--Stormwater Management--

ONE WATER VISION: Integrate flood protection and water quality enhancement into a unified system of stormwater management

PATHWAYS TO THE VISION

	Evolve canal management activities toward the need for minimal human intervention, promoting nature-based pollutant attenuation systems and mechanical management where viable.
	Conduct stormwater maintenance optimization process, identifying waterway-specific maintenance needs and upgrading maintenance communications/logistics.
	Address portions of the county that are exempt from current stormwater regulations by implementing stormwater mitigation incentives and features for lands outside of the county's MS4 system.
	Position the county as an incubator for emerging technologies to address water quality and quantity challenges
	In concert with complementary strategies such as the county's Watershed Master Plan and Vulnerability Assessment, identify opportunities to expand and/or enhance current stormwater management infrastructure.
	Using data acquired as part of comprehensive water quality and pollutant loading assessment efforts, identify and expand water quality improvement infrastructure within the county's MS4 system as needed, with the goal to meet water quality improvement standards in the 2024 stormwater rule.
	Increase outreach efforts among residents along county canal systems through stewardship and education programs.

CURRENT VISION TASKS

Categories	Task	Anticipated Regional Benefits
	Initiate the first phases of the stormwater maintenance optimization process, identifying waterway-specific maintenance needs and upgrading maintenance communications/logistics.	
	Review and Revise the County Stormwater Master Plan as needed, incorporating portions of the county not currently included in the Plan, and identifying opportunities for enhancing stormwater treatment and levels of service in light of revised 2024 stormwater	

Categories	Task	Anticipated Regional Benefits
	rule, and newly-acquired information on flood risks due to current and future coastal storm surge scenarios.	
	Install water elevation monitoring networks to track flow rates, flood risk, and tidal influence on water drainage in the region.	
	Based on output from the county Vulnerability Assessment and Watershed Master Plan, develop predictive tools as needed for stormwater runoff and drainage rates to assist in: -prioritizing enhanced water management in areas of higher flood risk. -developing predictive flood risk tools to assist in evaluating impacts of changing land use in an area.	
	Based on modeling and observed drainage characteristics, establish adaptation action areas, identify opportunities and options for neighborhood-scale detention and water quality improvement to serve residential and/or commercial areas as needed.	
	Implement pilot eelgrass planting projects in select waterways to evaluate water quality improvement efficacy and considerations related to flood control.	
	Pilot the installation of canal barrier systems to sequester and minimize the spread of nuisance floating vegetation throughout canals, in order to reduce the frequency/need for treatment.	
	Pilot installation of stormwater filter/infiltration system in association with canal systems exhibiting higher pollutant concentrations than other waterways in the region.	
	Develop pond monitoring and stewardship program to assist residents in identifying opportunities for enhancing private residential ponds. Evaluate options for including cost-share program to implement remediation solutions such as plantings and aeration structures.	

Associated Plans, Ordinances, and Mandates

- Charlotte County Stormwater Master Plan
- County NPDES MS4 Permit (LINK)
- Charlotte County Code of Ordinances Article V, Article XV
- Watershed Master Plan
- Charlotte County Vulnerability Assessment

Background

The county's stormwater management system plays a central role in how our actions influence the health of our surrounding estuaries. Much of the current infrastructure was developed as part of the mass platting of land for single family homes in the 1950s–1980s. Based on stormwater management requirements of that era, drainage ditch and canal systems were established for flood control purposes, but little to no infrastructure is present in these areas to attenuate the content of stormwater before discharging into canals and Charlotte Harbor. As increasing development in the county will result in greater coverage of impervious surface (and thus heightened stormwater runoff rates and nonpoint discharges), environmental degradation pressures experienced by the harbor may increase significantly. Due to the manner in which habitable land was platted and sold, retroactively implementing modern management features such as stormwater retention areas will be challenging, as such projects may rely on obtaining land from willing private sellers (**Figures 15-16**).

In addition to our need to account for the environmental impacts of development in Charlotte County, we must consider the influence of activities outside the county's boundaries. From the north, Charlotte Harbor receives drainage from over 1.85 million acres of river basin running through five counties. In addition, over 128,000 acres of land immediately surrounding Charlotte Harbor drain into this estuary, and the Lemon Bay watershed encompasses approximately 58,000 acres draining Sarasota and Charlotte Counties. The impact of land uses in the counties upstream of Charlotte Harbor and Lemon Bay vary in their influence on the harbor depending on the nature of those activities and their proximity to the harbor/bay. For example, the City of North Port's stormwater management system is designed so that most of their drainage is directed west toward the Myakka River via Myakkahatchee Creek. Charlotte County's stormwater management system is also linked to North Port's, so drainage from North Port can directly discharge into Charlotte County's canal systems if North Port canal levels exceed certain elevations. Sixteen potential discharge points from North Port into Charlotte County exist. This illustrates how imperative it is for Charlotte County to maintain strong relationships with our upstream neighbors to ensure all are working together to protect Charlotte Harbor and Lemon Bay.

