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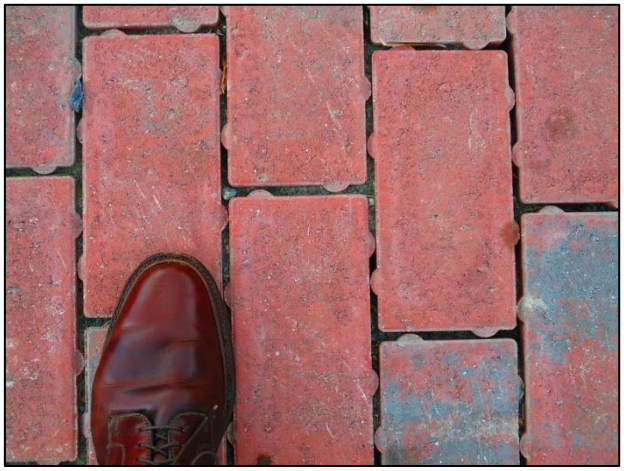

STRENGTHENING STORMWATER MANAGEMENT IN CAMBRIDGE, MARYLAND

PREPARED BY THE UNIVERSITY OF MARYLAND ENVIRONMENTAL FINANCE CENTER

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Executive Summary

Overview
In early 2019, the Environmental Finance Center at the University of Maryland (EFC) began an 18-month project to provide technical assistance to the City of Cambridge and non-profit partners on improving stormwater management efforts in the City.

This report is meant to complement a set of projects led by the Chesapeake Bay Foundation, ShoreRivers, and the Nanticoke Watershed Alliance that have focused on residential stormwater improvements in the City of Cambridge by looking at opportunities to strengthen municipal stormwater programming and work in tandem with other sectors to reduce overall stormwater flooding and pollution issues in the City. It builds on years of work and progress led by community members and local organizations.

Approach
Information was gathered for this study primarily through a series of meetings and interviews conducted in person and/or over the phone with City staff and partner organizations. Desktop review of relevant local plans, maps, and data also took place, as well as geospatial analysis work. Information on problematic flooding spots was gathered from community members at workshops and events during 2019 and early 2020. An initial memo as well as drafts of the final report were shared with the City and partners to gather their feedback.

In addition, the Project Team's work in Cambridge was informed by material and experience gathered by the EFC over the past several years from communities in Virginia, Maryland, North Carolina, Delaware, and Pennsylvania, as well as the District of Columbia, who have taken steps to change how they approach stormwater management, including the creation of stormwater utilities to generate sustained revenue for their programs and projects.

Findings and Recommendations
The Environmental Finance Center (EFC) at the University of Maryland developed near term, intermediate, and long-term recommendations for enhancing Cambridge's stormwater management program. The goal was to develop recommendations for the City that are meaningful, effective, and feasible and that build on the program's existing strengths and best practices.

The challenges of managing aging infrastructure alongside the City's other pressing issues have been a recurring theme in the discussions around the City's current stormwater management needs, existing activities, and investments. This is not an uncommon problem, since many communities nationwide have historically under-invested in proactive maintenance and replacement activities and are now feeling those impacts as infrastructure reaches the end of its lifespan. Many towns also struggle with raising sufficient funds to pay for these activities due to various political and demographic factors. The central role that well-functioning stormwater infrastructure plays in a community generally goes unnoticed (particularly by political leaders) until the problems become large, urgent, and more expensive to correct. Increasing precipitation and sea level rise add another level of complexity to resolving these issues, especially in Cambridge.

Communities with effective and comprehensive stormwater management programs often phase in new program components over time, starting with existing resources and ramping up investment as the community starts to understand the value and benefits of a robust stormwater management program

and demands a higher level of service. With this in mind, these findings are grouped as near term, intermediate term, and long-term opportunities. These opportunities are designed to help the City further streamline the integration of stormwater management and green infrastructure into existing operations. Examples of how other jurisdictions with a similar community profile have overcome obstacles to investing in stormwater maintenance and improvement, and how these investments have yielded additional benefits to the community, will be highlighted as they may help inspire municipal leaders to begin prioritizing these issues. A conscientious, proactive approach to managing stormwater—like many other types of infrastructure—saves money over the long run. Likewise, applying a holistic lens that incorporates other objectives like affordable housing, jobs, and revitalization to tackling the City's water-related challenges will only open up more opportunities to implement creative, multi-benefit projects in the future.

These recommendations, detailed in Chapter 3, should help the City build on its existing strengths and help them work more closely with partners to achieve shared goals and leverage resources together.

Recommendation	**Short-term**	**Intermediate-term**	**Long-term**
Prioritize maintenance, monitoring, and enforcement	X		
Proactive purchasing	X		
Take a Dig Once approach	X		
Take advantage of grants and partnerships	X		
Community outreach and engagement	X		
Develop an asset management program		X	
Leverage/collaborate with housing-related efforts		X	
Document economic impacts of stormwater and other flooding problems on the community		X	
Review ordinances and codes		X	
Strengthen collaboration with the Planning and Zoning division			X
Develop additional incentives			X
Create a mechanism to collect dedicated revenue for stormwater programs			X

Table 1. Recommendations for strengthening Cambridge's stormwater management program (listed by timing of opportunity, not by priority or potential impact)

Chapter 1: Introduction and Background

What is Stormwater?

Stormwater runoff is defined as, "precipitation from rain and snowmelt events that flows over land or impervious surfaces and does not percolate into the ground. As the runoff flows over the land or impervious surfaces (paved streets, parking lots, and building rooftops), it accumulates debris, chemicals, sediment or other pollutants that could adversely affect water quality if the runoff is discharged untreated."[1] Typically, this runoff is collected into storage ponds and/or channeled directly into the nearest body of water with no treatment to remove pollutants, unlike sewer systems that collect wastewater from homes and businesses for careful treatment prior to discharge.

Stormwater runoff is problematic in a few ways: it can cause flooding or excessive standing water; it alters the timing and velocity of natural stream flows; and it captures pollutants like nutrients, sediment, chemicals, and trash and deposits these in water bodies. In addition to the property damage and public health impacts associated with stormwater flooding and poor drainage, stormwater systems usually concentrate runoff into straight channels, further increasing the speed and volume of water reaching nearby streams. These excessive forces lead to streambank erosion, scouring, sedimentation, and often, warmer water temperatures, all of which adversely impact aquatic ecosystems.

Urban and suburban development has magnified the impact of stormwater runoff. The increase in acreage covered by impervious surfaces including roads, parking lots, houses, swimming pools, buildings, compacted soil (including many lawns), and sidewalks has changed the land's ability to naturally absorb stormwater. Until recent stormwater legislation was passed requiring stormwater best management practices (BMPs), developers built simple stormwater management systems, generally underground, to quickly convey runoff from rooftops, parking lots, driveways, and other surfaces in order to protect property and public safety. This combination of increased impervious land cover and inadequate stormwater treatment has contributed to impaired waterways and degraded aquatic habitat in urban and suburban areas. For these reasons, many jurisdictions have strengthened regulations to better handle stormwater runoff, and many new and improved BMPs have been developed in recent decades.

Why Stormwater is a Concern in Cambridge

Growth and development

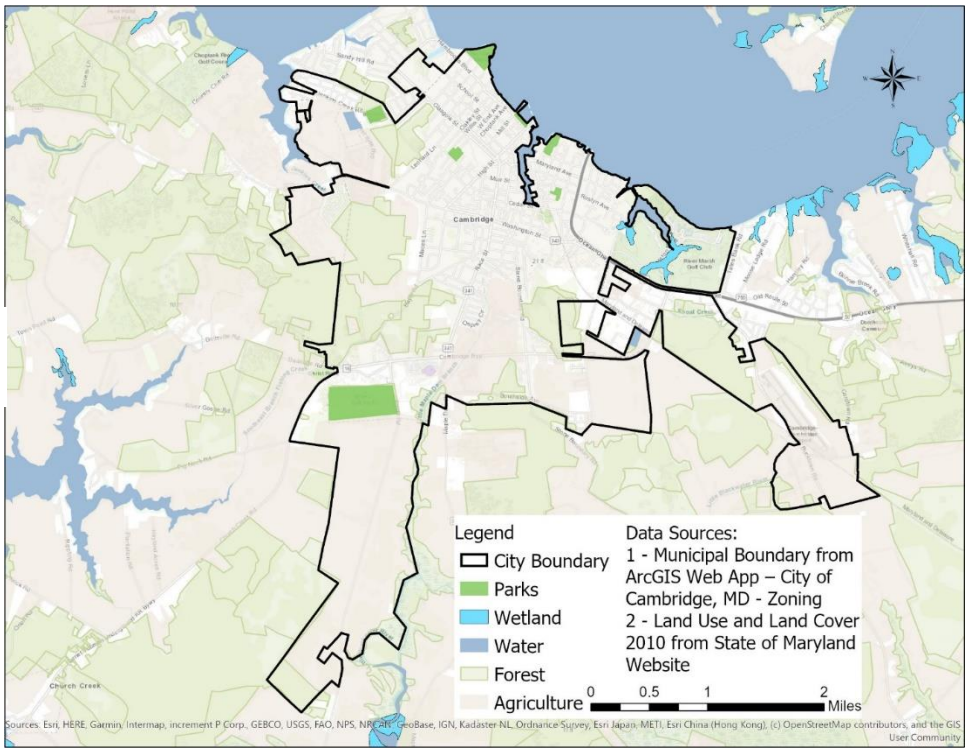
The City of Cambridge lies on the Choptank River at the northern edge of Dorchester County, Maryland. This area was and is inhabited by Nause-Waiwash and Nanticoke tribes, and English colonists established Cambridge as a settlement in 1684. In the 19th and early 20th centuries it was an important regional center for seafood and agriculture processing and distribution. While no buildings remain from the era before English settlement, the City does have a Historic District listed in the National Register of Historic Places, as well as other sites of cultural and historical importance. Cambridge "boasts resources from its maritime and agricultural past, but also claims a vibrant African- American community, with one of the oldest continuously-occupied African-American neighborhoods in the Nation."[2]

[1] U.S. Environmental Protection Agency. *NPDES Stormwater Program.* https://www.epa.gov/npdes/npdes-stormwater-program

[2] City of Cambridge. (2011). *City of Cambridge Comprehensive Plan.* https://www.choosecambridge.com/DocumentCenter/View/1530

The City's seafood and maritime industries declined considerably in the 1960s, causing economic hardship and corresponding population loss. Cambridge's 2019 population was estimated at 12,260, up from a decades-long decline that hit 10,834 in 2003. As of 2019, median income remained below national levels and the percentage of persons living in poverty was 23.5%, much higher than the national average of 11.8% and Maryland's average of 9.0%.[3] Cambridge has a higher than average proportion of renter-occupied housing, which is an important consideration when assessing how the City can approach the issue of stormwater runoff. Also, the City expects population growth over the next decade, which will present both opportunities and challenges for providing a sufficient level of municipal services like stormwater control to residents and businesses. Although the Comprehensive Plan notes that existing "water and sewer facilities are sufficient to serve the forecast growth in Cambridge," the plan does not account for how stormwater control and treatment needs may change due to projected growth.

Certain characteristics of Cambridge's location naturally contribute to water-related challenges in the City, which are then exacerbated by changing conditions like sea level rise, increasing precipitation, and growth and development. "A combination of high water tables, soils that do not drain well, low elevations, subsidence and sea level rise creates a situation where rainwater and tides heavily influenced the landscape. Rain events during high tides and strong southerly winds lead to substantial flooding throughout parts of Cambridge." The fact that drainage and flooding issues are common—even natural—in this geography and are worsening due to climate change makes managing stormwater runoff even more important for improving water quality and residents' quality of life.



Map 1. Land use in Cambridge

[3] U.S. Census Bureau. (2019). QuickFacts: Cambridge city, Maryland. Retrieved from https://www.census.gov/quickfacts/fact/table/cambridgecitymaryland,US/PST045219

Water quality

The main water bodies influenced by the City of Cambridge are Cambridge Creek, located wholly within the City, and the Lower Choptank River. The City also impacts the Fishing Bay watershed, which is part of the Nanticoke River drainage, and the Little Choptank watershed. The types of pollution present in these streams and rivers include nutrients, bacteria, sediment, toxics, and metals. All of these water bodies are part of the larger Chesapeake Bay watershed, which faces many water quality challenges. The Bay's health declined during the 20th century due to excess nutrient runoff causing algal blooms and low oxygen levels, killing aquatic life. To restore the Chesapeake Bay ecosystem, the U.S. Environmental Protection Agency (EPA) determined the maximum amount of pollution that the Bay could receive while continuing to meet water quality standards, known as a Total Maximum Daily Load (TMDL). The Bay TMDL, set in 2010, establishes limits for nitrogen, phosphorus, and sediment; these pollution limits are divided among the six Bay states and the District of Columbia. States develop Watershed Implementation Plans (WIPs) detailing the necessary pollutant load reductions for different sectors, and most counties then develop their own WIPs to "identify local goals and objectives to achieve reductions in nutrient loadings to the Chesapeake Bay."[4]

Dorchester County submitted a draft WIP to the Maryland Department of Environment in 2012 that outlines the necessary nitrogen and phosphorus reductions. It lays out a framework for the general types of actions in different sectors that should help achieve these reductions, which "must come from improved agriculture practices, septic system treatment, public wastewater treatment improvements and stormwater management for water quality."[5] Throughout the Bay, much of the work to address wastewater treatment plant improvements has been done, leaving the majority of remaining pollution reductions to come from nonpoint sources like agriculture and stormwater runoff. Importantly, these sources are not regulated like point sources such as wastewater treatment plants, so the County has little direct authority to compel actions that would reduce pollutant runoff. The City of Cambridge has a stormwater management ordinance that addresses the impacts of new and redevelopment, but ordinances do not change the existing built environment, which is the source of existing stormwater problems. In addition, until recently and as previously mentioned, most stormwater control infrastructure was designed to only mitigate the volume of water coming off impervious surfaces, but not the quality.

While agriculture is by far the biggest nonpoint source of nutrient pollution in the Chesapeake Bay, stormwater runoff from developed areas also contributes to the Bay's water quality problems. The more localized impact of urban runoff is demonstrated in the Lower Choptank and in Cambridge Creek, where the City's Comprehensive Plan points out that "much of the impact [on these bodies] is due to untreated stormwater runoff."[6] In particular, Cambridge Creek is strongly influenced by stormwater runoff from the City, as its watershed is small and located fully within the downtown area. The 2018 Cambridge Creek Watershed Assessment and Action Plan (Cambridge Creek Plan) details what is known about the water quality status of the Creek.[7] No regular water quality sampling has taken place in the Creek other

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[4] Local WIP Team. (2012). *Dorchester County Chesapeake Bay TMDL Phase II Watershed Implementation Plan (Proposed for Public Comment).* https://mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Documents/FINAL_PhaseII_Report_Docs/Final_County_WIP_Narratives/Dorchester_WIPII_2012.pdf

[5] Ibid.

[6] City of Cambridge. (2011). *City of Cambridge Comprehensive Plan.* https://www.choosecambridge.com/DocumentCenter/View/1530

[7] ShoreRivers. (2018 January 01). *Cambridge Creek Watershed Assessment and Action Plan*. https://www.shorerivers.org/s/MASTER_Cambridge-Creek-Watershed-Assessment-and-Action-Plan.pdf

than for fecal coliform, which has been carried out by the Maryland Department of Environment (MDE) shellfish harvest monitoring program since 2004. The shellfish harvest is closed in Cambridge Creek due to its proximity to the Cambridge Wastewater Treatment Plant and because of all the marinas located on the Creek. Fecal coliform levels have exceeded safe levels for human contact a number of times. Occasional samples collected by Dorchester Citizens for Planned Growth have captured high levels of nutrients and salinity and low dissolved oxygen in the Creek. The 2018 Cambridge Creek Plan identifies the sources of nonpoint pollution as coming 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."[8]

Achieving water quality goals in the Chesapeake Bay will require massive investments over a long period of time, and the benefits will be spread across a large geography and population. It is worth noting that investments to address stormwater runoff in Cambridge will yield tangible local benefits, as highlighted throughout this report.

