

REUSE, RESTORE, REPLENISH – BENEFICIAL USE OF DREDGED SEDIMENT IN THE LOWER GREEN BAY/ FOX RIVER AOC

June 26th, 2023

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GLRI Inter-Agency Economy Act Agreement
Focus Area 1 – Toxic Substances and AOCs



Photo credit: Nathan Beane



Northerly Island, Chicago, IL



Cat Island, Green Bay, WI



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ERDC





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OVERVIEW



- USACE – Chicago District
- Beneficial Uses of Dredged Sediment
- LGB/FR AOC Background
- Project Areas
 - De Pere Dam
 - Longtail Point
 - Duck Creek Delta
- Dredging and Beneficial Use Coordination



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CHICAGO DISTRICT



Area of Responsibility

- Covers portions of 4 states (WI, IL, IN, OH)
- 31,500 square miles
- Key Civil Works Missions:
 - Flood Risk Management
 - Navigation (21 Harbors)
 - Aquatic Ecosystem Restoration
 - Regulatory





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BENEFICIAL USES OF DREDGED SEDIMENT

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- Over 200 MCY of sediment is dredged annually from federally constructed/ maintained harbors and navigation channels, providing safe passage (Great Lakes includes ~5 MCY/year)
 - Provides opportunities for economic, environmental, and aesthetic beneficial uses
- Beneficial uses are productive and positive uses of dredged sediment, such as fish and wildlife habitat, human recreation, and industrial/commercial uses¹
 - ~ 85% of dredged sediments are available for beneficial uses
 - ❖ Of this, ~ 30-35% is currently beneficially used for environmental, economic, and social benefits
 - Goal of 70% beneficial use by 2030



Cat Island, Green Bay, WI



Burns Harbor, IN

¹USACE Beneficial Uses of Dredged Material, Engineer Manual 1110-2-5026



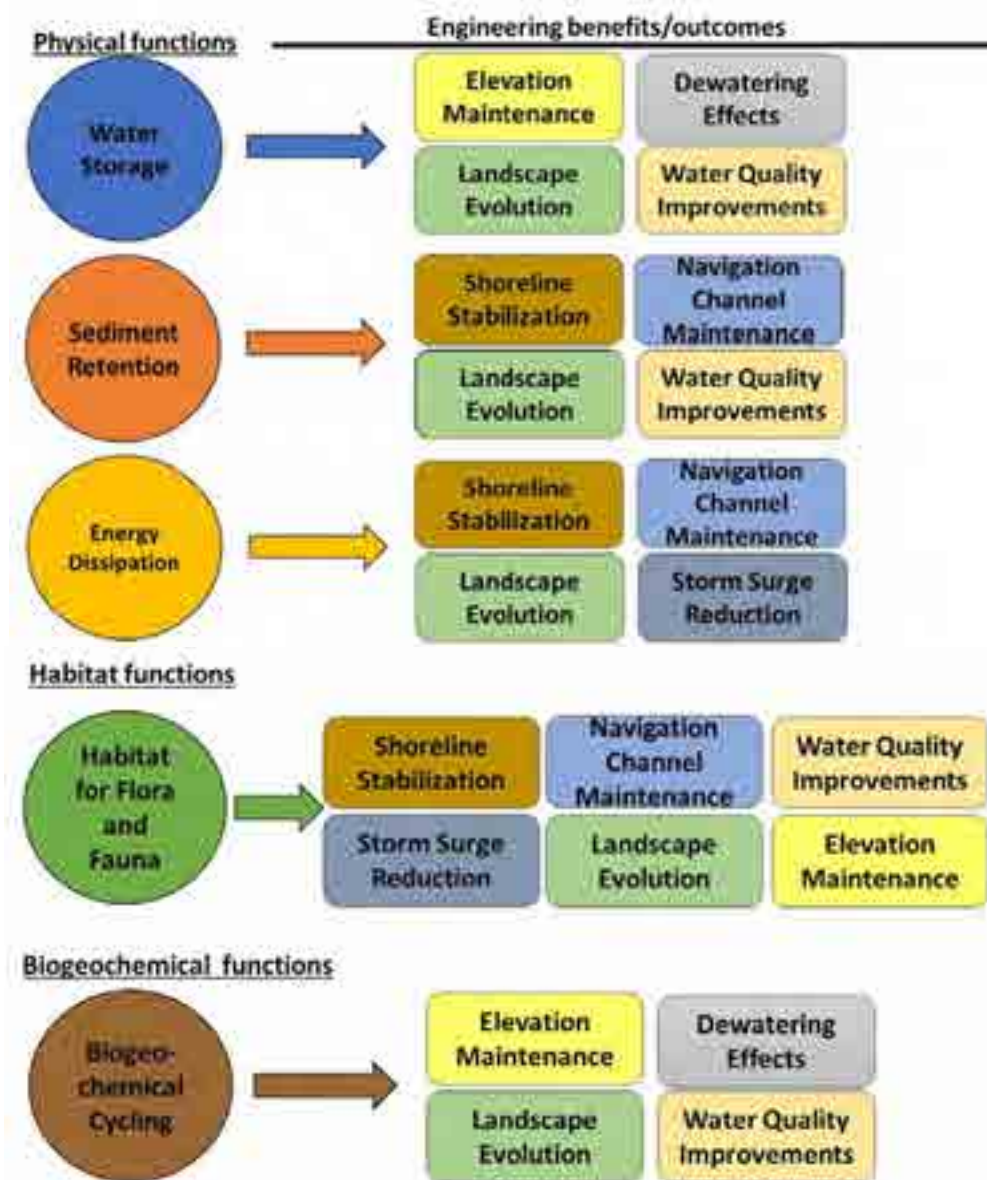
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BENEFICIAL USES OF DREDGED SEDIMENT