Current Stormwater Management

Charlotte County manages its stormwater via requirements described in the county Code of Ordinances and Nonpoint Discharge Elimination System MS4 Permit. Charlotte County is classified as a Phase 2 MS4 system, which requires: establishment and enforcement of ordinances designed to curtail illicit discharges and construction-induced runoff; stormwater system operation and maintenance procedures designed to reduce pollutant runoff; and public outreach programs designed to facilitate responsible management of lands and activities that could induce an illicit discharge if not sufficiently managed. In addition, construction activities are required to obtain an Environmental Resource Permit, which includes stormwater management requirements (though some construction activities such as single-family residences are exempted from certain requirements). In general, permits are issued by both water management districts and the county, though the county typically defers to SWFWMD or SFWMD requirements (depending on which District has jurisdiction over the construction location). Exceptions to that rule do occur, however; if during review the county identifies localized drainage considerations not considered by SWFWMD/SFWMD, the county will work with the agency to ensure permit requirements reflect additional management needs.

The county is responsible for maintaining most of the region-scale flood control canals and structures, whereas management of neighborhood-scale drainage systems can fall within the purview of the county, property owners associations served by that system, or individual homeowners where no such association or county authority is present. County-managed stormwater infrastructure is funded by various Municipal Services Benefit Units (MSBUs); three

regional MSBUs fund infrastructure serving all communities throughout that area, whereas many communities have their own MSBU to fund maintenance needs specific to their neighborhood.

Water elevations in several of the major drainage canals in Charlotte County are regulated via fixed-elevation weirs, providing some amount of water quality treatment by allowing particulates to settle out of the water column prior to discharging into the Charlotte Harbor/Lemon Bay estuary system. Much of the non-navigable segments of these canals have not been dredged since their construction in the mid-20th century, and have accumulated sediment and other material from decades of runoff. In late 2020, County Public Works received authorization to sequester MSBU funding for dredging several canals, citing potential water quality benefits from reducing organic matter and sediment in these systems. Dredging is not expected to increase the water carrying capacity in these canals because most were initially constructed well below the groundwater table (as evidenced by these systems containing water throughout the year, including during the dry season and drought conditions).

In addition, many undeveloped regions of the county currently function as natural stormwater attenuation features. As of January 2020, less than 50 percent of residential land around the harbor had been developed (**Figure 5**); many of these lots thus allow rain to collect and percolate into the surficial aquifer. Much of the undeveloped lands surrounding the harbor and bay is platted and will experience increased development, increasing flow rates and reducing potential pollutant attenuation by adding impervious surface and elevating parcels. Portions of the county may therefore experience reductions in stormwater mitigation capacity as the county population continues to increase (**Figures 5-6**).

In addition to water storage and conveyance systems, several stormwater runoff mitigation sites can be found throughout the county. Most of these sites are located along major roadways, receiving runoff from those roads and the surrounding community. These sites often focus on managing aquatic vegetation to support wildlife and help filter runoff and non-point source water discharge, thereby improving water quality in receiving waterways.

