Conceptual Resilience Plan

LITTLE CREEK, DELAWARE

July 24, 2020
First Look

CRDS
COASTAL RESILIENCE
DESIGN STUDIO

The **Coastal Resilience Design Studio (CRDS)** is an interdisciplinary team of student designers, researchers and engineers exploring creative and thoughtful solutions to the many challenges facing Delaware's coastal communities.

The **CRDS** aims to equip communities with tools, designs, and adaptation strategies aimed at mitigating disruptions from short-term hazardous events and long-term environmental changes.

Our Team

Emma Ruggiero Senior Designer, UD LA 2018
Mark Switliski Senior Designer, UD CE 2020
Josh Gainey Senior Designer, UD LA

Olivia Boon UD LA
DJ Bromley UD LA
Chris Fettke von Koeckritz UD LA
Leigh Muldrow UD LA

Community Aspirations

1. Residents wish to preserve the **small-town character** by balancing any new development with preservation of agricultural lands and open space. Annexation and new residential developments are generally not desired and are not a priority;

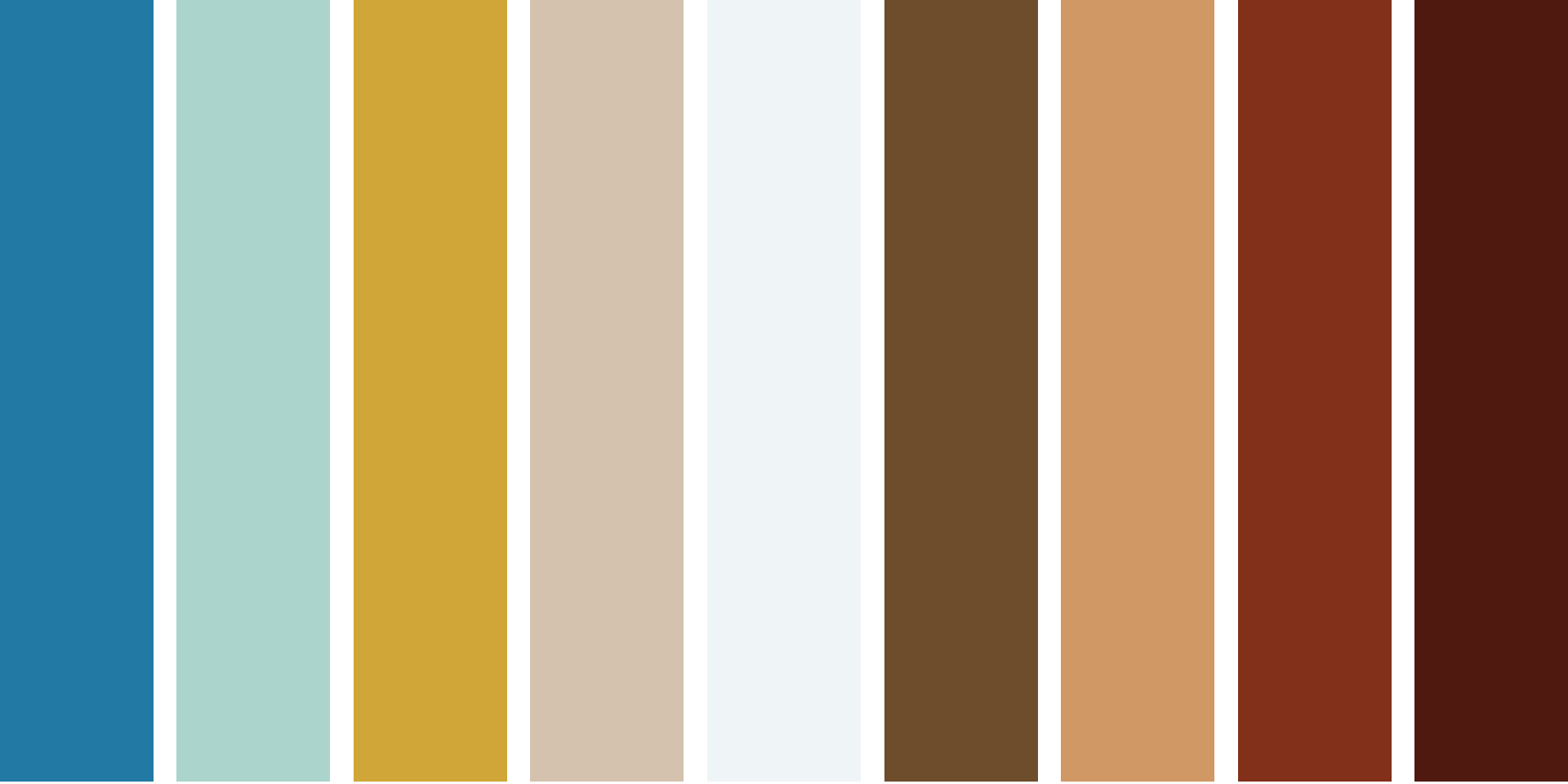
2. Residents desire to **re-establish public access** to Little River for commercial fishing and for recreational boating and fishing; thereby restoring their working waterfront and maritime heritage; and

3. Residents recognize that sea level rise is happening and they generally support action to **adapt and become a resilient community**.

Little Creek

Nestled on the shore of the Little River is a small coastal community with a rich maritime history. Little Creek is situated along Delaware's Bayshore Byway in Kent County. With 187 full time residents, Little Creek is a quintessential small town. Surrounded by the richness of tidal marshland, Little Creek offers our state tremendous value in its natural resources, habitat, and protection of our shoreline.


Little Creek
DELAWARE
= est. 1899 =
Slow Down. Live A Little.



The Colors


Little Creek
DELAWARE
= est. 1899 =


Little Creek
DELAWARE


Little
Creek
=DE=


Little Creek
DELAWARE


Little Creek
DELAWARE

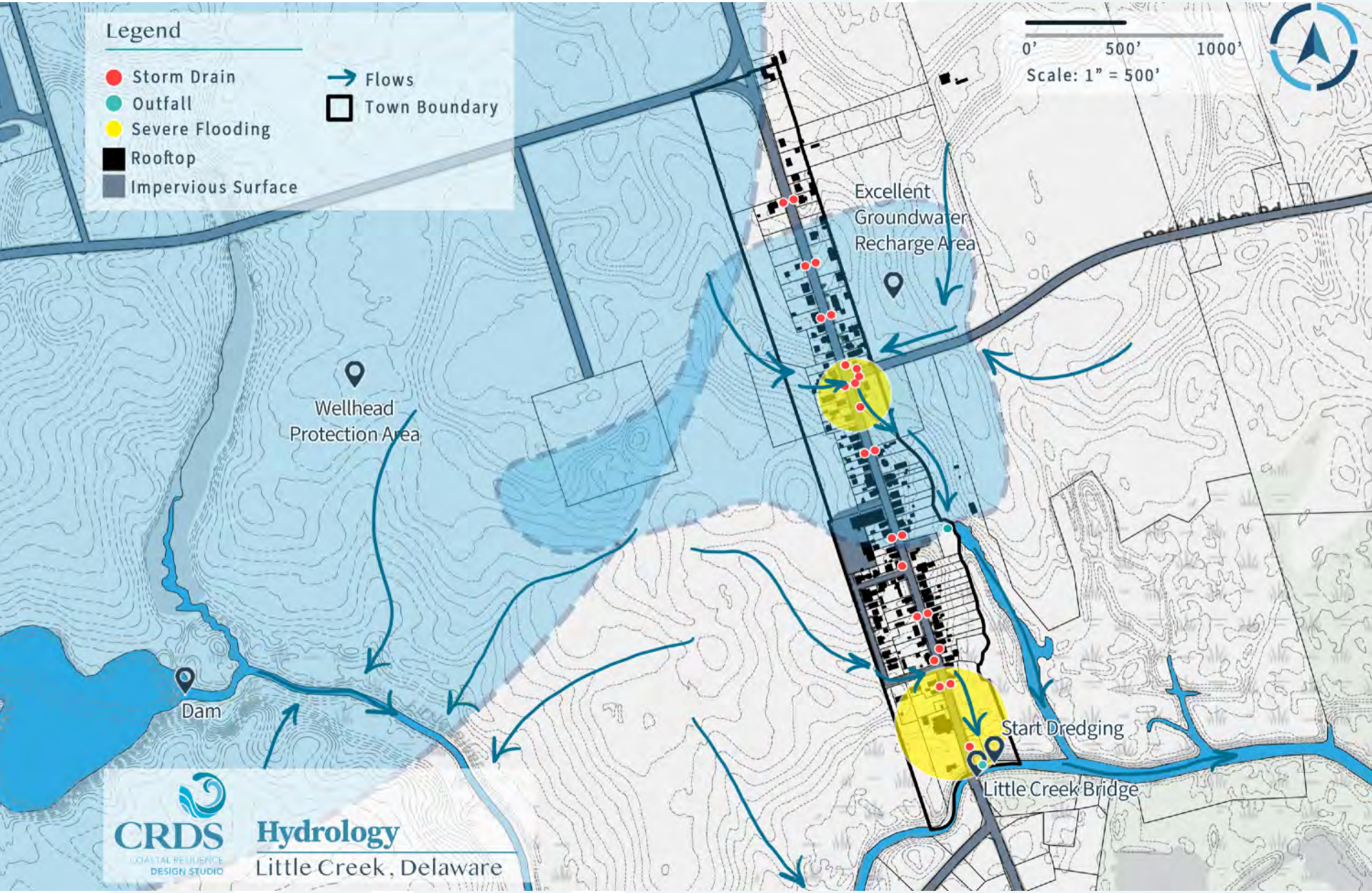

Little Creek
DELAWARE

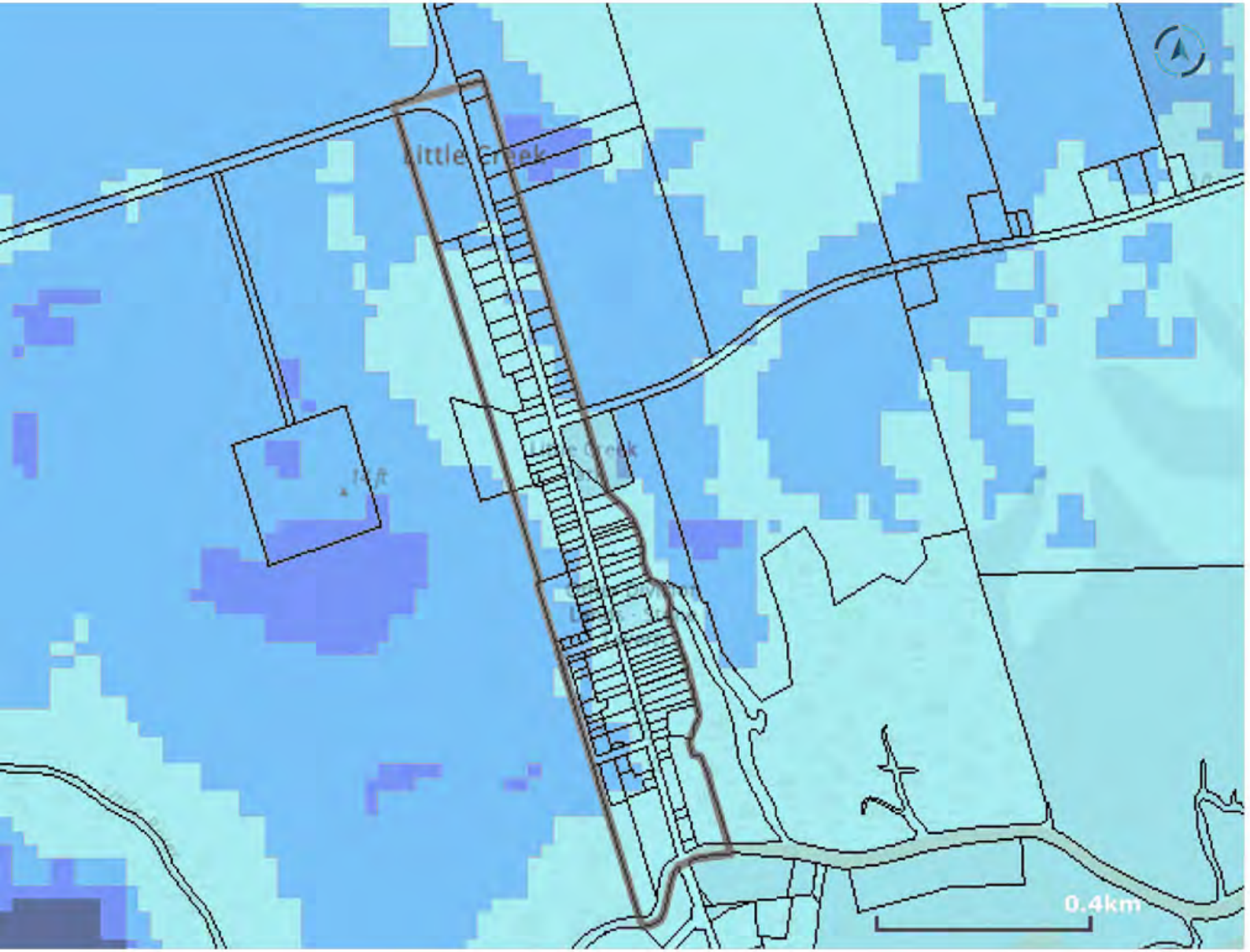

Stormwater Strategy
Traffic & Connection
Commercial Opportunity

Stormwater

LITTLE CREEK, DELAWARE


Bark Park


Legend
Storm Drain
Outfall
Severe Flooding
Rooftop
Impervious Surface
Flows
Town Boundary
0’
500’
1000’
Scale: 1” = 500’
Excellent Groundwater Recharge Area
Wellhead Protection Area
Dam
Start Dredging
Little Creek Bridge
CRDS
COASTAL RESILIENCE DESIGN STUDIO
Hydrology
Little Creek, Delaware



