DATE: April 10, 2024

TO: Ben Allushuski, PE, CFM (City of Tampa)

FROM: Taylor Lankford, PE (Applied Sciences)

SUBJECT: **City of Tampa – Davis Islands Stormwater Analysis – Task 2.1 Stormwater Analysis**
FDEP Grant Work Plan Number 22PLN79

INTRODUCTION

The City of Tampa (City) received a grant from the Florida Department of Environmental Protection (FDEP) through the Resilient Florida Program to perform the Davis Islands Stormwater Analysis (Project) and to provide information regarding existing and future conditions for directing stormwater through drainage systems due to sea level rise. SurvTech Solutions was tasked with completing Task 1, which included survey and data collection efforts focused on the stormwater outfalls on Davis Islands. Additionally, SurvTech contracted the assistance of Applied Sciences to execute specific engineering tasks related to the Project. Applied Sciences was tasked with performing a stormwater outfall analysis (Task 2), developing adaptation strategies, and participating in public outreach activities (Task 3).

The following memo includes a stormwater outfall analysis (Task 2) where the underlying costs and feasibility of implementing similar detailed survey work on a larger scale were investigated. Specifically, it outlines the survey techniques, asset access issues, and survey costs scale when considering the entire City of Tampa area.

TASK – 2: DAVIS ISLANDS STORMWATER OUTFALL ANALYSIS

The collected survey data from Task 1 was used to perform a stormwater analysis related to potential sea level rise and infrastructure vulnerabilities. Additionally, Applied Sciences, along with SurvTech's feedback, summarized key issues for extending the survey approach to a citywide effort.

2.1 Potential Areas for Tide Gates and Backflow Preventers

Various methods are used to assess the impact of sea level rise on coastal areas. This includes analyzing inundation maps at specific sea level elevations, conducting cut/fill analysis using terrain models, and tracing hydraulic systems. These approaches help identify vulnerable areas and assess the need for preventive measures like backflow preventers. By integrating these methods, planners can effectively mitigate risks and protect coastal communities and infrastructure from inundation.

The underlying terrain model was reviewed to identify the lowest elevations within Davis Islands. This analysis determined that elevations between 4 and 5 NAVD88-ft are commonly observed along streets and intersections. These areas are most likely to be inundated during relatively extreme high tides. For example, on 8/30/2023, Hurricane Idalia produced recorded tidal elevations of around 4.5 NAVD88-ft at the St Petersburg tide gauge. During this event, it is likely that tidal waters traveled upstream through the stormwater outfall pipes, causing inland flooding, even without additional rainfall. Specific stormwater infrastructure, such as tidal gates and backflow preventers, can address this backflow phenomenon.

To explore this phenomenon further, Applied Sciences developed inundation maps for potential sea level rise elevations of around 4.5 NAVD88-feet. This value corresponds to recent tidal activity from Hurricane Idalia and is similar to the NOAA 2017 future tidal projections for the 2070 Intermediate High scenario. The following figure, **Figure 1**, displays the inundation areas for potential sea level rise impacts along with a focus area.

***Figure 1**: Potential Sea Level Rise Impact for Tidal Elevation of 4.5 NAVD88-ft*

The highlighted focus area is further explored in the figure below. **Figure 2** demonstrates the ability of elevated tides to backflow through stormwater infrastructure, causing inland flooding without additional rainfall.

***Figure 2**: Hydraulic Tracing through Stormwater Infrastructure with Elevated Tides*

Performing this type of analysis on all tidally connected outfalls is essential for identifying vulnerable systems. The use of tidal gates and backflow preventers on these systems can improve resiliency and reduce the impact of inland inundation due to elevated tides. Backflow preventers will prevent tidal waters from infiltrating the stormwater systems and eliminate inland flooding during moderate to extreme tidal events.

2.2 Seawalls and Overland Low Points of Entry

Another common issue with tidally connected areas is related to the potential for future sea level rise or high tide events to overwhelm seawall elevations and inundate inland areas regardless of backflow prevention measures on the stormwater system. To further evaluate this phenomenon, Applied Sciences defined a boundary feature surrounding the Davis Islands project area. From this perimeter, elevations were extracted from the underlying terrain model in 10-foot intervals. **Figure 3**, seen below, displays the results of this analysis. Boundary points were symbolized to highlight locations with terrain elevations less than 6 NAVD88-ft.

***Figure 3**: Low Point Boundary Analysis for Davis Islands*

From **Figure 3**, many areas around Davis Islands could be inundated during tidal or surge events that exceed elevations 5 to 6 NAVD88-ft. During these events, backflow prevention devices on the stormwater systems may not be sufficient. Tidal waters will produce upstream flooding through overland flow. The lowest boundary areas should be further reviewed and evaluated for potential mitigation. Elevating seawalls in these areas is a common technique to increase resiliency and reduce future tidal vulnerabilities. This same approach should be applied throughout the City in future efforts.

