



Re-Inventing Canals: Stream Restoration for Transformative Benefits

**FSA Winter Conference
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Tampa, FL**

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John Ryan (Sarasota County)
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woodplc.com



Sarasota County

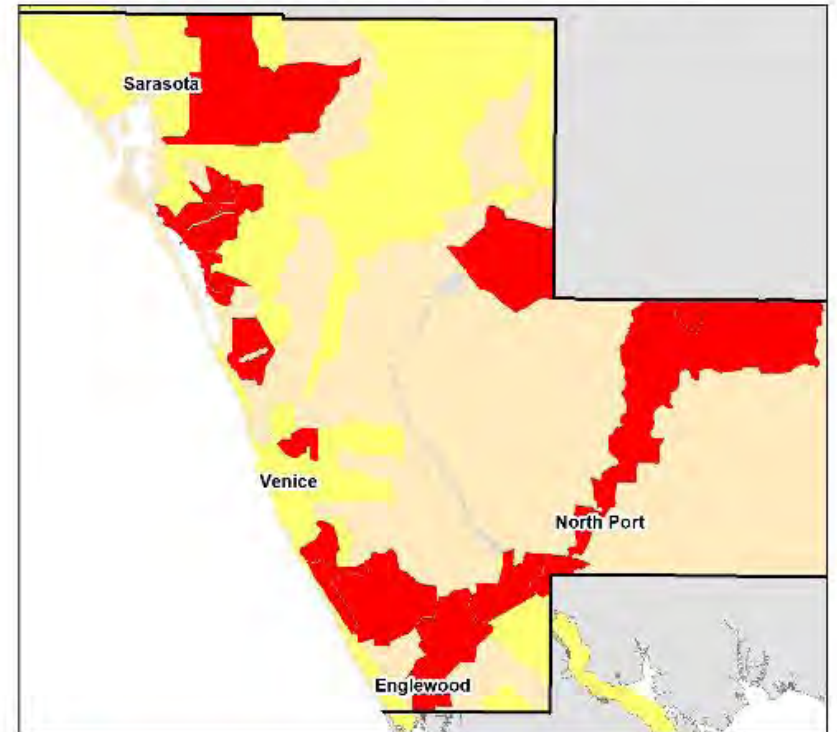
- Located between Tampa Bay and Charlotte Harbor
- Tourism & snowbird-based economy
- Beaches are No.1 attraction
- Bay boating, fishing, viewing
- Myakka “Wild and Scenic River” designation
- Clean water is essential to our reputation



Challenges - TMDLs

- TMDLs and Verified Impaired bodies of water
- Typical of developed areas
- Nitrogen and bacteria are the main pollutants

Sarasota County TMDL and Verified Impaired Waterbodies

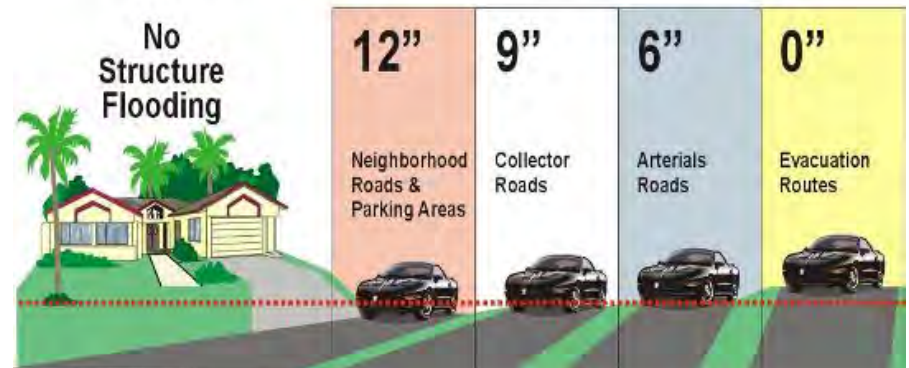


- TMDL Waterbodies
- Verified Impaired Waterbodies

Challenges – Stormwater Environmental Utility

- Focused on flood prevention
- Tasked with pollutant reductions via NPDES MS4 permit
- Fees not authorized for water quality projects
- Maintenance uses most of the money
- High pollutant loading areas are built out so few opportunities for reasonably priced retrofits

Acceptable Flooding for a 100 Year Storm

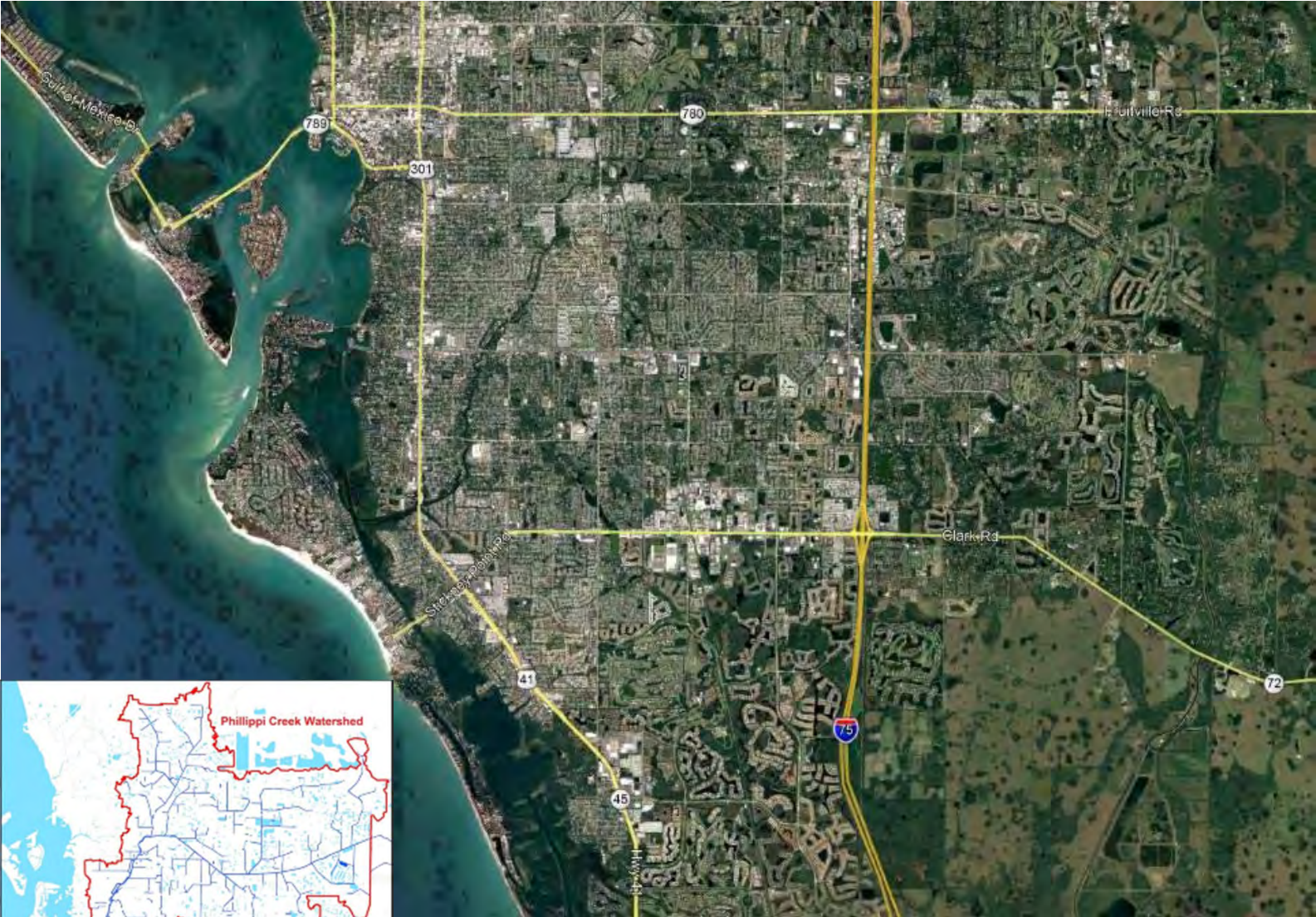


- Most intense red tide bloom - and long duration
- Significant economic impact
- Bad news traveled by social media
- Reclaimed water overflow - penalized and sued
- Elected officials make nitrogen pollution a TOP PRIORITY



- Hundreds of miles of canals
- Expensive to maintain and repair
- Exporting sediment downstream
- Unattractive – devalue surrounding properties
- Can we denitrify in canals?