Depth to Water Table

Little Creek, Delaware

Legend

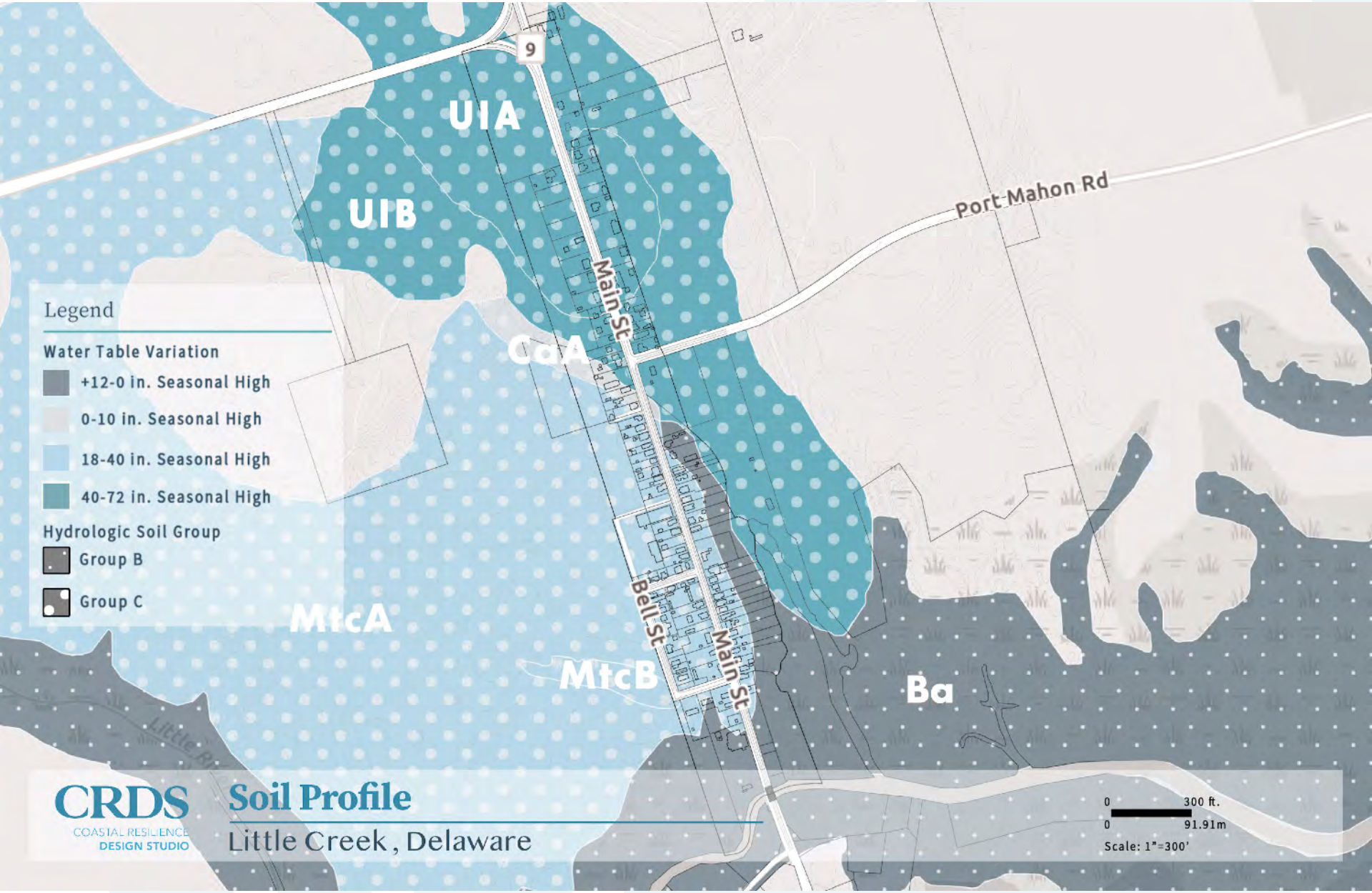
Delaware Municipalities

Delaware Kent County Parcels

Delaware DGS Depth To Water - NORMAL

- 0 - 3 ft
- 3 - 6 ft
- 6 - 9 ft
- 9 - 16 ft
- 16 - 20 ft
- > 20 ft

CRDS
COASTAL RESILIENCE DESIGN STUDIO


9
UIA
UIB
Main St
Port Mahon Rd
CaA
MtcA
Bell St
Main St
MtcB
Ba
Legend
Water Table Variation
+12-0 in. Seasonal High
0-10 in. Seasonal High
18-40 in. Seasonal High
40-72 in. Seasonal High
Hydrologic Soil Group
Group B
Group C
CRDS
COASTAL RESILIENCE DESIGN STUDIO
Soil Profile
Little Creek , Delaware
0 300 ft.
0 91.91m
Scale: 1"=300'

Stormwater Objectives

- Provide an opportunity for **Little Creek to independently manage stormwater**
- Address storm event flooding with green infrastructure treatments that **convey water slowly where infiltration is not possible**
- Increase residence time of water in areas where **water can safely and effectively infiltrate** to improve water quality and quantity

Three Areas of Focus

1. Agricultural Buffer + Swale
2. LC Park
3. Constructed Wetland

Agricultural Buffer & Swale

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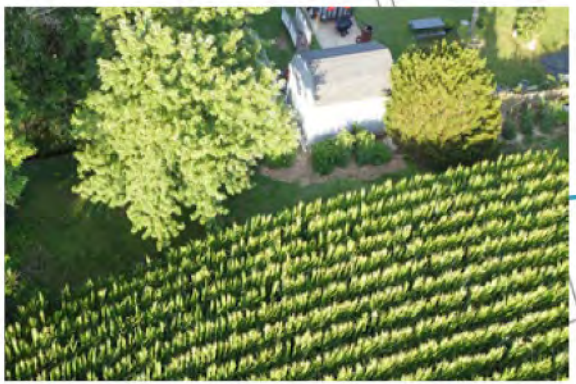


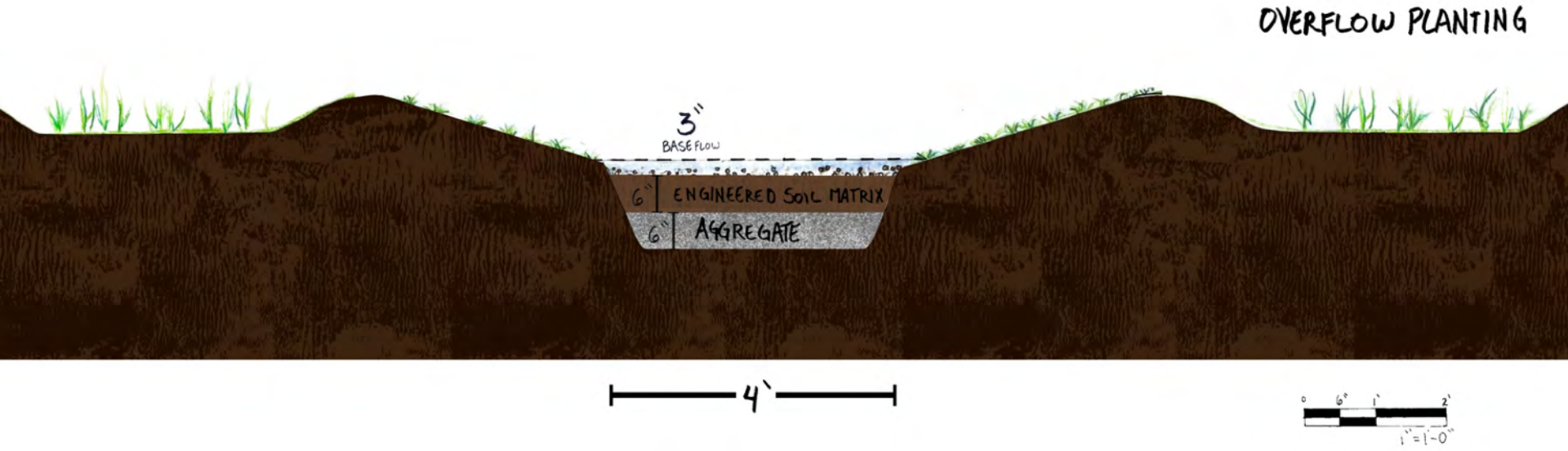
LEGEND

- Bioswale
- Enhanced Riparian Buffer
- Native Perennial Planting

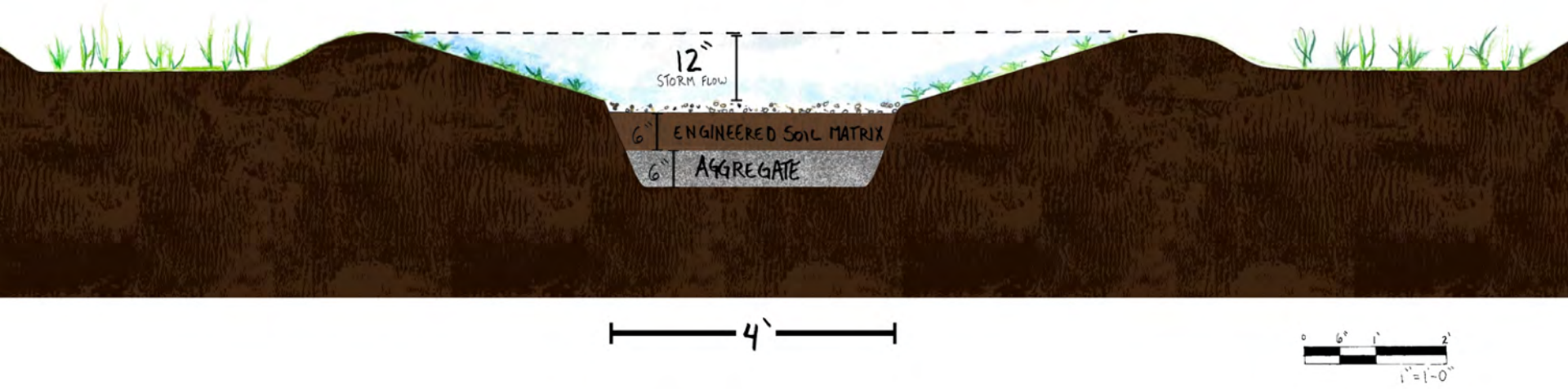
Agricultural Buffer Program:

- **Increase riparian buffer** to surround wetland from 50’ → 100’ increasing habitat at a DNREC designated wetland area
  - ~146,000 sq. ft. or 3.35 acres of farmland converted to shrub/ forest buffer
  - Potential incentives to farmers via CREP program
- **Create a bioswale** with meanders, native planted areas for overflow during storm events and check dams to slow and infiltrate water
  - Dissipate water energy with rocky inlets and outfalls
  - Increase infiltration capacity with an engineered soil matrix
  - Include an overflow drain that leads to stormwater system
- **Improve water quantity and quality** by increasing residence time, allowing for some infiltration and denitrification

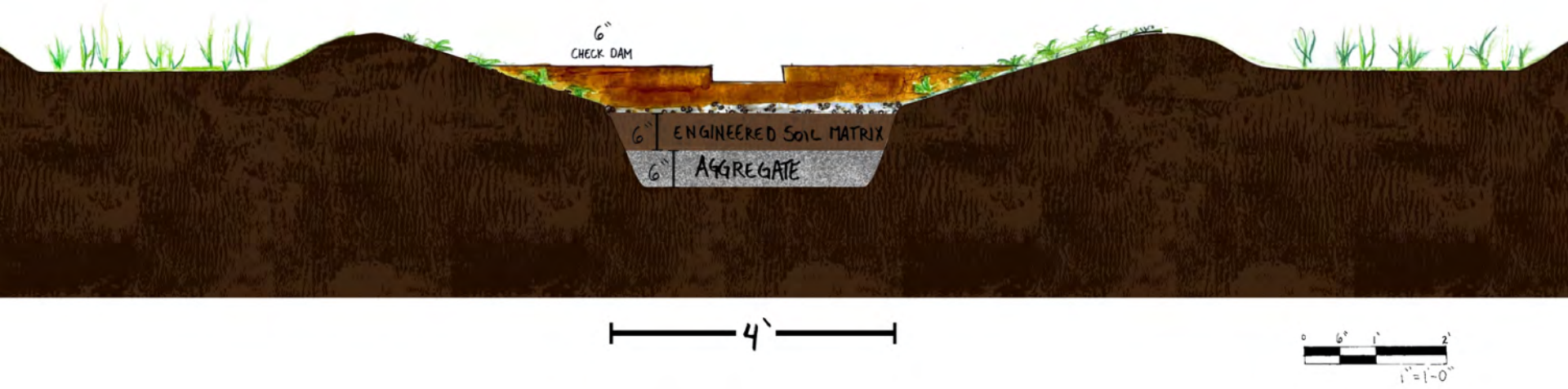

0' 50' 100' 200'
SCALE: 1" = 100'
N
MAIN ST.
ENHANCED BUFFER (100')
EXISTING BUFFER (50')
EX. WETLAND
PORT MAHON RD.
100 YR FLOODPLAIN
0' 10' 20' 40'
SCALE: 1" = 20'
N
INLET
ROCKS
PLANTED AREA
CHECK DAM
GRAVEL BOTTOM
OVERFLOW DRAIN
ROCKS
CULVERT
STORM DRAIN