2.3 Asset Accessibility

Specific challenges emerged in conducting the outfall survey, requiring innovative solutions for accurate data collection. One issue involved discrepancies in pipe size and material from the inlet to the outflow, necessitating multiple verification trips to ensure data accuracy. To streamline this process, synchronizing on-land crews with water-based teams could facilitate real-time communication and reduce the need for repeated inspections. Additionally, pipes located under bridges posed accessibility challenges for GPS and sighting equipment. To overcome this obstacle, a workaround involved measuring pipe lengths from both ends of the bridge and utilizing GPS measurements of water elevation, particularly in calm conditions, to determine invert levels. Most inflow and outflow locations corresponded well with GIS data. Conducting such surveys *without* GIS references would significantly increase the complexity of the task. Reviewing available GIS data before performing survey work is critical for ensuring efficiency in the field.

Addressing public and private access issues was vital, particularly concerning outflow structures situated on private property. Due to complications with owner outreach and accessibility, it proved more cost-effective to acquire data from these sites via water-based methods (Jon Boat). Moreover, the topography of sea walls on private property often featured steep inclines and outcroppings, making water-based surveys safer and more efficient than land-based approaches. By adapting survey methodologies to accommodate public and private access constraints, the project navigated logistical challenges and gathered comprehensive data essential for informed decision-making regarding coastal infrastructure management.

Lessons Learned

a. Synchronizing on-land and water-based teams, when needed.

b. Use of current water elevation as survey reference point.

c. Review of existing stormwater GIS data prior to fieldwork.

d. Outfall access through water-based approaches appears more cost-effective and efficient than exclusive land-based approaches.

2.4 Survey Workflow and Costs

SurvTech provided the following descriptions of the survey work performed on Davis Islands in late December 2023. The survey workflow involved teams of two individuals working to locate pipes on the island's east and west sides. On the east side, approximately six pipes could be located within an 8-hour

workday, with additional time required if the inlet or outflow was challenging to find. Despite encountering issues with four pipes, most of the survey proceeded smoothly.

On the west side, locating inflow structures posed challenges due to placement within public streets and manholes, necessitating time for traffic control and accessing structures. About five inflow structures could be located in a day under these conditions. Outflow pipes on the west side also required separate efforts from inflow surveys. Launching boats and traveling to locations consumed time, limiting the team's ability to locate approximately 10 outflow pipes in a day.

The outfall survey effort for Davis Islands took approximately one month to complete, assuming 8-hour workdays and a 5-day week. Additional time was needed for in-office post-processing and quality control, approximately 2 weeks. This workflow summary includes the characteristics of Davis Islands and the unique challenges present. The budgeted cost for this effort was around $37,500; however, after additional conversations with SurvTech, it was determined that the actual effort was more costly. Considerations for manhours, boats/fuel, and efficiency improvements puts the true effort at around $60,000. This information was used to support cost estimates for the citywide effort.

2.5 Extension to Citywide Effort

Expanding on the proposal to scale up the outfall survey effort from Davis Islands to a citywide initiative involves several key considerations and strategies. First, an estimate of the total number of outfalls is essential for planning purposes. By extrapolating from the Davis Islands study, which collected data on 80 outfall pipes, it's projected that an additional 540 outfalls exist along gravity mains and box culvert outfalls. This estimate provides a foundational understanding of the scope of the citywide effort. The following figure, **Figure 4**, displays the approximate locations of the stormwater outfalls within the City.