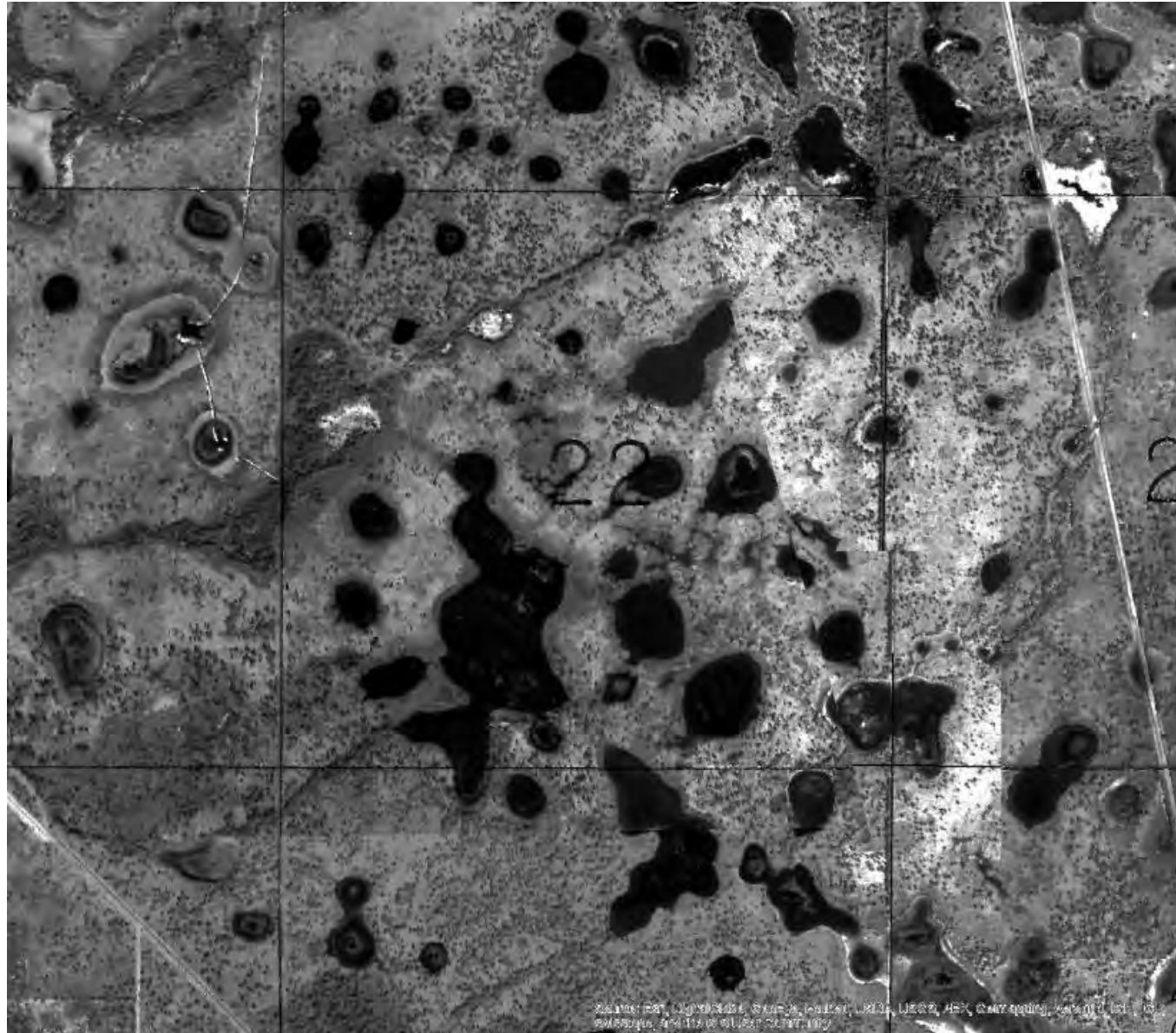
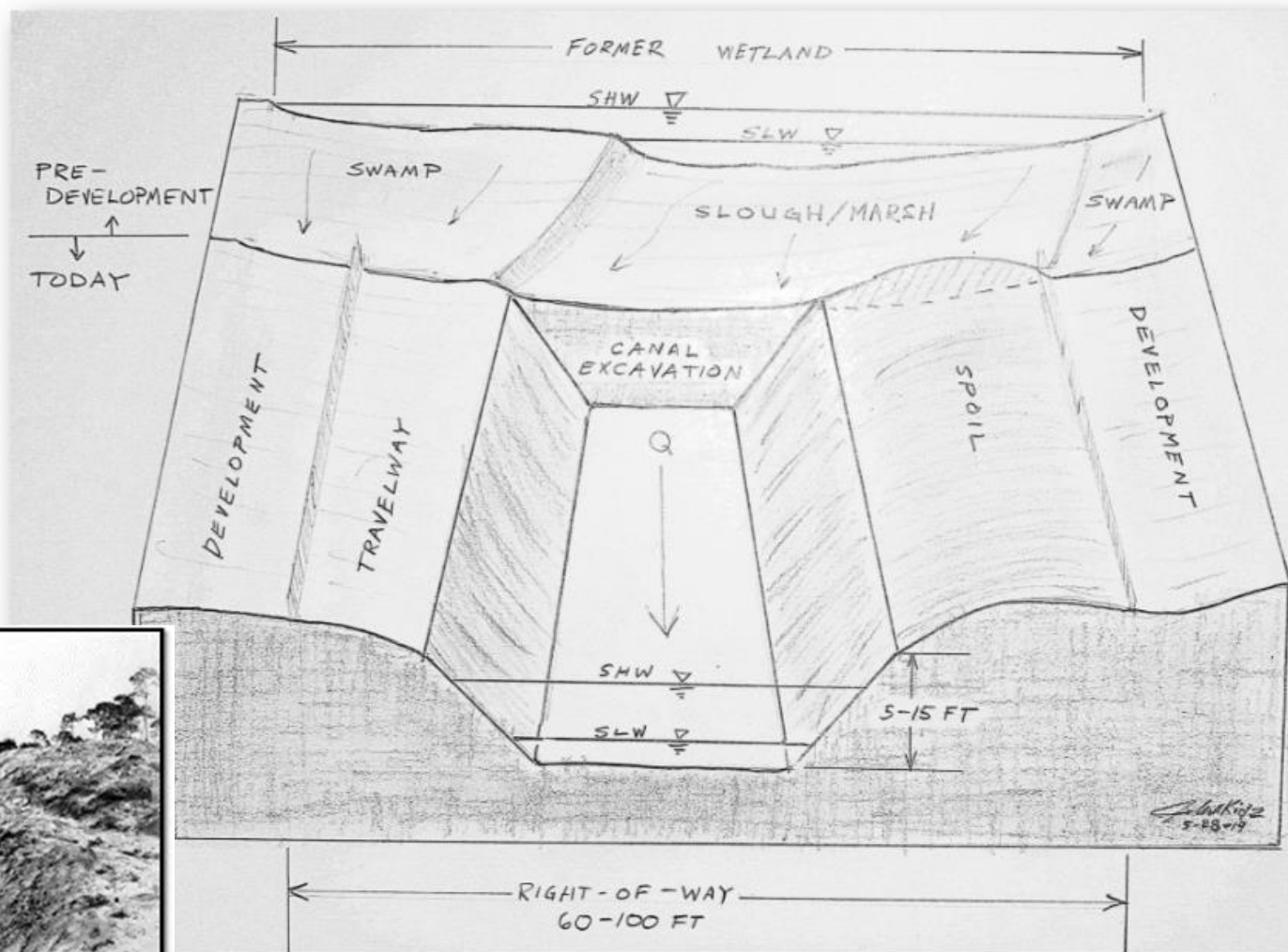




FIGURE 10.10: Aerial rendering of a residential development with a golf course, showing the layout of the community.



Phillippi Creek canal - east of Sarasota, 1929.

Simpson, G. G. Black & white photograph, 4 x 5 in. State Archives of Florida, Florida Memory. <<https://www.floridamemory.com/items/show/125094>>