OVERFLOW PLANTING
3"
BASE FLOW
6"
ENGINEERED SOIL MATRIX
6"
AGGREGATE
4'
0
6"
1'
2'
1"=1'-0"

OVERFLOW PLANTING



OVERFLOW PLANTING



LC Park

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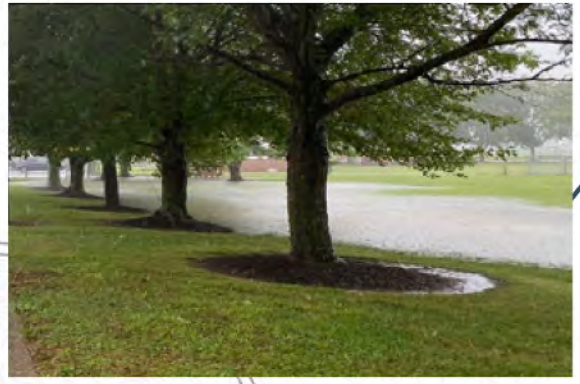
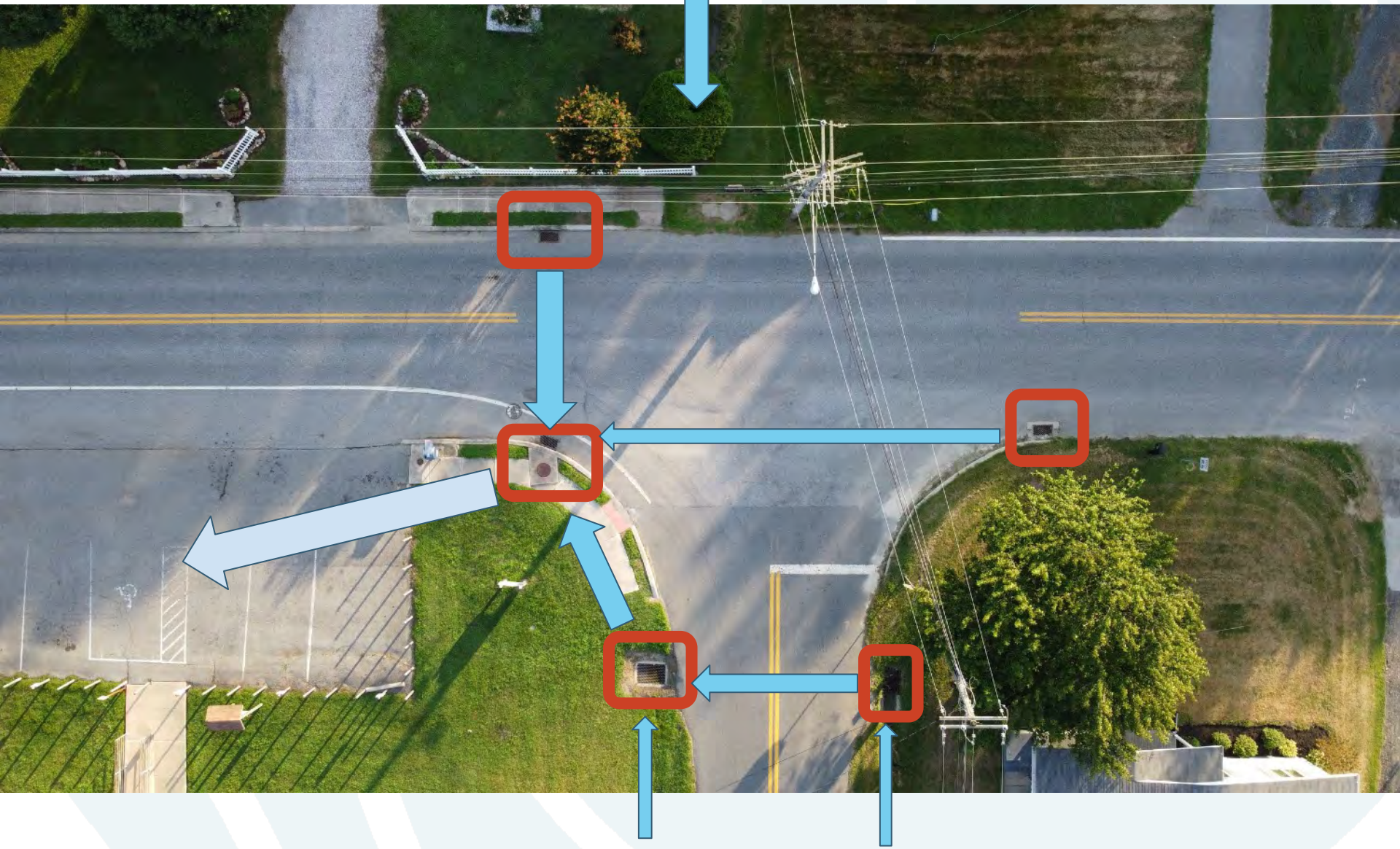


LEGEND

- Constructed Wetland
- Community Garden
- Sports Field
- Native Planting

drainage ditch



LC Park Program:

- Convey all stormwater from inlets to a forebay and to a **constructed wetland**
- Create a **native plant / pollinator garden** with an underdrain leading water to forebay
- Create **bioswales** in bump outs along Main Street and Port Mahon Road with curb cuts leading water to forebay
- Replace post office parking lot with **pervious pavement** and an underdrain that flows to the forebay
- Update park amenities to include a fuller breadth as noted from the LC Comprehensive Plan: **multi-use trail with lookouts; bench seating; community garden; stage with moveable seating; picnic area; sports field; educational signage**


0' 25' 50' 100'
SCALE: 1" = 50'
12' MULTI-USE PATH
OUTLOOK
HIGH MARSH
LOW MARSH
CONSTRUCTED WETLAND
DOG PARK
OPEN / SPORTS FIELD
BASKETBALL COURT (EX.)
STAGE
PICNIC AREA
FLEXIBLE SEATING
SWINGS
EX. PLAY-GROUND
COMMUNITY GARDEN
RAIN BARRELS
POST OFFICE
PORT MAHON RD.
NATIVE/ POLLINATOR GARDEN
FOREBAY
DEEP POOL
PERVIOUS PARKING
BIOSWALE
PARKSIDE TRAIL HEAD
MAIN ST.
BIOSWALE
CARSON LN.


Little Creek
L!VE


Pollinator
Habitat

Constructed Wetland

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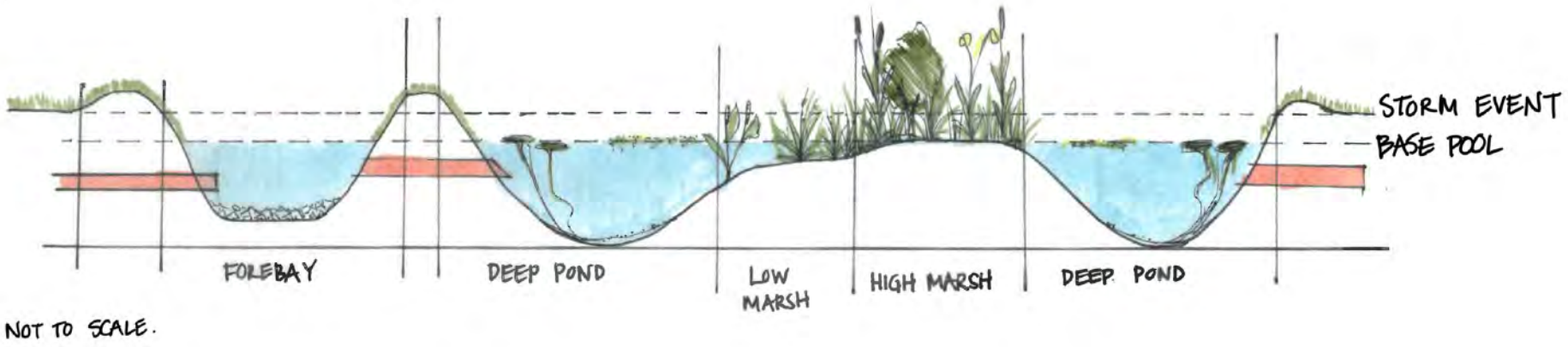
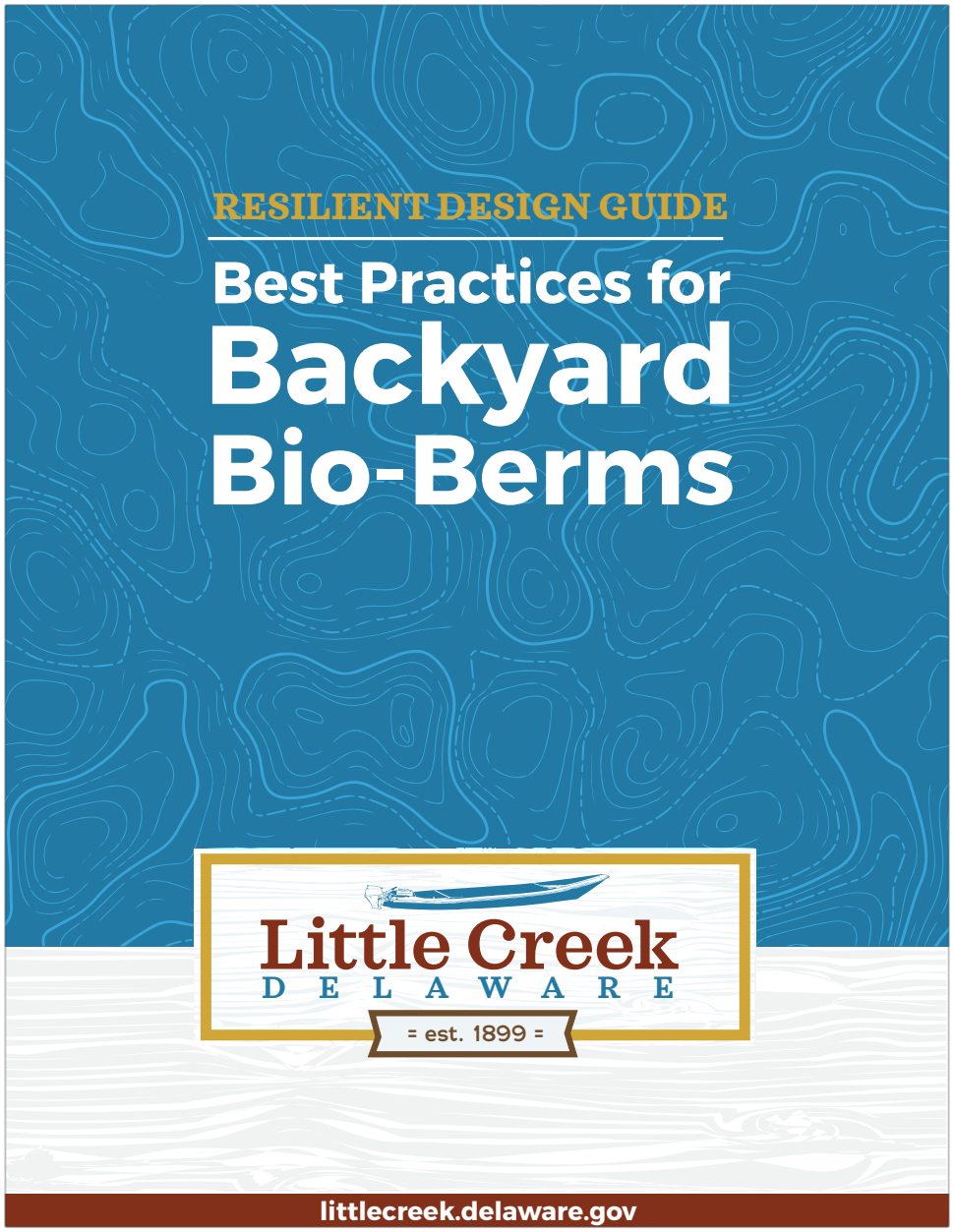
LEGEND
Culvert Adjustment/Bridge
Phragmites Removal
Trail-Park Connection

Constructed Wetland Program:

- **Remove stand of phragmites** in wetland and create a plan for invasives control
- Restore health to degraded wetland by creating a **constructed wetland** with a forebay, deep pools, low marsh and high marsh areas
    - Planting design conveys beautification as a park amenity and stormwater management
- **Remove culvert to allow for a natural flow** or replace culvert with a larger one at the pinch-point


FOREBAY
COLLECTION FOR A MAJORITY OF STORMWATER; ALLOWS SEDIMENT TO SETTLE.
INLET PIPE
EX. WETLAND BOUNDARY
HIGH MARSH
OFTEN BUT NOT CONSISTENTLY SATURATED ZONE.
DEEP POOL
STORES WATER + DISSIPATES ENERGY.
UPLAND ISLAND
LOW MARSH
CONSISTENTLY SATURATED WETLAND ZONE.
DEEP POOL
FINAL SETTLING OF SEDIMENT; COLLECTION BEFORE DISCHARGE.
EX. WETLAND
EX. CULVERT


STORM EVENT
BASE POOL
FOREBAY
DEEP POND
LOW MARSH
HIGH MARSH
DEEP POND
NOT TO SCALE.