Flooding

As noted elsewhere, the landscape in which Cambridge is located is naturally conducive to flooding due to its low elevation, proximity to tidal waters, high water table, and poorly drained soils. Modifications to the landscape such as the addition of buildings and pavement have only added to the challenge—impervious surfaces redirect and concentrate rainwater, overwhelming natural systems' ability to handle the flows. An aging and inadequately maintained storm sewer system will not help with flooding issues if water backs up in locations that pipes were originally intended to drain. All of these challenges are exacerbated and complicated by climate change: rising sea levels, combined with land subsidence, are already causing recurring tidal flooding problems in Cambridge. Increasing precipitation—especially in the form of heavy downpour events (Figure 1) but also overall (Figure 2)—dumps more water into the storm sewer system than it was originally designed to accommodate and saturates soils so they cannot infiltrate as well in the next storm.[9]

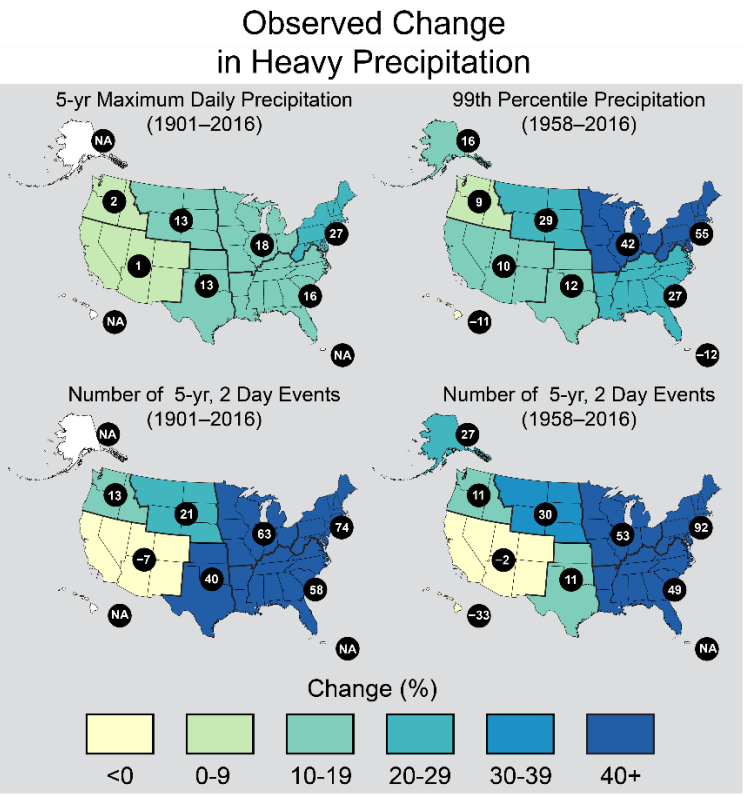


Figure 1. Observed changes in the number of 2-day precipitation events exceeding the threshold for a 5-year recurrence interval (from Easterling 2017)

[8] ShoreRivers. (2018 January 01). *Cambridge Creek Watershed Assessment and Action Plan*. https://www.shorerivers.org/s/MASTER_Cambridge-Creek-Watershed-Assessment-and-Action-Plan.pdf

[9] Easterling, D.R., et al. (2017). *Precipitation change in the United States*. In: *Climate Science Special Report: Fourth National Climate Assessment*, Volume I. U.S. Global Change Research Program. http://doi.org/10.7930/J0H993CC

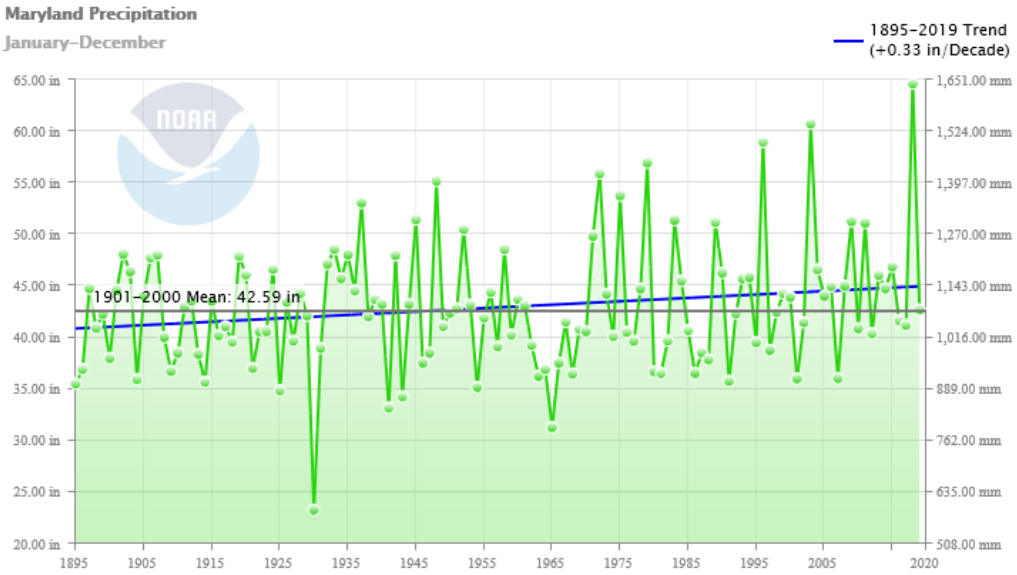
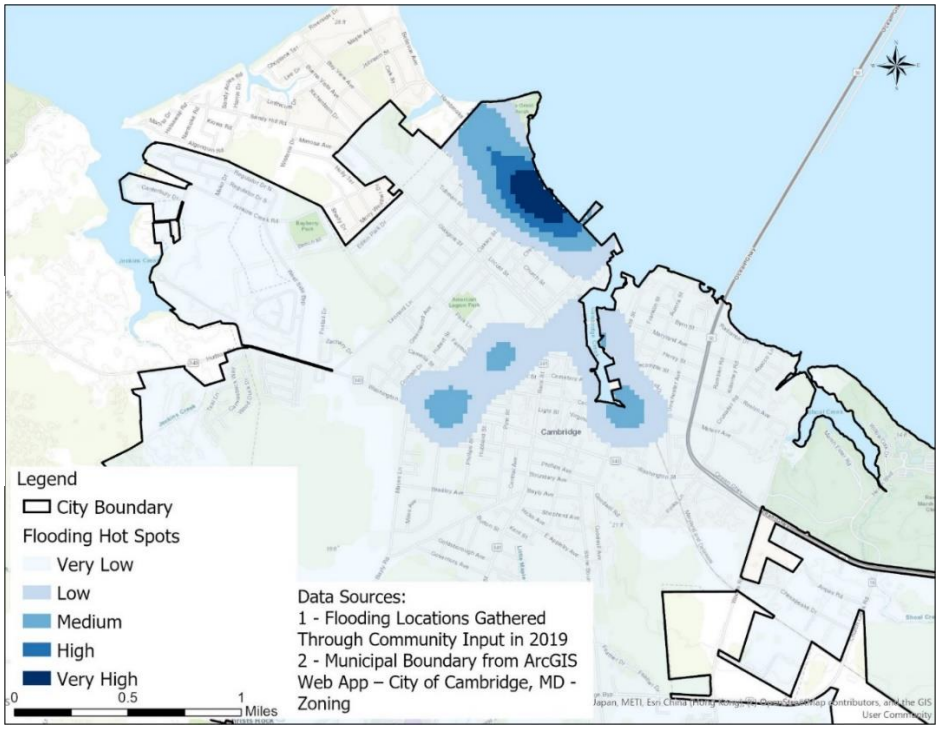


Figure 2. Annual total precipitation in Maryland, 1895-2019[10]

Tidal flooding that occurs in the absence of a weather event—sometimes called "sunny day flooding"—is labeled nuisance flooding by the state of Maryland and defined as, "high tide flooding that causes a public inconvenience."[11] In Cambridge, tidal nuisance flooding occurs most notably along and beyond Water Street (Map 2). Higher tides in this location interact with storm drains and worsen the situation.

Map 2. Density of flooding hot spots in Cambridge as reported by community members

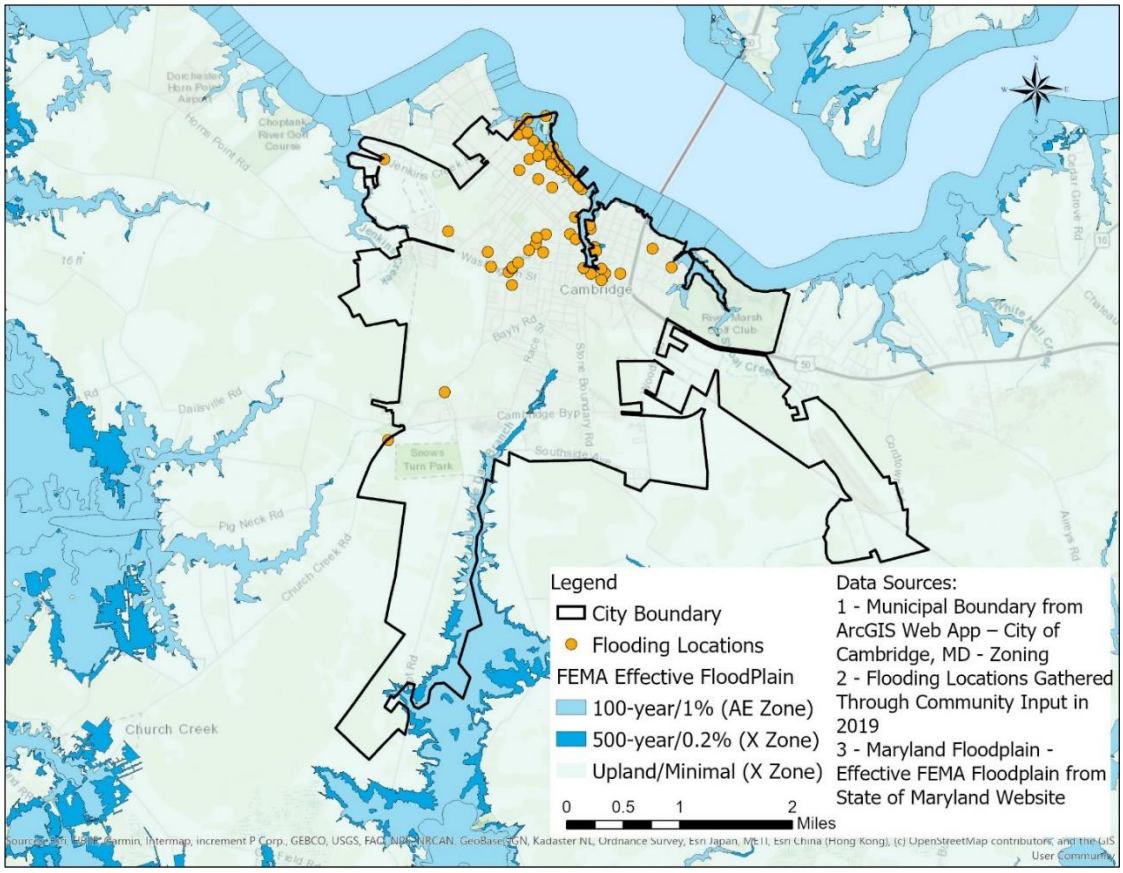


[10] NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published July 2020, retrieved on July 23, 2020 from https://www.ncdc.noaa.gov/cag/

[11] State of Maryland. *Nuisance Flood Plan Development Guidance*. (2019) https://dnr.maryland.gov/ccs/Documents/NuisanceFloodPlan.pdf

Unfortunately, Cambridge experiences both coastal and stormwater flooding problems, making efforts to address flooding more complicated. This may open up new avenues for funding, however, such as through hazard/disaster mitigation or sea level rise adaptation programs. Making sure that coastal, riverine, and stormwater flooding problems are highlighted in official Hazard Mitigation Plans is important for accessing some sources of flood mitigation and prevention funding.

Although the majority of Dorchester County (55.8%) is within the 100-year (1%) floodplain, most of Cambridge proper is outside of the current "mapped" or "regulatory" floodplain (this is the area that is subject to floodplain regulations but does not represent all areas that are at risk of flooding). Residents and businesses located in *or near* the regulatory floodplain "are at risk from tidal flooding, strong winds, storm surge and heavy rains that can cause destructive flooding in both waterfront and inland areas."[12] As depicted on Map 3, compiled from comments collected at public input events in 2019, community members have reported flooding and drainage problems in many locations outside the regulatory floodplain.



Map 3. Flooding hot spots and FEMA floodplains in the Cambridge area

[12] Dorchester County. *Floodplain Information*. Retrieved March 5, 2019, from http://www.dorchestercountymd.com/planning-zoning/floodplain-information/

Current Stormwater Infrastructure and Activities in Cambridge

The City's Public Works, Planning, and Engineering divisions oversee a variety of matters and services that relate to stormwater, such as planning and zoning, code enforcement, engineering, and roads and municipal facilities maintenance. There is no stand-alone stormwater program nor any staff devoted full-time to stormwater infrastructure and management in Cambridge, but the Engineering division generally holds the most oversight responsibility for the municipal storm sewer system and related infrastructure issues. They handle capital improvement projects, asset record-keeping, GIS, and construction plan review.[13] The Public Works grounds maintenance staff are involved in facilities and infrastructure maintenance and repair, including street sweeping. The City has a street sweeper currently but seeks to upgrade to a better model; this would allow them to increase the frequency of sweeping efforts to cover every city street once per month and better enable them to clean the City's 600 catch basins twice a year.[14]

The City has identified specific short-term needs, listed below, that will enable them to make rapid improvements to their maintenance program and address several known problems and opportunities. These types of items should regularly be included in long-term budget planning and integrated into the recommended asset management program where possible:

- Equipment, like a new street sweeper;
- Manhole sealing for 15-20 manholes;
- Stormwater retrofits, especially parking lots; and,
- Staffing, including another inspector to help with monitoring and enforcement.

The City of Cambridge has a stormwater management ordinance that sets the minimum requirements for managing stormwater on all new and redevelopment projects:

> "The purpose of this Ordinance is to protect, maintain and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse impacts associated with increased stormwater runoff. The goal is to manage stormwater by using environmental site design (ESD) to the maximum extent practicable (MEP) to maintain after development, as nearly as possible, the predevelopment runoff characteristics, and to reduce stream channel erosion, pollution, siltation and sedimentation, and local flooding, and use appropriate structural best management practices (BMPs) only when necessary. This will restore, enhance, and maintain the chemical, physical, and biological integrity of streams, minimize damage to public and private property, and reduce the impacts of land development."[15]

The question of whether this stormwater ordinance is doing as much as it can for protecting and improving water quality, and of whether the current minimum requirements are adequate for current and projected weather conditions, is discussed in a later section.

The source of existing stormwater problems largely remains the existing built environment, which the current ordinance does not address. In addition, most storm sewers and retention facilities were not

[13] City of Cambridge. Engineering Division. Retrieved July 21, 2020, from http://md-cambridge.civicplus.com/151/Engineering

[14] P. Comiskey, personal communication, May 14, 2020.

[15] City of Cambridge. (2010). Stormwater Management Ordinance. https://www.choosecambridge.com/DocumentCenter/View/86

designed for nutrient and sediment removal, so investing in maintenance, retrofits, and upgrades will be necessary to achieve water quality improvements.

Inadequate system maintenance and funding

The challenge of managing aging infrastructure alongside the City's other pressing financial issues has been a recurring theme in the discussions around the City's current stormwater management needs, existing activities, and investments. This is not an uncommon problem, since many communities nationwide have historically under-invested in proactive maintenance and replacement activities and are now feeling those impacts as infrastructure reaches the end of its lifespan. This is a widespread issue not limited to stormwater, with the American Society of Civil Engineers (ASCE) giving the overall state of America's infrastructure a D+ grade in their 2017 Infrastructure Report Card.[16]

The City's storm sewer system, like all infrastructure, requires regular maintenance and upkeep. However, the City has not incorporated this maintenance into their regular budget, opting for the most part to pay for expenses when an immediate need or emergency arises. Without a dedicated source of revenue it is difficult to fund stormwater maintenance on a continual basis, since it competes for funding against other local government services and programs and is not typically an activity that is eligible for grant support. In the absence of regular maintenance, the overall condition of the stormwater system is likely to worsen over time. In addition, addressing maintenance backlogs, adopting newer practices, and innovating in general will be necessary to ensure the City continues to provide adequate and sustainable stormwater management services, as noted in the Cambridge Creek plan:

> **"As this infrastructure continues to age and create major stormwater issues, it is important to incorporate alternative stormwater management techniques such as green infrastructure projects that will take stress off the dated system."**

The Stormwater Permit Landscape

A growing number of communities are being required to take more action to manage their stormwater runoff through Municipal Separate Storm Sewer System (MS4) permits. The City of Cambridge is not yet mandated by the State of Maryland to comply with a MS4 permit, which would require the City to take action to address its stormwater runoff.[17] This may be due in part to the largely rural nature of Dorchester County and the relatively slow urban growth rates in Cambridge (many municipalities that come under MS4 regulations have gained Urbanized Area between Census periods). However, the Maryland Department of Environment has the authority to mandate MS4 requirements wherever they choose—it does not have to be attached to a rapidly developing area. There are smaller communities than Cambridge in Maryland that have been issued MS4 permits. For this reason it is advisable to take steps to improve the City's stormwater programming now to make any future transitions into a permit situation easier. **Strengthening and supporting stormwater programming in the City is a no-regrets option** as it will benefit residents and businesses regardless of whether or not there is a regulatory driver behind the activities.

