VOLUME 4

WATERSHED MANAGEMENT RECOMMENDATIONS

VOLUME 4A

SITE-SPECIFIC RECOMMENDATIONS REPORT

CARPENTER CREEK & BAYOU TEXAR
WATERSHED MANAGEMENT PLAN
Task #4
Watershed Recommendations

Prepared for

Escambia County

Water Quality & Land Management Division

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DOCUMENT REVISION HISTORY

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4/8/22	Draft	Draft Submittal	N/A
5/26/22	Revision 1	Address comments received from County, City, PPBEP, and public	Added Litter and Trash Abatement recommendation to Section 3. Revisions to Concept Plans (Appendix A) per County and Public Meeting comments received

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

Recommendations Report Purpose

This report serves to document the project and programs recommended as a step toward restoring the watersheds, The report documents the methodology used to identify projects and programs and provides detailed information on the bmp recommendations for 15 sites and the criteria used to rank each project.

Identification of Restoration Sites

Water body and watershed assessments were conducted as part of Tasks 2 and 3. Detailed assessments can be found in previous project reports:

- Task 2 - Watershed Evaluation Report, November 2020
- Task 3.1 – Hydrologic & Hydraulic Model Development & Simulation Report, January 2022
- Task 3.2 – Water Quality Assessment Report, September 2021
- Task 3.3 – Stream Assessment
    - 3.3.1 – Stream Classification Report, April 2021
    - 3.3.2 - Categorical Improvements Report, June 2021
    - 3.3.3 - Stream Restoration Estimate Unit Costs and Develop Total Life-Cycle Cost Model, June 2021

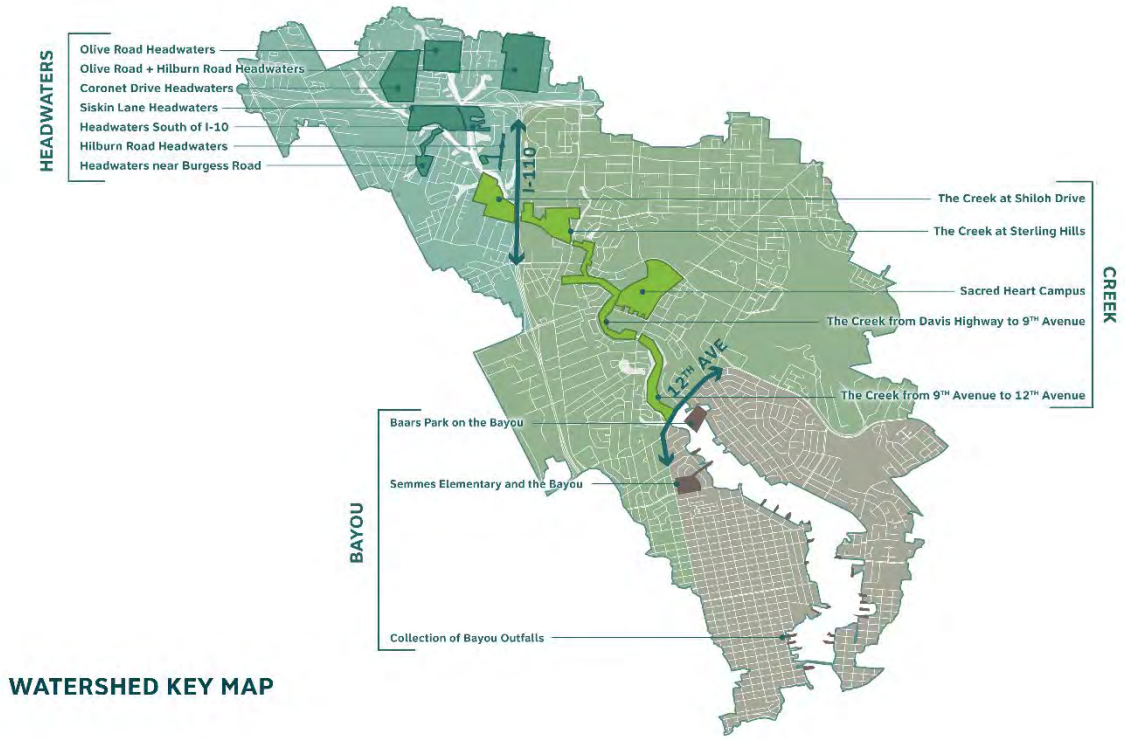
The detailed assessments identified several recurring issues for Carpenter Creek, Bayou Texar, and their watersheds. Water quality, hydromodification, erosion and sedimentation, invasive plants and wildlife, localized flooding, sea-level rise, and community equity and public access were identified as primary concerns and are the focus of the recommendations.

Recommendations

The WMP team identified areas for improvement in the watersheds based on several key factors, including assessment results, known issue areas, available public lands, appropriate land use designations and easements, and previous discussions with potential private partnerships. Forty-eight (48) sites were initially identified as potential recommendation areas. These sites were pared down to 15 based on feedback from Escambia County and the City of Pensacola, further evaluation of concept feasibility, assessment of available lands, and in some cases, combining sites to create larger-scale recommendations. **Section 2** provides detailed recommendations and scoring criteria for each of the 15 sites selected for conceptual design. Concept plans are included in **Appendix A**.

The fifteen sites were grouped by impact area (**See Figure ES-1**) and shared with the Technical Stakeholder Group to gain input on site-specific issues and recommendations and ensure potential projects would not conflict with future planned activities. Technical Stakeholder Feedback is provided in **Appendix B**.

Figure ES-1
Recommended Projects



Section 4 includes several sites that were vetted through the County and City as being viable projects, but lower priority than the selected 15. These sites should be evaluated in the future for potential restoration opportunities if funding is available.

Programmatic, watershed-wide actions will be necessary to ensure impactful and sustainable improvements to the Carpenter Creek and Bayou Texar watersheds. **Section 3** focuses on overarching programmatic recommendations that provide watershed-scale strategies and programs that could be advantageous for reaching restoration objectives. Programs to consider include:

- Appointing a Watershed Coordinator or Task Force
- Strategic Land Acquisition and Conservation
- Stormwater Asset Inventory and water-Mark Database Refinement
- Expansion of the County's Monitoring Program
- Septic Abatement Program Coordination
- Revisions to Existing Ordinances, Codes, and Regulations
- Generalized Stormwater Management and Retrofit Opportunities
- Retrofits of "Pinch Points" Along Carpenter Creek
- Implementation Funding and Grant Programs

Project Ranking and Summary of Beneficial Impact

In summary, 15 conceptual projects and 9 stormwater programs were recommended in Sections 2 and 3. If implemented, these projects and programs are intended to be a first-step measure to protect and restore the Bayou Texar and Carpenter Creek watersheds and their waterbodies. Additional projects may be needed to complete the recovery and long-term programs will need to be implemented to maintain a healthy and sustainable system.

If all projects are implemented as proposed, a cumulative:

- ✓ 3,285 lbs of TN, 119 lbs of TP will be removed from the system annually
- ✓ Flood stages will be reduced by over a foot in several areas
- ✓ 2,314.8 tons of sediment will be removed or redistributed to balance the system
- ✓ 2.4 miles of stream segment will be restored to a sustainable, resilient streambed
- ✓ 27.5 acres of wetland will be restored

Summary tables of benefits (**Table 5-1**), project scoring criteria (**Table 5-2**), and cost estimates (**Table 5-3**) are provided in **Section 5**.

1 INTRODUCTION

1.1 Authorization

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by Escambia County (County) to develop a comprehensive watershed management plan (WMP) for the Carpenter Creek and Bayou Texar watershed to address legacy impairments, develop best management practices (BMPs), and identify future site-specific projects and activities through stakeholder engagement and best available science. Funding for the development of the WMP was secured through the Escambia County Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) Direct Component allocation (Pot 1).

1.2 Background

The Carpenter Creek and Bayou Texar WMP will provide a roadmap for identifying, addressing, and recommending actions for the following objectives:

- ✓ Manage **water quantity** and improve **water quality** for a safer and healthier environment. Protect, enhance, and restore **fish and wildlife habitats** for a more vital ecosystem.
- ✓ Expand **public access** and **recreational opportunities** for learning and fun!
- ✓ Build more **equitable** and **resilient communities** in the face of a changing climate. Connect residents to their **watershed and waterways** for stewardship and conservation.

The WMP is being developed in three phases: Desktop Watershed Evaluation, Watershed

Assessment/Field Reconnaissance, and Watershed Management Recommendations.

The first phase was the development of the Carpenter Creek & Bayou Texar Watershed Evaluation Report (WER), which was completed in November 2020. The WER summarized the findings of Wood's extensive literature and data review and discussed the characterization of the Carpenter Creek and Bayou Texar watersheds in detail. It detailed such items as the community outreach efforts to date, water quality gap analysis and sampling efforts, and the existing hydrologic and hydraulic features of the watersheds, to name a few.

The second phase built upon the literature search with ground-truthing, field reconnaissance, survey, and in-depth engineering and scientific evaluations, which was broken into three parts:

- ✓ Hydrologic and Hydraulic Modeling and Sea Level Rise Evaluations – completed February 2022
- ✓ Water Quality Analysis and Pollutant Load Modeling – completed November 2021
- ✓ Stream Channel Classification, Categorical Improvements, and Total Life Cycle Cost Model – completed June 2021.

The third phase is to provide recommendations to protect and restore the watershed. This phase is also split into three parts:

- ✓ **Projects and Programs- April 2022 (This Report)**
- ✓ Regulatory Framework –Schedule to be complete July 2022
- ✓ Monitoring and Evaluation – Schedule to be complete July 2022

1.3 Objective

Previous WMP tasks included extensive assessments of stream, water quality, water quantity, and habitat conditions in the watershed, as well as a qualitative sediment and shoreline assessment of Bayou Texar. Collectively these assessments identified systemic and programmatic issues that need to be addressed to restore and protect the watershed. The WMP team reviewed the assessment results to identify projects and programs that can be implemented to help achieve restoration goals.

This report summarizes the methodology, recommendations, and project ranking. Conceptual level plans and cost estimates are included for 15 projects.

1.4 Summary of Watershed Issues

Water body and watershed assessments were conducted as part of Tasks 2 and 3. Detailed assessments can be found in previous project reports:

- Task 2 - Watershed Evaluation Report, November 2020
- Task 3.1 – Hydrologic & Hydraulic Model Development & Simulation Report, January 2022
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The detailed assessments identified several recurring issues for Carpenter Creek, Bayou Texar, and their watersheds. Water quality, hydromodification, erosion and sedimentation, invasive plants and wildlife, localized flooding, sea-level rise, and community equity and public access were identified as primary concerns and are the focus of the recommendations.

Over the past six decades or so, erosion due to channel modification from development, non-attenuated stormwater, gray vs. green infrastructure, and diminishment of the protective riparian zone have dramatically changed the Carpenter Creek and Bayou Texar bathymetry profiles diminished water quality and jeopardized several structures located along their banks. Displaced sediments from channel modifications and erosion in the upper headwaters have accumulated in the lower reaches of the creek and have significantly altered the mouth of Carpenter Creek that

discharges into upper Bayou Texar. Numerous directly connected impervious surfaces throughout the watersheds create a flashy hydrograph and have led to bank erosion and subsequent downstream sedimentation and water quality impairments.

The Carpenter Creek watershed is highly urbanized and built out with residential, commercial, and industrial areas. The high degree of impervious surfaces, relatively well-drained soils, and presence of multiple pollutant sources contribute to water quality issues within the watershed. Water quality assessment results indicated that total nitrogen (TN), fecal indicator bacteria (FIB), and dissolved oxygen are the major impairment concerns in the watersheds. A pollutant load analysis (PLA) identified the most significant TN hot spot to be in the creek segment near 9th Avenue.

Aquifer vulnerability maps indicated several areas throughout the Carpenter Creek watershed that is highly vulnerable to aquifer contamination. Due to the location of septic tanks and stormwater ponds, along with the presence of dissolved inorganic nitrogen, groundwater seepage was identified as a potential source of nutrient loading. Large areas of septic systems are present throughout the Carpenter Creek watershed, concentrated in the northwest corner and along the western and eastern boundaries of the watershed (Florida Department of Health (FDOH)). These septic areas are up-gradient of Carpenter Creek and Bayou Texar and have the potential to contribute nutrients and bacteria through groundwater connectivity.

The Bayou Texar watershed is also highly urbanized and primarily consists of residential development. Anthropogenic modification of the shoreline in the upper and middle portions of the Bayou and urban stormwater from local parks and residential areas that drain to the Bayou are likely contributing to water quality issues. Based on the characterization of sediments within the Bayou, a layer of fine-grained sediments is present across most of the Bayou. Fine-grained organic sediments can be a significant nutrient load contributor by internal loading driven by sediment flux, both diffusive and resuspension mechanisms.

The water quality assessment results also indicate FIB is a major impairment concern in the watershed. The results of the correlation analysis indicated a link between *E. coli* (freshwater FIB) and sediment transport and suggest stormwater discharge as a contributing factor to elevated *E. coli* counts in Carpenter Creek. The results of the correlation analysis also indicate the possible presence of *Enterococci* (marine FIB) in channel sediments and/or contributed via stormwater flows in Bayou Texar. Urban stormwater from local parks and residential areas that drain to Bayou Texar is a likely contributing factor, and remedies could include enhanced bioswales and extending the shoreline that intercepts and treats stormwater runoff before discharge into the Bayou.

Additional data collection is necessary to further identify sources of and contributors to the water quality impairments. The Water Quality Assessment Report included recommendations for expansions to the County's water quality monitoring program for surface water, groundwater, sediment characterization, and stream stage and flow. These recommendations are discussed in **Section 3.4** of this report.

A Hydrologic and Hydraulic model was developed for the Escambia County portion of the watersheds and joined with an existing model for the City of Pensacola portion. The H&H analysis

was completed using ICPR4. Due to limitations in the City model, the water quantity results focused on the County portion.

Design storm simulations were developed for the 10-yr and 100-yr storm events, for durations of 1, 2, 4, 8, 24, 72, 168, and 240 hours, to determine the critical storm duration (storm event resulting in the highest maximum stages). The 100-year, 8-hour storm was identified as the critical storm duration.

Model simulations were also developed for the intermediate-low and intermediate-high sea level rise (SLR) scenarios for the years 2040 and 2070. As the model's boundary condition time/stage nodes for Carpenter Creek and Bayou Texar were established at an elevation of 1.1 ft (NAVD88), the SLR projections were then added to the boundary condition elevations, resulting in adjusted SLR boundary conditions of 1.76 ft, 2.41 ft, 2.28 ft, and 4.25 ft, respectively.

The City and County each provided the Wood team with guidance in selecting and determining critical infrastructure locations in the modeled area. Two hundred twenty-three unique critical infrastructure locations were determined throughout the City and unincorporated area. From the critical infrastructure locations provided by the County and utilized as a part of this analysis, there were no threats to the critical infrastructure identified in the unincorporated areas based on the resulting floodplains from the model simulations, including the SLR model simulations, generated. There also doesn't appear to be a negative impact on the identified wetlands in the unincorporated area.

Generally speaking, local flooding issues were primarily located in the northwest portion of the Carpenter Creek watershed, with some localized flooding in the northeast. No threats to critical infrastructure were identified. Due to limited confidence in the model results from the City's existing model, detailed analysis related to projected SLR floodplains, and the potential inundation of critical infrastructure and wetlands was not a focus within the City limits.

Extensive urbanization of the terrestrial environment has disconnected the study area from an intact upland wildlife corridor, leaving only a few isolated patches of remnant habitat, most of which have seen an anthropogenic impact. A primary target is to connect wildlife corridors where possible.

1.5 Project Scoring Criteria

Escambia County uses an alternative evaluation decision matrix to rank projects recommended in their watershed management plans, which are described in the County's Basin Management Guidelines ((Escambia County, 2013.). This WMP follows the basin management guidelines but is also tasked to meet the RESTORE grant criteria. Therefore, the projects recommended in this section will be ranked using a modified decision matrix. **Table 1-1** below shows the difference in scoring criteria. **Sections 1.5.1 – 1.5.8** provide detailed information on the scoring criteria used in this WMP.

Table 1-1
Project Scoring Criteria

Carpenter Creek & Bayou Texar WMP (2022)		Basin Study Guidelines & Specifications (2013)	
Criteria	**Points**	**Criteria**	**Points**
Improves Water Quantity or Water Quality	0-15	Improves Flooding Conditions	0-20
Protects, enhances, and/or restores Fish & Wildlife Habitat	0-15	Impacts on Environmentally Sensitive Areas	0-10
Expands existing Public Access and Recreation opportunities	0-15	Improves Water Quality	0-10
Improves Community Resiliency	0-15	Provides for Future Growth / Development	0-10
Constructability	0-10	Constructability	0-10
Permitability	0-10	Permitability	0-10
Land Acquisition / P3 Requirements	0-5	Dependent / Independent	0-10
Cost vs. Benefit	0-15	Cost vs. Benefit	0-20
Total Possible Score	**100**	**Total Possible Score**	**100**

1.5.1 Improves Water Quantity or Water Quality:

This category rates the improvement of existing flooding and water quality problems. The scoring ranges from 0 to 15 based on the following:

11-15 Quality - Significant reductions in pollutant loadings from an area directly discharging to a surface water body with known water quality problems.

Quantity - Reduces/eliminates the most severe flooding problems such as flooding inside of homes and or businesses and roadway flooding of primary arteries and evacuation routes.

6-10 Quality - Good to moderate overall reductions in pollutant loadings.

Quantity - Reduces/eliminates yard, street, and parking lot flooding and roadway flooding of secondary arteries and collectors.

0-5 Quality - Indicates little to no reduction in pollutant loadings.

Quantity - reduces/eliminates minor drainage conditions such as shallow pools that tend to stand for periods after a rainfall event.

1.5.2 Protects, enhances, and/or restores Fish & Wildlife Habitat:

This category rates the improvement of current conditions throughout the watersheds relating to terrestrial and aquatic fish & wildlife habitats (including riparian buffers, floodplain connectivity,

wildlife corridors, invasive species abundance, locally important native species, legacy contamination). The scoring ranges from 0 to 15 based on the following:

11-15 Projects having significant positive impacts on fish and wildlife habitats.

6-10 Projects having a significant positive impact on fish or wildlife, but not both.

1-5 Projects providing some positive impact on fish or wildlife habitats.

0 Project having no impact on fish and wildlife habitats.

1.5.3 Expands existing Public Access and Recreation opportunities:

This category ranks the project's creation or improvement of public access and recreation and its ability to connect residents to their watershed and waterways. The scoring ranges from 0 to 15 based on the following criteria (within each range, projects are scored based on scale and thoroughness):

11-15 Project successfully provides all the following features: new or significantly increased water access, significant improvement to transportation networks (bicycle, pedestrian, kayak), and recreation opportunities.

6-10 Project successfully provides at least two of the following features: new or significantly increased water access, significant improvement to transportation networks (bicycle, pedestrian, kayak), and recreation opportunities.

0-5 Project successfully provides less than two of the following features: new or significantly increased water access, significant improvement to transportation networks (bicycle, pedestrian, kayak), and recreation opportunities.

1.5.4 Improves Community Resiliency:

Community resilience requires a layered approach that addresses physical infrastructure alongside social, ecological, and economic community needs. This category ranks the project's ability to improve the equity and resiliency of communities in the face of climate change, increased rainfall, sea-level rise, and severe weather events. The scoring ranges from 0 to 15 based on the following:

11-15 Project significantly offsets impacts from past and future development provides significant protection of vulnerable assets from climate change stressors and fosters stewardship by connecting residents to their watershed in new or significantly expanded ways.

6-10 Project offsets impacts from past development, provides moderate protection of vulnerable assets, and fosters stewardship by connecting residents to their watershed.

0-5 Project has little influence on development impacts or asset protection and does not connect residents to their watershed in any significant way.

1.5.5 Constructability:

This category ranks the improvements on the ease or difficulty of building the project. The scoring ranges from 0 to 10 based on the following:

- 8 – 10 Can be built easily using straightforward construction techniques employed by a majority of local contractors that bid County jobs.
- 4 – 7 More difficult but can still be constructed by some of the local contractors with the aid of specialty subcontractors and techniques.
- 0 – 3 Extremely difficult to construct the project; very few or none of the local contractors could build the project; it would require an out-of-town specialist.

1.5.6 Permitability:

This category refers to the ease or difficulty of obtaining the necessary permits from the various regulatory agencies required to construct the improvements. The scoring ranges from 0 to 10 based on the following:

- 8 – 10 Does not require any permits or requires only general permits that can be easily obtained.
- 4 – 7 Requires permits that are more difficult to obtain but should still be granted by the regulatory agencies.
- 0 – 3 Requires permits that have a good chance of being denied by one or more of the regulatory agencies.

1.5.7 Land Acquisition / Public-Private Partnership (P3) Requirements

This category refers to the land ownership and ease or difficulty of acquiring the properties to construct the project or partner with private landowners. The scoring ranges from 0 to 5 based on the following:

- 5 Property is owned by Escambia County or the City of Pensacola.
- 3-4 Property is owned by Escambia County or the City of Pensacola but may require private property access for construction.
- 1-3 Property is owned by a public entity other than Escambia County or the City of Pensacola or a private landowner that has expressed partnership interest.
- 0 Property is privately owned. Land acquisition or public-private partnership must be obtained.

1.5.8 Cost vs. Benefit

This category considers several factors. Each site may contain one or many benefits. In order to normalize the scoring, each benefit may score as low, medium, or high. In a few cases, individual benefits may be low or negligible, but the recommendations have multiple benefits, changing the ranking to medium:

11-15 High ranking

- TN removal <$150/lb - $175/lb
- TSS removal <$5/lb
- > 1.1' Flood reduction
- >0.5 mile Stream restoration

6-10 Medium ranking

- TN removal between < $175/lb - $250/lb
- TSS removal $5/lb-$13/lb
- 0.1'-1' Flood Reduction
- 0.11 – 0.5 mile Stream restoration

0-5 Low ranking

- TN removal $249/lb - >$475/lb
- TSS removal > $13/lb
- 0' Flood reduction
- 0 - 0.1 mile Stream restoration

1.6 Project Identification Process

The WMP team identified areas for improvement in the watersheds based on several key factors, including assessment results, known issue areas, available public lands, appropriate land use designations and easements, and previous discussions with potential private partnerships. Forty-eight (48) sites were initially identified as potential recommendation areas. These sites were pared down to 15 based on feedback from Escambia County and the City of Pensacola, further evaluation of concept feasibility, assessment of available lands, and in some cases, combining sites to create larger-scale recommendations. The fifteen sites were grouped by impact area (**See Figure 1-1**) and shared with the Technical Stakeholder Group to gain input on site-specific issues and recommendations and ensure potential projects would not conflict with future planned activities. Technical Stakeholder Feedback is provided in **Appendix B**.

Figure 1-1
Recommended Projects by Segment

HEADWATERS SITES

Headwaters Sites Synthesis Map - Figure A5

Olive Road Headwaters (Site 16)
See Figures A6, Report Section 3.1.4.1

Coronet Drive Headwaters (Site 1)
See Figures A7, Report Section 3.1.4.2

Olive Road + Hilburn Road Headwaters (Site 7)
See Figures A8, Report Section 3.1.4.3

Siskin Lane Headwaters (Site 3)
See Figures A9, Report Section 3.1.4.4

Headwaters South of I-10 (Site 14)
See Figures A10, Report Section 3.1.4.5

Headwaters near Burgess Road (Site 2)
See Figures A11, Report Section 3.1.4.6

Hilburn Road Headwaters (Site 4)
See Figures A12, Report Section 3.1.4.7

CREEK SITES

Creek Sites Synthesis Map - *Figure A14*

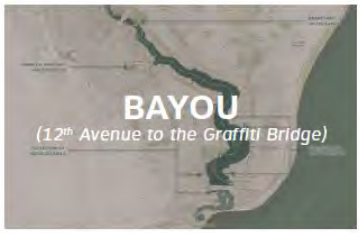
The Creek at Shiloh Drive (Site 5)
See Figures A15, Report Section 3.2.4.1

The Creek at Sterling Hills (Site 8)
See Figures A16, Report Section 3.2.4.2

The Creek from Davis Highway to 9TH Avenue (Site 10)
See Figures A17, Report Section 3.2.4.3

Sacred Heart Campus (Site 13)
See Figures A18, Report Section 3.2.4.4

The Creek from 9TH Avenue to 12TH Avenue (Site 11)
See Figures A19, Report Section 3.2.4.5



BAYOU SITES

Bayou Sites Synthesis Map - *Figure A21*

Baars Park on the Bayou (Site 20)
See Figures A22, Report Section 3.3.4.1

Semmes Elementary and the Bayou (Site 12)
See Figures A23, Report Section 3.3.4.2

Collection of Bayou Outfalls (Site 15)
See Figures A24, Report Section 3.3.4.3

1.7 Decision Matrix

Table 1-2 shows the scores applied to each project for the scoring criteria described in **Section 1.5**. **Section 2** describes the sites in detail. Conceptual plans are provided in **Appendix A**. Site numbering is a carryover from the initial identification process, exceeding 15 as the limit, and is not consecutive from headwaters to the bayou. Site numbers are helpful for quick reference between matrix, project descriptions, and concept plans.

Table 1-2
Decision Matrix

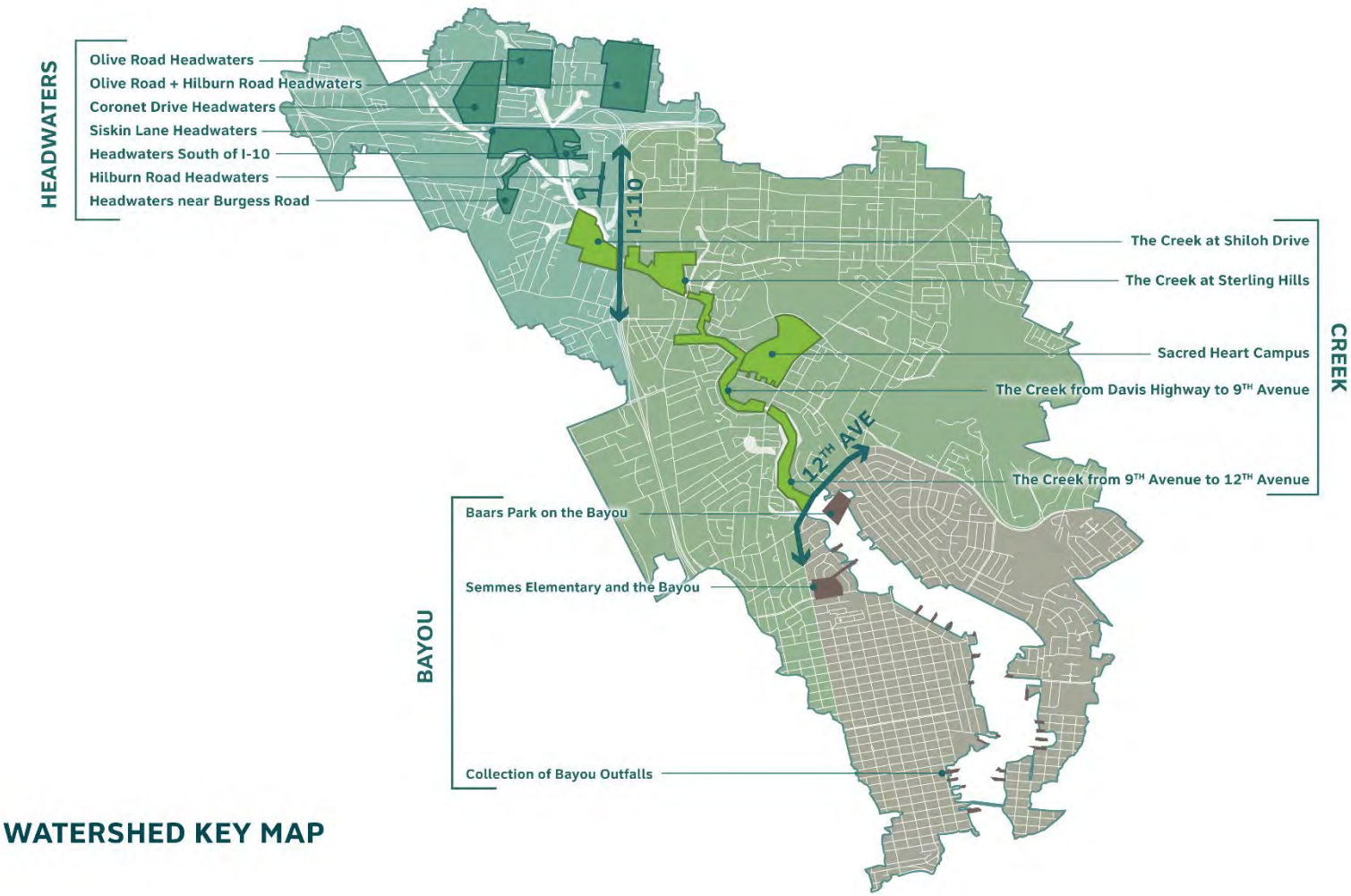
Ranking	Site_#	Segment	Site Names	Improves Water Quantity or Water Quality (0 15)	Protects, enhances, and/or restores Fish & Wildlife Habitat (0 15)	Expands existing Public Access and Recreation opportunities (0 15)	Improves Community Resiliency (0 15)	Constructability (0 10)	Permitability (0 10)	Land Acquisition / P3 Requirements (0 5)	Cost vs. Benefit (0 15)	Score (100 Possible)
1	2	Headwaters	Headwaters Near Burgess Rd	15	15	12	14	7	7	3	15	**88**
1	10	Creek	The Creek from Davis Hwy to 9th Ave	15	15	15	14	7	7	0	15	**88**
2	16	Headwaters	Olive Rd Headwaters	12	15	13	14	10	8	4	15	**64**
3	5	Creek	The Creek at Shiloh Dr	14	15	0	6	5	7	0	15	**56**
4	8	Creek	The Creek at Sterling Hills	13	15	10	13	7	7	0	11	**53**
5	1	Headwaters	Coronet Dr Headwaters	8	5	6	6	10	10	5	11	**49**
5	11	Creek	The Creek from 9th to 12th Ave	14	15	14	14	4	5	0	11	**49**
6	3	Headwaters	Siskin Lane Headwaters	11	5	5	8	10	10	0	11	**47**
6	4	Headwaters	Hilburn Rd Headwaters	2	7	12	7	10	10	5	13	**47**
7	20	Bayou	Baars Park Bayou	0	10	14	7	10	10	5	7	**42**
8	14	Headwaters	Headwaters South of 1-10	7	5	5	9	10	8	0	7	**37**
8	13	Creek	Sacred Heart Campus	2	5	10	12	10	10	3	7	**37**
9	7	Headwaters	Olive + Hilburn Rd Headwaters	10	0	2	2	7	8	3	7	**35**
10	15	Bayou	Collection of Bayou Outfalls	0	3	5	8	10	10	2	6	**31**
11	12	Bayou	Semmes Elementary and the Bayou	0	1	11	5	10	10	5	2	**28**

2 PROJECT RECOMMENDATIONS

The projects are organized by segments going from upstream to downstream in the watersheds (Headwaters, Creek, Bayou), in total fifteen projects are recommended to address identified issues and begin to achieve restoration and resiliency goals. The sections below describe the segment-specific issues and recommendations. Each project includes details related to the scoring criteria.

Cost estimates were calculated based on today's market at a conceptual level with consideration for recent inflation. Line item cost estimates were not complete per project, instead of average local and regional costs for nutrient removal and stream mile restoration were used. Cost estimates associated with improvements related to Public Access & Recreation and Community Resiliency are not included in these figures with the exception of recreational paths, where applicable. Costs related to such improvements would need to be studied more closely to accurately reflect scale, program, vegetation, and materiality within the public realm. Conceptual costs estimates are considered Class 5 estimates with an expected accuracy range of -20% to 50% (low) and +30% to +100% (high) (AACE International, 2020). To account for the accuracy range and projected near-term inflation, the high end of the cost estimate ranges were used with a 30% contingency. A summary of cost estimates for all projects is provided in **Section 5**

Figure 2-1
Project Locations by Segment



2.1 Headwaters

The headwaters segment (**Figure 2.1-1**) consists primarily of single-family residential housing with limited institutional or commercial partners and has the lowest median household income of the three segments.

There are approximately 3.7 miles of headwater streams that could benefit from restoration. These streams are small by well-defined, with a predominantly urban watershed. Urban runoff creates scour, incision, and bank erosion, and some have reduced nutrient attenuation potential, offer less aquatic habitat, and may limit fish passage.

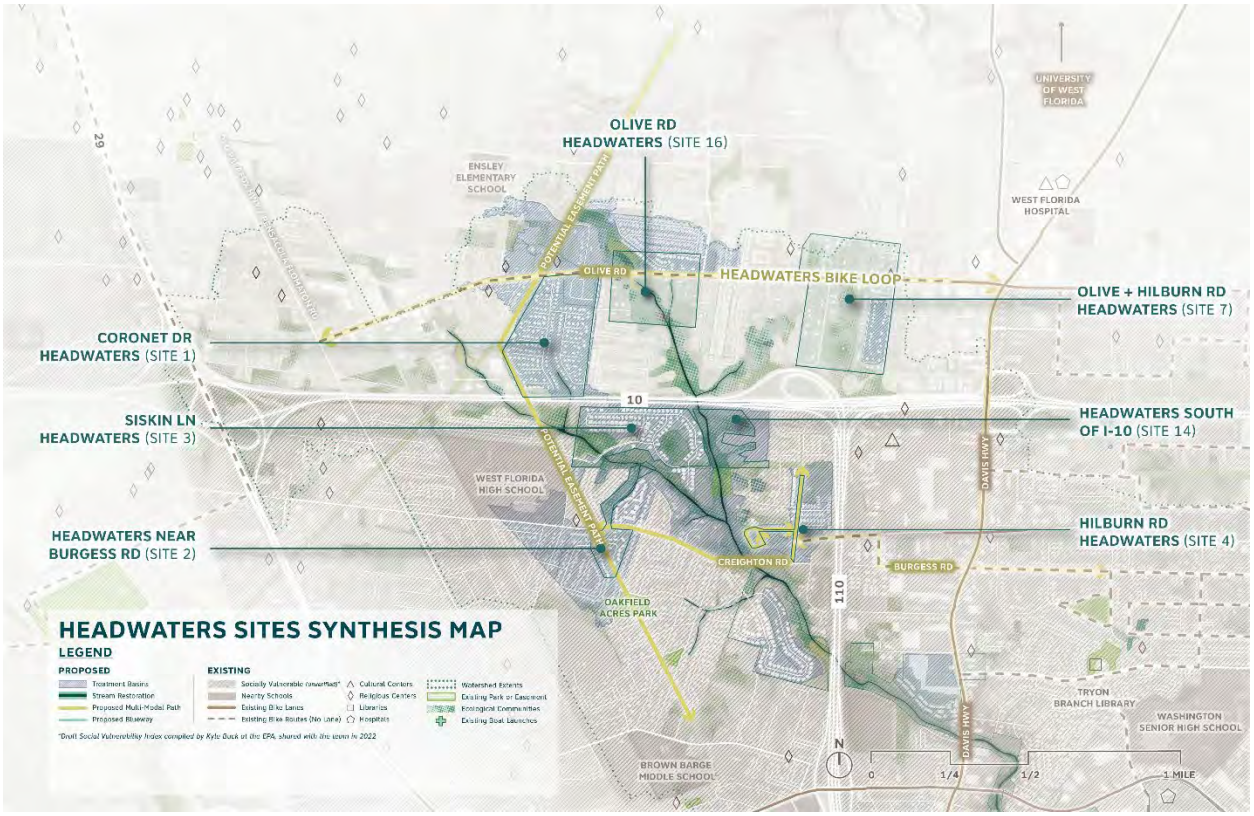
The Water Quality Assessment showed a hotspot for TN in the residential areas near the Olive Rd sampling location. Total Kjeldahl Nitrogen (TKN) concentrations were the highest at the CC @ Olive station and a significant decline downstream at the CC @ Burgess and other stations. Potential sources of TKN could include wetland soil/debris transport, fertilizers, pet waste, or failing septic tanks and sewage connections.

Large areas of floodplain were identified in areas where drainage networks may not be sufficient: Along the railroad tracks that run Palafox Street, from I-10 to Burgess Road; Commercial and residential areas between east of Palafox Street, north of Olive Road; the area near Sabra and Whitmore drives; northeast near Whitmore and Atwood drives; and north of Olive Road near Whitmore Drive.

Treatment options for Headwaters watershed and stream segments include watershed hydromodification treatments (LID/GSI stormwater retrofits, DCIA energy dissipation, and regenerative stormwater conveyance), green or gray infrastructure within the channel, and improved drainage networks. Forest and beaver management are also significant components.

Seven site-specific project recommendations were identified in the Headwaters segment (**Figure 2-2**). The sections below describe the project recommendations, including details specific to the scoring criteria. Conceptual plans are provided in **Appendix A**. **Section 3** provides programmatic recommendations that can be applied on a watershed scale, and **Section 3.6.2** specifies programmatic retrofit recommendations and related implementation programs that are most applicable to the Headwaters segment.

Figure 2.1-1
Headwaters Segment Project Locations



2.1.1 Olive Road Headwaters (Site 16)

A. Current Conditions

Olive Road bisects the headwaters area, and this hydraulic restriction reduces the effectiveness that a floodplain typically provides for a natural system. Two 30" culverts allow flow under Olive Road, and the marsh located on the north side of Olive Road is subject to a reduced hydroperiod. The drainage area to the crossdrain system is 91± acres. This current condition causes the north side of Olive Road to act as a detention system.

On the south side of Olive Road, a private access road crosses the creek bed and has one culvert located through it. The contributing drainage area to the upstream side of this access road location includes the 91± acres from the north side of the road as well as approximately 13.5 acres that are directed to this location by the existing Olive Road southern roadside ditch system. The access road has significantly eroded due to lack of maintenance and the high water flows and levels that area experiences. Beaver activity has been high in the past on the south side of Olive Road and within the parcels currently owned by Escambia County. Thus this forested wetland area has at times had impounded water levels due to the beaver dams resulting in ponded conditions. Subsequently, the wetland has transformed into more of a herbaceous marsh wetland. Currently, the beaver dam is ineffective due to failure during relatively recent hurricane activity, and the creek is able to flow freely through the wetland.

There is an existing incised manmade ditch ("East Ditch") on the eastern side of the Escambia County parcels located on the south side of Olive Road. This area has a 23± acre contributing drainage basin, and stormwater predominantly comes from the Mazurek Plantation subdivision, which is served by a stormwater management system (dry detention).

B. Recommendations/BMP Concept

Escambia County has a separate contract with a consultant to develop road and drainage improvements along Olive Road. At the time of the development of these concepts, the Olive Road Design project was not sufficiently advanced that the cooperative merging of the two projects could be fully taken advantage of, however, some input received just before the issuance of this report allowed for the addition of a concept BMP that addresses the roadway drainage. Concept BMPs were otherwise developed void of specific Olive Road Design project stormwater needs. See **Appendix A, Sheet A6** for the conceptual plan.

This concept would consist of a multi-modal trail creating a "Headwaters Loop". This would connect riders on E Olive Road to a greenway along the easement between Deborah Drive and Coronet Drive (see also sites 2, 3). The greenway would provide an impetus for a potentially elevated crossing over I-10, improving north/south pedestrian and bike connectivity in the watersheds at large. This concept would also include the construction of various recreational elements such as a recreation center, parking lot, and signage

The five stormwater management and hydrologic restoration components of the headwaters site location include the following:

1. Wet Detention- A drainage area of 90.8 acres of mixed land use areas currently drains toward a set of culverts under Olive Road at the Carpenter Creek headwaters. This concept includes a control structure fitted on the existing northern end of the 30" culverts. This structure can safely raise water levels in the marsh located on the north side of Olive Road, allowing stormwater treatment processes associated with extended wet detention to occur. The wetland will be hydrated improving the habitat of the system. By placing a control structure on the system and raising the "control elevation" of the wetland, additional cross-drain capacity is required under Olive Road (see model results below). Additionally, the final design of this concept system must take into account any nearby public features such as septic systems (from not only a hydraulic function but also a water quality perspective) and the existing dock located in the affected wetland.

2. Detention- The total drainage area to this location includes the 90.8 acres from the north side of Olive Road as well as approximately 26.3 acres from the west and conveyed easterly to this location by the paved Olive Road ditch. The concept will include an improved overflow weir located at the existing failed access road and located adjacent to a future boardwalk crossing of the creek. The overflow weir will be set several feet above the existing water level to increase the hydroperiod of the existing wetland located between Olive Road and the access road. A control structure will be installed on the east side of this area to intake base flow and flows from smaller storm events. These flows will be passed through an upflow biosorption activated media (BAM) system for the additional removal of dissolved nutrient pollutants. The discharge

from the BAM system can then be directed through a small diameter pipe under the boardwalk and to the wetland system located downstream.

3. Terraced Bioretention Ditches- The East Ditch receives offsite residential stormwater runoff from 22.9± acres that are currently passed as cross drainage under Olive Road. This concept includes placing grade control/ ditch block systems on the East Ditch and taking the flows offline to linear treatment ditches that are located parallel to the contours of the existing Escambia County parcels. These gently sloped ditches will be vegetated and fitted with BAM-supplemented bioretention features to account for possible restrictive infiltration conditions. The ditches will likely have some infiltration characteristics allowing stormwater to infiltrate into the ground and recharge the surficial water table supplying Carpenter Creek. The bioretention system is assumed necessary to recover the ditch storage capacity for the next storm while treating the detained water through the BAM media for increased nutrient removal. The ditches will be vegetated to blend in with the landscape.

4. Olive Road Improvements Wet Detention Facility- The Olive Road Improvements project is currently underway and the County arranged coordination meetings to achieve continuity between the roadway improvements and the watershed improvements of this project. This concept proposes a 1.85-acre wet detention facility to serve a drainage area of 19.39 acres of which 12.69 acres come from offsite residential areas. The road designers would be able to divert approximately 2.1 acres of drainage area that currently contributes to the Whitmore Drive drainage problem area to this pond. The detention pond is estimated to have 5.9 acre-feet of permanent pool volume and will be able to attenuate peak discharge rates associated with the changes in the improved drainage level of service of the roadway improvements.

5. Beaver Dam Analogues – Beavers historically built several small dams along Carpenter Creek downstream of the failed access road described in the Item 2 Detention section above. They also patched the access road as it progressively failed to maintain water levels in the pond south of Olive Road. However, Hurricane Sally displaced this population of beavers and their structures. Beavers are able to colonize this area because it is a small creek with a large forested bottomland. Their work has improved the resiliency of the system by spreading flow through the forest and patching areas of concentrated runoff, thus preventing loss of grade control (long-term channel incision). Low-cost stream enhancement and protection can be achieved through prudent beaver management. Beaver re-population could be jump-started by building beaver dam analogues (BDA). BDA are human-built structures that are designed to mimic beaver dams. These structures can last up to a few years without maintenance, but they are built more specifically to attract beavers who then perform the long-term maintenance of them. This type of stream restoration is highly applicable to this headwaters parcel. The result will be improved grade control and resiliency against excessive streambed erosion, modest water quality improvement, a more resilient fishing pond south of Olive Road, and better heterogeneity of hydraulic habitat with improved aquatic biodiversity in this section of Carpenter Creek.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The Wet Detention Concept provides extremely effective nutrient and suspended solids removal which will allow the downstream portion of the headwater area to provide improved nutrient uptake from those areas discharging directly into that segment. The Detention Concept also has a significant and effective nutrient and suspended solids removal capacity which can provide direct water quality benefits for the Olive Road improvements. Both the Wet Detention and Detention Concept BMPs are recommended for implementation due to the multiple benefits that they provide at cost-effective rates.

The bioretention ditches concept has limited nutrient removal and suspended solids capacity compared to the other alternatives. However, it is recommended that at least one shortened bioretention ditch be constructed to capture gross pollutants and nutrient loads associated with base flows. The Olive Road wet detention concept has favorable water quality benefits as it removes high nutrient and suspended solids pollutant loads while at the same time facilitating the Olive Road improvements. It is recommended that a modified version of the Olive Road wet detention pond BMP as currently depicted be implemented. Modifications should include the addition of multiple control structure discharges with spreader systems at the outfalls to distribute the flows and minimize potential downstream erosion impacts.

ii. Water Quantity

Wet Detention Concept- Since the Olive Road improvements are currently under design, it is recommended that the installation of the additional pipe be included in the Olive Road Improvements design if this concept is adopted. Other factors that must be considered include acceptance of the affected property owners to this hydraulic modification, verification that features such as existing septic systems are not impacted, permitting for temporary wetland impacts, and temporary construction easements for construction of the improvements. Detention Concept- This concept system will help reduce the peak discharge rates through the creek's headwater system. Other factors that must be considered include permitting this feature since it will be considered in the wetland; however, the overall benefits to the headwater creek habitat will far outweigh the temporary wetland impacts required to construct the system. Bioretention Ditches Concept- Capture of storm flows will reduce the impact that East Ditch has on Carpenter Creek at this headwater location. This BMP has the potential to provide high surficial water table recharge, which would enhance the Carpenter Creek headwater wetland at this location. Other factors that must be considered include the fact that the existing ditch is located on the adjacent property and not in what appears to be the originally intended alignment through a narrow County parcel. This could work to the County's advantage should it be decided by all parties that moving the ditch back to the west would serve both the County and the property owner with the most appropriate

alternative alignment. Additionally, permitting of this feature must be considered since this ditch will be considered "other surface waters" and is regulated by the agencies. The Olive Road Wet Detention Concept will have the ability to serve the Olive Road Improvements and can attenuate the flows from the highway system as well as the additional offsite drainage area directed to the pond. Special consideration must be given to dampening and spreading out the pond discharge so that it does not become an erosion issue in the future, degrading the wetlands and creek banks.

iii. Model Results

Wet Detention Concept- This concept requires an additional cross drain under Olive Road to prevent increased flood levels. Based on concept modeling, an additional 30" cross drain located above the proposed water quality elevation will achieve this. **The wet detention concept BMP has annual pollutant load reduction estimates as** follows: 52 lbs TN, 22.6 lbs TP, and 4990 lbs TSS. These reductions are based on estimated topography in the marsh area and must be verified during design with actual surveyed information. Detention Concept BMP- The overflow weir must be sized appropriately to dampen peak discharge rates without impacting Olive Road or the upstream contributing drainage area. The required BAM size was conceptualized based on engineering judgment and a more detailed design will be required during the design phase of the project if chosen. The Detention Concept BMP has annual pollutant load reduction estimates as follows: 127.7 lbs TN, 39.2 lbs TP, and 2774 lbs TSS. This concept has the potential to provide a slight reduction of peak discharge rates from the Olive Road improvements.

The Bioretention Ditches Concept BMP- The modifications to the ditch and protection of the ditches from scour will require detailed design during the design phase of this project. Slight relocation of East Ditch as noted above could facilitate scour control and ultimately reduce construction costs. The Bioretention Ditches Concept BMP has annual pollutant load reduction estimates as follows: 27.7 lbs TN, 4.5 lbs TP, and 400 lbs TSS. Olive Road Wet Detention BMP- It is our understanding that this concept can facilitate the highway improvements, allow for diversion of stormwater currently impacting the Whitmore Drive area of concern, as well as provide treatment for offsite residential drainage areas some of which are currently untreated. The Olive Road Wet Detention BMP has annual pollutant load reduction estimates as follows: 67 lbs TN, 17 lbs TP, and 3146 lbs TSS.

b. Fish & Wildlife Habitat Considerations

The Wet Detention and Detention BMP Concepts will improve the fish and wildlife success by creating more of a headwater swamp habitat at those locations. The Bioretention Ditches and Olive Road Wet Detention BMP Concepts will likely improve bird foraging habitat. All four of these concepts attenuate the flows currently coming through the headwaters area, reducing past hydraulic alterations' impacts on this section of Carpenter Creek.

c. Public Access/Recreational Considerations

The Olive Road Headwaters Site holds exciting potential to become a larger-scale, community-oriented intervention incorporating recreational, educational, and ecological enhancements. A primary park entrance accessible from East Olive Road would ensure accessibility by bike, foot, or car. Continuous public access would be provided through the extension of existing paths, connecting across the waterway and creating a "Headwaters Loop" to link both sides of the headwater's tributaries. To the south, access would encourage wildlife viewing for existing bird and beaver habitats while to the north, an expansion of the headwaters pond would allow for fishing. Educational programming of various scales, including a potential nature center, outdoor classrooms, and interpretive signage, would engage residents in restoration and stormwater management strategies.