RESILIENT DESIGN GUIDE
Best Practices for
Backyard
Bio-Berms
Little Creek
DELAWARE
= est. 1899 =
littlecreek.delaware.gov

Traffic & Connection

LITTLE CREEK, DELAWARE

Objectives

- Address **flooding issues** along Main Street
- Provide **traffic calming** through town using the Complete Streets model
- Reconnect the **community** with the **Little River**
- Provide a **walking trail** and **observation tower**
- Improve **bike access** and **safety**
- Maintain the **small town feel**
- **Resiliency** should be a common thread in all design recommendations

COASTAL RESILIENCE DESIGN STUDIO

TOWN OF LITTLE CREEK MONTHLY TRAFFIC DATA

			Total cars	25-29 Mph	30-34 Mph	35-39 Mph	40-44 Mph	45-49 Mph	50 Mph and Over	Total > 29 Mph
PRE COVID-19 SHUTDOWN	February 2020 **35 Days**	Totals % of Total **Avg per day**	24,187 **691**	7,782 32.17%	7,541 31.18%	3,831 15.84%	3,059 12.65%	1,554 6.42%	420 1.74%	16,405 67.83%
	March 2020 **35 Days**	Totals % of Total **Avg per day**	19,485 **557**	6,958 35.71%	6,195 31.79%	2,967 15.23%	2,150 11.03%	1,040 5.34%	175 0.90%	12,527 64.29%
COVID-19 SHUTDOWN	April 2020 **28 Days**	Totals % of Total **Avg per day**	16,523 **590**	6,029 36.49%	5,381 32.57%	2,485 15.04%	1,625 9.83%	795 4.81%	208 1.26%	10,494 63.51%
	May 2020 **27 Days**	Totals % of Total **Avg per day**	17,833 **660**	7,116 39.90%	5,794 32.49%	2,570 14.41%	1,495 8.38%	689 3.86%	169 0.95%	10,717 60.10%

1 in 3 drivers speed a little

The rest speed a lot

Why Complete Streets in Little Creek?

Enhance Little Creek as a **destination** on the **Bayshore Byway**

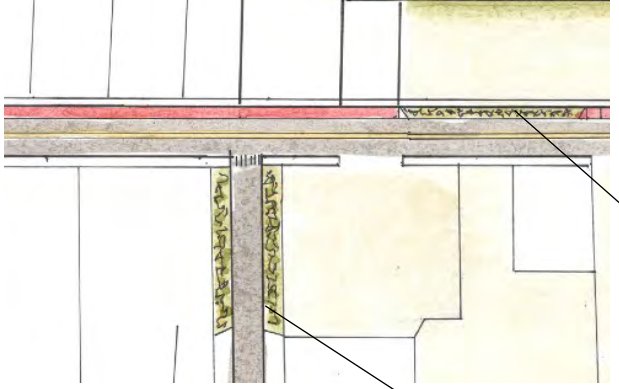
Increase **pedestrian access and safet**y with crosswalks

Enhance the community and visitor **experience** in the community

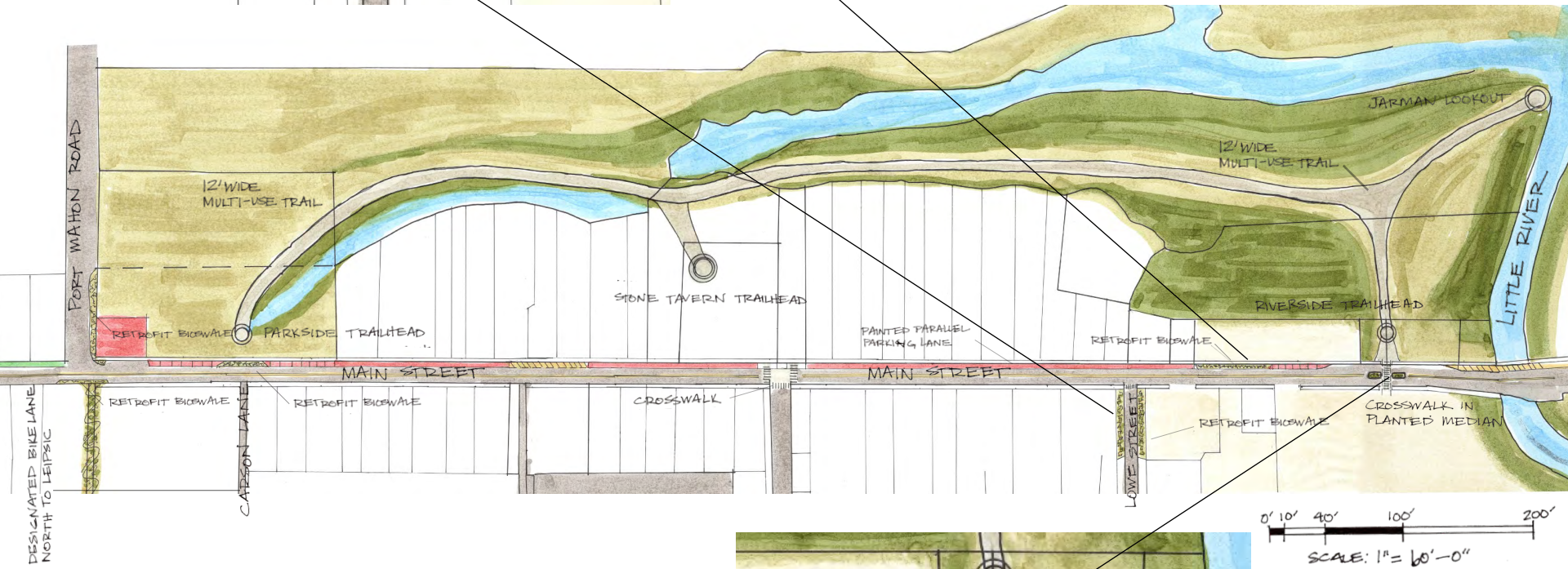
Provide **traffic calming** and facilitate foot traffic

Provide an opportunity for added **stormwater mitigation**

Incorporate native species of plants and trees to improve stormwater absorption, enhance habitat for native wildlife, and provide **locally driven beautification** for the community

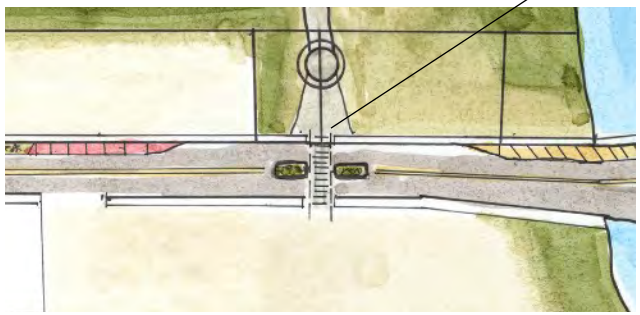


RETROFIT BIOSWALE



0' 10' 40' 100' 200'

SCALE: 1" = 60'-0"



CROSSWALK IN PLANTED MEDIAN

TRAFFIC CALMING + CONNECTIVITY

LITTLE CREEK, DELAWARE


Landing
Strip
12ft
10ft
8ft


INFO: 302-264-6691


LITTLE
CREEK

This is a bioswale at the L.A. Zoo. By centering it, run off is collected from both sections of the parking lot.


LITTLE
CREEK

Banners

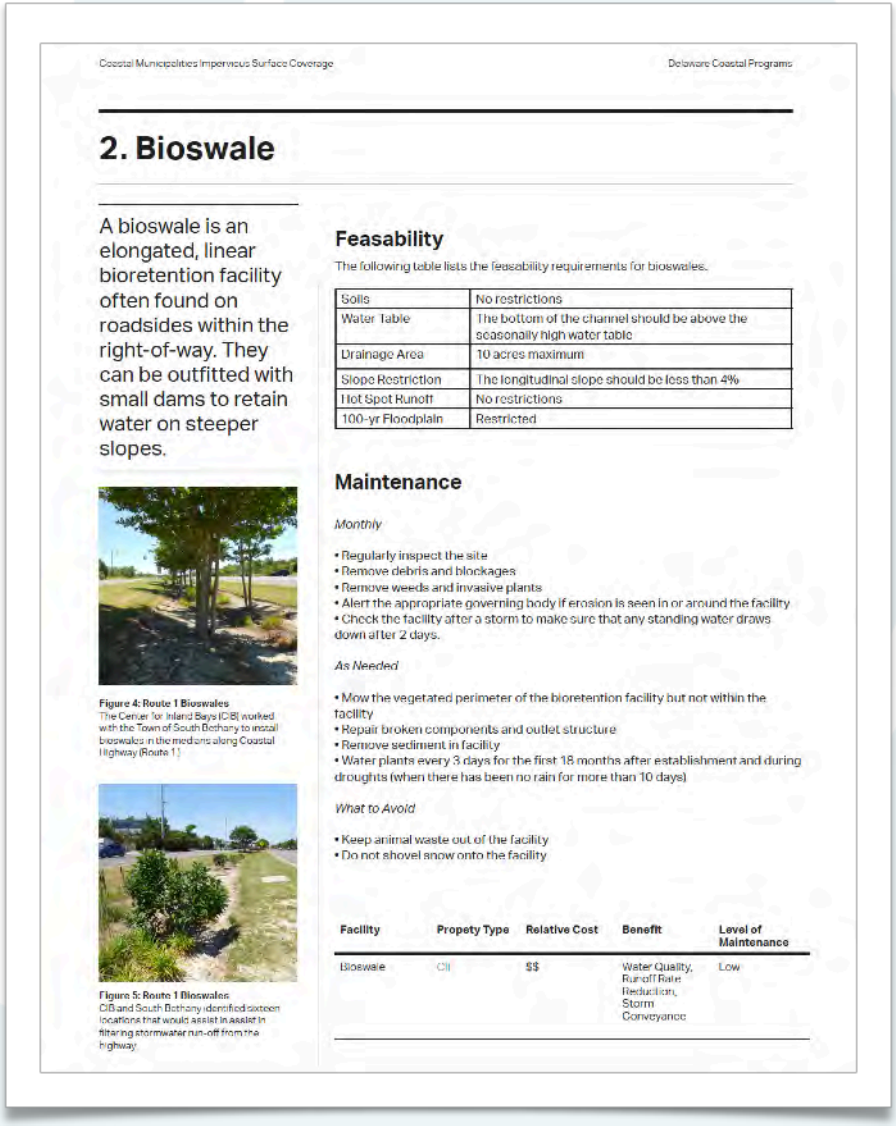

Little Creek
Little Creek
Little Creek
Little Creek
Little Creek


PARKING


Little Creek
Little Creek
BAYSHORE
PARKING

Why Bioswales

- When placed in the right-of-way, a **bump out** that **functions as a bioswale** can double as a traffic calming device
- **Poor soils + high water table** constrain the design options for green infrastructure
- **Slow, retain, and clean** water for short periods of time before it moves into the Little River through the **established stormwater system**
- **Low maintenance**, native plantings reinforce the local aesthetic and create **micro habitats**



Coastal Municipalities Impervious Surface Coverage — Delaware Coastal Programs

2. Bioswale

A bioswale is an elongated, linear bioretention facility often found on roadsides within the right-of-way. They can be outfitted with small dams to retain water on steeper slopes.

Figure 4: Route 1 Bioswales
The Center for Inland Bays (CIB) worked with the Town of South Bethany to install bioswales in the medians along Coastal Highway (Route 1).

Figure 5: Route 1 Bioswales
CIB and South Bethany identified sixteen locations that would assist in assist in filtering stormwater run-off from the highway.

Feasability

The following table lists the feasability requirements for bioswales.

Soils	No restrictions
Water Table	The bottom of the channel should be above the seasonally high water table
Drainage Area	10 acres maximum
Slope Restriction	The longitudinal slope should be less than 4%
Hot Spot Runoff	No restrictions
100-yr Floodplain	Restricted

Maintenance

Monthly

- Regularly inspect the site
- Remove debris and blockages
- Remove weeds and invasive plants
- Alert the appropriate governing body if erosion is seen in or around the facility
- Check the facility after a storm to make sure that any standing water draws down after 2 days.

