primary contact recreational" river	Lack of adequate BMP implementation paired with upstream agricultural runoff has led to elevated levels of Nitrogen and Phosphorus; highly developed urban areas, moderate levels of impervious surfaces such as that from portions of the Dover Downs

		and the Delaware Airforce Base, stormwater runoff and some agricultural feedlots
P3. Public safety, economic welfare, and impacts of sea level rise	Developed portions of the lower Little Creek watershed are prone to frequent nuisance flooding and water based structural damage to property; Mitigating the systems risk to the public will be a priority	Inadequate infrastructure and outdated/poorly designed stormwater management techniques have left developed areas exposed to nuisance flooding

Problem 1: Wetland Sedimentation and Habitat Degradation

Crucial wetland habitat is being slowly degraded downstream of the Little River dam. This is attributed to increased levels of sediment runoff from agricultural operations upstream, increased rates of stream bank erosion, and leakage from back-filled accumulation space behind the dam. By carefully dredging the unconsolidated loose material from behind the dam and gradually returning the flow regime back to precedent conditions, wetland habitat degradation may be slowed. With a lower stream level, unstable stream banks will need to be stabilized to prevent further mass erosion. We propose grading the stream banks and artificially extending the existing wetland up the little creek watershed in order to prevent bank erosion as well as generate valuable wetland habitat.

Delaware's coastal wetlands are recognized for significant ecological and habitat value at a global scale, including by the Nature Conservancy and the National Audubon Society. Relevant designations given to the Delaware Bay area include Migratory Shorebird Site of Hemispheric Importance, Wetland of International Significance, and Important Bird Area of Global Significance (Delaware Bayshore, 2020). Over 400 species of birds and other wildlife, including horseshoe crab, osprey, and bald eagle reside in this area and rely on the health of the wetland. Disturbance in this habitat has allowed for invasive *Phragmites australis* to colonize and become a significant threat to biodiversity.

Goal 1: Improve Habitat Quality and Decrease Erosion and Sedimentation

Removal or partial deconstruction of the dam and dredging of the stored sediment is a priority for improving the condition and natural functioning of the wetland. The dredged material may be used to generate soil amendments to offset costs throughout LEAP, or used for restoration projects in the Little Creek Wildlife Area. Mitigating flow velocity by beveling upstream exposed banks and establishing in channel stormwater wetland best management practices will

improve the wetland habitat and function for the well-being of wildlife and for the many uses of watershed residents and visitors. In addition, it is important that invasive vegetation, including expansive stands of *Phragmites australis*, be combated by mechanical pulling, herbicidal control, and prescribed burn and flood methods in order to restore biodiversity (NRCS, n.d.). This will require a long-term invasive management plan. Additional outcomes of this goal outside of habitat quality improvement may include enhanced recreational, educational, and economic opportunities (birding, wildlife viewing and photography, coastal education programs, fishing and crabbing, hiking and cycling, paddling and boating).

Problem 2: Nutrient Loading and Abundant Bacterial Runoff

In the Little Creek watershed, 2.9 miles of the lower Little River has been impaired by low dissolved oxygen (DO) levels and nutrient pollution from nonpoint sources (NPS), as well as 5.5 miles of the upper Little River and 2.1 miles of the Pipe Elm Branch. DO levels are less than the state minimum Water Quality Standard (WQS) (4 mg/L) and the Little Creek watershed is also exhibiting elevated levels of chlorophyll-a. These low levels of DO could be due to the breakdown of organic material in wetland/marsh regimes in the watershed. Due to the system's elevated levels of nitrogen and phosphorus, it is also likely that algal growth/respiration could be depleting DO in the Little River.

Enterococcus bacteria is currently impairing all sections of the Little Creek watershed. It has been designated as an impairment for the same 2.9 miles of the lower Little River, 5.5 miles of the upper Little River and 2.1 miles of the Pipe Elm Branch. The source of observed bacterial pollution is believed to be from agricultural and urban nonpoint sources.

Goal 2: Improve Water Quality and Reduce Enterococcus Bacteria

Methods for improving water quality will focus on the implementation of BMPs to enhance infiltration of runoff and meet TDMLs of 40% reduction for N and P and 75% reduction for enterococcus bacteria (Delaware Watersheds, n.d.). Reducing N and P inputs by agriculture and residential lawn application in the watershed via public outreach and extension will slow algal growth and decomposition, allowing DO levels to increase. Establishing riparian buffers along current stream-adjacent agricultural fields, as well as the newly developed stream corridor (upstream of dam) will mitigate Nitrogen-N runoff. Stormwater wetland development upstream of the (proposed) removed dam may remove in-stream bacterial loadings by up to 90%. In addition, updates to residential sewage and stormwater runoff systems may be implemented, including the removal of septic systems. Implementing additional green infrastructure BMPs adjacent to impervious surfaces will reduce pollutant loads and increase habitat value. Options include bioswales, bioretention/rain gardens, and detached downspout with rain barrels. Outcomes of reaching this goal include meeting the primary contact recreation designation for

the Little River, which would safely allow boating, fishing, and paddling/kayaking activities. Associated benefits with implementing green nonpoint source pollution control strategies include habitat creation, community greening and public health benefits.