Shallow Plane Failures

Variably Stable Toe



Stable

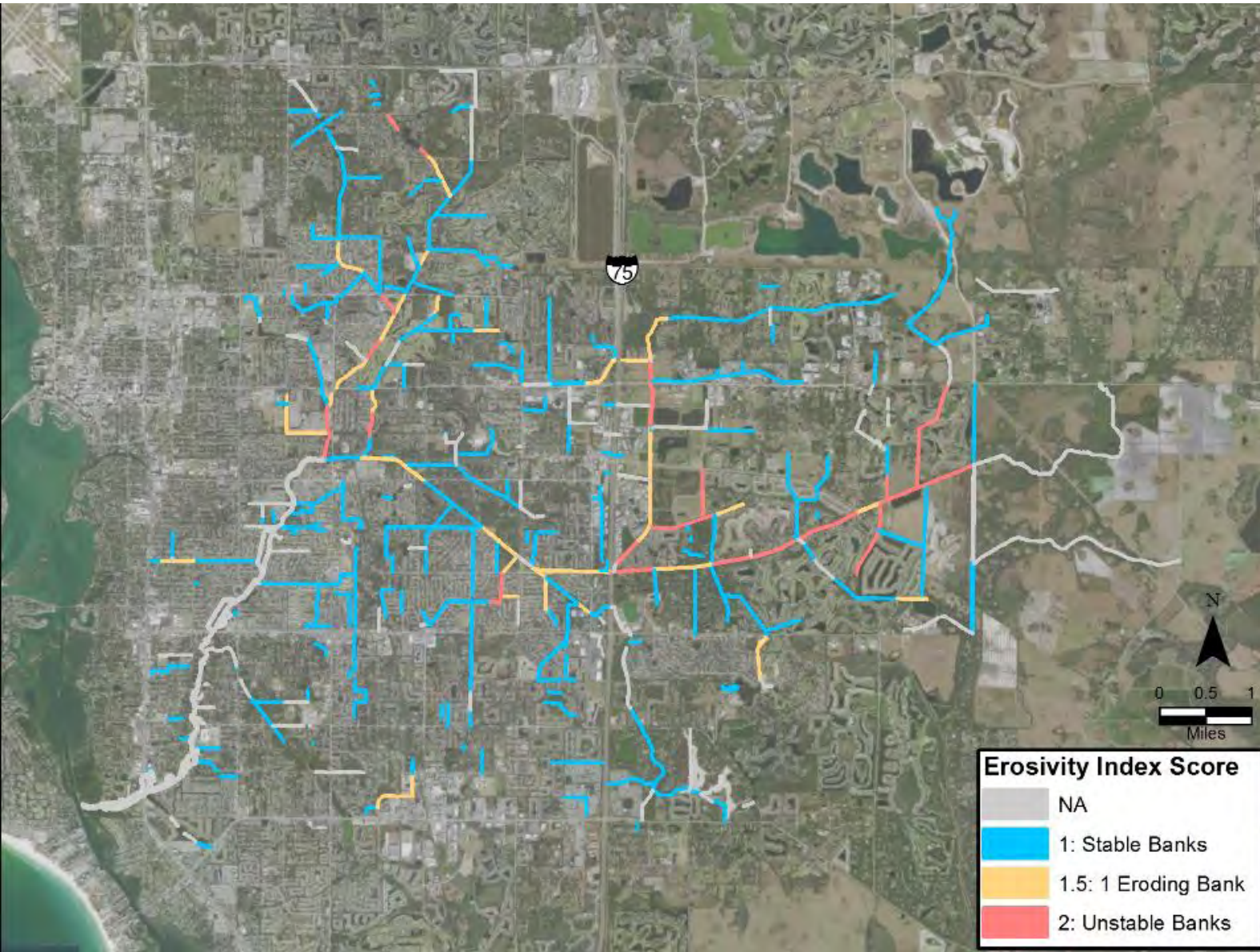
Unstable

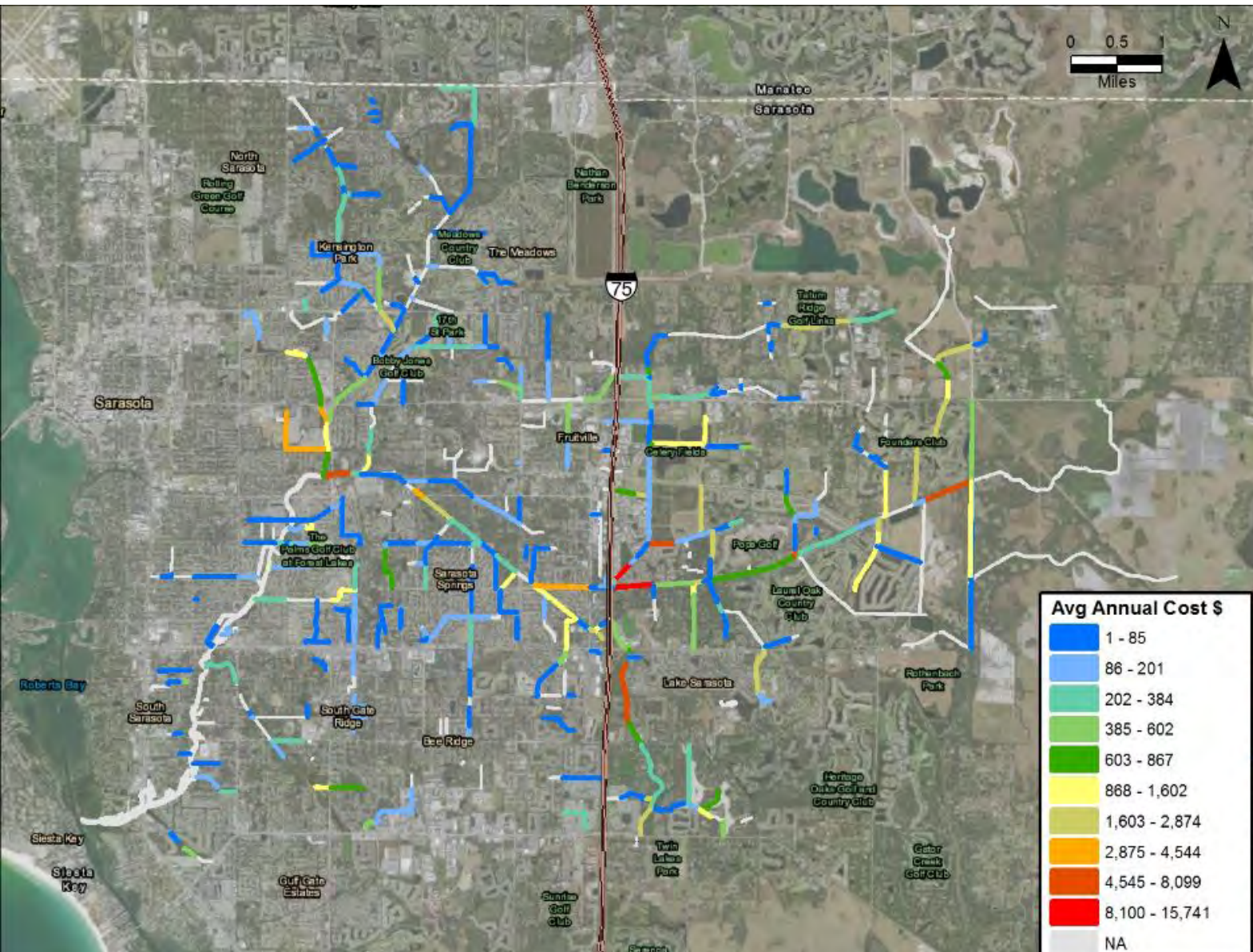
Scalloped Gravity Failures

Toe Scour



Uniform water depth over soft sand bed





North Sarasota
Rolling Green Golf Course

Kensington Park
Meadows Country Club
The Meadows

Halton Beachmen Park

Manatee Sarasota

Tatum Ridge Golf Links

Sarasota

75

17th St Park