As Needed

- Mow the vegetated perimeter of the bioretention facility but not within the facility
- Repair broken components and outlet structure
- Remove sediment in facility
- Water plants every 3 days for the first 18 months after establishment and during droughts (when there has been no rain for more than 10 days)

What to Avoid

- Keep animal waste out of the facility
- Do not shovel snow onto the facility

Facility	Propety Type	Relative Cost	Benefit	Level of Maintenance
Bioswale	C/I	$$	Water Quality, Runoff Rate Reduction, Storm Conveyance	Low

2.1.5 Inlet Retrofits

Within N4 (South Bethany) there were many inlets located in small depression areas. Examples are provided in Figure 9. One potential retrofit to improve stormwater quality before entering the inlet is to remove the pavement and rip-rap surrounding these inlets. Grass and native vegetation can then be planted around the inlets to serve as pretreatment.

Figure 9. Inlets surrounded by rip-rap and concrete in N4 (South Bethany) that can be modified to remove the impervious cover and include grass/native vegetation pretreatment.

Bioswales

Connectivity & Traffic Calming Context Map

LITTLE CREEK, DELAWARE

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DESIGN STUDIO

LEGEND

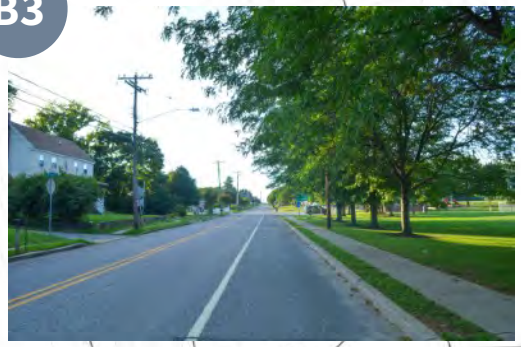
- Median
- Crosswalk
- Bioswale
- Trailhead

B4

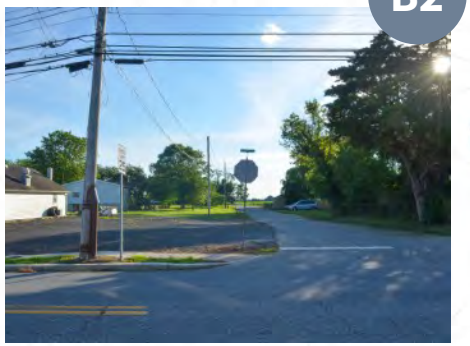
B5

B5
B4
B3

B3



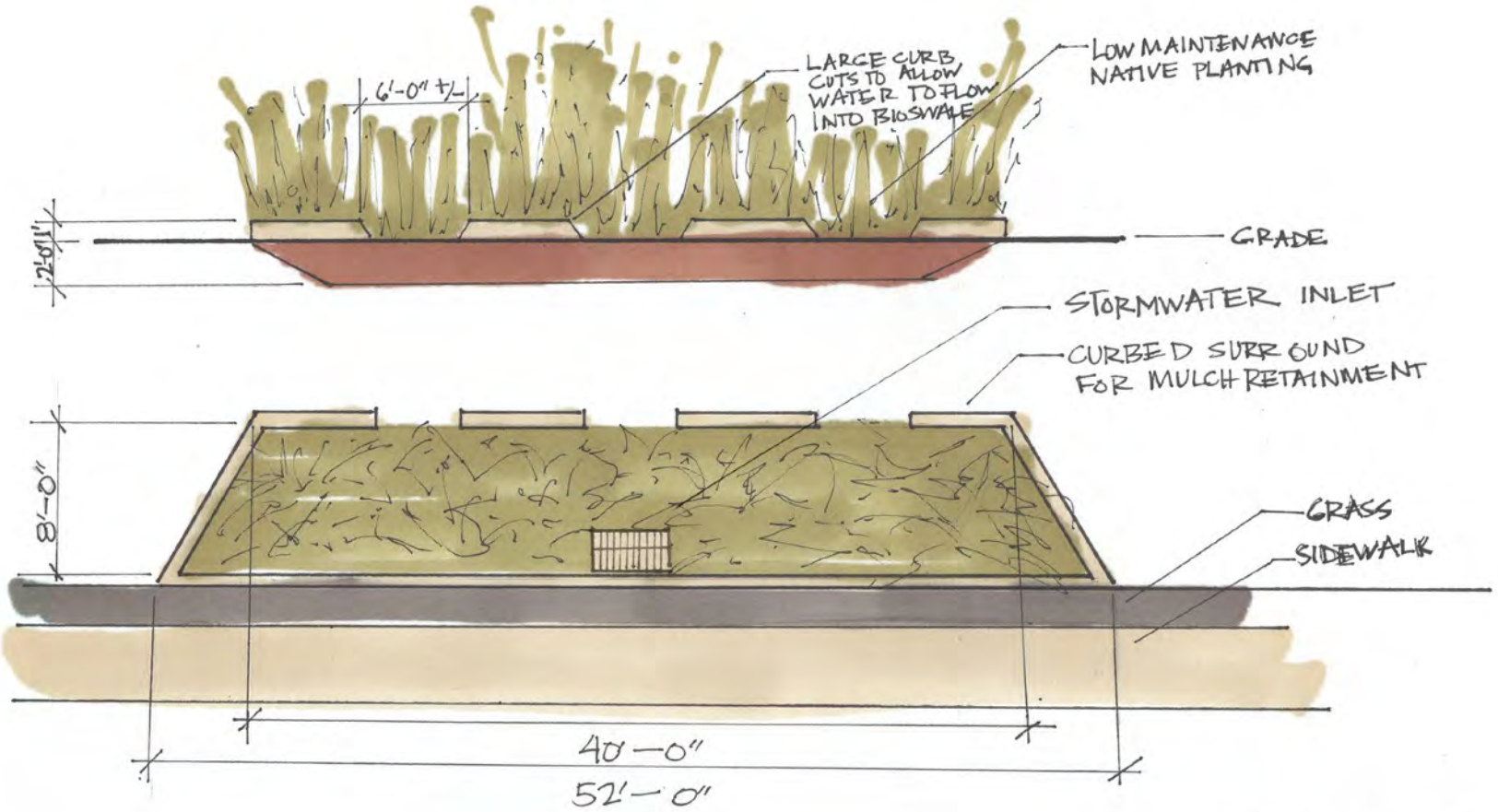
B2

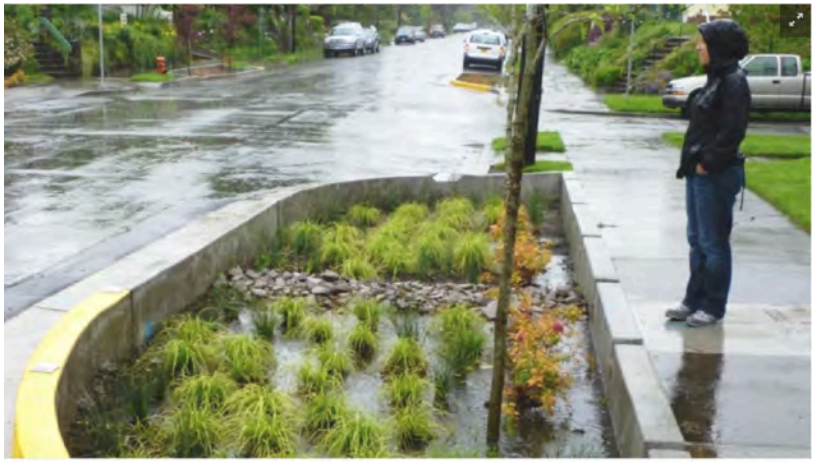


B2
B1

B1

SAMPLE RETROFIT BIOSWALE





Bioswales have many benefits, including a reduction in strain on a city's municipal sewer system. Less water in sewers generally leads to cleaner rivers and waterways. Click through the gallery for more about Portland's bioswales.

Connection

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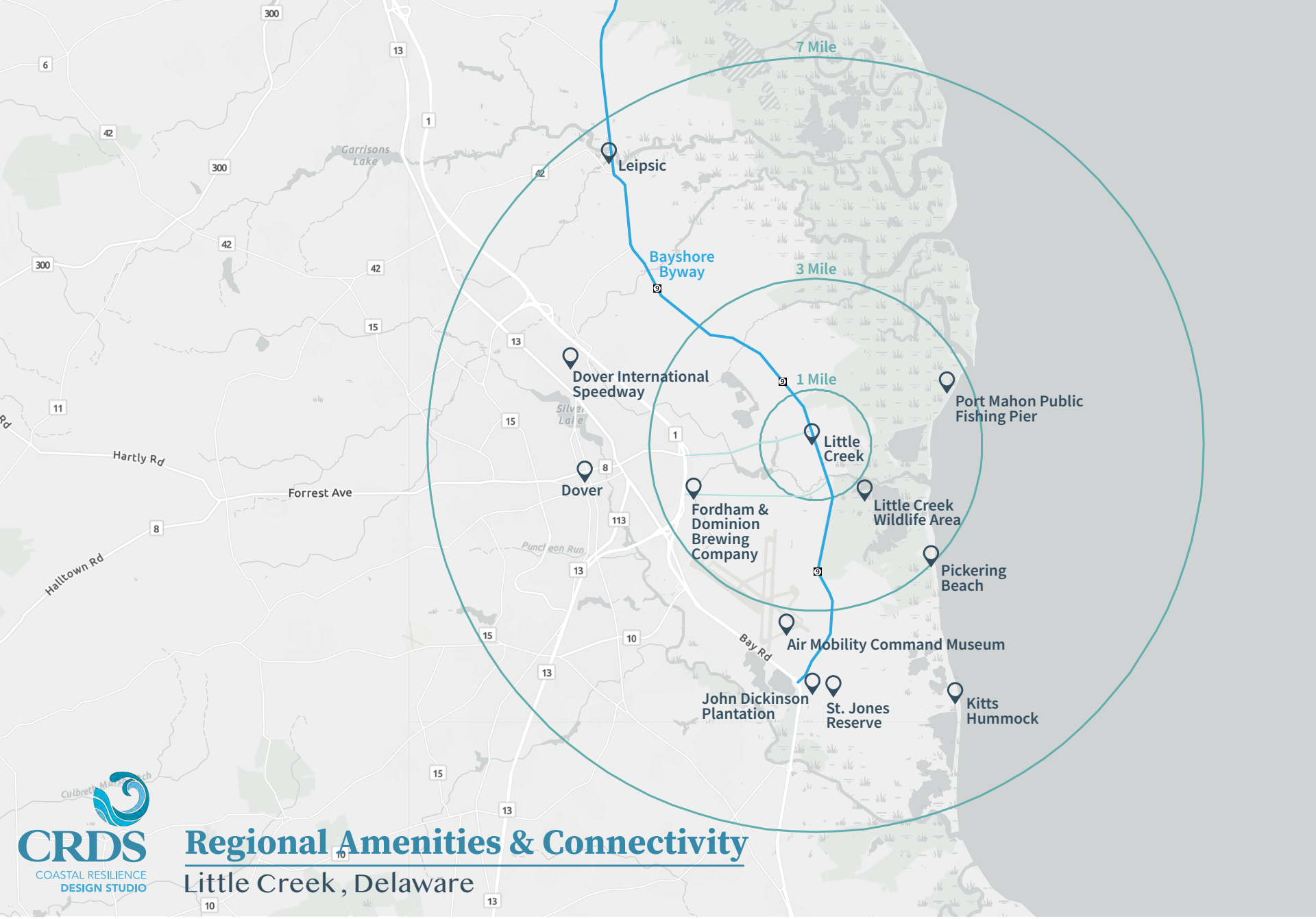

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Regional Amenities & Connectivity