- Several categories of beneficial uses¹:
 - Habitat development
 - ❖ Aquatic
 - ❖ Wetland
 - ❖ Island
 - ❖ Upland
 - Beach nourishment
 - Parks and recreation
 - Cultivation (ag' amendments and manufactured topsoil)
 - Construction, industrial, and commercial uses
 - Multipurpose and other uses

- Decision Process²:
 - Contaminant Status
 - Site Selection
 - Technical Feasibility
 - Environmental Acceptability
 - Cost/Benefit
 - Legal Constraints



¹USACE Engineer Manual 1110-2-5025; ²ERDC/EL TF-22-9 Environmental Evaluation and Management of Dredged Material for Beneficial Use – A Regional Beneficial Use Testing Manual for the Great Lakes



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BENEFICIAL USES OF DREDGED SEDIMENT



■ Several categories of beneficial uses¹:

➤ **Habitat development**

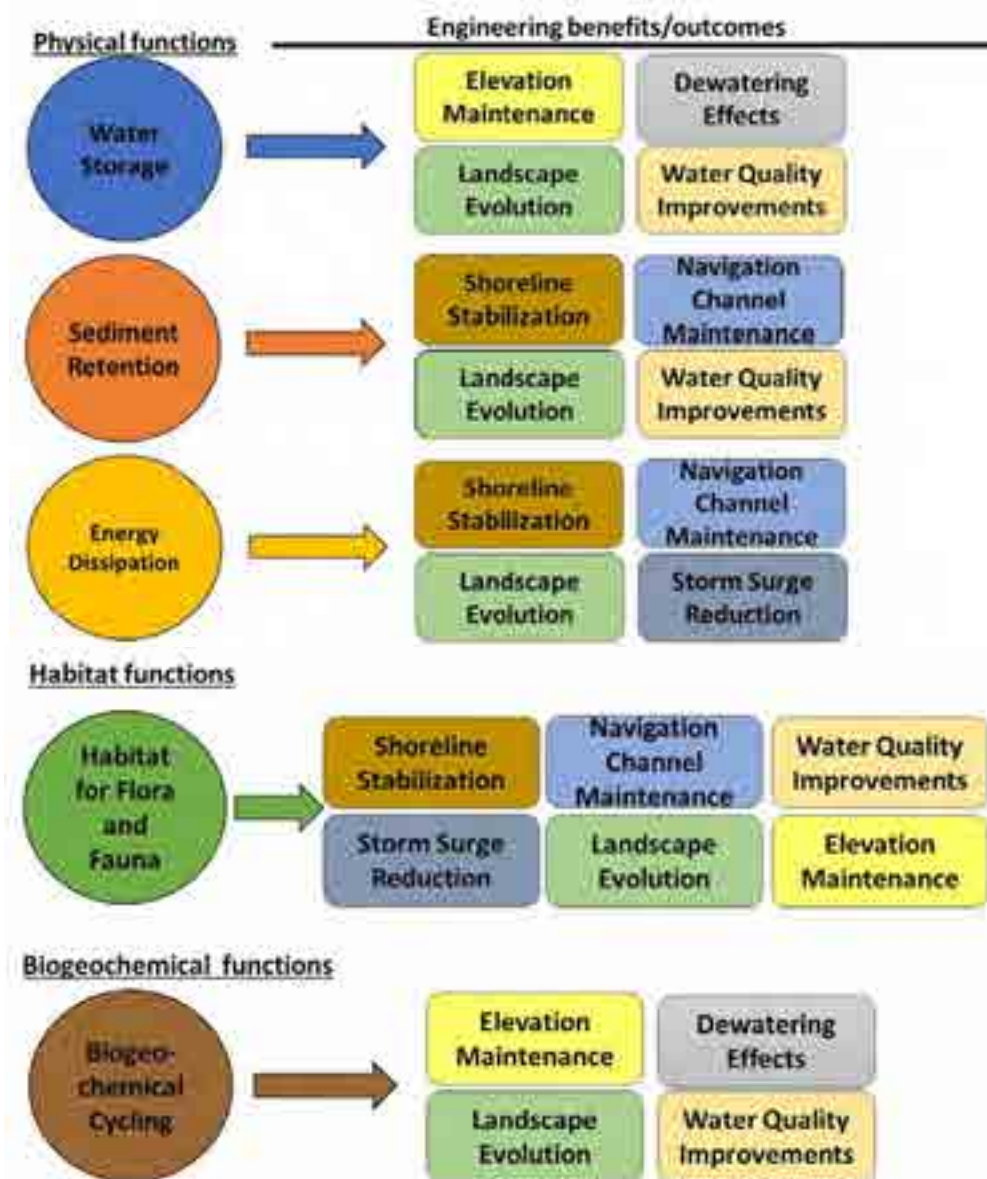
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➤ **Beach nourishment**