[16] American Society of Civil Engineers. 2017 Infrastructure Report Card. Retrieved on June 19, 2020, from https://www.infrastructurereportcard.org/

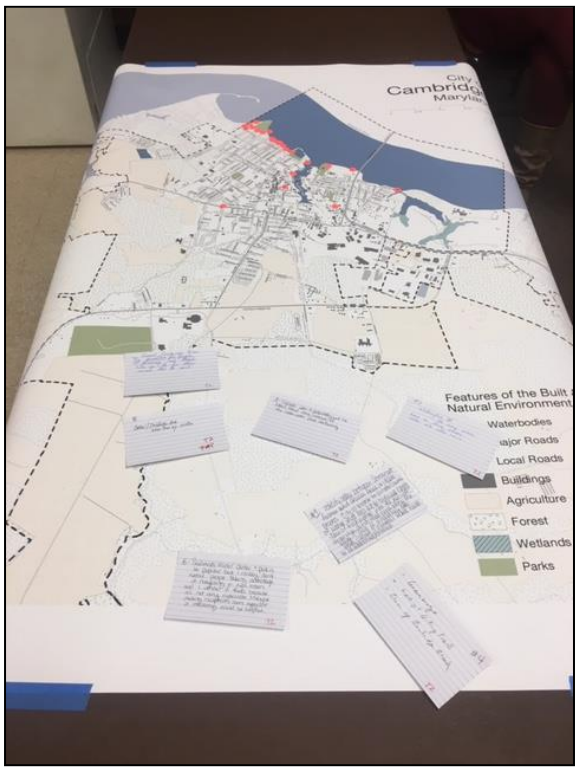
[17] ShoreRivers. (2018 January 01). *Cambridge Creek Watershed Assessment and Action Plan*. https://www.shorerivers.org/s/MASTER_Cambridge-Creek-Watershed-Assessment-and-Action-Plan.pdf

Chapter 2: Community Engagement

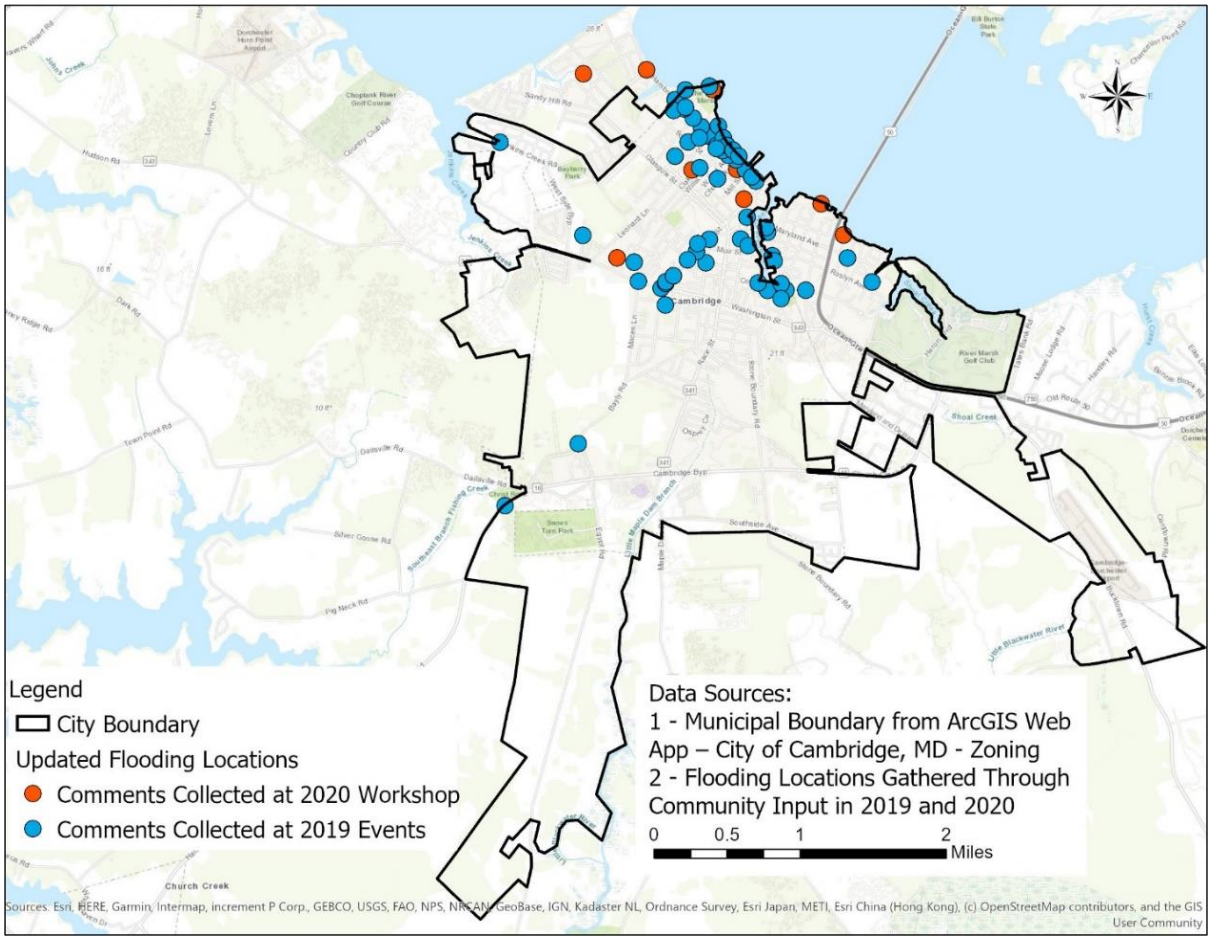
An important aspect of this project's community engagement work included gathering stakeholder input on locations that flood frequently or have poor drainage. This exercise helps inform stakeholders about the current project while building their understanding of the broader need for more public and private investment in stormwater and flood mitigation projects across the City. The information gathered can be compared against existing plans and data to help project partners and the City understand where noticeable problems are occurring. These flooding "hot spots" could inform stormwater maintenance and improvement schedules, and partner organizations could also use them to identify project opportunities and support grant applications.

EFC staff attended several workshops, meetings, and events in 2019 and early 2020.

- March 2019 residential stormwater workshop
- Habitat for Humanity Choptank & AARP event, August 2019
- Dorchester Faith Alliance, August 2019
- Cambridge Association of Neighborhoods (CAN) "CAN JAM," August 2019
- CAN meeting, September 2019
- January 2020 residential stormwater workshop



Large printed maps were provided at these events, and meeting participants were invited to place numbered stickers on the maps at locations where they have noticed standing water or flooding. Then they wrote more details about the location and issue on a corresponding index card. These comments were compiled into a spreadsheet and matched up with the stickers on the maps. The best estimates of the stickers' locations were approximated in digital maps so that a latitude/longitude could be assigned to each flooding problem spot. This data was then used to create a point layer in geospatial information system (GIS) software to visualize and analyze the flooding hot spots. Preliminary results of the analyses were shared at the 2020 residential stormwater workshop and additional flooding hot spots were mapped to see if there were any major differences or new locations identified by participants (Map 4).



Map 4. Points with flooding or drainage issues submitted by community members

Next, the flooding hot spot layer was analyzed to characterize the information and to look for patterns in the data. It was also mapped against other data layers to better understand the spatial relationships between hot spots and other factors, such as mapped floodplains, zoning, coastal flood risk, social vulnerability, and proposed water quality projects. The series of resulting maps can be found in Appendix D.

Chapter 3: Benefits of and Opportunities for Improved Stormwater Management

Benefits of a stronger stormwater management program

Strengthening the City's stormwater management program will yield a variety of benefits and improve the overall quality of life for residents. Taking steps to adequately maintain existing infrastructure and add more infiltration capacity can reduce the frequency and extent of precipitation-induced flooding, which may also reduce the economic impacts of this type of flooding. Proactive maintenance and asset management enables cost savings and can help reduce the need for costly emergency repairs and replacements.

Health problems associated with excessive moisture or standing water are also a concern in the region, particularly among vulnerable populations. Damp crawl spaces fuel mold and rot problems in homes, which can exacerbate asthma and other conditions; also, standing water facilitates mosquito breeding and the potential transmission of vector-borne illnesses.

Managing stormwater adequately will help improve local water quality, which is important for watermen as well as tourism and recreational activities like fishing, boating, and swimming. Integrating green stormwater projects, as the City and its residents have done in a number of areas, also beautifies the community and has public health benefits like reducing local heat island effects and cleaning the air. Finally, a strong stormwater management program will also better position the City to be able to handle future conditions such as changing weather patterns, demographics, and regulatory environments. This is particularly important due to the likelihood that Cambridge already expects population growth, and beyond that, it may become a receiving area for people moving out of lower-lying areas of Dorchester County in the coming decades.

Near-Term Stormwater Program Opportunities

Prioritize maintenance, monitoring, and enforcement
Being able to maintain and monitor existing projects, or enforce existing codes and ordinances, often becomes a lower priority when budgets are tight. Insufficient maintenance is one of the most common issues stormwater systems face, and ongoing maintenance and enforcement efforts are rarely funded by the grants the City has been so effective in obtaining. Intensifying the regular municipal stormwater maintenance schedule is a good place to start and aligns with the intermediate-term recommendation to implement an Asset Management approach to stormwater management. The City has expressed interest in doing this for street sweeping and catch basin cleanouts. There are equipment and staffing considerations to making these changes, some of which are discussed below and some in other sections. The Cambridge Clean Water Advisory Committee (CWAC) and partner organizations such as ShoreRivers and the Chesapeake Bay Foundation can advise the City on developing a regular catch basin cleaning program in the near term.

The City may need to hire additional maintenance and/or enforcement staff to meet its system's needs. In addition, City staff, particularly grounds maintenance staff from the Public Works division, should engage in more training about both traditional and green stormwater project maintenance so they are able to keep this infrastructure functioning well. Relevant online and in-person training opportunities

are available through the MOST Center (free through February 2021) and UMD Sea Grant Extension. The UMD Sea Grant-led Chesapeake Bay Landscape Professionals (CBLP) training program has been offered to the City for free.[18] This training will benefit anyone who would be involved in green infrastructure design and maintenance, and any City employees with relevant responsibilities should participate. This certainly helps advance the skill set of City employees and improves the longevity of local projects, and at the same time, being able to speak to having CBLP-trained maintenance staff can become a compelling factor to funders when pursuing grants for project installation.

When the City's budget does not permit hiring additional staff to assist with ongoing stormwater infrastructure maintenance and monitoring needs, alternative arrangements should be considered. Non-profit partners may be able to organize volunteers to help through clean-up events or assign some maintenance tasks to interns or students at a lower cost. Conservation corps, youth employment programs, and other workforce development programs may also provide options for adding capacity to monitor and maintain stormwater projects. All of these alternative labor arrangements would require a City and/or partner organization staff member to be on site to provide guidance on the tasks at hand. An EPA webinar, Growing New Jobs With Green Infrastructure, discusses the training and workforce needs and opportunities of these types of projects in more detail.

To plan better for the ongoing maintenance needs of green stormwater projects, an important lesson learned from this type of work elsewhere is that designing parks and stormwater features to fit the existing or expected maintenance capacity is more conducive to long-term success of the project. This means that the parties who will potentially be responsible for maintenance need to be engaged in the design process, and also that simple designs fare better.[19]

One near-term enforcement opportunity has been identified through recent discussions with partners and the City. Partners and community members have noticed an issue with yard waste like grass clippings and leaves being deposited in streets, storm drains, or drainage ditches. Cambridge has an ordinance prohibiting this practice, but it is not currently being enforced.[20] Section 16-9 *Depositing debris in gutters or sidewalks* states that "No person shall deposit in the gutters or streets any ashes, leaves or other debris or material which might or could obstruct the free flow of water."[21]

In addition, there seems to be confusion among residents about what yard waste disposal practices are allowed. This can be remedied in the short-term in two ways: educating residents about the ordinance and how to dispose of their yard waste, and enforcing violations of the ordinance. Partner organizations can assist with or even lead the education campaign. It is recommended that the City allows time for education before acting to enforce violations of the ordinance. An alternate or back-up option to reducing dumping of yard waste could be to install filters or similar inserts in stormwater catch basins to collect grass clippings and leaves before they make their way further into the storm drain system. The

[18] J. Dindinger, personal communication, July 10, 2020

[19] Albro, S., Freeman-Wilson, K., & Leahy, I. (2019, October 23). *Vacant to Vibrant: Embedding green space in neighborhoods to clean water, cool cities, and bring equitable prosperity*. [Webinar]. Security & Sustainability Forum. https://vimeo.com/368407621

[20] P. Comiskey, personal communication, June 16, 2020

[21] Cambridge, Maryland, Municipal Code (1972, § 4.09; Ord. No. 738, § 1, 8-29-88) https://library.municode.com/md/cambridge/codes/code_of_ordinances?nodeId=PTIITHCO_CH16STSIPUPL_S16-9DEDEGUSI

Town of Easton has equipped 100 of their catch basins with filters, which they clean several times each year and replace every three years.[22]

Proactive purchasing

As the City begins to invest more in its stormwater management program over the long term, efficiencies will be created and allow for more proactive purchasing.

A high priority for the City in the near-term is purchasing a new, larger street sweeper to facilitate more regular street sweeping and increasing the frequency of their catch basin cleaning operations.[23] These steps would help reduce the amount of sediment and debris that currently ends up in local streams and the Lower Choptank, and improve the functionality of storm drains in heavy rain events. Nearby communities have shared information on their street sweeper operations and regular maintenance costs. These are detailed in Appendix C.

The start-up costs for a new sweeper and additional dumpsters are prohibitive for Cambridge, particularly in the current pandemic-induced recession, so creative arrangements may need to be explored. Grant funding usually does not support equipment purchases, so options like shared service agreements, leasing, and contracting with a third party could be considered. Examples of several towns and counties that have entered into shared service agreements are listed in Appendix C.

Take a Dig Once approach

The City's new Capital Improvement Plan (CIP) provides an opportunity to examine projects that have existing support and seek ways to integrate green infrastructure and stormwater components into them. This "Dig Once" approach can result in cost efficiencies and yield multiple benefits for the community beyond the primary function of the project. Cambridge has utilized this approach on several occasions, such as by adding green stormwater features to the Maryland Avenue project and to the High Street historic restoration project. This kind of integration may require a little more up-front investment in order to research, develop project ideas, and educate peers and officials about the benefits of taking this approach, but it has the potential to bring about a greater return on that investment in the long run. The EFC's Municipal Online Stormwater Training (MOST) Center offers a free, on-demand course on how to integrate green infrastructure components into capital projects using a Dig Once approach. You can find the course here.

Will Parson/Chesapeake Bay Program

A great near-term opportunity for using Dig Once may be to build on the sidewalk and accessibility inventory that is currently underway for the City.[24] This downtown infrastructure is a high priority for the City, as noted in the Comprehensive Plan:

> "The City should begin immediately to identify key repair and rehabilitation projects in downtown. It should upgrade and modernize its street infrastructure with special emphasis on

[22] T. Leigh, personal communication, June 17, 2020
[23] P. Comiskey, personal communication, May 14, 2020
[24] B. Roche, personal communication May 11, 2020

pedestrian and cycling routes and improvements. For the downtown in particular, the City will create a program of "Small Projects That Make a Big Difference" to install and/or repair sidewalks, curbs and gutters, crosswalks, bicycle lanes, and street trees. Sixty percent of households in the downtown area do not own a car; pedestrian and bicycle access in the downtown district must be the priority."[25]

As pedestrian and bicycle infrastructure are surveyed and assessed for maintenance, continuity, and Americans with Disabilities Act (ADA) compliance issues, stormwater problem spots and potential sites for improving or installing new features, especially green infrastructure and tree planting, can be noted. As a list of projects is developed and prioritized, stormwater needs and ideas can be factored into these projects. The, funds obtained or allocated for sidewalk projects can be stretched further by adding stormwater improvements into the design and construction steps of the process.

Take advantage of grants and partnerships

A number of federal, state, and private funding opportunities support infrastructure improvements, including traditional and green stormwater projects. Cambridge has already demonstrated great skill in monitoring for RFPs and matching up potential projects with open opportunities, as are a number of non-profit partners that work in the City and region. Strong partnerships with other City departments and with local non-profits are especially helpful for securing new sources of funding beyond traditional infrastructure grants or loans that yield multiple benefits, such as grants for neighborhood revitalization, flood mitigation, community development, and the like. A proactive, holistic approach to projects and programs that advance water resource objectives is attractive to funders and allows faster mobilization when opportunities arise. An asset management program in particular can help the City identify high priority projects and seek funding and partnerships for design, construction, and education.

The City should be sure to maximize their accounting of in-house services as match for grants; for example, counting the time of staff engineers and others in the Public Works or Engineering divisions related to installation and maintenance of grant-funded projects. Maximizing match contributions enables the City or their nonprofit partners to ask for larger grants and also makes proposals more attractive and competitive to funder organizations and grant review panels. Grants and partnerships can sometimes add temporary capacity to City staff, like a position that was funded for two years under the Pine Street project. Ultimately, however, it may become more difficult for the City to pursue grant opportunities if staff are stretched thin and too overloaded to prepare proposals and manage awards.

Will Parson/Chesapeake Bay Program

Although they are more focused on water quality than quantity, the Cambridge Clean Water Advisory Committee (CWAC) 10-year plan and the Cambridge Creek Watershed Assessment and Action Plan both contain stormwater-related project and program ideas and can be referenced when applying for grants. Funders often find proposals for projects that are a part of a wider, consensus driven plan more compelling. Projects that are part of an existing plan are typically viewed as a result of strategic thinking and local buy-in, improving their credibility with grant reviewers.

[25] City of Cambridge. (2011). *City of Cambridge Comprehensive Plan.* https://www.choosecambridge.com/DocumentCenter/View/1530

A set of maps was developed to illustrate the locations and other characteristics of projects proposed in the Cambridge Creek plan. These projects were also mapped against flooding problem spots identified through this project's community input process to identify opportunities to address both water quality and flooding problems. These maps are located in Appendix D.

Specific grant opportunities that may be worth pursuing are detailed in Chapter 4.

Community outreach and engagement

Implementation of projects by community members and partner organizations can help spread the burden of stormwater capture beyond what the City can do by itself. Meeting with community members to better understand problem areas in Cambridge can identify opportunities to overlap existing or proposed projects in the City with locations where citizens see a need to invest. For example, the mapping exercises described in Chapter 2 produced information for the City while providing an opportunity to interact with community members. Showing local leaders the problem areas and opportunities identified by their constituents may help build political support for making changes in stormwater program structure and municipal budget priorities. Outreach and education efforts also help residents understand the value of well-functioning stormwater infrastructure, which can generate bottom-up demand for greater investment in these projects and programs.

Better community engagement can also help the City's projects succeed. More communication about proposed projects provides opportunities for any impacted residents and businesses to ask questions and provide input, which may alleviate their concerns and increase their willingness to cooperate with the City if needed. Research into lessons learned from green stormwater feature and vacant lot beautification projects has shown that community engagement is critical to their success.[26] Good community engagement also helps set expectations about how a project is supposed to look, which is important when projects may involve reduced mowing or native species that are perceived to have a "messy" appearance.