The Detention Concept BMP, the Bioretention Ditches Concept BMP, and the Olive Road Wet Detention Concept BMP can all be worked into the future Carpenter Creek Headwaters project. The Detention Concept BMP can be strategically located with a recreational path/boardwalk over the creek area, providing the water quality, water quantity, and educational benefits through signage as well.

d. Community Resiliency Considerations

Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace. Environmental education programming, including a potential nature center, outdoor classrooms, and interpretive signage, would foster stewardship by engaging residents in restoration and stormwater management strategies. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions.

e. Constructability Considerations

The location of the Wet Detention and Detention Concept BMPs has a high probability of muck and the designs will have to account for this site condition. Additionally, all three projects could benefit from the coordination of this project with the Olive Road Design project to facilitate future improvements associated with the Grant project. Of course, permitting the Grant project is more complex and could impact the Olive Road Improvements implementation schedule. Finally, water management will be critical during the construction of these concept BMPs and a carefully thought-out stormwater pollutant prevention plan will be required to ensure the BMPs are not adversely affected during construction due to contractor means and methods.

f. Permitting Considerations

Stormwater retrofit of this will require an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff.

g. Land Acquisition / Public-Private Partnership Requirements

The Wet Detention Concept BMP will change the existing water levels on several parcels and a "flood conveyance easement" or similar legal instrument should be secured by the County. The implementation of the Bioretention Ditches Concept BMP is somewhat complicated by the fact that the existing ditch is located on the adjacent property and not in what appears to be the originally intended alignment through a narrow County parcel. This could work to the County's advantage should it be decided by both parties that moving the ditch back to the west would serve both the County and the adjacent property owner with the most appropriate alternative alignment.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

Wet Detention Concept BMP- The estimated opinion of the construction cost for BMP #1 ranges from $22,500 to $29,000 and could be further improved if the Olive Road Construction Project can share in the cost of this improvement. The estimated opinion of the construction cost for the Detention Concept BMP ranges from $133,500 to $181,500. The estimated opinion of the construction cost for the Bioretention Ditches Concept BMP ranges from $129,000 to $174,000, however, the benefits this BMP could have for the Olive Road Improvement project could surely result in a cost-share arrangement and reduced costs for either County department. The estimated opinion of the construction cost for the Olive Road Wet Detention Concept BMP ranges from ±$400,000 to $535,000, inclusive of the pond and outfall structures but no storm sewer inflow system. The BDAs could add up to $20,000 to this estimate.

The estimated costs of the proposed recreational elements have not been included in the estimated costs for the water quality improvement BMPs conceptualized within the Olive Road Headwaters Site (Site 16) limits. The following recreational elements are assumed for the construction cost estimate: an 8' multi-modal path, an 8' wide boardwalk crossing of Carpenter Creek at two locations, an open outdoor classroom of pole barn-type construction, a 625 square foot indoor Nature Center, a small parking lot, associated signage, and incidental construction elements. Our opinion of the estimated construction costs for these improvements is a range from $917,000 to $1,243,000 based on the noted assumptions and the schematic layout contained in this report. There is significant flexibility in the type of construction for several of the concept elements and this cost range can be expanded downward with various substitutions. The County can choose to phase improvements as well if needed. Additionally, conservative dimensions or costs were assumed for such items as the boardwalk and the nature center which account for a significant percentage of the overall site recreational improvements depicted in the concept. Value engineering during the design phase will be implemented and cost savings should be realized relative to the estimated opinion construction cost range presented above.

The total estimated project cost for the water quality and specified recreational trail, including 30% contingency is $2,115,750 on the high end. This cost estimate excludes

the Olive Road Wet Detention, which may be completed under the Olive Road drainage project currently underway.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$285,000	$384,500	$0	$20,000	$1,243,000	$1,627,500	$2,115,750

ii. BCA

Wet Detention Concept BMP- The 50-year life cycle cost for this concept would yield effective estimated unit nutrient removal costs of $12-$15 per lb TN and $27 -$35 per lb TP, both of which are highly favorable benefit values. The Detention Concept BMP has a 50-year life cycle cost that would yield effective estimated unit nutrient removal costs of $47-$60 per lb TN and $513-$650 per Lb TP, both of which are favorable benefit values. The Bioretention Ditches Concept BMP has a 50-year life cycle cost that would yield effective estimated unit nutrient removal costs of $202 - $260 per lb TN and $1,244-$1,600 per lb TP. These benefit values are a bit less favorable than the other concepts however the potential influence that the Olive Road Design project participation could have on the benefits and costs of this project cannot be understated. The Olive Road Wet Detention Concept BMP has a 50-year life cycle cost that would yield effective estimated unit nutrient removal costs of $140 - $180 per lb TN and $553 -$718 per lb TP. The benefits of this concept are favorable from a number of standpoints. The potential for "cost-share" arrangements of the Headwaters grant project with the Olive Road improvements project makes this concept all the more favorable as grant funds could be stretched to capture many, if not all, of the elements of the concept BMPs presented for the headwaters area.

D. Other Considerations

a. Geotechnical Considerations

The location of the Wet Detention and Detention Concept BMPs has a high probability of muck. The projects must have geotechnical designs performed to confirm the requirements for firm foundations for the proposed improvements. Earthwork for the Olive Road Wet Detention Concept BMP will be significant, and considerations for making the concept pond fit the topography and have a net positive influence on the surficial water table adjacent to the headwater wetlands are desired.

2.1.2 Coronet Drive Headwaters (Site 1)

E. Current conditions

Site 1 is located within a single-family residential neighborhood with existing stormwater infrastructure. The stormwater is discharged into an existing ditch that flows between Coronet

Drive and Dartmoor Drive without treatment. Once in the creek, the water goes through an existing 3-foot by 8-foot box culvert under Interstate 10.

F. Recommendations/BMP concept

To treat the existing urbanized runoff, it is recommended that multiple "Smart Boxes", or a stormwater infrastructure structure containing sediment settling chamber or chambers be installed. There are several types of "Smart Box" technologies. The two most common systems are baffle boxes and continuous deflection separation (CDS). A single second-generation baffle box removes 20% Nitrogen, 19% of Phosphorus, and 90% of total suspended solids.

Any additional nutrients not removed by the proposed baffle boxes can be treated on the southside of Interstate 10 in conjunction with Site 3.

Construction of approximately 3,380 lineal feet of recreational trail, would create formalized bicycle infrastructure creating a "Headwaters Loop" would connect riders on E Olive Road to a greenway along the easement between Deborah Drive and Coronet Drive (see also sites 2, 3). The greenway would provide an impetus for a potentially elevated crossing over I-10, improving north/south pedestrian and bike connectivity in the watersheds at large. See **Appendix A, Sheet A7** for the conceptual plan.

G. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The proposed BMP retrofits moderately reduce the TN loading. Excess nitrogen can cause overstimulation of the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters.

ii. Water Quantity

Site 1 was determined to benefit from Water Quality treatment more than Water Quantity in previous tasks.

iii. Model Results

Utilizing BMPTrains 2020, the removal efficiencies mentioned in the BMP concept section, and the pollutant load model in a previous task, the model calculated to remove 71 lbs of TN per year and 11.45 lbs of TP per year. No further modeling was conducted under this scope. Additional modeling will only be required to permit and construct this project. H&H modeling, such as ICPR, will be required for final design and permitting.

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 1 it is within reason to expect that the fish and wildlife habitat has also improved in the area. No further consideration was applicable for Site 1.

c. Public Access/Recreational Considerations

Recommendations at the Coronet Drive Headwaters Site seek to improve access to upland Carpenter Creek. Formalized bicycle infrastructure creating a "Headwaters Loop" would connect riders on E Olive Road to a greenway along the easement between Deborah Drive and Coronet Drive (see also sites 2, 3). The greenway would provide an impetus for a potentially elevated crossing over I-10, improving north/south pedestrian and bike connectivity in the watersheds at large. The Housing Authority parcel at the northeast corner of the site holds potential for a new public green space and/or demonstration space for stormwater best management practices. A pedestrian path at the end of Coronet Drive ending in a low-impact window to the creek [1] would engage residents in restoration and stormwater management strategies.[2]

[1] Windows to the creek or bayou are framed views (such as an overlook) that visually connect residents with the Carpenter Creek and Bayou Texar system without disturbing riparian vegetation. Getting "eyes on the creek" can encourage stewardship and engage the community in areas that would otherwise be too sensitive for public access.

[2] While these proposed programs represent input received to date, it is important to note that all public programming should be determined through community outreach and input regardless of recommendation or site location.

d. Community Resiliency Considerations

Pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

e. Constructability Considerations

Retrofitting stormwater BMPs such as baffle boxes into existing stormwater infrastructure is a straightforward construction technique to employ and can be completed by experienced contractors who have had experience installing stormwater infrastructure.

f. Permitting Considerations

A stormwater retrofit of this size may qualify for exemption from an environmental resource permit (ERP) from the Northwest Florida Water Management District. Baffle boxes are typically designed to allow for high flows to pass through unimpeded but the consultant will

be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff.

g. Land Acquisition / Public-Private Partnership Requirements

The installation of the baffle box can be completed in the existing County right of way.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

Water quality improvement projects focused on removing nutrients such as nitrogen and phosphorus have been analyzed for cost-effectiveness throughout the years to help government agencies allocate funds appropriately. Projects such as the one proposed are such a project. Using the calculated removal amount of 71 lbs of TN per year, the anticipated design and construction cost is between $249,,000 and $674,000.

The recreational recommendations at Site 1 include the construction of approximately 3,380 linear feet of trail with an approximate cost of $363,000.

It is also recommended that a park be constructed on the empty lots on the south side of Olive Road between Windee Drive and Coronet Drive. The design and permitting of a park vary dramatically depending on the facilities being provided and the end-use of the park, at this point of the design a cost estimate would not be possible.

The total estimated project cost for water quality and specified recreational trail, including 30% contingency is $799,110 on the high end.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$215,700	$251,700	$0	$0	$363,000	$614,700	$799,110

ii. BCA

When evaluating projects for grants and funding, government agencies look at the project's cost-effectiveness. For consistent comparison of BCA for similar projects, a life span of 20 years was used. A water quality project with the measurable benefit of TN removed is typically highly cost-effective if it costs less than $150 per pound, medium if it is between $175 and $250 per pound, and not cost-effective if it is more than $475 per pound. This project would rank as a high cost-effectiveness project.

2.1.3 Olive Road and Hilburn Road Headwaters (Site 7)

H. Current conditions

Site seven is a single-family residential neighborhood with existing stormwater infrastructure. The area of concern is bracketed by Sabra Road on the east and south, Whitmire Road on the west,

and Erwin Road on the north. The existing infrastructure is focused on discharge on the south end of Sabra Road, which outfalls into an existing drainage ditch in a 66-foot drainage easement running parallel to Atwood Drive. Once in the drainage ditch, it then feeds into a tributary that is part of the Carpenter Creek system.

The area is known for flooding frequently, which is supported by our existing conditions model. The flooding occurs behind houses on the east side of Sabra Road and the west side of Whitmire Road. This is due to the existing topography of the area coupled with the development of the area.

The County has entered into an agreement with Moffatt & Nichol to improve the existing conditions along Olive Road. The intersection of Whitmire Drive and Olive Road is within their area of improvement. It is possible that the proposed improvement along Olive Road will change the existing conditions in our project area. However, with the current information available, the proposed BMP is not taking their project into account.

I. Recommendations/BMP concept

To alleviate flooding between the properties it is recommended that the County pursue a 20-foot drainage easement to construct a bioswale that will capture the excess water and allow it through a new ditch bottom inlet near the portion of Sabra that runs in the east-west direction and tie it into the existing stormwater infrastructure. To accompany the added flow from the new bioswale system to the existing infrastructure it is recommended that the stormwater pipes downstream of the ditch are upsized from 18- inch RCP to 30-inch RCP. See **Appendix A, Sheet A8** for the conceptual plan.

J. Concept Scoring

a. Water Quality & Quantity Considerations

i. Water Quality

Water quality was not a significant consideration at this site, although the proposed bioswale will provide some improvement.

ii. Water Quantity

The improved site conditions will reduce flooding from approximately 44 yards and subsequent roadways. In total, the BMP will result in a 1.25 'flood reduction.

iii. Model Results

Table 2.1-1 summarizes the maximum stage (ft) improvement.

Table 2.1-1
Max Flood Stages

Storm Event	Existing Conditions Maximum Stage (ft)	Proposed Conditions Maximum Stage (ft)
Mean Annual	112.26	112.09
100YR-8HR	116.51	115.26

The 100YR-8HR storm event reduces the maximum stage of 1.25-ft and reduces the flooded area from 6.85 acres to 2.45 acres. That is a reduction of 64%. A reduction of the flooding of this magnitude is moderately high.

b. Fish & Wildlife Habitat Considerations

This section is not applicable for a flood reduction retrofit proposed.

c. Public Access/Recreational Considerations

As part of ongoing Olive Road improvements, the Olive and Hilburn Road headwaters site could include improvements to bike routes along E Olive Road in alignment with existing planned improvements to create a continuous "Headwaters Loop."

d. Community Resiliency Considerations

Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

e. Constructability Considerations

To construct a bioswale behind already developed lots requires coordination with the existing homes and landowners. Informing the landowners that their property will be impacted to alleviate nuisance flooding. The upsizing of existing infrastructure currently located within the County right of way is a common practice and very easily completed.

The bioswale being constructed behind existing homes is complex and is why the constructability of this project is ranked as moderately difficult.

f. Permitting Considerations

The proposed BMP retrofits will require an Environmental Resource Permit (ERP) from the Northwest Florida Water Management District. The ERP process is not as labor-intensive as other governmental agencies and can be easily obtained.

g. Land Acquisition / Public-Private Partnership Requirements

A public-private partnership will be required to complete the recommended improvement. This improvement will require the County to work with the homeowners to construct the proposed bioswale. If nuisance flooding is prevalent, as indicated during the process, the homeowners should be willing to work with the county to reduce the flooding.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

The probable cost for the proposed BMP ranges between $500,000 to $600,000. The primary cost will be the cost of the construction of the bioswale.

The recreational recommendations surrounding Site 7 only include a regional recommendation. Site 7 recommendations are to continue the bike path along Olive Road. The cost estimate for this bike path is not included in the Site 7 cost estimate as this is recommended to be completed under the Olive Road drainage project underway.

The total estimated project cost for water quality components, including 30% contingency is $780,000 on the high end of the range.

Stormwater		**Stream Restoration**		**Parks & Rec**	**High Total**	**Contingency**
Low	High	Low	High			30%
$500,000	$600,000	$0	$0	$0	$600,000	$780,000

ii. BCA

The benefit value is medium based on 1.25′ of flood stage reduction. If implemented, the flooding will be reduced from 44 yards. This project's potential flood reduction in the area cannot be understated.

2.1.4 Siskin Lane Headwaters (Site 3)

The existing stormwater ponds treat an estimated 46 acres of urbanized runoff, and have an efficiency of approximately 81%, with an estimated reduction in the nitrogen and phosphorus loading by 2.32 kg/yr and 0.32 kg/yr. These ponds do not appear to be connected to their adjacent wetlands. To help rehydrate Carpenters Creek, it is recommended that all of the ponds have an overtopping weir constructed above the 25yr-24hr storm elevation to allow water to flow through the wetland and have further treatment before reaching carpenters creek.

According to the Natural Resources Conservation Service (NRCS), the soil types in these areas are Type A which has the highest groundwater recharge rate of the soil types. Another intervention would be to add a 12″ BAM layer at the bottom of the ponds to treat the water as it infiltrates into the ground.

A. Current conditions

Site three is a single-family residential neighborhood with existing stormwater infrastructure. Wood was unable to locate drainage plans to understand the exact drainage but using our best engineering judgment, it is assumed all of the runoff is directed into three ponds; two located on the northeast side of the property between Parakeet Trail and Tree Swallow Drive and one located near the center of the neighborhood between Tree Swallow Drive and Siskin Lane. According to the stormwater infrastructure inventory provided by the County, the two ponds located on the northeast side of the property between Parakeet Trail and Tree Swallow Drive have a discharge pipe to a tributary that feeds into Carpenter Creek

B. Recommendations/BMP concept

The treatment area for the existing stormwater ponds is approximately 46 acres of urbanized runoff. It is recommended that Bio-Sorption Activated Media (BAM) be placed at every pond bottom to improve the efficiency of the existing stormwater treatment ponds. The layer of BAM material has an efficiency of 45%.

The single pond located on the southeast side of the neighborhood should also have the discharge upgraded to a level spreader, such as a spreader swale. The addition of the level spreader will not necessarily improve water quality but will remove energy from the system during heavy rainfall events.

Construction of a 3,000 linear foot at grade recreational trail system and 500 feet of a boardwalk. This trail would start at the existing easement and would run south of Siskin Lane ultimately reaching the Carpenter Creek tributary. This could provide an opportunity for low-impact pedestrian access, and potentially connect to a second easement to the west for a larger "Headwaters Loop" greenway. See **Appendix A, Sheet A9** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The proposed layer of BAM at the pond bottom moderately reduces the TN loading. Excess nitrogen can cause overstimulation of the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters.

ii. Water Quantity

Site 3 was determined to benefit from Water Quality treatment more than Water Quantity.

iii. Model Results

Utilizing BMPTrains 2020, the removal efficiencies mentioned in the BMP concept section, and the pollutant load model in a previous task, the model calculated to remove 192 lbs

of TN per year and 32 lbs of TP per year. No further modeling was conducted under this scope. Additional modeling will only be required to permit and construct this project. The modeling required will include an ICPR model.

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 3 it is within reason to expect that the fish and wildlife habitat has also improved in the area. No further consideration was applicable for Site 3.

c. Public Access/Recreational Considerations

Recommendations at the Siskin Lane Headwaters Site center around pedestrian infrastructure along the easement to the south of the site. The easement, which crosses the creek, could provide an opportunity for low-impact pedestrian access, and potentially connect to a second easement to the west for a larger "Headwaters Loop" greenway (see also sites 1, 2).

d. Community Resiliency Considerations

Pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

e. Constructability Considerations

The installation of BAM material and upgrading outfall structures with a BAM filter is a simple task for a qualified contractor. The process includes excavating the current pond bottom and replacing it was the BAM layer.

The construction of the spreader swale is also a relatively simple task that involves improving the outfall with a sump-like structure that fills up with water and then will flow over an overland weir rather than a point discharge through a pipe.

f. Permitting Considerations

g. A stormwater retrofit of this size may qualify for exemption from an environmental resource permit (ERP) from the Northwest Florida Water Management District. The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff. Land Acquisition / Public-Private Partnership Requirements

The installation of the BAM material and construction of the spreader swale cannot be completed within the existing County right of way. A public-private partnership agreement may be required in this instance by establishing a drainage easement over the area.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

Water quality improvement projects focused on the removal of nutrients such as nitrogen and phosphorus have been analyzed for cost-effectiveness throughout the years to help government agencies allocate funds appropriately. Using the calculated removal amount of 192 lbs of TP per year they anticipate a design and construction cost between $575,000 and $670,000.

The recreational recommendations at Site 3 include approximately 3,000 linear feet of an at grade trail system and 500 feet of a boardwalk at the cost of approximately $480,000.

The total estimated project cost for water quality and recreational trail, including 30% contingency is $1,495,000 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$575,000	$670,000	$0	$0	$480,000	$1,150,000	$1,495,000

ii. BCA

When evaluating projects for grants and funding, government agencies look at the project's cost-effectiveness. A water quality project with the measurable benefit of TN removed is typically highly cost-effective if it costs less than $150 per pound, medium if it is between $175 and $250 per pound, and not cost-effective if it is more than $475 per pound. This project would rank as a high cost-effectiveness project for the water quality elements.

2.1.5 Headwaters South of I-10 (Site 14)

A. Current conditions

Site 14 is a historic flow path for Carpenters Creek and is immediately east of Site 3. The floodplain in this area has been encroached on by developing neighborhoods east and west of the area. A new neighborhood is located west of our site, called Cardinal Cove. The permitted plans under permit number 286500-1 were available on the NWFWMD website. The proposed conditions will consist of several dry stormwater treatment ponds with overflow structures that discharge to Site 14.

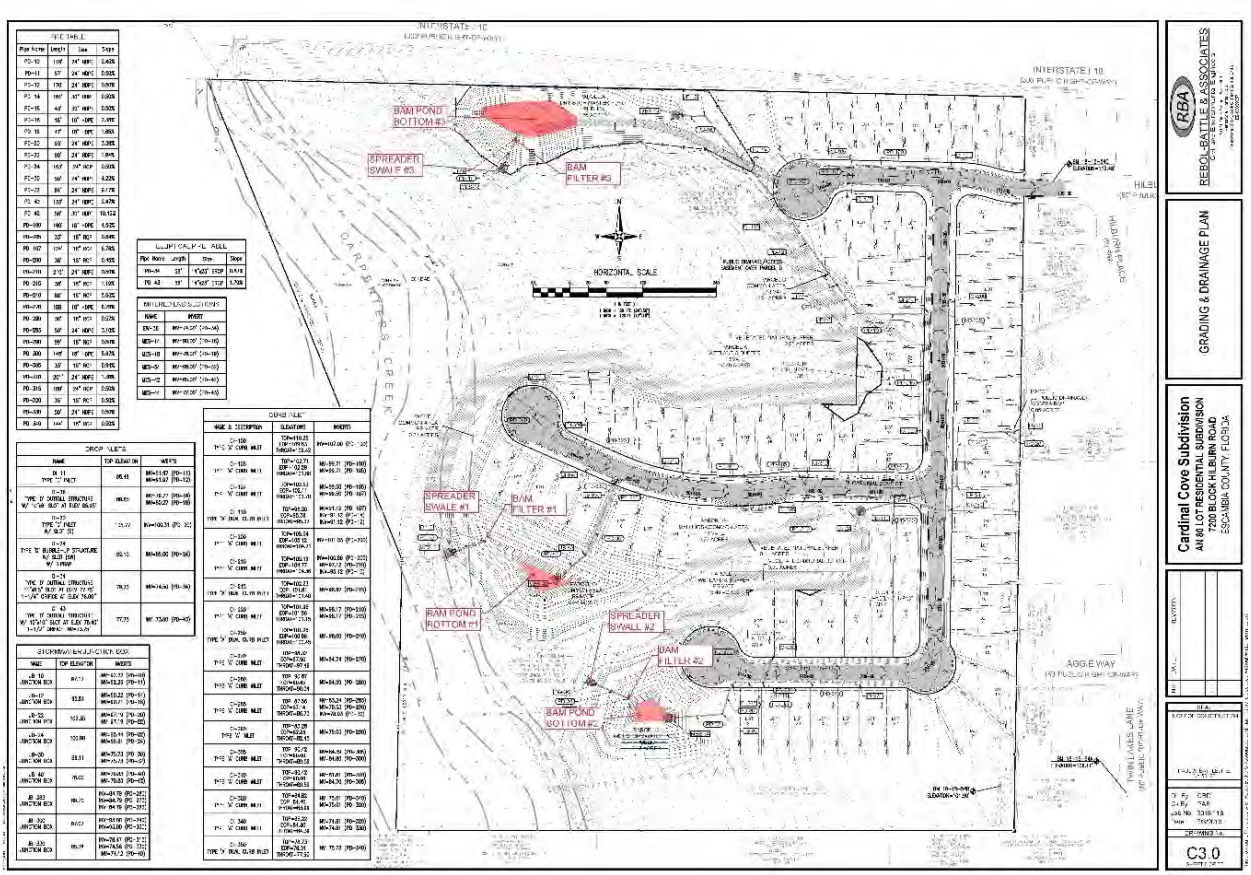
B. Recommendations/BMP concept

BAM is recommended to be installed at the pond bottom of the three dry retention ponds. Also, each has Type 'D' Outfall structures. It is recommended that the outfall structures be outfitted with BAM filters and a spreader swale be constructed at the discharge location. The addition of the spreader swale will not necessarily improve water quality but will remove energy from the

system during heavy rainfall events. **Figure 2.1-2** shows the permitted plans marked up with the proposed BMP retrofits.

Construction of 1,400 linear feet at grade recreational trail system and 500 feet of a boardwalk. This trail would start at Hillburn Road and runs west towards the same tributary as Site 3. This could provide an opportunity for low-impact pedestrian access, and potentially connect to a second easement to the west for a larger "Headwaters Loop" greenway. See **Appendix A, Sheet A10** for the conceptual plan.

Figure 2.1-2
Cardinal Cove Permit Plans with BMP Retrofits



C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Recommendations will provide a moderate reduction in pollutant TN loadings from an area that has a direct discharge to a surface water body with known water quality

problems. Excess nitrogen can cause overstimulation of the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters.

ii. Water Quantity

Site 14 was determined to benefit from Water Quality treatment more than Water Quantity.

iii. Model Results

The pollutant load model provided in previous tasks calculated a loading of 212 lbs of nitrogen per year and 22 lbs. of phosphorus per year. A BMPTrains model was set up to calculate the removal of TN and TP for Site 14. The BMPTrains calculated a removal rate of 55.4 lbs. of TN per year and 8.5 lbs. of TP per year. No further modeling was conducted under this scope. Additional modeling will only be required to permit and construct this project. The modeling required will include an Interconnected Channel and Pond Routing (ICPR).

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 14 it is within reason to expect that the fish and wildlife habitat will be improved in the area. No further consideration was applicable for Site 4.

c. Public Access/Recreational Considerations

Located between Tree Swallow Drive and a planned subdivision to the west of Hilburn Road, the Headwaters Site South of I-10 holds potential for low-impact pedestrian infrastructure along an existing easement. At the western edge of the site, the trail could offer a visual connection with the creek. Interpretive signage along the trail would engage residents in restoration and stormwater management strategies.

d. Community Resiliency Considerations

Pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

Improving and maintaining stormwater infrastructure would ensure the community is prepared for increased precipitation and other impacts.

e. Constructability Considerations

Installing BAM material and upgrading outfall structures with a BAM filter is a simple task for a qualified contractor. The process includes excavating the current pond bottom and replacing it with the BAM layer to the existing pond bottom elevation.

The construction of the spreader swale is also a relatively simple task that involves improving the outfall with a sump-like structure that fills up with water and then flows over an overland weir rather than a point discharge through a pipe.

f. Permitting Considerations

Depending on when this stormwater retrofit is introduced, the proposed improvements may be considered a permit modification and require updating plan sets to the NWFWMD. However, if the project is completed and the permit is satisfied. Then the project has the opportunity to be exempt from an environmental resource permit (ERP). The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff.

g. Land Acquisition / Public-Private Partnership Requirements

The installation of the BAM material and construction of the spreader swale cannot be completed within the existing County right of way. A public-private partnership agreement may be required in this instance by establishing a drainage easement over the area.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

Water quality improvement projects focused on the removal of nutrients, such as nitrogen and phosphorus, have been analyzed for cost-effectiveness throughout the years to help government agencies allocate funds appropriately. Projects such as the one proposed are such a project. Using the calculated removal amount of 55 lbs of TN per year, they anticipate a design and construction cost between $195,100 and $500,000.

The recreational recommendations at Site 14 include approximately 1,400 linear feet of an at grade trail system with an anticipated cost of approximately $140,000.

The total estimated project cost for water quality and recreational trail, including 30% contingency is $832,000 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$195,100	$500,000	$0	$0	$140,000	$640,000	$832,000

ii. BCA

When evaluating projects for grants and funding, government agencies look at the project's cost-effectiveness. A water quality project with the measurable benefit of TN removed is considered highly cost-effective if it costs less than $176 per pound, medium if it is between $176 and $475 per pound, and not cost-effective if it is more than $475 per pound. This project would rank as a medium cost-effectiveness project for the water quality elements.

2.1.6 Headwaters near Burgess Road (Site 2)

A. Current conditions

Site 2 is an un-named heavily eroding tributary of Carpenter Creek that drains several residential neighborhoods across a 0.35 square mile area. The stream flows through a 1,500-foot long 7-acre bottomland forest located north of East Burgess Road between single-family and multi-family residential developments. A large parking lot and paved access road abut the eastern flank of the riparian corridor with several directly connected runoff areas. Erosion is induced by hydromodification of the watershed from impervious surfaces and storm intensification. The channel is eroding to accommodate the greater runoff peaks and volumes generated by these changes. The erosion puts sediment into transport that is a pollutant to downstream waters, including Carpenter Creek and Bayou Texar, where it smothers aquatic habitat. The sediment and stormwater carry excessive nutrients and other pollutants as well. Large litter loads are also delivered from the developed drainage area and highway to the tributary and its bottomland. Channel instability, polluted runoff, and litter impair the biological integrity of the corridor and downstream areas. This is one of the worst conditioned tributaries in the watershed, generating more than 40 times the natural sediment yield of the best remaining headwater creeks in the drainage network.

B. Recommendations/BMP concept

The design approach is to give the drainage corridor the larger alluvial floodplain and lower bottomland forest that it requires to stabilize the valley and its stream channel (referred to as Priority 2 Stream Restoration). This step fits the drainage system to accommodate its hydromodifications in a manner that will prevent decades of erosion, reduce downstream pollutant loads, cultivate a sustainable bottomland forest, and develop a resilient stream channel with greater biological integrity. To provide a stable conveyance, the new bottomland area will consist of a 2-to-2.5-acre area of low bottomland meander belt, at least 65 feet wide, embedded

within the existing 150-to-200-foot-wide forest. A natural headwater channel about 6 feet wide will be contoured to meander across the newly created forested meander belt.

Priority 2 stream restoration is a highly resilient countermeasure for urban hydromodification. Its positive outcomes can be significantly augmented when coupled with stormwater management system improvements in the neighborhoods as part of a layered solution. Low-impact development (LID) measures that treat the first inch or two of rainfall before it reaches the curb and gutter are especially effective at diminishing hydromodification effects in ways that increase system resiliency against erosion and improve the stream hydrology for fish and wildlife. LID treatments and in-line stormwater management systems downstream of curb-and-gutter (e.g., baffle boxes, detention ponds) form powerful treatment trains that improve water quality before it reaches the stream.

To assist in stream restoration, it is recommended that additional measures be taken to improve the stormwater runoff throughout the region. There are three locations called out in **Figure 2.1-3** below.

Area 1 is an existing Escambia County right-of-way just south of East Burgess Road that is not being utilized. This area would be a good location to retrofit a stormwater treatment pond in a dense urban area. The pond would have a Type "D" Overflow structure that will discharge to a spreader swale to decrease the erosion issues this tributary has suffered from.

Area 2 includes improvements to the neighborhood discharge by either constructing a treatment area or retrofitting a second-generation baffle box with a BAM filter at outfall locations. The outfalls of either the treatment area or the baffle box should be a level spreader instead of a point discharge to dissipate energy and help alleviate erosive forces in the tributary.

Area 3 includes implementing a neighborhood-wide BMP program that includes the construction of curbs and gutters. For more information regarding public-private partnerships and incentivization programs, see **Section 3.7.2**.

Another BMP to consider is the construction of approximately 3,300 lineal feet of an at grade trail system to act as an enhanced pedestrian path behind the adjacent Beauclerc Apartments, formalized bike lanes on N Burgess Road, and a new greenway along the easement between the site and West Florida High School would promote connectivity throughout the watersheds. See **Appendix A, Sheet A11** for the conceptual plan.

Figure 2.1-3
Headwaters near Burgess Road (Site 2) Additional BMPs

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Priority 2 headwater stream restoration is very effective at removing nitrogen and other pollutants as well as reducing sediment loads. The proposed stream restoration will remove 167 lb. TN/year and prevent the erosion of up to 130 tons of sediment per year.

ii. Water Quantity

Priority 2 stream restoration typically reduces flood elevations, and the effect is expected to be moderate in this case.

iii. Model Results

Because the proposed restoration in Site 2 is primarily designed to mitigate erosion and improve water quality and is not expected to substantially change flow rates or flood elevations, it was not included in the updated model.

b. Fish & Wildlife Habitat Considerations

Priority 2 stream restoration in this part of Florida involves providing stable ground for the long-term and self-sustaining establishment of a forested bottomland along the creek meander and an upland forest buffer on the valley hillslopes. This diverse forest will support a variety of birds and other wildlife and will contribute to the aquatic food chain of this tributary and Carpenter Creek, benefitting fish and other aquatic species. A healthy Carpenter Creek requires healthy headwaters and restoring this headwater system not only benefits the tributary itself but also contributes to the biological integrity of the Creek downstream.

c. Public Access/Recreational Considerations

The Headwaters Site near Burgess Road offers a multiplicity of exciting opportunities for improved public access and connectivity to the creek. Formalized bike lanes on N Burgess Road and a new greenway along the easement between the site and West Florida High School would promote connectivity throughout the watersheds (see also sites 1, 3). Specifically, N Burgess Road connects Davis Highway and Palafox Highway, while the easement greenway would connect the school to Oakfield Park.

d. Community Resiliency Considerations

Priority 2 stream restoration provides climate change resiliency by allocating a stable and productive forest area for nature and receiving and improving runoff from development without eroding. The approach provides the system that it requires for long-term self-organization and stability under the existing hydromodification of its watershed.

Pairing the recommended stream restoration effort with an enhanced pedestrian path behind the adjacent Beauclerc Apartments, windows to the creek, and interpretive signage would foster stewardship by connecting residents and students at West Florida High School to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. . Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

e. Constructability Considerations

Priority 2 stream restoration requires somewhat specialized and more difficult construction methods. However, there are many contractors within Escambia County and the Mobile Bay region who have constructed similar stream restoration projects. Overall construction concerns include clearing trees and vegetation in the proposed construction area, constructing in the dry season and/or rerouting flow, establishing site access for transport of materials and equipment, and coordination of stockpile locations. For Site 2, the power line easement on the downstream end of the project and the parking lot bordering the left bank could provide site access. If the apartment complex is willing to coordinate for LID BMP retrofits, the parking lot could be used for access and staging, so any areas potentially experiencing damage from construction activities would be replaced with LID components.

f. Permitting Considerations

Priority 2 stream restoration requires an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). It is usually self-mitigating and thus relatively straightforward in application. This area is not on tribal lands or in the tide and is not expected to require a separate USACE permit. If a separate permit is required, it would most likely be the Nationwide Permit for stream restoration. The project area is likely within the FEMA flood zone and may require a LOMR/CLOMR. This is also expected to be a perfunctory application as the project will be, at worst, flood neutral and will likely reduce flood elevations. The process requires tree clearing to create the necessary floodplain and may invoke aspects of County or City tree protection ordinances. Of note, the trees to be cleared are typically within the ongoing erosion zone and will be replaced by a young forest on stabilized ground assuring greater forest continuity. Trees across most of the existing forest will be preserved as an upper terrace floodplain buffer.

g. Land Acquisition / Public-Private Partnership Requirements

About 70% of the proposed stream restoration project area is owned by Escambia County, but the upstream and downstream parts of the valley are privately owned and would require approval for construction access and easements.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

According to the stream restoration cost model presented in **Task 3.3.3**, Priority 2 stream restoration in the Carpenter Creek headwaters would cost approximately $1,464,100 per valley mile of restoration (including construction and wetland establishment). For approximately 0.3 miles of stream restoration in Site 2, the estimated project cost is approximately $427,000.

The probable cost for the water quality retrofits for Area 1 is estimated between $132,000 and $370,000 and between $30,000 and $90,000 for Area 2.

The recreational recommendations at Site 2 include approximately 3,300 lineal feet of an at grade trail system and 400 feet of a boardwalk. This trail creates a loop between Songbird Drive and Appomattox Drive. The cost of this recreational trail is approximately $460,000.

The total estimated project cost for stream restoration, water quality, and recreational trail, including 30% contingency is $1,913,561 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$162,000	$460,000	$297,210	$551,970	$460,000	$1,471,970	$1,913,561

ii. BCA

Priority 2 stream restoration provides a variety of financial, environmental, and social benefits, and the cost-benefit model presented in **Task 3.3.3** estimated the values of these benefits per valley mile of Priority 2 stream restoration in the Carpenter Creek headwaters. **Table 2.1-2** presents the estimated ranges of costs and values associated with Priority 2 stream restoration along the 0.3 miles of headwater tributary creek in Site 2. This site is considered to have a high cost-benefit ratio due to the relatively low cost and multi-factored benefits, including cost per pound of nutrient removal, the potential for flood reduction, miles of stream restoration, resiliency, and recreation/access.

Table 2.1-2
Estimated Value Ranges for Site 2 Stream Restoration

Item	Mean	Worst Case	Best Case
Retrofit Cost	$ (424,590)	$ (551,970)	$ (297,210)
Avoided O&M	$ 55,070	$ 27,540	$ 205,320
Wetland Habitat	$ 36,250	$ 8,130	$ 47,130
Stream Habitat	$ 1,210,170	$ 605,090	$ 1,573,220
Water Quality	$ 890,970	$ 445,480	$ 1,158,260
Property Value	$ 59,650	$ -	$ 77,550
Flood Avoidance	$ 14,500	$ -	$ 87,000
Overall	**$ 1,842,020**	**$ 544,260**	**$ 2,851,260**

D. Other Considerations

a. Slope Considerations

the apartment complex pavement encroaches to within 10 feet of the forest slope in places and may warrant additional investigation.

2.1.7 Hilburn Road Headwaters (Site 4)

A. Current Conditions

Site four is along Hillburn Road between Allen Court and the Papillon Apartments. This stretch of Hillburn Road has a series of ditches and culverts under driveways that are designed to flow south. Located near Allen Court and the southern entrance to the Cottages at Twin Lakes Apartments is a ditch bottom inlet (DBI). This inlet is part of the FDOT stormwater infrastructure for the pond located at the west end of Allen Court.

The stormwater infrastructure seems to be in disarray, with inconsistent ditch bottoms, and debris in the ditches and culverts. It also shows that several ditches are not defined and provide no treatment. Reviewing the site, it was clear that the leaf litter is a major concern and has the ability to clog the DBI.

B. Recommendations/BMP Concept

This stretch of Hillburn Road will benefit significantly from constructing a bioswale on both the east and west sides of Hillburn Road. There is also a median that has two oak trees located in it. These Oak Trees are not only a cause for concern for their contribution to the leaf litter issue but to the roadway integrity. It is recommended that the trees be removed, and the median be converted into a bioswale.

On the south end of Hillburn, just north of Allen Court, it is recommended that a "Smart Box", or a stormwater infrastructure structure containing sediment settling chamber or chambers be installed. There are several types of "Smart Box" technologies. The two most common systems are baffle boxes and continuous deflection separation (CDS). A single baffle box removes 20% Nitrogen, 19% of Phosphorus, and 90% of total suspended solids.

Any additional nutrients that are not removed by the proposed improvements can be treated by the FDOT pond located on the west end of Allen Court.

Another BMP to consider would be the construction of approximately 4,600 lineal feet of an at grade trail way system. This trail would start at Hillburn Road and run west towards the FDOT pond and then loop around the FDOT pond and head north creating a large loop. This could provide an opportunity for low-impact pedestrian access, See **Appendix A, Sheet A11** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The proposed BMP retrofits reduce the pollutant loading, but the major benefit to the installation of this baffle box and the bioswales is the removal of suspended solids (TSS). When it comes to water quality, high TSS may decrease water's natural dissolved oxygen levels and increase water temperature. Turbidity and suspended solids are often used interchangeably, which can make it difficult to understand the difference between the two. However, they are not quite the same thing. Turbidity refers to water's transparency and the more suspended solids water contains, the less transparent it will be. In short, turbidity is a measurement of how well light can pass through water, while TSS is a quantitative measurement of suspended particles in water.

ii. Water Quantity

Site 4 was determined to benefit from Water Quality treatment more than Water Quantity in previous tasks.

iii. Model Results

The pollutant load model indicates that our TSS loading for this basin is 1551.62 lbs. per year. Using the removal efficiency of 90% results in a removal of approximately 1400 lbs. per year. A BMPTrains model was set up to calculate the removal of TN and TP for Site 4. The BMPTrains indicate that the removal rate is 1.96 lbs. of TN per year and 0.3 lbs. of TP per year. No further modeling was conducted under this scope. Additional modeling will only be required to permit and construct this project. The modeling required will include an ICPR model.

b. Fish & Wildlife Habitat Considerations

TSS can prevent organisms living in the water, such as small fish, from being able to survive. High TSS will also result in the blocking of sunlight, which may halt photosynthesis, decreasing the survival of plants and further decreasing water's oxygen levels.

c. Public Access/Recreational Considerations

The Hilburn Road Headwaters Site adjacent to the upcoming Creighton Road expansion holds potential as a new public green space. As part of the Creighton Road expansion, the bike route that currently runs along Creighton Road would be extended and formalized to provide multi-modal access to the site. Building on the existing detention pond at the site, the potential park could include low-impact pedestrian paths, areas for nature play, interpretive signage, and areas for wildlife viewing.

d. Community Resiliency Considerations

Pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the headwater segment of the watersheds indicates that residents of the area south of I-10 are more vulnerable than others in the watersheds and could benefit from increased access to greenspace.

e. Constructability Considerations

Retrofitting stormwater BMPs such as baffle boxes into existing stormwater infrastructure is a straightforward construction technique to employ and can be completed by experienced contractors who have had experience installing stormwater infrastructure.

f. Permitting Considerations

Stormwater retrofit of a baffle box of this size qualifies for exemption from an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff. The work surrounding the bioswales can be considered maintenance.

g. Land Acquisition / Public-Private Partnership Requirements

The installation of the baffle box and bioswale can be completed in the existing County right of way.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

Water quality improvement projects focused on the removal of nutrients, such as nitrogen and phosphorus, have been analyzed for cost-effectiveness throughout the years to help government agencies allocate funds appropriately. Projects such as the one proposed are such a project. Using the calculated removal amount of 1400 lbs. per year they anticipate a design and construction cost of between $140,000.00 and $364,000.

The recreational recommendations at Site 14 include approximately 4,600 lineal feet of trail. The cost of this recreational trail is approximately $480,000.

It is also recommended that a park be constructed southeast of the existing FDOT pond. The design and permitting of a park vary dramatically depending on the facilities being provided and the end-use of the park, at this point of the design a cost estimate would not be possible.

The total estimated project cost for water quality and recreational trail, including 30% contingency, is $1,097,000 on the high end of the range.

Stormwater		**Stream Restoration**		**Parks & Rec**	**High Total**	**Contingency**
Low	High	Low	High			30%
$140,000	$364,000	$0	$0	$480,000	$844,000	$1,097,200

ii. BCA

When evaluating projects for grants and funding, government agencies look at the project's cost-effectiveness. In some areas of the state, a water quality project with the measurable benefit of TSS removed is considered highly cost-effective if it costs less than $5 per pound, medium if it is between $5 and $13 per pound, and not cost-effective if it is more than $13 per pound. This project will likely be ranked as a medium-cost-effectiveness project.

2.2 Creek

The creek segment, (**Figure 2.2-1**), is made up of single-family residential, multi-family residential complexes, and many commercial and institutional developments, and represents the most middle-income bracket of the watershed's segments. The northern portion of the creek segment is within the County's jurisdiction, while the southern portion of the creek segment is within the City's jurisdiction.

Areas of high pollutant loading were concentrated around the Cordova Mall, Sacred Heart Hospital Complex, and the University Town Plaza, all of which currently implement some form of stormwater treatment. This suggests that existing stormwater treatment efforts in these areas may not be sufficient to treat the current volume of stormwater.

The pollutant load model results suggest the area around 9th Avenue is a critical hot spot for TN. From the monitoring data - Carpenter Creek at 9th Avenue and Bayou Blvd has some of the highest TN and TP concentrations in the watersheds. The area upstream of Davis Highway was the second-highest TP.

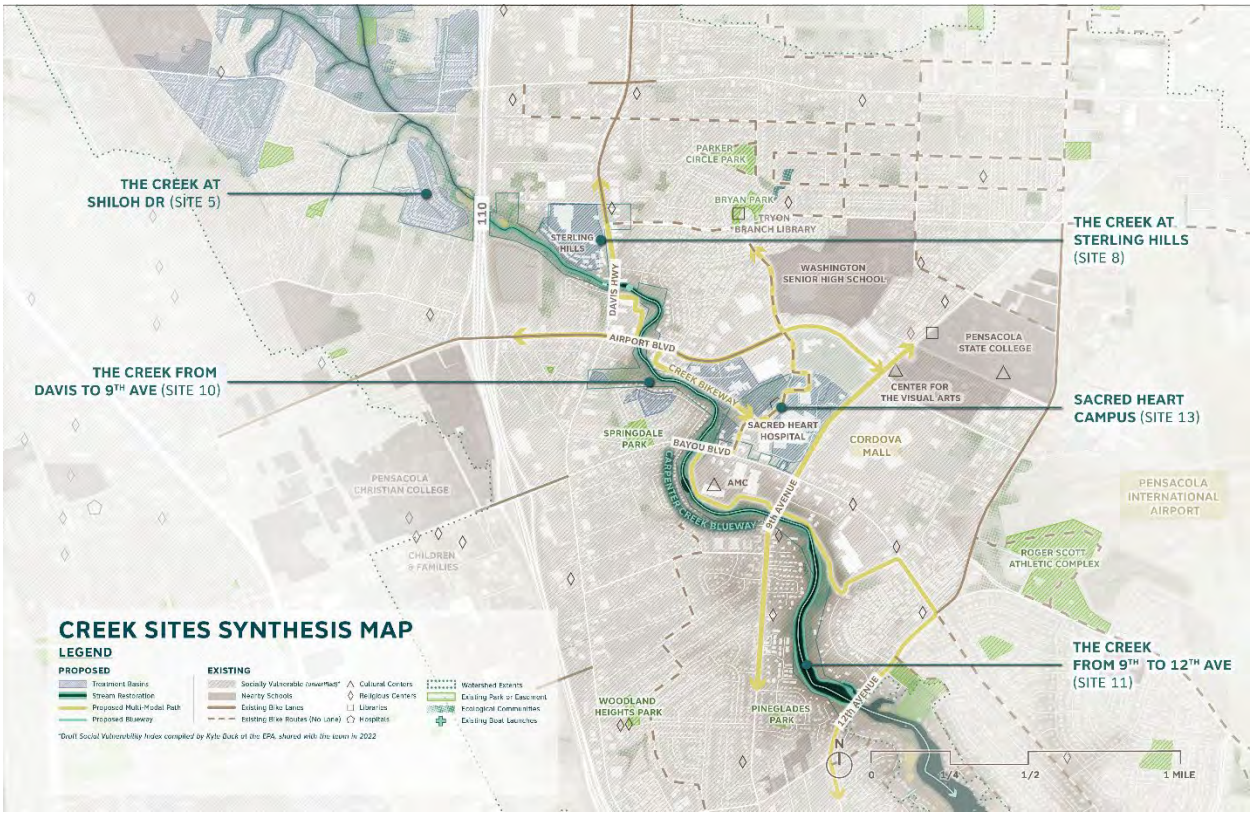
Turfgrass fertilizers are a significant source of soluble nitrogen, including nitrates. Heavily landscaped areas around the Ascension Sacred Heart hospital, Cordova Mall, and surrounding shopping centers could be contributing factors. Manicured lawns and septic tanks in the residential neighborhoods along the west bank of Carpenter Creek near 9th Ave. could also be contributing factors. These subdivisions were developed before the statewide stormwater rule (F.A.C. Ch.17-25, 1982) was adopted and may lack adequate stormwater control measures.

Creek restoration includes repatterning and dimensioning unstable sections of Carpenter Creek and its tributaries to bring them into balance with their watershed conditions, so they no longer excessively erode. This form of restoration improves upon the currently limited water quality processing capacity of the unstable and artificially straightened stream channels and their truncated wetland floodplains and greatly improves the fish habitat of the streams. It creates a more stable, diverse, and resilient bottomland forest. The proposed earthwork is restricted to forest areas in direct jeopardy of long-term destruction from erosion and will stabilize existing forests on slopes at higher elevations. The stabilizing effects of the treatments will protect existing public and private infrastructure currently subject to future erosion. The specific countermeasures to urban hydromodification and climate change will result in a more resilient community,

Stream valley resiliency and water quality improvements can be enhanced by programmatic low-impact development and other stormwater retrofits across the watersheds. Those especially targeting massive blocks of the impervious surface could be particularly effective. Almost all of the necessary and most beneficial watershed and waterbody improvements require the cooperation of multiple private property owners, in fact, many dozens overall. Some owners are local businesses, corporations own others with out-of-state mailing addresses, but most are residential. The entire affected community must rally around an ambitious call to save Carpenter Creek. It can be done, and it can be done well. The concept is to turn a system that has become a community hazard and return it into a resilient, beautiful, and fully functional community asset. Much will be asked of the community and even more is available to be gained.