Little Creek, Delaware

BAYSHORE BYWAY

BAYSHORE BYWAY

New Castle | Delaware City | Port Penn | Leipsic

BAYSHORE River Towns

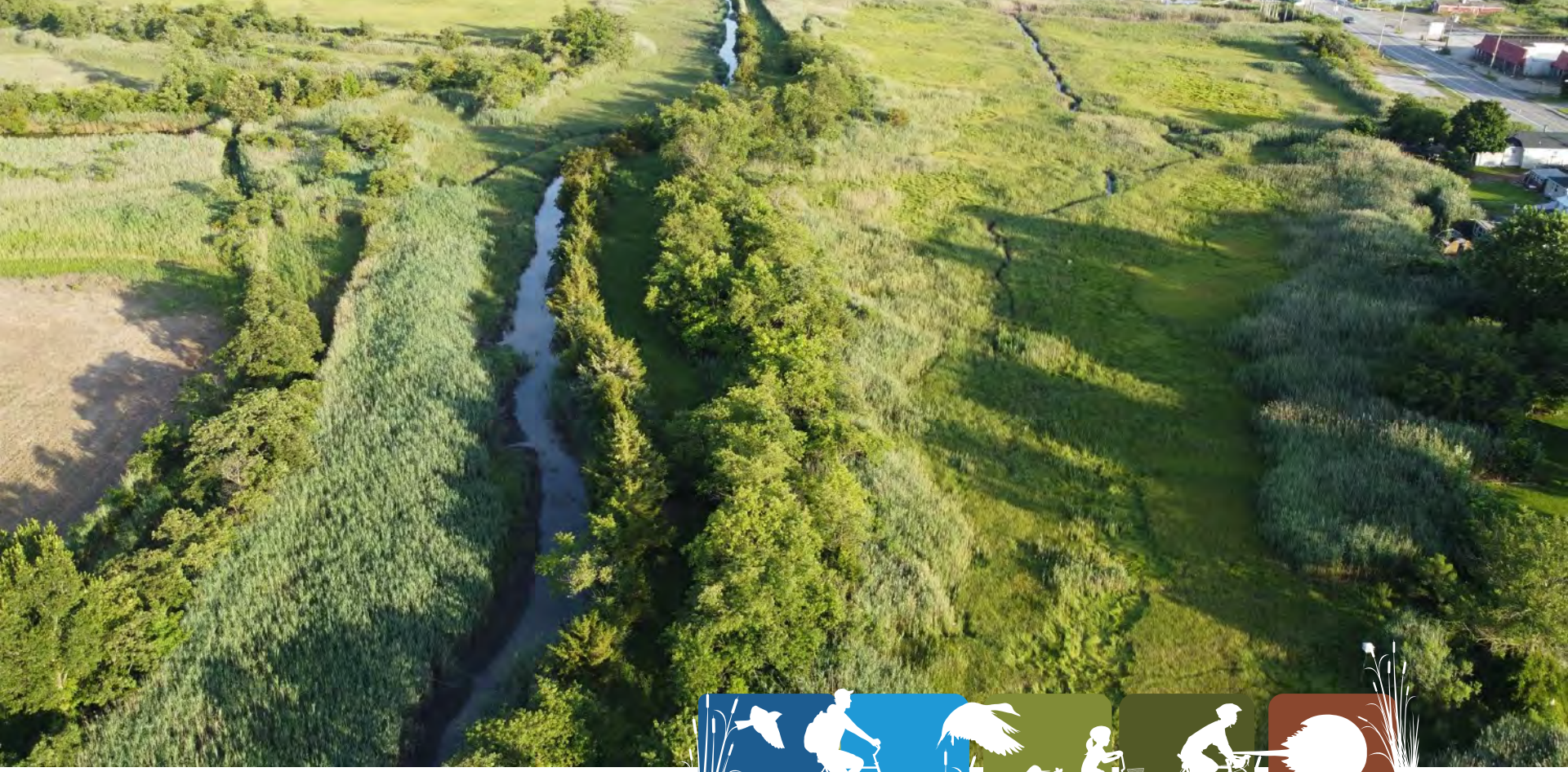
Little Creek | Frederica | Milford | Milton