The economic impact of fees and especially the potential equity concerns about these impacts are certain to come up in discussions about how to pay for more stormwater management. This can be addressed in part by good stakeholder outreach and engagement, but also by approaching the topic with open minds. Focusing the conversations on the community's shared interests, needs, and values and the desired outcomes of a strengthened stormwater program, rather than how a fee structure should be set up or attempting to replicate how other communities have done it, can engender more creative solutions.

As the City's stormwater program becomes more robust, a good outreach and engagement plan will ensure that resources invested in these activities are directed towards the specific needs and objectives that the City, its residents, and its businesses have identified as priorities. These plans typically incorporate a number of components including the goals of the community; the target audiences that need to be reached; the messaging that will best promote behavior change; the best methods for formatting and distributing messaging; and, the method for evaluating impact.

[26] Albro, S., Freeman-Wilson, K., & Leahy, I. (2019, October 23). *Vacant to Vibrant: Embedding green space in neighborhoods to clean water, cool cities, and bring equitable prosperity*. [Webinar]. Security & Sustainability Forum. https://vimeo.com/368407621

One lower-cost community outreach and education opportunity is the development of a pet waste program in partnership with local non-profit organizations. Unmanaged pet waste, specifically dog waste, can have a significant impact on nitrogen, phosphorus and bacterial loads in local waterways. Pet waste also contains a multitude of pathogens that can impact the health of humans and other animals. There is a MOST course on this topic: Making Pet Waste Management Work for Your Water Quality Goals. The course is designed for municipalities and other communities that are considering implementing pet waste management programs. It explores the connections between pet waste, water quality and human health, and explains how implementing a pet waste management program can help meet water quality goals and permit requirements. The fast track and comprehensive approaches to pet waste management are introduced, as well as how to determine which approach is the best fit for a community like Cambridge. In addition, adopting a pet waste ordinance, developing a pet waste program, and conducting outreach and engagement around this issue could garner up to 15 points towards Sustainable Maryland certification, a program that the City has been participating in since 2015.

As discussed under enforcement, there is a need to educate residents about the yard waste ordinance and proper disposal practices. This can also include education about home composting of yard waste materials. Non-profit partner organizations and the Watershed Restoration Specialists of University of Maryland Extension are well-suited to assist the City with these types of community outreach campaigns.

Intermediate-Term Stormwater Program Opportunities

Develop an asset management program

Many drinking water and wastewater utilities employ an asset management approach to their systems, but this is not the case for most stormwater programs. Adopting an asset management approach can help ensure that a municipality's stormwater program is able to deliver adequate services to the community now and into the future, at the lowest life cycle cost. Consciously choosing the level of service that the City wants to provide in terms of stormwater management, evaluating the stormwater system's current functionality, and developing an understanding of what it will take to achieve the desired level of service can help drive the improvement of the program and get local leaders and community members on board. Given the growing costs of managing stormwater and the City's limited budget, it is important that the City be able to deal effectively in a cost-efficient manner with the aging infrastructure that comprises the stormwater system. Proactively managing infrastructure assets over time and continually addressing resource gaps has proven to be a cost-effective measure that can improve the functionality of a stormwater program. Asset management provides this framework to set goals and then make data-driven decisions about how to operate, maintain, repair, rehabilitate, and replace assets in order to maintain the system's performance at a desired level.

The City should begin to develop a formal asset management program. Asset management tactics are clearly a part of existing efforts--integrating stormwater projects and components wherever possible. There appears to be an opportunity to create a more codified asset management program that can be developed over time and become more robust as projects in the near- and long-term are prioritized. Small steps may be easier to take on first, especially if they could be integrated with routine or

upcoming maintenance work or if they could use interns or summer workforce programs to supplement City staff. For example, formally inventorying the stormwater system (possibly including private facilities that may have gone unmapped as well) and assessing each asset in order to understand its condition would be an effective starting point and could likely be done with existing staff in the division. It may be possible to use existing resources or employ interns/Conservation Corps members to round out the stormwater system inventory by mapping the private system, which would enable assessment of the entire system's condition and prioritization of inspection, enforcement, maintenance, and replacement of those assets. This creates a more efficient system that is proactive and is less costly in the long-term. This program can be done at varying levels of sophistication, whereby more resources can be allocated in the intermediate- and long-term as appropriate.

Cross-mapping Capital Improvement Plan (CIP) and stormwater asset management plan needs will further help the City's Public Works division and other relevant staff communicate with local decision-makers on the investment needed to keep the system from failing, which can be detrimental to the City's fiscal, environmental, and public health. This enables local decision-makers to make fully informed decisions about the level of investment required to adequately manage stormwater.

For more information on adopting an asset management approach for stormwater systems, see Appendix A and the A.M. KAN Work resource.

Leverage/collaborate with housing-related efforts

Housing affordability, property maintenance, and vacant/derelict properties are major concerns for residents and the City. The development of solutions to these pressing challenges also creates an opportunity to incorporate stormwater improvements and improve the services delivered to some of the City's most underserved members. Continuing to partner with Habitat for Humanity and other local NGOs to creatively integrate stormwater components into affordable housing, revitalization, and beautification projects will be an important strategy and will help leverage dollars from alternative funding sources into multi-benefit projects (*see also*: Develop incentives, below). One regional example of a housing redevelopment project that integrated affordable housing, energy efficiency, and green stormwater objectives is the Galen Terrace project in Washington, DC. It was the "first rehabilitated property in DC to meet all of the 'green' criteria under the Enterprise Green Communities Initiative."[27] The Galen Terrace Tenant Association and their development partners chose to incorporate a variety of green features in the building's renovation, including green stormwater retention planters and rain barrels (which also helped reduce the building's stormwater fees). The DC Department of Housing and Community Development provided Community Development Block Grant funding to assist the Tenant Association and development partners with acquisition costs.[28]

A number of communities have implemented vacant lot greening projects and initiatives to assist them with stormwater challenges, such as combined sewer overflows, by reducing stormwater volume with green infrastructure while also beautifying vacant lots. According to the EPA, "by creatively using vacant lots as an asset, these cities are addressing legacy environmental challenges in new ways that create

[27] National Housing Trust. *Sustainability Case Studies*. Retrieved July 20, 2020, from https://www.nationalhousingtrust.org/sustainability-case-studies-0

[28] D.C. Department of Housing and Community Development. *Featured Project - Galen Terrace*. Retrieved July 20, 2020, from https://dhcd.dc.gov/page/featured-project-galen-terrace

multiple community co-benefits."[29] Webinar recordings on this topic are available here: Greening Vacant Lots and Vacant to Vibrant.

Document economic impacts of stormwater and other flooding problems on the community
An economic impact study that shows how the City's flooding and drainage problems require greater investment in its stormwater program—and would benefit from an integrated approach to managing the different types of flooding experienced in the City—could help build support for this needed investment among City Council members and their constituents. The impacts of coastal flooding on the City are better-known, especially because they have resulted in cancellation or postponement of major events like the Ironman Maryland triathlon. The impacts of inadequately maintained storm drains and other stormwater infrastructure around Cambridge are less clear, but these problems do impact residents' quality of life as well as the City's and businesses' bottom lines. A study that documents these impacts and the costs of failing to invest in this infrastructure could be enlightening for local leaders and constituents.

Review ordinances and codes
Building stricter stormwater requirements into municipal codes and ordinances is one way to shift some of the costs of stormwater management onto the private sector, residents, and other entities as appropriate. The impact of most stormwater-related codes and ordinances is primarily seen when new development or redevelopment projects occur because these regulations are largely aimed at design and construction practices. The EFC conducted a desktop review of current standards to identify whether any adjustments might be made to strengthen requirements for new development and redevelopment projects in the City. Project partners were also queried for their suggestions on updates that would be beneficial for stormwater. In addition to potential updates discussed below, a near-term opportunity would be for the City to educate residents about and then enforce existing codes, such as the yard waste ordinance mentioned under "Prioritize maintenance, monitoring, and enforcement," that will help alleviate some stormwater runoff problems.

The Center for Watershed Protection has developed a comprehensive guide and accompanying worksheet, referred to collectively as the Code and Ordinance Worksheet (COW), which "is intended to help communities evaluate their local development regulations to identify revisions that allow or require site developers to minimize impervious cover, conserve natural areas and use runoff reduction practices to manage stormwater."[30] EFC used this COW to carry out a surface level review of Cambridge's codes and ordinances. The overall finding was that the City's codes are "silent" for many of the worksheet's specific questions, which indicates that there may be room to strengthen what is not explicitly addressed in current codes. The recommended starting point for the City would be to review the COW's 22 model development principles and then choose a few principles that are most important and relevant for Cambridge to review in more depth. Then the City can explore ways to encourage or require certain practices, design standards, etc. that will help accomplish the community's goals.

In addition to referring to the benchmarks laid out in the COW, there are other excellent, comprehensive resources the City can use for strengthening stormwater management and flood

[29] US EPA Green Infrastructure Program. *Greening Vacant Lots*. Retrieved August 27, 2019, from https://www.epa.gov/green-infrastructure/greening-vacant-lots
[30] Center for Watershed Protection. (2017). *The Code and Ordinance Worksheet: A Tool for Evaluating the Development Rules in Your Community.* https://owl.cwp.org/mdocs-posts/better-site-design-code-and-ordinance-cow-worksheet-2017-update/

resiliency via codes and ordinances. Two highly recommended resources come from the U.S. EPA. First, their nonpoint source program has compiled overviews and examples of ordinances that can help a community better achieve their stormwater reduction goals, which are available on their website: Urban Runoff: Model Ordinances to Prevent and Control Nonpoint Source Pollution. In addition, the EPA Smart Growth program has a report called Smart Growth Fixes for Climate Adaptation and Resilience: Changing Land Use and Building Codes and Policies to Prepare for Climate Change that walks through short- and long-term policy options that will help a community build its resilience to climate change, including flooding, sea level rise, and extreme heat. Options are categorized by climate impact, type of policy change, and the magnitude of change that a recommendation may entail for a community. A sortable table of policy options from the report can be viewed here.

One priority recommendation suggested by partner organizations is for the City to adopt a street tree ordinance, or update and expand the existing forest conservation ordinance. These types of ordinances in general can protect existing trees on public and private property, require mitigation when trees are removed (which can generate revenue for the City), and require tree plantings in new development projects. They can also complement other urban tree goals and initiatives in the City. Retaining and adding trees throughout the City will yield many benefits beyond slowing down and filtering stormwater runoff: they clean the air, provide shade (which in turn reduces energy costs and the urban heat island effect), and can boost property values and consumer spending.[31]

A number of resources exist on the topic of urban tree canopy and urban forests. The City and partners such as the CWAC may wish to use the guide and worksheet developed by the Center for Watershed Protection called *Making Your Community Forest-Friendly.*[32] The web-based Urban Forestry Toolkit from the USDA Forest Service's Vibrant Cities Lab suggests several ways to protect and enhance urban tree canopy through ordinances and regulations (see Step 8: Promoting Better Forestry on Private Lands).[33] The International Society of Arboriculture (ISA) also provides a guide for evaluating and developing tree ordinances, with a section that details basic and goal-specific components of an ordinance and provides example language for each component.[34] Local municipalities with such ordinances in place include Easton, Hyattsville, and Bel Air (these three towns also participate in Tree City USA, which is another helpful program for communities seeking to improve their urban tree canopy, as well as close to three dozen other Maryland municipalities). Finally, a new guidebook on financing urban tree canopy programs, produced by EFC and the Alliance for the Chesapeake Bay, is available here, and there is a MOST course on the topic as well.

Two recent studies led by the Eastern Shore Climate Adaptation Partnership (ESCAP) contain regionally specific recommendations for improving resilience to climate change-related flooding that the City should consider adopting over the next several years. These include a number of regulatory strategies that go beyond what Cambridge and Dorchester County have already adopted (such as the 2-foot freeboard requirement in the county building code). One component of the 2019 report, titled Higher

[31] Wolf, K.L. (2010). Local Economics. Green Cities: Good Health. https://depts.washington.edu/hhwb/Thm_Economics.html

[32] Center for Watershed Protection. (2018). *Making Your Community Forest-Friendly: A Worksheet for Review of Municipal Codes and Ordinances*. https://owl.cwp.org/mdocs-posts/making-your-community-forest-friendly-a-worksheet-for-review-of-municipal-codes-and-ordinances/

[33] Vibrant Cities Lab. *Urban Forestry Toolkit*. http://www.vibrantcitieslab.com/toolkit/

[34] Swiecki, T.J., and Bernhardt, E.A. (2001). *Guidelines for Developing and Evaluating Tree Ordinances*. https://www.isa-arbor.com/Credentials/Types-of-Credentials/ISA-Certified-Arborist-Municipal-Specialist/Tree-Ordinance-Guidelines

Standards: Opportunities for Enhancing Flood Resilience, was prepared by the Georgetown Climate Center (GCC) and "contains strategies pertaining to floodplain, zoning, and regulatory standards to help enhance resilience to future flooding. It highlights higher regulatory standards that Eastern Shore jurisdictions can adopt, in combination with non-regulatory approaches, to reduce increasing flood risks posed by sea levels."[35] One of this report's recommendations, to expand the regulatory floodplain (such as by adopting the 0.2%/500-year floodplain instead of the 1%/100-year floodplain), is also an action listed in the 2017 Dorchester County Flood Mitigation Plan.[36]

The 2020 report, Preparing for Increases in Extreme Precipitation Events in Local Planning and Policy on Maryland's Eastern Shore, is more directly relevant to stormwater issues. The Eastern Shore Land Conservancy (ESLC) worked with Dr. Kaye Brubaker and research assistants in the Department of Civil and Environmental Engineering at the University of Maryland College Park to develop projections for future precipitation across the Eastern Shore and translate that information into equivalent storm event and flood size scenarios, which can then be used for planning and decision-making purposes. ESLC then evaluated strategies for "local jurisdictions to reduce flood risks and improve stormwater management practices," which resulted in seven priority policy recommendations[37]:

1. Upgrade infrastructure to reflect future precipitation estimates
2. Utilize hybrid green-gray infrastructure
3. Implement stormwater utility
4. Adopt Executive Order criteria into development standards
5. Create recovery plans which prioritize flood mitigation and future flood risk
6. Restore unutilized agricultural land to natural ecosystem
7. Prepare plans for future funding and grant opportunities

These recommendations are applicable across a number of City departments and initiatives, but are particularly relevant to infrastructure design standards.

For an example of a municipality that is incorporating climate scenarios into infrastructure decisions, the City of Virginia Beach, VA recently updated their Public Works Design Standards Manual based on future precipitation (approximately 20% above NOAA Atlas 14 data) and sea level rise projections.[38] More information about their "comprehensive program for addressing rising sea levels and recurrent flooding risks," called Sea Level Wise, is posted on their website.

[35] Grannis, J., Li, J., and Spidalieri, K. (2019). *Higher Standards: Opportunities for Enhancing Flood Resilience in the Eastern Shore of Maryland*. Georgetown Climate Center. https://www.georgetownclimate.org/files/report/GCC%20Higher%20Standards%20Report%20for%20ESCAP%20-FINAL.pdf

[36] Dorchester County Emergency Management Agency. (2017). *Dorchester County 2017 Flood Mitigation Plan*. https://c4d.327.myftpupload.com/wp-content/uploads/2018/12/2017-Dorchester-County-Flood-Mitigation-Plan_Public-Version.pdf

[37] Charochak, M., and Bass, J. (2019). *Preparing for Increases in Extreme Precipitation Events in Local Planning and Policy on Maryland's Eastern Shore*. Prepared for the Eastern Shore Climate Adaptation Partnership by the Eastern Shore Land Conservancy. https://www.eslc.org/wp-content/uploads/2020/01/ExtremePrecipitationReport.pdf

[38] City of Virginia Beach. *Design Standards and City's Amendments to VDOT's Specs. & Stds*. Retrieved July 14, 2020, from https://www.vbgov.com/government/departments/public-works/standards-specs/Pages/default.aspx

Long-term Stormwater Program Opportunities

Due to the City's infrastructure needs and its geographic location, there is a strong need to invest more in addressing flooding and sea level rise alongside economic challenges and regional relocation issues in the long term. The EFC's long-term recommendations are that the City more aggressively and intentionally invest in stormwater projects, capital funding, and operations and maintenance. This can build upon existing efforts, resources, and partners, as well as a formal asset management program.

Strengthen collaboration with the Planning and Zoning division
The Public Works division already works closely with the Planning and Zoning division, and this collaboration should continue. Many of the Planning and Zoning Commission's priorities are compatible with stormwater best management practices, such as achieving quality site designs and compact development patterns. Beautification and revitalization efforts are particularly compatible with green stormwater projects, as are efforts to reduce the urban heat island effect and improve public health. Collaborating with Planning staff helps distribute capacity across departments and opens up additional grant opportunities that may not be appropriate for Public Works alone. A related suggestion by Cambridge Clean Water Advisory Committee (CWAC) members is to provide a stormwater management checklist for planning commissioners to use when reviewing projects. This would make it easier for them to review proposals for compliance.

Develop additional incentives
One way to leverage private sector dollars into stormwater projects is to create incentives for developers to go beyond minimum requirements and/or implement green stormwater infrastructure practices in new or redevelopment projects. Incentives could be financial or procedural, such as expedited permit reviews. The US EPA has a handbook on municipal incentive mechanisms for green infrastructure, which they group into five categories: stormwater fee discounts, development incentives, grants, rebates and installation financing, and awards and recognition programs.[39] One such project that combined potential stormwater incentives with other objectives including affordable housing was the aforementioned Galen Terrace project in Washington, DC. The on-site stormwater features were expected to lower the building's stormwater fees and could potentially be a revenue source through DC's Stormwater Retention Credit (SRC) trading program.[40] Financial incentives (e.g. reduced fees or increased density allowances) must be carefully designed so that revenue is not impacted significantly. These ideas will require collaboration with Planning and Zoning and support from City leadership.