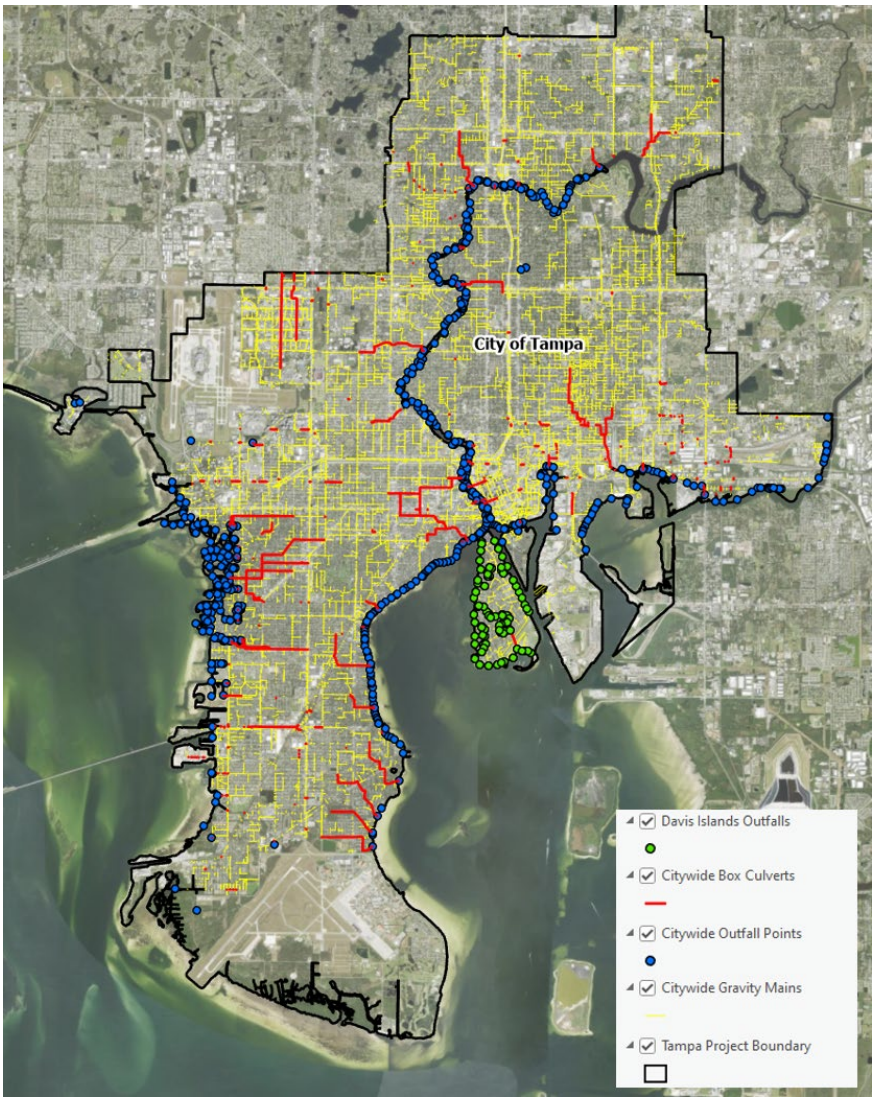

***Figure 4**: Citywide Gravity Main and Box Culvert Outfalls*

In implementing the citywide survey effort, it's important to leverage lessons learned from the Davis Islands study, including survey techniques and access strategies. It's evident that accessibility varies across different areas of the City. While many structures are accessible from public right-of-way, exceptions exist in areas of the Hillsborough River, Channel District, and Beach Park Isles, necessitating boat access. To address this, a strategic approach involving boat-based surveying is recommended for these areas. By prioritizing boat access where needed, one can ensure comprehensive coverage of outfall structures citywide, effectively overcoming accessibility challenges and facilitating accurate data collection.

Citywide Timeline and Budget Projection

- Survey Duration: Given the extrapolation from the Davis Islands study and considering an optimized survey approach, we estimate the additional 540 outfalls can be surveyed within approximately 12 months.

- Budget Projection: The total budget for the additional 540 outfalls would be approximately $400,000. This estimate also includes the increased spatial distribution of features across the City. The 80 outfalls surveyed for Davis Islands represents a dense distribution of outfalls, as we expand this effort to the entire City, it is expected that travel times and other logistical issues will increase. Additionally, there will need to be greater coordination with land and water based survey teams for the citywide effort. These factors are included in the following budget breakdown:
- Breakdown:
    - Surveying Equipment and Personnel: $300,000
    - Data Analysis and Reporting: $60,000
    - Contingency (~10%): $40,000

This timeline and budget projection provides a framework for the citywide outfall survey effort, ensuring efficient resource allocation and timely project completion while accommodating potential contingencies.

CONCLUSIONS AND FUTURE EFFORTS

In summary, the Davis Islands data collection and stormwater analysis pilot project provided insights into the challenges and vulnerabilities associated with stormwater infrastructure in coastal areas. By surveying approximately 80 stormwater outfall pipes and conducting a stormwater analysis, the study has yielded a deeper understanding of the potential impacts of extreme weather events and future sea level rise on these critical systems. The data collected in Task 1, including outfall pipe size, invert elevation, material, and condition, serves as a foundational resource for informed decision-making and future planning efforts.

Moving forward, citywide, extending the survey effort presents a significant opportunity to enhance stormwater management strategies and build resilience in coastal communities. By applying the lessons learned from the Davis Islands project and leveraging a strategic approach, we can effectively survey an estimated 540 additional outfalls across the City. A projected timeline of approximately 12 months and a budget of $400,000, including costs for surveying equipment, personnel, data analysis, and contingency, was established.

Future efforts include further addressing adaptation strategies for long-term stormwater resilient solutions based on the data collection survey and stormwater analysis findings. The report and data collection efforts will be shared via public outreach advertised through the City's website/social media outlets and presented during a virtual meeting. The meeting will be memorialized as an educational resource and future reference. Through these resiliency planning efforts, the City can better protect communities and infrastructure from the impacts of climate change and ensure a more sustainable and resilient future.