Five projects were identified in the Creek segment (**Figure 2.2-1**). The sections below describe the restoration recommendations and project scoring. Conceptual plans are provided in **Appendix A**. See **Section 3** for program recommendations to address issues throughout the watersheds.

Figure 2.2-1
Creek Segment Project Locations



2.2.1 The Creek at Shiloh Drive (Site 5)

A. Current Conditions

Site 5 is an un-named eroding tributary of Carpenter Creek that drains several residential neighborhoods across a 0.19 square mile area. The stream flows through a 500-foot-long 3-acre bottomland forest located north of Shiloh Drive between single-family residential developments. Four paved roads converge at the head of this headwater creek valley, delivering harsh runoff volumes and pollutants to the creek. Erosion is induced by hydromodification of the watershed from impervious surfaces and storm intensification. The channel is eroding to accommodate the greater runoff peaks and volumes generated by these changes. The erosion puts sediment into transport that is itself a pollutant to downstream waters, including Carpenter Creek and Bayou Texar, where it smothers aquatic habitat. The sediment and stormwater carry excessive nutrients and other pollutants as well. Channel instability, polluted runoff, and litter impair the biological integrity of the corridor and downstream areas. This system is in the early stages of channel evolution in response to hydromodification, with pockets of severe erosion interspersed between short stretches of channel that have resisted erosion so far. However, it appears that this section of the creek is beyond saving by simply retrofitting its drainage area with LID treatment in the watersheds (unless that could be accomplished very quickly). Absent intervention, this creek could ultimately generate more than 40 times the natural sediment yield of the best remaining headwater creeks in the drainage network.

B. Recommendations/BMP Concept

The design approach is to give the drainage corridor the larger alluvial floodplain and lower bottomland forest that it requires to stabilize the valley and its stream channel (referred to as Priority 2 Stream Restoration). This step fits the drainage system to accommodate its hydromodifications in a manner that will prevent decades of erosion, reduce downstream pollutant loads, cultivate a sustainable bottomland forest, and develop a resilient stream channel with greater biological integrity. To provide a stable conveyance, the new bottomland area will consist of a 0.5 area of low bottomland meander belt at least 40 feet wide embedded within the existing 300-foot-wide forest. A natural headwater channel about 4 to 5 feet wide will be contoured to meander across the newly created forested meander belt.

Priority 2 stream restoration is a highly resilient countermeasure for urban hydromodification, and its positive outcomes can be significantly augmented when coupled with stormwater management system improvements in the neighborhoods as part of a layered solution. Low-impact development (LID) measures that treat the first inch or two of rainfall before it reaches the curb and gutter are especially effective at diminishing hydromodification effects in ways that increase system resiliency against erosion and improve the stream hydrology for fish and wildlife. LID treatments could potentially be a major part of the solution in this case as the erosion is somewhat incipient and the existing forest is holding the stream together in places.

If LID could be implemented throughout the contributing drainage area at a high enough threshold to re-establish a pre-development runoff condition, before the erosion becomes more continuous along the valley, then Priority 2 stream restoration would not be necessary. Priority 1 stream restoration could be considered instead.

Priority 1 restoration consists of stabilizing the channel in ways that arrest loss of grade control (preventing channel incision or deepening) and that serve to disperse water across the pre-development bottomland surfaces. The methods vary, but in this case, would likely involve beaver dam analogs or other soil bioengineering solutions as opposed to rock weirs or more inert forms of grade control. Priority 1 restoration is only a viable option if the full effects of hydromodification can be tamed by work in the stream's contributing basin.

Additional measures can be implemented to address hydromodification within the contributing drainage area for the Shiloh Drive neighborhood. One measure includes improvements to an existing Escambia County stormwater treatment pond located behind homes on Shiloh Drive. To remove additional nutrients when water infiltrates, it is recommended that a layer of BAM be installed at the pond bottom. At the location of the neighborhood outfall to Carpenter Creek north of Shiloh Drive (which is also on Escambia County property), it is recommended that the outfall be converted to a level spreader, likely in the form of a spreader swale. This level spreader will replace a point discharge and mitigate erosive energy that erodes the creek banks.

Another measure is to implement a neighborhood-wide LID BMP program that includes the construction of bioswales. Bioswales help to curb peak runoff and facilitate infiltration and can improve water quality. See **Appendix A, Sheet A15** for the conceptual plan. For more information regarding public-private partnerships and incentivization programs see **Section 3.7.2.**

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Priority 2 headwater stream restoration is very effective at removing nitrogen and other pollutants as well as reducing sediment loads. The proposed stream restoration will remove 55 lb TN/year and prevent the erosion of up to 45 tons of sediment per year.

ii. Water Quantity

Priority 2 stream restoration typically reduces flood elevations, and the effect is expected to be moderate in this case.

iii. Model Results

Because the proposed restoration in Site 5 is primarily designed to mitigate erosion and improve water quality and is not expected to substantially change flow rates or flood elevations, it was not included in the updated model.

b. Fish & Wildlife Habitat Considerations

Priority 1 and 2 stream restoration involve providing stable ground for the long-term and self-sustaining establishment of a forested bottomland along the creek meander and an upland forest buffer on the valley hillslopes. This diverse forest will support a variety of birds and other wildlife and will contribute to the aquatic food chain of this tributary and Carpenter Creek, benefitting fish and other aquatic species. A healthy Carpenter Creek requires healthy headwaters and restoring this headwater system not only benefits the tributary itself but also contributes to the biological integrity of the Creek downstream.

c. Public Access/Recreational Considerations

There are no specific public access considerations specific to this site. There may be some programmatic overlays that may be considered.

d. Community Resiliency Considerations

e. Priority 2 stream restoration will allow for more flood storage volume and the stream banks and bottom will be better equipped to handle increased precipitation and runoff. Constructability Considerations

Priority 2 stream restoration requires somewhat specialized and more difficult construction methods, however, there are many contractors within Escambia County and the Mobile Bay region who have constructed similar stream restoration projects. Overall construction concerns include clearing trees and vegetation in the proposed construction area, constructing in the dry season and/or rerouting flow, establishing site access for transport of materials and equipment, and coordination of stockpile locations. Site 5 does not have ample

clear land surrounding the site, so access coordination could potentially be more difficult in this area.

f. Permitting Considerations

Priority 1 and 2 stream restoration require state ERP permitting. They are usually self-mitigating and thus relatively straightforward in application. This area is not on tribal lands or in the tide and is not expected to require a separate USACE permit. If a separate permit is required, it would most likely be the Nationwide Permit for stream restoration. The project area is likely within the FEMA flood zone and may require a LOMR/CLOMR. This is also expected to be a perfunctory application as the project will be at worst flood neutral and will likely reduce flood elevations. The process requires tree clearing to create the necessary floodplain and may invoke aspects of County or City tree protection ordinances. Of note, the trees to be cleared are typically within the ongoing erosion zone and will be replaced by a young forest on stabilized ground assuring greater forest continuity. Trees across most of the existing forest will be preserved as an upper terrace floodplain buffer.

g. Land Acquisition / Public-Private Partnership Requirements

All of the proposed stream restoration project area is owned by a single private entity and would require approval for construction access and establishment activities.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

According to the stream restoration cost model presented in **Task 3.3.3**, Priority 2 stream restoration in the Carpenter Creek headwaters would cost approximately $1,464,100 per valley mile of restoration (including construction and wetland establishment). For the approximately 0.1 miles of stream restoration in Site 5, the estimated project cost is approximately $146,410.

The probable cost for the water quality retrofits for Area 1 is estimated between $53,000 and $142,000.

The total estimated project cost for stream restoration and water quality components, including 30% contingency, is $432,000 on the high end of the range.

Stormwater		**Stream Restoration**		**Parks & Rec**	**High Total**	**Contingency**
Low	High	Low	High			30%
$53,000	$142,000	$102,487	$190,333	$0	$332,333	$432,033

ii. BCA

Priority 2 stream restoration provides a variety of financial, environmental, and social benefits, and the cost-benefit model presented in **Task 3.3.3** estimated the values of these benefits per valley mile of Priority 2 stream restoration in the Carpenter Creek

headwaters. **Table 2.2-1** presents the estimated ranges of costs and values associated with Priority 2 stream restoration along the 0.1 miles of headwater tributary creek in Site 5. This site is considered to have a high cost-benefit ratio due to the relatively low cost and multi-factored benefits, including cost per pound of nutrient removal, the potential for moderate flood reduction, 0.1 miles of stream restoration, resiliency, and recreation/access.

Table 2.2-1
Estimated Value Ranges for Site 5 Stream Restoration

Item	Mean	Worst Case	Best Case
Retrofit Cost	$ (146,410)	$ (190,333)	$ (102,487)
Avoided O&M	$ 18,990	$ 9,495	$ 70,800
Wetland Habitat	$ 12,500	$ 6,250	$ 16,250
Stream Habitat	$ 417,300	$ 208,650	$ 542,490
Water Quality	$ 307,230	$ 153,615	$ 399,399
Property Value	$ 20,570	$ -	$ 26,741
Flood Avoidance	$ 5,000	$ -	$ 30,000
Overall	**$ 635,180**	**$ 187,677**	**$ 983,193**

D. Other Considerations

a. Geotechnical Considerations

The site digital elevation model suggests the system has a large 5-foot deep knickpoint and has already lost grade control about 160 feet upstream of its confluence with Carpenter Creek. Priority 2 stream restoration will subsume this headcut and eliminate it, but Priority 1 restoration will not arrest its encroachment into the restoration. If the latter approach is taken, a grade-control structure will be required in this area to protect the upstream restoration from future headcut erosion. A rock structure like a Newbury riffle that allows upstream fish passage is preferred over a sheet pile weir.

2.2.2 The Creek at Sterling Hills (Site 8)

A. Current conditions

Site 8 is a variably eroding 2,600-foot-long reach of the Carpenter Creek valley between I-110 and Davis Highway that drains a 4.1 square mile area. The stream flows through a 22-acre bottomland forest ranging from 60 to 760 feet wide, located between single-family and multi-family residential developments in its downstream half and a large undeveloped lot and large FDOT stormwater pond in the upper part of the valley. A large parking lot and paved access road abut the northern flank of the riparian corridor with several directly connected impervious runoff areas. The most severe erosion along the Site 8 stream reach occurs near this large impervious area. Historic aerials and the present form of the creek indicate that the downstream creek segment within Site 8 was ditched decades ago. The ditch is straight and deep along the downstream 700 feet of the reach,

upstream of Davis Highway. Several residences along this downstream reach are supported on stilts overhanging the ditch.

Erosion is induced by hydromodification of the watershed from impervious surfaces and storm intensification. The area also receives a high upstream sediment yield, and the corridor vacillates between degradation (erosion of the streambed), aggradation (burial of the streambed), and even areas in relatively stable condition.

The adverse conditions stem from the greater runoff peaks and volumes generated by upstream hydromodification and local directly connected impervious area, plus development encroachment into the floodplain. The erosion puts sediment into transport that is itself a pollutant to downstream waters including the rest of Carpenter Creek and Bayou Texar, where it smothers aquatic habitat. The sediment and stormwater carry excessive nutrients and other pollutants as well. Large litter loads are also delivered from the developed drainage area and highway to the tributary and its bottomland. Channel instability, polluted runoff, and litter impair the biological integrity of the corridor and downstream areas. In general, Carpenter Creek is in better condition upstream of I-110, and this site represents the transition area toward the worst conditions of the system downstream of Davis Highway.

B. Recommendations/BMP concept

Site 8 consists of three types of stress zones:

1) An unentrenched upper area to the north with an excellent forest buffer several hundred feet wide and a large FDOT wet detention pond to the south. The creek in this area is affected mostly by upstream sedimentation and could benefit from programmatic LID stormwater retrofits and the stabilization of eroding headwater streams west of I-110. About 670 linear feet of Priority 1 stream restoration is recommended to restore fish and wildlife habitats and improve water quality. The restoration corridor would average about 110 feet wide and entail beaver dam analogs and other in-stream habitat approaches in about 1.5 acres of existing riparian forest.

2) An 830-foot-long middle zone that is entrenched from ditching and heavy erosion. The entrenchment of this zone is headcutting upstream, and the unentrenched upstream zone is vulnerable to erosion and bank failure if the headcutting in this entrenched zone is not stabilized. The work in this middle zone would consist of Priority 2 stream restoration on about 2 acres of bottomland forest, 100 feet wide, in an area where the current forest width spans about 170 feet. The outer areas of the existing forest would be preserved as upper terrace buffers for the restored creek and bottomland forest. This zone is bounded on its northern flank mostly by an apartment complex's parking lot and roadway that lacks stormwater treatment and sends large hydraulic, and litter loads into the valley, contributing directly to its pollution and erosion. Stormwater retrofits, including better energy dissipation and end treatments, could help maximize the benefits of the creek restoration in this location.

3) The downstream 700 feet of valley was historically ditched and is currently tightly flanked by single-family residences along the southern bank, some of which overhang the creek on stilts. These homes overhanging the creek along with private property and development to the north compresses the riparian corridor available to support Priority 1 or 2 restoration. Any type of stream restoration along this section would modify flood routes such that private property and public

infrastructure could potentially experience additional interaction with flood flows. The creek banks in this zone are intermittently eroding, and the channel shows indicators of embayment during low flow conditions. Priority 2 restoration would be beneficial but is currently deemed impractical because it would entail negotiations with as many as 15 private property owners to remove existing homes and other structures from the floodplain

The stream restoration approach to this transitionally impacted area will likely be fluid over time as sediment loads from upstream pulse through, and as the middle zone's knickpoint continues to headcut up into the upper zone. If upstream restoration is delayed by several years, then the positions and characteristics of the stresses currently encountered are likely to differ. This is an area in unfortunate flux requiring a variety of treatment types.

Additional measures are recommended to enhance the benefits of stream restoration by improving stormwater runoff to the creek. One such measure involves modifications to an existing FDOT stormwater pond. Anytime changes are made to an existing FDOT facility, such as a stormwater pond, it will require extensive analysis and coordination. However, this treatment pond is a great candidate for Continuous Monitoring & Adaptive Control (CMAC). CMAC is a category of stormwater best management practice that allows for a wider range of operation of detention and retention ponds. CMAC systems typically consist of a water level sensor, an actuated valve, and an internet connection. CMAC could help to reduce peak runoff and reduce the impacts of hydromodification in the creek.

Another measure could involve amending discharges at the Sterling Hills Apartment complex that abuts the creek corridor. Stormwater runoff from the apartment complex site is currently focused on several untreated discharges. It is recommended that a stormwater treatment pond be constructed to capture this untreated runoff. The discharge from these ponds will be an overland weir to reduce the energy of the current point sources and prevent channel scour. See **Appendix A, Sheet A16** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The proposed water quality BMPs are intended to remove nutrients and will improve water quality.

ii. Water Quantity -

Flood benefits are likely to be negligible.

iii. Model Results

Water quality benefits of the proposed stream restoration would include approximately 444 lbs/year of TN reduction and 90 tons per year of sediment reduction.

b. Fish & Wildlife Habitat Considerations

The proposed stream restoration will create a more stable bottomland forest and better continuity of flow and material characteristics beneficial for fish passage.

c. Public Access/Recreational Considerations

Recommendations for the Creek at Sterling Hills aim to reduce pollution from adjacent big-box retailers and multi-family residences while connecting residents to creek restoration efforts. Relocating the complex's dog park further back from the creek would prevent it from polluting stormwater runoff. Creating a window to the creek at the complex's central existing outfall would provide a visual connection to restoration efforts.

d. Community Resiliency Considerations

Pairing stormwater management and public access strategies, particularly the recommended window to the creek, with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the creek segment of the watersheds indicates that residents living and working between 12th Avenue and Interstate I-110 are more vulnerable than others in the watershed and lack access to shared greenspace or the creek itself. This area of the watershed could benefit from increased access to the creek and its floodplain, with paths connecting back to the existing social infrastructure in the area.

e. Constructability Considerations

Priority 2 stream restoration requires somewhat specialized and more difficult construction methods, however, there are many contractors within Escambia County and the Mobile Bay region who have constructed similar stream restoration projects. Overall construction concerns include clearing trees and vegetation in the proposed construction area, constructing in the dry season and/or rerouting flow, establishing site access for transport of materials and equipment, and coordination of stockpile locations. This site should be relatively easily accessible through coordination with FDOT in the northern sub-section and coordination with the apartment complex in the southern sub-section. Similar to Site 2, coordination with the apartment complex could facilitate the use of the parking lot for staging and material transport activities, replacing any potentially damaged areas with improved LID BMPs after stream restoration activities are complete.

f. Permitting Considerations

Priority 1 and 2 stream restoration require state ERP permitting. They are usually self-mitigating and thus relatively straightforward in application. This area is not on tribal lands or in the tide and is not expected to require a separate USACE permit. If additional permitting is required, it would most likely be the Nationwide Permit for stream restoration. The project area is likely within the FEMA flood zone and may require a LOMR/CLOMR. This is also expected to be a perfunctory application as the project will be at worst flood neutral and will

likely reduce flood elevations. The process requires tree clearing to create the necessary floodplain and may invoke aspects of County or City tree protection ordinances. Of note, the trees to be cleared are typically within the ongoing erosion zone and will be replaced by a young forest on stabilized ground assuring greater forest continuity. Trees across most of the existing forest will be preserved as an upper terrace floodplain buffer.

g. Land Acquisition / Public-Private Partnership Requirements

The proposed work in the upper zone of Site 8 requires agreements with FDOT and a single private property owner partnership on undeveloped lands. The work considered for the middle zone occurs mostly on the property of a single private owner, with a potential need for tie-ins at the upstream and downstream ends of that zone involving two more landowners. No work is proposed in the downstream zone because it would entail the purchase and demolition of at least several existing residences.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

According to the stream restoration cost model presented in **Task 3.3.3**, Priority 2 stream restoration in mid-order Carpenter Creek would cost approximately $6,091,500 per valley mile of restoration (including construction and wetland establishment). For the approximately 0.3 miles of stream restoration in Site 8, the estimated project cost is approximately $1,794,000.

The water quality retrofits for Site 8 are estimated to cost $57,000 and $76,000.

The design and permitting of a park, even dog parks, vary dramatically depending on the facilities being provided and the end-use of the park, at this point of the design a cost estimate would not be possible. The recreational recommendations surrounding Site 8 also include a regional recommendation. Site 8 recommendations are to continue the bike path along Davis Highway. The cost estimate for this bike path was not included as part of the Site 8 cost estimate.

The total estimated project cost for stream restoration and water quality components, including 30% contingency, is $3,084,245 on the high end of the range.

Stormwater		**Stream Restoration**		**Parks & Rec**	**High Total**	**Contingency**
Low	High	Low	High			30%
$57,000	$76,000	$1,236,575	$2,296,496	$0	$2,372,496	$3,084,245

ii. BCA

Priority 1 and 2 stream restoration provide a variety of financial, environmental, and social benefits, and the cost-benefit model presented in **Task 3.3.3** estimated the values of these benefits per valley mile of Priority 2 stream restoration in mid-order Carpenter

Creek. **Table 2..2-2** presents the estimated ranges of costs and values associated with Priority 2 stream restoration along the 0.3 miles of mid-order creek in Site 8.

Table 2.2-2
Estimated Value Ranges for Site 8 Stream Restoration

Item	Mean	Worst Case	Best Case
Retrofit Cost	$ (1,766,535)	$ (2,296,496)	$ (1,236,575)
Avoided O&M	$ 58,406	$ 29,203	$ 205,320
Wetland Habitat	$ 106,662	$ 53,331	$ 138,661
Stream Habitat	$ 1,210,170	$ 605,085	$ 1,573,221
Water Quality	$ 2,341,431	$ 1,170,716	$ 3,043,860
Property Value	$ 149,930	$ -	$ 194,909
Flood Avoidance	$ 14,500	$ -	$ 87,000
Overall	**$ 2,114,564**	**$ (438,161)**	**$ 4,006,396**

D. Other Considerations

a. Geotechnical Considerations

No special geotechnical considerations are apparent from within the proposed restoration areas, although the stilt homes may be perched on increasingly unstable ground as climate change amplifies runoff intensities in the region. Their piles and embankment might have a history of scour and the piles may be weakened by time and should be inspected prior to any restoration along Carpenter Creek within Site 8. The reason for this recommendation is not that the proposed restoration is expected to worsen existing erosion potential, but that existing and previous conditions may have already stressed the structures to a point of vulnerability. Documenting such antecedent conditions prior to working on the creek upstream is prudent. Further, the restoration design should include existing and proposed conditions hydraulic modeling and perhaps a piling scour analysis to verify the upstream hydraulic system modifications will not cause the scour regime to cross a tipping point along the structures.

2.2.3 The Creek from Davis Highway to 9th Avenue (Site 10)

A. Current conditions

Site 10 is the most ambitious and essential project for restoring the watershed functions of the Bayou Texar and for restoring Carpenter Creek. It includes a systematically and significantly eroding section of Carpenter Creek 7,500 feet long that drains a 4.7 square mile area at its upstream end near Davis Highway and 5.6 square miles where it crosses 9th Avenue downstream. The entirety of the site was artificially straightened and ditched in the 1970s, setting off a particular vulnerability to the subsequent loss of grade control and periods of severe and ongoing slope failures caused by urban hydromodification and storm intensification.

Bridge crossings at Davis Highway, Airport Boulevard, and Bayou Boulevard have arrested severe headcuts, partially stalling entrenchment from reaching its fullest potential. Large storms result in severe slope failures along high bluffs supporting development along the narrow-forested bottomland. The creek currently exists as a tenuously forested artificial gully that is trying to create a wide enough floodplain to endure flood pulses it receives from urban runoff. Streambank erosion, loss of forestland, and slope failures affecting the developed landscape are the result of this response. This pattern of progressive instability will unfold for decades and currently results in the largest sediment loads in the watershed.

The creek flows through a 32-acre bottomland forest that is impacted by erosion. The forest is crossed by four of Pensacola's largest highways and is bordered by an immense contiguous 300-acre area of mostly impervious drainage covered by parking lots and commercial buildings to the east of the creek. Six dry detention ponds closely border the valley slopes, perched on bluffs generally 10 feet or so above the valley floor nearby. Some of the worst erosion encountered at the site occurs along the creek frontage adjacent to these ponds, but erosion is so intense along multiple areas of the reach at any given time that correlation to pond effects is difficult to firmly assign. In other words, it may be coincidental.

Erosion is induced by hydromodification of the watershed from impervious surfaces and storm intensification. The channel is eroding to accommodate the greater runoff peaks and volumes generated by these changes. The erosion puts sediment into transport that is itself a pollutant to downstream waters, including Carpenter Creek and Bayou Texar, where it smothers aquatic habitat. The sediment and stormwater carry excessive nutrients and other pollutants as well. Channel instability, polluted runoff, and litter impair the biological integrity of the corridor and downstream areas. This system is in the intensifying and severe stages of channel evolution in response to hydromodification. It is somewhat unique within the watershed in terms of the valley hillslope failures the creek erosion is inducing and the combination of public and private infrastructure at jeopardy from these failures.

Additional measures recommended to enhance the benefits of stream restoration by improving stormwater runoff to the creek at Site 10 include:

- Implement a commercial complex-wide LID BMP program, in the commercial complex east of the creek and south of Airport Boulevard, that includes the construction of bioswales in existing greenspaces. Bioswales help to curb peak runoff and facilitate infiltration and can improve water quality. For more information regarding public-private partnerships and incentivization programs see **Section 37.2**.
- Treat the existing urbanized runoff from the neighborhood along Springhill Drive. It is recommended that multiple "Smart Box", or a stormwater infrastructure structure containing sediment settling chamber or chambers be installed. There are several types of "Smart Box" technologies the two most common systems are baffle boxes and continuous deflection separation (CDS). A single second-generation baffle box removes 20% Nitrogen, 19% of Phosphorus, and 90% of total suspended solids.
- Treat the existing commercial complex east of the creek and south of Bayou Blvd. It is recommended that Bio-Sorption Activated Media (BAM) be placed at the pond bottom

to improve the efficiency of the existing stormwater treatment ponds. It is also recommended that the overflow structures be replaced and include a BAM filter to continue the removal of TN and TP during heavy rainfall events. The pond should also have the discharge upgraded to a level spreader, such as a spreader swale. The addition of the level spreader will not necessarily improve water quality but will remove energy from the system during heavy rainfall events.

- Implement a neighborhood-wide LID BMP program that includes the construction of bioswales in existing greenspaces. Bioswales help to curb peak runoff and facilitate infiltration and can improve water quality. For more information regarding public-private partnerships and incentivization programs see **Section 3.7.2**.

B. Recommendations/BMP concept

The valley requires 7,500 linear feet of Priority 2 stream restoration to provide the system with a stable and resilient forested bottomland and valley hillslope as the primary countermeasure against systematic stream erosion and sedimentation and periodically severe hillslope erosion. The restoration and stabilization require the creation of an 80- to 100-foot-wide meander belt and sloped bottomland forest with a 17- to 20-foot-wide meandering open channel coursing through the created meander belt. This 14.9 acres of work will be embedded within an existing mostly forested and actively eroding gully ranging from 80 to 390 feet wide, spanning 34.9 acres. Once the new bottomland is stabilized, it will protect the existing forested slopes and bluffs above it from slope failure, creating a sustainable and diverse native forested corridor across and along the valley ranging from mesic hammock to bottomland swamps.

The restoration could be split into three construction phases if required. with each phase separated by the Airport and Bayou Boulevard highway crossings. The upper segment between Davis Highway and Airport Boulevard differs from the remaining down valley segments in that it has the most severe profile drop, most of which is close to Davis Highway. The 5-foot grade drop within a couple of hundred feet of the highway is not sustainable for the watershed conditions and regional climate and is better spread out along a much longer reach of the creek. The total drop of 8 feet along the 1,600 feet of valley length is within the range of stable nature for this size watershed. So, in this case, the restoration concept will fill the degraded creek bottom in the upper part of the valley just downstream of Davis Highway and gradually ramp the profile to the existing grade where it approaches just upstream of Airport Boulevard. The result will be a stable grade when contoured in concert with providing a wider meander belt. Both conditions, a wider bottomland and a more gradually and uniformly sloped longitudinal profile are necessary to assure long-term self-maintaining stability.

This ramped-grade scenario was modeled in ICPR and does not reduce the existing level of flood service protection along the Site 10 domain. 100-year 8-hour runoff water levels were simulated to rise at most by 0.01 feet and generally were reduced by at least a half foot. Some existing low-lying stormwater outfalls will need to be retrofit to accommodate the raised streambed where it occurs close to Davis Highway, perhaps most notably the existing vortex separator along the north bank of Carpenter Creek. The required stormwater outfall retrofits can be designed to be

compatible or in some cases to augment the creek restoration objectives to dissipate stormwater runoff energy, improve water quality, and reduce erosion.

The remainder of the restoration in the two sections down-valley from Airport Boulevard does not appear to require similar ramping, and the existing channel bottom elevation can be largely maintained there, simply widening the meander belt as in all Priority 2 restoration approaches.

The proximity of the series of 6 dry ponds flanking the valley hillslope and perched more than 10 feet above the bottomland elevation may be acerbating erosion via concentrated groundwater erosion (sapping), by inducing rapid changes in slope pore pressures in the stream embankment, or by surface scour when the design limits of the pond outfalls are hydraulically overwhelmed. To counter most of these potential erosion mechanisms, the contoured slope of the proposed meander belt could be constructed using soil bioengineering slope stabilization consisting of robust forested geogrids backed by groundwater drains. Such slopes can be designed to resist scour and prevent concentrated flow through vulnerable or easily transported soil layers, directing to a rock toe protection layer instead. The porous nature of these drains could incorporate biologically active media (BAM) to reduce the nitrogen load to the creek.

Programmatic LID retrofits and stream stabilizations in the watershed upstream of this part of the drainage network will strengthen the resiliency and function of the creek restoration. The 300-acre contiguous commercial parking lot zone east of the creek, and other commercial areas with large parking lots elsewhere along the creek corridor could be retrofit with better internal drainage in the form of rain gardens and shade trees that intercept much of the first inch of rainfall and direct it into the groundwater system with long flow paths to the valley. This approach corrects the first major adverse aspect of urban hydromodification which is a shortened stormwater flow path to the creek. Such retrofits could be conducted without compromising the necessary parking loads while also making for a more pleasant and attractive parking experience for customers. See **Appendix A, Sheet A17** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The overall TN reductions for Site 10 stream restoration will be approximately 1,954 lbs./year. The distribution of this is 410, 842, and 702 lbs./year for the north, middle, and south sub-sections, respectively.

The potential site-wide sediment reduction is 2000 tons/year, distributed among the three sub-sections at 900, 600, and 500 tons/year from north to south.

ii. Water Quantity

Priority 2 stream restoration typically reduces flood elevations, and the effect is expected to be moderate in this case.

iii. Model Results

Preliminary ICPR modeling shows the project will be flooding neutral for the upstream segment and steadily improves flood levels by as much as 1-foot down-valley.

b. Fish & Wildlife Habitat Considerations

This work creates a diverse, sustainable, and resilient bottomland forest and perennial stream corridor flanked by nearly continuous upland forest buffers 1.4 miles long and on average, about 200 feet wide, totaling 34 acres. The creek will be kayak able during normal flow conditions, with some portages necessary. It will offer substantial and diverse arrays of fish habitats, restoring a series of deep bend pools and sand and gravel point bars.

c. Public Access/Recreational Considerations

The Creek from Davis Highway to 9th Avenue features an east bank with relatively large commercial and institutional parcels that present the opportunity for exciting public access components. dynamic pedestrian trails that weave through restoration segments and adjacent dry detention ponds, particularly from Bayou Boulevard to N 9th Avenue, would significantly improve access to the creek throughout this dense segment. Creating floodable recreation spaces in the recreation ponds themselves would make use of publicly owned property to benefit the surrounding community. The historic Aunt Jennie's Swimming Hole was also located between Bayou Boulevard and N 9th Avenue and presents an opportunity for restoration and commemorative signage to connect Pensacolans with the creek's history. Installing a kayak launch at or near Aunt Jennie's Swimming Hole and at or near Airport Boulevard would expand the Bayou Texar blueway into the creek's wider, restored bankfull channel.

d. Community Resiliency Considerations

The historic Aunt Jennie's Swimming Hole was located between Bayou Boulevard and N 9th Avenue and presents an opportunity for restoration and commemorative signage to connect Pensacolans with the creek's history. Generally, pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the creek segment of the watershed indicates that residents living and working between 12th Avenue and Interstate I-110 are more vulnerable than others in the watersheds and lack access to shared greenspace or the creek itself. This area of the watershed could benefit from increased access to the creek and its floodplain, with paths connecting back to the existing social infrastructure in the area.

e. Constructability Considerations

Priority 2 stream restoration requires somewhat specialized and more difficult construction methods, however, there are many contractors within Escambia County and the Mobile Bay region who have constructed similar stream restoration projects. Overall construction

concerns include clearing trees and vegetation in the proposed construction area, constructing in the dry season and/or rerouting flow, establishing site access for transport of materials and equipment, and coordination of stockpile locations. For Site 10, the parking lot to the east of Davis Highway that has been damaged from slope failures could be used for access and construction staging, as it already requires repair upon the completion of restoration activities. Additionally, the City of Pensacola owns several parcels along Airport Boulevard and Bayou Boulevard that could provide site access for construction materials and equipment.

f. Permitting Considerations

An environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD), and possibly a Nationwide Permit from the USACE. FEMA LOMR/CLOMR will be required. Tree ordinances will be invoked, and permissions required. All of these matters are rather perfunctory.

g. Land Acquisition / Public-Private Partnership Requirements

Most of the project area needs to occur on undeveloped private property, the majority of which is within the FEMA floodplain. A total of 60 to 70 private property owners, mostly single-family residential but also including a few commercial owners, will need to agree to the work. The design focuses on undevelopable land and preserves and stabilizes an existing tree buffer between the earthwork and private residences. Two public owners to be involved include FDOT and the City of Pensacola.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

According to the stream restoration cost model presented in **Task 3.3.3**, Priority 2 stream restoration in mid-order Carpenter Creek reaches would cost approximately $6,091,500 per valley mile of restoration (including construction and wetland establishment). For the approximately 1.3 miles of restoration within Site 10, the estimated project cost is $7,902,900. Distributed by sub-section, the project costs would be $1,661,300 for the north sub-section, $3,403,400 for the middle sub-section, and $2,838,100 for the south sub-section.

The recreational recommendations at Site 10 include approximately 11,000 lineal feet of an at grade trail system. This trail starts on 9th Street and meanders along the Carpenter Creek path until it reaches Davies Highway, north of Airport Boulevard. The cost of this recreational trail is approximately $1,000,000. It is also recommended that a park be constructed in an area behind Lowe's Home Improvement on Airport Road, as well as north of Airport Blvd and east Davis. The design and permitting of a park vary dramatically depending on the facilities being provided and the end-use of the park, at this point of the design a cost estimate would not be possible.

The total estimated project cost for stream restoration, a recreation trail, and water quality components, including 30% contingency, is $14,800,341 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$88,000	$114,000	$5,530,473	$10,270,878	$1,000,000	$11,384,878	$14,800,341

ii. BCA

Priority 2 stream restoration provides a variety of financial, environmental, and social benefits, and the cost-benefit model presented in **Task 3.3.3** estimated the values of these benefits per valley mile of Priority 2 stream restoration in mid-order Carpenter Creek. **Table 2.2-3** shows the estimated ranges of costs and values associated with Priority 2 stream restoration along the 1.3 miles of mid-order Carpenter Creek in Site 10. Of the overall estimated $9.5 million return on investment from stream restoration in Site 10, each sub-sections overall value is distributed as approximately $2.0 million for the north sub-section, $4.1 million for the middle sub-section, and $3.4 million for the south sub-section. This site is ranked high on the cost-benefit.

Table 2.2-3
Estimated Range of Values for Site 10 Stream Restoration

Item	Mean	Worst Case	Best Case
Retrofit Cost	$ (7,900,676)	$ (10,270,878)	$ (5,530,473)
Avoided O&M	$ 61,216	$ 130,608	$ 918,276
Wetland Habitat	$ 477,037	$ 238,51	$ 620,148
Stream Habitat	$ 5,412,38	$ 2,706,191	$ 7,036,095
Water Quality	$ 10,471,848	$ 5,235,924	$ 13,613,403
Property Value	$ 670,549	$ -	$ 871,71
Flood Avoidance	$ 64,850	$ -	$ 389,100
Overall	**$ 9,457,205**	**$ (1,959,637)**	**$ 17,918,263**

2.2.4 Sacred Heart Camps (Site 13)

A. Current conditions

Site 13 is a commercial area that includes the Sacred Heart Memorial Hospital Complex. This site is characterized by high impervious area coverage. Upon review of existing plans, it appears there are several stormwater treatment areas on the Northern and Western sides of the parcel. It is not clear if the ponds have any connection to their adjacent wetland or Carpenter Creek.

B. Recommendations/BMP Concept

Encouraging widespread LID practices in existing high impervious areas such as this site is an effective strategy to mitigate existing water quality issues, improve resiliency, and prevent future watershed degradation. Simple retrofits such as adding curb cuts to existing parking lot landscape areas can help increase stormwater runoff treatment. These BMPs can be designed and planted to fit a wide variety of applications and landscaping aesthetics, so they are well suited to implementation in existing parking lots and other landscaped areas around the hospital campus. Pervious pavement allows stormwater infiltration through the drivable surface and serves to reduce the volume of runoff (compared to conventional directly connected impervious paved surfaces). Depending on site constraints, a wide variety of pervious paving options are available for surfaces such as parking lots, streets, driveways, and trails. Pervious concrete or asphalt looks like traditional concrete or asphalt but is porous enough to allow for infiltration. See **Appendix A, Sheet A18** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

The proposed BMP retrofits can moderately reduce the TSS and TN loading, depending on the areas selected. Excess nitrogen can cause overstimulation of growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters. When it comes to water quality, high TSS may decrease water's natural dissolved oxygen levels and increase water temperature. Turbidity and suspended solids are often used interchangeably, which can make it difficult to understand the difference between the two.

ii. Water Quantity

Site 13 was determined to benefit from Water Quality treatment more than Water Quantity in previous tasks.

iii. Model Results

The pollutant load model provided in previous tasks indicates a loading of 357.43 lbs. of nitrogen per year, 61 lbs. of phosphorus per year, and 21,582.15 lbs. of TSS. A BMPTrains model was not set up to calculate the removal of TN and TP for Site 13 because the individual contributions areas are small and subsequently, a small removal amount of nutrients and TSS. Table 2.2-4 was extracted from a research paper entitled "Identifying priority sites for low impact development (LID) in a mixed-use watershed".

This table summarizes the typical removal efficiencies. Additional modeling will only be required to permit and construct this project. The modeling required will include an ICPR model.

Table 2.2-4
Estimated Percent Removal Efficiency of LID Techniques

Estimated percent removal efficiency of LID techniques[1].

LID Type	TP[2]	TN	TSS
Rain barrel	NI	NI	NI
Green roof	0	0–91%[3]	0–93%
Porous pavement	25–50%	0–42%[3]	68–86%
Bioretention/rain garden	0–42%	0–58%[3]	69–89%
Vegetated swale	0	0–32%	6–55%
Detention pond	4–37%	0	50–75%
Retention pond	48–61%	15–40%	75–85%
Riparian buffer	41–93%[4]	56–87%[5]	58–100%[6]

[1] All % removal ranges calculated based on the International Stormwater Best Management Practice (BMP) Database (Geosyntec & WWE, 2012), unless otherwise noted.
[2] TP = total phosphorus; TN = total nitrogen; TSS = total suspended solids.
[3] Collins et al., 2010; concentration-based removal efficiencies.
[4] Hoffmann, Kjaergaard, Uusi-Kämppä, Hansen, & Kronvang (2009); ranges calculated across several buffer widths, expressed as percentage yearly retention as compared with TP load.
[5] Mayer et al. (2007); for buffer widths between 26 and 50 m.
[6] Zhang, Liu, Zhang, Dahlgren, and Eitzel (2010); range represents 95% confidence interval based on the median Note: all values < 0 are expressed as 0. NI = no information.

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 13 it is within reason to expect that the fish and wildlife habitat will also improve in the tributary and Carpenter Creek. No further consideration was applicable for Site 13.

c. Public Access/Recreational Considerations

The Sacred Heart Campus provides an opportunity to build on the hospital community's specific needs along with existing site assets. Improving pedestrian and bicyclist infrastructure based on current circulation paths through the campus would connect the site back to larger bike networks in the area as well as the creek edge. The existing wetlands compensation area to the west of the campus holds potential as a recreational asset, with low-impact pedestrian trails, a perimeter bike path, and wildlife viewing opportunities.

d. Community Resiliency Considerations

On campus, adding an outdoor classroom and wellness farm to the green space north of Trinity Drive would foster stewardship by connecting patients and healthcare workers with stormwater management strategies. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the

future. Preliminary analysis of social vulnerability in the creek segment of the watershed indicates that residents living and working between 12th Avenue and Interstate I-110 are more vulnerable than others in the watersheds and lack access to shared greenspace or the creek itself. This area of the watersheds could benefit from increased access to the creek and its floodplain, with paths connecting back to the existing social infrastructure in the area.

e. Constructability Considerations

Retrofitting stormwater BMPs, such as those described above, are designed to seamlessly fit into existing stormwater infrastructure. This is a straightforward construction technique and can be completed by contractors who have had experience installing stormwater infrastructure.

f. Permitting Considerations

A stormwater retrofit of this size qualifies for exemption from an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff.

g. Land Acquisition / Public-Private Partnership Requirements

Retrofits for this site will require a public-private partnership with Sacred Heart.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

In 2015, the EPA produced a report called Low Impact Development Stormwater Control Cost Estimation Analysis. Below are cost data and estimation procedures for LID controls for eventual deployment within the U.S. Environmental Protection Agency's (EPA) National Stormwater Calculator (NSC). **Table 2.2-5** provides a very detailed cost estimate that can be used when discussed with The Sacred Heart Hospital.

Table 2.2-5
BMP Real Cost Equations (EPA)

Table 2-10. BMP-REALCOST Construction Cost Equations (Reported in 2010 Dollars)

LID Control	Capital Cost Equation
Constructed Wetland Basin	$21,368 + $0.89(V)
Constructed Wetland Channel[1]	$6,700 + $102.70(F)
Extended Detention Basin (WQCV)	$23,897 + $0.89(V)
Extended Detention Basin (EURV)	$26,196 + $0.55(V)
Hydrodynamic Separator	$16,639 + $13,337(F)
Inlet Inserts	$393.32 + $1,967(F)
Media Filter Vault	$30,373 + $57,880(F)
Porous Landscape Detention	$10,729 + $9.93(V)
Retention (Wet) Pond (WQCV)	$23,082 + $0.71(V)
Retention (Wet) Pond (EURV)	$27,884 + $0.46(V)
Sand Filter Basin	$9,861 + $3.55(V)
Sand Filter Vault	$27,046 + $36.26(V)
Sediment/Oil/Grease Separator	$8,851+ $17,960(F)
Vault with Capture Volume	$16,616 + $19.49(V)
Concrete Grid Pavers (Modular Blocks)	$102.86 + $10.10(SA)
Permeable Interlocking Concrete Pavers	$7,257 + $14.23(SA)
Porous Concrete Pavement	$14,409 + $16.49(SA)
Porous Gravel Pavement	$7,258 + $6.87(SA)
Reinforced Grass Pavement	$13,236 + $11.82(SA)

[1]cost per 100 linear feet of channel
WQCV = water quality capture volume
EURV = excess urban runoff volume
V = storage volume (cubic feet)
F = design flowrate (cfs)
SA = surface area (ft^2)

Depending on the complexity of the design, the amount and variety of the landscaping, and how the water is directed into the rain garden the cost of the rain garden and bioswales currently proposed will be $1,200,000.

The design and permitting of outdoor classrooms and wellness farms vary dramatically depending on the elements selected for implementation, at this point of the design a cost estimate would not be possible.

The total estimated project cost for water quality components, including 30% contingency, is $1,560,000 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$0	$1,200,000	$0	$0	$0	$1,200,000	$1,560,000

ii. BCA

This site is considered to have a moderate cost-benefit ratio due to the relatively low cost anticipated for each retrofit added to the campus and the positive gain to the ecosystem and public. Public recreation and access are invaluable, especially on or near

a hospital campus. Each stormwater retrofit will provide water quality improvements to the entire system and will likely increase beautification if selected and designed with that in mind.

2.2.5 The Creek from 9th Avenue to 12th Avenue (Site 11)

A. Current conditions

This lower section of Carpenter Creek starts at 9th Avenue and flows 4,700 feet to the head of Bayou Texar just upstream of 12th Avenue. It was divided into two ditches, one dug on each side of a 30-acre bottomland swamp. The western branch has been rendered largely ineffective, likely from the effects of beavers and sedimentation. The eastern branch remains an open channel. Due to its artificial straightness and very high upstream sediment loads the channel has filled with sand and lacks deep pools and complex instream fish habitat. The freshwater bottomland forest is very boggy and the species composition is diverse and dominated by native taxa, but it is close enough to tide to be vulnerable to sea-level rise. Salinity and higher water levels will cause forest die off and the area will eventually succeed to tide marsh.

B. Recommendations/BMP concept

The project area will benefit from programmatic and site-specific BMPs that address the erosive effects of hydromodification and stabilize upstream channels to reduce the excessive sediment yield. Once the load has been largely controlled, a Priority 1 stream restoration involving re-meandering the eastern branch is recommended. This will reconstitute bends in the straight section which will generate bend pools and instream natural channel structures will induce more diverse pool and bar types, including gravel beds that are now largely buried by excessive sand sediment.

This section of the creek will be perennial and kayakable upon watershed and waterbody restoration. The restored channel will be 20 feet wide and will meander across a subset of the existing floodplain. Only the channel bends will be retrofit into a valley, and floodplain excavation and reforestation will be minimal. The meander belt will be about 120 feet wide, and the prevailing existing forested bottomland width is 300 feet.

About 30 new bends should be sufficient to generate the desired pool morphology and fish habitat. There is likely overlap in the range of freshwater and tidal creek bend morphology for this position in the drainage network, and the bend geometry should be designed with both conditions in mind because the system will evolve from a current freshwater creek under tidal influence to become more fully a tidal creek over a period of decades or less.

Special limited-access fish rearing areas can be excavated within the lower part of the floodplain, which is developing as a delta. These areas are lateral to the main channel and allow young- fish to enter and grow but have inlets that are shallow enough to preclude large predatory fish. See **Appendix A, Sheet A19** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Water quality benefits of the proposed stream restoration in Site 11 include approximately 137 lbs./year of TN reduction.

ii. Water Quantity

Flooding was not a major consideration for this site.

iii. Model Results

Because Priority 1 stream restoration restores the channel and floodplain at existing grades and is not expected to substantially impact flow rates or flood elevations, this project was not changed in the model.

b. Fish & Wildlife Habitat Considerations

The Priority 1 stream restoration will create abundant and diverse fish habitat and establish channel morphology that can accommodate the ongoing system transition from freshwater to tidal embayment. It will create channel habitat for a variety of mature and juvenile freshwater fish and rearing areas for saltwater species.

c. Public Access/Recreational Considerations

Recommendations for the Creek from 9th to 12th Avenue focus on multi-modal access and punctual connections with the creek edge. Improving bike infrastructure on major corridors surrounding the site would improve the creek's overall accessibility. A multi-modal "creekway loop" through under-utilized space behind big box stores to the north of the site would provide opportunities for wildlife viewing, windows to the creek, and low impact public access to the water's edge. Intermediary pedestrian trails throughout the creek loop and at key access points along the site, including the recommended anabranch, would connect residents with restoration efforts. A kayak launch at or near Sake Café Pensacola would expand the Bayou Texar Blueway into the creek's wider, restored bankfull channel.

This can be an ideal location for public recreation for kayaking and swimming. Installing a kayak launch at or near Sake Café Pensacola would expand the Bayou Texar blueway into the creek's wider, restored bankfull channel. The existing straight sandy channel will become a more naturally appearing meandering creek with deep pools and a combination of sand and gravel bars.

d. Community Resiliency Considerations

Pairing programming with interpretive signage addressing restoration strategies, history, and watershed management principles would foster stewardship by connecting residents to their watershed. Investment in non-vehicular travel with bike and pedestrian paths would bolster

the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the creek segment of the watersheds indicates that residents living and working between 12th Avenue and Interstate I-110 are more vulnerable than others in the watersheds and lack access to shared greenspace or the creek itself. This area of the watersheds could benefit from increased access to the creek and its floodplain, with paths connecting back to the existing social infrastructure in the area.

e. Constructability Considerations

Priority 1 stream restoration requires somewhat specialized and more difficult construction methods, however, there are many contractors within Escambia County and the Mobile Bay region who have constructed similar stream restoration projects. Overall construction concerns include clearing trees and vegetation in the proposed construction area, constructing in the dry season and/or rerouting flow, establishing site access for transport of materials and equipment, and coordination of stockpile locations. Of all the proposed stream restoration sites, Site 11 poses the most accessibility challenges as it is located deep within existing upland and wetland forests, typically 200-400 ft from the nearest road or bridge. Coordination with FDOT and one landowner could provide site access for the northern sub-section, and a City of Pensacola parcel could provide access for the middle sub-section. Site access for materials and equipment would need to be carefully coordinated with several private landowners for the southern sub-section. The location of the restoration work for Site 11 deep within wooded wetlands could also potentially require specialized contractors or equipment, as the bottomland wetland terrain could be difficult for standard construction vehicles to traverse.

f. Permitting Considerations

ERP, FEMA, USACE, and perhaps FDEP Sovereign Submerged Lands permitting are required. None of these matters are likely to obstruct the proposed treatments or materially affect the construction costs.

g. Land Acquisition / Public-Private Partnership Requirements

Most of the project would need to occur on 4 to 7 undeveloped privately-owned parcels within the FEMA floodplain. The proposed project area in the southern third of the proposed work area would occur primarily within a public parcel (likely Florida sovereign submerged lands.)

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

According to the stream restoration cost model presented in **Task 3.3.3**, Priority 1 stream restoration in base level Carpenter Creek would cost approximately $1,458,870 per valley mile restored (including construction and wetland establishment). For the approximately 0.4 miles of base-level restoration in Site 11, the estimated project cost is $605,100.