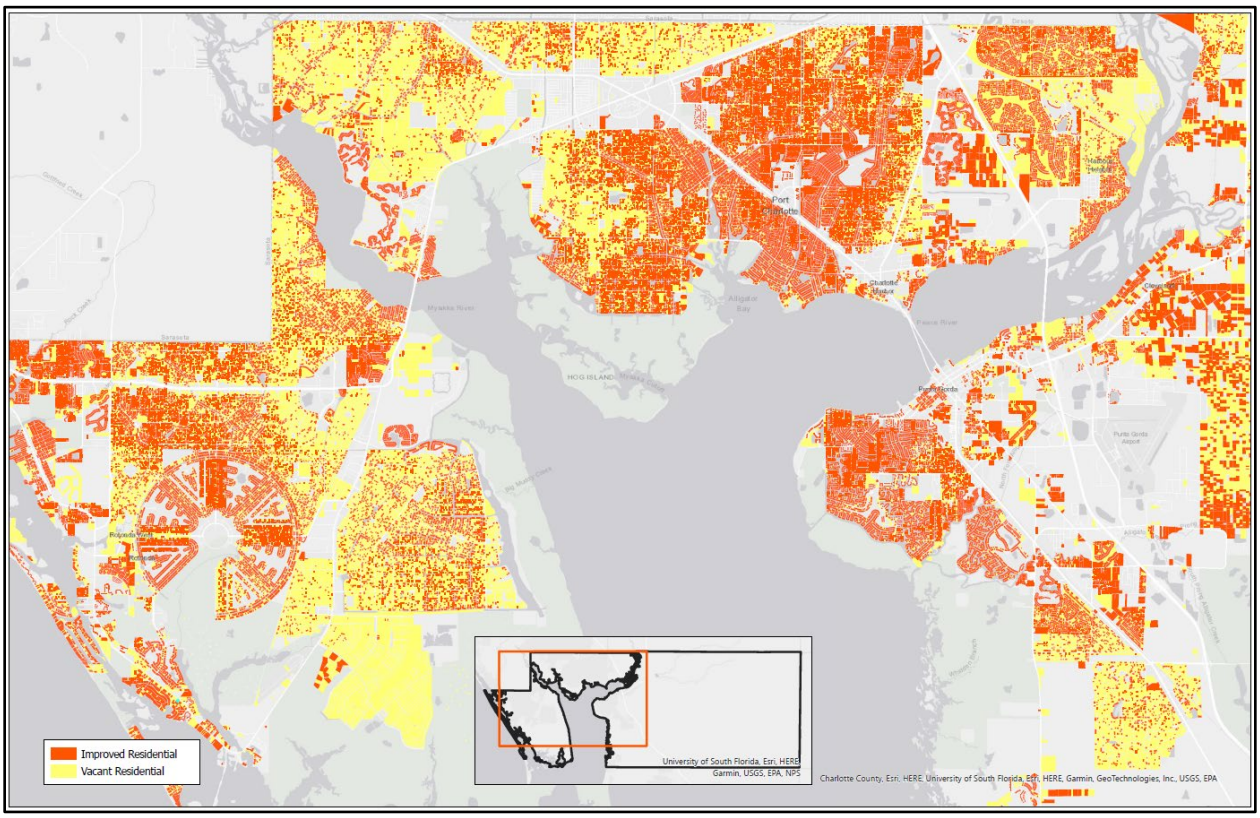

Figure 19. Residential parcels in west Charlotte County. Yellow regions are vacant, and orange are constructed as of January 2022.

Figure 20. Residential parcels near Port Charlotte. Most of these properties are unimproved (not developed); stormwater volume is expected to increase in this area as these lots are developed.

2024 Stormwater Rule

In June 2024, Governor DeSantis signed Senate Bill 7040, which contained extensive revisions to stormwater management requirements in the state. Most notable are implementing minimum treatment requirements for stormwater systems, which vary depending on proximity to impaired waters or Outstanding Florida Waters such as Charlotte Harbor (**Table 6**). Treatment estimates must be based on modeling or empirical data rather than presumptive Best Management Practice (BMP) efficiency estimates. In addition, permittees must provide a schedule and assurance of available funding for ongoing operations and maintenance of the stormwater system post-construction.

TABLE 6: SB 7040 nutrient reduction requirements.

Project Scenario	TP % Reduction	TN % Reduction	Additional Criteria
All Sites	80	55	Or post-construction discharge ≤ pre-construction
Adjacent to OFW	90	80	Or post-construction discharge ≤ pre-construction
Adjacent to Impaired Water	80	80	And post ≤ pre plus net improvement
Adjacent to Impaired + OFW	95	95	And post ≤ pre plus net improvement
Redevelopment Activity	80	45	N/A
Redevelopment + Adjacent to OFW	90	60	N/A
Redevelopment + Adjacent to Impaired Water	80	45	And net improvement for the pollutant of concern

Certain activities are exempt from these requirements, such as National Pollutant Discharge Elimination Systems (NPDES) (such as the previously described county MS4), single-family residences, project areas of less than 1 acre, and impervious surface designs less than 2 acres. This is of particular concern for water management in Charlotte County, as platted lots zoned as single-family homes dominate certain regions of the county, such as Northwest Port Charlotte.

The effective date of the rule varies by the parts within the rule. The new performance criteria become effective 18 months after its ratification, whereas other parts became effective immediately. The rules also have grandfathering considerations.

Vegetation and Mosquito Control Practices

Ensuring the proper function of the county's stormwater systems, while recognizing the role these systems must play in attenuating pollutant runoff within the county, is a priority for both environmental and public health and safety considerations. Water conveyance systems, including canals, ponds, and rights-of-way, are crucial for managing stormwater and facilitating drainage in Charlotte County. These systems also support local ecosystems by providing habitats for various wildlife species and enabling recreational activities such as fishing and boating. However, poorly maintained waterways can lead to flooding and other safety hazards, emphasizing the need for regular upkeep. The

presence of invasive aquatic plants can hinder drainage and impact local ecosystems, making effective management vital. Meanwhile, rights-of-way adjacent to roads and highways require ongoing management to prevent the spread of aquatic weeds that could impede drainage and exacerbate flooding issues. Addressing these challenges is essential for maintaining the functional integrity of these water bodies and ensuring they continue to serve the community effectively. Ultimately, a well-rounded approach to aquatic weed control can prevent loss of life and property, support healthy ecosystems, and enhance recreational opportunities for visitors and residents.

Effective water conveyance helps to minimize the risk of stagnant water, which can create breeding grounds for a variety of mosquito species including Mansonia sp., Culex sp., Aedes sp. and Anopheles sp. Psorophora sp. These mosquitoes are capable of vectoring diseases such as West Nile virus, St Louis Encephalitis, Easter Equine Encephalitis, Chikungunya, Yellow Fever, Dengue Fever Zika and even Malaria. Stagnant systems can also be overwhelmed by invasive aquatic weed proliferation, potentially choking out native vegetation and degrading aquatic habitats.