Create a mechanism to collect dedicated revenue for stormwater programs
Dedicated financing mechanisms can deliver reliable, sustainable support for stormwater management needs, particularly for operations and maintenance costs that cannot be supported through grants or loans. The most common approach, creating a stormwater utility for collecting fees from properties that generate runoff, creates a funding source that can only be used for stormwater programs, eliminating the competition with other general fund priorities. It also facilitates a transformation in how municipalities think about and treat their stormwater services – as important infrastructure and assets that need to be managed comprehensively and proactively. More information about the benefits and administration of stormwater utilities is in Appendix B.

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[39] U.S. EPA. (2009). *Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms*. https://www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf
[40] National Housing Trust. *Sustainability Case Studies*. Retrieved July 20, 2020, from https://www.nationalhousingtrust.org/sustainability-case-studies-0

Chapter 4: Funding Options

There are a variety of funding mechanisms communities turn to for their stormwater improvement needs. Some can be used to fund one-time capital expenses, others for ongoing operations and maintenance costs. Few will cover all of these costs as highlighted in the table below:

Funding Source	Capital	Operations & Maintenance
Grants	Yes	No
Maryland Loan Programs	Yes	No
Bond Financing	Yes	Yes
General Fund	Yes	Yes
Permit Review Fees	No	Yes
Inspection Fees	No	Yes
Utility Rates	Yes	Yes

There are pros and cons to each of these options, and most communities use the blend of these mechanisms best suited to their needs and goals.

Grants

Grants can support the planning, design, and installation of stormwater projects, as well as outreach and education campaigns. One particularly effective approach to using grants for stormwater is for pilot projects that demonstrate practices, engage citizens and elected officials, and build momentum for broader stormwater programming. However, the highly competitive nature and finite timelines of grants make them ineffective at sustainably supporting a stormwater program over time, and few if any can be used for operations and maintenance. In addition, this "free money" comes with management, procurement, tracking, and reporting requirements that can be overly burdensome for municipal staff. Reductions in staffing can make acquiring and managing grants more difficult, as well, especially if the City needs to be the lead applicant for the funding.

Cambridge has done a very successful job to date of pursuing grant funding to support stormwater infrastructure improvements, water quality projects, and other City priorities. Over the last decade, several substantial grants have supported the design and/or implementation of stormwater improvement projects around the City. Approximately $475,000 from the Chesapeake Bay Trust went towards the Long Wharf and Maryland Avenue improvement projects that replaced impervious with permeable pavement and installed other green stormwater features, like bioretention cells and conservation landscaping.[41] Cambridge has also secured grant funds to support the Pine Street Neighborhood Revitalization project, and the City has benefited from grants secured by local partner organizations to install green stormwater infrastructure, conduct outreach to the community, and revitalize housing.

One important way that Cambridge can help offset the costs of proposed stormwater capital improvement projects in the next few years is to continue seeking funding from the Chesapeake and Atlantic Coastal Bays Trust Fund (Trust Fund), offered through the Maryland Department of Natural

[41] Chesapeake Bay Trust. (n.d.) *Cambridge Gateway Green Infrastructure and Long Wharf Park Projects Fact Sheet*. https://cbtrust.org/wp-content/uploads/cambridge.pdf

Resources (DNR). Through the Trust Fund, Maryland municipalities and non-governmental organizations are eligible for stormwater capital improvement funding on "shovel ready" projects if they are located within the Chesapeake and Costal Bay watersheds. The City has received a few grants from the Trust Fund in recent years, including $1.8 million for the Cambridge Creek stream restoration project,[42] and should continue to pursue support from this source in the future to supplement funds from the City and other sources.

Additionally, Cambridge should seek grant funding from the Federal Emergency Management Agency (FEMA) and the Maryland Emergency Management Agency (MEMA) to offset proposed and future capital improvement projects that address stormwater or a combination of stormwater and tidal flooding problems. The City could be a good candidate to receive flood mitigation and possibly pre-disaster/resiliency funding for stormwater retrofits. As these types of projects are included in the County's Hazard Mitigation Plan (HMP), Cambridge should ensure that any priority flood mitigation projects in the City are noted in future County HMP updates. If the City's pending application to the FEMA Flood Mitigation Assistance program (FY2019) is successful, that will provide an excellent opportunity to identify future stormwater and other flood mitigation projects that will be a good fit with FEMA and MEMA funding sources. The City should also become familiar with FEMA's new Building Resilient Infrastructure and Communities (BRIC) program, which is rolling out in 2020 and "replaces the existing Pre-Disaster Mitigation (PDM) program and is a result of amendments made to Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) by Section 1234 of the Disaster Recovery Reform Act of 2018 (DRRA)."

As discussed under the *Take advantage of grants and partnerships* recommendation, working with local partner organizations to submit proposals for projects and initiatives recommended in either the Cambridge Clean Water Advisory Committee (CWAC) 10-year plan or the Cambridge Creek Watershed Assessment and Action Plan (Creek Plan) is a promising approach to accomplish stormwater improvement work. If the Creek Plan is approved by the U.S. EPA, Section 319 (Nonpoint Source Management Program) funding will become available to implement the plan. These funds are administered by the Maryland Department of the Environment (MDE) and must go to local and state entities, so the City would need to be the lead applicant for 319-funded projects in the Cambridge Creek watershed.

Grants should continue to be pursued to support projects with multiple benefits and as a supplement to the City's budget. Grants can enhance current activities related to stormwater but should be considered just a piece of a larger financing program, especially considering grants' limited ability to support the ongoing operations and maintenance needs of stormwater infrastructure, whether it is pipes or rain gardens.

Maryland Loan Programs

The state of Maryland does provide opportunities to acquire loans at low interest rates to municipalities. Maryland's Department of the Environment (MDE) offers these through their Water Quality Revolving Loan Fund. Nonpoint source, green infrastructure, and other water quality protection projects are eligible for the funding. These programs enable the borrower to make costly capital investments up front and pay them off slowly over time. Communities need to demonstrate strong fiscal capacity to

[42] Clipper, P. (2018 February 05). *Cannery Park construction begins*. Dorchester Banner. Retrieved January 22, 2020, from https://www.dorchesterbanner.com/local-history/cannery-park-construction-begins/

qualify for these funds, which can be a challenge for smaller, under-resourced communities. Much like grants, the state loan program will also only cover capital improvement costs, leaving the need to find another revenue source for future operations and maintenance.

The Local Government Infrastructure Finance Program offered by the Maryland Department of Housing and Community Development (DHCD) through the Community Development Administration (CDA) offers another potential avenue for borrowing. It is available for stormwater capital improvements and has agreeable lending terms for municipalities. Much like MDE's loan fund, a community's ability to incur debt obligations will factor into how accessible these funds are.

Bond Financing

Bonds offer another debt mechanism that can be used to finance the capital needs of stormwater management programs. Local governments can use this financing mechanism when they cannot meet stormwater programming demand through general funds and need large sums of money upfront for one-time capital improvement costs.

Much like loan programs, bond financing relies on borrowed funds and the debt must be repaid. In the case of many local governments, bond debt is often paid off through the general fund, which can lead to the underfunding of other government programs in the future. Bond financing is an effective tool for making short-term stormwater management projects possible, but it will not sustain a program over time. It should be noted that engaging in long-range fiscal planning and risk management activities, such as Capital Improvement Planning, disaster mitigation, and climate adaptation, can help the City obtain better terms from lenders.

General Fund

Most local stormwater programs are almost entirely supported with general funds, which are typically collected from property and other taxes. General funds offer the flexibility to be used for both capital needs and operations and maintenance costs. However, because these general funds are not obligated for a particular municipal purpose, community priorities dictate how they are spent, leaving stormwater needs to compete with other critical local needs such as roads, schools, and emergency services.

Permit Review Fees and Impact Fees

These fees specifically target new development and offset the costs associated with the subsequent need to expand or enhance existing stormwater infrastructure. To be sufficient, it is critical to set these fees at a rate that allows the true cost of the service being provided to be recovered. When set properly, these fees can be highly effective at addressing the capital needs of system expansion, but they are not appropriate for the improvement or management of existing stormwater assets.

Stormwater Utility Fees

A utility is an entity that may collect fees for a specific purpose, in this case, to fund a stormwater management program. A stormwater utility fee provides a predictable, dedicated revenue stream that cannot be re-allocated to serve a purpose other than the stormwater program. These fees also offer

flexibility in that they can be used for infrastructure retrofits and replacement, public outreach, operations and maintenance programs, and a variety of other items including staff, training and technology needs. More detail on this approach to funding stormwater programs and how it could look in Cambridge is provided in Appendix B.

Appendix A

Asset Management for Stormwater Systems

While it has become common practice for communities to continuously maintain drinking water and wastewater infrastructure to ensure the health and safety of its users, stormwater infrastructure has not received the same attention. Drinking and wastewater customers make a clear connection between the utility rates they pay and their individual health and safety, enabling robust drinking and wastewater utilities to be set up over time. For stormwater that connection is less clear to the consumer, contributing to underinvestment in stormwater infrastructure that is needed to mitigate the environmental and public health risks associated with impaired waterways.

Although stormwater infrastructure looks and acts differently than drinking water and wastewater, there are many similarities between these sectors of water infrastructure, and asset management provides a framework that can be applied to all of them. In a general context, asset management can be used for making smart decisions with a limited budget. It has become common practice for wastewater and drinking water operators to utilize asset management for making decisions about investing in the physical infrastructure that conveys and treats these essential utilities in modern American communities, repairing and replacing assets strategically so that the risk is reduced for all users. In this case, the only difference between waste and drinking water and stormwater is the physical infrastructure, both green and gray, that is necessary to convey and treat the water. But the same process can be used for developing an asset management program to help guide strategic decision-making.

Five core components of asset management

1. Current State of Assets – Inventories all of the physical components of the facility and/or conveyance system. It is the most straightforward aspect of asset management.
2. Level of Service – Enables goal setting for the facility and/or conveyance system regarding the services to the City wants to provide.
3. Criticality – Used to determine which assets are the most vital to the sustained operation of the facility and/or conveyance system.
4. Life Cycle Costing – Builds upon the information regarding the first three components – what assets the City owns, what the City wants them to do, and which ones are critical to sustaining operations, which provides a framework to start making informed decisions about the operation, maintenance, and replacement of assets.

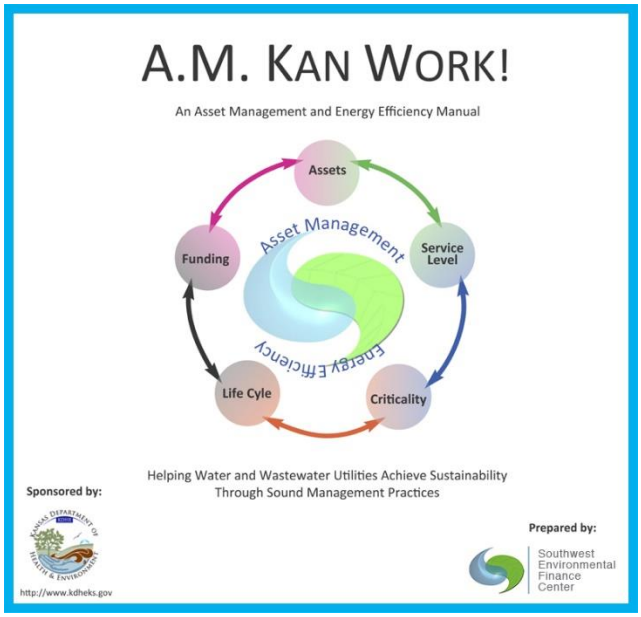

Diagram credit: Southwest Environmental Finance Center

5. Long-term Funding – Managers must determine how much money they need to operate and maintain the assets and how much they need to replace or rehabilitate the assets over time. It is important to determine how to maintain adequate funding over time to achieve a desired level of service identified throughout the process of developing an asset management program.

Asset management examples and resources

- Scranton, PA – The UMD EFC worked with the City of Scranton in 2014 to produce a customized guide about how to apply asset management to stormwater in the City. Although Scranton is considerably larger than Cambridge and is subject to more water quality regulations, including MS4 permit obligations, this short guide can serve as a good example for how Cambridge might adopt an asset management framework for its stormwater program.
- *A.M. Kan Work!* – This is an asset management and energy efficiency manual sponsored by the Kansas Department of Health & Environment and prepared by the Southwest Environmental Finance Center. An important element of the Scranton project mentioned above included staff training on asset management using this manual, which was led by Southwest EFC staff. More information, including downloadable and online versions of the manual and videos, is available from: http://southwestefc.unm.edu/asset-management-manual/.
- U.S. EPA Region 9 and U.S. Environmental Protection Agency Office of Science and Technology. (2017) Asset Management Programs for Stormwater and Wastewater Systems: Overcoming Barriers to Development and Implementation. EPA Contract No. EP-C-14-003. https://www.epa.gov/sites/production/files/2018-01/documents/overcoming-barriers-to-development-and-implementation-of-asset-management-plans.pdf

Appendix B

Stormwater Utility Fees

A utility is an entity that may collect fees for a specific purpose, in this case, to fund a stormwater management program. A stormwater utility fee provides a predictable, dedicated revenue stream that cannot be reallocated to serve a purpose other than the stormwater program. These fees also offer flexibility in that they can be used for infrastructure retrofits and replacement, public outreach, operations and maintenance programs, and a variety of other items including staff, training and technology needs.

Stormwater utility fees have increasingly become a "go-to" solution to funding stormwater management programs in the U.S. In 1994, the EPA reported the existence of approximately 100 utilities around the country. The Western Kentucky University Stormwater Utility Survey of 2019 documents more than 1,700 stormwater utilities throughout 40 states and the District of Columbia. The scale of these fees vary from community to community. The 2019 study from Western Kentucky University reports that the average monthly single family residential fee in the surveyed communities was $5.85.[43]

Following a model similar to what is used by a water and wastewater utility, stormwater utilities charge a recurring (usually monthly or quarterly) user fee to property owners to pay for the stormwater services they receive. The most equitable fee systems consider the amount of stormwater "produced" on a particular parcel and use the amount of impervious surface (land that does not permit the absorption of rainwater) on the property as the metric the fee is based on. In other words, a property owner would be assessed a fee in proportion to the amount of driveway, rooftop, patio, parking lot, and other paved areas on the property.

Many communities choose to set up a rate system based on a factor called an Equivalent Residential Unit (ERU). Once an average amount of impervious surface for a single family residential parcel is determined, an ERU (the square footage on a property that is expected to be impervious) is established. The ERU is then used to determine the amount a parcel is charged, sometimes as a flat fee and sometimes as a tiered system. Fees for non-residential properties are typically assessed by multiplying the ERU times the non-residential parcel size.

Stormwater utility fees offer a number of advantages over other funding and financing mechanisms for supporting stormwater program needs:

- Stormwater utility fee revenue is dedicated and predictable and can only be used for stormwater programming. Programs that rely on tax-based general fund revenue can be less reliable because property values, sales, and incomes fluctuate, and this puts stormwater programs in the position of having to compete, year-to-year, with other critical local services and programs funded by taxes.
- Stormwater utility fees are often viewed as more equitable because the fee is based on a property's impervious surface and reflects the property's contribution to stormwater runoff.
- Creating a utility treats the stormwater system as infrastructure that must be planned for, invested in, and maintained like other critical community infrastructure.

[43] Campbell, W. (2019). *Western Kentucky University Stormwater Utility Survey 2019*. https://www.wku.edu/seas/undergradprogramdescription/swusurvey2019.pdf

- A stormwater fee structure can be designed to take into account a community's unique characteristics. They can designed to consider housing type, lot size, proportion of industry to residential to government-owned properties, local demographics, the population's ability to pay, and other factors that may be unique.
- Stormwater utility fees that include credit systems can be a powerful driver for engaging private property owners in addressing stormwater management needs. Credit systems can create an economic incentive for property owners to minimize impervious surface.
- Stormwater utility fees can be charged to tax-exempt properties, meaning that government buildings, places of worship, and schools and nonprofits, who often have large footprints, will be paying for the stormwater management services they are receiving.

Setting up a stormwater utility fee can also present challenges that should also be taken into account that can include:

- If the stormwater utility fee cannot be folded into an existing billing system, administrative hurdles at project onset could require startup funding to set up a new billing system, manage billing and administration, and respond to public inquiries.
- Public education for citizens, municipal staff, and elected officials is essential to the success of establishing a stormwater utility fee. This may require direct funding or in-kind funding at the local level, possibly through grants or partnerships. A 2010 Black and Veatch Stormwater Utility Survey reported that 70% of the communities surveyed believed that "organized ongoing public information/education were essential to a stormwater utility fee."[44]
- Stormwater utility fees are typically based on impervious surface, so the impervious surface of each property must be calculated (or a community may choose to assess the impervious surface of a set of representative properties). This typically requires the use of geographical information systems (GIS) as well as an employee to interpret this data, which presents another cost to local governments.

Other small- and medium-sized communities in Maryland with stormwater utilities and fees

The Town of **Berlin** passed legislation in January 2013 to create a stormwater utility and establish a stormwater fee. The Town is not subject to state or federal stormwater regulations (such as an MS4 permit) but needed to address recurring stormwater and flooding issues. The EFC completed a study on how Berlin should best handle these issues and recommended creating a sustainable, dedicated funding source to pay for their stormwater program and projects. The fees ($50/year for residential properties and townhouses and $25/ERU for non-residential properties) have generated revenue that the Town has used as match to secure grants to complete capital projects. They are currently considering raising the fees because, according to the mayor, "'we've got some big projects ahead of us and we're going to have to put up our fair share.'"[45] The EFC study and a brief fact sheet can be viewed on their website.