The recreational recommendations at Site 11 include approximately 4,300 linear feet of an at grade trail system. This trail creates a loop at the southeast intersection of Carpenters Creek Drive and North 9th Avenue. The cost of this recreational trail is approximately $400,000. It is also recommended that a park be constructed in an area behind the Target on Carpenter Creek Drive. The design and permitting of a park vary dramatically depending on the facilities being provided and the end use of the park, at this point of the design, a cost estimate would not be possible.

The total estimated project cost for stream restoration and recreation trail, including 30% contingency, is $1,297,594 on the high end of the range.

Stormwater		**Stream Restoration**		**Parks & Rec**	**High Total**	**Contingency**
Low	High	Low	High			30%
$0	$0	$418,704	$598,149	$400,000	$998,149	$1,297,594

ii. BCA

Priority 1 stream restoration provides a variety of financial, environmental, and social benefits, and the cost-benefit model presented in **Task 3.3.3** estimated the values of these benefits per valley mile of Priority 1 restoration in base level reaches of Carpenter Creek. **Table 2.2-6** – presents the estimated ranges of costs and values associated with Priority 1 stream restoration along the 0.4 miles of the base-level creek in Site 11. This site is considered to have a moderate BCA based on $220.84/lb TN removal, 0.4 miles of stream restoration, and $672.33/ton sediment removal.

Table 2.2-6
Estimated Value Ranges for Site 11 Stream Restoration

Item	Mean	Worst Case	Best Case
Retrofit Cost	$ (598,149)	$ (777,594)	$ (418,704)
Avoided O&M	$ 77,367	$ 38,684	$ 290,280
Wetland Habitat	$ 44,280	$ 22,140	$ 57,564
Stream Habitat	$ 1,710,930	$ 855,465	$ 2,224,209
Water Quality	$ 727,176	$ 363,58	$ 945,329
Property Value	$ 212,257	$ -	$ 275,934
Flood Avoidance	$ 20,500	$ -	$ 123,000
Overall	**$ 2,194,361**	**$ 502,283**	**$ 3,497,612**

2.3 Bayou

The bayou segment (**Figure 2.3-1**) is comprised primarily of single-family residential neighborhoods, many of which are directly adjacent to Bayou Texar. This segment is located entirely in the City's jurisdiction and therefore has additional access to City programs and funding sources. This segment exhibits the highest income bracket of the three segments. Pollutant loads in the Bayou Texar portion of the watershed are likely associated with untreated stormwater runoff that drains directly into the waterbody. Efforts to improve water quality should consider the implementation of stormwater treatment BMPs or retrofitting existing stormwater treatment units, specifically for LID projects throughout the watersheds. Fertilizer use and animal waste should also be considered likely contributing sources of nitrogen.

From the open waters of the Bayou to the shoreline, there was an obvious gradient of decreasing fine-grain sediment thickness except for the area between Gamarra Road and the 12th Ave bridge. Fine-grained organic sediments can be a significant nutrient load contributor. Reducing stormwater inflows into these areas and/or targeted removal are ways to reduce sediment accumulation in the Bayou.

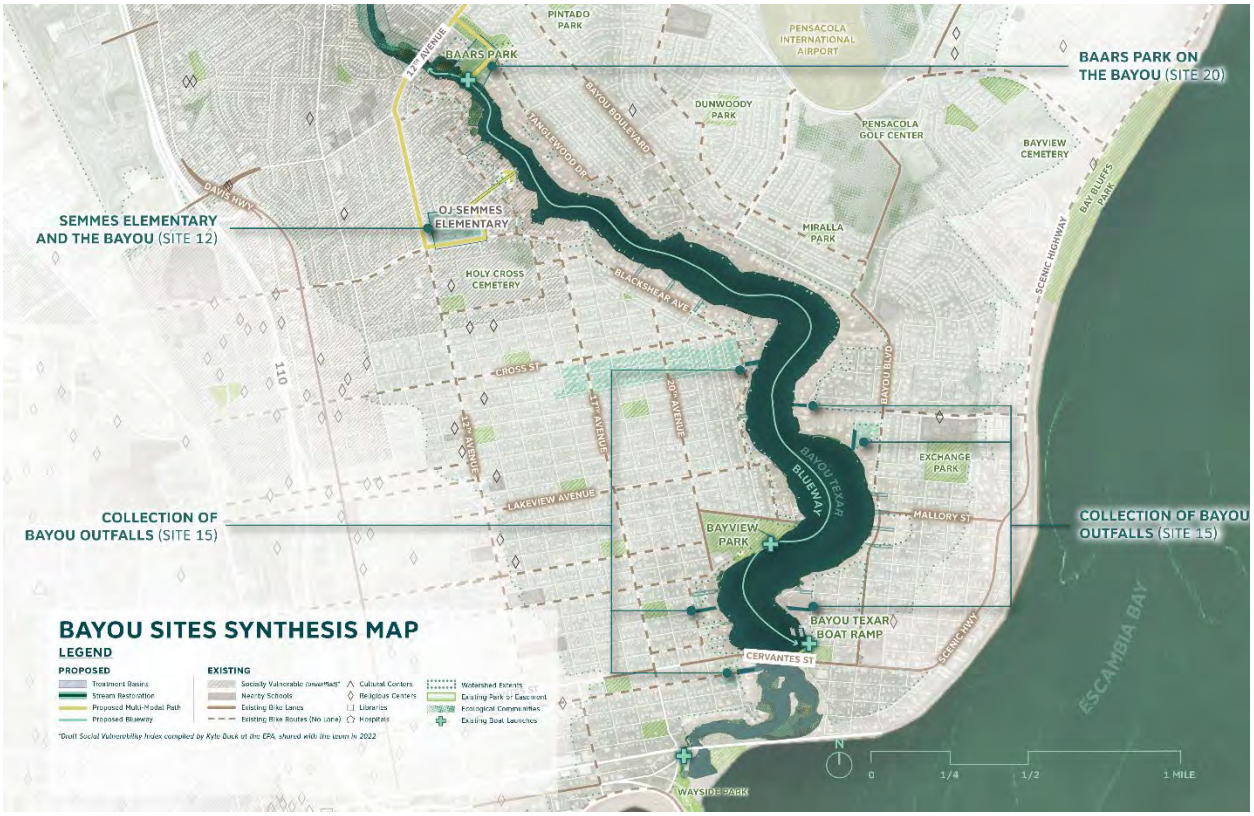
The qualitative shoreline assessment identified areas of anthropogenic impact. These are not directly assessed in the 15 site-specific project recommendations but should be addressed as part of a city or countywide shoreline program.

- Anthropogenic modifications, including vertical seawalls, highly impact the shoreline between the Cervantes Street bridge and Gamarra Road, vertical seawalls faced with rock, rock revetments, manicured lawns that terminate at the mean high water, and shorelines graded to resemble an open beach.
- From Gamarra Road north to the North 12th Avenue bridge, the shorelines are comprised largely of broad low littoral zones dominated by dense coverage of sawgrass (Cladium jamaicense).

Field reconnaissance indicated greater anthropogenic modification of the shoreline in the middle and upper portions of the bayou where *Enterococci* counts were higher. Dredging related to dock construction, graded beach shorelines, and other modifications may have increased the long-term vulnerability of sediments to erosion and tidal activity. It may also promote conditions ideal for establishing *Enterococci* colonies within sediments. Urban stormwater from local parks and residential areas that drain to Bayou Texar is also a likely contributing factor.

Three projects were identified in the Bayou segment (**Figure 2.3-1**). The sections below describe the restoration recommendations and project scoring. Conceptual plans are provided in **Appendix A**. See B for program recommendations to address issues throughout the watersheds.

Figure 2.3-1
Bayou Segment Project Recommendations



2.3.1 Baars Park on the Bayou (Site 20)

A. Current conditions

Baars Park is an existing public green space owned and maintained by the City of Pensacola. The park is accessible to the public but does not have any trails, amenities, or another programming to encourage focused public access. At about 14 acres spanning from Dunwoody Drive to the edge of Bayou Texar, Baars Park exhibits an ecological gradient that moves through sandhills, mixed hardwood hammocks, wetlands, and marshes on the Bayou. The site's diverse ecological profile and existing status as a public green space make it a key candidate for recreation, environmental education, and habitat restoration.

B. Recommendations/BMP concept

Recommendations for Baars Park seek to connect Pensacolans with the Bayou's ecology. Introducing bike access to the site from Tanglewood Drive and N 12th Avenue would connect residents further north to the park and bayou. Trails weaving through the site would encourage and focus on public access. At the park's waterfront edge, a kayak launch would improve water access and serve as a key stop along the Bayou Texar Blueway. See **Appendix A, Sheet A22** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality - Water quality bmps were not considered at this site.

ii. Water Quantity –

Flood reduction or water quantity improvements were not considered at this site.

iii. Model Results – not applicable

b. Fish & Wildlife Habitat Considerations

Preserving and restoring Baars Park's unique ecological gradient is critical to maintaining a diversity of native plant and animal species within Pensacola's urbanized core. The high sandhill habitat in particular is threatened throughout Florida. Restoring this landscape in Baars Park would support vulnerable species that call it home, including the gopher tortoise.

c. Public Access/Recreational Considerations

Recommendations for Baars Park seek to connect Pensacolans with the Bayou's ecology. The park exhibits an ecological gradient that moves through sandhills, mixed hardwood hammocks, wetlands, and marshes on the Bayou. Educational signage, interpretive trailways, and outdoor classrooms would connect visitors to the park's rich ecology. Introducing bike access to the site from Tanglewood Drive and N 12th Avenue would connect residents further north to the park and bayou. At the park's edge, a kayak launch would improve water access and serve as a key stop along the Bayou Texar Blueway.

d. Community Resiliency Considerations

Baars Park exhibits an ecological gradient that moves through sandhills, mixed hardwood hammocks, wetlands, and marshes on the Bayou. Educational signage, interpretive trailways, and outdoor classrooms would foster stewardship by connecting visitors to the park's rich ecology. Investment in non-vehicular travel with bike and pedestrian paths would bolster the area's ability to limit greenhouse gas emissions into the future. Preliminary analysis of social vulnerability in the bayou segment of the watersheds indicates that residents living and working south of 12th Avenue are less vulnerable than others in the watersheds, and currently have access to many smaller neighborhood parks yet residents who do not live on the Bayou's edge have limited options for accessing the water and any increased access to the Bayou for those residents would be beneficial.

e. Constructability Considerations

Park restoration elements, such as mixed hardwood hammock thinning, exotic species removal, kayak launch, and trail installation are straightforward construction techniques and can be completed by contractors who have had experience installing stormwater infrastructure.

f. Permitting Considerations

The design and permitting of a park vary dramatically depending on the facilities being provided.

g. Land Acquisition / Public-Private Partnership Requirements

No acquisitions or public-private partnerships are required for construction.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

The design and permitting of a park vary dramatically depending on the facilities being provided and the end use of the park, at this point of the design a cost estimate would not be possible

ii. BCA

This site is considered to have a medium cost-benefit ratio due to the high value any educational or park components would add to this park.

2.3.2 Semmes Elementary and the Bayou (Site 12)

A. Current conditions

Site 12 surrounds OJ Semmes Elementary School and Semmes Park. The school has a stormwater treatment pond located north of the campus and south of East 34th Street. Existing plan sets do not indicate an overflow structure to discharge the pond during heavy storm events.

B. Recommendations/BMP concept

Focusing strictly on water quality improvements, the recommended BMP is to place BAM at the pond bottom to improve the removal efficiency of the existing stormwater treatment pond.

Other low-impact techniques that can also be used for educational purposes include rain gardens at the existing gutter downspout locations and replacing some of the large impervious areas with pervious pavers to reduce the runoff from the school.

The recreational BMP recommendation for Site 12 includes 3,000 linear feet at grade bike path starting at the intersection of Texar Drive and N 12th Avenue running east on Texar Drive, then turning north onto Cortez Drive, continues on Cortez Drive before turning east on East 34th Street. See **Appendix A, Sheet A22** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Depending on the selected areas, the proposed BMP retrofits can moderately reduce the TSS and TN loading. Excess nitrogen can cause overstimulation of the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters. When it comes to water quality, high TSS may decrease water's natural dissolved oxygen levels and increase the water temperature. Turbidity and suspended solids are often used interchangeably, which can make it difficult to understand the difference between the two. However, they are not quite the same thing. Turbidity refers to water's transparency, and the more suspended solids water contains, the less transparent it will be. In short, turbidity is a measurement of how well light can pass through water, while TSS is a quantitative measurement of suspended particles in water.

ii. Water Quantity

Site 12 was determined to benefit from Water Quality treatment more than Water Quantity.

iii. Model Results

A BMPTrains model was not set up to calculate the removal of TN, TP, or TSS for Site 12 because the individual contributions areas are small. Subsequently, the BMPs will result in a slight reduction of nutrients and TSS. **Table 2.3-1** was extracted from a research paper entitled "Identifying priority sites for low impact development (LID) in a mixed-use watershed". The table summarizes the typical removal efficiencies. Pollutant load and ICPR modeling will only be required to permit and construct this project.

Table 2.3-1
Estimated Percent Removal Efficiency of LID Techniques

Estimated percent removal efficiency of LID techniques[1].

LID Type	TP[2]	TN	TSS
Rain barrel	NI	NI	NI
Green roof	0	0–91%[3]	0–93%
Porous pavement	25–50%	0–42%[3]	68–86%
Bioretention/rain garden	0–42%	0–58%[3]	69–89%
Vegetated swale	0	0–32%	6–55%
Detention pond	4–37%	0	50–75%
Retention pond	48–61%	15–40%	75–85%
Riparian buffer	41–93%[4]	56–87%[5]	58–100%[6]

[1] All % removal ranges calculated based on the International Stormwater Best Management Practice (BMP) Database (Geosyntec & WWE, 2012), unless otherwise noted.

[2] TP = total phosphorus; TN = total nitrogen; TSS = total suspended solids.

[3] Collins et al., 2010; concentration-based removal efficiencies.

[4] Hoffmann, Kjaergaard, Uusi-Kämppä, Hansen, & Kronvang (2009); ranges calculated across several buffer widths, expressed as percentage yearly retention as compared with TP load.

[5] Mayer et al. (2007); for buffer widths between 26 and 50 m.

[6] Zhang, Liu, Zhang, Dahlgren, and Eitzel (2010); range represents 95% confidence interval based on the median Note: all values < 0 are expressed as 0. NI = no information.

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 12 it is within reason to expect that the fish and wildlife habitat would also improve in the area. No further consideration was applicable for Site 12.

c. Public Access/Recreational Considerations

The site at O.J. Semmes Elementary School provides a unique opportunity to combine streetscape improvements, educational signage, and water access. An improved streetscape wrapping around the O.J. Semmes Elementary School campus and ending in a window to the bayou at the existing E 34th Street outfall would offer a low-impact public access point and visual connection to the Bayou.

Additional recommendations for the E 34th Street outfall may include those detailed for the Collection of Bayou Outfalls in **Section 2.3.3**.

d. Community Resiliency Considerations

Creating educational rain gardens at downspouts along the Semmes Elementary building would integrate opportunities for environmental education into students' school day. Pairing stormwater management and public access strategies with interpretive signage would foster stewardship by connecting Semmes Elementary students and neighborhood residents to their watershed. Preliminary analysis of social vulnerability in the bayou segment of the watersheds indicates that residents living and working south of 12th Avenue are less

vulnerable than others in the watersheds, and currently have access to many smaller neighborhood parks yet residents who do not live on the Bayou's edge have limited options for accessing the water and any increased access to the Bayou for those residents would be beneficial.

e. Constructability Considerations

Retrofitting stormwater BMPs such as BAM at the pond bottom in an existing stormwater treatment pond and rain gardens at gutter downspouts are straightforward construction techniques employed by qualified contractors. It is also possible to have some of the plantings in the rain garden be completed by the students at the school.

f. Permitting Considerations

Stormwater retrofits of this size are typically exempt from an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). The consultant will be required to show that the project does not negatively impact the current system's ability to convey stormwater runoff or decrease the groundwater infrastructure.

g. Land Acquisition / Public-Private Partnership Requirements

The property is owned by Escambia County School Board (ECSB). ECSB has expressed interest in partnership with Escambia County for water quality and educational purposes.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

In 2015, the EPA produced a Low Impact Development Stormwater Control Cost Estimation Analysis report. This report aims to develop cost data and estimation procedures for LID controls for eventual deployment within the U.S. Environmental Protection Agency's (EPA) National Stormwater Calculator (NSC). **Table 2.2-5** provides a very detailed cost estimate that can be used when discussed with the ESBSB.

The recreational recommendations for Site 12 include a 3,000 linear feet bike path with a cost of $320,000 and unique educational components pervious pathways rain gardens etc., with an estimated cost of $215,000. Finally, site 12 will include BAM installation with an estimated cost of $45,000.

The total estimated project cost for water quality components, including 30% contingency, is $806,000 on the high end of the range.

Stormwater		Stream Restoration		Parks & Rec	High Total	Contingency
Low	High	Low	High			30%
$260,000	$300,000	$0	$0	$320,000	$620,000	$806,000

ii. BCA

This site is considered to have a low cost-benefit ratio due to the relatively moderate cost anticipated for each retrofit with minimal improvement to the water quality. However, the bayou segment is lined with many residential properties and roads that drain directly into Bayou Texar. If implemented throughout, small water quality interventions, such as those proposed on this site, will add up to make a significant impact. Additionally, the value of early education and recreational components is immense, although difficult to quantify.

2.3.3 Collection of Bayou Outfalls (Site 15)

A. Current conditions

Site 15 is comprised of multiple parcels in residential neighborhoods along the Bayou. Each area is either County or City-owned, and parcels predate modern-day stormwater water quality regulations, thus discharging untreated stormwater directly into Bayou Texar. A review of aerial imagery showed evidence of sedimentation resulting from these discharges. The water quality analysis and pollutant load model indicate elevated nutrient concentrations at downstream monitoring stations, likely resulting from untreated stormwater runoff.

Existing infrastructure at most sites appears to include a paved flume leading from the curb inlet into the Bayou. Additional treatment could be provided by replacing the paved flume with a more natural meandering "green" outfall consisting of riprap and vegetation. This component would also provide an aesthetic element.

B. Recommendations/BMP concept

Although each area is slightly different, general recommendations include the installation of a "Smart Box". There are several types of "Smart Box" technologies. The two most common systems are baffle boxes and continuous deflection separation (CDS). A single baffle box removes 20% Nitrogen, 19% of Phosphorus, and 90% of total suspended solids. The discharge out of the "Smart Box" should be a level spreader, either in the form of a meandering bioswale or spreader swale. This will remove erosive energy from discharging out of the "Smart Box." See **Appendix A, Sheet A24** for the conceptual plan.

C. Concept Scoring Criteria

a. Water Quality & Quantity Considerations

i. Water Quality

Depending on the selected areas, the proposed BMP retrofits can moderately reduce the TSS and TN loading.

ii. Water Quantity

Site 15 was determined to benefit from Water Quality treatment more than Water Quantity in previous tasks.

iii. Model Results

The pollutant load model provided in previous tasks indicates an event mean concentration of 2.070 mg/L of Total Nitrogen, 0.327 mg/L of Total Phosphorous, and 58 mg/L of TSS. A BMPTrains model was not set up to calculate the removal of TN, TP, or TSS for Site 15 because the individual contributions areas are small, and subsequently, a small removal amount of nutrients and TSS. **Table 2.3-1** summarizes the typical removal efficiencies. Pollutant load and ICPR modeling will only be required to permit and construct this project.

b. Fish & Wildlife Habitat Considerations

By improving the water quality in the immediate area of Site 15 it is within reason to expect that the fish and wildlife habitat will also improve in the tributary and Carpenter Creek.

c. Public Access/Recreational Considerations

The selected Bayou Outfalls present opportunities to provide low-impact windows to the bayou that visually connect residents with the water and showcase native vegetation and wildlife. Where possible, small-scale community kayak launches, or other public access programming would elevate residents' connection with the Bayou. Detailed recommendations should consider each outfall's unique assets and the surrounding community's needs.

d. Community Resiliency Considerations

Preliminary analysis of social vulnerability in the bayou segment of the watershed indicates that residents living and working south of 12th Avenue are less vulnerable than others in the watershed, and currently have access to many smaller neighborhood parks yet residents who do not live on the Bayou's edge have limited options for accessing the water and any increased access to the Bayou for those residents would be beneficial.

e. Constructability Considerations

Retrofitting stormwater BMPs described above are designed to fit into existing stormwater infrastructure seamlessly. The process is a straightforward construction technique that a qualified contractor can complete.

f. Permitting Considerations

Stormwater retrofit of this scale typically qualifies for exemption from an environmental resource permit (ERP) from Northwest Florida Water Management District (NWFWMD). The consultant will be required to show that the project is not negatively impacting the current system's ability to convey stormwater runoff.

g. Land Acquisition / Public-Private Partnership Requirements

Ownership varies from site to site. For more information regarding public-private partnerships and incentivization programs, see **Section 3.7.2**.

h. Benefit-Cost Analysis

i. Opinion of Probable Cost

In 2015, the EPA produced a report called Low Impact Development Stormwater Control Cost Estimation Analysis. The purpose of this report is to develop cost data and estimation procedures for LID controls for eventual deployment within the U.S. Environmental Protection Agency's (EPA) National Stormwater Calculator (NSC). **Table 2.2-5** provides a very detailed cost estimate that can be used when discussed with the landowners.

ii. BCA

This site is considered to have a medium cost-benefit ratio due to the relatively low cost anticipated for each retrofit and improvement to the water quality. The bayou segment is lined with many residential properties and roads that drain directly into Bayou Texar. If implemented throughout, small water quality interventions, such as the ones proposed, will add up to make a significant impact.

3 PROGRAMMATIC RECOMMENDATIONS

Programmatic, watershed-wide actions will be necessary to ensure impactful and sustainable improvements to the Carpenter Creek and Bayou Texar watersheds. This section focuses on overarching programmatic recommendations that provide watershed-scale strategies and programs that could be advantageous toward reaching restoration objectives. While **Section 2** describes conceptual designs associated with specific locations within the watersheds, the programmatic recommendations described below are meant to be considered holistically, watershed-wide, and applied anywhere applicable.

3.1 Appointment of a Watershed Coordinator or Task Force

The development of this WMP demonstrates a great commitment toward a focus on the health and vitality of the Carpenter Creek and Bayou Texar watersheds. Successful implementation of the management measures presented in this WMP will require a high level of coordination and communication between multiple jurisdictions and should include a diverse array of stakeholders. This level of coordination and communication may be best accomplished through the appointment of a watershed task force, or perhaps a "watershed champion", whose focus shall be primarily on facilitating the implementation of the recommendations proposed in this WMP.

The Carpenter Creek and Bayou Texar watershed stakeholders may include Escambia County, the City of Pensacola, the Florida Department of Transportation (FDOT) District 3, the Northwest Florida Water Management District (NWFWMD), Emerald Coast Utilities Authority (ECUA), the Pensacola and Perdido Bays Estuary Program (PPBEP), the Florida Department of Environmental Protection (FDEP), Florida Department of Health, the Escambia County Board of County Commissioners, Pensacola's City Council, nongovernmental and nonprofit organizations (such as the Bream Fisherman Association and Emerald CoastKeeper), local business owners, tourism organizations (such as Visit Pensacola), individual and commercial property owners, homeowners'

associations, and academic organizations (University of West Florida, University of Florida, the Washington High School's Marine Science Academy), to name a few.

The task force could be populated through the assembly of many of the existing members of the entities identified above. Alternatively, if the workload justified a specific "watershed coordinator", consideration could be given to establishing and funding that position. As many of the recommendations within the watersheds may involve City/County coordination or involvement from a regulatory and/or funding perspective, the designee would have strong familiarity and working relationships with the City and County leadership. However, the role of the watershed coordinator should be to take a holistic approach to watershed planning, avoiding bias toward any particular agency's procedures, policies, or jurisdictional boundaries.

The appointment of a task force or watershed coordinator would assist with establishing more routine inter-departmental and inter-agency communication and coordination during both the planning and implementation of projects throughout the watersheds. For example, under the direction of a designated watershed coordinator quarterly meetings (or as often as deemed necessary), to include the various watershed stakeholders could be organized to discuss and collaborate on all planned or active projects in the watersheds. From the large meeting, breakout sessions could then be established as needed to provide the opportunity for a more in-depth discussion regarding specific projects that may involve multiple departments or agencies.

The task force/watershed coordinator could also serve as the vehicle to engage the public, work with property owner groups, apply for project grants, and foster community outreach and education. The established task force/watershed coordinator could also be utilized or expanded upon for the implementation of similar watershed-scale efforts in the future, if feasible.

Given the severity of the problems facing the Carpenter Creek and Bayou Texar watersheds, and in order to avoid losing the momentum gained during the development of this WMP, the task force/watershed coordinator should be delegated as soon as possible following the adoption of this WMP, focusing on immediate implementation of the recommendations put forth.

3.2 Strategic Land Acquisition and Conservation

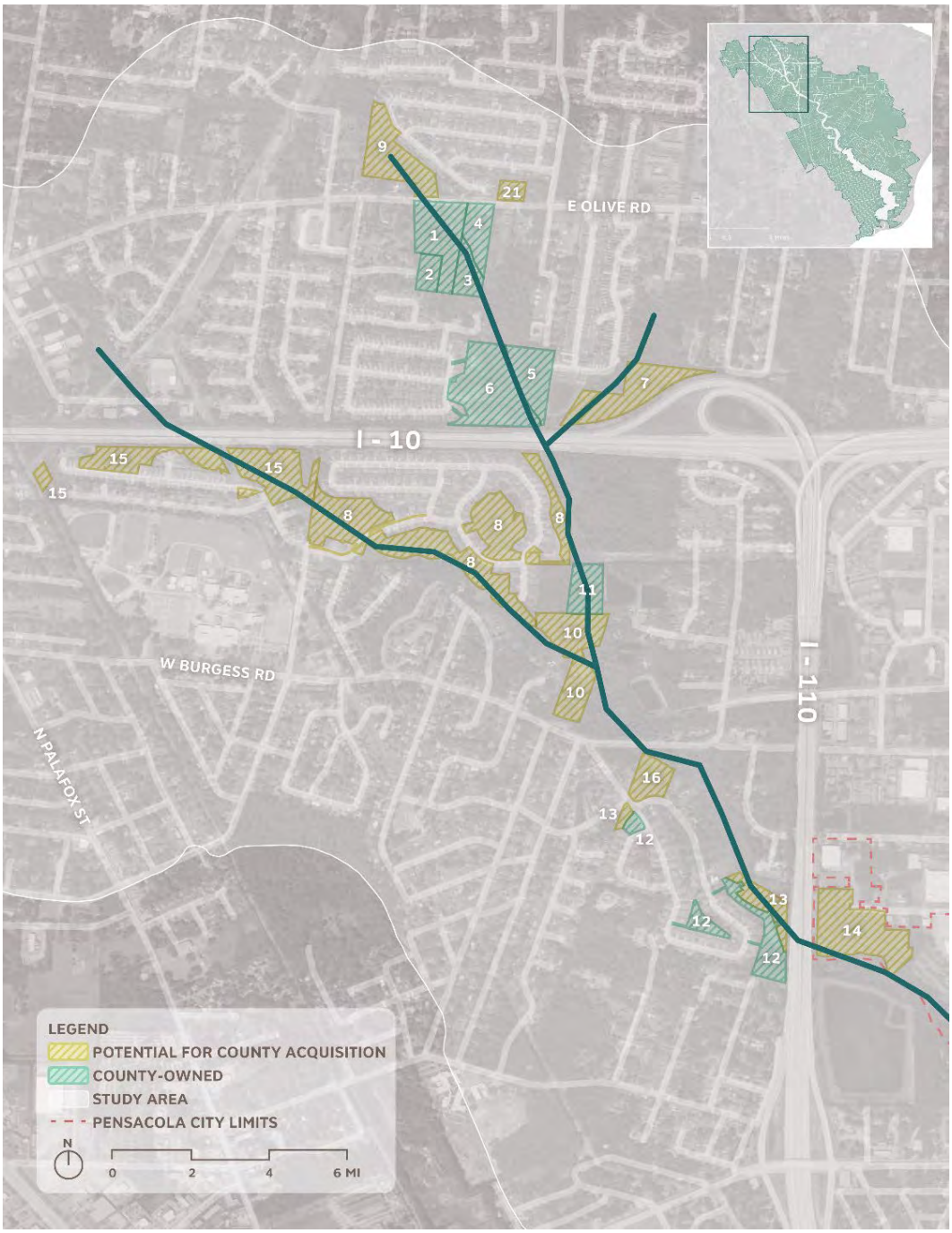
Considering the high degree of urbanization within the watersheds, there are still strategic opportunities for additional land acquisition for conservation or restoration purposes. A land acquisition could translate into opportunities for conservation easements or land-use planning to minimize development impacts. It can also help the County and City gain resilience in the face of rising sea levels. The land acquisition should be particularly considered in the Carpenter Creek watershed, specifically in areas directly adjacent to Carpenter Creek, given their increased potential to provide maximum benefits to the overall health of the creek/bayou system.

Figure 3-1 shows locations, specifically along the creek, that should be considered for acquisition for conservation or restoration purposes. **Figure 3-1** shows the locations of lands that the County already owns, lands that the County is considering purchasing, and other areas in both the County and City that demonstrate strong potential for acquisition consideration.

Several areas favored for acquisition consideration, especially those directly adjacent to Carpenter Creek and in a currently undeveloped state, are critically important. In some cases, the creek is

reaching its tipping point in terms of overall health. Acquiring and conserving these areas would be ideal for providing the creek segment an opportunity to improve itself naturally. Other areas along the creek and bayou would be strong candidates for potential low-impact development (LID)/green infrastructure (GI) retrofits to provide water quality treatment from upstream developments.

Figure 3-1
County Owned Properties and Land Acquisition Considerations



Even in developed watersheds like Carpenter Creek and Bayou Texar, preserved and undeveloped green spaces can offer a variety of benefits to society. These benefits include, but are not limited to:

Increased stormwater infiltration, which minimizes or slows down the runoff entering the creek, thereby reducing creek channel erosion issues,

- Aesthetic quality of the urban environment,
- Opportunities for public recreation and access to the creek and bayou,
- Water quality treatment of stormwater runoff before entering the creek and bayou,
- Resilience in terms of protecting against sea-level rise,
- Ecotourism opportunities,
- Habitat and travel corridors for wildlife, and
- Increased real estate values as residents and prospective businesses tend to flock to areas that promote quality of life in these ways.

A variety of measures may be available to pursue the preservation of undeveloped properties, including fee acquisition, purchase of conservation easements, the establishment of tax incentives to avoid development in certain areas, public/private partnerships, and enactment of land use ordinances, and construction of regional detention facilities. Some funding sources are listed in **Section 3.9** that may assist the city and county.

Ultimately, the success of such efforts, especially those related to development restrictions or ordinances, depends largely upon the ability to gain community-wide understanding and support. A watershed coordinator, or watershed task force, would be ideal in terms of helping to foster this kind of community support and understanding.

3.3 Stormwater Asset Inventory and Highwater-Mark Database Refinement

3.3.1 Stormwater Asset Inventory

As of the date of this report, Escambia County's stormwater asset inventory, housed in a GIS database, was noted to be last updated in 2021, although the ponds layer is updated close to monthly. During the course of the WMP, the stormwater asset inventory database was utilized as a source of information for developing the hydrologic & hydraulic model for the Carpenter Creek watershed.

Gaps, inconsistencies, and incompleteness in data can lead to a lack of confidence when relying on the data for modeling, design, and other critical decisions. The database was observed to be missing key stormwater infrastructure throughout the watershed compared to observations made during field reconnaissance and from information gleaned from recent aerial photography, various design plans, ERPs, and surveys. Also, pertinent data for certain infrastructure (invert elevations, material, span, rise, etc.) in the database was observed to be missing in some cases or other cases, not verifiable.

A complete and accurate stormwater asset inventory is a critical element of informed decision-making. Asset inventories are used to develop models that aid in flood-reduction projects and are necessary to make decisions related to resiliency planning efforts, for example. The County and City would inevitably benefit from an investment in refining and expanding its existing stormwater asset inventory database for future planning and design efforts. Chapter No. 2021-194, Laws of Florida (HB 53, 2021 Session) requires all local governments with wastewater or stormwater management systems to create a 20-year needs analysis, including a description of the system, the number of future residents served, revenues, and expenditures, maintenance costs, etc. and transmit the analysis to the Legislature's Office of Economic and Demographic Research (EDR) by June 30, 2022, and every five years thereafter.

To develop the EDR-required needs analysis, each local government must include:

- A detailed description of the stormwater management program or system and its facilities and projects
- The number of current and projected residents served, calculated in 5-year increments
- The current and projected service area for the stormwater management program or system
- The current and projected cost of providing services, calculated in 5-year increments
- The estimated remaining useful life of each facility or its major components
- The most recent 5-year history of annual contributions to, expenditures from, and balances of any capital account for maintenance or expansion of any facility or its major components
- The local government's plan to fund the maintenance or expansion of any facility or its major components
- The plan must include historical and estimated future revenues and expenditures with an evaluation of how the local government expects to close any projected funding gap

3.3.2 Highwater-Mark Database

As of the date of this report, the County does not have an official highwater-mark database developed. Highwater-mark information is a key element in planning and design projects, especially in assisting with calibration and verification of hydrologic & hydraulic (H&H) modeling efforts and analyses related to resiliency and sustainability planning.

The County provided GIS datasets with information related to rainfall data and high-water records/flood complaints observed during the event. Most of the high-water observations and flood records were qualitative in nature though, rather than quantitative, therefore offering little value in terms of actual flood elevations or depths reached during the storm. However, the county does have substantial recorded data available from the April 2014 storm event, which resulted in heavy rains and flooding on April 29, 2014.

Also, in late September 2020, and early October 2020, as part of this WMP, field reconnaissance efforts were conducted to document high-water marks and storm-related impacts following Hurricane Sally. Although much of the data collected during the post-storm field reconnaissance

was qualitative in nature, high-water marks were recorded in certain locations which provided the opportunity to obtain quantitative elevations from a survey.

It is recommended that the County and the City coordinate efforts to develop an official record or database of historical flooding events for use in future modeling, planning, and design projects to the benefit of both jurisdictions. Ideally, the database of information should include critical information related to observed depths of flooding, with locations described/placed as exactly as possible, and should include a date and time stamp, recording entity (landowner, County/City staff, etc.), among other key details. Otherwise, there is limited measured or anecdotal information related to recent flood events, at least in a recorded fashion.

3.4 Expansion of the County's Monitoring Program

Based on the limitations outlined in **Section 1.4.1** related to available data, additional data collection for surface water, groundwater, sediment characterization, and stream stage and flow are recommended to make more informed decisions related to the determination of sources for the impairments identified in the watersheds.

The following recommendations were presented in the SWRA, and remain a priority recommendation for the WMP overall:

- Level 1 Source Tracking: involves screening of specific parameters to identify stations with elevated pollutants and stations where water quality may be highly influenced by groundwater connectivity. In addition to the suite of parameters sampled under the County's existing monitoring program, Level 1 includes aluminum and iron. At least one full year of data, collected monthly, should be analyzed to account for seasonality.
- Level 2 Source Tracking: builds on the sampling frequency and parameters from Level 1, but with a period of record of at least 5 years. This sampling effort would produce enough useable data points to run a machine learning random forest model to aid in source tracking within the watersheds.
- Level 3 Source Tracking: can be implemented without having to incorporate Level 2 Source Tracking. Advanced source tracking includes the collection of nitrogen and oxygen isotopes, wastewater tracers (i.e., sucralose and pharmaceuticals), and/or microbial source tracking. The frequency of collection is based on screening level results produced from Level 1 Source Tracking.

Table 3-2 below incorporates the proposed source tracking enhancements into the previous recommendations provided to the County in June 2020, as part of the WMP's watershed characterization.

Table 3-2
Updated Comprehensive Monitoring Recommendations

Data Type	Monitoring Level	Recommendation
Surface Water Quality	Basic	Implement Level 1 Source Tracking as part of the County ambient monitoring program
	Comprehensive	Basic + Level 3 Source Tracking
Stream Stage and Flow	Basic	Install at least one staff gage equipped with a continuous water level recorder and develop a rating curve to calculate flow
	Comprehensive	Basic + 4 additional flow gages, with 2 on Carpenter Creek and 2 on inflowing tributaries; consider side looking at doppler current meters to measure continuous water velocities and level
Groundwater Quality	Basic	Begin monthly sampling at four locations. Detailed location recommendations can be found in Monitoring Program Options for Carpenter Creek and Bayou Texar (Wood 2020)
	Comprehensive	Basic + Level 3 Source Tracking
	Seepage Study	Conduct a groundwater seepage study
Sediment Characterization	Sediment Cycling Evaluation	Conduct pre-screening sediment characterization sampling event and flux incubation study

Microbial source tracking (MST) methods specific to the organisms that would be found in the watersheds should be implemented in areas found to have high levels of (FIB), to examine differences in molecular signatures associated with different sources of FIB (pet waste, wastewater, etc.) as a first step towards ultimately identifying and addressing localized sources. MST is specifically recommended at the water quality monitoring stations associated with Davis Highway and 12th Avenue to provide guidance on the sources of elevated levels of FIB found at these sites. MST findings have implications for how stormwater is managed and how water quality is maintained or improved.

3.5 Septic Abatement Program Coordination

The Emerald Coast Utilities Authority (ECUA) is a stakeholder in developing this WMP. A coordination meeting was held during the early stages of the WMP to understand their septic abatement program plans.

The ECUA noted that their sanitary sewer line coverage was relatively complete around Bayou Texar. The ECUA identified two project areas within the northern portion of the Carpenter Creek watershed for septic abatement, referred to as the Atwood Drive sewer expansion area and the Airway Drive/Stockdale Avenue sewer expansion area. As of the date of this report, the Atwood/Stockdale project was designed and estimated at $5.5 million. The Atwood Drive project has not yet been allocated funding but is being considered for future funding opportunities.

Logically, septic systems can, in some cases, be attributed to water quality issues due to the potential for failure of aging and poorly maintained systems as well as those located in high groundwater areas. However, due to the lack of source tracking and other water quality data, no correlation was made between the septic systems and the water quality issues in the watershed. Continued cooperation and collaboration with the ECUA on their septic abatement program are highly recommended. It is recommended that the County share with the ECUA any findings from future source-tracking efforts (see **Section 3.4**) that may help the ECUA prioritize and secure funds for future septic abatement projects.

3.6 Litter and Trash Abatement

Trash, garbage, and waste debris are obvious sources of pollution that are evident in both Carpenter Creek and Bayou Texar, which is unfortunately common for such urban waterbodies. However, there are many stormwater entries into the creek and bayou that offer little to no opportunity for the initial screening of trash and debris before they enter the waterways. For example, there are many private developments that are designed to discharge their stormwater via concrete flumes directly into Carpenter Creek, with no mechanism to capture debris prior to entry. Also, along Bayou Texar are many dead-end streets that provide limited impediments to trash and debris entering the bayou. Also, select locations along the creek and bayou have been witnessed to serve as illegal dumping grounds, resulting in additional creek and bayou pollution. As part of the second Public Engagement meeting for the WMP, hosted on May 2, 2022, multiple public comments were received on the issues of litter, trash, and illegal dumping, with many stakeholders noting specific locations where these issues have been witnessed. These specific locations are noted in the concept plans in Appendix A.

The trash and litter issues along the creek and bayou have received attention already. For example, the Pensacola and Perdido Bay Estuary Program (PPBEP) obtained a grant from the EPA for a comprehensive pilot project to study the quantity, composition, and extent of water-borne trash in local waterways and work to identify, reduce, and eliminate potential sources. The project focused on three water bodies in the area, one of which is Carpenter Creek.

Also, Emerald Coastkeeper is a local non-profit organization that hosts routine "Carpenter Creek Headwater's Cleanup" events, with the aim of cleaning up trash and debris along Carpenter Creek with the help of local volunteers. To date, the group has facilitated over 20 cleanups along the creek, primarily within City limits between Davis Highway and 12th Avenue. There were two cleanups noted in the unincorporated area: one at the headwaters near Olive Road and the other off of Burgess Road. Altogether, there were over 20 tons of debris estimated to be removed from the creek bed. The items recovered seemed to originate from illegal dumping and homeless camps. Thirteen homeless camps were documented within the City limits and observed during

the various cleanups. Illegal dumping was noted to be prevalent behind commercial businesses and empty properties, in particular. Many of the homeless camps were reported as being removed or cleaned up through the cooperation of property owners, code enforcement, and the Pensacola Police Department. It is recommended that volunteer and agency-sponsored activities, such as the examples noted above, continue to reduce the litter, trash, and illegal dumpsites along the creek and bayou. In addition, revisions to existing ordinances, codes, and regulations (as mentioned in Section 3.7) may be beneficial in terms of reducing or eliminating possible vectors of such pollution and/or enforcing penalties for offenders. Other options that may be considered include installing additional trash receptacles, removal/relocation of homeless camps, and installing physical barriers to existing stormwater outfalls along the waterways. In essence, possible recommendations to curb this issue include a focus on reducing the entry of unwanted debris into the waterways and/or removal of the unwanted debris that has already entered the waterways, and likely that both of these recommendations are necessary to make an impact.

3.7 Revisions to Existing Ordinances, Codes, and Regulations

It should be noted that a subsequent WMP task is dedicated to conducting a thorough review of the regulatory framework of the watershed authorities and responsibilities pertaining to applicable federal, state, and local rules, regulations, laws, statutes, and ordinances addressing erosion, sediment containment, stormwater management, stream restoration, nonpoint source pollution, etc. in the watersheds. Regulatory frameworks will be examined to identify potential opportunities to coordinate efforts or integrate goals and/or strategies identified in the WMP.

This section provides specific recommendations for regulations and ordinances regarding dumpster placement and fertilizer use. During the watershed characterization, these issues were identified to be of known concern in the watersheds.

3.7.1 Dumpster Placement Regulations and Provisions

Throughout the watersheds, especially along Carpenter Creek, numerous instances of dumpsters were located immediately adjacent to the creek. In most cases, there were no secondary containment devices or other barriers to stop overtopping trash or liquid waste from combining with stormwater runoff and finding its way into the creek system, as shown in **Figure 3-2** below:

Figure 3-2
Example of a dumpster located directly adjacent to Carpenter Creek

Property owners could take several steps, or relatively simple provisions, that could be introduced to, or strengthened in, County and City ordinances that could offer water quality benefits to the creek and bayou, such as, but not limited to:

- Locate dumpsters at least 50 feet away from concentrated stormwater flows, drainage paths, and storm drains.
- If liquid seepage from dumpsters is expected, install containment trays under the dumpsters **(Figure 3-3).**
- Ensure dumpsters have leak-proof lids or covers **(Figure 3-3)** to prevent rain from entering the container. Cover the area with a roof or canopy, when possible, to prevent its exposure to the elements.

Figure 3-3
Example of a dumpster containment tray and a leak-proof lid

3.7.2 Fertilizer Ordinances

A Fertilizer Use Ordinance is a tool used to reduce the sources of nutrients from urban landscapes on Florida's surface and ground waters. Limiting the amount of fertilizer applied to the landscape will reduce the risk of nutrient enrichment of surface and ground waters.

The ordinance regulates the proper use of fertilizers by any applicator; requires proper training of Commercial and Institutional Fertilizer Applicators; establishes training and licensing requirements; establishes a Prohibited Application Period; specifies allowable fertilizer application rates and methods, fertilizer-free zones, low maintenance zones, and exemptions. The Ordinance requires Best Management Practices, which provide specific management guidelines to minimize negative secondary and cumulative environmental effects associated with the misuse of fertilizers. Overgrowth of algae and vegetation hinders the effectiveness of flood attenuation provided by natural and constructed stormwater conveyances. Regulation of nutrients, including phosphorus and nitrogen contained in fertilizer, will help improve and maintain water and habitat quality.

3.8 Generalized Stormwater Management and Retrofit Opportunities

Given the historical development patterns and the projected future land uses for the watersheds, stormwater runoff reduction and pre-treatment measures must be considered watershed-wide. Control of stormwater runoff must be addressed holistically if the creek degradation and sediment transport problems are to be resolved. Otherwise, the health of Carpenter Creek and Bayou Texar is not sustainable and certainly not capable of measurable improvement. Regulations for new development will be reviewed in the next task. This section offers watershed-scale retrofit potential and overall stormwater management improvements for consideration

A watershed-scale retrofit program will be more cost-effective and will better accomplish its objectives if planned and implemented with a programmatic approach. Every action taken individually to reduce or slow stormwater runoff can ultimately produce significant cumulative positive impacts toward restoring the hydrology of the watersheds.

This section discusses stormwater retrofit opportunities that modify existing stormwater systems or install new management facilities in already developed areas. Retrofits may incorporate low-impact development (LID) and green infrastructure (GI) tenets, which are decentralized stormwater management strategies that provide onsite water quantity and water quality treatment, utilizing physical, chemical, and biological principles.

The programmatic recommendations described in this section can be associated with three main segments: Headwaters, Creek, and Bayou, as shown in **Figure 2-1.** However, any recommendations and incentives described below can be applied throughout the watershed, where applicable.

3.8.1 Programmatic Retrofit Recommendations – Headwaters Segment

Through the engagement of various stakeholders during the development of this WMP, it became apparent that there are many engaged, concerned, and interested residents, tenants, and homeowner association (HOA) members that have expressed interest in helping to improve the

health of the watershed they live in. In the headwaters, the programmatic recommendations may be best focused on a smaller scale, perhaps involving partnerships with HOAs and community organizations, focusing on things like lawn rewilding and residential stormwater management strategies, and could include the following, for example:

- Educational campaigns on improving drainage on residential properties (rain barrels, lawn-to-meadow principles, natural plant management, zero-scaping, permeable pavement replacement programs, etc.)
- Community-matching grant programs at the County level for watershed improvement projects (park improvements, bioswales, rain gardens, etc.)
- Homeowner rebate programs, such as for rain barrels or per-square-foot residential permeable pavement replacement programs
- Public/private partnerships, for example, during planned flood-control projects, offer incentives to HOAs or neighborhoods that agree to apply local-scale water quality retrofits that align with and complement the drainage improvements. Cost-sharing opportunities could be considered by Escambia County here in terms of sharing the cost of materials such as permeable pavers, native plant species, etc., or by offering County labor and/or consulting assistance.
- Environmental stewardship programs are a possibility for older neighborhoods with drainage issues. For example, on a case-by-case basis, the County could offer to assist in resolving drainage issues, with a commitment from the HOA or residents to employ and maintain an environmentally conscious approach, such as using bio-armoring techniques instead of riprap, when feasible.

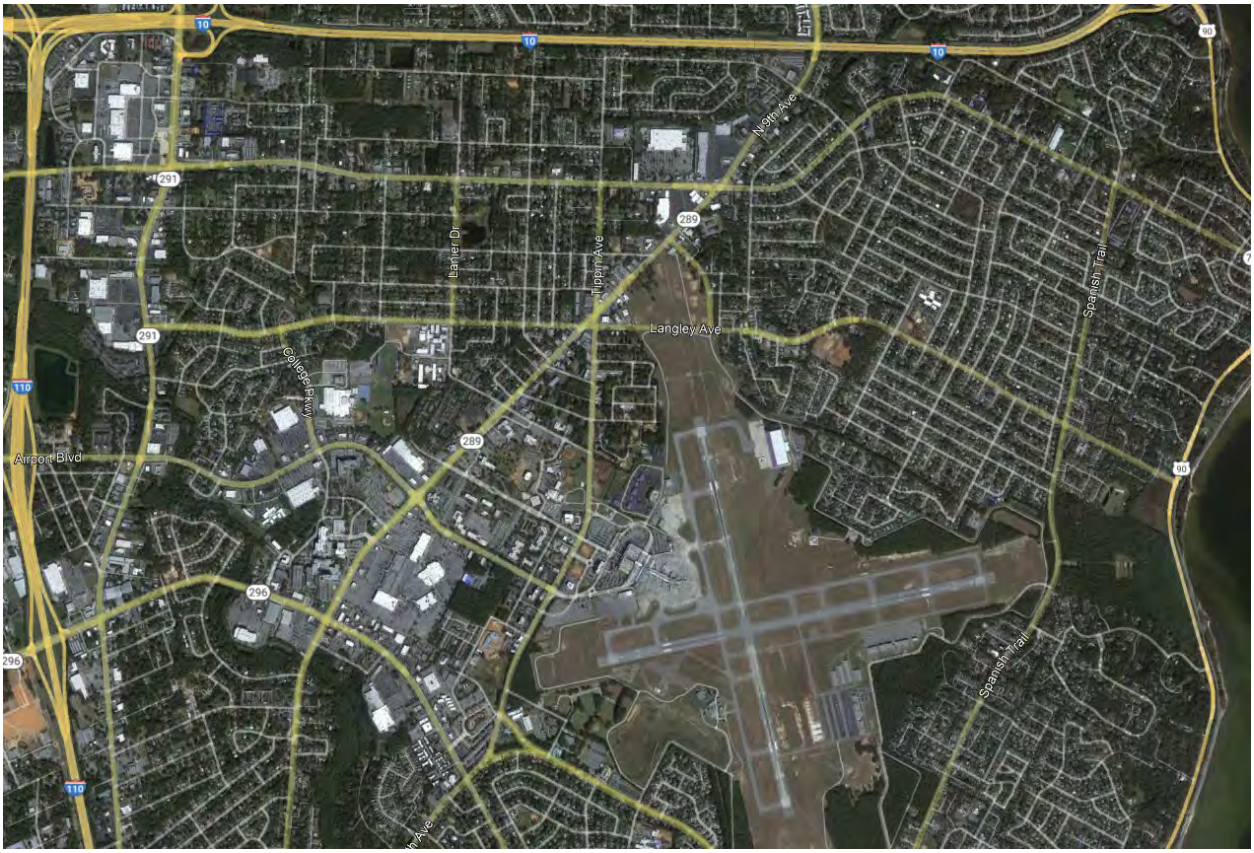
Specific examples of potential locations of the program recommendations on the Headwater concept sites can be found in **Figures A6-A12** and are shown in red.