Waterway maintenance is currently conducted by two departments in Public Works: Operations and Maintenance addresses drainage concerns in swales and terrestrial vegetation on county waterway shorelines, while Aquatic Weed and Mosquito Control manages freshwater canals, drainage rights-of-way, and mitigation sites throughout 2,521 surface acres (or roughly 415 miles) of drainageways. Canals are scheduled to be inspected three times a year, but an investigation can also occur in response to a citizen service request. Whether scheduled or not, the inspector utilizes this opportunity to evaluate the site for vegetation treatment prior to it becoming a larger issue. Citizen requests for service also provide us an opportunity to engage the public and inform them about beneficial or native plants that are good for the ecosystem as well as the specifics of our program. A recently implemented software management tool called FieldSeeker ® GIS for Mosquito Control provides real-time dispatching and response to citizen service requests along with updates to treatment records and inventory management by the licensed applicators in the field.

Accurate identification of aquatic plants is crucial for effective weed management in Charlotte County. Trained applicators must be skilled in recognizing various aquatic species to implement appropriate control measures. Understanding the differences between native and non-native plants is particularly important for managing invasive species effectively. Native plants contribute to ecosystem health and support local wildlife. Conversely, non-native invasive species can outcompete these beneficial plants, necessitating focused management efforts to protect local biodiversity.

The most common nuisance and invasive plants that are encountered by the Unit of aquatic weed control are Brazilian Pepper Trees, Primrose species, Alligator Weed, Water Lettuce, Ambulia, and Chara. Many factors are considered prior to conducting an herbicide treatment but it usually starts with the plant type and the plant density. Other factors of equal importance include time of day, time of year, current weather conditions, and dissolved oxygen levels in the prospective treatment area.

Several state and federal agencies play pivotal roles in aquatic weed management in Charlotte County. The Florida Fish and Wildlife Conservation Commission (FWC) oversees biological control methods and regulates herbicide use in local water bodies. Additionally, the Florida Department of Environmental Protection (FDEP) ensures compliance with environmental standards for chemical applications, contributing to the overall effectiveness of management efforts. These agencies work collaboratively to develop comprehensive management strategies that address ecological health while meeting the needs of the community. Integrated Pest Management (IPM) strategies utilized by the Charlotte county's Aquatic Weed Program employs a combination of managing aquatic weeds effectively while minimizing environmental impact. This approach includes a mix of education and plant control, often through herbicide after biological control methods have been evaluated and implemented. By using IPM, aquatic weed managers can target invasive species without harming native plants or disrupting local ecosystems. Regular monitoring and assessment of

aquatic vegetation help inform management decisions, ensuring that interventions are timely and effective. Through the implementation of IPM practices, Charlotte County attempts to create a balanced and sustainable approach to aquatic weed management.

Herbicides are a widely used method for managing invasive aquatic plants due to their low cost and high effectiveness. The application of herbicides must be carefully regulated to ensure public safety and environmental protection. Licensed applicators are trained to apply these chemicals responsibly, adhering to strict guidelines that minimize risks to non-target species and the environment. The regulatory framework governing herbicide use requires that applicators demonstrate a clear understanding of safe application practices and compliance with environmental standards. By focusing on responsible herbicide use, Charlotte County can effectively control invasive aquatic weeds while safeguarding the health of its waterways. This careful approach is vital for maintaining the ecological integrity of local ecosystems as well as stormwater management.

Under certain conditions, Triploid grass carp can serve as an effective biological control for managing aquatic weeds by preferably grazing on invasive species such as hydrilla, which can promote the health of native vegetation. Their introduction offers a sustainable, long-term solution with minimal reliance on herbicides, but requires permits from the Florida Fish and Wildlife Conservation Commission (FWC) to monitor ecological impacts. This regulatory process is essential for maintaining oversight of biological control methods and ensuring they align with environmental protection goals. The application for permits must include detailed information about the proposed introduction and its potential ecological effects. By enforcing permit requirements, the FWC helps safeguard local ecosystems while allowing for effective management of invasive aquatic weeds. This regulatory framework fosters responsible practices that benefit both the environment and the community. As a key component of an integrated management strategy, triploid grass carp contribute significantly to maintaining healthy aquatic environments. Their role underscores the importance of varied approaches in addressing environmental challenges and promoting biodiversity. Certain communities in the county utilize carp to maintain waterways under their jurisdiction.

Future Management Considerations

The planting of native noninvasive plants in mitigation areas and Rights of Way can prevent monocultures from becoming established. Such plants filter and benefit non-point surface runoff which ultimately reach ditches, canals, and the Charlotte Harbor/ Lemon Bay estuaries. Native plants are easier managed and can establish complex plant and animal ecosystems benefiting both flora and fauna. Through this, Charlotte County can enhance its approach to aquatic weed management and promote the sustainability of its waterways.