Problem 3: Public Safety, Economic Welfare and Impacts of Sea Level Rise

Those residing within the Little Creek watershed, especially in the town of Little Creek where average elevation is 5-15 feet above sea level, experience risk associated with flooding. Current drainage systems in town were implemented in 1966 and are in poor condition, preventing proper drainage and allowing water to pool along the main corridor (Route 9) and in town every day with high tide. Nuisance flooding becomes worse during special tide events, with further flooding during large storm events. All current flooding will be exacerbated by sea level rise, which is projected to pose serious impacts to infrastructure (including Route 9, the main corridor along the Delaware Bayshore Byway) and buildings, expanding inundated areas an estimated 17-40% by the year 2100 (LC Comprehensive Plan, 2016). The position of the dam restricting water flow to the wetlands has prevented the sediment from being carried far enough downstream to the Delaware Bay, increasing siltation and allowing the water to flow over the banks. Since the town of Little Creek is small (estimates ~230 people), the cost and resources for maintenance or management of these systems is a concern. FEMA insurance rates for homeowners in this susceptible area are a significant burden and are likely to increase with sea level rise and continued encroachment of flooded areas. Intrusion of saltwater into groundwater wells is another concern for residents. With financial burdens and flooding issues, it is becoming less likely for businesses to invest into this area, which reduces the economic viability of the town.

Little Creek has been designated a ‘discovery zone’ as part of the Delaware Bayshore Byway, a program that preserves scenic and natural qualities along over 100 miles of Delaware’s coastal roadways. A discovery zone is a node where travelers may stop for recreational activities or other amenities (Delaware Bayshore, 2020). If access for recreation at the public boat ramp and the Little Creek Wildlife Area are impaired, ecotourism and stopovers along the scenic byway are reduced.

Goal 3: Reduce Flood Risk and Increase Economic Viability

Flood management tactics including updates and improvements to stormwater infrastructure and implementation of coastal protection and green infrastructure to reduce risk to residents and visitors. If stormwater infrastructure is not replaced, it will require removing blockages and maintaining clear flows. Green infrastructure will reduce flooding and restrict pollutant loads in the headwaters of this small watershed. The protection of groundwater quality for drinking will

be prioritized by implementing a source water protection ordinance, requiring impervious surface mitigation plans for all new developments in the watershed. Associated benefits include promoting nature-based tourism with all above strategies to benefit the small coastal town economy. Outcomes may include reducing FEMA insurance rates and impacts to infrastructure, and improving the quality of life by increasing the quality of recreation and attracting local businesses to invest in the town.

Summary of Outcomes & Conclusions

Table 3: Summarized Goals and Actionable Strategies Recommended by LEAP.

Goal	Recommended Strategy	Outcome
G1. Improve Habitat Quality and Decrease Erosion and Sedimentation	• Dredging, removal, and repurposing of accumulated sediment • Upstream dam removal • Control of invasive species	• Improves ecosystem health • Increases biodiversity • Provides recreational, educational, and economic opportunities
G2. Improve Water Quality and Reduce Enterococcus Bacteria	• BMP implementation along stream-adjacent agricultural property • Stormwater BMP implementation adjacent to impervious surfaces watershed-wide	• Allows water to infiltrate • Reduces nonpoint sources of pollution
G3. Reduce Flood Risk and Increase Economic Viability	• Update and maintain stormwater infrastructure • Implement a long-term plan for stormwater infrastructure maintenance • Implementing a source water protection ordinance	• Reduce risks associated with nuisance flooding • Improve groundwater recharge • Reduce FEMA insurance rates and impacts to infrastructure

The Little Creek Environmental Action Plan is an applicable plan to solve the main challenges that face the Little Creek watershed. The team identified three problems which are wetland sedimentation and habitat degradation, nutrient loading and abundant bacterial runoff, and public safety, economic welfare and impacts of sea-level rise. Then the team indicated three measurable goals in order to resolve these issues and come with recommended strategies to achieve these goals. However, the collaboration of all stakeholders especially state agencies and residents is needed to execute this plan and acquire all the possible positive outcomes.

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