The City of **Salisbury** enacted a stormwater utility as part of their Public Works Department in 2015, after contracting with EFC to conduct a feasibility study.[46] They established a $20 per ERU fee and allow

[44] University of Maryland Environmental Finance Center. (2012). *Financing Feasibility Study for Stormwater Management in Berlin, Maryland*. https://berlinmd.gov/wp-content/uploads/2014/03/BerlinStormwaterFeasibilityStudyFinalReport1.pdf

[45] Sharpe, C. (2020 May 14). *Berlin Discusses Utility Fee Increases*. Retrieved from https://mdcoastdispatch.com/2020/05/14/berlin-discusses-utility-fee-increases/.

[46] DispatchAdmin. (2015 March 26). *Salisbury Sets Stormwater Utility Fee*. Retrieved from https://mdcoastdispatch.com/2015/03/26/salisbury-sets-stormwater-utility-fee/.

credits for certain types of on-site stormwater systems on properties that are not designated as single-family residential use. Details of the legislation are available on Municode.

The Town of **Oxford** formed a Stormwater Task Force and contracted with EFC to conduct a study on how the Town could address their recurring stormwater and tidal driven flooding. The result was passage in 2014 of a Stormwater Management and Shoreline Protection Fee, which recognized the interconnectedness of their stormwater and tidal flooding problems. The enabling legislation allows the Town flexibility to set a fee, a tax, or a combination of the two options.

Fee and revenue scenarios for Cambridge

A stormwater utility fee could provide Cambridge with a stable, reliable source of funding to meet much of the City's ongoing stormwater programming needs. To illustrate the potential impacts of a fee, the Project Team developed hypothetical fee scenarios and calculated potential revenue by using a flat rate fee for single-family residential parcels and an Equivalent Residential Unit-based (ERU) fee structure for multi-family and non-residential properties.

Development of hypothetical rate structures for single-family residential properties
Some small communities who have stormwater utility fees have chosen to set a flat rate fee for residential parcels and that is the approach laid out for these example scenarios. A parcel-specific fee structure usually requires additional capacity to properly estimate the total impervious surface on all residential properties in the community. Based on EFC's experience with stormwater utilities in other communities, calculating the level of impervious surface on every residential property can cause significant administrative burden. In addition to this being a large up-front effort, the risk of errors on bills may cause confusion about the billing calculation and increase the risk of complaints from the residential population. Additionally, in many communities there is not a large enough spread among the sizes of the residential units to make the task of developing unique bills for thousands of single-family parcels worthwhile. Multi-family units are commonly suggested to be treated as non-residential properties, however, meaning that these buildings' owners or management firms would be billed as commercial properties and can then determine how best to recuperate these costs from their buildings' residents.

Development of hypothetical rate structure for multi-family and non-residential properties
Because the size and nature of non-residential units vary widely, it is usually suggested that a parcel-based rate structure--that takes a parcel's specific level of impervious surface into account--would be the fairest method of assessing a stormwater fee on these properties. Calculating the impervious surface for non-residential properties is a feasible, practical, and appropriate task given specific software and training. An impervious cover dataset was under development for Dorchester County but was put on hold in 2019; this is the type of data that can be used to develop custom estimates for the impervious surface of each commercial building. Although the size of some properties may be significant, the total number of non-residential properties to be analyzed is much smaller than the number of residential properties in nearly any community.

For these non-residential parcels, a utility fee can be calculated based on each property's total impervious surface. For example, if a commercial property is estimated to have an impervious surface of 1.13 acres (out of a parcel size of 1.57 acres) and each ERU is equal to 0.10 acres, the property would be billed for 11.3 ERUs. If each ERU costs $36 per year, the total bill per year for this business would be

$407. It is typically recommended that all non-residential properties, regardless of status (governmental, non-profit, etc.) should be assessed a stormwater utility fee based on its contribution to stormwater runoff volumes.

For the sake of illustration, the project team used average impervious cover estimates generated from a sample of communities within the Chesapeake Bay watershed. For more information on these estimates and on how to develop them for your own community, see Impervious Cover and Land Use in the Chesapeake Bay Watershed.[47] As this is a hypothetical fee scenario, three fee levels were used to illustrate a range of estimated annual costs and revenues. The ERU was set to 0.10 acres, which is close to the average amount of impervious surface area on single-family residential parcels. The 2019 average monthly single family residential fee from the Western Kentucky University survey of stormwater utilities was $5.85, which is approximately $70 per year. This amount was used for the upper end of these estimates. Lower fees of $3/month or $36/year and $4/month or $48/year were also used. These flat fees (which are essentially the ERU values) were applied directly to single-family residential parcels. To calculate the fees for other parcel types, the average amount of impervious surface for each type was translated into the average number of ERUs and then the corresponding ERU fee was multiplied by each parcel category's average number of ERUs.

Hypothetical fees and estimated total revenue from all properties
The estimated total revenue generated is distributed between residential and non-residential properties and is calculated as follows:
Residential – The single-family residential properties would yield between approximately $228,000 and $444,000 per year based on a fixed yearly rate of $36 to $70 on 6,338 residential properties. As multi-family parcels are very small, their fees would add $2,600 to $5,100 per year in revenue to the residential category.

Non-Residential – The non-residential properties could generate between $462,000 and $898,000 each year based on a $36-70 per ERU per year rate on 896 parcels.

Total -- The total revenue per year, using the hypothetical rate structures for all properties, ranges between $693,000 and $1,347,000. These estimates include "exempt" parcels, which comprise one-third of all non-residential parcels. Parcels in the exempt category have larger average lot sizes than residential and commercial parcels in Cambridge, and they likely contain parking lots and larger buildings, so they contribute to the City's stormwater runoff and have not been excluded from these example fee scenarios.

[47] Cappiella, K., and Brown, K. (2001). *Impervious Cover and Land Use in the Chesapeake Bay Watershed*. Center for Watershed Protection. Retrieved from https://owl.cwp.org/mdocs-posts/impervious_cover_and_land_use/

The table below illustrates how three different ERU values would translate to fees for average parcels in each category as well as the potential revenue from each ERU level.

Hypothetical stormwater fee and revenue scenarios for properties in Cambridge

Cambridge, MD Parcels by Type	Total Number of Parcels	Average Lot Size (Acre)	Percent Impervious Surface Applied*	Average Impervious Area (Acre) by Type	Average # ERUs	Average annual fee per parcel			Total Annual Revenue		
Annual Fee per ERU						$ 36.00	$ 48.00	$ 70.00	$ 36.00	$ 48.00	$ 70.00
Residential Parcels											
Apartments	18	0.8924	44.4%	0.3962	3.96	$142.64	$ 190.19	$ 277.36	$ 2,568	$ 3,423	$ 4,992
Residential**	6,338	0.4334	22.0%	0.0953	1.00	$ 36.00	$ 48.00	$ 70.00	$228,168	$304,224	$ 443,660
Residential Condominium	162	0.00152	40.9%	0.0006	0.01	$ 0.22	$ 0.30	$ 0.44	$ 36	$ 48	$ 70
Town House	26	0.0133	40.9%	0.0054	0.05	$ 1.96	$ 2.61	$ 3.81	$ 51	$ 68	$ 99
All Residential Parcels	6,544	0.4223							**$230,823**	**$307,764**	**$ 448,822**
Non Residential Parcels											
Agricultural	26	29.7962	1.9%	0.5661	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Commercial	522	1.5647	72.2%	1.1297	11.30	$406.70	$ 542.26	$ 790.80	$212,296	$283,061	$ 412,797
Commercial Residential	4	0.5833	40.9%	0.2386	2.39	$ 85.89	$ 114.51	$ 167.00	$ 344	$ 458	$ 668
Exempt***	115	8.0396	30.0%	2.4119	24.12	$868.28	$1,157.70	$1,688.32	$ 99,852	$133,136	$ 194,156
Exempt Commercial***	177	5.5596	30.0%	1.6679	16.68	$600.44	$ 800.58	$1,167.52	$106,277	$141,703	$ 206,650
Industrial	52	4.2931	53.4%	2.2925	22.93	$825.31	$1,100.41	$1,604.76	$ 42,916	$ 57,221	$ 83,448
All Non Residential Parcels	896	4.1581							**$461,684**	**$615,579**	**$ 897,720**
All Parcels	7,440	0.8722							**$692,507**	**$923,343**	**$1,346,541**

1 ERU = 0.10 average amount of impervious surface per acre

*From CWP 2001 estimates

** 1/2 acre lot = 21.2%, 1/4 acre lot = 27.8%; compromised by rounding to 22%

*** Exempt parcels are a mix of municipal, school, church, etc.; using a lower impervious surface estimate of 30%

Appendix C

Street sweepers and vac trucks

Equipment needs in Cambridge

One of the immediate stormwater management priorities identified by City staff is the purchase of a new street sweeper. The current equipment is too small and not always functioning, but the City needs a truck to be running full-time to meet their objectives. Ideally, Cambridge would have one sweeper running full-time and one running part-time. The City first obtained quotes for a larger sweeper with a suction hose feature that would enable them to more easily implement their plans for twice-annual stormwater catch basin cleaning, in addition to being more reliable. However, staff have identified an alternate piece of equipment that is already on hand that can help with catch basin cleanouts, so another quote was obtained for a mechanical sweeper without vacuum functionality. Potential models have been chosen to avoid needing operators with commercial driver's licenses (CDL), which means the City will have a larger pool of potential operators, making it easier to keep the sweeper in operation for the desired number of hours. Funds to go towards the new sweeper were passed in the FY21 budget but concerns about costs remain due to pandemic-related financial issues.

Local examples

The Town of Easton has two street sweepers that they run daily to keep streets and parking lots clean and to remove particulates before they enter storm drains. They used funds from the Sanitation capital budget to purchase the sweepers and cover the annual operations and maintenance costs of approximately $60,000 with tax revenue and budget allocations. Two full-time employees operate the sweepers. The Town also has a vac truck that they use to clean their 450 catch basins annually.[48]

Salisbury's street sweeping division, housed within the Field Operations Department, is **fully funded through the City's stormwater utility fees**. They estimate their annual costs to run around $300,000. Maintaining employees to run sweepers has sometimes been a challenge, but the program has yielded "a huge benefit for [their] MS4 program" in addition to keeping their streets clean.[49]

Shared service agreements (SSAs)

A common arrangement for communities that are too small or do not have the budget to purchase their own street sweeper or other equipment is to enter into a shared service agreement with a nearby community or with the county in which they are located. Some examples of this type of arrangement around the Mid-Atlantic are highlighted below.

In Prince George's County, Maryland, the Four Cities Coalition of Greenbelt, Berwyn Heights, College Park, and New Carrollton share a street sweeper. In Greenbelt, the sweeper services all City streets at least eight times per year.[50]

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[48] T. Leigh, personal communication, June 17, 2020

[49] Ibid.

[50] Prince George's County Department of the Environment. *2018 Annual NPDES MS4 Supplemental Report*. https://www.princegeorgescountymd.gov/DocumentCenter/View/24860/2018-NPDES-MS4_Phase-II-Supplemental_Report

Ten Boroughs in the Wyoming Valley of Pennsylvania pooled funds to purchase and share equipment, including a $131,000 street sweeper and a vac truck.[51] https://www.pahomepage.com/news/forty-fort-9-other-boroughs-partner-to-buy-shared-street-sweeper/

Matawan Borough and Keyport, New Jersey have a shared service agreement in place for Keyport to use Matawan's sweeper instead of buying their own. They are allowed to use it up to three times per week for $300 per use, to a maximum of $20,000 per year.[52] https://patch.com/new-jersey/matawan-aberdeen/matawan-and-keyport-enter-shared-service-agreement-fo582e8b66b6

A variety of equipment-sharing arrangements are in place in Bergen County, New Jersey. The Borough of North Arlington, NJ has an agreement to use a county sweeper on an as-needed basis. "The move is part of Bergen County Executive James J. Tedesco and the Board of Chosen Freeholders' vision of offering County services to Bergen County's 70 municipalities to increase efficiency and provide savings to taxpayers."[53] The county has passed similar street sweeper contracts with eight towns. Three coops have formed within Bergen County to "share equipment that would have been too costly for one community to procure on its own. The 11 towns in the Pascack Valley Co-Op share a sewer vacuum."[54] https://dailyvoice.com/new-jersey/lyndhurst/news/street-sweeper-rolls-into-north-arlington/690754/ https://co.bergen.nj.us/shared-services

Gloucester County, New Jersey makes their sweeper available to Paulsboro as needed at $350/day with a 2-year Shared Services Agreement term. The Resolution can be viewed at http://www.co.gloucester.nj.us/civica/filebank/blobdload.asp?BlobID=5858.

[51] Hiller, M. (2014, May 08). Forty Fort, 9 other Boroughs Partner to Buy Shared Street Sweeper. Retrieved June 19, 2020, from https://www.pahomepage.com/news/forty-fort-9-other-boroughs-partner-to-buy-shared-street-sweeper/

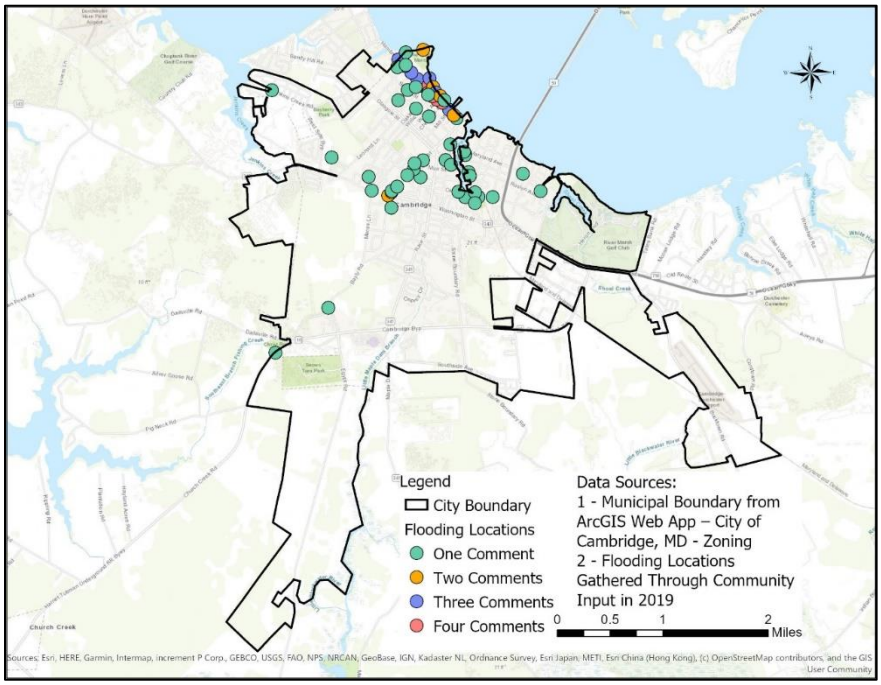
[52] Naso, C. (2013, April 19). Matawan and Keyport Enter Shared Service Agreement for Street Sweeper. Retrieved June 19, 2020, from https://patch.com/new-jersey/matawan-aberdeen/matawan-and-keyport-enter-shared-service-agreement-fo582e8b66b6

[53] Levine, C. (2016, November 22). Street Sweeper Rolls Into North Arlington. Retrieved June 19, 2020, from https://dailyvoice.com/new-jersey/lyndhurst/news/street-sweeper-rolls-into-north-arlington/690754/

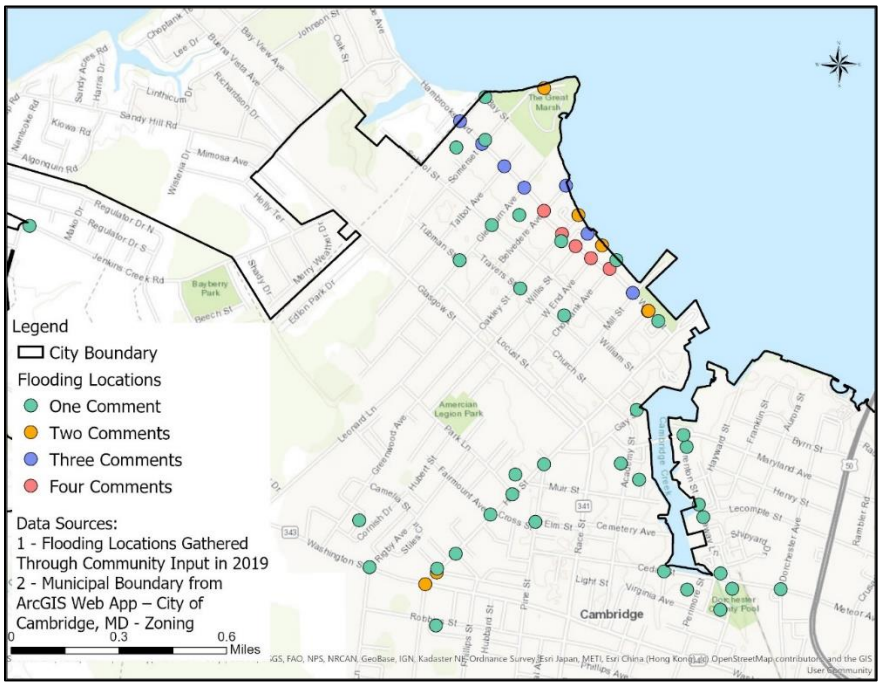
[54] Bergen County, New Jersey. Shared Services. Retrieved June 10, 2020 from https://co.bergen.nj.us/shared-services