County stormwater staff are charged with assuring the county's water conveyance systems maximize protection of life and property from flooding. To achieve this goal, the waterways often must be maintained so they are free of nuisance vegetation and debris that may otherwise impede flow and flushing. Current county processes are largely effective in accomplishing this goal, however multiple challenges in maintaining the system persist, such as:

- Natural challenges- in subtropical environments, nuisance vegetation proliferation is rapid and constant, especially during the wet season when flood control is most critical.
- Economic challenges- Increasing resource and personnel costs, in addition to competitive labor markets, creates persistent obstacles to obtaining and retaining sufficient numbers of qualified water management staff.
- In addition to the above, several portions of the county are going to see increased stormwater input into the system due to rapid development of currently natural lands, adding impervious surface and further runoff to the landscape. While the county's flood management system is engineered to accommodate storm events at full

buildout, additional water quality improvement measures will be needed to protect ecosystems services in downstream receiving waters.

Given these challenges, it is recommended to conduct a review and refinement of storm system management practices, with the goal to maximize maintenance efficiency while minimizing staff onboarding/training requirements and allowing for greater nature-based water quality attenuation in these systems.

Examples of opportunities to be addressed in this process include:

- Many drainage systems maintained by the county are plagued by regular vegetative obstruction of the inflow and outflow culverts, creating flood risks for upstream communities. Maintenance practices thus involve mowing of bankside and littoral vegetation around the waterway. In some cases, limiting vegetation removal to the points of inflow and outflow should provide the same flood control benefits as current practices, while also minimizing impacts to the system's ability to improve water quality and providing habitat to aquatic fauna. As each system might need its own targeted management plan, simply instructing staff on what should be maintained for each waterway will require a level of training that is simply not tenable; as such, app-based systems should be developed to guide individuals towards exactly what areas should be cleared, eliminating guesswork and allowing staff to document exactly what maintenance has been done in each drainage system.

Figure 21: Typical stormwater pond system maintained by the county. Yellow arrows indicate inflow/outflow points requiring regular maintenance

- Certain drainageways are entirely impacted by vegetation, and current management strategies may allow only short-term relief from potential drainage concerns. For example, vegetation such as cattails which regularly infiltrate county canal systems will reestablish their shoots relatively rapidly, refilling a canal in a matter of weeks. Review of the contours of some of these drainageways should be conducted to determine more permanent solutions for addressing vegetation impaction issues like the one shown in **Figure 22**. For example, it may be possible to alter channel morphology such that cattails are less likely to proliferate in the centerline of the channel, which would assure proper floodwater drainage while decreasing maintenance frequency. This would have the added benefit of allowing vegetation to remain along the banks and edge of the main channel, allowing for additional water quality improvement benefits. In addition, in some cases the conveyance system as designed may have much greater capacity than what is needed to service an area; as such, the maintenance refinement process should include the determination of drainage area to canal ratio via stormwater modeling, in order to ascertain if active vegetation maintenance is even necessary.

Figure 22: Vegetation maintenance operation in local drainage way, which is fully impacted by cattail growth.

Transitioning to an app-based system for directing maintenance priorities and processes also allows for streamlining documentation of activities, which will be a valuable asset to confirm waterways are being maintained to established levels of service, and for public communication needs. Apps are also capable of collecting written and photographic confirmation of what activities are needed and have been completed.

As has been alluded to in this section, citizens can be a major driver of where, when, and how often the county engages in canal maintenance activities. While citizen reporting can help the county stay on top of areas in need of canal maintenance, it is not uncommon for staff to receive complaints for drainage ways that do not need attention at that point in time. By creating a system with operating procedures and level of service requirements outlining what is needed

to assure a drainage system is optimally maintained, while also verifying what work has been done, staff will be able to better educate the public when their concerns over the flood mitigation capability of a system might be unwarranted. In addition, significant public outreach efforts will be needed to educate our populace concerning what is truly required to assure a well-functioning conveyance system, and how over-maintenance of a system can result in significant negative impacts to water quality.

In summary, optimizing our maintenance processes will allow the county to identify opportunities for streamlining current waterway maintenance procedures, while also promoting establishment/protection of aquatic and shoreline vegetation critical to attenuating pollutant inflows creating vibrant ecosystems within our waterways. In addition, the county is engaging in pilot aquatic vegetation planting projects to demonstrate the viability and benefits of establishing such restoration projects throughout the county.

Summary of Opportunities and Obstacles

Recent implementation of revised state stormwater management rules will result in greater reduction of nutrients entering Charlotte Harbor and Lemon Bay for qualifying projects under the rule.

New stormwater rule requirements may not be applicable to a significant proportion of undeveloped acreage in the county, as several large-scale developments will be grandfathered under the previous requirements, or are exempt, such as single-family housing.

Due to the widespread platting of single-family lots in the latter half of the 20th Century, substantial swaths of the county do not have modern stormwater treatment systems nor will they be required to implement such a system.

In 2023, the state issued a moratorium on adding or amending any ordinances or permit requirements that may be construed as “burdensome” to development; as of this writing, that moratorium is scheduled to lift in fall 2026.