Augustine | Woodland | Pickering | Kitts Hummock | Bowers

BAYSHORE Beaches

South Bowers | Slaughter | Prime Hook | Broadkill | Lewes


12ft
10ft
8ft



BAYSHORE Bikeway

COASTAL RESILIENCE DESIGN STUDIO | UNIVERSITY OF DELAWARE

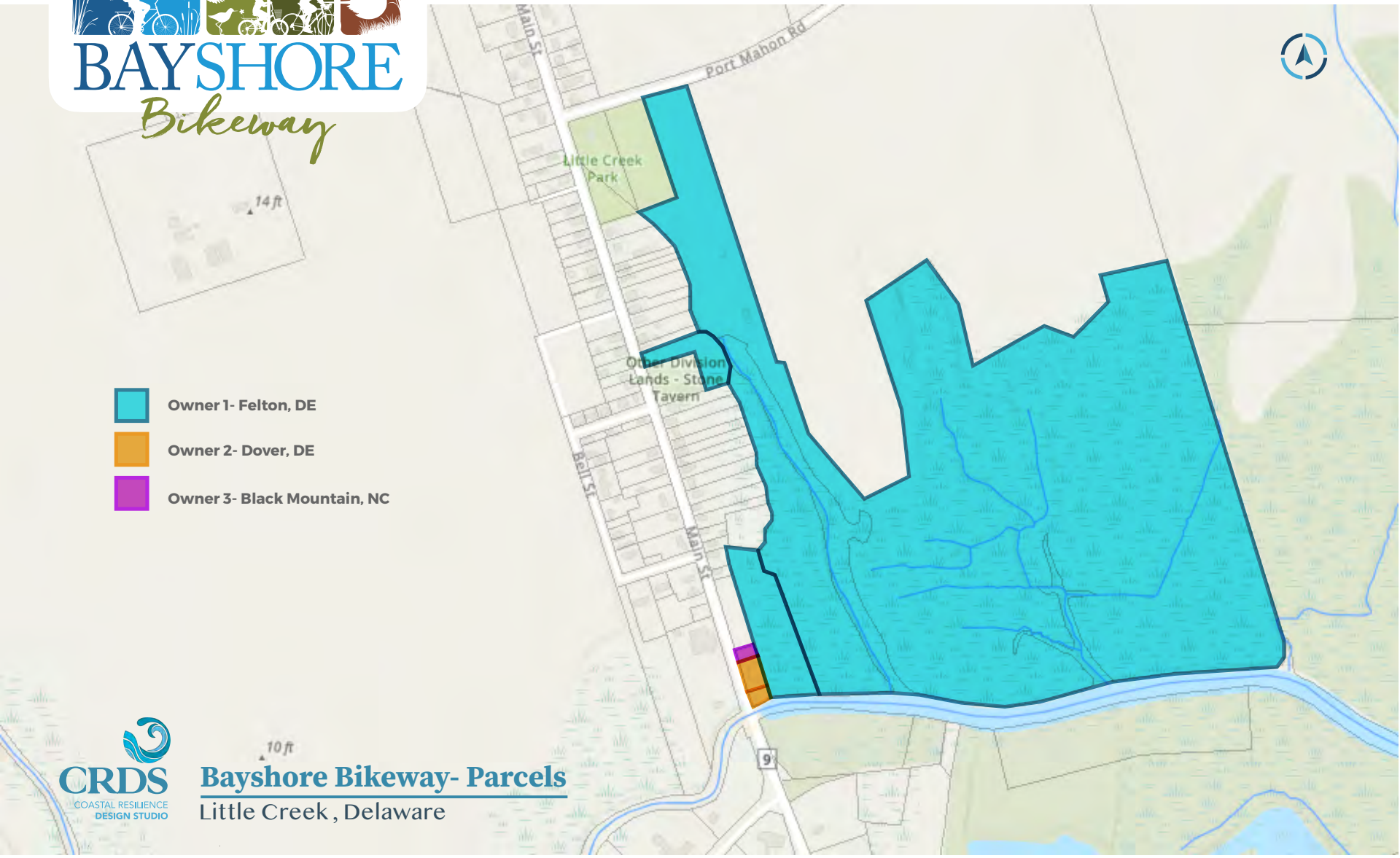
BAYSHORE Bikeway

CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Trail

Little Creek , Delaware

BAYSHORE Bikeway

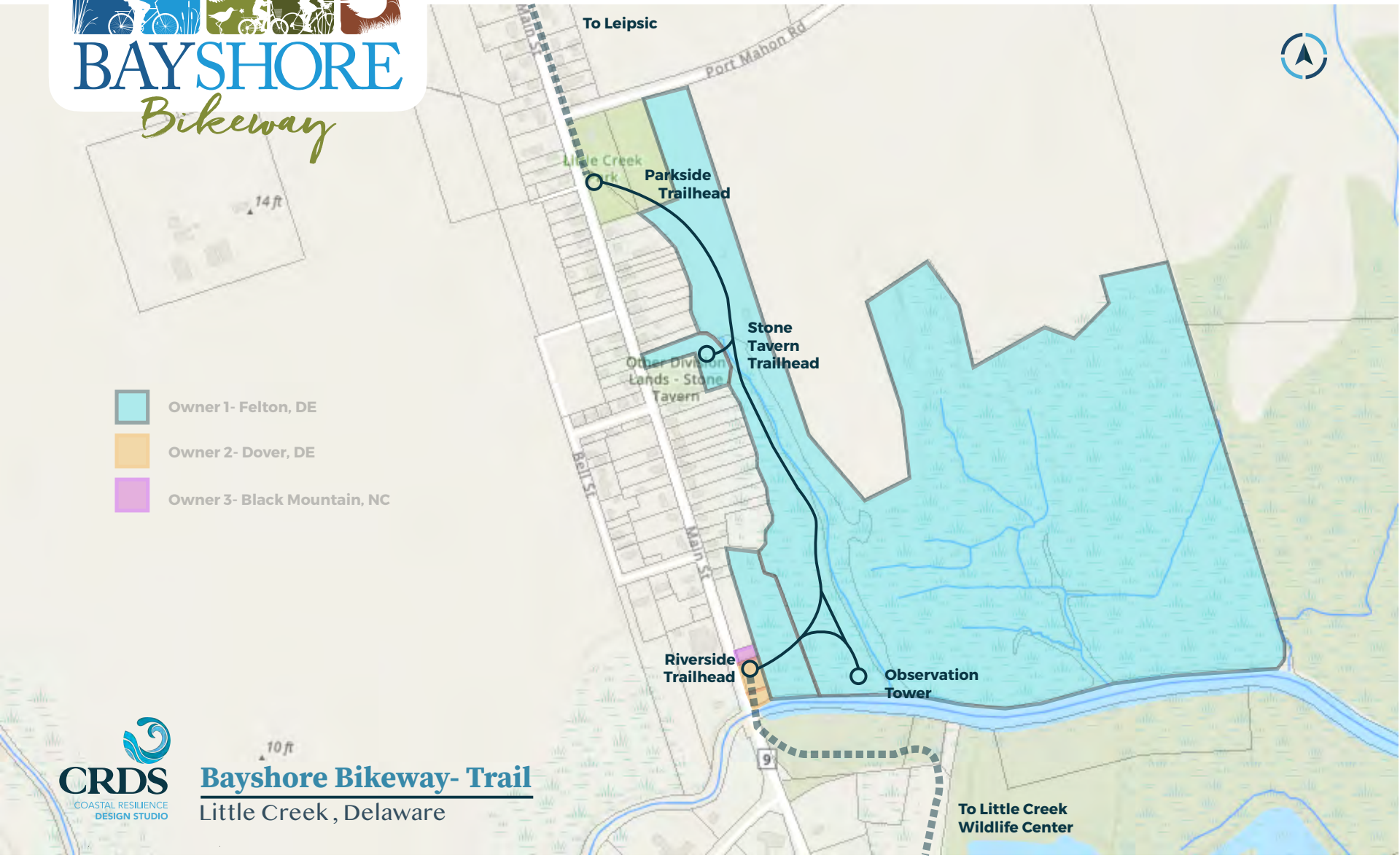


CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Parcels

Little Creek , Delaware

BAYSHORE Bikeway

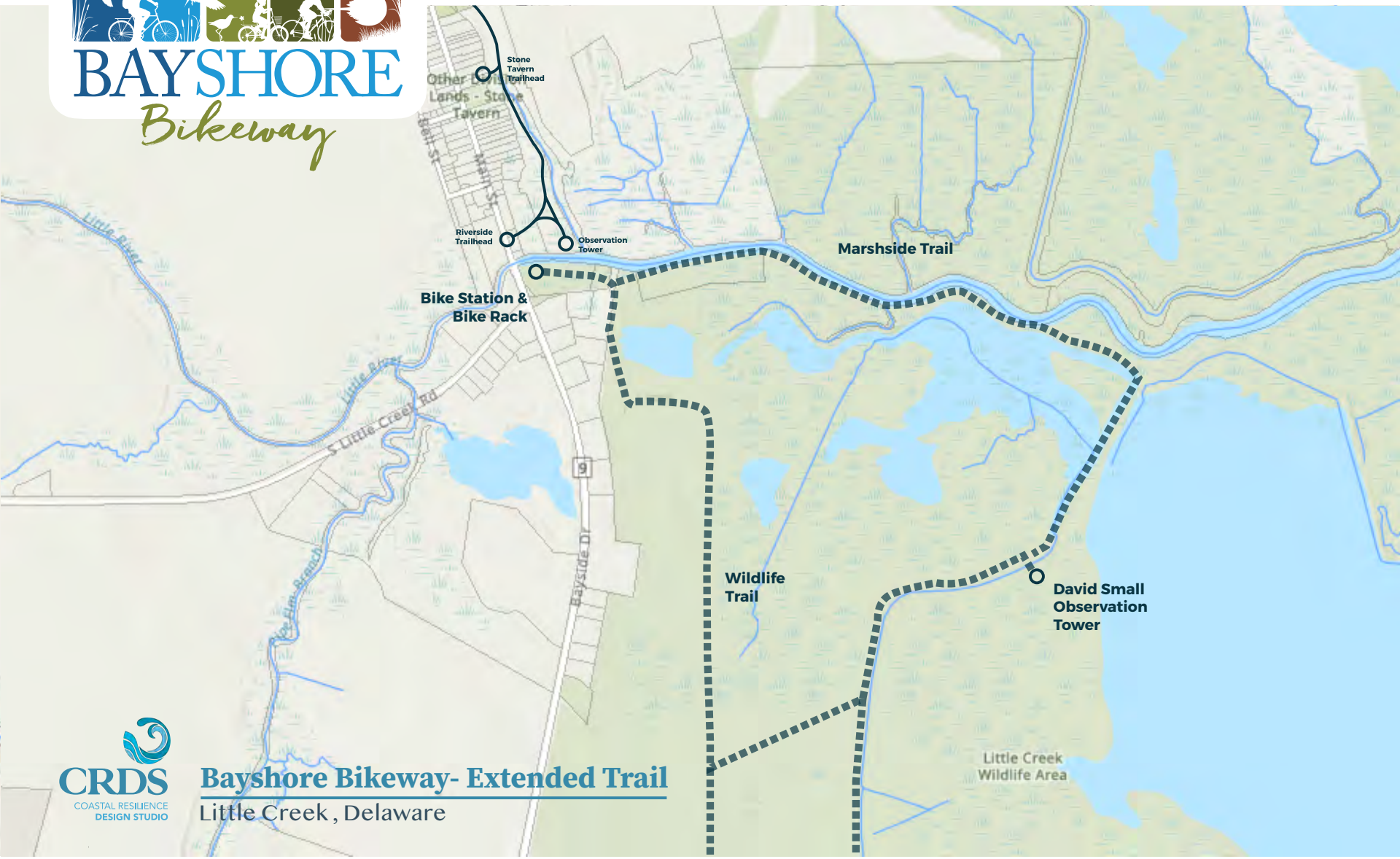


CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Trail

Little Creek , Delaware

BAYSHORE Bikeway



CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Extended Trail

Little Creek , Delaware

BAYSHORE Bikeway

CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Extended Trail

Little Creek, Delaware

BAYSHORE BYWAY

Bloodthirsty 5k

LITTLE CREEK, DE

BIKE TRAIL MILES

T3 Parkside

Trailheads

Connectivity & Traffic Calming Context Map

LITTLE CREEK, DELAWARE

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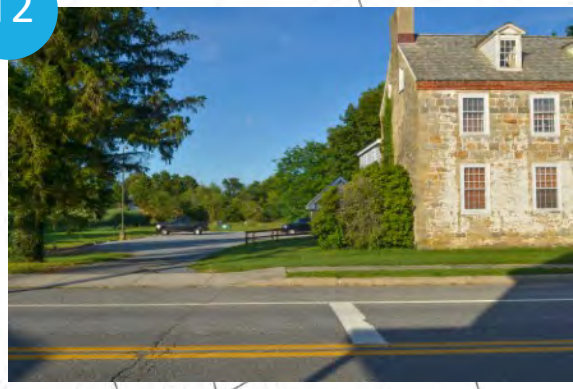
LEGEND
- Median
- Crosswalk
- Bioswale
- Trailhead

T2 Stone Tavern

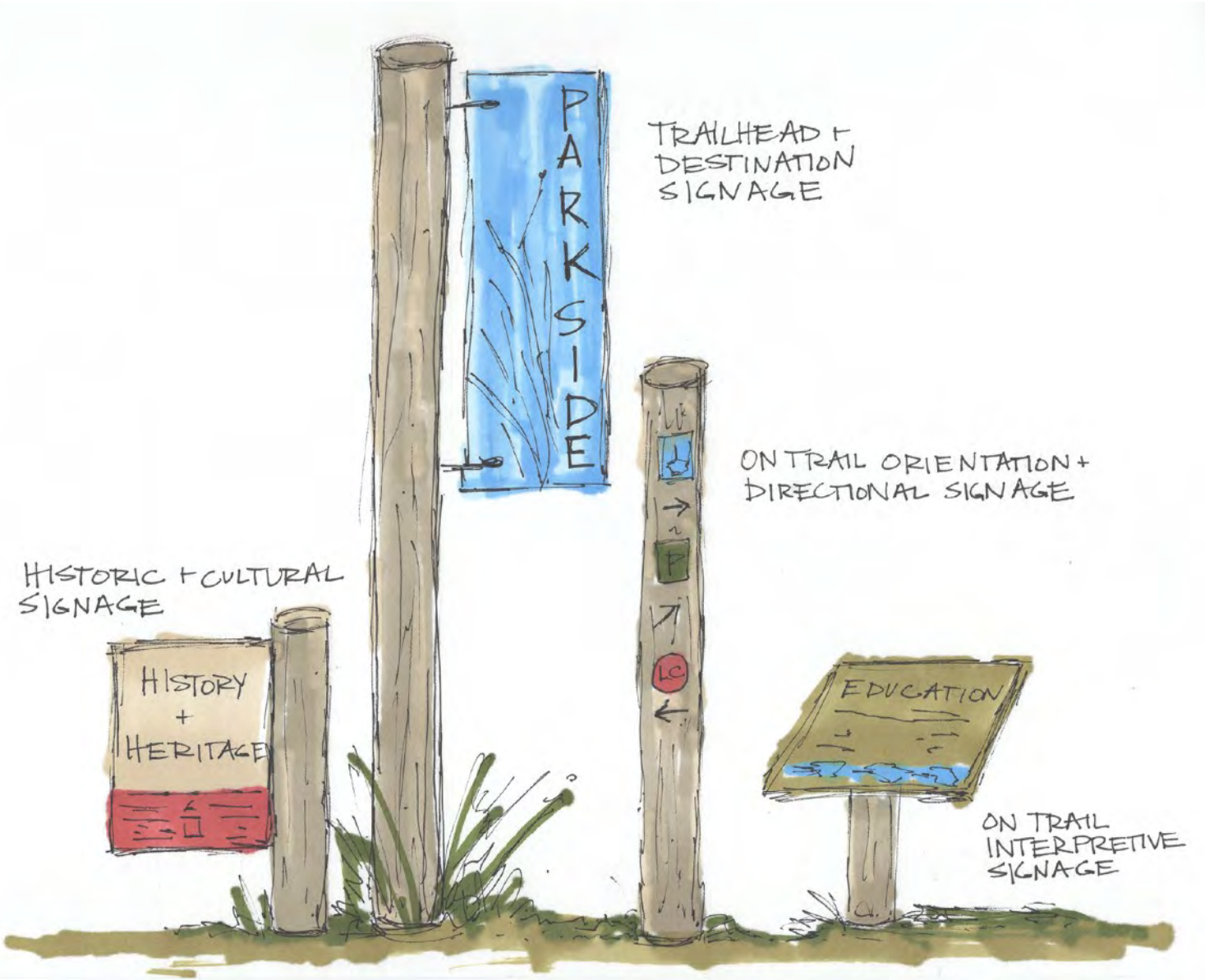


T1 Riversid
e

T3
T2
T1


BAY SHORE
Bike
LITTLE CREEK
RIVERSIDE

BAYSHORE
Bikeway

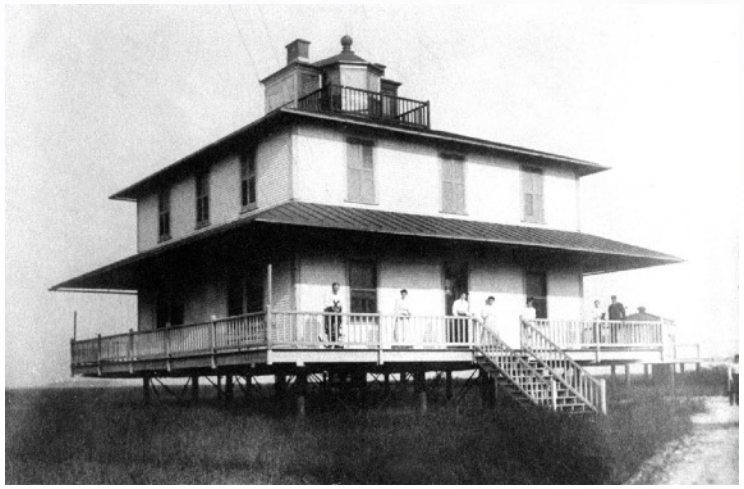


BAYSHORE Bikeway

CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Trail

Little Creek , Delaware



JARMAN LOOKOUT
OBSERVATION TOWER

LITTLE RIVER OVERLOOK

Little Creek
DELAWARE
= est. 1899 =

Slow Down. Live A Little.

Delaware BAYSHORE
All American, All Natural

DelDOT

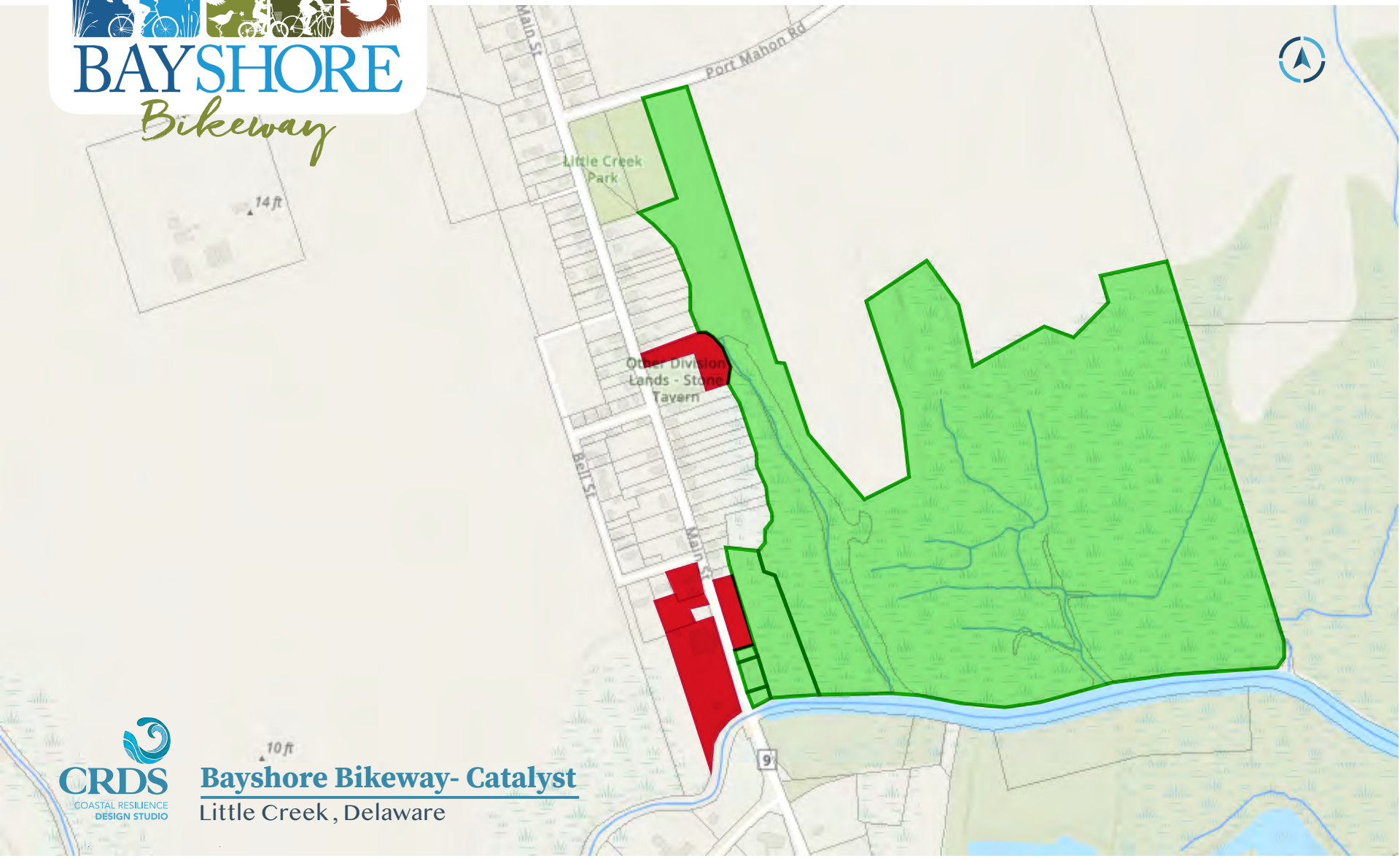
DELAWARE DIVISION OF WATER

The Town of Little Creek is a charming Bayshore town with an interesting history while offering the potential for traveler services. The Town of Little Creek, settled in the early 1800's, allegedly was first inhabited by pirates. Originally called Little Landing, the town was most prosperous in the late 1800's when a thriving oyster industry emerged. Nearby Port Mahon grew into a stopover for large ships and commercial boats that led to businesses, such as bait shops, restaurants and a cannery in town. The Old Stone Tavern, actually never a tavern, was built in 1829 with the stone from the ballast of old sailing ships. Today, few boats are found in the Town's waters. Now, part of the Little Creek Wildlife Area, Port Mahon was previously lined with fishing shacks and oyster-shucking houses."

Bikeway Extension

- Phased goals aimed at connecting the bikeway south to the Little Creek Wildlife Center and north to Leipsic through a **buffered shared path** along Route 9, eventually converting to a marked sharrow lane.
- Bayshore Byway communities have an opportunity to offer **unique bike and walking experiences** in their community.
- The ultimate goal is to continue the bikeway north through **all the Bayshore Byway towns** to Delaware City.