Appendix D

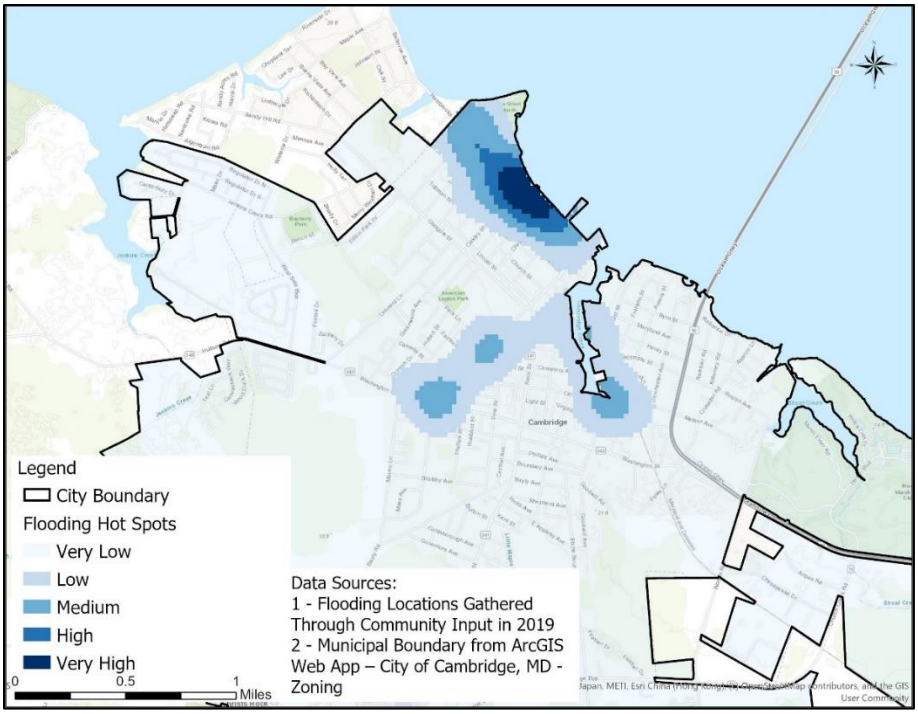
Spatial analysis and maps



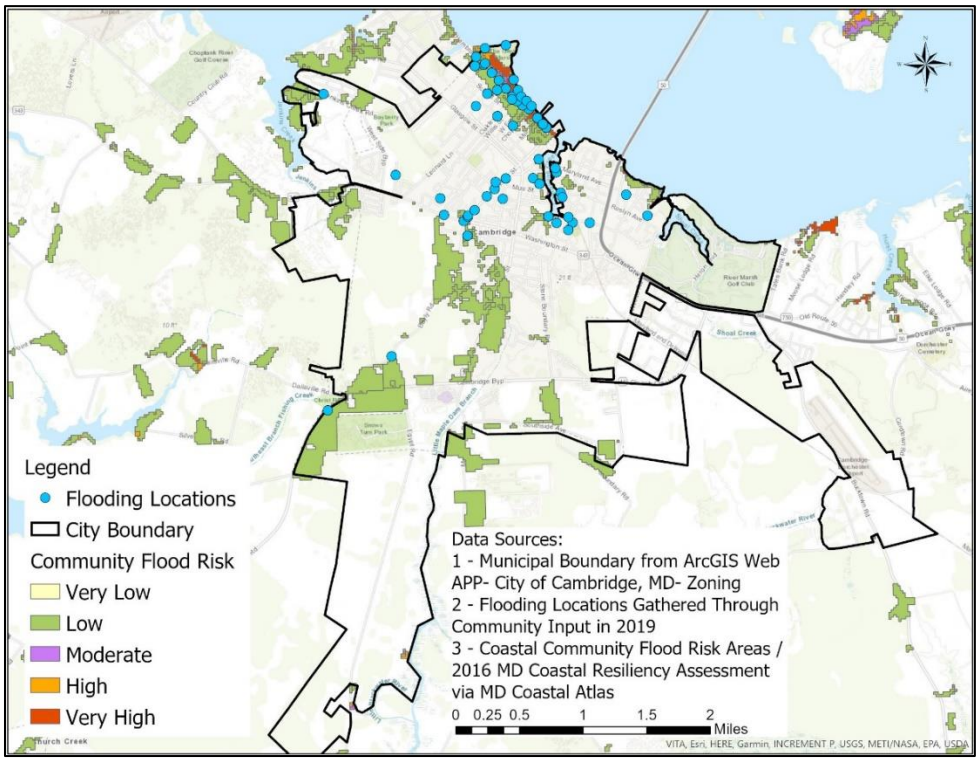
Flooding problem spots submitted by residents who participated in workshops or events at which EFC provided maps and solicited their comments. Locations are approximate.



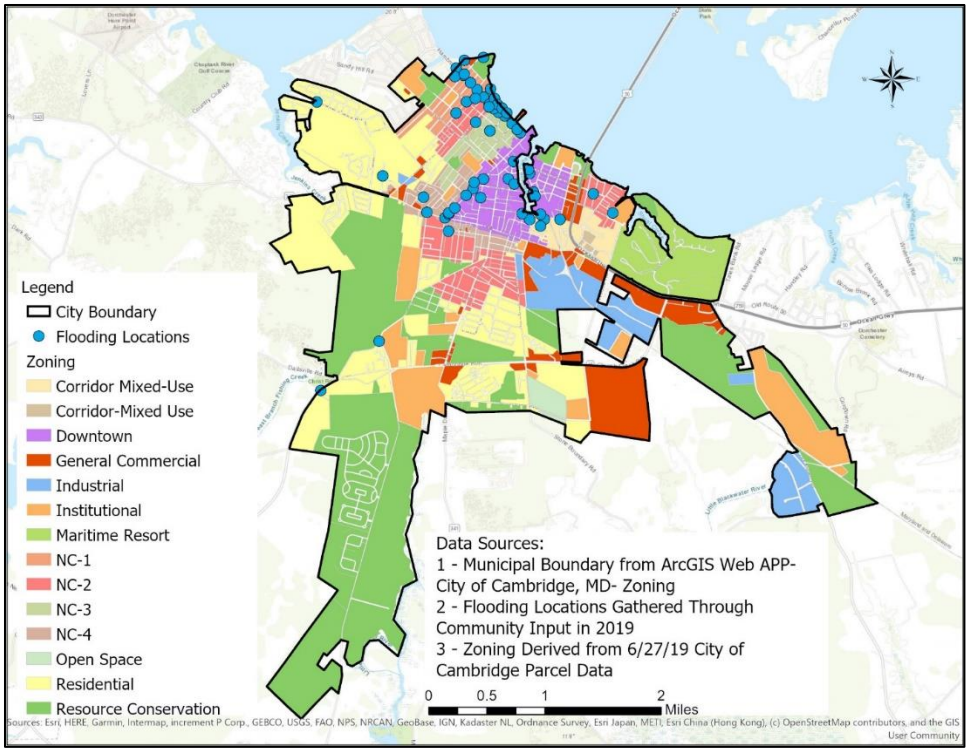
Close-up of flooding problem spots submitted by residents.



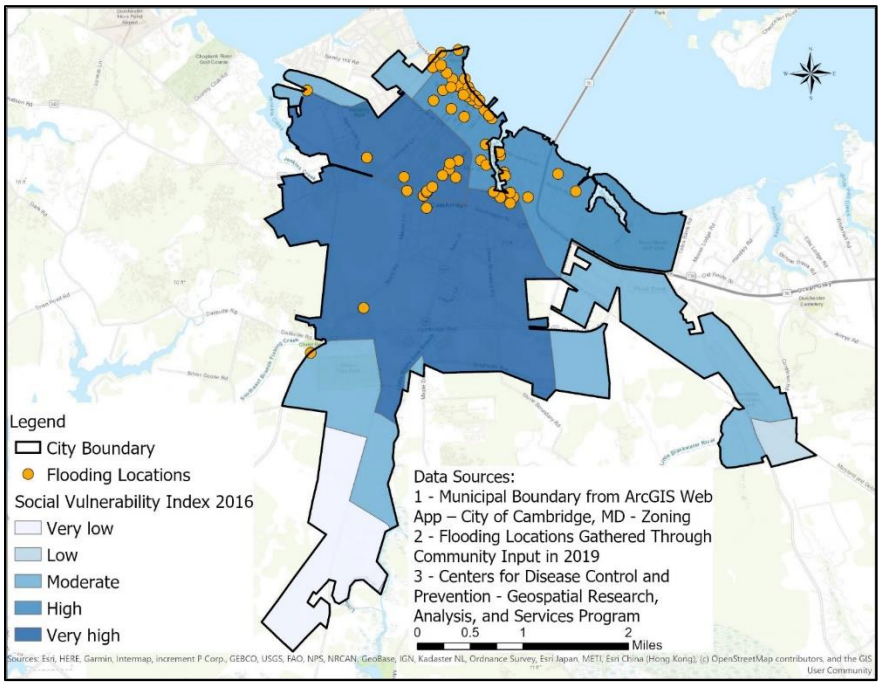
Density analysis of flooding problem spots.



Flooding hot spots next to the Maryland Coastal Community Flood Risk Areas. More points were found outside (35) of coastal flood risk areas versus inside (25).

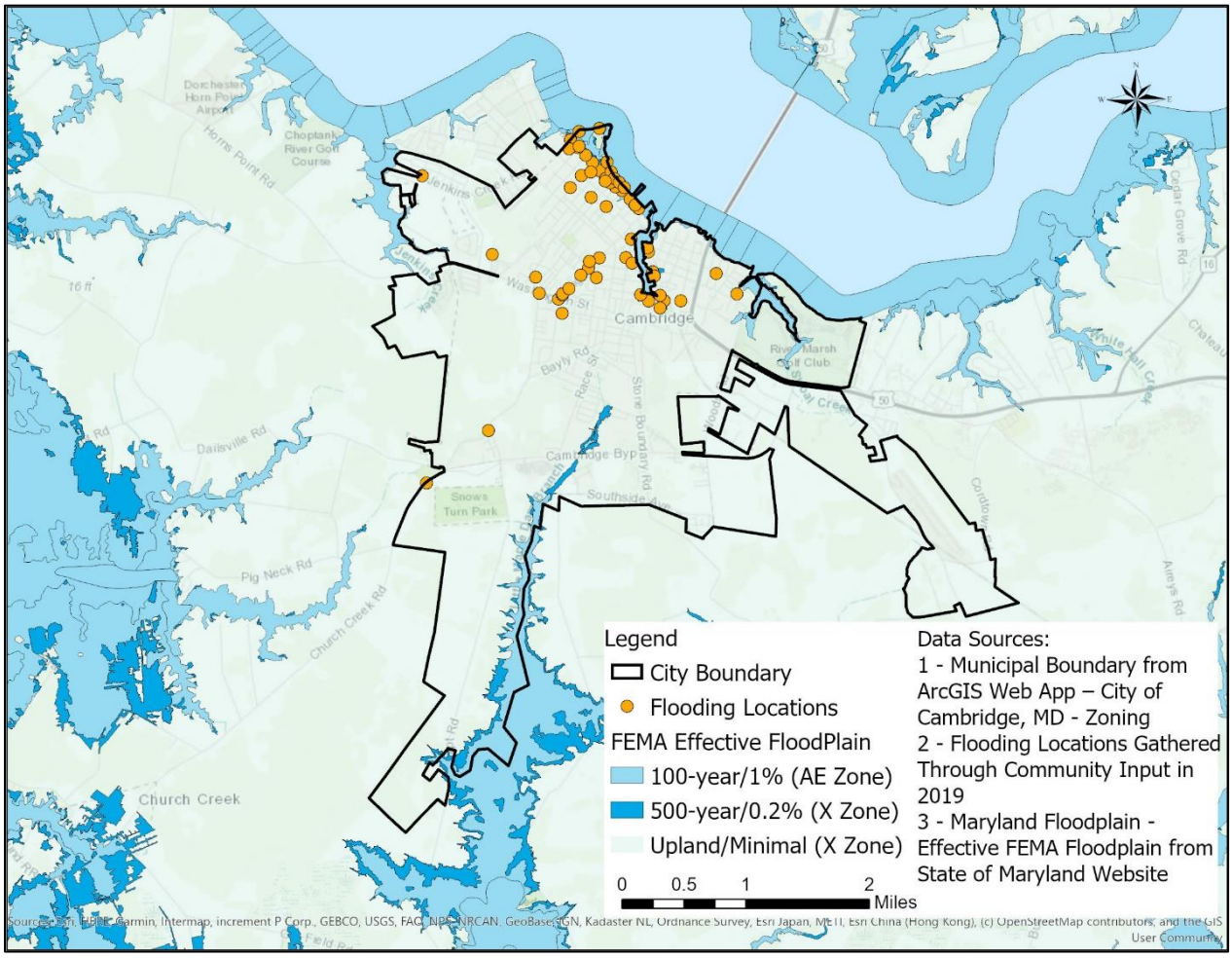


Flooding problem spots and zoning.



Flooding problem spots and the CDC's Social Vulnerability Index (SVI), which "ranks each [Census] tract on 15 social factors, including poverty, lack of vehicle access, and crowded housing." These factors "may weaken a community's ability to prevent human suffering and financial loss in a disaster."[55]

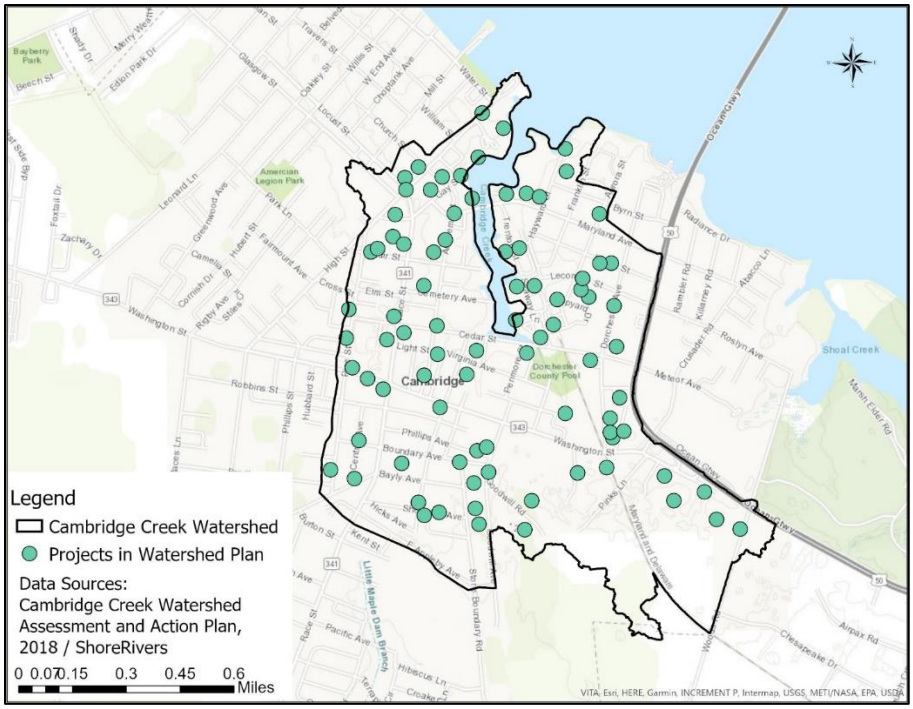
[55] Centers for Disease Control and Prevention. *Fact Sheet: What is social vulnerability?* Retrieved September 25, 2019, from https://svi.cdc.gov/factsheet.html



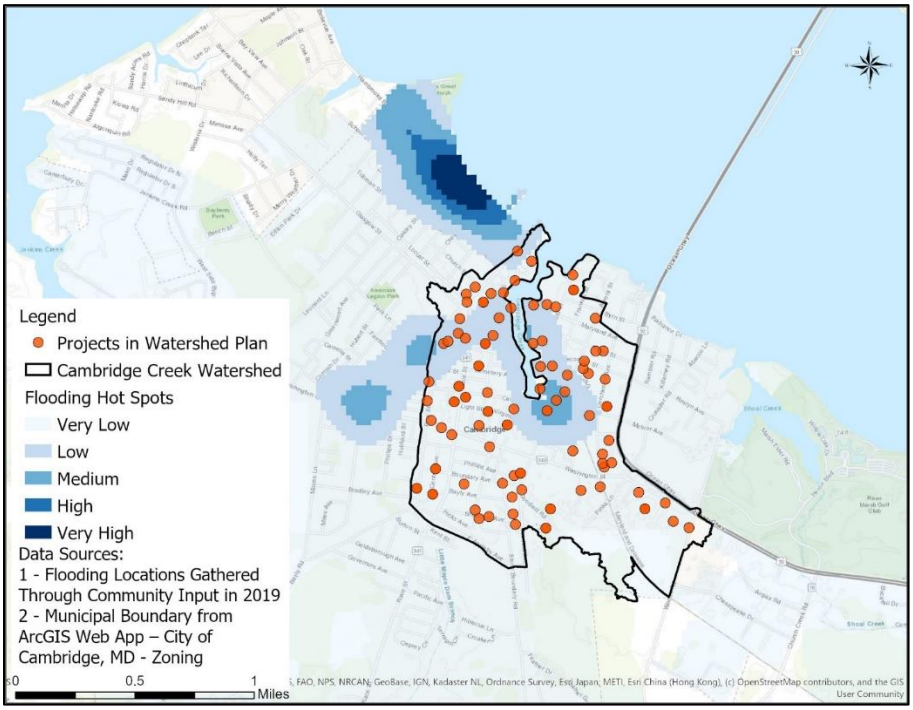
Flooding problem spots next to current FEMA regulatory floodplains. Note that most points are outside of mapped floodplains and thus are not subject to the City's/County's floodplain regulations.