For the reasons described above, the county’s swales and canal systems are the primary stormwater management/treatment systems in several regions of the county. Increasing the county stormwater treatment capabilities will require refocusing our canal systems as part of that treatment train and managing it as such.

Based on initial surveys and conversations with Public Works staff and local citizens, canal-adjacent residents appear to be divided on whether a more “natural-looking” canal is desirable or appropriate. Some of this is because of the need for additional outreach to waterfront communities, educating them on beneficial, native vegetation vs invasive or potentially toxic species and algal blooms. Additional effort is needed to determine residents’ support of converting canals to a more nature-based treatment system and what level of outreach will be required to combat misconceptions about aquatic vegetation.

Charlotte County has a substantial available resource in our citizenry, and their concern for the health of our waters can be leveraged to initiate robust citizen monitoring and neighborhood pond enhancement programs.

Vision Task Details

Task A: *Initiate the first phases of the stormwater maintenance optimization process, identifying waterway-specific maintenance needs and upgrading maintenance communications/logistics.*

Estimated Development Cost: HIGH (>$1,000,000). Other modeling and related tasks in this document may significantly reduce this estimate.

Details and Justification: As discussed in the Background section, opportunities exist to optimize stormwater management processes to streamline time and personnel expense, while also maximizing preservation of aquatic habitat and the system's natural pollutant filtration/interception capacity. This task seeks to accomplish the first phases of that effort via the following:

1. Use information provided by maintenance staff alongside independent field surveys and identify inflow/outflow points, maintenance priority, frequency of maintenance required, and optimal drainage patterns for each waterway maintained by the county.
2. Design waterway-specific maintenance processes and appropriate Levels of Service (LOS) to minimize the impact to aquatic habitats while allowing for efficient conveyance of water. In some cases, an initial investment in resources might be needed to adjust the waterway in a manner that will allow for more efficient maintenance.
3. Create a geospatial application that field staff can use to quickly identify inflow/outflow points and precise maintenance regions for more targeted efforts. This can also be designed to allow managers to easily create work queues in the app so that it can serve as an all-in-one tool to guide timing, location, and type of maintenance needed for each waterway. In addition, the app can be used to document the timing and extent of management efforts in track maintenance progress and respond to citizen concerns.

Task B: *Review and Revise the County Stormwater Master Plan as needed, incorporating portions of the county not currently included in the Plan, and identifying opportunities for enhancing stormwater treatment and levels of service in light of revised 2024 stormwater rule, and newly-acquired information on flood risks due to current and future coastal storm surge scenarios.*

Estimated Development Cost: MEDIUM ($100,000-$1,000,000)

Details and Justification: The county Stormwater Master Plan was last revised in the late 1990s; since then, the county has seen dramatic changes in growth, land use, and stormwater management needs. Because of this and the recent issuance of the revised statewide stormwater rule, the Master Plan should be reviewed and modernized to address our current and future stormwater management requirements and processes. This is proposed to be accomplished in two phases:

Phase 1:

- Develop updated stormwater model for Charlotte County MS4:
    - Model storm events based on current required level of service, as well as max event that most of the system is capable of mitigating, in order to identify areas that might underperform in either scenario

    - Model system response to storm events based on current database of water control structures, via two scenarios:
        - All structures are fully functioning to designed specifications.
        - Structures are not operating to designed specifications.
- Based on model output and county staff input, develop documented minimum maintenance requirements to achieve levels of service for conveyance systems within the county's jurisdiction.
- Conduct system-wide assessment of location, condition, and maintenance needs of county stormwater conveyance infrastructure in Mid and West Counties, and that portion of South County outside of the current Burnt Store modeling area.
- Based on results from tasks, develop maintenance/improvement strategy for infrastructure not meeting current minimum maintenance requirements, as specified in updated Stormwater Master Plan.
- Based on output of model and input from county staff, conduct system-wide assessment of communities/neighborhoods at high risk of localized flooding, and determine remediation options to address impacted properties through either infrastructure improvement, property enhancement, or property acquisition.

Task C: *Install water elevation monitoring networks to track flow rates, flood risk, and tidal influence on water drainage in the region.*

Estimated Development Cost: MEDIUM ($100,000-$1,000,000). Current estimates place this Activity at Approximately $300,000 for the first year of equipment installation and calibration, and ~$120,000 per year for Maintenance and Operation.

Details and Justification: Recent regional storm events have underscored the county's need for enhanced water elevation and flow monitoring systems to allow the county to better predict and prepare areas susceptible to flooding. For example, immediately after Hurricane Ian, historic rainfall throughout the region caused near unprecedented levels of flooding in the Peace River, Myakka River, and Big Slough basins draining into Charlotte Harbor and breached some water control structures in North Port. This created concern among Charlotte County staff that Port Charlotte was at risk of receiving uncontrolled discharges from North Port, potentially threatening life and property if the stormwater canals responsible for managing runoff in the area were already at or near maximum capacity due to localized rain and flooding.