3.8.2 Programmatic Retrofit Recommendations – Creek Segment

The creek segment consists mainly of commercial development directly connected to impervious areas (DCIA), multi and single-family residential, and industrial land uses. Of the three segments discussed in this report, the creek segment displays the highest concentration of commercial retail areas and associated DCIA. The creek segment also demonstrates possibly the most promising opportunities for incorporating public access and recreation and creative opportunities for incentivizing impactful stormwater retrofit projects.

Throughout the creek segment, especially in and around the commercial supercenters off Davis Highway, Airport Boulevard, and Bayou Boulevard, there are substantial swaths of DCIA, as illustrated in **Figure 3.3.**

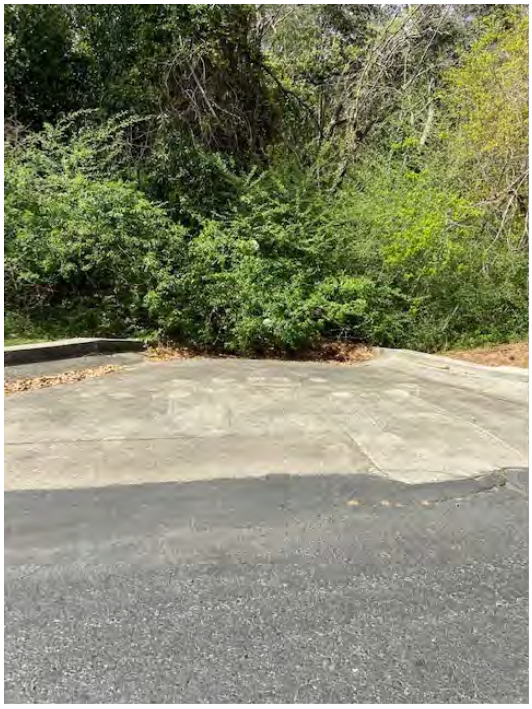
Figure 3-3
Large areas of directly connected impervious areas in the watershed



Cordova Mall, Sacred Heart Hospital, Target, and other commercial retail centers along these main thoroughfares have large impervious areas dedicated to parking lots, buildings, etc. In many cases, the parking lots are rarely at full capacity. Site 13 provides retrofit ideas for the Sacred Heart campus. Similar approaches can be considered for other large (and small) commercial areas throughout the creek segment.

During field and desktop reconnaissance, there were a number of locations observed in the creek segment to have undisturbed stormwater conveyance pathways into the creek, offering little to no water quality treatment before their points of discharge. In some cases, these open stormwater conveyances take the form of concrete flumes that funnel the runoff directly into the creek, as shown in **Figure 3-4**.

Figure 3-4
Concrete flume that discharges untreated stormwater directly into Carpenter Creek



In this example, due to the direction of stormwater flow, from both direct runoff and through stormwater infrastructure, Carpenter Creek eventually receives much of the untreated stormwater runoff from the apartment complex and the large commercial center to its north. Public/private partnerships and incentivization programs, like the ones discussed below, can be explored throughout the watershed to develop stormwater retrofits that can positively influence water quality.

Another notable feature within the creek segment is stormwater ponds located immediately adjacent to Carpenter Creek, as shown in **Figure 3-5**. Many of which appear to be designed as dry ponds for urban site drainage. The ponds along the creek are typically perched 5-25 ft above the channel bed and floodplain elevation. It is possible that percolation through a steep gradient immediately adjacent to the creek banks could be destabilizing the soils of the banks. If it is determined to be feasible, lowering the elevations of these ponds and retrofitting them as wetlands integrated with the restored creek and wetland floodplains could increase flood storage area, improve water quality treatment and infiltration/groundwater recharge, increase wetland habitat, and provide a larger riparian buffer between the creek and surrounding urban sites. These improvements could serve to improve the surrounding community's resilience to changes in storm volume and intensity, climate change, and sea-level rise.

Because these ponds currently sit at elevations much higher than the creek's floodplain and provide specific, permitted drainage for existing urban sites, it may not be feasible or cost-effective to utilize them as additional floodplain areas. If this is the case, these ponds could be retrofitted with BAM and/or native plantings to improve water quality and habitat benefits. The

County would likely need to perform a more detailed study of these ponds to determine if they are currently performing up to design standards if the percolation is measurably destabilizing adjacent creek banks, and whether it would be feasible and cost-effective to lower elevations and incorporate the pond areas into the Carpenter Creek wetland floodplain.

Figure 3-5
Large stormwater ponds directly adjacent to Carpenter Creek

Of the three watershed segments, this one may offer the most benefit from creative public/private partnerships that offer economically attractive strategies. The retrofits, partnerships, and strategies could include things like:

- Developing an award program and offering awards as an incentive for "going green", is especially attractive to commercial property owners
- Offering per-square-foot rebate programs for de-paving commercial parking lots and replacing them with impervious pavement
- Permit incentive program for development and redevelopment by commercial landowners when LID/GI tenets are adopted
- Offer incentives on the stormwater fee (City only, as County, does not currently have a stormwater utility fee) for parking lot bioswales, rain garden installations, etc.
- Focus on parking-to-meadow principles, bioswale installation, and water body edge improvements
- Utilize social media campaigns to advertise and showcase example businesses, complexes, that are serving as an example for implementing LID/GI tenets

Specific examples of potential locations of the program recommendations on the Creek concept sites can be found in **Figures A15-A19** and are shown in red.

3.8.3 Programmatic Retrofit Recommendations – Bayou Segment

Of the three segments, the bayou perhaps exhibits the most engaged group of stakeholders, demonstrating much interest in getting involved with the advancement of the goals of the WMP, on an individual level. In the bayou, the programmatic recommendations may be able to reach mid-scale and may involve rebate-driven interventions by homeowners and local businesses. Partnerships and strategies in the bayou may include things like:

- Developing an award program and offering awards as an incentive for "going green", for both commercial and residential property owners
- Educational campaigns on best management practices for water body edge design and other residential properties and businesses, such as rain barrel programs, permeable pavement replacement programs, lawn-to-meadow principles, natural plant management, zero-scaping, etc.
- Educational campaigns to impress upon bayou homeowners the importance of the creek health in the headwaters, to encourage investment in upstream projects
- Rebate programs for conservation landscaping in back and front yards
- Facilitation of promotional events, such as bike or walking tours, possibly coordinated with ecotourism stakeholders such as Visit Pensacola, to advertise, showcase, and promote LID/GI implementation around the City (**Figure 3-6**).

Specific examples of potential locations of the program recommendations on the Bayou concept sites can be found in **Figures A20-A24** and are shown in red.

Figure 3-6
Promotional material for a LID/GI bike tour event hosted in Indianapolis

3.9 Retrofits of "Pinch Points" Along Carpenter Creek

There are a number of roadways that cross Carpenter Creek, and the creek's passageway under each of these roadways varies. At some locations, the creek passes under roadways through culverts, and at other locations the creek passes through a bridge-like structure with piers, enjoying a wider flow path (**Figure 3-7**).

Due to the nature of the creek dynamics, a wider floodplain is necessary to accommodate the creek's flow path as it travels downstream. In other words, the downstream reaches of the creek become wider than the upstream, generally speaking, as the creek continues to accept stormwater inflows combined with its baseflow at various locations along the way.

Figure 3-7
Newly constructed bridge feature at the Carpenter Creek crossing at 9th Avenue

Pipes and culverts (round and box culverts, included) serve as "pinch points" to the creek at various roadway intersections, which force the creek into a smaller cross-section than it needs, at times, to flow unrestricted. In addition to culvert crossings, poorly designed bridge spans can serve as pinch points, especially when boulders and rocks are added to the nearby banks, which causes another type of pinch point. These pinch points can produce unfavorable conditions in the creek in terms of flooding. They can also contribute to scour and erosion, resulting in overall creek bank instability, infrastructure failure, and a diminishment in water quality from excess sediment loading, among others.

On a watershed-wide scale, especially along Carpenter Creek, retrofit projects should be considered to replace creek culvert crossings with features that allow for a wider cross-section of flow, such as bridges with pier structures. Special care should be given to these creek crossings to avoid limiting the flow path.

In general, it makes the most sense from a planning and funding aspect to plan these types of retrofit projects in conjunction with other County/City projects occurring at the same location, such as sidewalk or drainage improvement projects and/or other new adjacent developments. The employment or assignment of a watershed coordinator (**Section 3.1**) would be ideal for ensuring proper inter-departmental and inter-agency coordination for this purpose.

3.10 Implementation Funding and Grant Programs

Establishing a steady stream of funding sources for the recommendations proposed in this WMP will be a challenge, especially on a watershed scale. A unique challenge stems from the overlapping political jurisdictions, which all share the responsibilities of striving to meet common goals presented in this WMP. However, political jurisdictions don't follow watershed boundaries, and a holistic approach will be necessary to meet shared objectives. So, this challenge also presents a real opportunity for all involved stakeholders to work collaboratively, in a proactive manner, toward the implementation of the recommendations presented in this WMP. As discussed in **Section 3.1**, the appointment of a watershed coordinator, or watershed task force, is a strongly recommended option to help facilitate future collaboration efforts.

Many financial structures could facilitate funding for the projects and recommendations identified in this WMP. Some structures could be helpful across the entire watershed and some within specific areas. Many will require public-private partnerships in cooperation among landowners and governments.

Typically, retrofit projects are sponsored by public entities and funded by public sources, rather than the costs being borne by the original developers. Securing long-term and sustainable funding is an essential first step for implementation. Retrofit projects will usually require the cooperation and/or permissions of private entities (i.e., property owners associations, business owners, etc.). Coordination with and support from the community is critical to effecting meaningful and impactful improvements on a watershed scale.

Below is a summary of possible funding sources identified for the future implementation of the recommendations of this WMP:

3.10.1 Stormwater Utility Fee

A stormwater utility fee is a reliable revenue source used by numerous Florida cities and counties to meet their growing stormwater challenges. The fees are used for the design, construction, and maintenance of stormwater improvements across an entire community. The City of Pensacola currently has a stormwater utility fee in place. The City's stormwater fee is assessed based on the impact of stormwater generated from the particular property, calculated based on the amount of impervious area, shown as an equivalent stormwater unit. However, Escambia County does not currently have a stormwater fee in place. It is highly recommended that the County consider the enactment of such a fee to implement the recommendations in this WMP and to fund other critical stormwater needs within the County's jurisdiction. If implemented, ordinance language needs to be structured to allow for water quality and restoration projects, in addition to the standard drainage improvements.

3.10.2 State and Local Fiscal Recovery Funds Program

The Coronavirus State and Local Fiscal Recovery Funds (SLFRF) program, funded through the American Rescue Plan Act of 2021, was passed on March 11, 2021. The treasury department recently released the Final Rule, effective April 1, 2022, outlining the permitted uses for SLFRF

funds, including using funds for stormwater and resiliency infrastructure. In general, the use of the funds shall be aligned with Clean Water State Revolving Fund or Drinking Water State Revolving Fund with expanded eligible components. Below are some permitted uses of the funds for stormwater projects as defined by the final rule:

Planning and design and associated pre-project costs

- Costs for the acquisition of land (only if needed to locate eligible project components.)
- Green infrastructure investments
- Resilience improvement projects
- Infrastructure improvements that increase the capacity of existing infrastructure and extend the useful life of existing infrastructure

3.10.3 RESTORE Act

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast (RESTORE) Act established the Gulf Coast Restoration Trust Fund in the U.S. Treasury Department. Funding was provided by responsible parties pursuant in connection with the Deepwater Horizon oil spill, which was the largest offshore oil spill in the United States. Funds were distributed into five components: Direct, Comprehensive plan, Spill impact, Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program, and the Centers of Excellence Research Grants. Funds would be available to five Gulf Coast states, including Texas, Alabama, Mississippi, Louisiana, and Florida, for various projects and programs aimed at restoring the Gulf Coast region.

3.10.4 Rebuild Florida Mitigation General Infrastructure Program

The United States Department of Housing and Urban Development (HUD) has designated the Florida Department of Economic Opportunity (FDEO) to be the lead agency, and responsible entity for administering Community Development Block Grant - Mitigation (CDBG-MIT) funds allocated to the state. Funding becomes available to the state of Florida for disaster mitigation projects in areas impacted by presidentially declared disasters.

3.10.5 Beaches Funding Program

The Beaches Funding Program, administrated through the Florida Department of Environmental Protection (FDEP), provides financial assistance to county and municipal governments of up to 75% for eligible projects, which include the types listed below:

- Beach restoration and nourishment activities
- Project design and engineering studies
- Environmental studies and monitoring
- Inlet management planning

- Inlet sand transfer
- Dune restoration
- Beach and inlet protection activities
- Other beach erosion, prevention-related activities consistent with the adopted Strategic Beach Management Plan

3.10.6 The Florida Resilient Coastlines Program

The Florida Resilient Coastlines Program, administrated through the FDEP, provides financial assistance to local governments abutting the Gulf of Mexico or the Atlantic Ocean that include or are contiguous to waters of the state. The program offers Resilience Implementation Grants (RIGs) to analyze and prepare coastal communities for rising sea levels' current and future effects. There must be a coastal management element included in the comprehensive plan to be eligible for funding.

Eligible projects include:

- Comprehensive plan amendments and necessary analyses for complying with the "Peril of Flood" statute (Sec. 163.3178(2)(f) F.S.) for communities with a Coastal Management Element in their comprehensive plan
- Vulnerability assessments, other than those necessary for compliance with Peril of Flood statutes, that identify or address risks of flooding and sea-level rise
- Development of adaptation/resilience plans, projects, and policies that allow for preparation for threats from flooding and sea-level rise
- Projects to adapt critical assets to the effects of flooding and sea-level rise
- Regional collaboration efforts

3.10.7 National Coastal Resilience Fund (NCRF)

Administered through the National Fish and Wildlife Foundation (NFWF), these funds provide for the planning, design, and restoration of natural and nature-based solutions to help protect coastal communities from the impacts of storms, floods, and other natural hazards and enable them to recover more quickly and enhance habitats for fish and wildlife. Eligible projects must encompass the four criteria below:

- Community Planning and Capacity Building
- Site Assessment and Preliminary Design
- Final Design and Permitting
- Restoration Implementation

3.10.8 Northwest Florida Water Management District

The FDEP works in partnership with water management districts to provide funding assistance toward developing alternative water supplies, protection and restoration of springs, and other projects that improve water quality or help manage water quantity.

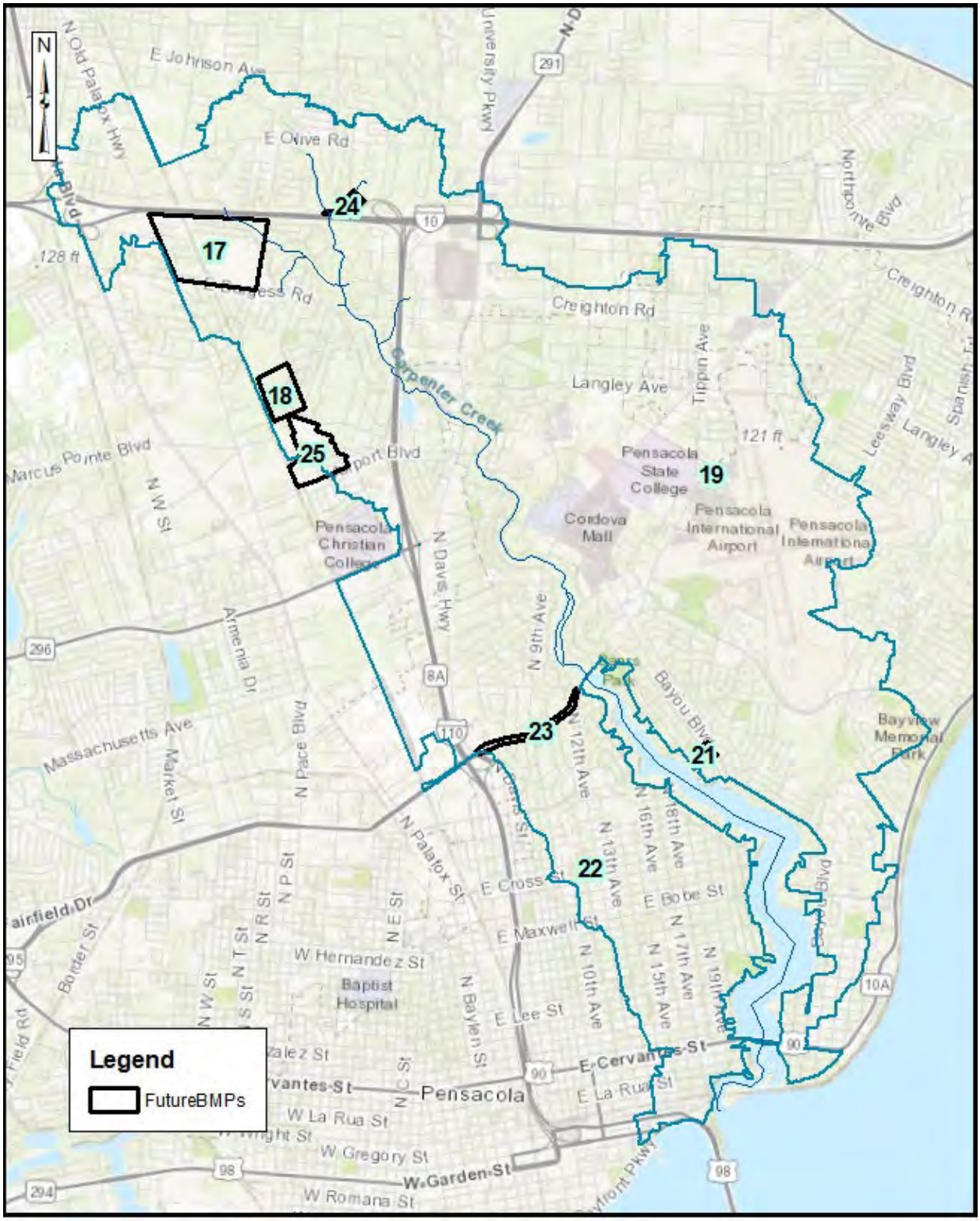
4 PROJECTS FOR FUTURE CONSIDERATION

As described in **Section 1.6**, Forty-eight (48) sites were initially identified as potential recommendation areas. **Section 2** provides details on the fifteen sites selected for conceptual level planning. Many sites were removed from the original 48 based on the county and city's feedback. Other sites were merged to provide more significant restoration impacts. Eight sites remained as good, viable projects, although considered lower priority than the 15 (**Table 4-1 and Figure 4-1**).

Table 4-1
Future Restoration Opportunities

Site #	Site Name	Category	Description
17	Palafox to NE Oakfield South of I-10	Water Quantity / Water Quality	Flooding occurs on residential properties along Flagler Drive and the Woodham Middle School property to the east of the railroad. A preliminary engineering study should be completed to evaluate the potential to reduce or eliminate flooding in the neighborhood by developing a regional stormwater facility on school property or expanding the County pond on Willow Tree Acres.
18	Monarch Lane	Water Quantity / Water Quality	Opportunity to expand upon current plans to improve flood control with a new pond.
19	Airport pond - Service Center Road	Water Quantity / Water Quality	Potential for stormwater retrofit at pond to enhance WQ. Side benefits could be additional flood control and reduction in sedimentation. Would Need PNS partnership
21	Douglas Square	Public Access & Recreation / Water Quality	Possible consideration for public access and bioswales in ROWs
22	E Fisher St Pond	Water Quality	Opportunity to retrofit new City pond to add treatment
23	E Fairfield Greenway	Public Access & Recreation	Potential for a greenway in this area, a strong network of sites along the creek identified in research and through outreach and engagement
24	Tributary North of I-10	Water Quality / Fish & Wildlife Habitat / Public Access & Recreation	Area at the tipping point in terms of stream health. LID retrofit, and/or conservation key here. Public access is desired but must balance with stream/habitat health
25	St. Augustine Ave	Water Quantity / Water Quality	Expand County Pond to the west or add a stormwater feature to St. Augustine Park or Brown Barge Middle School to reduce flooding along St. Augustine Av

Figure 4-1
Future Restoration Opportunities



5 FINAL PROJECT RANKING AND SUMMARY OF BENEFICIAL IMPACT

In summary, 15 conceptual projects and 9 stormwater programs were recommended in Sections 2 and 3. If implemented, these projects and programs are intended to be a first-step measure to protect and restore the Bayou Texar and Carpenter Creek watersheds and their waterbodies. Additional projects may be needed to complete the recovery and long-term programs will need to be implemented to maintain a healthy and sustainable system

If all projects are implemented as proposed, a cumulative:

- ✓ 3,285 lbs. of TN, 119 lbs. of TP will be removed from the system annually
- ✓ Flood stages will be reduced by over a foot in several areas
- ✓ 2,314.8 tons of sediment will be removed or redistributed to balance the system
- ✓ 2.4 miles of stream segment will be restored to a sustainable, resilient streambed
- ✓ 27.5 acres of wetland will be restored

Summary tables of benefits (**Table 5-1**), project scoring criteria (**Table 5-2**), and cost estimates (**Table 5-3**) are provided below.

By nature, conceptual plans have a lot of variability in design and implementation potential. It is essential to hire design and construction firms who understand the importance of natural design and restoration. It is also imperative that the holistic benefits of such projects on the community be weighed with the cost of the project. Generally speaking, these types of projects are not as cost-effective as traditional engineering and single benefit projects. However, these projects are necessary to restore the watersheds and revitalize and sustain a vibrant creek and bayou community.

Table 5-1 – Potential Project Beneficial Impacts on the Watershed

			Project Objectives / RESTORE Grant Goals				Benefits					
Site #	Site Names	Cost	Water Quantity	Fish & Wildlife Habitat	Public Access and Recreation	Community Resiliency	Flood Reduction (ft)	TN (lbs/yr) Removed	TP (lbs/yr) Removed	Sediment (Tons/yr) Removed	Stream (mi) Restored	Wetland (Ac) Restored
Headwaters												
16	Olive Rd Headwaters (BMPs 1, 2, 3A)	$ 2,115,750	√	√	√	√	-	207.4	66.3	4.1	-	-
1	Coronet Dr Headwaters	$ 799,110	√	-	√	√	-	71	11.4	-	-	-
7	Olive + Hilburn Rd Headwaters	$ 780,000	√	-	√	-	1.25	-	-	-	-	-
3	Siskin Lane Headwaters	$ 1,495,000	√	√	√	-	-	192	32	-	-	-
14	Headwaters South of 1-10	$ 832,000	√	-	√	-	-	55.4	8.5	-	-	-
2	Headwaters Near Burgess Rd	$ 1,913,561	√	√	√	√	-	167	-	130	0.3	2.3
4	Hilburn Rd Headwaters	$ 1,097,200	√	√	√	-	-	1.96	0.3	0.7	-	-
	Total Headwaters Sites	$ 9,032,621	**7**	**4**	**7**	**3**	**1.25**	**694.76**	**118.5**	**134.8**	**0.3**	**2.3**
Creek												
5	The Creek at Shiloh Dr	$ 432,033	√	√	-	√	-	55	-	45	0.1	0.5
8	The Creek at Sterling Hills	$ 3,084,245	√	√	√	√	-	444	-	90	0.3	3.8
10	The Creek from Davis HWY to 9th Ave	$ 14,800,341	√	√	√	√	1	1,954	-	2,000	1.3	14.6
13	Sacred Heart Campus	$ 1,560,000	√	√	√	√	-	-	-	-	-	-
11	The Creek from 9th to 12th Ave	$ 1,297,594	√	√	√	√	-	137	-	45	0.4	6.3
	Total Creek Sites	$ 21,174,213	5	5	4	5	1	2,590	0	2,180	2.1	25.2
Bayou												
20	Baars Park on the Bayou	Varies	√	-	√	-	-	-	-	-	-	-
12	Semmes Elementary and the Bayou	$ 806,000	√	√	√	√	-	-	-	-	-	-
15	Collection of Bayou Outfalls	Varies	√	√	√	-	-	-	-	-	-	-
	Total Bayou Sites	$ 806,000	3	2	3	3	0	0	0	0	0	0
	GRAND TOTAL	$ 31,012,834	**15**	**11**	**14**	**9**	**2.25**	**3,284.76**	**118.5**	**2,314.8**	**2.4**	**27.5**

Table 5-2
Ranking of Recommended Projects

Site #	Segment	Site Names	Improves Water Quantity or Water Quality (0 15)	Protects, enhances, and/or restores Fish & Wildlife Habitat (0 15)	Expands existing Public Access and Recreation opportunities (0 15)	Improves Community Resiliency (0 15)	Constructability (0 10)	Permitability (0 10)	Land Acquisition / P3 Requirements (0 5)	Cost vs. Benefit (0 15)	Score (100 Possible)	Ranking
16	Headwaters	Olive Rd Headwaters	12	15	13	14	10	8	4	15	**64**	2
1	Headwaters	Coronet Dr Headwaters	8	5	6	6	10	10	5	11	**49**	5
7	Headwaters	Olive + Hilburn Rd Headwaters	10	0	2	2	7	8	3	7	**35**	9
3	Headwaters	Siskin Lane Headwaters	11	5	5	8	10	10	0	11	**47**	6
14	Headwaters	Headwaters South of 1-10	7	5	5	9	10	8	0	7	**37**	8
2	Headwaters	Headwaters Near Burgess Rd	15	15	12	14	7	7	3	15	**88**	1
4	Headwaters	Hilburn Rd Headwaters	2	7	12	7	10	10	5	13	**47**	6
5	Creek	The Creek at Shiloh Dr	14	15	0	6	5	7	0	15	**56**	3
8	Creek	The Creek at Sterling Hills	13	15	10	13	7	7	0	11	**53**	4
10	Creek	The Creek from Davis HWY to 9th Ave	15	15	15	14	7	7	0	15	**88**	1
13	Creek	Sacred Heart Campus	2	5	10	12	10	10	3	7	**37**	8
11	Creek	The Creek from 9th to 12th Ave	14	15	14	14	4	5	0	11	**49**	5
20	Bayou	Baars Park Bayou	0	10	14	7	10	10	5	7	**42**	7
12	Bayou	Semmes Elementary & the Bayou	0	1	11	5	10	10	5	2	**28**	11
15	Bayou	Collection of Bayou Outfalls	0	3	5	8	10	10	2	6	**31**	10

Table 5-3
Summary of Conceptual Level Cost Estimates

Site #	Site Names	Stormwater		Stream Restoration		Parks & Rec	High Total	+Contingency
		Low	High	Low	High			+30%
16	Olive Rd Headwaters	$ 285,000	$ 384,500	$ 0	$ 0	$ 1,243,000	$ 1,627,500	$ 2,115,750
1	Coronet Dr Headwaters	$ 215,700	$ 251,700	$ 0	$ 0	$ 363,000	$ 614,700	$ 799,110
7	Olive + Hilburn Rd Headwaters	$ 500,000	$ 600,000	$ 0	$ 0	*	$ 600,000	$ 780,000
3	Siskin Lane Headwaters	$ 575,000	$ 670,000	$ 0	$ 0	$ 480,000	$ 1,150,000	$ 1,495,000
14	Headwaters South of 1-10	$ 195,100	$ 500,000	$ 0	$ 0	$ 140,000	$ 640,000	$ 832,000
2	Headwaters Near Burgess Rd	$ 162,000		$ 297,210	$ 551,970	$ 460,000	$ 1,471,970	$ 1,913,561
4	Hilburn Rd Headwaters	$ 140,000	$ 364,000	$ 0	$ 0	$ 480,000	$ 844,000	$ 1,097,200
5	The Creek at Shiloh Dr	$ 53,000	$ 142,000	$ 102,487	$ 190,333	$ 0	$ 332,333	$ 432,033
8	The Creek at Sterling Hills	$ 57,000	$ 76,000	$ 1,236,575	$ 2,296,496	*	$ 2,372,496	$ 3,084,245
10	The Creek from Davis HWY to 9th Ave	$ 88,000	$ 114,000	$ 5,530,473	$ 10,270,878	$ 1,000,000	$ 11,384,878	$ 14,800,341
13	Sacred Heart Campus	$ 0	$ 1,200,000	$ 0	$ 0	*	$ 1,200,000	$ 1,560,000
11	The Creek from 9th to 12th Ave	$ 0	$ 0	$ 418,704	$ 598,149	$ 400,000	$ 998,149	$ 1,297,594
20	Baars Park Bayou*	$ 0	$ 0	$ 0	$ 0	*	*	*
12	Semmes Elementary & The Bayou	$ 260,000	$ 300,000	$ 0	$ 0	$ 320,000	$ 620,000	$ 806,000
15	Collection of Bayou Outfalls*	*	*	$ 0	$ 0	*	*	*

*Not calculated due to high variability in design options

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VOLUME 4A APPENDIX A

CONCEPT PLANS

WOOD
SCAPE
IMPACT CAMPAIGNS
WETLAND SCIENCES
REBOL-BATTLE & ASSOCIATES

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

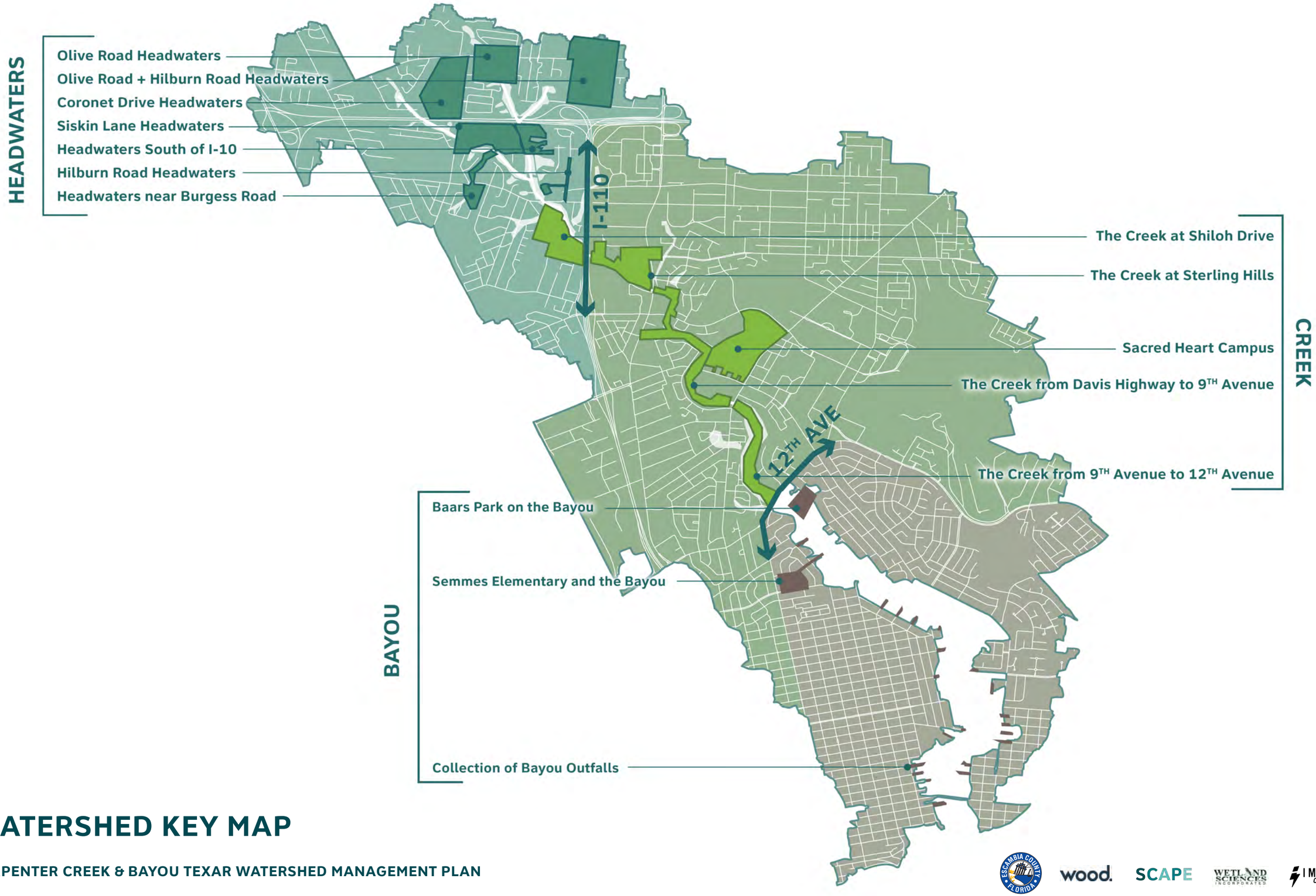
FOR ESCAMBIA COUNTY

RECOMMENDATIONS REPORT - APPENDIX A: DRAFT CONCEPT PLANS

MAY 2022

TABLE OF CONTENTS

Organized by Headwaters, Creek and Bayou
Watershed Key Map - Figure A3 on the next page



WATERSHED KEY MAP

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

HEADWATERS SITES

CORONET DR HEADWATERS (SITE 1)

SISKIN LN HEADWATERS (SITE 3)

HEADWATERS NEAR BURGESS RD (SITE 2)

OLIVE RD HEADWATERS (SITE 16)

OLIVE + HILBURN RD HEADWATERS (SITE 7)

HEADWATERS SOUTH OF I-10 (SITE 14)

HILBURN RD HEADWATERS (SITE 4)

OLIVE RD

HEADWATERS BIKE LOOP

POTENTIAL EASEMENT PATH

CREIGHTON RD

BURGESS RD

ENSLEY ELEMENTARY SCHOOL

WEST FLORIDA HIGH SCHOOL

OAKFIELD ACRES PARK

BROWN BARGE MIDDLE SCHOOL

UNIVERSITY OF WEST FLORIDA

WEST FLORIDA HOSPITAL

TRYON BRANCH LIBRARY

WASHINGTON SENIOR HIGH SCHOOL

OLD PALAFOX HWY / PENSACOLA FLOMATON RD

NEW PALAFOX HWY

PALAFOX ST

DAVIS HWY

29

110

HEADWATERS SITES SYNTHESIS MAP

LEGEND

PROPOSED

- Treatment Basins
- Stream Restoration
- Proposed Multi-Modal Path
- Proposed Blueway

EXISTING

- Socially Vulnerable *(unverified)**
- Nearby Schools
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Cultural Centers
- Religious Centers
- Libraries
- Hospitals
- Watershed Extents
- Existing Park or Easement
- Ecological Communities
- Existing Boat Launches

**Draft Social Vulnerability Index compiled by Kyle Buck at the EPA, shared with the team in 2022*

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

OLIVE RD HEADWATERS (SITE 16)

CORONET DR HEADWATERS (SITE 1)

SISKIN LN HEADWATERS (SITE 3)

HEADWATERS NEAR BURGESS RD (SITE 2)

OLIVE + HILBURN RD HEADWATERS (SITE 7)

HEADWATERS SOUTH OF I-10 (SITE 14)

HILBURN RD HEADWATERS (SITE 4)

HEADWATERS BIKE LOOP

POTENTIAL EASEMENT PATH

OLIVE RD

CREIGHTON RD

BURGESS RD

PALAFOX ST

OLD PALAFOX HWY / PENSACOLA FLOMATON RD

NEW PALAFOX HWY

DAVIS HWY

ENSLEY ELEMENTARY SCHOOL

WEST FLORIDA HIGH SCHOOL

OAKFIELD ACRES PARK

BROWN BARGE MIDDLE SCHOOL

TRYON BRANCH LIBRARY

WASHINGTON SENIOR HIGH SCHOOL

UNIVERSITY OF WEST FLORIDA

WEST FLORIDA HOSPITAL

29

10

110

N

0 1/4 1/2 1 MILE

OLIVE ROAD HEADWATERS (SITE 16) - CONCEPT PLAN

BENEFITS

- Total Nitrogen: 207.4 lb/yr
- Total Phosphorus: 66.3 lbs/yr
- Sediment: 4.1 tons/yr

RECOMMENDATIONS

1. Modify the existing drainage pipe north of Olive Road to create a permanent headwaters pond
2. Construct sediment sump with skimmer device in existing roadside ditch for sediment and gross pollutants capture
3. Amend soil upflow treatment system to remove nutrients from baseflow and low stormwater flows
4. Potential location for stormwater pond to provide detention and treatment for Olive Road drainage and sidewalk improvements.
5. Install water flow control feature under boardwalk
6. Construct linear planted channels that work with grade control structures to move and filter water from incising eastern ditch to the wetlands at the center of the site
7. Create primary park entrance and improve existing bike routes in alignment with ongoing Olive Road drainage and sidewalk improvements
8. Improve and extend existing paths on site to create continuous public access, with combination of walking and biking trails
9. Provide opportunities for fishing and wildlife viewing, including a boardwalk north of Olive Road and a paddle craft launch
10. Pair restoration with educational programming of various scales such as a nature center, an outdoor classroom with benches and tables, and signage
11. Homeowner rebate programs for "going green," permeable pavement replacement programs, public/private partnerships to inventivize LID/GI retrofits
12. Restore drainage ditch with a meander and compact forested floodplain to prevent excessive erosion and improve water quality
13. Support beaver habitat by installing beaver dam analogs and restoring central pond

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY

- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT

- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION

- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

NOTE: ALL CONCEPT PLANS ARE DRAFTS AND WILL BE EDITED TO REFLECT FEEDBACK RECEIVED DURING THE PUBLIC MEETING

CORONET DRIVE HEADWATERS (SITE 1) - CONCEPT PLAN

BENEFITS

- Total Nitrogen: 71 lbs/yr
- Total Phosphorus: 11.4 lbs/yr

RECOMMENDATIONS

1. Install four baffle boxes or Continuous Deflection Separators (CDS) to treat stormwater runoff before it reaches the creek system
2. Establish a public-private partnership to reduce flooding in flood-prone area
3. Introduce a low impact window to the creek at the south end of the site, such as a pedestrian hiking trail parallel to I-10 with interpretive signage relating to stormwater management and an overlook at the stream edge
4. Pair baffle boxes with interpretive signage
5. Create park on Housing Authority parcel at northeast corner of site
6. Install bike lane in alignment with ongoing Olive Road drainage and sidewalk improvements
7. Work with Florida Power and Light to use existing powerline easement for trails through the headwaters, connecting to UWF trails to the north
8. Homeowner rebate programs for "going green," permeable pavement replacement programs, public/private partnerships to inventivize LID/GI retrofits

LEGEND

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WATER QUANTITY & QUALITY

- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT

- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION

- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
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CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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ESCAMBIA COUNTY FLORIDA · wood. · SCAPE · WETLAND SCIENCES INCORPORATED · IMPACT Campaigns

OLIVE ROAD + HILBURN ROAD HEADWATERS (SITE 7) - CONCEPT PLAN

BENEFITS

- Flood Stage: 1.25 ft

RECOMMENDATIONS

1. Construct bioswale with a five foot bottom width to capture stormwater runoff behind properties to prevent flooding conditions. Consider investigation of flood-control options to include potential upsizing of discharge pipes and/or piping the existing ditch system
2. Install bike lane in alignment with ongoing Olive Road drainage and sidewalk improvements
3. Homeowner rebate programs for “going green,” permeable pavement replacement programs, public/private partnerships to inventivize LID/GI retrofits

LEGEND

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WATER QUANTITY & QUALITY

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- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT

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PUBLIC ACCESS & RECREATION

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- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

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CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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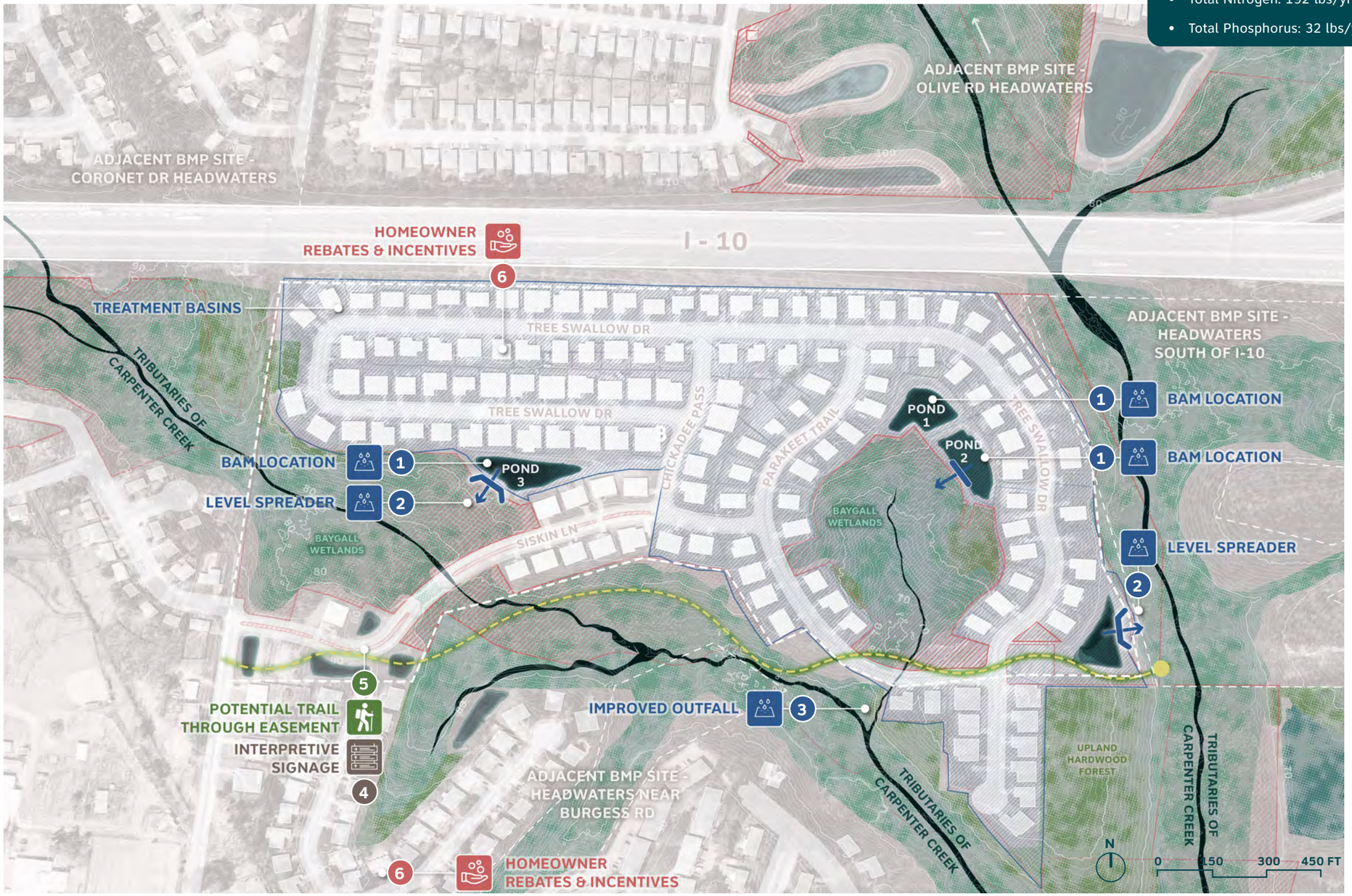
SISKIN LANE HEADWATERS (SITE 3) - CONCEPT PLAN

BENEFITS

- Total Nitrogen: 192 lbs/yr
- Total Phosphorus: 32 lbs/yr

RECOMMENDATIONS

1. The three existing stormwater treatment ponds should be retrofitted with a layer of BAM at the pond bottom and overflow structures outfitted with BAM filters
2. Construct outfall level spreaders to dissipate energy during high discharge events
3. Improve existing outfall to dissipate energy
4. Install interpretive signage to engage residents in stormwater management strategies
5. Expand pedestrian creek access through a hiking trail along the existing easement
6. Environmental stewardship and homeowner rebate programs for “going green,” permeable pavement replacement programs, rain gardens, public/private partnerships to incentivize LID/GI retrofits



LEGEND

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WATER QUANTITY & QUALITY

- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT

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- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION

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- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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HEADWATERS SOUTH OF I-10 (SITE 14) - CONCEPT PLAN

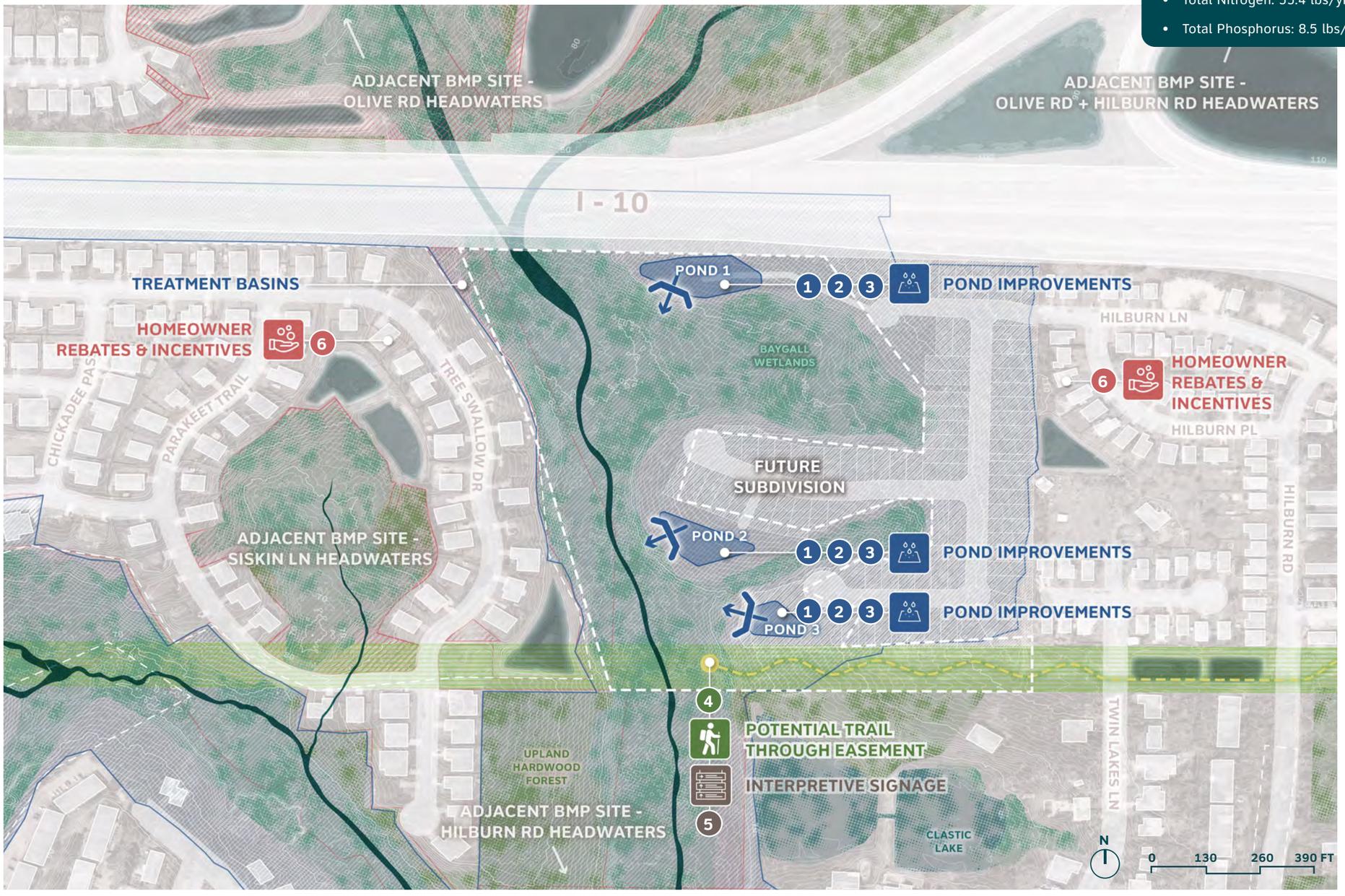
BENEFITS

- Total Nitrogen: 55.4 lbs/yr
- Total Phosphorus: 8.5 lbs/yr

RECOMMENDATIONS

At each of the three ponds:

1. Install a layer of BAM at pond bottoms to remove nutrients during infiltration
2. Upgrade existing outfall structure to have BAM filter to remove nutrients from stormwater runoff being introduced into the creek system.
3. Construct spreader swales to dissipate energy and prevent erosion in creek
4. Expand pedestrian creek access through a hiking trail along the existing easement in partnership with private owner
5. Install interpretive signage to connect residents with the creek
6. Environmental stewardship and homeowner rebate programs for “going green”, permeable pavement replacement programs, rain gardens, public/private partnerships to incentivize LID/GI retrofits



LEGEND

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WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

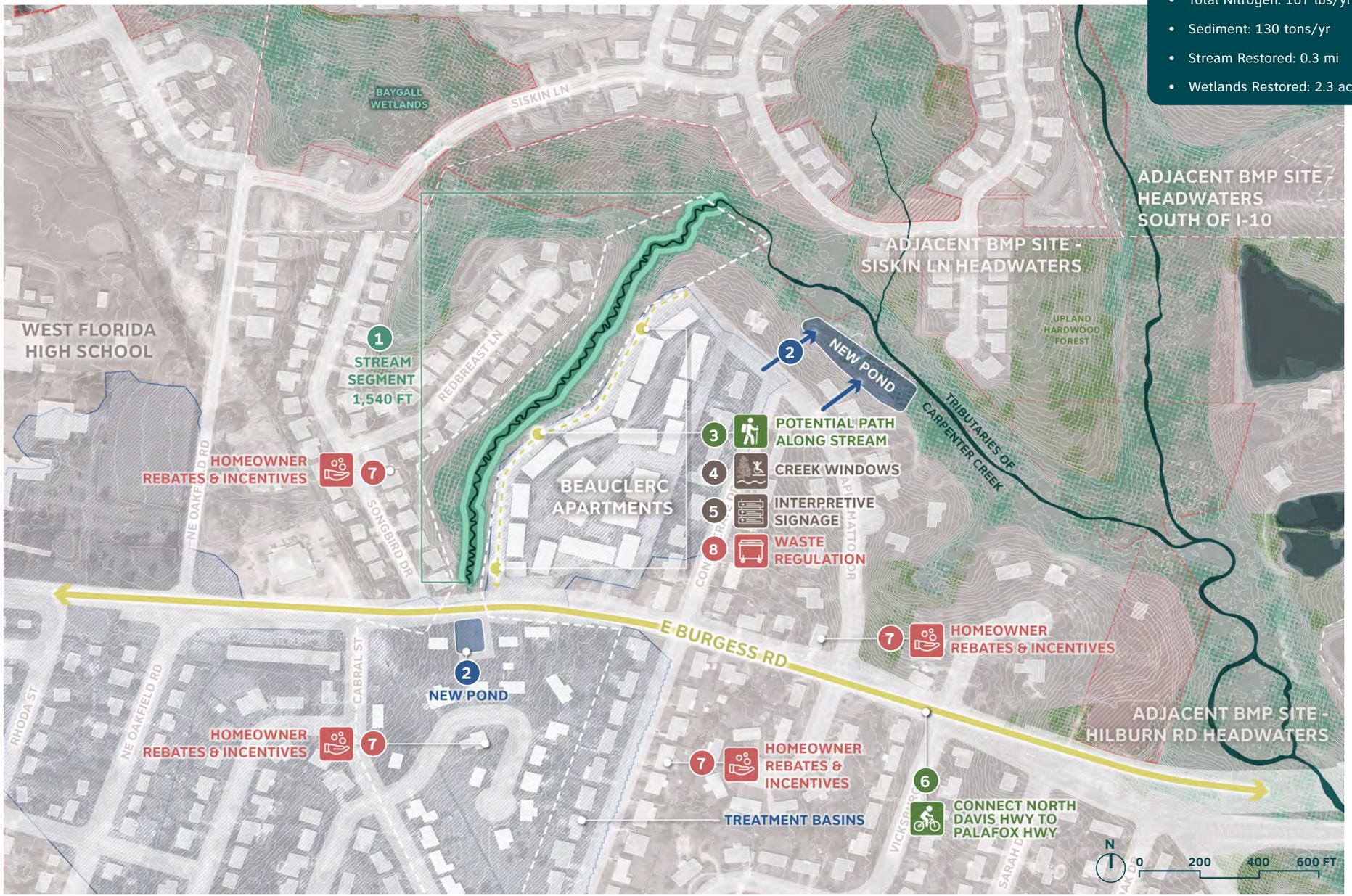
HEADWATERS NEAR BURGESS ROAD (SITE 2) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore stream segment, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Create two detention ponds
3. Provide a pedestrian path along stream restoration
4. Punctuate pedestrian path with overlooks that provide windows to the creek
5. Put the community's eyes on the creek by introducing educational signage that encourages stewardship
6. Create a bike lane along E Burgess Road, tying into the Headwaters Bike Loop
7. Environmental stewardship and homeowner rebate programs for "going green", permeable pavement replacement programs, rain gardens, public/private partnerships to incentivize LID/GI retrofits
8. Dumpster regulation/ordinance review to provide restrictions on dumpster placement on creek-adjacent sites

BENEFITS

- Total Nitrogen: 167 lbs/yr
- Sediment: 130 tons/yr
- Stream Restored: 0.3 mi
- Wetlands Restored: 2.3 ac



LEGEND

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WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

N 0 160 320 480 FT

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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HILBURN ROAD HEADWATERS (SITE 4) - CONCEPT PLAN

RECOMMENDATIONS

1. Construct new swales and repair existing swales along Hilburn Road to provide additional treatment to stormwater runoff - upgrading existing FDOT system
2. Install second generation baffle box or CDS unit to remove leaf litter and other nutrient sources
3. Create access to the creek with a potential new park along the upcoming Creighton Road expansion
4. Utilize projects such as a hiking trail, wildlife viewing, and interpretive signage north of the Creighton Road expansion as mitigation for the new construction
5.
6. Environmental stewardship and homeowner rebate programs for “going green”, permeable pavement replacement programs, rain gardens, public/private partnerships to incentivize LID/GI retrofits

BENEFITS

- Total Nitrogen: 1.96 lbs/yr
- Total Phosphorus: 0.3 lbs/yr
- Sediment: 0.7 tons/yr

LEGEND

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WATER QUANTITY & QUALITY

- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE

- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION

- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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CREEK SITES


THE CREEK AT SHILOH DR (SITE 5)
THE CREEK FROM DAVIS TO 9TH AVE (SITE 10)
THE CREEK AT STERLING HILLS (SITE 8)
SACRED HEART CAMPUS (SITE 13)
THE CREEK FROM 9TH TO 12TH AVE (SITE 11)
110
DAVIS HWY
AIRPORT BLVD
CREEK BIKE
PARKER CIRCLE PARK
BRYAN PARK
TRYON BRANCH LIBRARY
STERLING HILLS
WASHINGTON SENIOR HIGH SCHOOL
PENSACOLA STATE COLLEGE
CENTER FOR THE VISUAL ARTS
CORDOVA MALL
BAYOU BLVD
AMC
CARPENTER CREEK BLUEWAY
9th AVENUE
12th AVENUE
PENSACOLA CHRISTIAN COLLEGE
CHILDREN & FAMILIES
WOODLAND HEIGHTS PARK
PINEGLADES PARK
PENSACOLA INTERNATIONAL AIRPORT
ROGER SCOTT ATHLETIC COMPLEX

CREEK SITES SYNTHESIS MAP

LEGEND

PROPOSED

- Treatment Basins
- Stream Restoration
- Proposed Multi-Modal Path
- Proposed Blueway

EXISTING

- Socially Vulnerable *(unverified)**
- Nearby Schools
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Cultural Centers
- Religious Centers
- Libraries
- Hospitals
- Watershed Extents
- Existing Park or Easement
- Ecological Communities
- Existing Boat Launches

**Draft Social Vulnerability Index compiled by Kyle Buck at the EPA, shared with the team in 2022*

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

THE CREEK AT SHILOH DR (SITE 5)

THE CREEK FROM DAVIS TO 9TH AVE (SITE 10)

THE CREEK AT STERLING HILLS (SITE 8)

SACRED HEART CAMPUS (SITE 13)

THE CREEK FROM 9TH TO 12TH AVE (SITE 11)

PARKER CIRCLE PARK
BRYAN PARK
TRYON BRANCH LIBRARY
STERLING HILLS
110
DAVIS HWY
WASHINGTON SENIOR HIGH SCHOOL
AIRPORT BLVD
CREEK BIKEWAY
PENSACOLA STATE COLLEGE
CENTER FOR THE VISUAL ARTS
SPRINGDALE PARK
BAYOU BLVD
SACRED HEART HOSPITAL
CORDOVA MALL
AMC
CARPENTER CREEK BLUEWAY
9th AVENUE
PENSACOLA CHRISTIAN COLLEGE
CHILDREN & FAMILIES
PENSACOLA INTERNATIONAL AIRPORT
ROGER SCOTT ATHLETIC COMPLEX
WOODLAND HEIGHTS PARK
PINEGLADES PARK
12th AVENUE
N
0
1/4
1/2
1 MILE

THE CREEK AT SHILOH DRIVE (SITE 5) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore stream segment, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Construct spreader swale to dissipate energy
3. Install a BAM filter at the bottom of two existing drainage ponds to treat water that drains to the creek
4. Environmental stewardship and homeowner rebate programs for “going green”, permeable pavement replacement programs, rain gardens, public/ private partnerships to incentivize LID/GI retrofits

BENEFITS

- Total Nitrogen: 55 lbs/yr
- Sediment: 45 tons/yr
- Stream Restored: .1 mi
- Wetlands Restored: 0.5 ac

LEGEND

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WATER QUANTITY & QUALITY

- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE

- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION

- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
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- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY

- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC

- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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THE CREEK AT STERLING HILLS (SITE 8) - CONCEPT PLAN

BENEFITS

- Total Nitrogen: 444 lbs/yr
- Stream Restored: 0.3 mi
- Wetlands Restored: 3.8 ac

RECOMMENDATIONS

1. Restore two stream segments, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Improve existing outfall locations with inlet filters and energy dissapators
3. Create a bioswale rain garden behind Big Lots to slow stormwater runoff and guide a path to the creek
4. Install a Continous Monitoring & Adaptive Control (CMAC) system to reduce peak runoff and hydromodification impacts
5. Relocate dog park to area not directly adjacent to creek, to avoid runoff pollution into creek
6. Create low impact windows to the creek at existing Sterling Hills Apartments outfalls
7. Put the community's eyes on the creek by introducing educational signage that encourages stewardship
8. Connect bike infrastructure to create a continuous dedicated bike lane along Davis Hwy and a link to the new creek window
9. Public/private partnership opportunity to include LID/GI tenets, award program, permit incentives
10. Install "litter-gitter" or other trash collection and removal device
11. Opportunity for regulation and ordinance changes to create buffer requirements for dumpster placement along creek edge
12. Offer incentives to property owners such as stormwater fee reduction for "going green", rebate programs for de-paving, rain garden installation, waterbody-edge improvements
13. Restore baygall wetland habitat

LEGEND

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WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
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- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
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STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
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CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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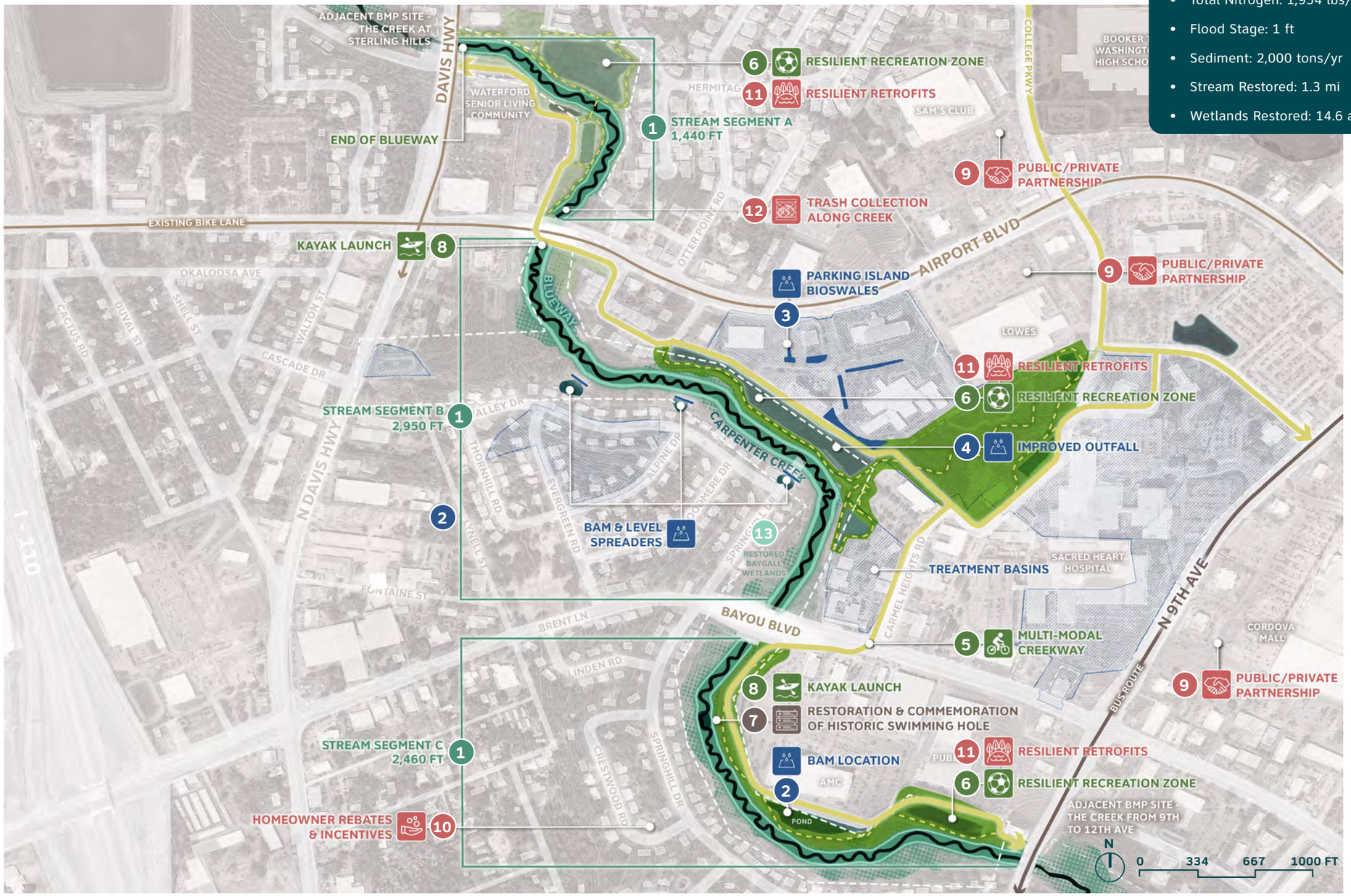
THE CREEK FROM DAVIS HIGHWAY TO 9TH AVENUE (SITE 10) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore three stream segments, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Install BAM filters at three existing treatment ponds to filter water that ultimately runs into the creek system and construct level spreaders to dissipate energy
3. Create bioswales in four parking lot islands in partnership with private owners
4. Improve existing outfall to treat water draining to the creek
5. Create a multi-modal creekway from Davis Highway to N 9th Avenue, including a connection to Booker T. Washington High School
6. Develop floodable recreation programming in dry ponds adjacent to the creek
7. Restore the historic Aunt Jennie's Swimming Hole and commemorate its legacy with interpretive signage
8. Install a kayak launch at or near Aunt Jennie's Swimming Hole and/or near Airport Boulevard to expand the blueway network
9. Offer award programs and assist with social media campaigns to celebrate businesses that are "going green," permit incentive program or stormwater fee reduction for adopting LID/GI tenets
10. Offer incentives to property owners such as stormwater fee reduction for "going green," rebate programs for de-paving, rain garden installation, waterbody-edge improvements
11. Pond retrofit to improve community resiliency to sea level rise and/ or improve water quality
12. Install "litter-gitter" or other trash collection and removal device
13. Restore baygall wetland habitat

BENEFITS

- Total Nitrogen: 1,954 lbs/yr
- Flood Stage: 1 ft
- Sediment: 2,000 tons/yr
- Stream Restored: 1.3 mi
- Wetlands Restored: 14.6 ac



LEGEND

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WATER QUANTITY & QUALITY
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- Level Spreader or Bioswale

FISH & WILDLIFE
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

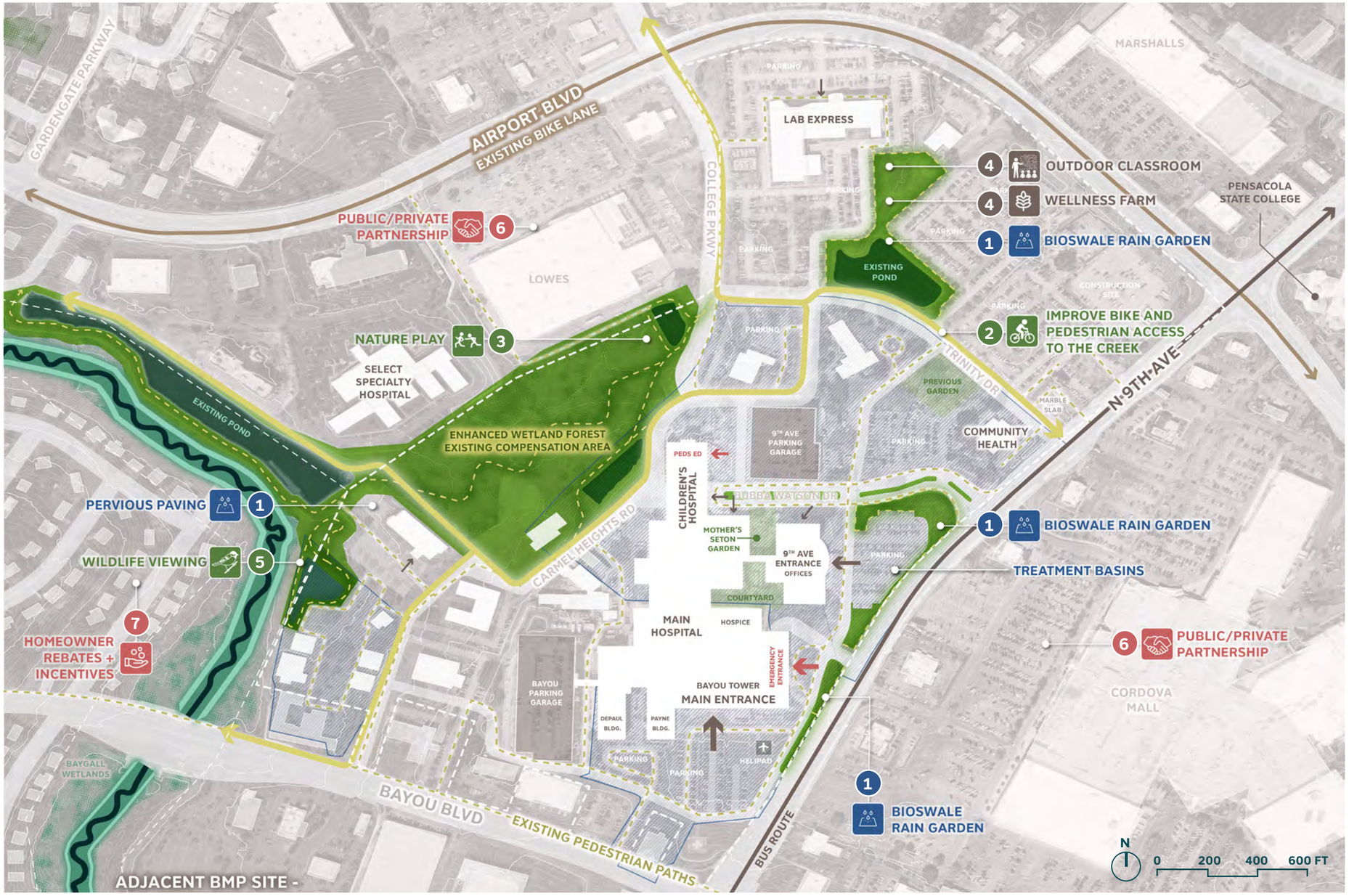
CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

NOTE: ALL CONCEPT PLANS ARE DRAFTS AND WILL BE EDITED TO REFLECT FEEDBACK RECEIVED DURING THE PUBLIC MEETING

SACRED HEART CAMPUS (SITE 13) - CONCEPT PLAN

RECOMMENDATIONS

1. Improve existing vegetated areas within parking lots with curb-cuts, replanting with Florida-friendly landscape, pervious paving, and bioswales where applicable
2. Improve existing circulation for pedestrians and cyclists and connect to larger bike networks in the area, especially those with existing connection(s) to Carpenter Creek
3. Add programming, hiking trail(s), and perimeter bike path connecting Carpenter Creek to existing wetlands compensation area to the west of the Sacred Heart Hospital campus
4. Upgrade existing greenspace north of Trinity Drive with outdoor classroom, and wellness farm for patients and healthcare workers benefit
5. Connect patients and healthcare workers to wildlife viewing opportunities
6. Public/private partnership opportunity to include LID/ GI tenets, award program, permit incentives
7. Work with property owners and incentivize “lawn-to-meadow” principles, rain garden installations, bioswale installation, etc.



LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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THE CREEK FROM 9TH AVENUE TO 12TH AVENUE (SITE 11) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore three stream segment, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Create an “anabranch” made up of narrow channels and shallow pools separate from the main creek channel to encourage fish development
3. Improve bike infrastrastructure on major corridors surrounding the site to strengthen creek access
4. Create a multi-modal creekway loop through underutilized space behind bix-box retailers
5. Provide wildlife viewing opportunities, windows to the creek, and low impact
6. pedestrian paths throughout the
7. creekway loop and at key access points, including the anabranch
8. Install a kayak launch at or near Sake Cafe Pensacola to continue the Carpenter Creek blueway
9. Pair programming with interpretive signage to engage residents in restoration, history, and watershed management
10. Offer incentives to property owners such as stormwater fee reduction for “going green,” rebate programs for de-paving
11. Offer award programs and assist with social media campaigns to celebrate businesses that are “going green,” permit incentive program or stormwater fee reduction for adopting LID/GI tenets
12. Install “litter-gitter” or other trash collection and removal device
13. Restore baygall wetland habitat

BENEFITS

- Total Nitrogen: 137 lbs/yr
- Sediment: 45 tons/yr
- Stream Restored: 0.4 mi
- Wetlands Restored: 6.3 ac

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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BAYOU SITES

PINTADO PARK
PENSACOLA INTERNATIONAL AIRPORT
12TH AVENUE
BAARS PARK
BAARS PARK ON THE BAYOU
BAYOU BOULEVARD
DUNWOODY PARK
TANGLEWOOD DR
PENSACOLA GOLF CENTER
BAYVIEW CEMETERY
BAY BLUFFS PARK
DAVIS HWY
SEMMES ELEMENTARY AND THE BAYOU
OJ SEMMES ELEMENTARY
MIRALLA PARK
SCENIC HIGHWAY
HOLY CROSS CEMETERY
BLACKSHEAR AVE
CROSS ST
110
BAYOU BLVD
EXCHANGE PARK
BAYOU BLUEWAY
BAYOU TEXAR
LAKEVIEW AVENUE
COLLECTION OF BAYOU OUTFALLS
MALLORY ST
BAYVIEW PARK
COLLECTION OF BAYOU OUTFALLS
BAYOU TEXAR BOAT RAMP
SCENIC HWY
CERVANTES ST
E CERVANTES ST
ESCAMBIA BAY
WAYSIDE PARK

BAYOU SITES SYNTHESIS MAP

LEGEND

PROPOSED

- Treatment Basins
- Stream Restoration
- Proposed Multi-Modal Path
- Proposed Blueway

EXISTING

- Socially Vulnerable *(unverified)**
- Nearby Schools
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Cultural Centers
- Religious Centers
- Libraries
- Hospitals
- Watershed Extents
- Existing Park or Easement
- Ecological Communities
- Existing Boat Launches

**Draft Social Vulnerability Index compiled by Kyle Buck at the EPA, shared with the team in 2022*

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

SEMMES ELEMENTARY AND THE BAYOU (SITE 12)

COLLECTION OF BAYOU OUTFALLS (SITE 15)

BAARS PARK ON THE BAYOU (SITE 20)

COLLECTION OF BAYOU OUTFALLS (SITE 15)

PINTADO PARK
PENSACOLA INTERNATIONAL AIRPORT
12TH AVENUE
BAARS PARK
BAYOU BOULEVARD
TANGLEWOOD DR
DUNWOODY PARK
PENSACOLA GOLF CENTER
BAYVIEW CEMETERY
BAY BLUFFS PARK
SCENIC HIGHWAY
DAVIS HWY
OJ SEMMES ELEMENTARY
MIRALLA PARK
HOLY CROSS CEMETERY
BLACKSHEAR AVE
CROSS ST
110
17TH AVENUE
20TH AVENUE
BAYOU BLVD
12TH AVENUE
LAKEVIEW AVENUE
BAYOU TEXAR BLUEWAY
EXCHANGE PARK
MALLORY ST
BAYVIEW PARK
BAYOU TEXAR BOAT RAMP
CERVANTES ST
SCENIC HWY
ESCAMBIA BAY
WAYSIDE PARK
N
0
1/4
1/2
1 MILE

BAARS PARK ON THE BAYOU (SITE 20) - CONCEPT PLAN

RECOMMENDATIONS

1. Create an interpretive trail that crosses Baars Park's ecological gradient with educational components describing ongoing restoration efforts
2. Create kayak launch and/ or other water access opportunities to incorporate Baars Park into the Blueway
3. Improve existing circulation to enhance public access to Bayou Texar for pedestrian and cyclists
4. Ask community members for additional programmatic recommendations
5. Restore sandhill ecosystem to improve habitat for gopher tortoise and other native species
6. Rebate programs for conservation landscaping, rain barrel programs, permeable pavement replacement programs, lawn-to meadow principles
7. Educational campaigns on BMPs for waterbody-edge design and on importance of the health of the headwaters

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

SEMMES ELEMENTARY AND THE BAYOU (SITE 12) - CONCEPT PLAN

RECOMMENDATIONS

1. Install layer of BAM material at pond bottom to remove nutrients before entering the surficial aquifer and plant Florida -friendly landscape for additional nutrient uptake and education
2. Replace impervious parking throughout the school campus with pervious parking or pavers
3. Construct rain gardens at existing roof downspouts to provide onsite water quality and stormwater education to students
4. Improve streetscape for multi-modal use along stretch of Texar Drive south of Semmes Elementary with connection to the Bayou along 34th Street
5. Introduce educational signage for students of Semmes Elementary and neighborhood use to describe stormwater management and watershed health concepts
6. Provide a low impact window to the bayou for visual connection to Bayou Texar
7. Rebate programs for conservation landscaping, rain barrel programs, permeable pavement replacement programs, lawn-to meadow principles
8. Educational campaigns on BMPs for waterbody-edge design and on importance of the health of the headwaters

LEGEND

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CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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COLLECTION OF BAYOU OUTFALLS (SITE 15) - CONCEPT PLAN

RECOMMENDATIONS

1. Naturalize flume by replacing existing concrete with rip rap
2. Install an inlet filter or other stormwater treatment unit at the head of the outfall
3. Plant native riparian vegetation along both sides of the outfall to slow runoff
4. Provide a low impact window to the bayou at outfall to visually connect residents with the water and showcase native vegetation and wildlife
    - *Where possible, consider potential small-scale community kayak launches or other public access programming in conjunction with Windows to the Bayou*
5. Rebate programs for conservation landscaping, rain barrel programs, permeable pavement replacement programs, lawn-to meadow principles
6. Educational campaigns on BMPs for waterbody-edge design and on importance of the health of the headwaters
7. Install “litter-gitter” or other trash collection and removal device
8. Encourage and assist with promotional events such as bike tours to showcase green infrastructure, awards program for businesses that “go green”

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
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PUBLIC ACCESS & RECREATION
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COMMUNITY RESILIENCY
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STREAM RESTORATION
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PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
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Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

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VOLUME 4A APPENDIX B

TECHNICAL STAKEHOLDER FEEDBACK

Scroll to the right and leave your comments next to each project! ------>

Site Names	Scope_Cat	Ownership	Segment	Selection Justification	Stream Assessment	Water Quality Assessment
Coronet Dr Headwaters Site	Water Quality/Public Access & Recreation/Community Resiliency	Escambia County, stream zone recreation. Private and County Parcels	Headwaters	Site has been considered previously for stormwater management, and offers the potential for neighborhood-scale interventions with water quality improvements and recreational amenities.		Adjacent segment of Carpenter Creek water quality (sampling station CC @ Olive) high for TN and TP. Drainage basins included in project area also Medium-High to High for TN and TP in pollutant load analysis
Headwaters Site Near Burgess Rd	Stream Restoration/Water Quality/Water Quantity/Public Access & Recreation/Community Resiliency	Private, FDOT, and County Parcels	Headwaters	High-priority site for stream restoration, making use of the existing conservation easement perpendicular to E Burgess Rd and proximity to West Florida High School.	Priority 2 Stream Restoration candidate. High settlement yields. Pavement along valley slopes tend to create high runoff, high amount of litter observed too.	Nox driving high TN for water quality at tributary sampling station CC #8. Upstream basins high for TP in pollutant loading. Basins included in project area, as well as surrounding and upstream very high for TN pollutant loading.
Siskin Lane Headwaters Site	Water Quality/Fish & Wildlife Habitat	Private and County Parcels	Headwaters	Site offers water quality improvements for residential development near upper reaches of Carpenter Creek and existing conservation easements.	Priority 2 Stream Restoration candidate. US and DS segments also deteriorating.	Surrounding basins very high for TN pollutant loading
Hilburn Rd Headwaters Site	Water Quality/Public Access & Recreation/Community Resiliency	Private and FDOT Parcels	Headwaters	Site presents high total nitrogen counts in need of additional monitoring to determine appropriate water quality improvements with potential FDOT partnership.	Adjacent areas in top notch condition worthy of protecting. Overlaps with plans for Burgess Rd extension. Stable morphology, good instream habitat and substrate condition.	Surrounding basins medium-high for TN, and high for TP pollutant loading. Area marked as high vulnerability for groundwater impacts.
Olive + Hilburn Rd Headwaters Site	Water Quantity	County stormwater. Private and City Parcels	Headwaters	Site provides opportunities for large-scale flood mitigation and drainage improvement in a flood risk area.		Northern basins in propsed project area found to have very high TN and TP pollutant loading
Headwaters Site South of 1-10	Water Quality	Private and County Parcels	Headwaters	New development currently under construction will back up to the Creek and could assist with treating and improving water quality.		Surrounding basins North of I10 and East of creek show high TN pollutant loading

Site Names	Leave Comments Here	Add Comments Here	Add Comments Here	Add Comments Here	(Insert More Comments As Needed) -->
Coronet Dr Headwaters Site					
Headwaters Site Near Burgess Rd	This site would be a worthy choice.Reducing the high runoff and sediment yields will have a major impact on the water quality downstream. This project would also meet all 4 objectives established by the Restore Grant.	It meets all four objectives and think this would be a high priority project.	This seems a great choice for headwater area. Checks all the boxes.	I agree with previous comments. This meets a lot of the needs that have been identified in PPBEP CCMP. This also ties into current EPA TFW project at Davis Hwy to reduce litter downstream. Large scale tactical clean up conducted throughout all segments Feb 2022.	This is a great site to chose. It checks all 4 objective boxes. Good location to do education and outreach at the high school and teach the students about Carpenters Creek and the importance of restoring frgamented streams. Be care in FDOT partnership and make sure environmental engineers are included in the design.
Siskin Lane Headwaters Site	Would support this project due to LID interventions and the target of nitrogen reduction.				
Hilburn Rd Headwaters Site	This site is important. Espeically given potential public access and recreation opportunity.				
Olive + Hilburn Rd Headwaters Site	Unclear on strategies for handling stormwater and how this would impact downstream water quality.				
Headwaters Site South of 1-10	Would again support this project due to LID intervention and WQ improvement.	I like the idea of assisting with new development. Unsure of impacts on creek from pond upsizing.			

Scroll to the right and leave your comments next to each project! ------>						
Site Names	Scope_Cat	Ownership	Segment	Selection Justification	Stream Assessment	Water Quality Assessment
Olive Rd Headwaters Site	Water Quantity/Water Quality/Fish & Wildlife Habitat/Public Access & Recreation/Community Resliency	Private and County Parcels	Headwaters	Site offers an opportunity for a large-scale restoration project in the headwaters of the watershed, balancing conservation of existing habitat and the opportunity for low-impact public access and education to increase stewardship of the headwaters.		Water quality station CC @ Olive has shown elevated TN and TP concentrations. Basins North and South of Olive road associated with high TN pollutant loading and medium TP pollutant loading
The Creek at Shiloh Dr	Water Quantity/Water Quality/Fish & Wildlife Habitat	Private and County Parcels	Creek	High-priority site for stream restoration with opportunity for water quality and quantity improvements to residential development.	Priority 2 Stream Restoration. In terrible shape. Heavily eroded. US of this area shoots off heavy runoff	Basin associated with northern stormwater pond shown to have high TP pollutant loading. Highest TN concentration (at CC #5) out of all the tributaries sampled for water quality (based on one sampling event)
The Creek at Sterling Hills	Water Quantity/Water Quality/Fish & Wildlife Habitat/Public Access & Recreation/Community Resliency	Private and FDOT Parcels	Creek	High-priority site for stream restoration with potential for improvements to existing access.	Priority 2 Restoration. End of Village Oaks sluice gate. Improve access into the creek from the large reservoir. Current path is rocky and hard to traverse .Add treatment at flumes/reduce flow. trash barrier.	Extremely high TN and TP poolutant loading in project area basins directly along the creek as well as the basins to the North that drain to the creek
The Creek from Davis HWY to 9th Ave	Water Quantity/Water Quality/Fish & Wildlife Habitat/Public Access & Recreation/Community Resliency	Private, FDOT, and City Parcels	Creek	Opportunity to restore reach of impaired stream and improve public and recreational access in densely populated area, while celebrating the site's historic significance and cultural identity.	maybe the most extreme erosional characteristics btwn Davis and 9th. High settlement yields throuhout. More akin to landslides than typical stream erosion.	Area marked as vulnerable to groundwater impacts. Multiple water quality sampling stations in project area (CC @ bayou and Springhill Tributary) showing elevated concentrations of TN and TP. Surrounding basins on the Eastern bank associated with high TP pollutant loading. Surrounding basins on both sides of bank show very high TN pollutant loading. Possible localized TN source between Davis and Bayou sampling stations.

Site Names	Leave Comments Here	Add Comments Here	Add Comments Here	Add Comments Here	(Insert More Comments As Needed) -->
Olive Rd Headwaters Site	This has potential to be higher impact project. The opporunity for education and low-impact public access is significant in this area as well.				
The Creek at Shiloh Dr	Again would support with LID interventions.	Important due to reduction in nearby development impacts.			
The Creek at Sterling Hills	This is a high priority area and checks all of the important boxes. There is a huge benefit in the community resilience piece here as well. I really like this site selection.	Meets all objectives and seems to be a pinch point so high priority. Links to other projects ongoing in this segment (TFW).	Hits all 4 objectives. Does this site need reduced flow to prevent scouring or it suffering from low flow? Options for green infastructure treatment here		
The Creek from Davis HWY to 9th Ave	Would support this one, targets all four objectives.	Great for the cultural and educational component. You would get a lot of exposure to the public here.	High priority. Meets many priorities of stakeholders. Needs to be addressed ASAP.	This is a very high priority area to fix and restore. The roads and bridge are structurally threatened here due to the negligent engineering that happened. This site also hits all 4 objectives. This would be a crowed pleaser site to restore properly.	

Scroll to the right and leave your comments next to each project! ------>

Site Names	Scope_Cat	Ownership	Segment	Selection Justification	Stream Assessment	Water Quality Assessment
The Creek from 9th to 12th Ave	Water Quality/Fish & Wildlife Habitat/Public Access & Recreation/Community Resliency	Private, City, and County Parcels	Creek	High-priority site for stream restoration that could introduce low impact access points to the creek.	Was dredged but has filled in with sediment. Bulk of settlement goes to Bayou. Could try a Priority 1 Restoration from 9th to 12th	Sampling station CC@9th in upstream segment of project area consistently high for TN. All drainage basins included in project area associated with very high TN and medium-high TP pollutant loading
Sacred Heart Campus	Water Quantity/Water Quality/Public Access & Recreation/Community Resliency	Private and City Parcels	Creek	Large, urban hospital campus offers a large-scale opportunity to address flood reduction, increase permeability, and improve water quality. Potential for public access could bolster patient and community wellness.		Basins included in project area are among the hottest for TP and TN pollutant loading, likely due to high percentage of impervious coverage. Downstream water quality stations (CC @ Bayou and CC @9th) show consistently high TN concentrations.
Semmes Elementary and the Bayou	Water Quality/Public Access & Recreation/Community Resliency	Private, City, and County Parcels	Bayou	Site could provide connectivity between Semmes Elementary and the Bayou, introduce additional public access to the Bayou, while improving water quality.		No extensive stormwater infrastructure apparent for surrounding area
Collection of Bayou Outfalls	Water Quality	Private and City Parcels	Bayou	Collection of sites along the densely populated stretch of the Bayou in need of restoration at outfalls to improve water quality.		Much of surrounding area developed prior to implementation of stormwater rule. Pollutant loading associated with stormwater runoff appears to be discharging directly in to the Bayou, with minimal treatment.
Baars Park Bayou Site	Public Access & Recreation/Community Resliency	Private Parcels	Bayou	City recently received funding for improvements at Baars Park and thus could be a joint County and City effort to improve public access and water-based recreation.		
General Comments						

Site Names	Leave Comments Here	Add Comments Here	Add Comments Here	Add Comments Here	(Insert More Comments As Needed) -->
The Creek from 9th to 12th Ave	This would be a high impact project. Reducing sediment loads will have a major impact downstream. The areas to the east are highly developed and moderately developed to the west. Addressing sources of runoff from these areas will be key. This project also meets all 4 objectives.	Would support this one. Targest all four objectives.	Agreed. Support this project. Reducing sediment and nutrient loads is high priority. Also impacts downstream locations so addressing root cause issues throughout. Meets objectives.	Is a high priority site and hits the 4 objectives. Upstream headwater restoration and re-connection should be prioritizes over these downstream locations.	
Sacred Heart Campus	This would be a worthy project. Sacred Heart's cooperation is going to greatly benefit this project. The installation of the pervious pavement would be key to mitigating the runoff (and sediment load) over the large impervious areas. Also, the potential media attention for this project may be beneficial to draw attention to the watershed project (overall).	Past work done by this teams suggest this project would have a high impact.	Like the idea of partnering with the hospital for wellness education and opportunities. Potential for high impact.	Collaboration is key. Supportive of adding other partners to this project as well. Opportunity for green infrastructure elements to reduce impervious surface/loading.	
Semmes Elementary and the Bayou	Connectivity to school adds great educational component as well as improving community connection.				
Collection of Bayou Outfalls	This would be a high impact project. These outfalls are in desperate need of evaluation and updating.	Other water quality monitoring suggests this would be a good project.	Stormwater management high priority, especially in this segment of creek. Our program would support this.		
Baars Park Bayou Site	I think this being a joint effort is great. Also think the idea of an access point for kayak-type launch is great.	Program would support opportunity to get community connected to creek. Could assist in elevating education and outreach efforts.			
General Comments	Add historial and informational plaques at each site as well as community information "big screens" located at key locations in Pensacola (i.e at wayside park visible to 3 mile bridge traffic)				

VOLUME 4B

CATALYTIC PROJECTS

WOOD
SCAPE
IMPACT CAMPAIGNS
WETLAND SCIENCES

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

FOR ESCAMBIA COUNTY

CATALYTIC PROJECTS

JULY 2022

A VISION FOR CARPENTER CREEK

Hidden in Pensacola's backyard, Carpenter Creek is an extraordinary and undervalued historic, cultural, economic, and ecological asset. This vision reveals the heart of the Carpenter Creek and Bayou Texar Watershed Management through investment in a catalytic reach of the creek – between I-110 and N 12th Avenue. Within the catalytic reach, 2.25 miles of new off-street multimodal trails and pedestrian paths connect residents with 2,500 acres of newly accessible public green space. Two miles of stream restoration to various segments of Carpenter Creek will allow for a nearly 2.5-mile northwestern extension of the Bayou Texar blueway, with two new kayak launches and a kayak resting stop.

LEGEND

- Proposed Bike Path
- Proposed Pedestrian Only Path
- Existing Bike Path
- Proposed Park Space
- Kayak Launch/Rest

N

0 325 750 1,500 ft

METHODOLOGY

The selection and design concept development for this catalytic reach of the Creek builds on multiple public engagement efforts as part of the Carpenter Creek and Bayou Texar Watershed Management Plan (WMP). The WMP team members identified fifteen (15) sites that would have maximum benefit for the health of the watershed. Input from a diverse range of technical advisors, community members, and stakeholders were considered in the selection of sites and their respective recommendations.

Following the selection of 15 key sites and development of recommendations for each of these sites, a public meeting was held at Bayview Community Center on May 2, 2022. The meeting served to inform the public about the projects and invite residents and stakeholders to voice which sites they felt would benefit most from continued development as catalytic projects. In addition to this input, the WMP team referred to comments and surveys submitted through the project website, input from the Technical Advisory Group, and team member expertise.

"The Creek from Davis Highway to 9th Avenue" received immense public support to move forward as a catalytic project with residents and stakeholders noting the area's cultural and historic assets and the need for restoration. Sites within the headwaters and Bayou Texar were also considered. Ultimately, the WMP team agreed that a holistic approach to creek restoration should include vulnerable areas upstream while responding to public enthusiasm for reclaiming downstream segments for their recreational and ecological value. The continuous stretch of creek that emerged as a priority for catalytic project development includes three of the fifteen sites – "The Creek at Sterling Hills," "The Creek from Davis Highway to 9th Avenue," and "The Creek from 9th Avenue to 12th Avenue."

DESIGN CONCEPT DEVELOPMENT

Design development was guided by three central principles that speak to the RESTORE grant categories and priorities articulated by watershed residents and stakeholders:

- Ecological Restoration
- Historic and Cultural Recognition
- Equitable Access

The selection of adjoining sites provided an opportunity for the WMP team to engage with Carpenter Creek from I-110 to 12th Avenue as a synthetic stretch of high-priority stream restoration and public access improvements. Considering the reach holistically, three areas emerged as critical for further design consideration:

- The Creek from Davis Highway to Airport Boulevard (located within The Creek at Sterling Hills)
- The Creek at Aunt Jennie's Swimming Hole (located within "The Creek from Davis Highway to 9th Avenue")
- The Creek at N 9th Avenue (located at the intersection of "The Creek from Davis Highway to 9th Avenue" and "The Creek from 9th Avenue to 12th Avenue")

These three areas represent a range of strategies for public access and recreation that incorporate significant stream restoration ambitions and illustrate the central principles of ecological restoration, historic and cultural recognition, and equitable access.

Each of the three areas required a site-specific design process. Public feedback on preferred programming guided the design and were evaluated for feasibility based on site constraints including existing topography, proposed stream restoration profiles, and adjacent land ownership and uses. Specific design exercises included comparison scale studies to understand the applicability of various park precedents and programmatic elements, conceptual grading studies to minimize switchbacks and other disturbances along accessible paths within the floodplain, and the identification of key gathering locations.

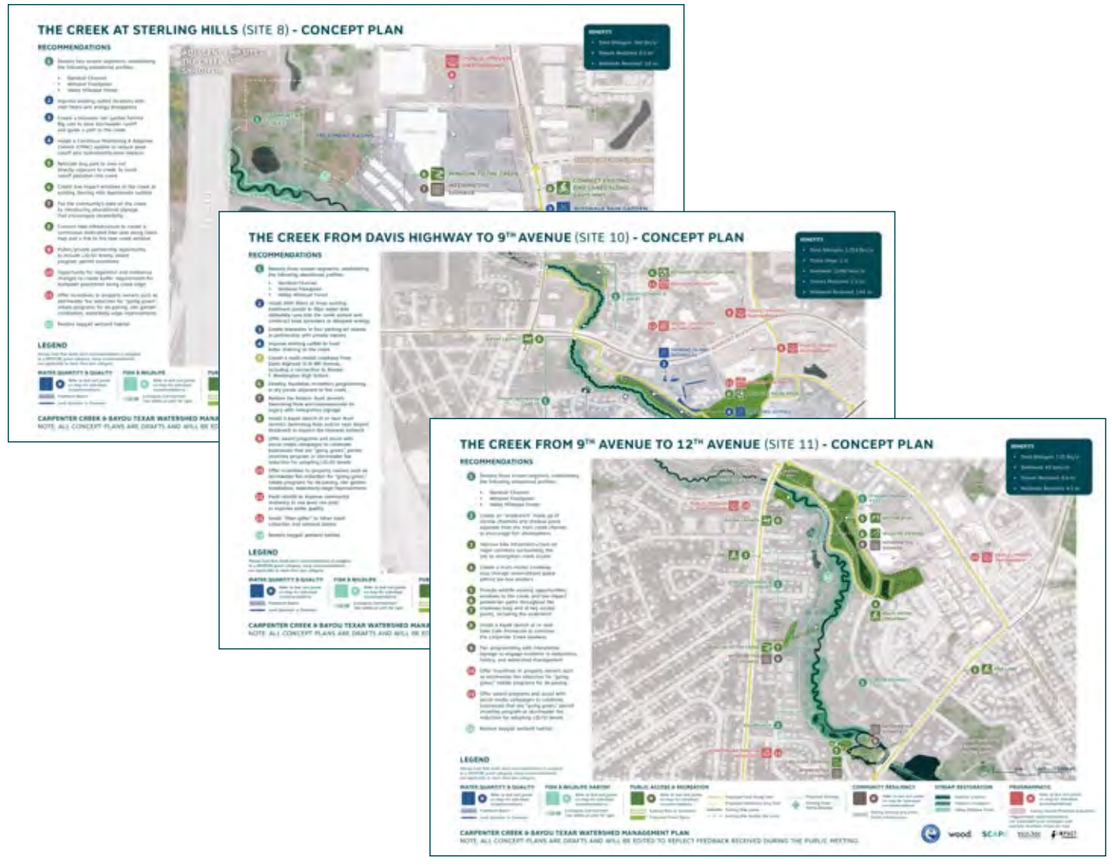
In addition to previous community engagement and technical expertise, design development of these three sites was driven by input from a targeted stakeholder workshop held on June 6, 2022. Meeting minutes from the workshop can be found in Appendix A. Presentation slides can be found in Appendix B.