Bobby Jones Golf Club

Fruitville

Galaxy Fields

Founders Club

The Palms Golf Club of Forest Lakes

Sarasota Springs

Papa Golf

Louis Oak Country Club

Roberts Bay

South Sarasota

South Gate Ridge

Bee Ridge

Lake Sarasota

Ratherbach Park

Siesta Key

Siesta Key

Gulf Gate Estates

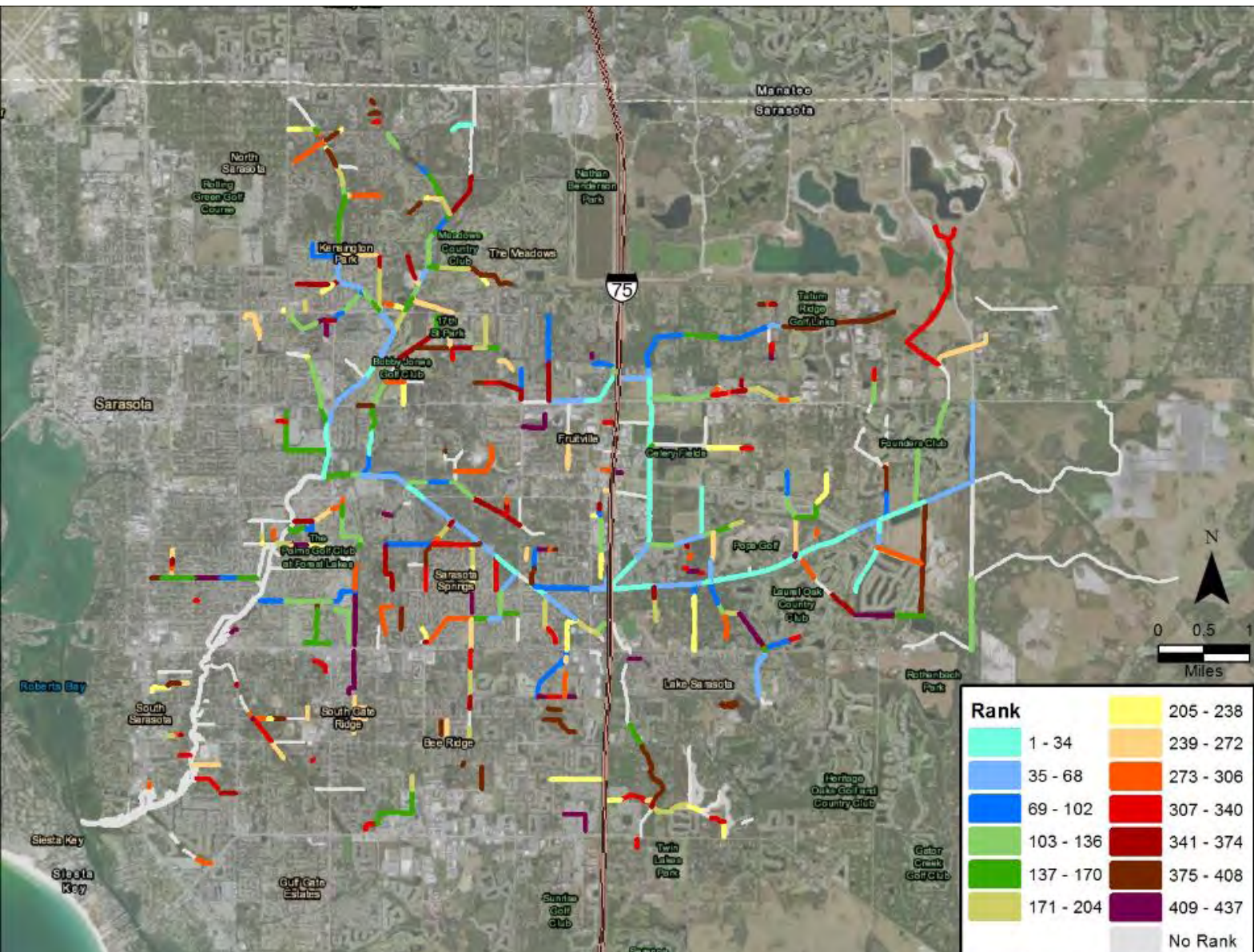
Sundee Golf Club

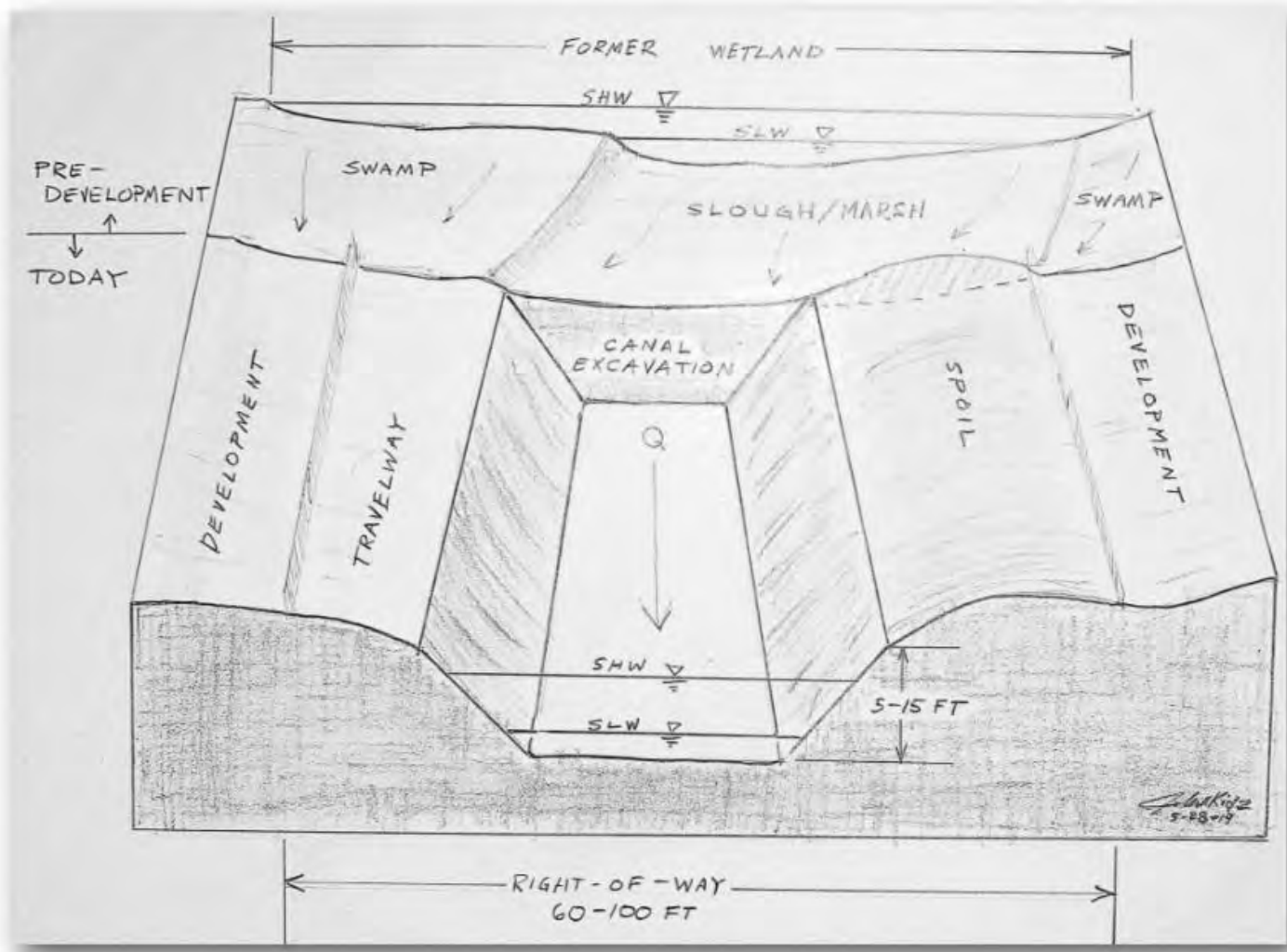
Twin Lakes Park