BAYSHORE Bikeway



CRDS COASTAL RESILIENCE DESIGN STUDIO

Bayshore Bikeway- Catalyst

Little Creek , Delaware

Commercial Opportunity

LITTLE CREEK, DELAWARE

Commercial Objectives

- Create an inviting commercial district in close proximity to the river
- Honor maritime history and small-town character
- Incentivize private investment
- Increase wetland habitat
- Increase the riparian buffers


Little Creek
DELAWARE
= est. 1899 =

Limitations

Wetlands

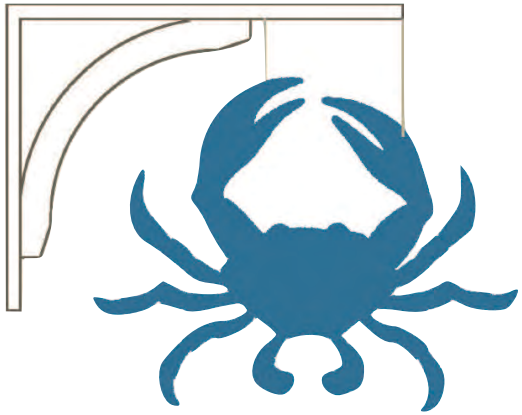
Riparian Buffer

Setbacks

Base Flood Elevation (BFE - 1%) - 11ft + 1.5ft freeboard = 8.5ft Finished Floor Elevation

WATERMANS

Village



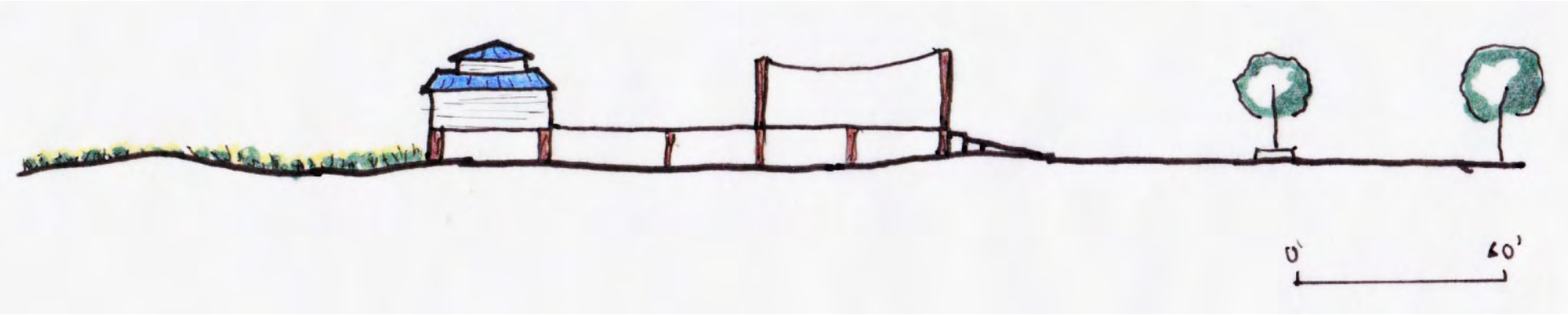
Bayshore

SEAFOOD MARKET

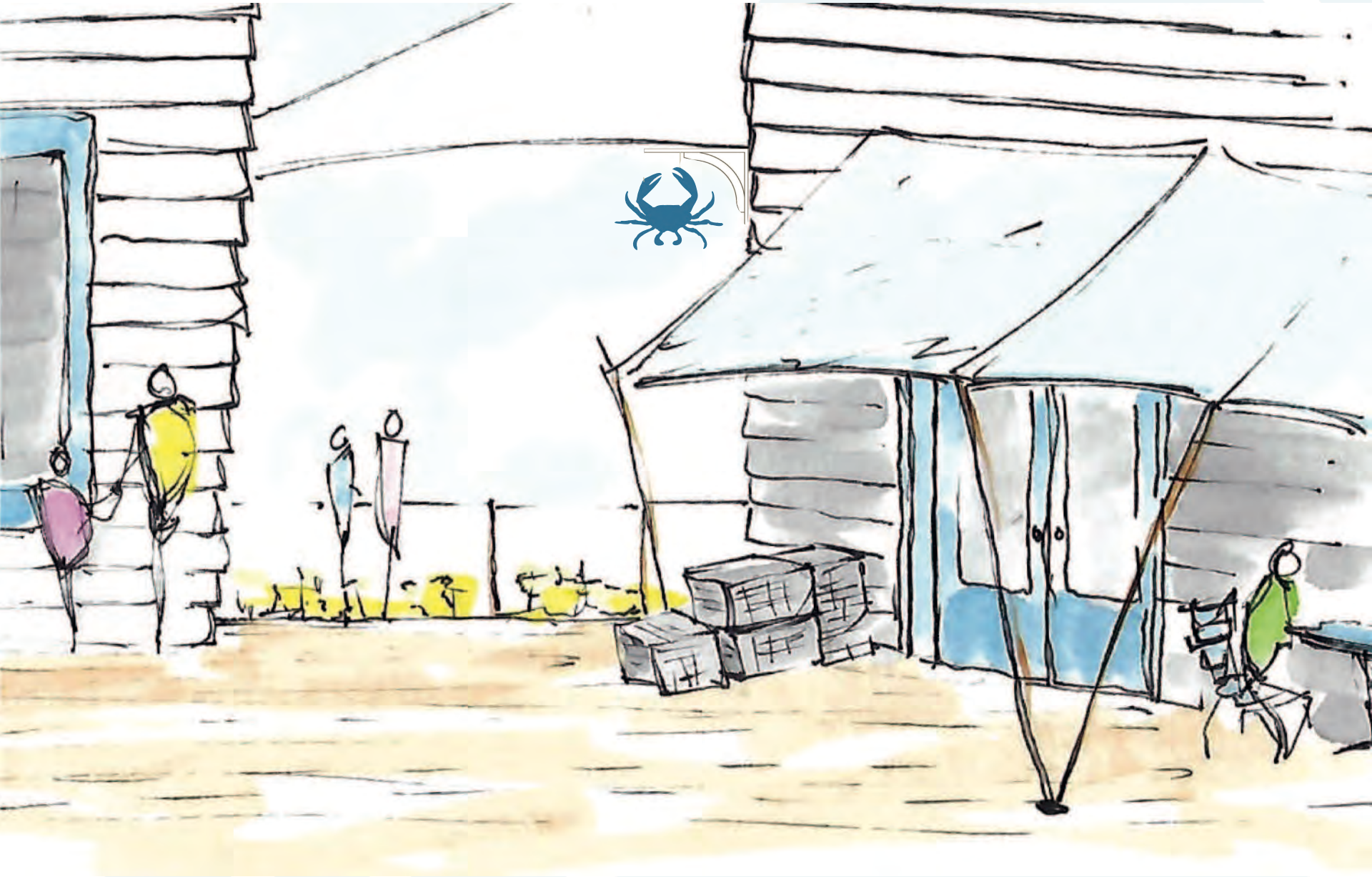
Fresh off the Boat


WATERMAN'S VILLAGE
RESTAURANT
RETAIL
REST.
REST.
RESTAURANT
RESTORED WETLAND
SHORELINE HABITAT RESTORATION AREA
LITTLE RIVER
RAMP
PERMEABLE PAVING
MAIN STREET
SHADE SAILS
TRAILHEAD
COMMERCIAL POP-UP SEAFOOD/FARMERS MARKET AREA
TRAFFIC MEDIAN
0'
60'
120'
0"
1"
2"

Section of Waterman's Village




WATERMAN'S
Village
Bayshore
SEAFOOD MARKET
Fresh off the Boat




TONY'S SEAFOOD


KERBISHER & MALT
FISH AND CHIPS
EAT-IN
TAKEAWAY
53


WATERMAN'S VILLAGE
RESTAURANT
RETAIL
REST.
REST.
RESTAURANT
RESTORED WETLAND
SHORELINE HABITAT RESTORATION AREA
LITTLE RIVER
RAMP
PERMEABLE PAVING
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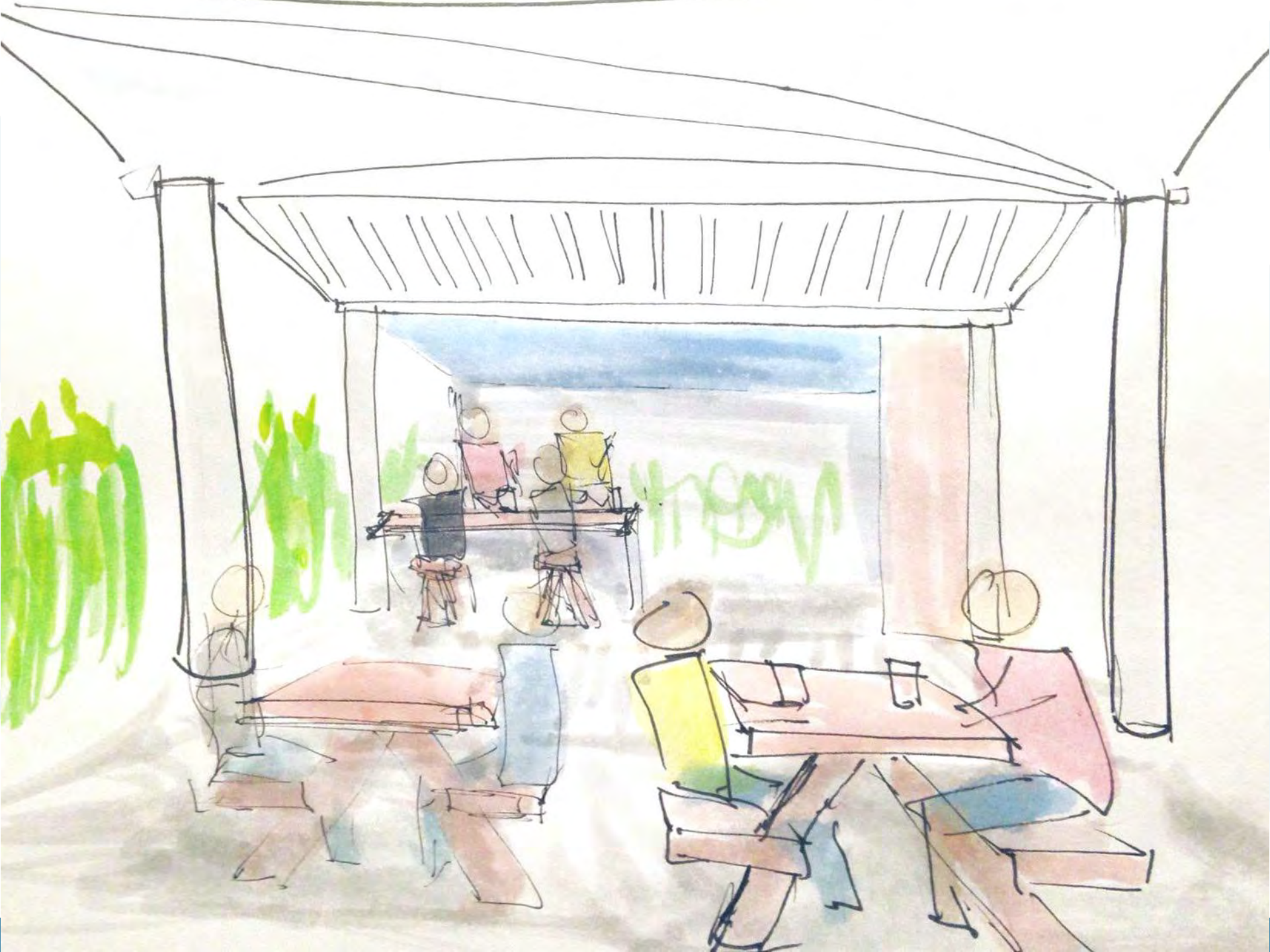


Bayshore
SEAFOOD MARKET
Fresh off the Boat

Gained Benefits

- **5k sq ft** of **commercial space** in 5 buildings
- **3k sq ft** of outdoor **seating and recreation**
- **28 parking spaces** (+ on street parking and optional parking underneath the deck)
- **10k sq ft new wetland habitat**

Questions

- What are the limitations of placing a crosswalk near the bridge?
- We ran the calculator on the median taper line and it worked out to 52.4’ but the diagram indicated 100’ minimum. Does this location require 100’ taper line?
- With a low posted speed and a low pedestrian count, do we need more than the standard crosswalk signage?
- What are the limitations of parking lane placed bioswales? Can they be curbed to avoid mulch floating into the road?
- Can we use roadway paint as a visual constraint for the parking lane, or do we need to consider tinted asphalt? The on street parking is not consistently full enough to constrict the roadway for traffic calming.
- Are there top of mind funding sources that we could look into to implement any of the proposed projects? Particularly, sources that could be layered to address the stormwater and the bikeway as a combined effort?

Thank You!

CRDS
COASTAL RESILIENCE
DESIGN STUDIO