RECOMMENDED NEXT STEPS

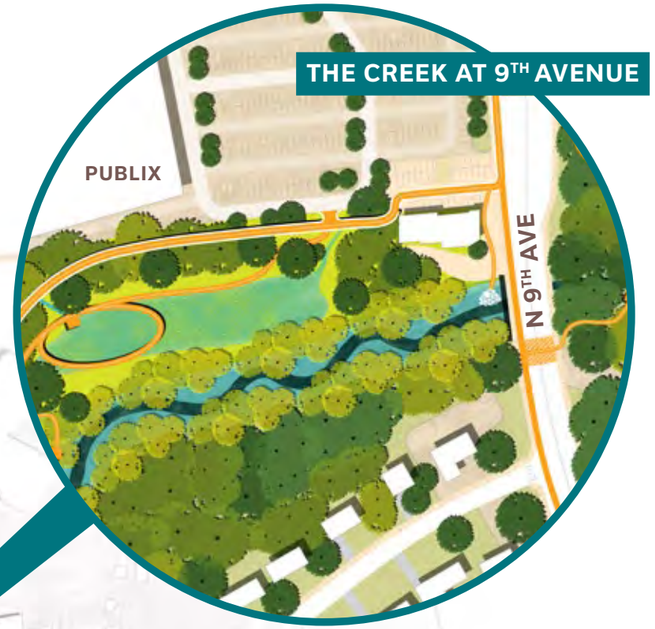
As with all recommendations identified by the WMP, the catalytic projects are intended to provide a roadmap for identifying, addressing, and recommending actions that will improve the health of the Bayou Texar and Carpenter Creek watersheds. The sites selected represent a significant prioritization process that has incorporated feedback from hundreds of watershed residents and stakeholders. As such, any next steps should build on existing design work and prior public input on the catalytic project sites.

In the long term, potential next steps to execute the catalytic projects recommended by the WMP team include identifying funding sources and lead agencies, refining cost estimates and phasing, and continuing to develop design details. The full WMP provides a starting point from which relevant governmental, non-profit, and private partners can begin working to make a more resilient, healthy, and accessible Carpenter Creek a tangible reality. Cost estimates for the 15 conceptual plans, do not account for catalytic designs and would need to be calculated separately. An early account of impacted parcels can be found in Appendix A.

In the short term, the WMP Team recommends utilizing interim activation strategies to maintain engagement and to foster continued stewardship for Carpenter Creek and the larger watershed. Interim activation strategies could include public art in partnership with local artists, educational programming in partnership with Booker T. Washington or other area schools, and events-based programming in partnership with business owners and activist organizations can help to build public awareness of the creek and its potential for transformation into a flourishing community amenity.




THE CREEK FROM DAVIS HIGHWAY TO AIRPORT BOULEVARD
WATERFORD SENIOR LIVING COMMUNITY
N DAVIS HWY
AIRPORT BLVD


THE CREEK AT 9TH AVENUE
PUBLIX
N 9TH AVE

BOOKER T. WASHINGTON HIGH SCHOOL
COLLEGE PKWY
LANGLEY AVE
AIRPORT BLVD
EXISTING BIKE LANE
TRINITY PKWY
CORDOVA MALL
SACRED HEART HOSPITAL
N DAVIS HWY
EXISTING BIKE LANE
SPRINGDALE PARK
BAYOU BLVD
PUBLIX
AMC
TARGET
N 9TH AVE
N 12TH AVE
BAARS PARK

BAYOU BLVD
AMC
THE CREEK AT JENNIE'S SWIMMING HOLE

THE CREEK FROM DAVIS HIGHWAY TO AIRPORT BOULEVARD

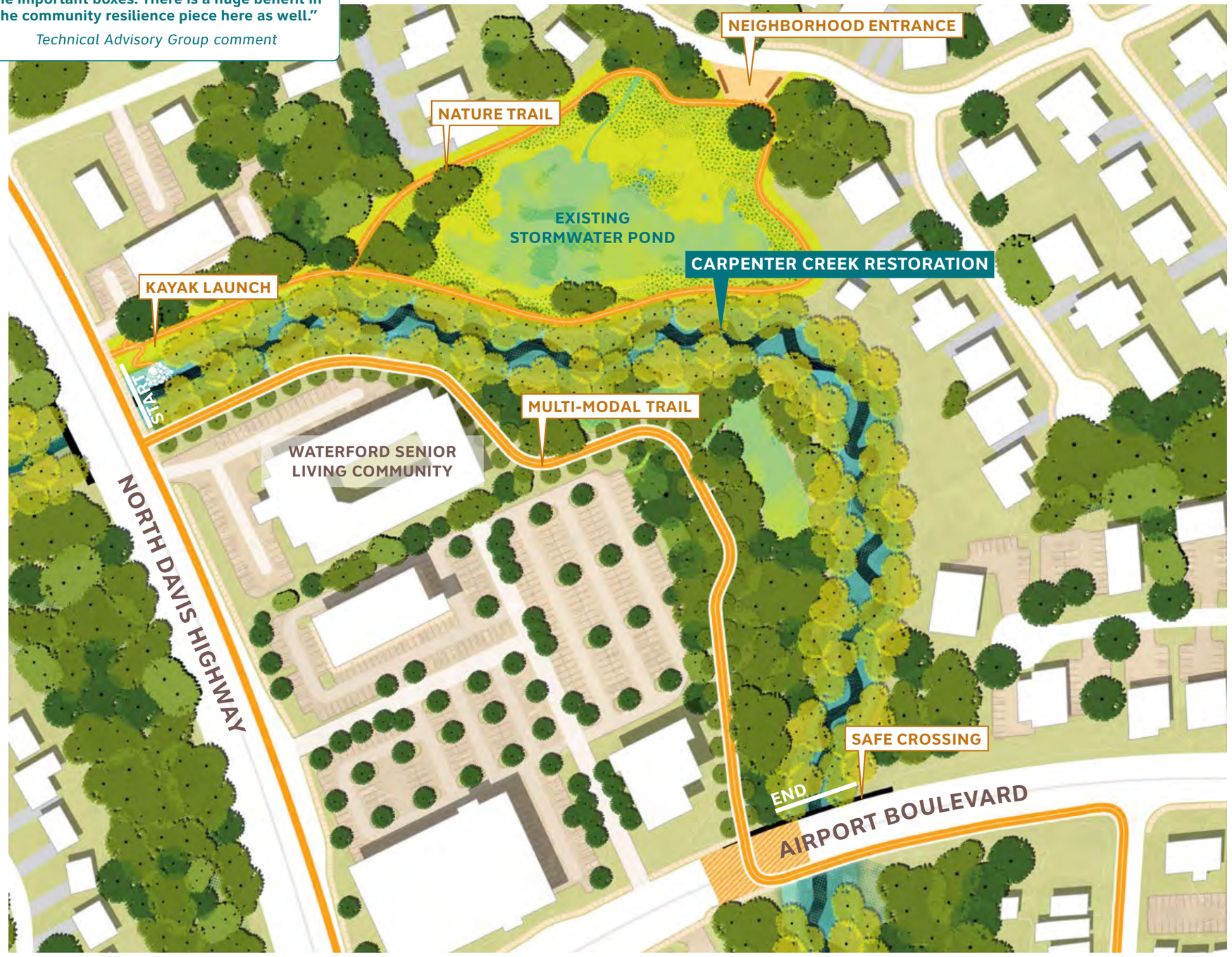
While stream restoration is proposed throughout the catalytic projects, the 1,440-foot stretch between Davis Highway and Airport Boulevard is a critically urgent segment of proposed restoration that will improve water quality further downstream. The WMP Watershed Assessment found that Carpenter Creek is highly vulnerable from I-110 to N 9th Avenue, facing such challenges as valley slope failures. Recommended access to the creek's banks is minimal through this highly compromised segment, with an existing stormwater pond activated by pedestrian trails providing nearby residents with public green space and a multi-modal trail linking the site to key destinations. The proposed stream restoration will also extend the Bayou Texar blueway to Davis Highway, presenting the opportunity for a low impact kayak launch along the proposed trail.

Eroded hillslopes at Davis Highway (existing condition)

Upper Myakka River restoration approximately one year after construction

"This is a high priority area and checks all of the important boxes. There is a huge benefit in the community resilience piece here as well."

Technical Advisory Group comment



LEGEND

- Proposed Main Path
- Proposed Pedestrian Only Path
- Safe Crossing
- Proposed Park Space

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

N

0 50 150 300 ft

THE CREEK AT JENNIE'S SWIMMING HOLE

Recognizing the historic and cultural significance of Jennie's Swimming Hole is a resounding priority. Jennie Hudgins was a matriarch of Pensacola's Black community and co-founder of the New Hope Missionary Baptist Church. Beyond its 2,950-foot stream restoration, the site has the potential to become a vibrant public park that serves surrounding communities while educating Pensacolans on Jennie's legacy. Potential park programming includes a flexible lawn, a swooping nature trail lined with public art installations, a dynamic "scramble" comprised of dynamic pedestrian paths interlaced with stone seating, a kayak rest, and an elevated overlook facing the restored swimming hole.

AMC parking lot backing up to the dense riparian vegetation of Carpenter Creek (existing condition)

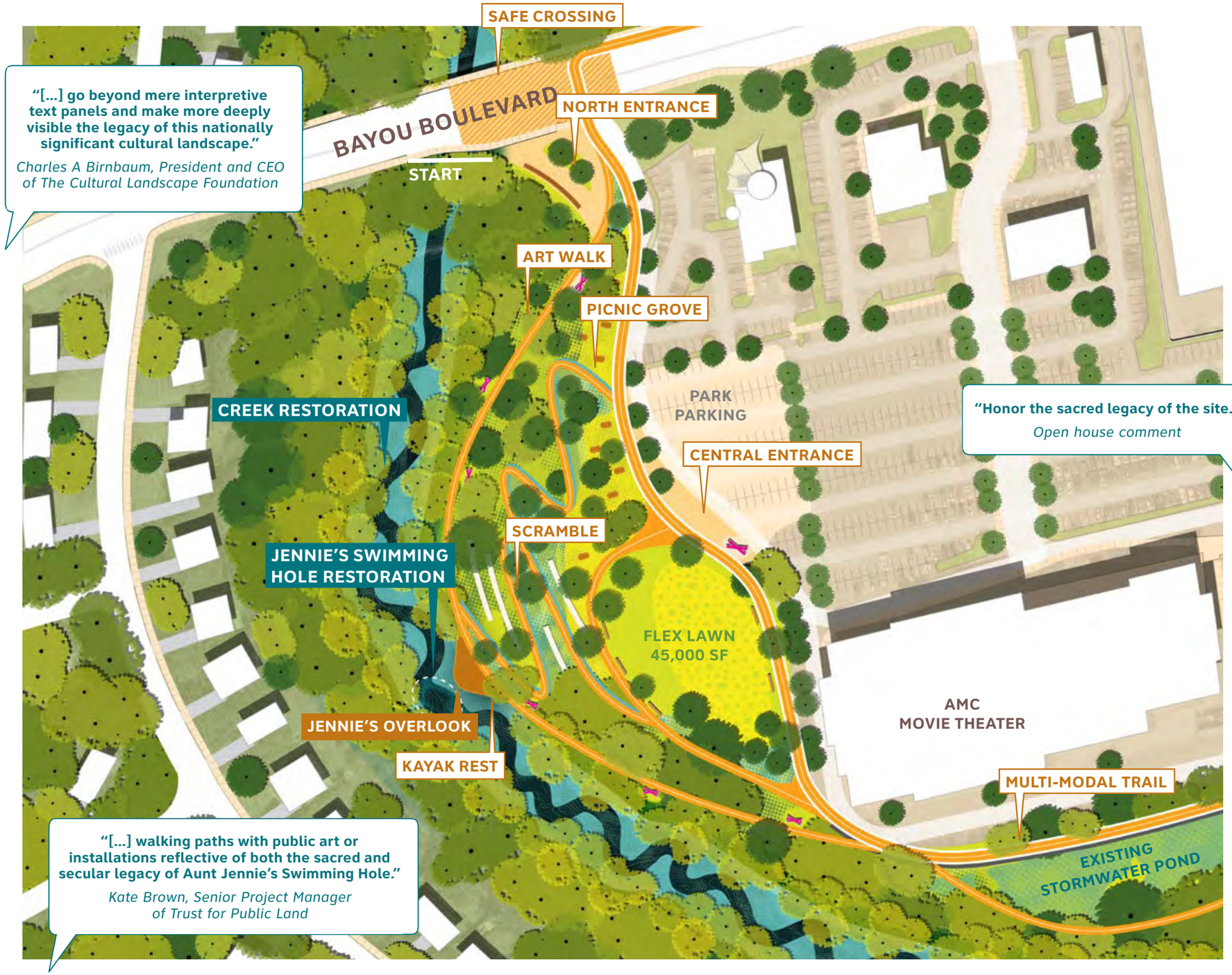
Author and historian Ora Will and her daughter Angela Kyle, direct decendents of Jennie Hudgins

LEGEND

- Proposed Main Path
- Proposed Pedestrian Only Path
- Safe Crossing
- Proposed Park Space

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest



"[...] go beyond mere interpretive text panels and make more deeply visible the legacy of this nationally significant cultural landscape."

Charles A Birnbaum, President and CEO of The Cultural Landscape Foundation

"Honor the sacred legacy of the site."

Open house comment

"[...] walking paths with public art or installations reflective of both the sacred and secular legacy of Aunt Jennie's Swimming Hole."

Kate Brown, Senior Project Manager of Trust for Public Land

THE CREEK AT 9TH AVENUE

Carpenter Creek holds the potential to become the spine in a braided network of multi-modal trails, bike lanes, blueway routes, and pedestrian rambles that connect Pensacolans to one another and to key destinations across the city. At N 9th Avenue, these elements intersect. Multi-modal and walking trails paired with a kayak launch and dedicated parking provide a connection to diverse mobility networks. Plugging into a recommended bike lane along N 9th Avenue connects visitors with Downtown Pensacola to the south. Looping boardwalks over an existing stormwater pond and a low-impact window to the proposed stream restoration connect residents with water management practices in the watershed. Cumulatively, these strategies serve to provide equitable access to the creek and the amenities it will soon support.

Creek windows

Multi-modal greenway

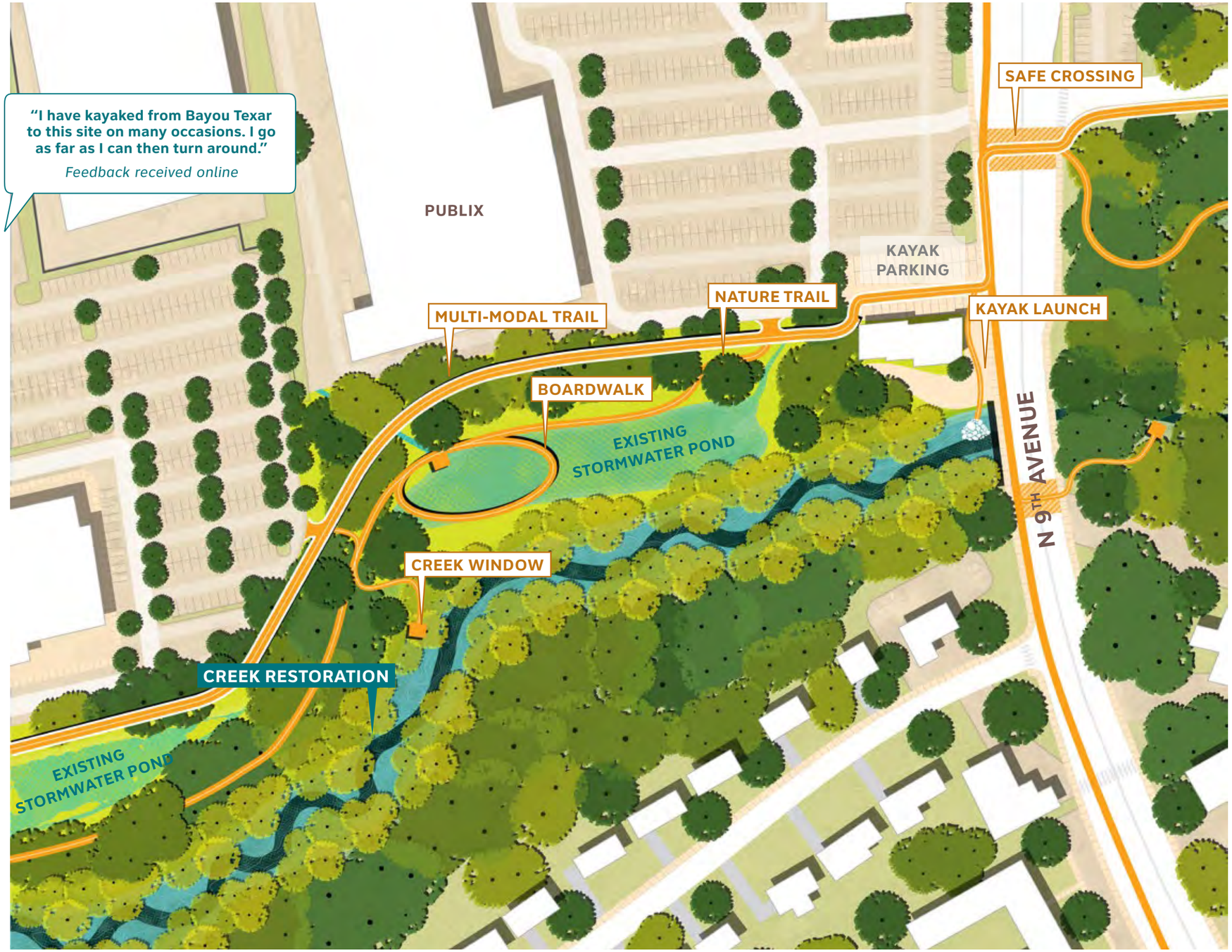
Blueway kayak launches

LEGEND

- Proposed Main Path
- Proposed Pedestrian Only Path
- Safe Crossing
- Proposed Park Space

STREAM RESTORATION

- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest



N

0 50 150 300 ft

VOLUME 4B APPENDIX A

POTENTIAL ACQUISITIONS, EASEMENTS, AND PARTNERSHIPS NEEDS

APPENDIX A

POTENTIAL ACQUISITIONS, EASEMENTS, AND PARTNERSHIP NEEDS

POTENTIAL ACQUISITIONS, EASEMENTS, AND PARTNERSHIP NEEDS

LEGEND

- City-Owned Property
- Proposed Acquisition/Easement (City/County)
- Proposed Public/Private Partnership
- Existing Easement
- Escambia County ROW

N

0 325 750 1,500 ft

VOLUME 4B APPENDIX B

STAKEHOLDER WORKSHOP MEETING MINUTES

APPENDIX B

STAKEHOLDER WORKSHOP MEETING MINUTES

SCAPE LANDSCAPE ARCHITECTURE DPC
277 BROADWAY NINTH FLOOR NEW YORK NY 10007
T 212 462 2628 SCAPESTUDIO.COM

MINUTES

Date: June 21, 2022
Time: 2:00-3:30 PM, CST
Location: Zoom
Topic: Carpenter Creek & Bayou Texar WMP
Catalytic Sites Stakeholder Workshop
ATTENDEES: Terri Berri (Escambia County RESTORE Program), Mark Jackson (City of Pensacola), Matt Posner (Estuary Program), Angela Kyle (Jennie's Legacy), Cinderella Burt (New Hope Baptist Church), Rand Hicks (Ciclovia), Caitlin Cerame (City of Pensacola Transportation Planner), Bill Kimball (City of Pensacola, Parks Superintendent), Christine Mehle, John Kiefer (WOOD), Sophie Riedel, Kaede Polkinghorne (SCAPE),

MEETING MINUTES (06/21)

- ***Introductions***
  - Everyone went around for introductions, Cinderalla Burt came later

- ***Project Timeline*** *(SCAPE presented, see slides)*
  - The project started October of 2019 and will wrap up end of this year
  - Public engagement (both virtual and in person) has been ongoing since September of 2019
    - 3 in-person meetings + Virtual engagement

- ***Engagement Recap*** *(SCAPE presented, see slides)*
  - May 2 Open House
  - Social Pinpoint surveys
  - Tallying of open house + virtual "votes"
  - Selected three catalytic sites – Sites 8, 10, and 11

- ***Catalytic Projects*** *(SCAPE presented, see recommendations in presentation slides)*
  - The Creek at Sterling Hills (Site 8)
  - The Creek from Davis Hwy to 9th Ave (Site 10)
  - The Creek from 9th Ave to 12th Ave (Site 11)
  - Together creates one contiguous creek segment from I-110 to 12th Avenue

- ***Watershed-Wide RESTORE Goals***
  - *Guided by the RESTORE grant*
  - *Priorities for Creek: Ecological Restoration, Historic and Cultural Recognition, Equitable Access*

- ***Priority Setting Workshop***
  - ***Ecological Restoration***
    - RH (Rand Hicks): Makes sense to approach that point first
    - MP (Matt Posner): Hopefully on the design side of things, the full set of sites would be designed as one project and phasing would be a construction question (upstream to downstream?)
    - JK (John Kiefer): The sequence of restoration does matter but doesn't have to be completely upstream to downstream. Any critical area upstream of 9th Avenue should be addressed most urgently because work further downstream will be buried by unstable upstream conditions if not.
      - Most of the highest sediment is coming from upstream (Davis Hwy to 9th Ave) – bank failures, heavy development, etc. Public opinion also favors this segment.
      - The erosion upstream of Davis Hwy can be processed by what we do between Davis Hwy and 9th Ave.
    - RH: This makes sense, and this segment of the creek also has the most compelling narrative – getting access to continuous stretches of land will be important.
    - AK (Angela Kyle): The level of publicity and awareness around Davis Hwy is so high, so starting there with a story about restoration and repair is a good catalyst to move into the larger story of what's happening.
      - Curious how efforts in the headwaters will be coordinated with those further downstream?
    - JK: The WMP sets out a cohesive vision for all the work. The phases of construction each must provide some tangible benefit because they will have to be funded/phased separately. Each project is a meaningful chunk to break out.
      - SR (Sophie Riedel): "Diet" vs. "open heart surgery" – some areas of the creek need a more extreme intervention, but all areas (including the ones that receive a more extreme intervention) will need a long-term shift.
    - RH: We should bring people in with the magic of Aunt Jennie's Swimming Hole story – we should tell that story as soon as we can to contextualize why the work further upstream is meaningful
    - CB (Cinderella Burt): That sounds good
    - AK: There were questions on the social pinpoint about interim activation. Wondering what the feeling was on that?
    - SR: Not sure we've discussed that any more robustly.
    - AK: Now that we understand that the sites are contiguous and go through one of the most dense and commercial areas of town, there could be opportunities to do early action projects
      - Environmental education in collaboration with Booker T. Washington?
      - Waller Creek in Austin art competition and installations as a precedent?

    - https://austin.culturemap.com/news/arts/09-09-21-waller-creek-show-2021-waterloo-park-art-installations/#slide=0
  - There are so many businesses and institutions in the area, they could become partners.
- MP: Agree that education and awareness are areas that can move ahead without significant funding – we don't want to lose the momentum that's been generated thus far, so it's important to keep thinking "what's next?"
  - We need the support of adjacent property owners. The sooner we can start the messaging and outreach, the better.
- AK: There is a community along the creek and a community of people who have been impacted/stewarded the creek.
- JK: Nice melding of art, culture, history, etc. – excited about the whole concept of honoring Aunt Jennie's Swimming Hole.

- ***Historic and Cultural Recognition***
  - AK: Despite knowing about this location for many years, the WMP presented the opportunity to "daylight" the creek through this location. Church elders at New Hope have shared their experience of being baptized in the creek. Most discourse on the creek across Facebook pages and similar forums is primarily from white residents talking about the creek's recreational uses. Making sure that these stories are understood and taken into consideration should be a priority.
  - CB: Jennie Hudgins was a founder of New Hope. Church centennial was a good opportunity to record stories from church in collaboration with Angela.
  - AK: There is also something really powerful from a landscape point of view here that could serve as inspiration.
  - CB: The information from Ms. Kelly and Ms. Brown should be recorded.
  - AK: it is being recorded, and UWF professor will be helping with writing this up/calling for more stories. Leveraging the publicity of this process can motivate more stories to better understand the multi-layered/multi-cultural nature of the creek.
    - The sacred and secular is a good/interesting binary to think about for this site.
  - RH: Go beyond a mere reconstruction or a telling of the story – we need to physically deliver people to that area. People should experience this area through walking, biking, and any other modalities. Need to make it physical.
  - AK: Need to broaden the audience to bring more people and more diverse types of people.
  - RH: Events *and* daily access. Also, though, we need to own it first!
  - MP: Ownership/access on the commercial parcels is not going to be very challenging compared to the residential side. The handful of stakeholders on the commercial side is manageable.

SCAPE LANDSCAPE ARCHITECTURE DPC

  - JK: "the accordion effect" – often, stream restoration is halting based on constraints, in this case land ownership. However, the greater the public participation is the greater the result tends to be. It falls upon the community itself/community leaders to provide landowners with a compelling vision so they view it as a win-win.
    - If we can help landowners understand the need for stable banks and other ecological benefits, landowners might understand that this is a benefit to their property as well. A lot of public outreach must occur.
  - AK: To get landowners invested, you need to give them something to buy into. Now that these sites are forming a continuous stretch, we can think more at a district scale.
    - Precedent: The Gentilly Resilience District in New Orleans got residents invested in a more holistic vision of what was happening.
    - Could we do something similar?
  - JK: Agree, we are trying to move away from the patchwork/band aid approach and do something holistic and continuous. Should put effort into codifying benefits to the directly adjacent landowners and the community.

- ***Equitable Access***
  - AK: "What qualifies as equitable access" is the most pressing question here – much bigger question and would require demographic data that we don't have but it is key.
  - SR: EPA has undertaken preliminary mapping of 'access deserts' to green spaces, would be interesting to use that to see where we could fill in these gaps.
  - RH: From Waterford to Airport Blvd, we face every kind of obstacle… Particularly private ownership. One option might be a practicum to get early buy in from landowners.
    - The entirety of 9th Ave and 12th Ave are proposed as bike paths, which is very ambitious (but I love it!)
  - CC (Caitlin Cerame): A lot of these roads are state maintained and the likelihood of them being reconstructed with a separated multi-use path is highly unlikely. If the community wants to have that as a long-term goal great, but we should also look at the areas that border the creek itself. If that's a more pervious, crushed coquina trail as we see in other areas, it might be much more realistic.
  - SR: Is there a preference for path surface material?
  - JK: The valley needs a forest that knits the banks together. If this valley weren't forested, it would be eroding much more rapidly than it is today. Anything that diminishes the forest, we need to strengthen (this includes paths, windows to the creek, etc.). This can be costly and require more thoughtful design.
    - Pavement diet for any paths
    - We can terrace the new morphology to accommodate trails while still honoring the hydraulic needs of the valley – we should plan collectively.

  - RH: Doesn't Waterford make more sense as a step 1 for connectivity? And maybe behind Publix? Push them from both sides to meet in the middle at Aunt Jennie's Swimming Hole?
  - CB: Makes sense
  - SR: Three focus areas – Waterford (restoration), Publix Pond (access), Aunt Jennie's Swimming Hole (history and culture)
  - MP: Access at 9th will have more opportunities. There is a restaurant at 9th and the creek that is for sale, could this be purchased?
  - AK: The bridge at that restaurant's parcel gives a really interesting view.

- ***Next Steps***
  - MP: Will definitely take the effort of all stakeholders, one entity will not have the capacity or power to see this through.

VOLUME 4B APPENDIX C

PRESENTATION SLIDES

APPENDIX C

PRESENTATION SLIDES

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

JUNE 21, 2022

TODAY'S AGENDA

1. **Introduction + Project Review** *(15 minutes)*
2. **Selected Concept Plans** *(10 minutes)*
3. **Priority Setting Workshop** *(40 minutes)*
4. **Next Steps** *(20 minutes)*

INTRODUCTION
+ PROJECT REVIEW

EMERALD COAST KEEPER

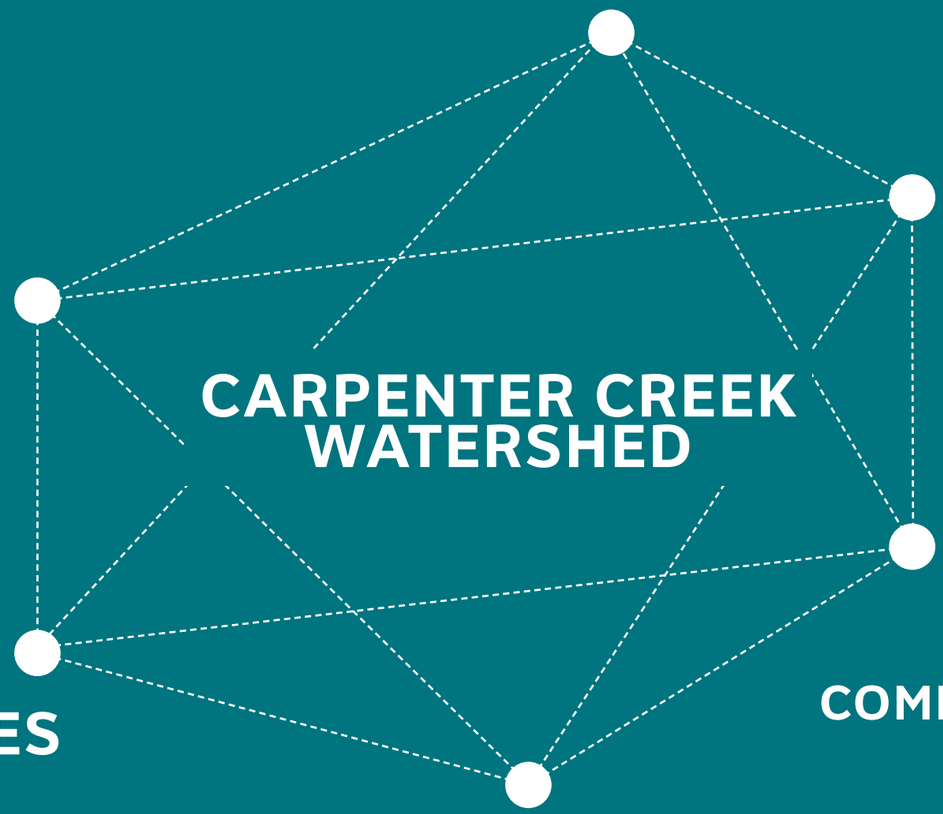
JENNIE'S LEGACY

BOOKER T. WASHINGTON HIGH SCHOOL

LOCAL ADVOCATES, ACTIVISTS, AND PUBLIC OFFICIALS

PENSACOLA AND PERDIDO BAY ESTUARY PROGRAM

PANHANDLE WATERSHED ALLIANCE



ESCAMBIA COUNTY
CLIENT

CITY OF PENSACOLA

CARPENTER CREEK WATERSHED

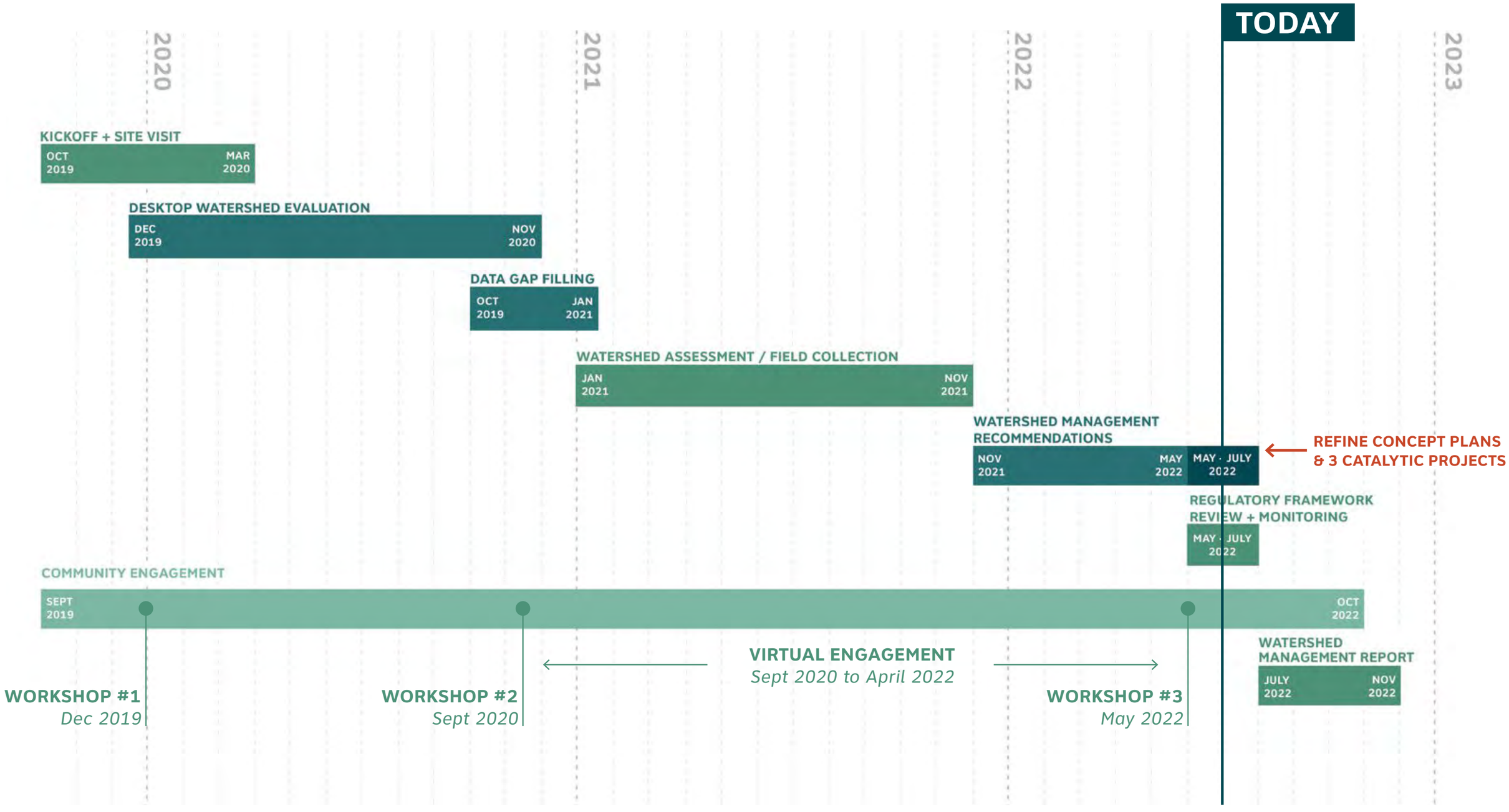
WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS
BIOPHYSICAL ENGINEERING & WATER QUALITY

SCAPE
LANDSCAPE ARCHITECTURE & COMMUNITY ENGAGEMENT

WETLAND SCIENCES
ENVIRONMENTAL CONSULTING

IMPACT CAMPAIGNS
OUTREACH & COMMUNICATIONS

PROJECT TIMELINE



MAY 2 OPEN HOUSE

Open house attendees listening to an introductory presentation by the WMP Team (Gregg Pachkowski for PNJ)

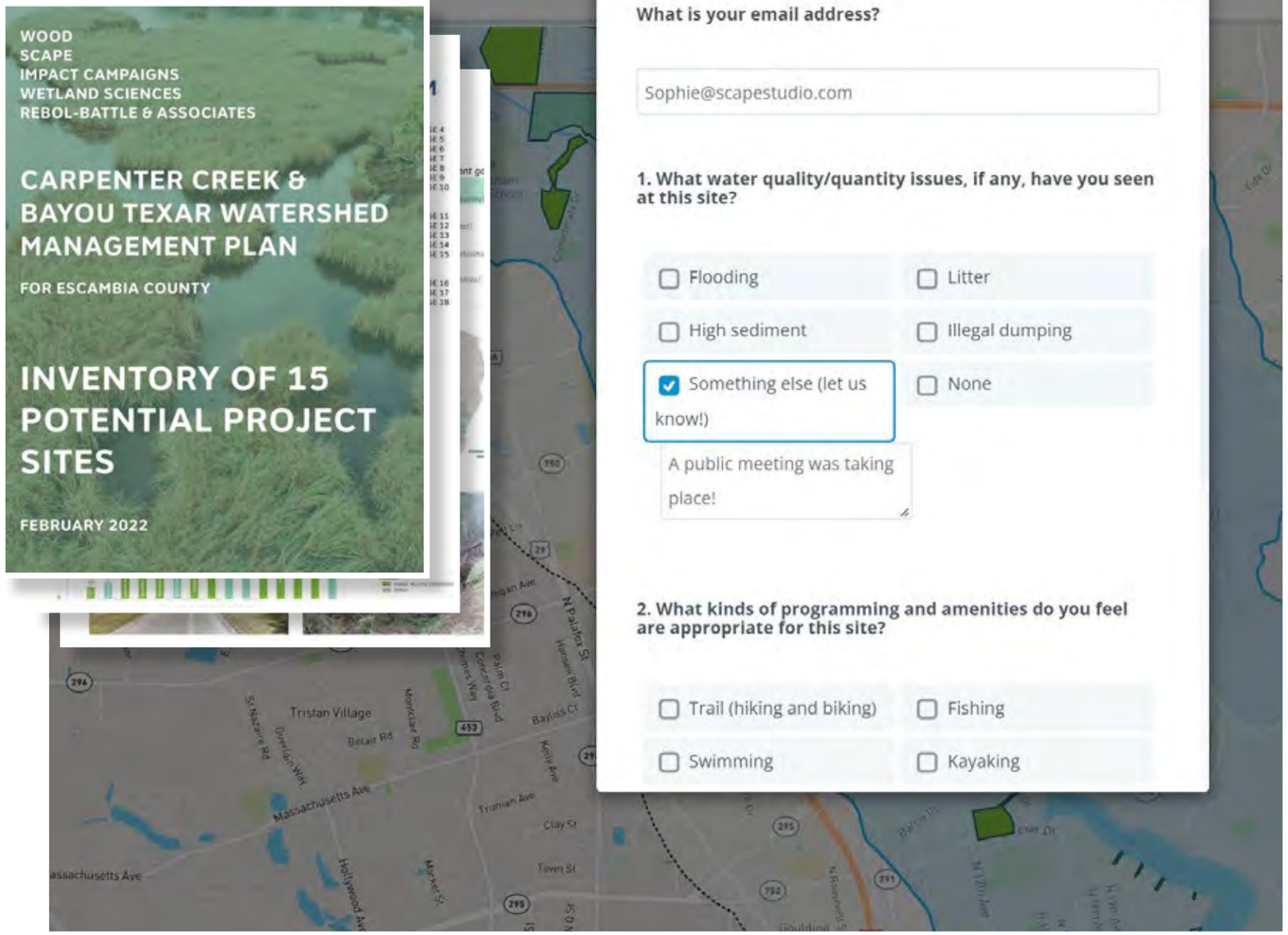
Conversations about each segment of the watershed (headwaters, creek, and bayou) were centered around respective tables staffed with experts

Open house attendees reviewing concept plans and using post-its to mark their top three priority sites

A site model of the watershed with flags marking each priority project site aids attendees in connecting the sites

RECOMMENDATIONS PHASE FEEDBACK RECEIVED ONLINE

CATALOGUE OF SITES FOR DOWNLOAD



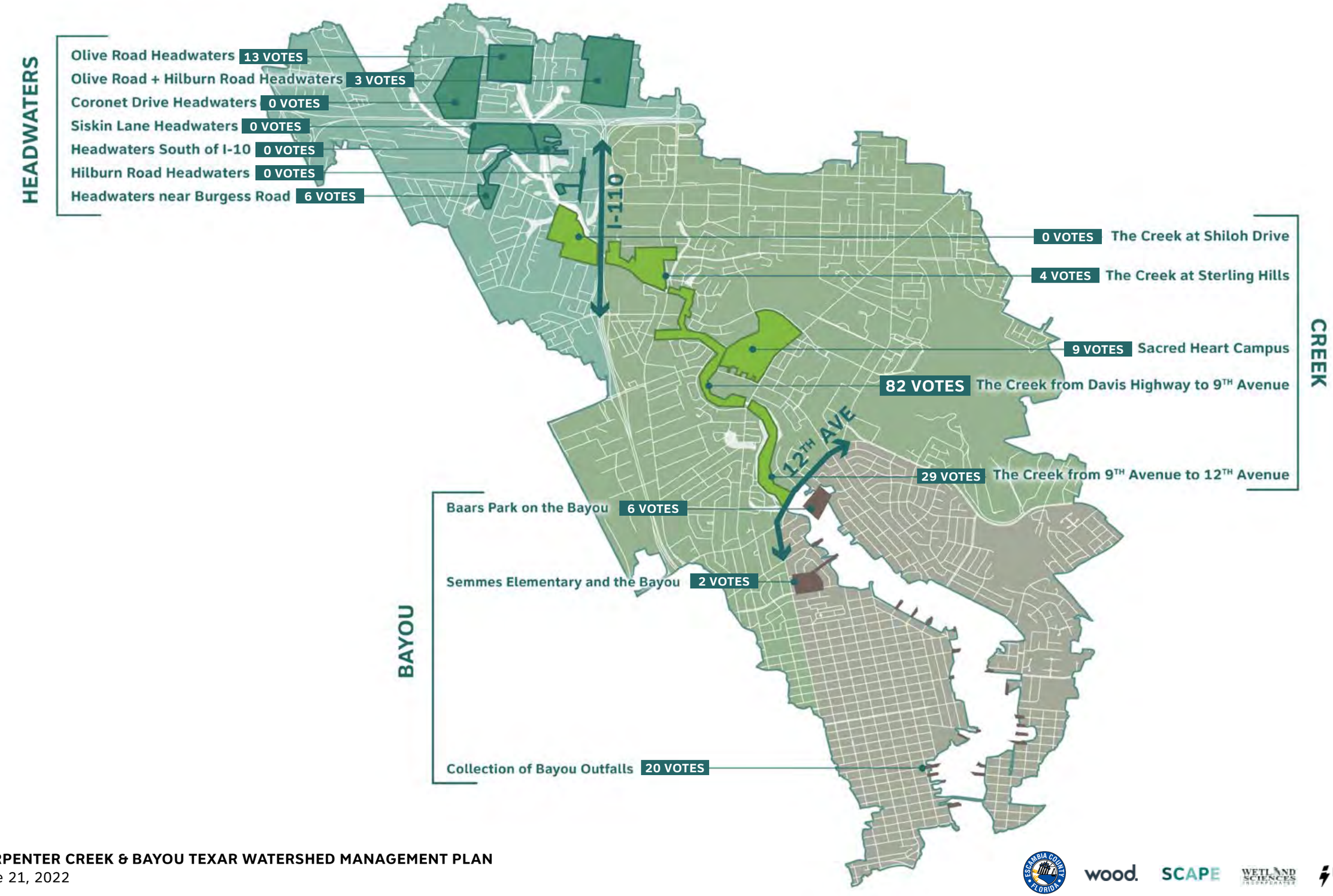
INTERACTIVE MAP

TAKEAWAYS

- Carefully incorporate the creek's cultural legacy from N Davis Highway to N 9th Avenue, where public access was historically concentrated
- Address sediment, litter, and polluted runoff
- Provide trails, kayaking, and seating where possible across the creek system

RESTORE-THE-WATERSHED.COM

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN
June 21, 2022


HEADWATERS
Olive Road Headwaters 13 VOTES
Olive Road + Hilburn Road Headwaters 3 VOTES
Coronet Drive Headwaters 0 VOTES
Siskin Lane Headwaters 0 VOTES
Headwaters South of I-10 0 VOTES
Hilburn Road Headwaters 0 VOTES
Headwaters near Burgess Road 6 VOTES
I-110
CREEK
0 VOTES The Creek at Shiloh Drive
4 VOTES The Creek at Sterling Hills
9 VOTES Sacred Heart Campus
82 VOTES The Creek from Davis Highway to 9TH Avenue
12TH AVE
29 VOTES The Creek from 9TH Avenue to 12TH Avenue
BAYOU
Baars Park on the Bayou 6 VOTES
Semmes Elementary and the Bayou 2 VOTES
Collection of Bayou Outfalls 20 VOTES

THREE CATALYTIC PROJECTS SELECTED

COMMENDATIONS

1. Restore three stream segments, establishing the following elevational profiles:
   - Bankfull Channel
2. Improve existing outfall to treat water draining to the creek
3. Create a multi-modal creekway from Davis Highway to N 9th Avenue, including a connection to Booker T. Washington High School
4. Develop floodable recreation programmin n dry ponds adjacent to the creek
7. Restore the historic Aunt Jennie's Swimming Hole and commemorate its legacy with interpretive signage
8. Install a kayak launch at or near Aunt Jennie's Swimming Hole and/ or near Airport Boulevard to expand the blueway network
9. Offer award programs and assist with social media campaigns to celebrate businesses that are "going green," permit incentive program or stormwater fee reduction for adopting LID/GI tenets
10. Offer incentives to property owners such as stormwater fee reduction for "going green," rebate programs for de-paving, rain garde installation, waterbody-edge improvement
11. ond retrofit to improve community siliency to sea level rise and/ or improve water quality
12. Restore baygall wetland habitat

- Flood Stage: 1 ft
- Sediment: 2,000 tons/yr
- Stream Restored: 1.3 mi
- Wetlands Restored: 14.6 ac

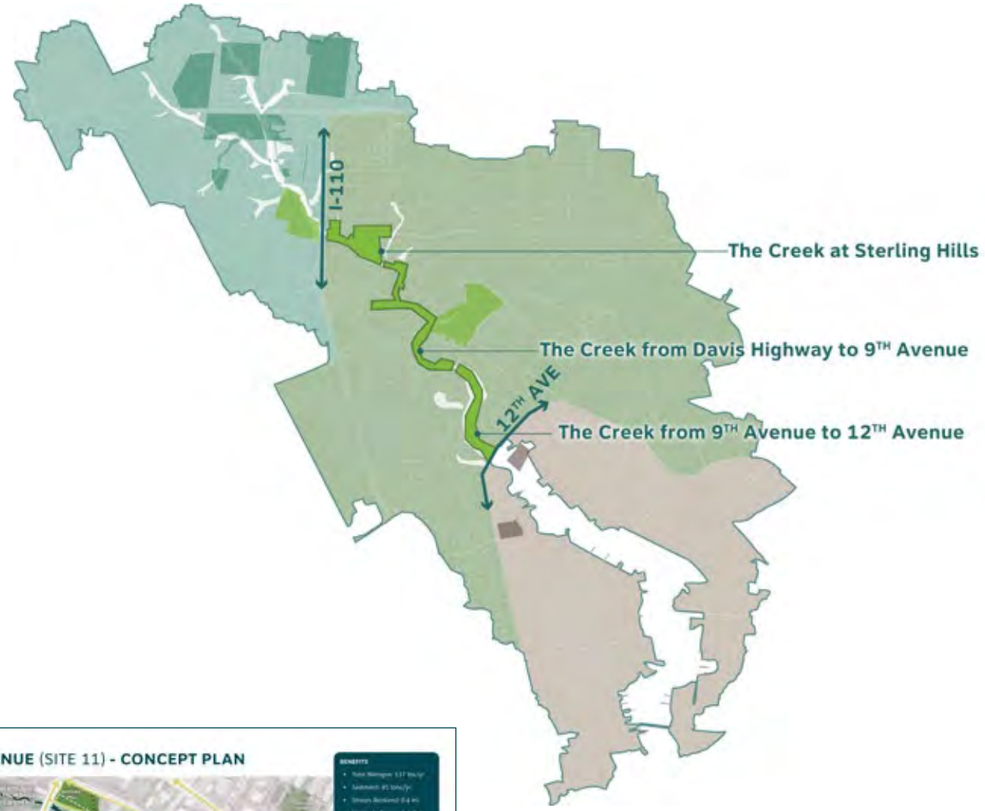
STREAM SEGMENT A 1,440 FT
BIOSWALES
RESILIENT RETROFITS
RESILIENT RECREATION ZONE
IMPROVED OUTFALL
TREATMENT BASINS
BLUEWAY
CARPENTER CREEK
N 9TH AVE
WATERFORD SENIOR LIVING COMMUNITY
SACRED HEART HOSPITAL
LOWES

Treatment Basins
Existing Park or Easement
Proposed Green Space
Refer to text and plan on map for individual recommendations