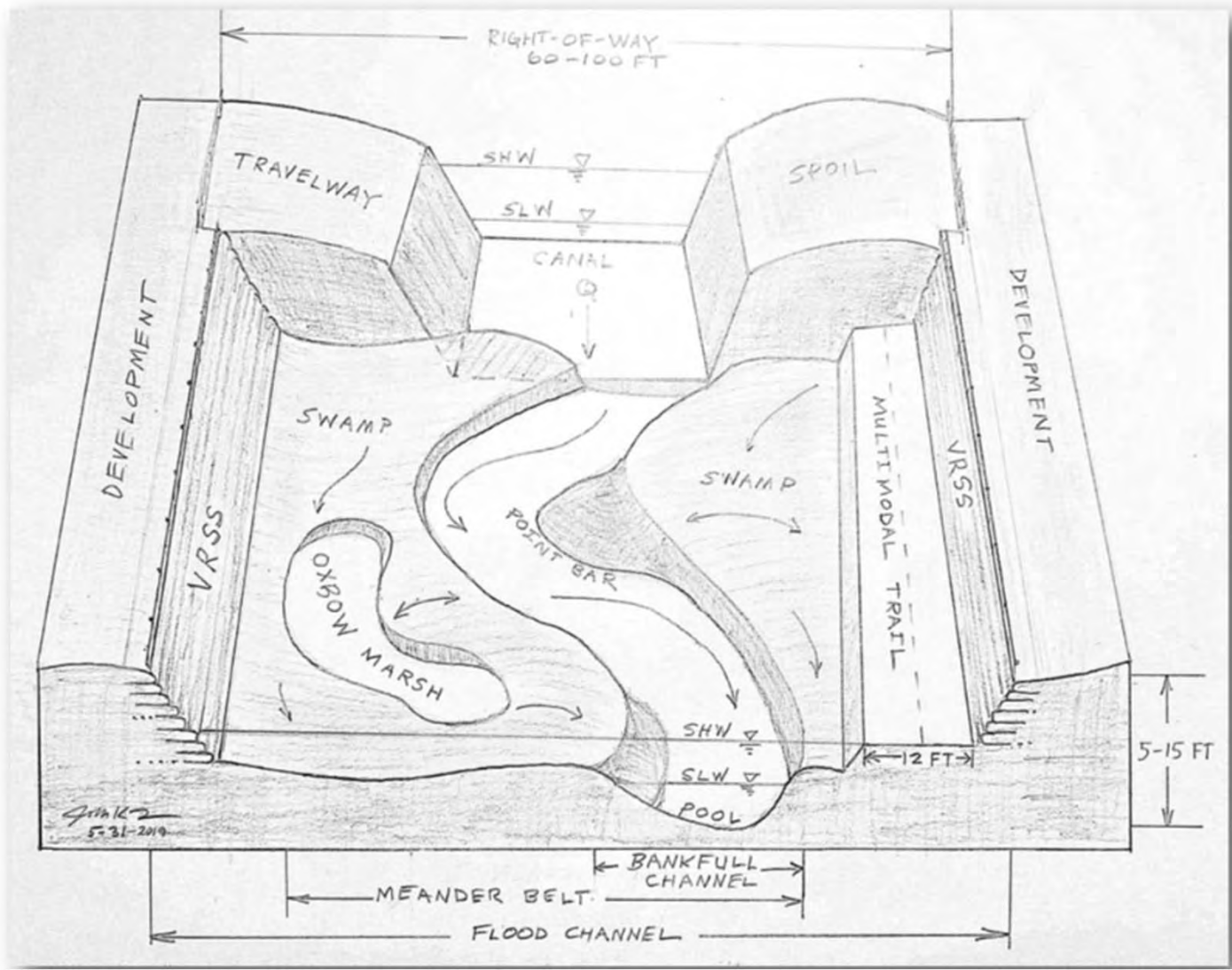
Horizon Oaks Golf and Country Club

Gator Creek Golf Club

Sarasota











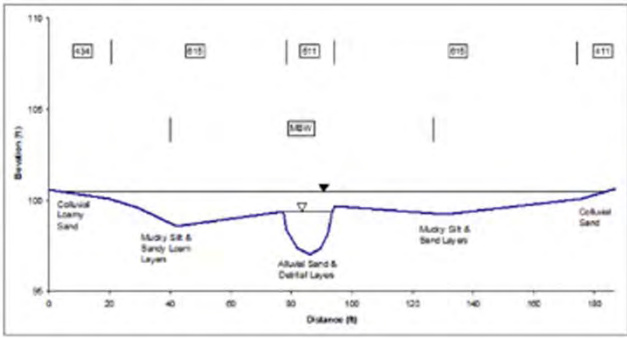


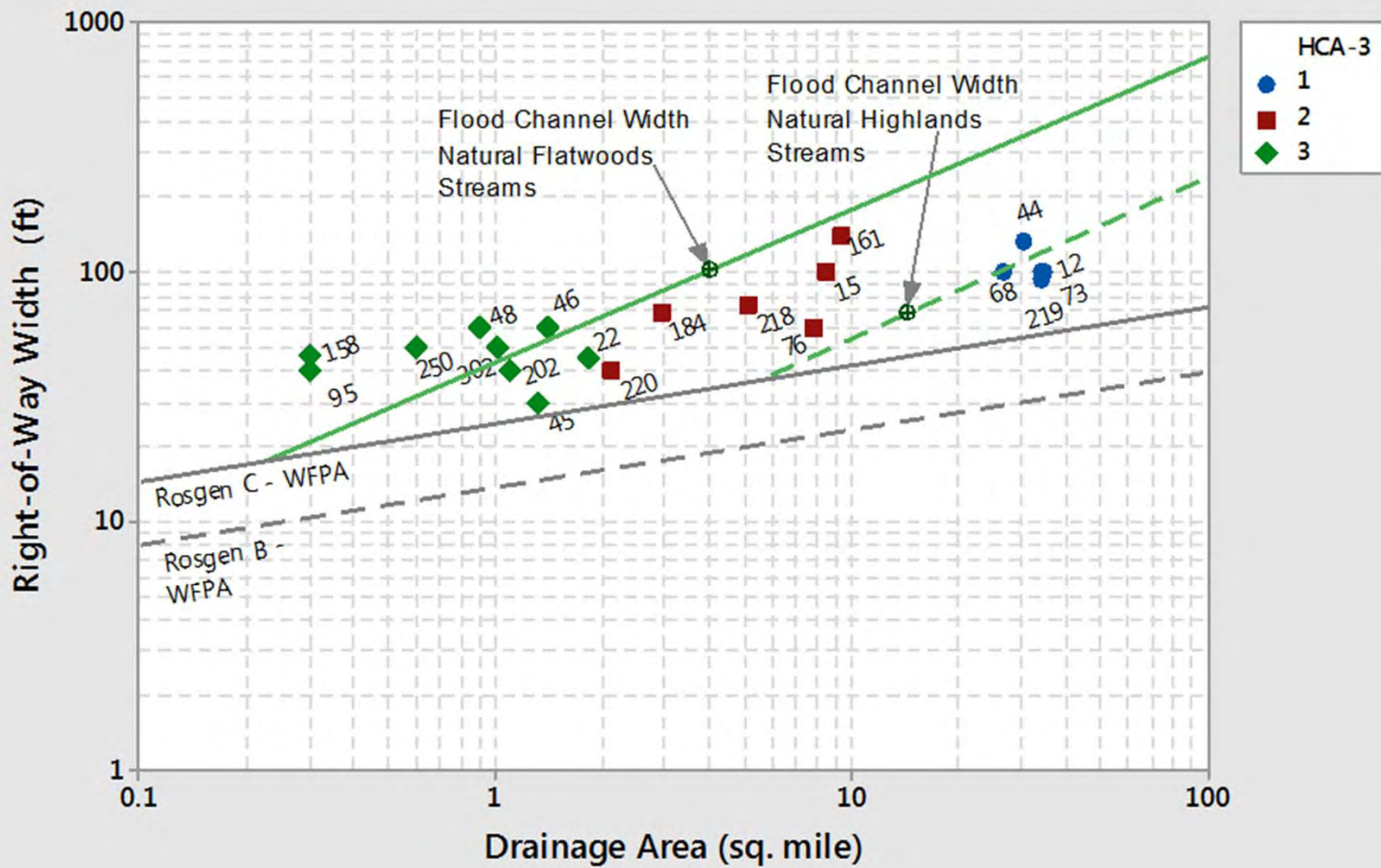


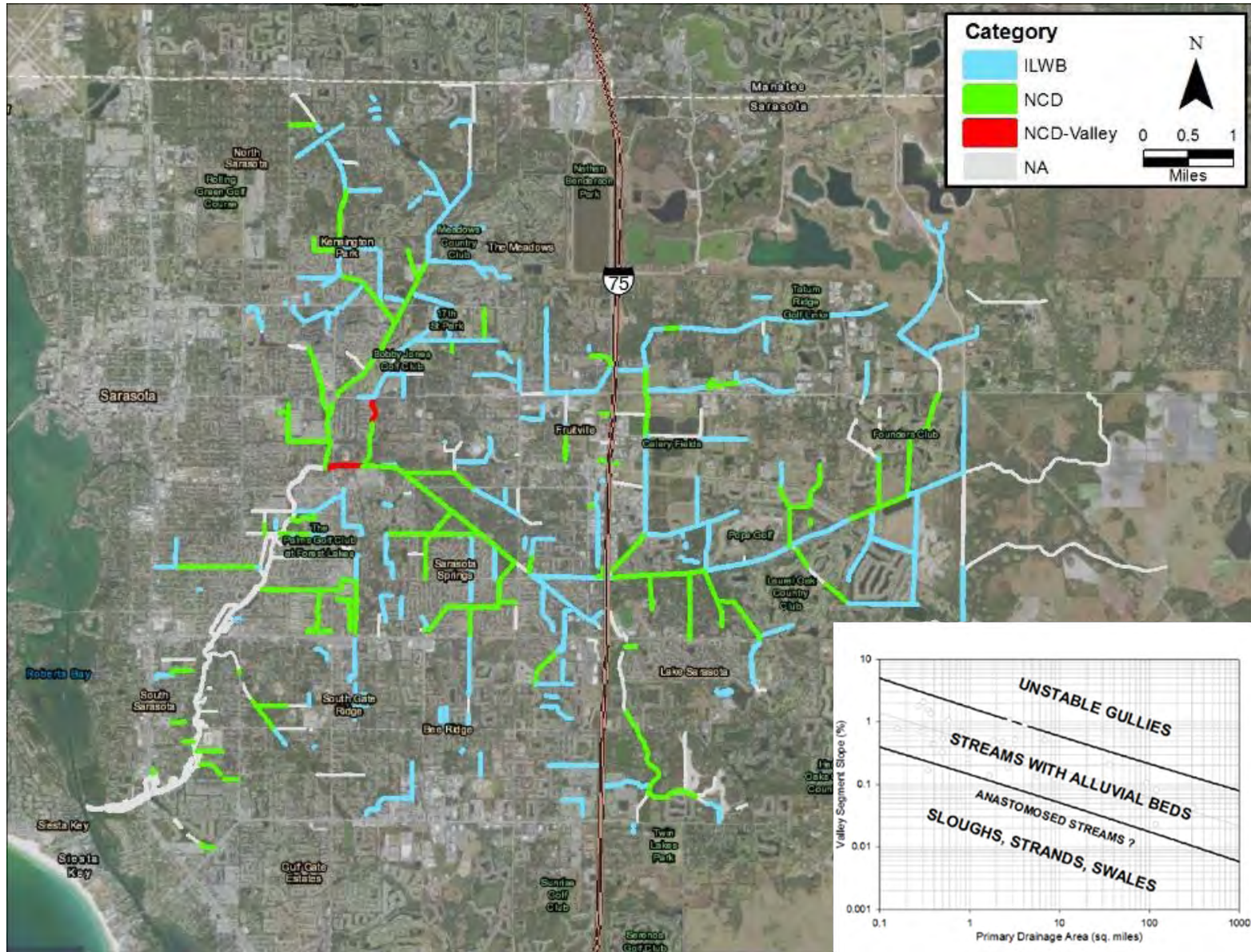


i. Photo credit: <http://gabion1.co.uk/river-bank-protection/>











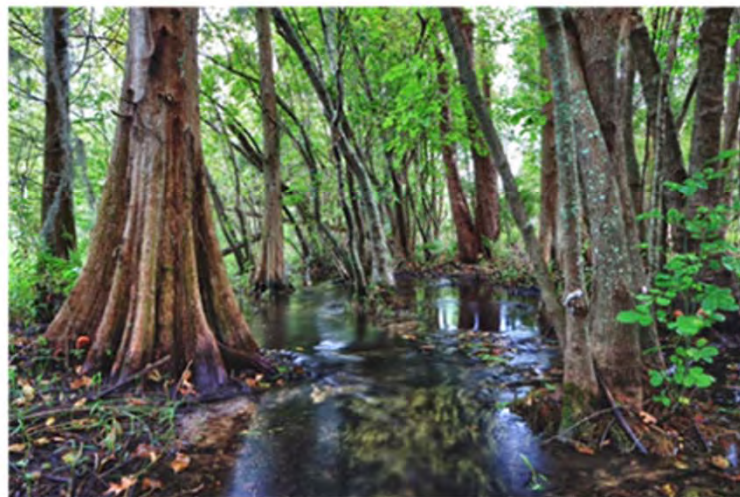
Year 0. Edwards Bottomlands, Starke FL.
(Drainage Area = 25 sq. mi.)