Projects from the Cambridge Creek Watershed Assessment and Action Plan (2018)

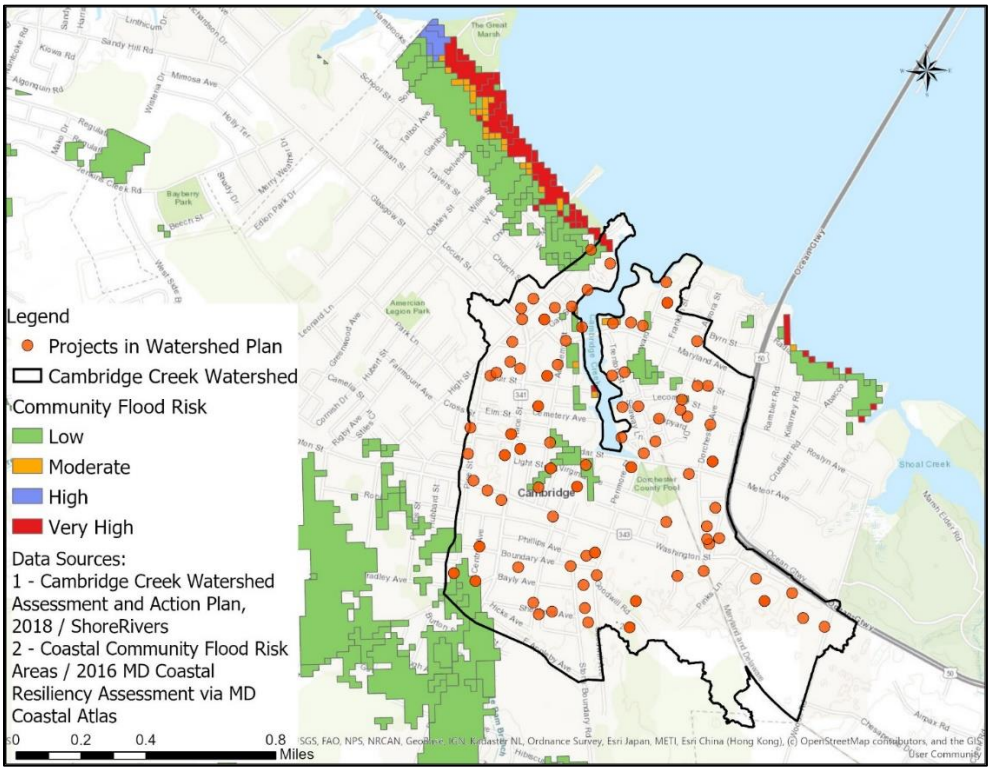
Projects identified in the Cambridge Creek Watershed Assessment and Action Plan were digitized and assessed alongside other relevant information to highlight potential cost efficiencies and help the City and local partner organizations prioritize their investments.



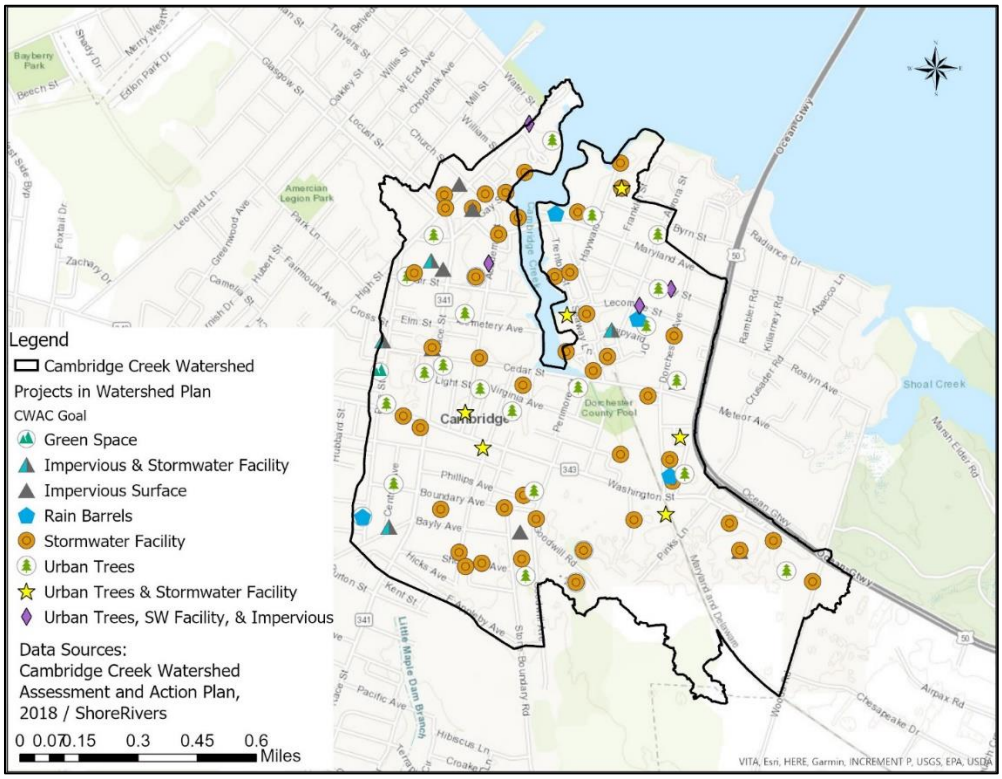
Locations of projects from the Cambridge Creek Plan.



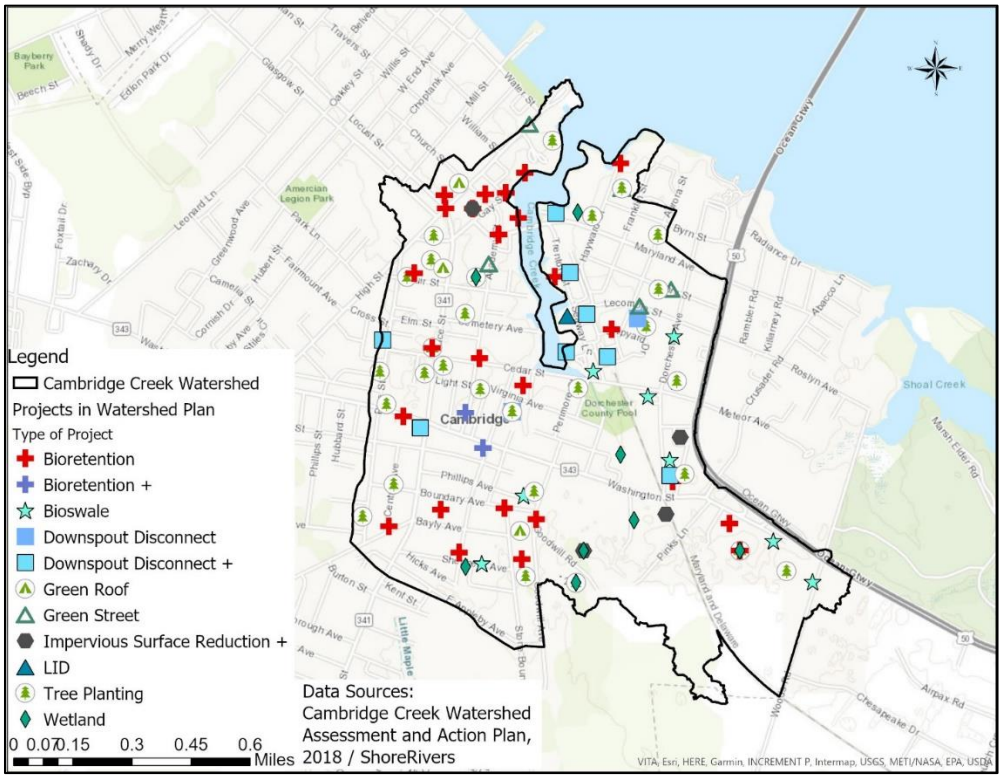
Flooding hot spot density analysis and Cambridge Creek Plan projects.



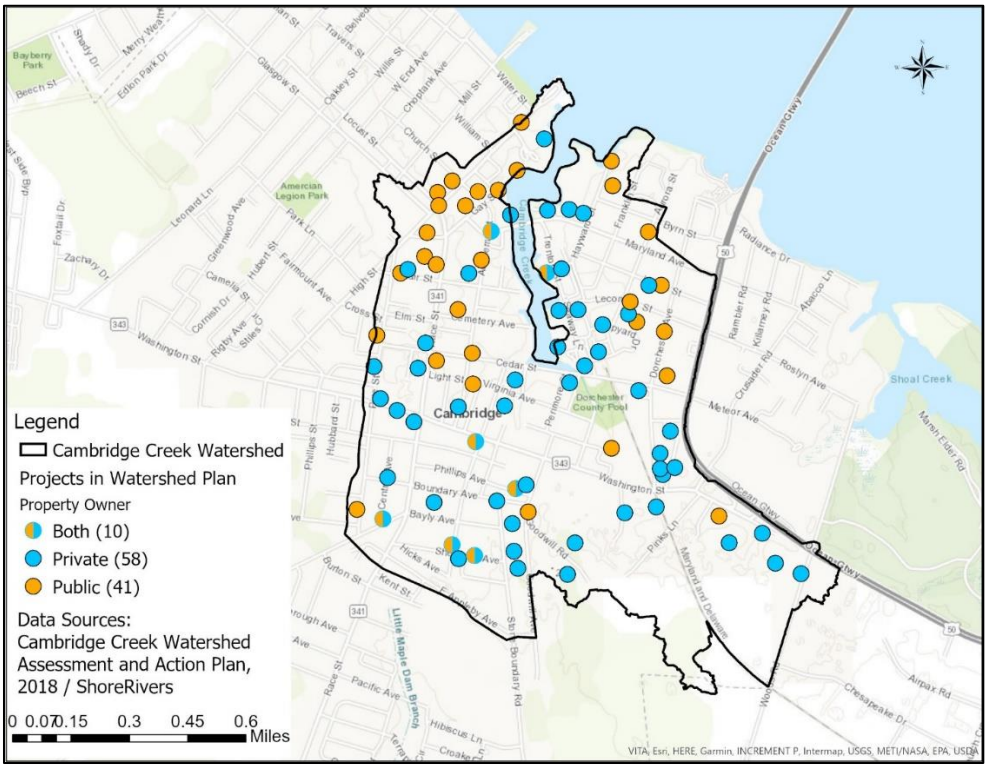
Maryland Coastal Community Flood Risk and Cambridge Creek Plan projects.



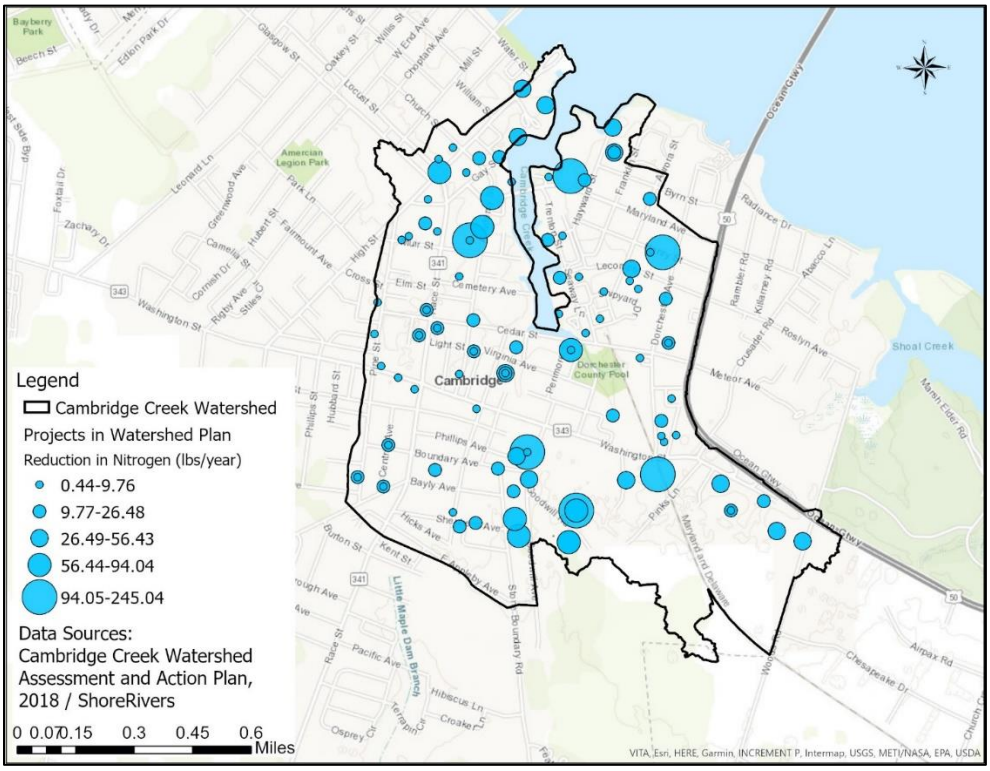
Creek Plan projects according to which Clean Water Advisory Committee (CWAC) goal(s) they meet.



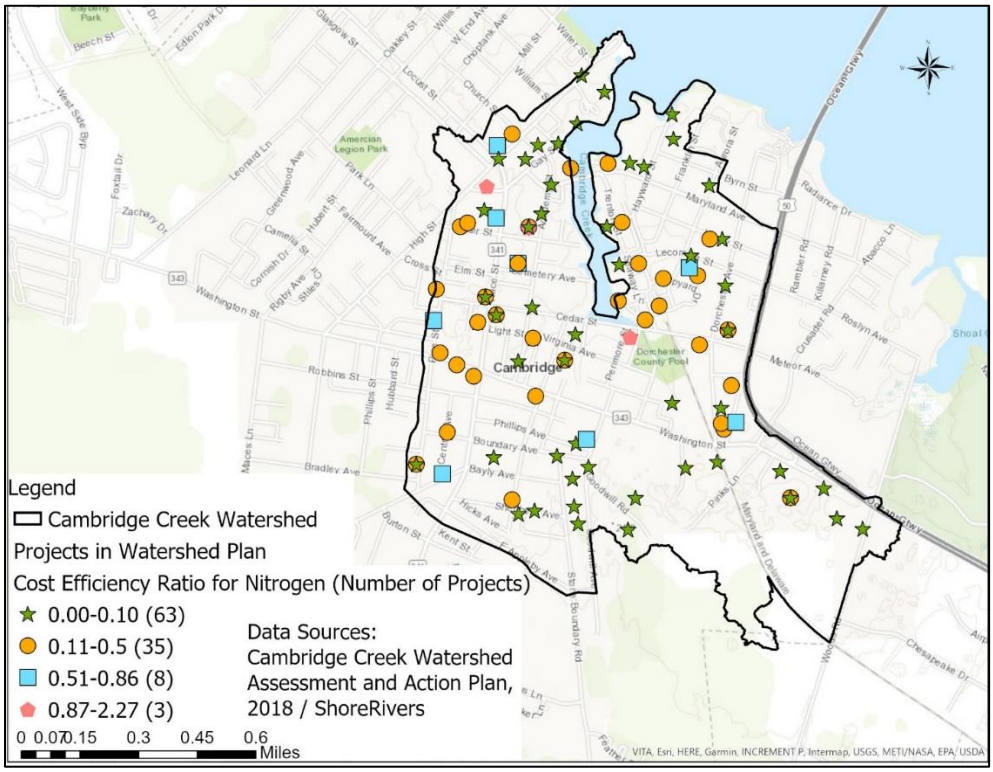
Cambridge Creek Plan projects according to type of project.



Cambridge Creek Plan projects by property ownership.



Cambridge Creek Plan projects ranked by annual nitrogen reduction potential.



Cambridge Creek Plan projects and their nitrogen removal cost efficiency ratio.

Project Team & Acknowledgements

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Lan Song, Graduate Student Assistant, Geospatial Information Sciences (GIS) Master's program

Project Partners:
Chesapeake Bay Foundation
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ShoreRivers

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Clean Water Advisory Committee members
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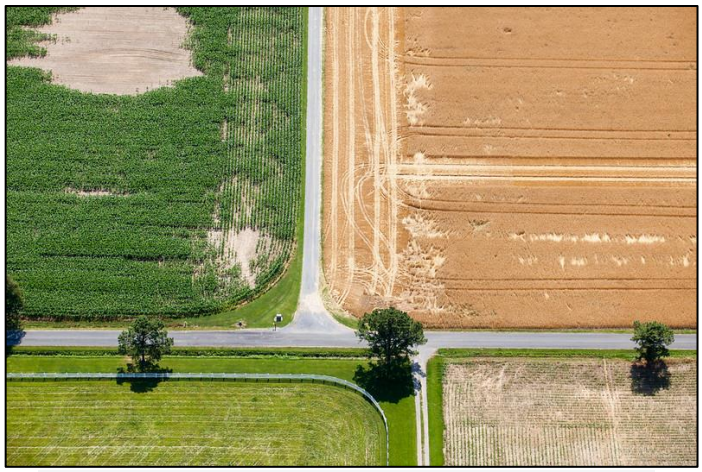
UMD Sea Grant Extension

All photo credits: UMD Environmental Finance Center, unless otherwise indicated



Will Parson/Chesapeake Bay Program with aerial support by LightHawk

About the Environmental Finance Center at the University of Maryland
The Environmental Finance Center at the University of Maryland is part of a network of university-based centers across the country that works to advance finance solutions to environmental challenges. Our focus is protecting natural resources by strengthening the capacity of decision-makers to analyze challenges, develop effective financing methods, and build consensus to catalyze action. Through research, policy analysis, and direct technical assistance, we work to equip communities with the knowledge and tools they need to create more sustainable environments, more resilient societies, and more robust economies. The Environmental Finance Center is housed within the School of Architecture, Preservation and Planning.

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ENVIRONMENTAL FINANCE CENTER

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Recommended Resources and References

Recommended Resources

Municipal Online Stormwater Training (MOST) Center

Maryland Sea Grant Extension

EPA's green infrastructure webcast series

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