Nearly 1 year later, Hurricane Idalia brought moderate rainfall to the area (3–5 inches on average), which the county's stormwater system has sufficient capacity to manage. Unlike Ian, however, tidal surges helped push harbor and tidal river elevations into low-lying areas of the county, causing extensive flooding in our coastal communities. Surge flooding from Hurricanes Helene and Milton were even more extreme than Idalia, damaging or destroying thousands of homes throughout the county. If we experience a storm that combines precipitation rates on par with Ian in addition to tidal surges like Idalia, Helene, or Milton, the flood impacts to our residents could be catastrophic.

These events highlight the need to establish mechanisms by which county EOC staff can receive advance notice of potential flooding by installing telemetry-based water elevation/flow gages. No elevation gages are present in any canals in Charlotte County, preventing decision-makers at the county EOC from ascertaining the actual risk of flooding within residential areas. Only one telemetry-based water elevation station is in the marine waters of Charlotte County, in the tidal Peace River near the Harbor Heights neighborhood. In addition, the county lacks a comprehensive stormwater flow model, and thus the EOC has relied on flow estimates from generalized models provided by NOAA. Because these model runs predicted wildly varying pictures of the actual flood risk to residents during Hurricane Ian, a stormwater model calibrated using data collected within Charlotte County waterways is clearly needed to accurately predict and act on future potential flood risks in our jurisdiction.

In addition to the public safety elements described above, establishing a water elevation monitoring system is the first step in developing accurate stormwater and pollutant loading models, allowing the county to more accurately target "hot spots" of pollution sources into Charlotte Harbor and Lemon Bay. This is a necessary element to developing waterbody restoration plans such as Reasonable Assurance Plans, which are vital component to have in place when requesting water quality improvement funding.

Task D: *Based on output from the county Vulnerability Assessment, Watershed Master Plan, and water elevation monitoring network described in Stormwater Task C, develop predictive tools as needed for storm runoff and drainage rates to assist in prioritizing enhanced water management in areas of higher flood risk, and inform predictive flood risk tools to assist in evaluating impacts of changing land use in an area.*

Estimated Development Cost: MEDIUM ($100,000-$1,000,000)

Details and Justification: As of this writing, multiple flood and surge impact investigation products are being developed in the county. The state-mandated vulnerability assessment is examining tidal surge and flooding probabilities based on current tides and future sea level rise estimates. Meanwhile, the Watershed Master Plan (being developed to benefit the county's standing in the National Flood Insurance Program) uses the most recently collected land elevation data to estimate the location and extent of flood-prone areas when subjected to various intensity rainfall events and to recommend strategies for mitigating flood impacts. Missing from each of these projects are flood and flow data because the county lacks an extensive water elevation monitoring network. In addition, these products are static in that they are not currently planned to be updated to account for any substantial changes in land use or local land elevation (which can occur when extensive development in an area results in large regions elevated with imported fill to protect infrastructure from flooding and tidal surges). Hence, the county needs a dynamic predictive tool that can be used by Community Development, Stormwater, and other planners to evaluate possible impacts from proposed changes in land use and stormwater management. The tool will leverage information provided by the aforementioned plans in conjunction with the water elevation monitoring network described in Task B.

Task E: *Based on modeling and observed drainage characteristics, establish adaptation action areas, identify opportunities and options for neighborhood-scale detention and water quality improvement to serve residential and/or commercial areas as needed.*

Estimated Development Cost: HIGH (>$1,000,000)

Details and Justification: Due to the manner with which much of Charlotte County was planned and platted, significant acreage adjacent to Charlotte Harbor and Lemon Bay contains single-family residential dwellings exempt from implementing any meaningful stormwater treatment practices. In addition, little public land is available in these areas, making immediate construction of stormwater treatment basins in some areas impossible without relying on willing sellers of private property in the areas of greatest need for increased stormwater management. This task proposes to use the previously described projects to identify high-priority areas for property acquisition to create water quality improvement infrastructure at a neighborhood scale. These features can also serve as an amenity to the local community, creating an oasis of nature within a developed area for the community to enjoy. Such features have proven to be popular among residents in other portions of the county with similar features, such as Ollie's Pond Park in Port Charlotte.

Task G: *Implement pilot eelgrass planting projects in select waterways to evaluate water quality improvement efficacy and considerations related to flood control.*

Estimated Development Cost: LOW (<$100,000)

Details and Justification: For many locations in the county, the flood control canal system will likely be among the only opportunities to attenuate stormwater pollution in these areas before discharging into the harbor and bay. Swale systems provide some nutrient reduction during winter and early spring, but most of that network will have limited treatment capability during more intense stormwater events and peak wet season when surficial groundwater levels are high enough to drastically reduce the landscape's soil infiltration capacity. As such, adjusting canal management practices to allow for nature-based filtration of nutrients and pollutants should be explored. Planting eelgrass, a native freshwater submerged grass, in canal systems has shown success in reducing nutrient and bacteria concentrations in other south Florida counties while allowing for flow to continue unobstructed (as a grass, the plant lacks rigidity to emerge above the water surface and otherwise block or reduce flow). In theory, this activity should help to reduce nutrients in the system, reduce the frequency of canal vegetation management activities by the county, and create habitat for aquatic biota to thrive. However, some boating communities in Charlotte County already experience a proliferation of seagrass in their canals, and several residents have complained that the eelgrass is a nuisance to navigation.