Year 3. Doe Branch 5, Hardee Co. FL.
(Drainage Area = <1 sq. mi.)

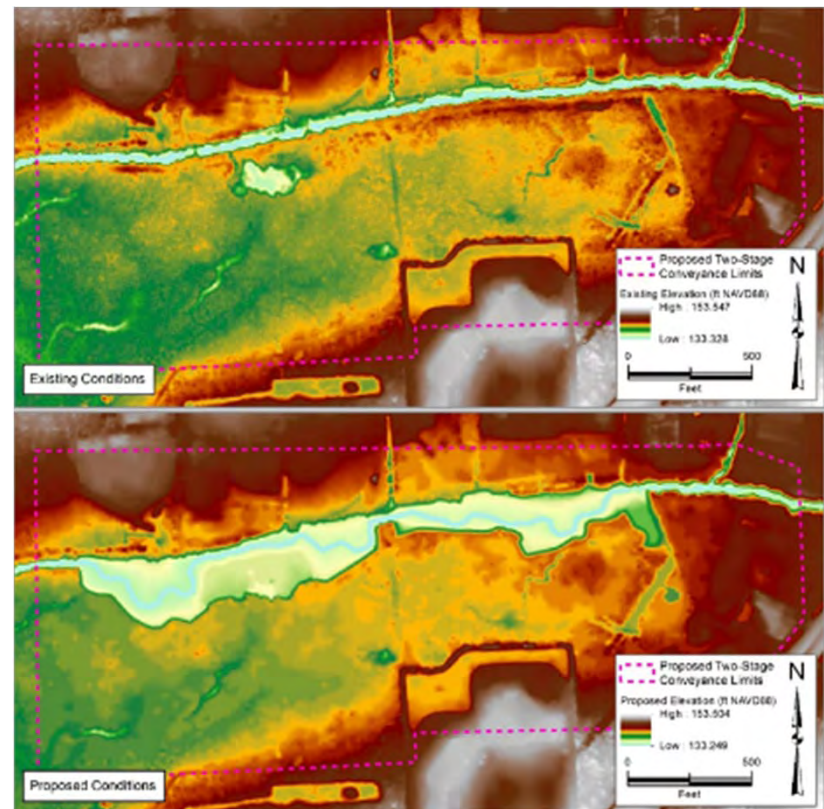
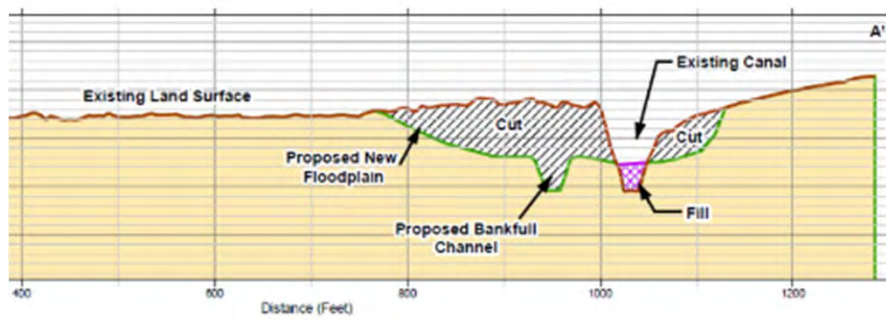


Year 12. Maron Run, Polk Co. FL.
(Drainage Area = 3 sq. mi.)



Year 25. Hickey Branch, Hardee Co. FL.
(Drainage Area = 2 sq. mi.)

- Three-Stage Channel – Edwards Bottomlands











Water Quality Benefits - Chesapeake Bay TMDL Stream Restoration Protocols

- P1: Bank stabilization
- P2: Hyporheic exchange during baseflow
- P3: Floodplain reconnection
- P4: Dry RSC – Provides add-on reductions downstream of untreated impervious surface

Phillip Canal Restoration – Estimated Nitrogen Reduction

TN Removed (lb TN/yr/mile)				
Stream Category	P1 - Erosion	P2 - Hyporheic	P3 - Floodplain	Total
Headwater (<2 SM)	51	539	62	652
Mid-Order (2-20 SM)	51	742	79	872
Lowland (>20 SM)	51	1011	103	1165