CARPENTER CREEK & BAYOU TEXAR WATERSH
NOTE: ALL CONCEPT PLANS ARE DRAFTS AND W
BACK RECEIVED

THREE CATALYTIC PROJECTS SELECTED

RECEIVED THE MOST VOTES ACROSS PLATFORMS

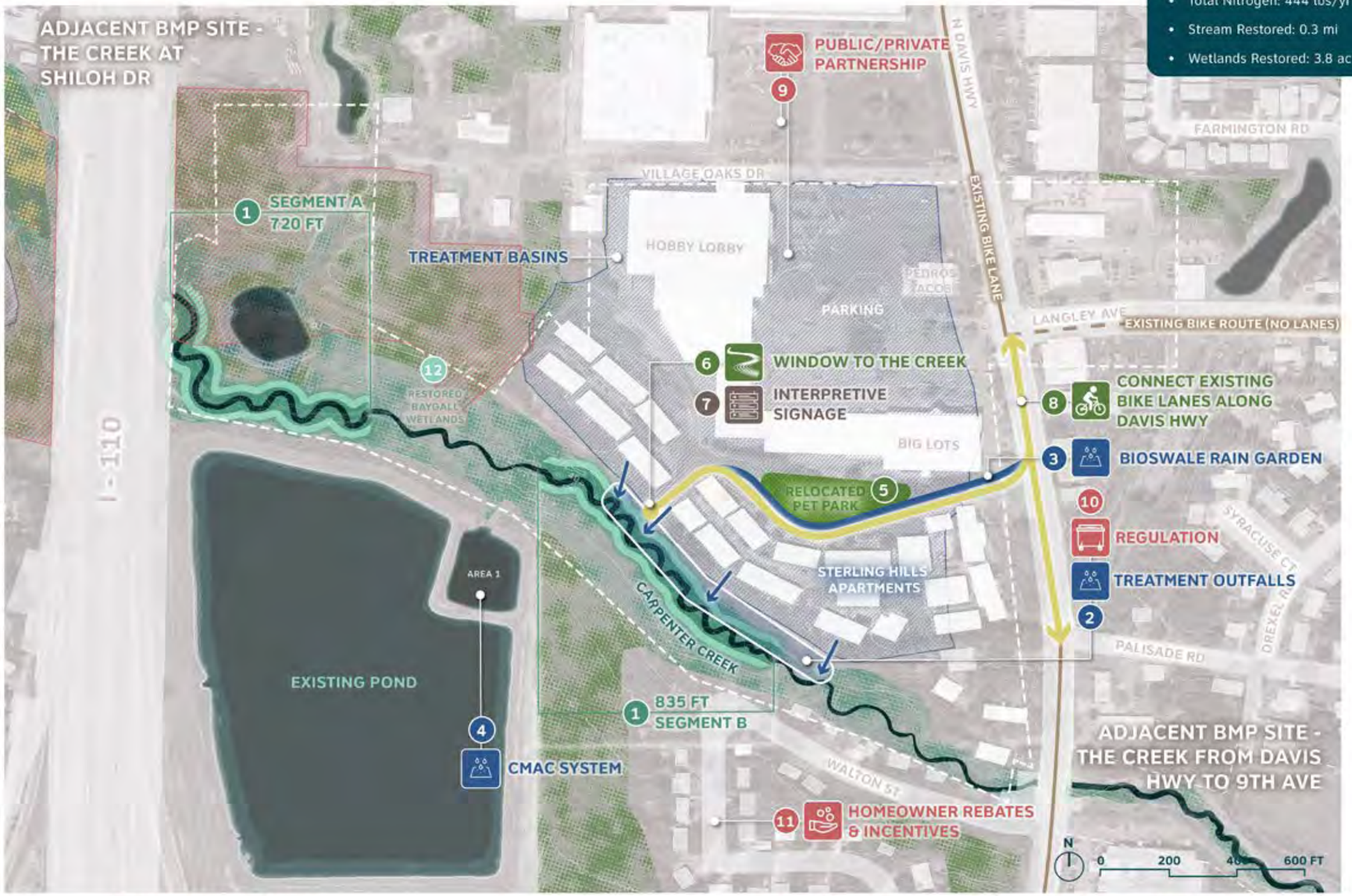


SELECTED CONCEPT PLANS

THE CREEK AT STERLING HILLS (SITE 8) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore two stream segments, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Improve existing outfall locations with inlet filters and energy dissapators
3. Create a bioswale rain garden behind Big Lots to slow stormwater runoff and guide a path to the creek
4. Install a Continous Monitoring & Adaptive Control (CMAC) system to reduce peak runoff and hydromodification impacts
5. Relocate dog park to area not directly adjacent to creek, to avoid runoff pollution into creek
6. Create low impact windows to the creek at existing Sterling Hills Apartments outfalls
7. Put the community's eyes on the creek by introducing educational signage that encourages stewardship
8. Connect bike infrastructure to create a continuous dedicated bike lane along Davis Hwy and a link to the new creek window
9. Public/private partnership opportunity to include LID/GI tenets, award program, permit incentives
10. Opportunity for regulation and ordinance changes to create buffer requirements for dumpster placement along creek edge
11. Offer incentives to property owners such as stormwater fee reduction for "going green", rebate programs for de-paving, rain garden installation, waterbody-edge improvements
12. Restore baygall wetland habitat



BENEFITS

- Total Nitrogen: 444 lbs/yr
- Stream Restored: 0.3 mi
- Wetlands Restored: 3.8 ac

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

NOTE: ALL CONCEPT PLANS ARE DRAFTS AND WILL BE EDITED TO REFLECT FEEDBACK RECEIVED DURING THE PUBLIC MEETING

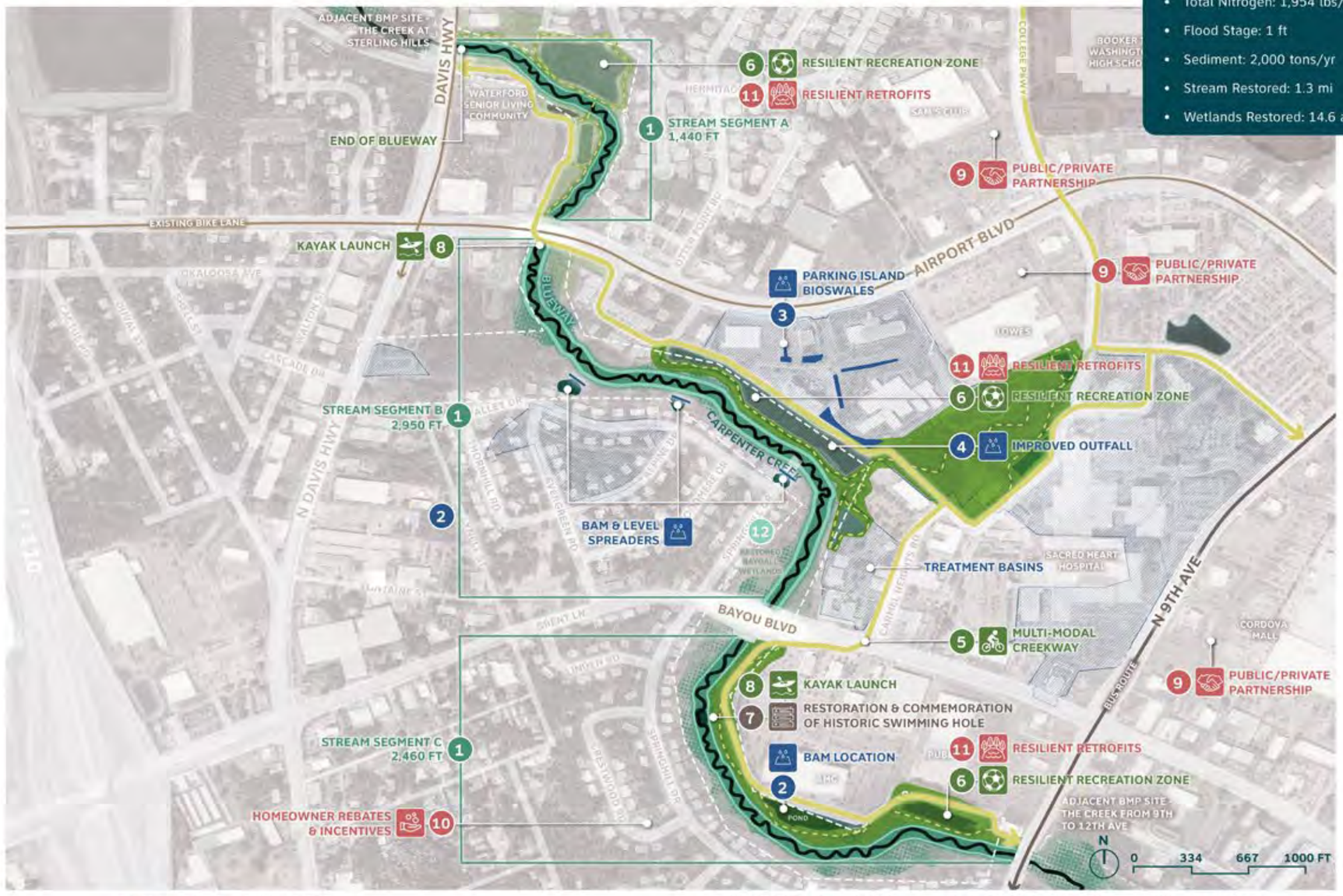
THE CREEK FROM DAVIS HIGHWAY TO 9TH AVENUE (SITE 10) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore three stream segments, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Install BAM filters at three existing treatment ponds to filter water that ultimately runs into the creek system and construct level spreaders to dissipate energy
3. Create bioswales in four parking lot islands in partnership with private owners
4. Improve existing outfall to treat water draining to the creek
5. Create a multi-modal creekway from Davis Highway to N 9th Avenue, including a connection to Booker T. Washington High School
6. Develop floodable recreation programming in dry ponds adjacent to the creek
7. Restore the historic Aunt Jennie's Swimming Hole and commemorate its legacy with interpretive signage
8. Install a kayak launch at or near Aunt Jennie's Swimming Hole and/ or near Airport Boulevard to expand the blueway network
9. Offer award programs and assist with social media campaigns to celebrate businesses that are "going green," permit incentive program or stormwater fee reduction for adopting LID/GI tenets
10. Offer incentives to property owners such as stormwater fee reduction for "going green," rebate programs for de-paving, rain garden installation, waterbody-edge improvements
11. Pond retrofit to improve community resiliency to sea level rise and/ or improve water quality
12. Restore baygall wetland habitat

BENEFITS

- Total Nitrogen: 1,954 lbs/yr
- Flood Stage: 1 ft
- Sediment: 2,000 tons/yr
- Stream Restored: 1.3 mi
- Wetlands Restored: 14.6 ac



LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # *Refer to text and points on map for individual recommendations*
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE
- # *Refer to text and points on map for individual recommendations*
- Ecological Communities* **see labels on plan for type*

PUBLIC ACCESS & RECREATION
- # *Refer to text and points on map for individual recommendations*
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # *Refer to text and points on map for individual recommendations*
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # *Refer to text and points on map for individual recommendations*
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

NOTE: ALL CONCEPT PLANS ARE DRAFTS AND WILL BE EDITED TO REFLECT FEEDBACK RECEIVED DURING THE PUBLIC MEETING

ESCAMBIA COUNTY FLORIDA · wood. · SCAPE · WETLAND SCIENCES INCORPORATED · IMPACT Campaigns

THE CREEK FROM 9TH AVENUE TO 12TH AVENUE (SITE 11) - CONCEPT PLAN

RECOMMENDATIONS

1. Restore three stream segment, establishing the following elevational profiles:
   - Bankfull Channel
   - Wetland Floodplain
   - Valley Hillslope Forest
2. Create an "anabranch" made up of narrow channels and shallow pools separate from the main creek channel to encourage fish development
3. Improve bike infrastrastructure on major corridors surrounding the site to strengthen creek access
4. Create a multi-modal creekway loop through underutilized space behind bix-box retailers
5. Provide wildlife viewing opportunities,
6. windows to the creek, and low impact
7. pedestrian paths throughout the creekway loop and at key access points, including the anabranch
8. Install a kayak launch at or near Sake Cafe Pensacola to continue the Carpenter Creek blueway
9. Pair programming with interpretive signage to engage residents in restoration, history, and watershed management
10. Offer incentives to property owners such as stormwater fee reduction for "going green," rebate programs for de-paving
11. Offer award programs and assist with social media campaigns to celebrate businesses that are "going green," permit incentive program or stormwater fee reduction for adopting LID/GI tenets
12. Restore baygall wetland habitat

BENEFITS

- Total Nitrogen: 137 lbs/yr
- Sediment: 45 tons/yr
- Stream Restored: 0.4 mi
- Wetlands Restored: 6.3 ac

LEGEND

Please note that while each recommendation is assigned to a RESTORE grant category, many recommendations are applicable to more than one category

WATER QUANTITY & QUALITY
- # Refer to text and points on map for individual recommendations
- Treatment Basins
- Level Spreader or Bioswale

FISH & WILDLIFE HABITAT
- # Refer to text and points on map for individual recommendations
- Ecological Communities* *see labels on plan for type

PUBLIC ACCESS & RECREATION
- # Refer to text and points on map for individual recommendations
- Existing Park or Easement
- Proposed Green Space
- Proposed Multi-Modal Path
- Proposed Pedestrian Only Path
- Existing Bike Lanes
- Existing Bike Routes (No Lane)
- Proposed Blueway
- Existing Stops Along Blueway

COMMUNITY RESILIENCY
- # Refer to text and points on map for individual recommendations
- Nearby Schools and other Social Infrastructure

STREAM RESTORATION
- Bankfull Channel
- Wetland Floodplain
- Valley Hillslope Forest

PROGRAMMATIC
- # Refer to text and points on map for individual recommendations
- County Owned/Potential Acquisition

Programmatic recommendations are watershed-wide strategies with example locations shown on map

CARPENTER CREEK & BAYOU TEXAR WATERSHED MANAGEMENT PLAN

NOTE: ALL CONCEPT PLANS ARE DRAFTS AND WILL BE EDITED TO REFLECT FEEDBACK RECEIVED DURING THE PUBLIC MEETING

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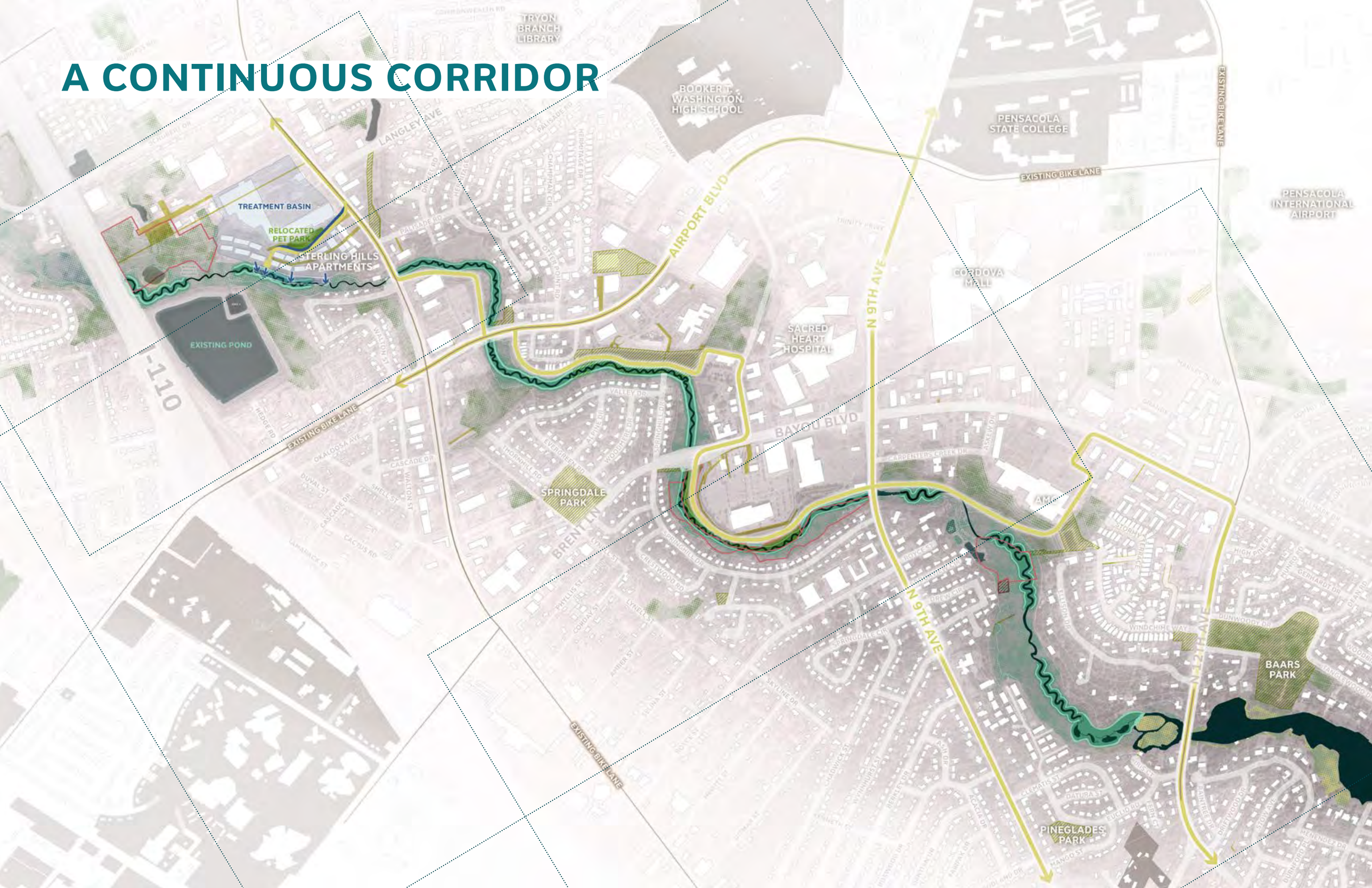
STITCHING TOGETHER THE PLANS

A CONTINUOUS CORRIDOR



PRIORITY SETTING WORKSHOP

WATERSHED-WIDE RESTORE GOALS

- Manage water quantity and improve water quality
- Protect, enhance, and restore wildlife habitat
- Expand public access and recreation opportunities
- Build more equitable and resilient communities
- Foster stewardship by connecting residents to their watershed

DRAFT CATALYTIC SITE PRIORITIES

Three recurring priorities we've heard:

- **Ecological Restoration**
- **Historic and Cultural Recognition**
- **Equitable Access**

ECOLOGICAL RESTORATION

WHAT WE'VE HEARD

"This is a high priority area and checks all of the important boxes. There is a huge benefit in the community resilience piece here as well."

Technical Advisory Group comment

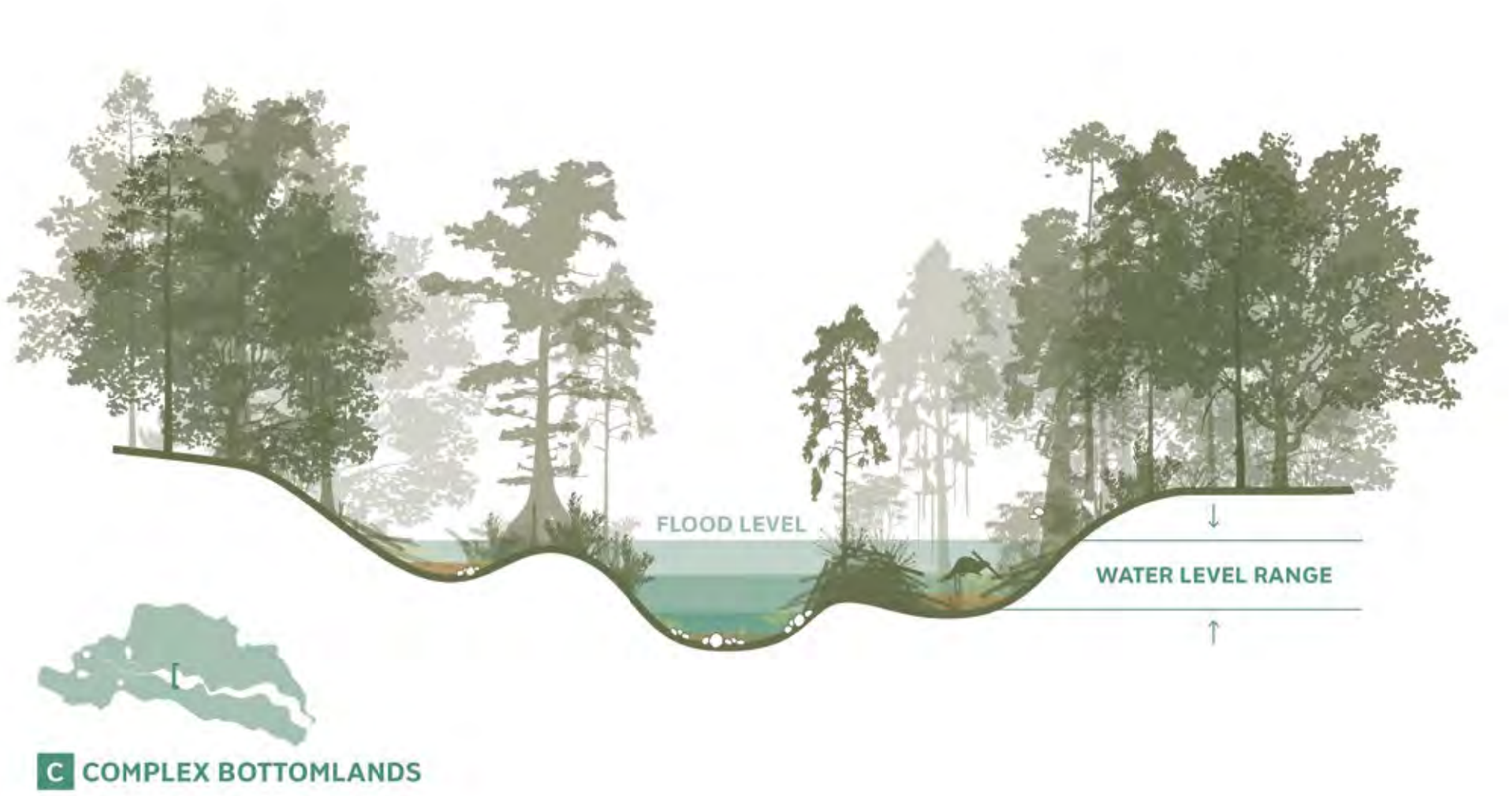
"[...] seems to be a pinch point so high priority."

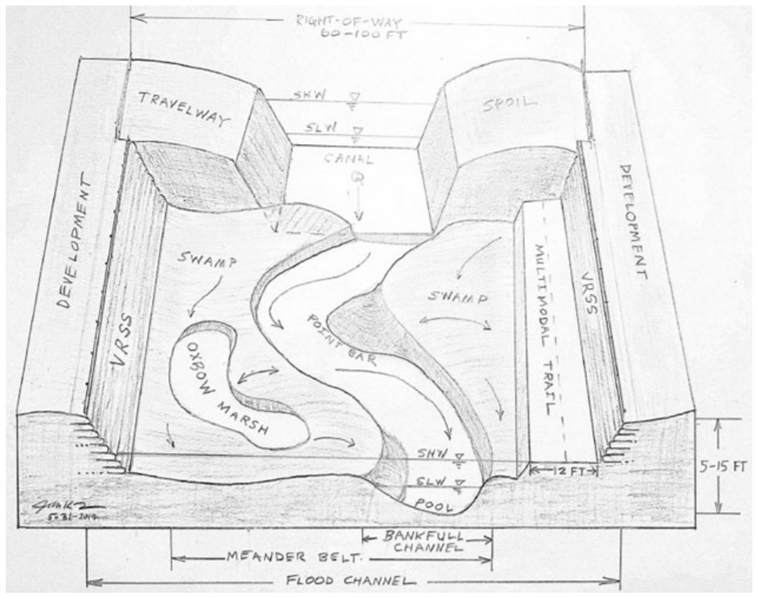
Technical Advisory Group comment

"Clean up the dirtiest."

Open house comment

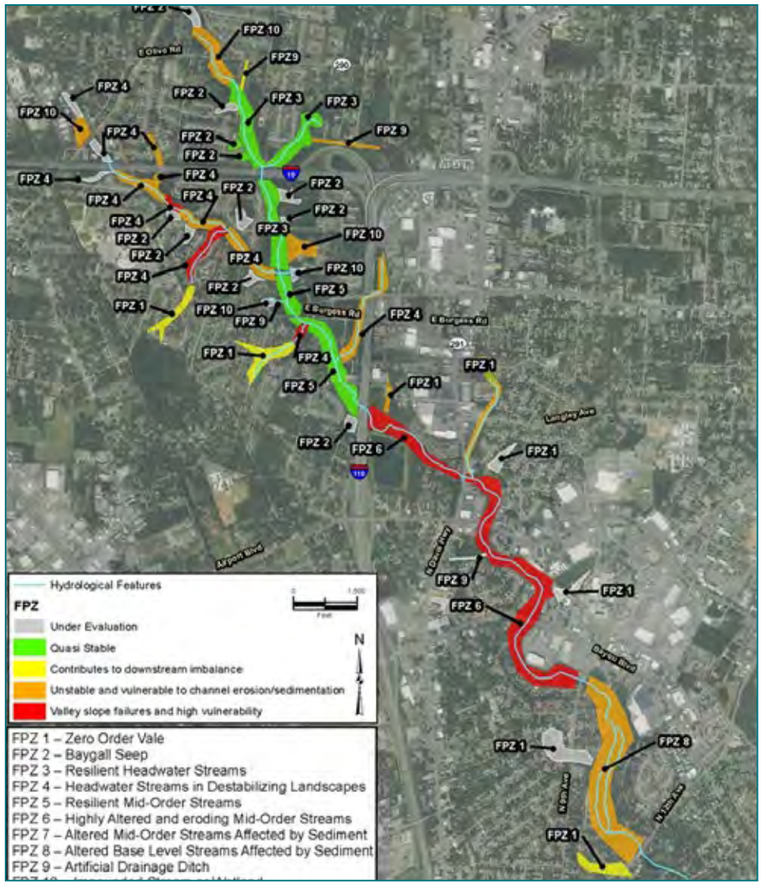
PRIORITY 2 STREAM RESTORATION
PROVIDE A BIGGER FLOODPLAIN





A HIGHLY VULNERABLE CREEK

Last year's Watershed Assessment found that the creek is highly vulnerable from I-110 to N 9th Avenue. Each portion of the catalytic reach is unstable/ highly vulnerable and/or subject to major erosion/slope failure



Carpenter Creek is highly vulnerable from I-110 to N 9th Avenue (shown in red), and vulnerable from N 9th Avenue to N 12th Avenue (shown in orange)

PENSACOLA

Carpenter Creek at 'tipping point' where banks may collapse, damage property, expert says

Jim Little
Pensacola News Journal

Published 6:01 a.m. CT June 16, 2022 | Updated 3:20 p.m. CT June 16, 2022

View Comments

12 Photos VIEW FULL GALLERY

Photos: Environmental scientist says the health of Carpenter Creek in Pensacola is at a tipping point

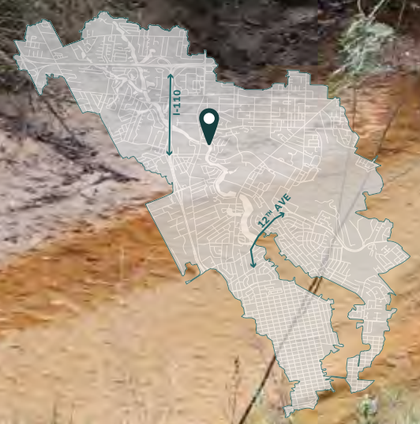
Environmental scientist Barbara Albrecht says the health of Carpenter Creek is at a tipping point, but can be saved if

A recent article from the Pensacola News Journal reporting on the highly vulnerable state of Carpenter Creek at the intersection of Davis Highway

Red clay being used to stabilize an embankment stripped of vegetation near Davis Highway (photo courtesy of the Pensacola News Journal)

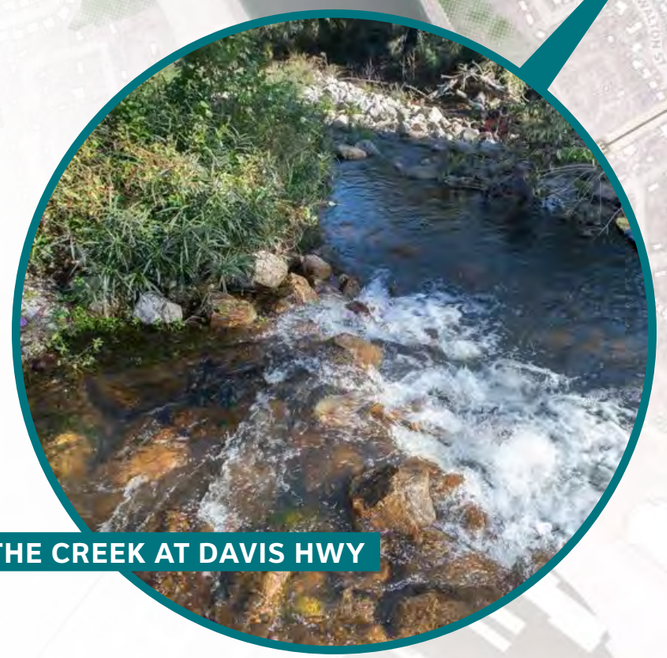
Looking up through Sterling Hills Apartments, between Davis Highway and I-110

Carpenter Creek just south of Davis Highway (future stream restoration area)



Carpenter Creek just south of Davis Highway (future stream restoration area)

ZOOMED-IN PLAN FOR ECOLOGICAL RESTORATION



THE CREEK AT DAVIS HWY

TREATMENT BASIN
RELOCATED PET PARK
STERLING HILLS APARTMENTS
AIRPORT BLVD
N 9TH AVE
EXISTING BIKE LANE
PENSACOLA STATE COLLEGE
CORDOVA MALL
SACRED HEART HOSPITAL
BAYOU BLVD
SPRINGDALE PARK
AMC
BAARS PARK
PINEGLADES PARK

QUESTIONS TO CONSIDER

- Is this the best place to start? How would restoration in this entire stretch be phased?
- How can the catalytic design process tie into any existing efforts in the area?
- Besides ecological restoration, what are some priority themes to address at this site?
- Is there critical habitat in the area to preserve?
- What approach and/or programmatic elements would best pair with the proposed stream restoration at the Davis Highway crossing?

HISTORIC AND CULTURAL RECOGNITION

WHAT WE'VE HEARD

"[...] go beyond mere interpretive text panels and make more deeply visible the legacy of this nationally significant cultural landscape."

Charles A Birnbaum, President and CEO of The Cultural Landscape Foundation

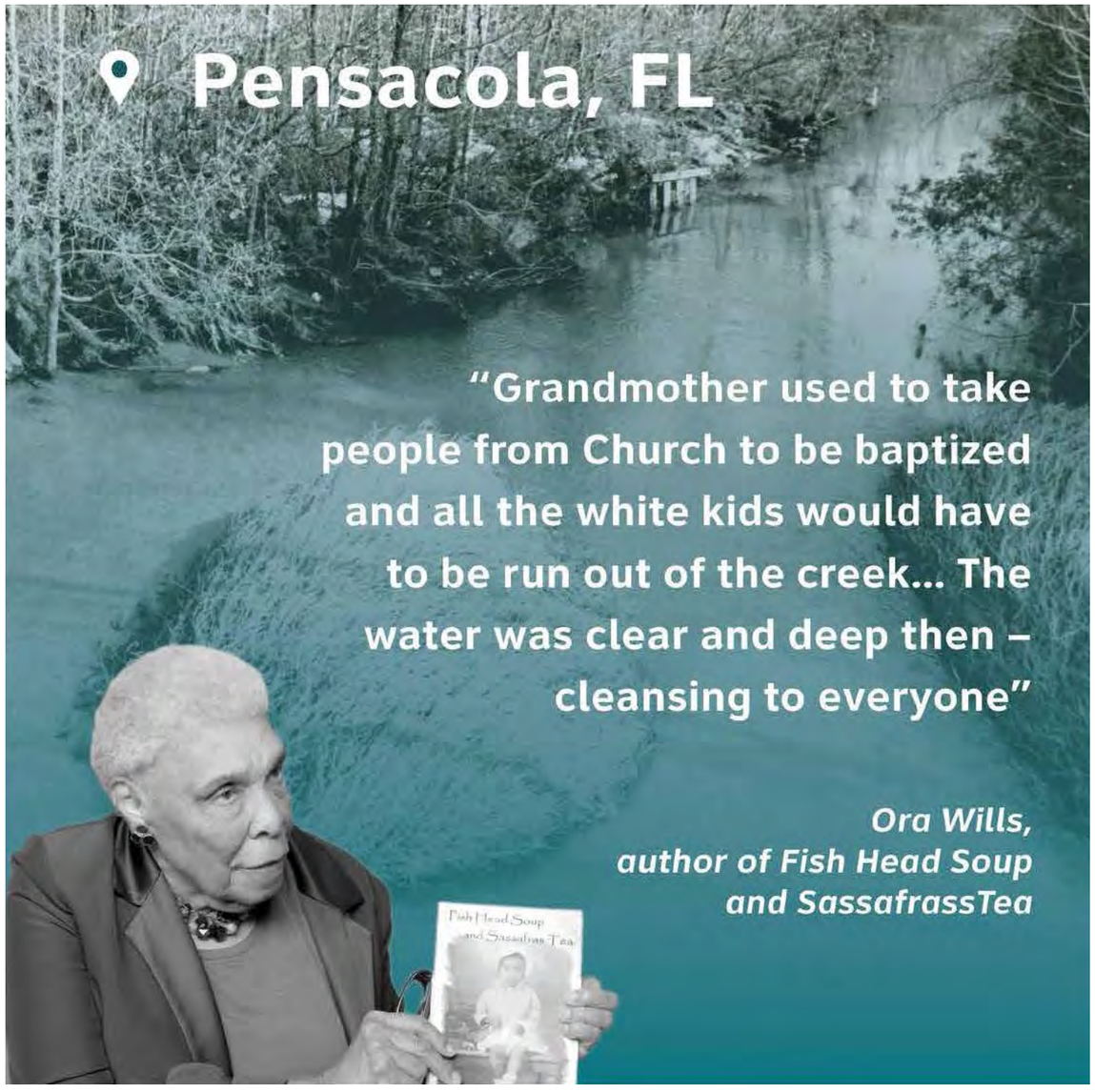
"[...] walking paths with public art or installations reflective of both the sacred and secular legacy of Aunt Jennie's Swimming Hole."

Kate Brown, Senior Project Manager of Trust for Public Land

"Honor the sacred legacy of the site."

Open house comment

RECREATION ON THE CREEK



AUNT JENNIE'S SWIMMING HOLE

Jennie Hudgins, or "Aunt Jennie," owned 10 acres of land along Carpenter Creek between Bayou Boulevard and N 9th Avenue that was used by the community for recreation and baptisms. Author and historian Ora Wills and her daughter Angela Kyle are direct decendents of Jennie Hudgins, and work to bring attention to the site's legacy.

Ora (Dawson) Wills (L), Jennie Hudgins (seated), Doris Dawson (R)

1930 census recording "Jannie Hudgins" and her family

Dense vegetation along Carpenter Creek between Bayou Boulevard and N 9th Avenue

Retaining wall behind the AMC movie theatre

AMC movie theatre parking lot backing up to the dense riparian vegetation of Carpenter Creek

ZOOMED-IN PLAN FOR HISTORIC + CULTURAL RECOGNITION

JENNIE'S SWIMMING HOLE

QUESTIONS TO CONSIDER

- What approach and/or programmatic elements would best recognize history and culture at Aunt Jennie's Swimming Hole?
- Are there any additional historic and cultural sites and/or narratives that could be incorporated into the catalytic design process at this site?
- If this effort moves forward, who should be involved?
- Are there precedents for this type of cultural and historic recognition?
- How can we make this legible to all ages? Interactive and engaging to youth?

EQUITABLE ACCESS

WHAT WE'VE HEARD

"I have kayaked from Bayou Texar to this site on many occasions. I go as far as I can then turn around. There is a lot of litter."

Feedback received online

"Green and blue space along Carpenters Creek."

Open house comment

"Beautiful place to kayak."

Feedback received online

WATERSHED RECREATION / GREENWAY + BLUEWAY ACCESS

MULTI-MODAL GREENWAY

CREEK WINDOWS

BLUEWAY KAYAK LAUNCHES

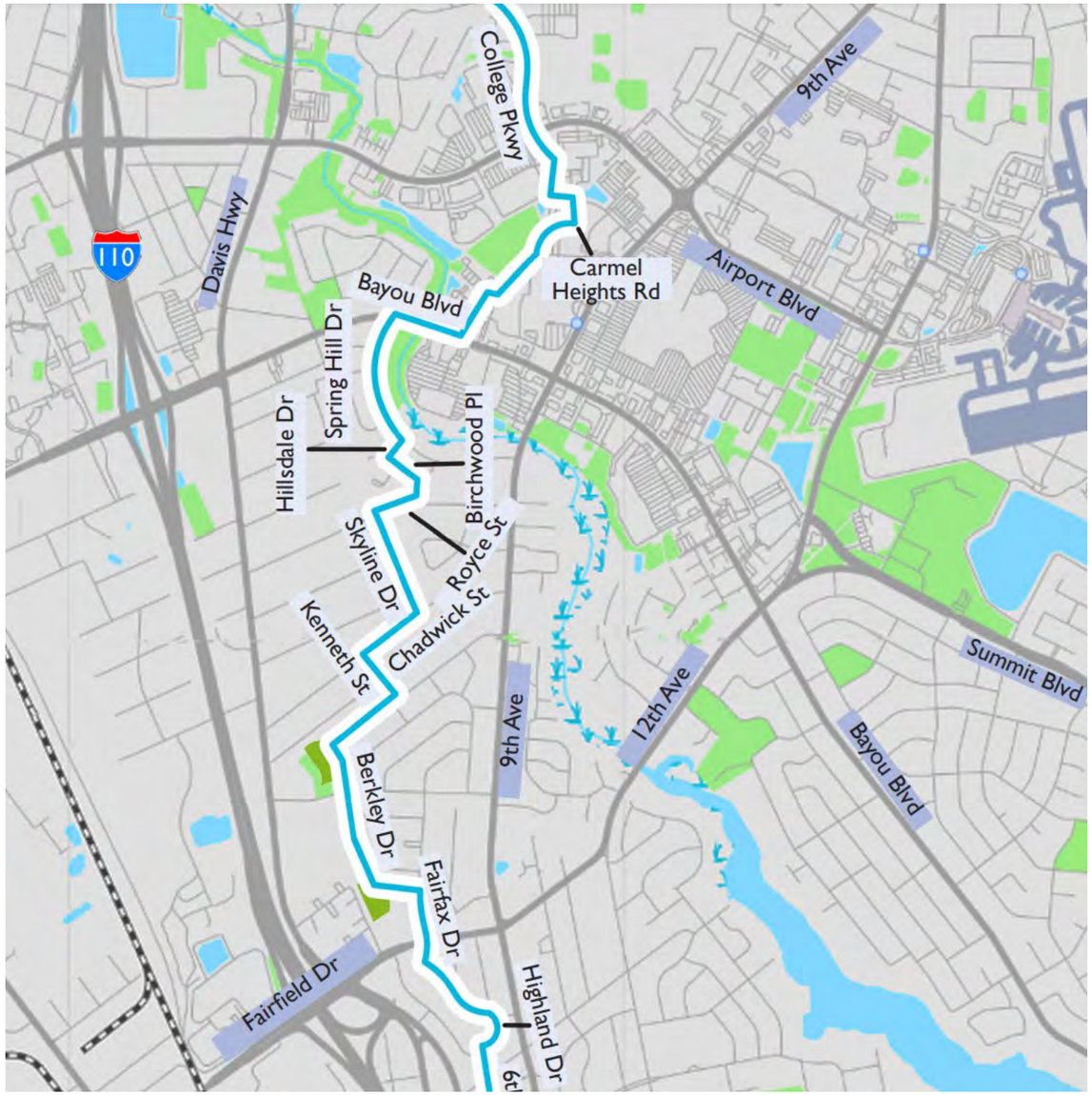
BAYOU TEXAR AND CARPENTER CREEK BLUEWAY

Map of the existing Pensacola Bay Paddlnig Trail

Existing public boat launch at Bayview Park

Kayak rentals at the existing Bayview Park Outdoor Pursuits Center

BAYOU TEXAR AND CARPENTER CREEK BLUEWAY



Bike Pensacola's uptown to downtown safe riding route along the creek

Airport Boulevard bike lane

Multi-modal crossing at Davis Highway

Carpenter Creek just north of N 9th Avenue

Wooded areas along Carpenter Creek Drive south of N 9th Avenue

Carpenter Creek just south of N 9th Avenue

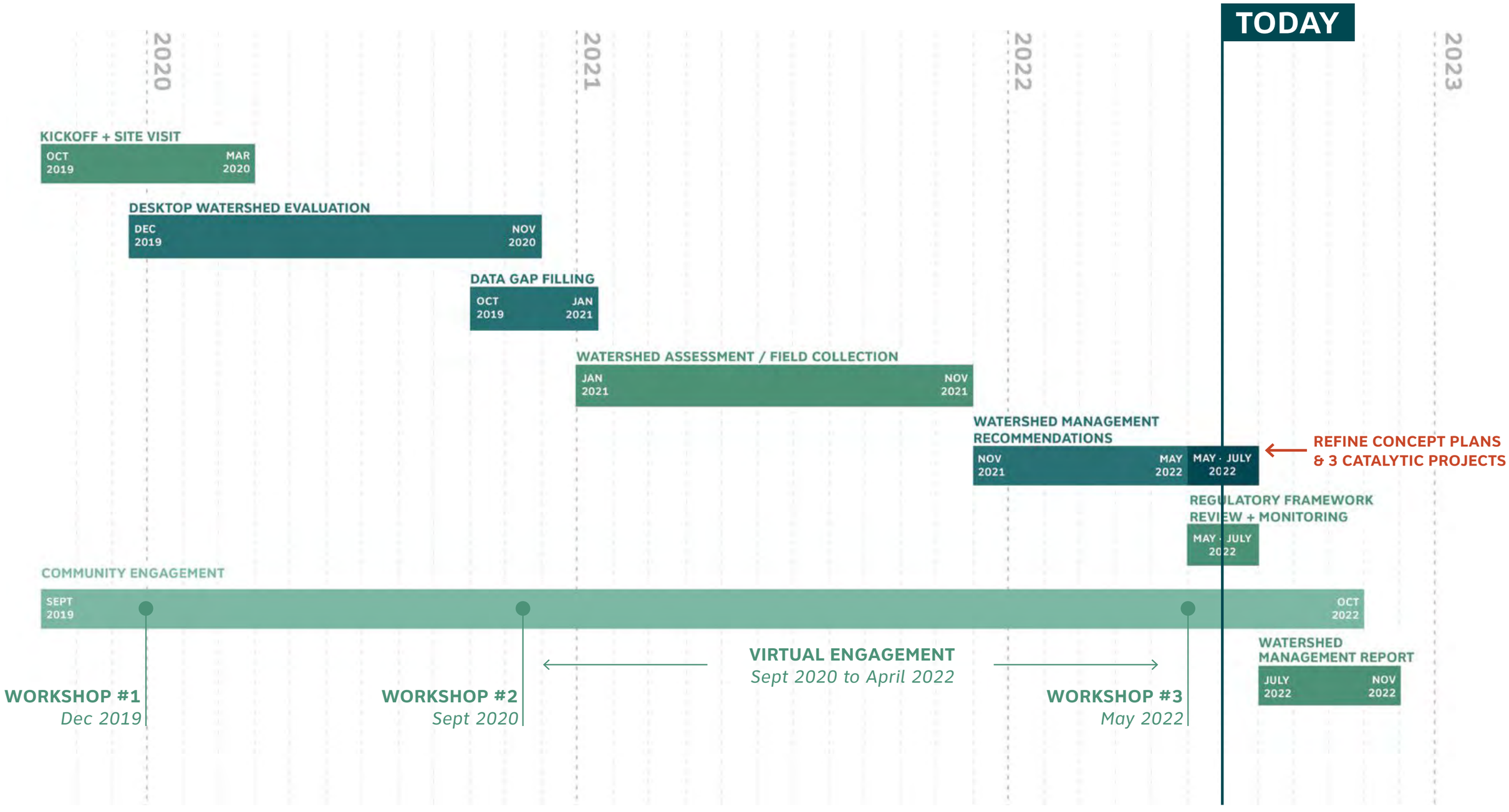
ZOOMED-IN PLAN FOR EQUITABLE ACCESS

QUESTIONS TO CONSIDER

- If we were to redraw the bike path where would it go?
- Where should the bike path be a separate lane along an existing road, a shared path, or a new separate greenway closer to the creek?
- If we were to redraw the locations of kayak launches within this stretch, where should they go? What criteria should we consider in placing these moments of access to the creek?
- What qualifies as equitable access?
- What are the existing community anchors that this trail system should tie into?

NEXT STEPS

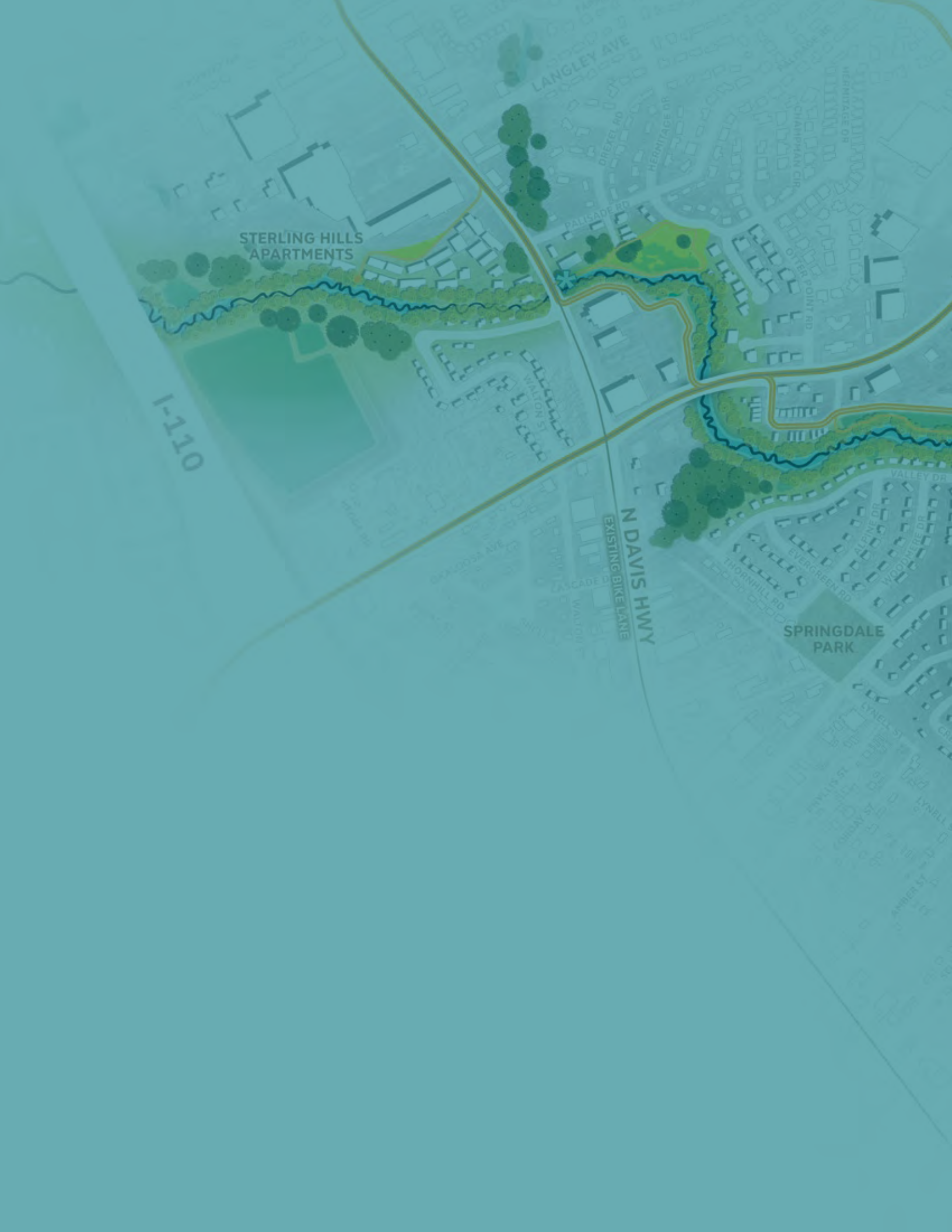
PROJECT TIMELINE



QUESTIONS TO CONSIDER

- **What would successful implementation look like?**
- **What role do you want to play in seeing the Watershed Management Plan through?**
- **Do you want to form a task force that convenes regularly to champion projects like these in the watershed moving forward?**
- **How do you see this project being phased?**

THANK YOU!


STERLING HILLS APARTMENTS
I-110
N DAVIS HWY
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SPRINGDALE PARK