The county has identified a few candidate non-navigable canals to test plant eelgrass to evaluate its efficacy in reducing nutrient concentrations and enhancing habitat and to determine any management considerations that will need to be taken into account if this effort were expanded throughout the county.

Task H: *Pilot installation of floating canal barrier systems to sequester and minimize spread of nuisance floating vegetation and litter to reduce the frequency/need for chemical-based treatment.*

Estimated Development Cost: LOW (<$100,000)

Details and Justification: One of the drivers of the frequency and extent of nuisance vegetation management by the county concerns the volume of floating vegetation transported into and throughout these systems. Other counties have had success in limiting the proliferation of floating vegetation by installing booms at key locations to intercept and "hold" vegetation pending removal by county staff. The goal of this project is to use booms to evaluate whether installing and maintaining vegetation at boom installation locations can reduce the frequency of herbicide application downstream. This is a companion project to the eelgrass study above; the goal is to determine if using native grass combined with physical management of nuisance floating vegetation can reduce, if not eliminate, the need for more active vegetation management throughout the entirety of the canal system.

Task I: *Pilot installation of stormwater filter/infiltration system in association with canal systems exhibiting higher pollutant concentrations than other waterways in the region.*

Estimated Development Cost: LOW-MEDIUM (<$1,000,000), dependent on installation

Details and Justification: Many urbanized areas have used underground stormwater storage/filtration systems to reduce pollution in runoff, especially in neighborhoods with few opportunities for installing surface ponds or land infiltration. Certain portions of Charlotte County transport stormwater via swale systems, and water from these swales discharges directly into receiving canals. In some parts of the county, land elevation at the point of the swale discharge may be high

enough to allow a test installation of filtration basins to evaluate treatment efficiency and maintenance needs (Most of these systems require installing above the surficial groundwater table, which can be a challenge for many locations in Charlotte County that are at or near sea level). **Appendix B** describes options and efficiency expectations for recommended filtration systems used to successfully reduce nutrient outflows. The initial area of focus for this effort should be the region around western Port Charlotte/ tidal Myakka, which based on data collected thus far is exhibiting occasional periods of high Nitrogen concentrations compared to other areas of the county.

Task J: *Develop pond monitoring and stewardship program to assist residents in identifying opportunities for enhancing private residential ponds, including cost-share program for implementing remediation solutions like plantings and aeration structures.*

Estimated Development Cost: LOW (<$100,000)

Details and Justification: Many stormwater ponds in Charlotte County are managed by property owner associations, who often desire to see a vibrant, healthy aquatic system in their backyard. Over the years, the county has received requests from associations for advice or support in assessing and rehabbing their pond, but the county does not have a formal program in place to assist with this. Using similar programs in Lee and Sarasota Counties as guidance, this task will develop a formal mechanism for residents to sample, assess, and determine management strategies to create a healthy habitat for aquatic species while providing some level of nutrient reduction in these systems before their inevitable discharge into Charlotte Harbor or Lemon Bay. In addition, this task should explore the possibility of installing a cost-share program to acquire and establish remediation solutions for those communities that may lack the resources to do so. This could take the form of a revolving fund with annual limits or multi-year grants from state or national non-point source focused entities.

Task K: *Develop stormwater and green infrastructure design manual for county asset construction and maintenance.*

Estimated Development Cost: MEDIUM ($100,000-$1,000,000)

Details and Justification: The design manual for county facilities currently requires stormwater management plans to meet the base detention and treatment requirements in the state and SWFWMD's ERP permit manuals. In recognition of the need to maximize stormwater treatment capabilities of county properties, adapt to anticipated changes to stormwater management requirements in the updated 2024 stormwater rule, and create opportunities to demonstrate the efficacy of comprehensive stormwater management systems, the county will update the design manual and operation procedures as follows:

- Develop a menu of options for green infrastructure implementation on county properties as part of both construction and refurbishment activities, prioritizing options that maximize water infiltration, retention, and canopy cover for facilitating evapotranspiration. Construction planning processes will utilize a cost/benefit analysis to determine appropriate measures for achieving minimum infiltration rates.
- For construction activities centered around expansion of existing facilities, require design strategies that result in, at minimum, no net loss of stormwater attenuation capacity, and minimal to zero loss of pervious land.
- Outline comprehensive maintenance plan to assure treatment system continues to operate as designed, including determination of responsible parties for assuring maintenance requirements are met.

In addition to the above, routine sampling efforts will be expanded to select facility stormwater systems to evaluate the efficacy of implemented management features and refine future stormwater management system design strategies.