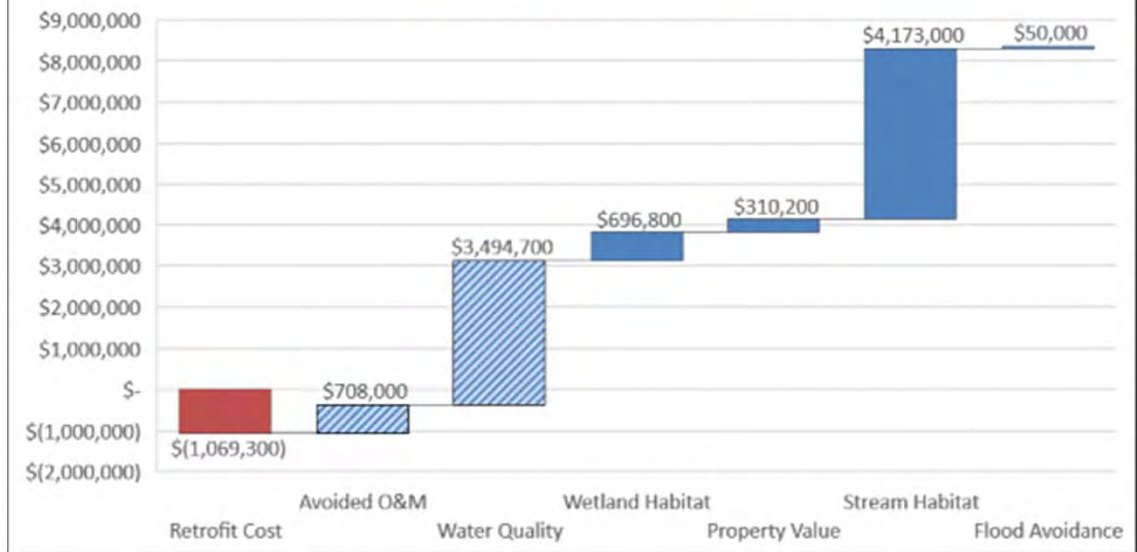


Convert Headwater Canal to Natural Channel System, 1 mile



Total NPV = \$8,360,000

■ Increase ■ Decrease ■ Total



Capital Investment

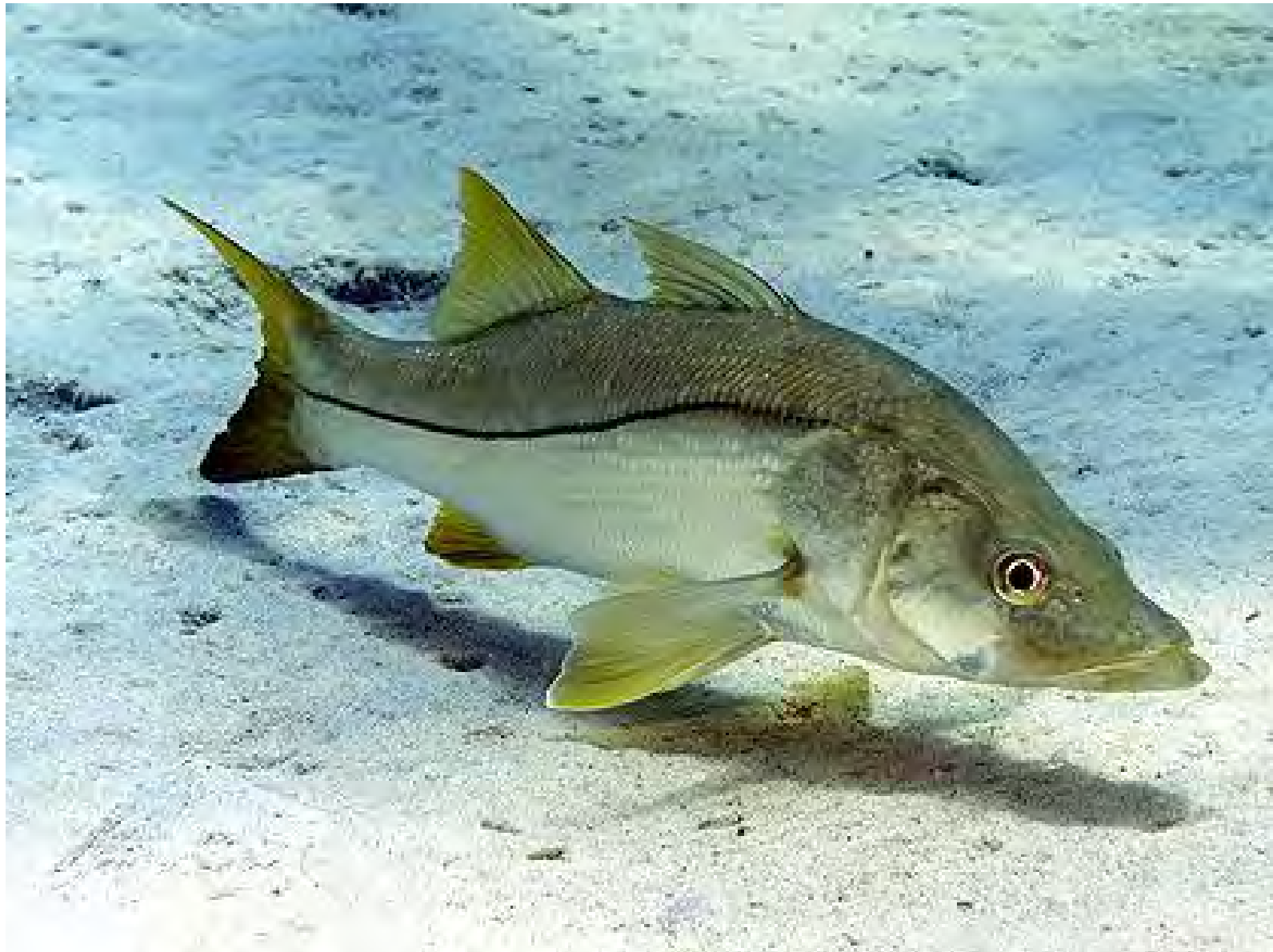
Retrofit Scenario	Position	Mean Capital	Capital Range	
			Worst Case	Best Case
Turf over VRSS	HW	\$ (724,800)	\$ (942,240)	\$ (507,360)
Forest over VRSS	HW	\$ (731,900)	\$ (951,470)	\$ (512,330)
Stream Restoration	HW	\$ (1,069,300)	\$ (1,390,090)	\$ (748,510)
VRSS - Whole Bank	HW	\$ (1,194,300)	\$ (1,552,590)	\$ (836,010)
Riprap	HW	\$ (1,256,700)	\$ (1,633,710)	\$ (879,690)
Articulated Block	HW	\$ (1,432,900)	\$ (1,862,770)	\$ (1,003,030)
Gabion	HW	\$ (2,371,300)	\$ (3,082,690)	\$ (1,659,910)
Turf over VRSS	MO	\$ (1,539,300)	\$ (2,001,090)	\$ (1,077,510)
Forest over VRSS	MO	\$ (1,548,000)	\$ (2,012,400)	\$ (1,083,600)
VRSS - Whole Bank	MO	\$ (2,509,400)	\$ (3,262,220)	\$ (1,756,580)
Stream Restoration	MO	\$ (3,688,700)	\$ (4,795,310)	\$ (2,582,090)
Riprap	MO	\$ (4,063,000)	\$ (5,281,900)	\$ (2,844,100)
Gabion	MO	\$ (4,063,200)	\$ (5,282,160)	\$ (2,844,240)
Articulated Block	MO	\$ (4,591,700)	\$ (5,969,210)	\$ (3,214,190)
Turf over VRSS	LL	\$ (1,576,100)	\$ (2,048,930)	\$ (1,103,270)
Forest over VRSS	LL	\$ (2,179,200)	\$ (2,832,960)	\$ (1,525,440)
VRSS - Whole Bank	LL	\$ (2,428,000)	\$ (3,156,400)	\$ (1,699,600)
Gabion	LL	\$ (3,914,500)	\$ (5,088,850)	\$ (2,740,150)
Riprap	LL	\$ (4,591,700)	\$ (5,969,210)	\$ (3,214,190)
Stream Restoration	LL	\$ (5,211,800)	\$ (6,775,340)	\$ (3,648,260)
Articulated Block	LL	\$ (6,448,700)	\$ (8,383,310)	\$ (4,514,090)



Triple Bottom Line

Retrofit Scenario	Position	Mean NPV	NPV Range	
			Worst Case	Best Case
Stream Restoration	HW	\$ 8,363,400	\$ 3,146,160	\$ 11,749,000
Stream Restoration	LL	\$ 8,150,000	\$ (636,440)	\$ 13,957,080
Stream Restoration	MO	\$ 7,312,300	\$ 421,690	\$ 11,954,210
Forest over VRSS	HW	\$ 408,100	\$ (381,470)	\$ 969,670
Turf over VRSS	LL	\$ 249,000	\$ (1,482,780)	\$ 1,269,360
Turf over VRSS	HW	\$ 61,200	\$ (549,240)	\$ 514,440
Forest over VRSS	MO	\$ 100	\$ (1,411,550)	\$ 928,930
Forest over VRSS	LL	\$ (100)	\$ (2,089,810)	\$ 1,307,390
VRSS - Whole Bank	HW	\$ (54,300)	\$ (982,590)	\$ 945,990
VRSS - Whole Bank	LL	\$ (248,900)	\$ (2,413,250)	\$ 1,433,230
Turf over VRSS	MO	\$ (345,200)	\$ (1,577,240)	\$ 474,820
Riprap	HW	\$ (357,300)	\$ (1,184,010)	\$ 289,530
Articulated Block	HW	\$ (533,500)	\$ (1,413,070)	\$ 166,190
VRSS - Whole Bank	MO	\$ (961,300)	\$ (2,661,370)	\$ 555,950
Gabion	HW	\$ (1,471,900)	\$ (2,632,990)	\$ (490,690)
Gabion	LL	\$ (3,015,100)	\$ (4,639,150)	\$ (1,570,930)
Riprap	MO	\$ (3,163,600)	\$ (4,832,200)	\$ (1,674,880)
Gabion	MO	\$ (3,163,800)	\$ (4,832,460)	\$ (1,675,020)
Riprap	LL	\$ (3,692,300)	\$ (5,519,510)	\$ (2,044,970)
Articulated Block	MO	\$ (3,692,300)	\$ (5,519,510)	\$ (2,044,970)
Articulated Block	LL	\$ (5,549,300)	\$ (7,933,610)	\$ (3,344,870)

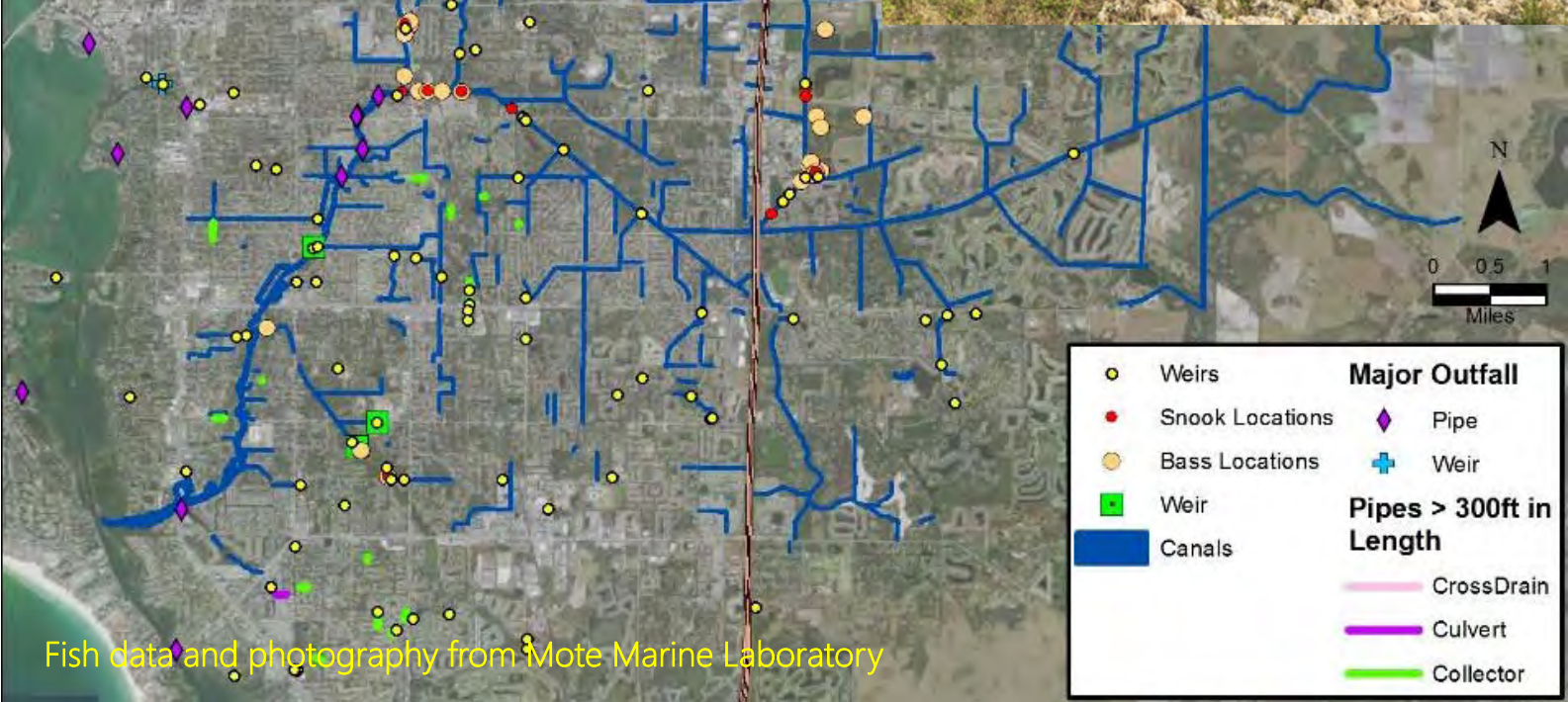




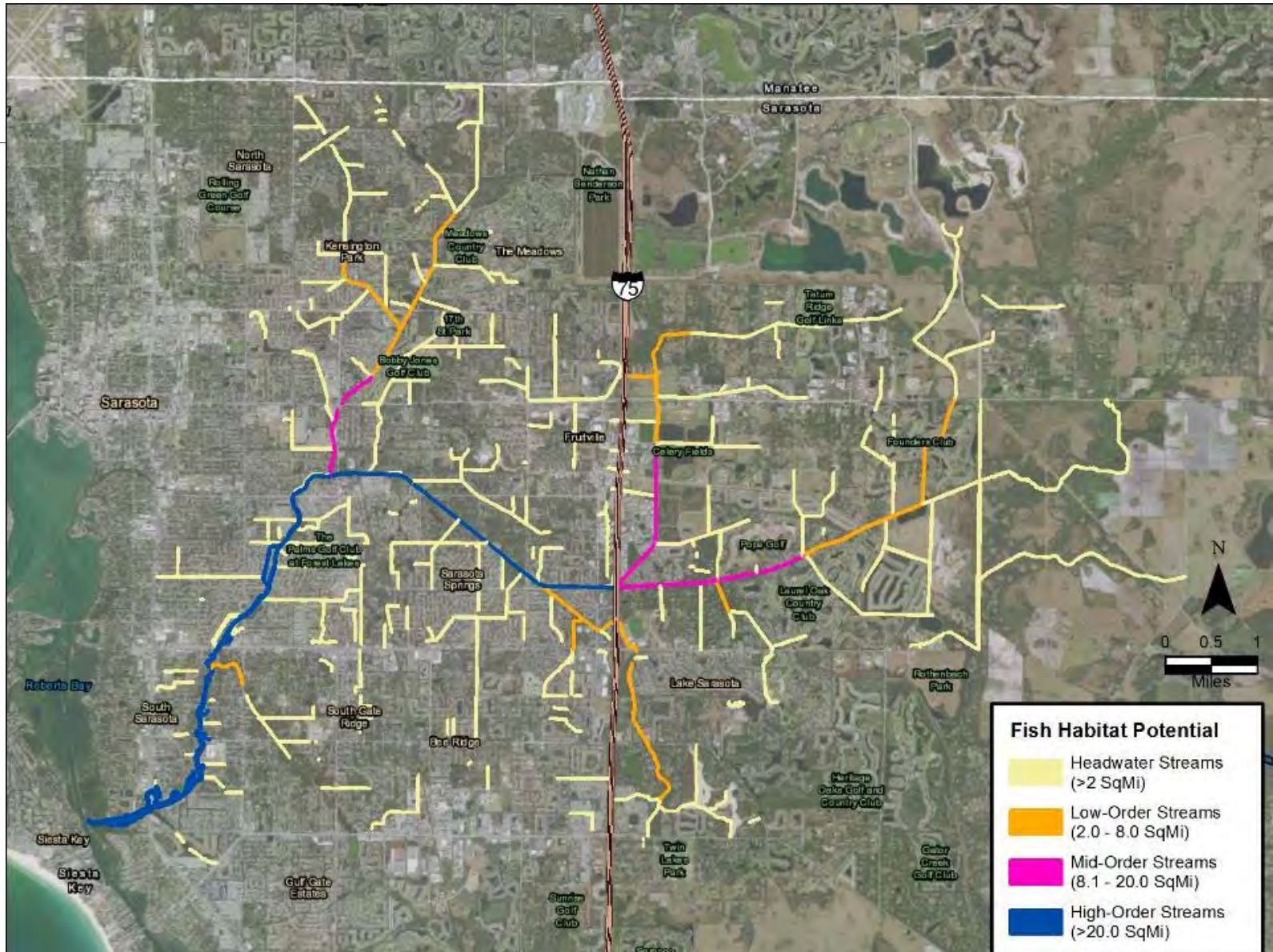


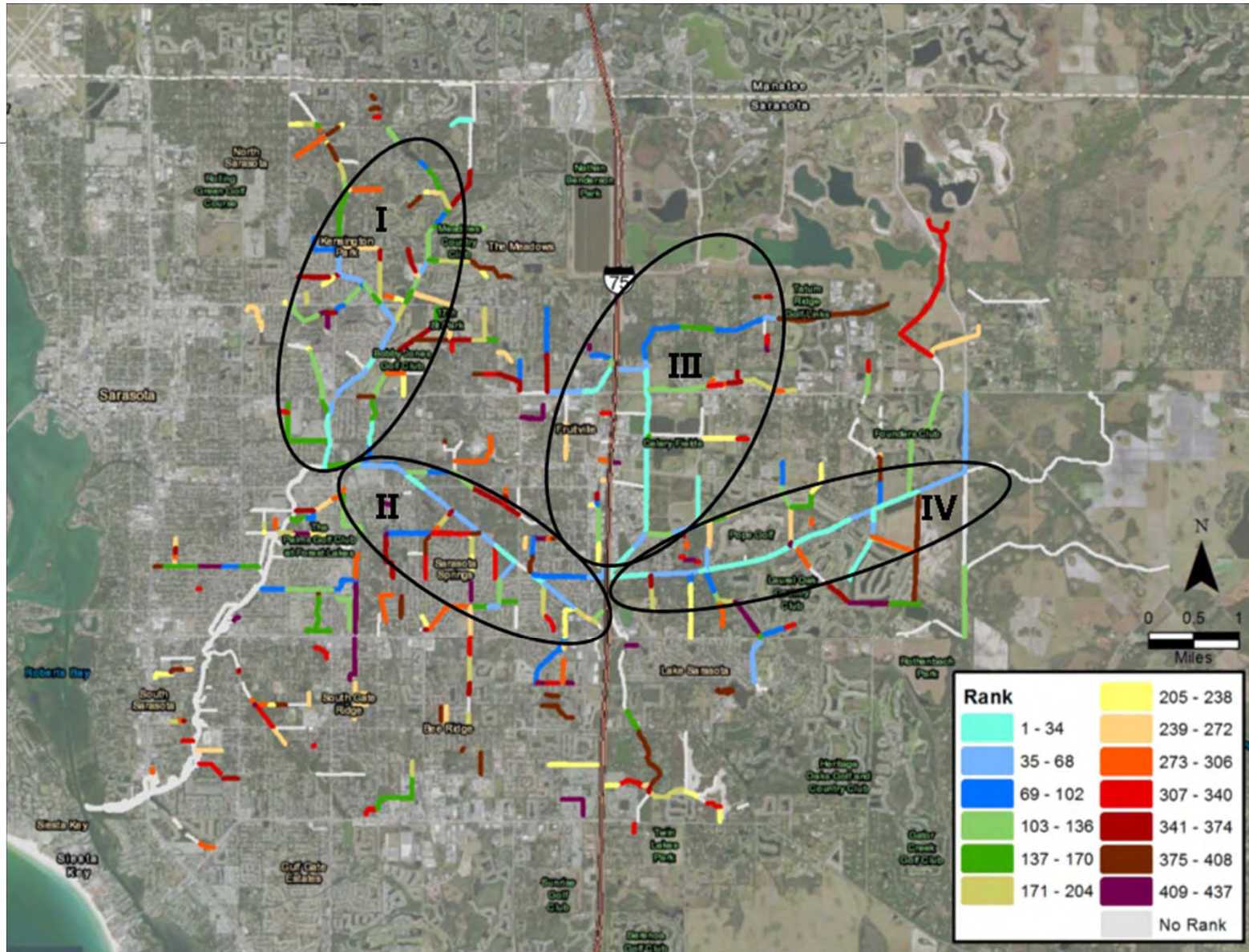
Protect our Creek!





Fish data and photography from Mote Marine Laboratory







Waters of Florida

- 27,000 miles of rivers/streams in FL
- 43,000 miles of canals in FL
 - ~30,000 miles of canals are included in an impaired WBID

Based on Florida National Hydrography Dataset



Statistics

- Declines in habitats in rivers/streams
- Declines in natural streams
- Loss of >50% sensitive species
 - Fish - 16% of streams in SE
 - Invertebrates - 32% of streams in SE
- Population growth in FL ~1 million every five years

Citation: Van Metre, P.C., Waite, I.R., Qi, S., Mahler, B., Terando, A., Wieczorek, M., Meador, M., Bradley, P., Journey, C., Schmidt, T., and Carlisle, D. Projected urban growth in the southeastern USA puts small streams at risk. 2019, PLoS One, <https://doi.org/10.1371/journal.pone.0222714>.



DEP's Viewpoint

- Water Quality Restoration Alternatives
 - TMDLs and BMAPs are not always the answer to waterbody restoration.
- Need for demonstration projects to quantify benefits
 - Iterative process
- With better understanding of benefits DEP can better allocate grant funds
 - Surface Water-quality Assistance Grants



Florida Canal Improvements

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