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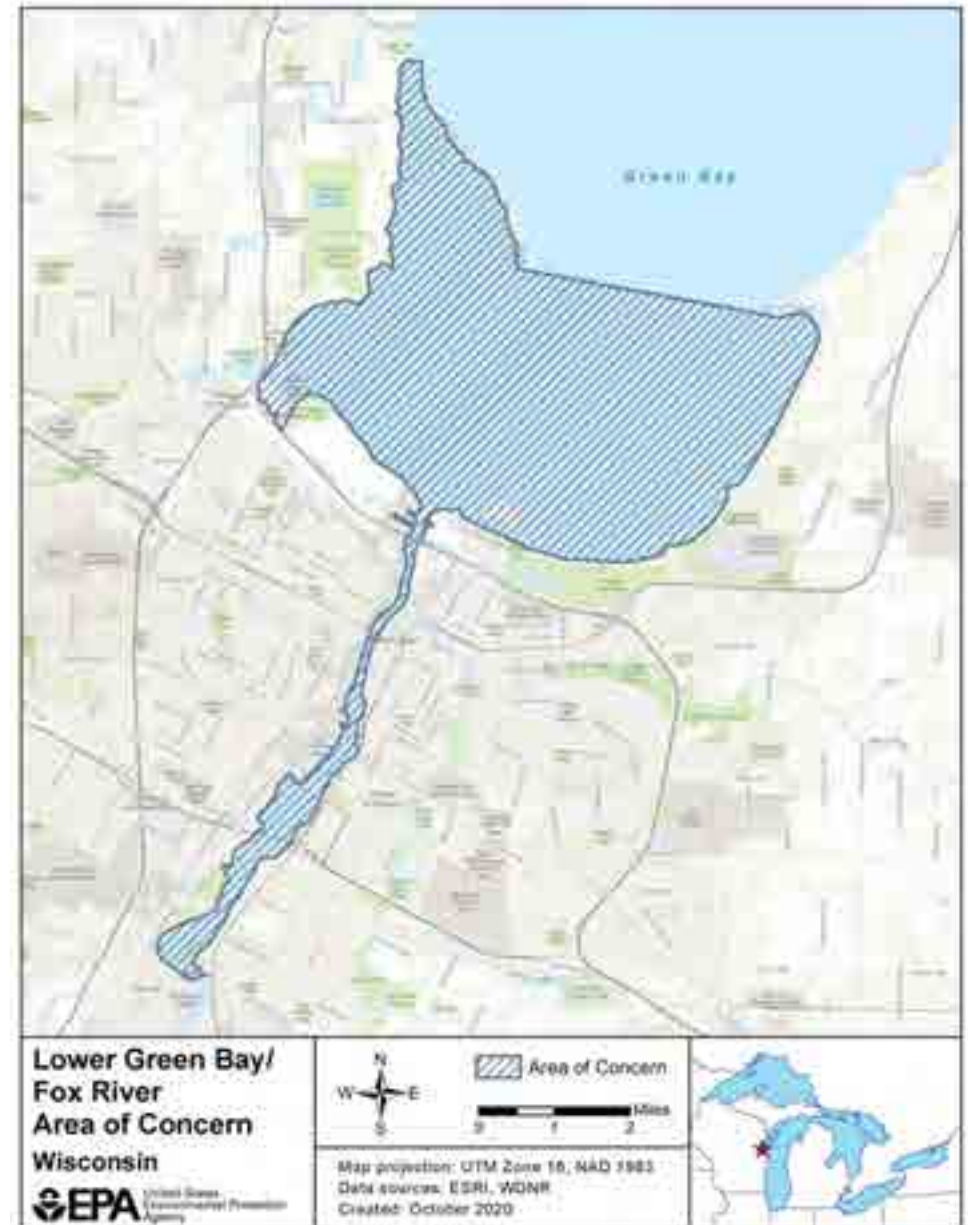


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LOWER GREEN BAY/ FOX RIVER AOC



- Part of the Fox Wolf Watershed
- Designated an AOC under the 1987 Great Lakes Water Quality Agreement¹
 - Last 7 miles of the Lower Fox River
 - 22 mi² of southern Green Bay
- Environmental degradation from land use practices
 - Non-point and point source industrial discharges
 - ❖ Pulp and paper mills
 - ❖ Agricultural runoff
 - ❖ Urban storm and wastewater
 - Several existing beneficial use impairments, including:
 - ❖ Degradation of fish and wildlife populations
 - ❖ Loss of fish and wildlife habitat
 - ❖ Degradation of phytoplankton, zooplankton, and benthos populations
 - ❖ Eutrophication or undesirable algae
 - ❖ Beach closings



¹<https://www.epa.gov/great-lakes-aocs/lower-green-bayfox-river-aoc>



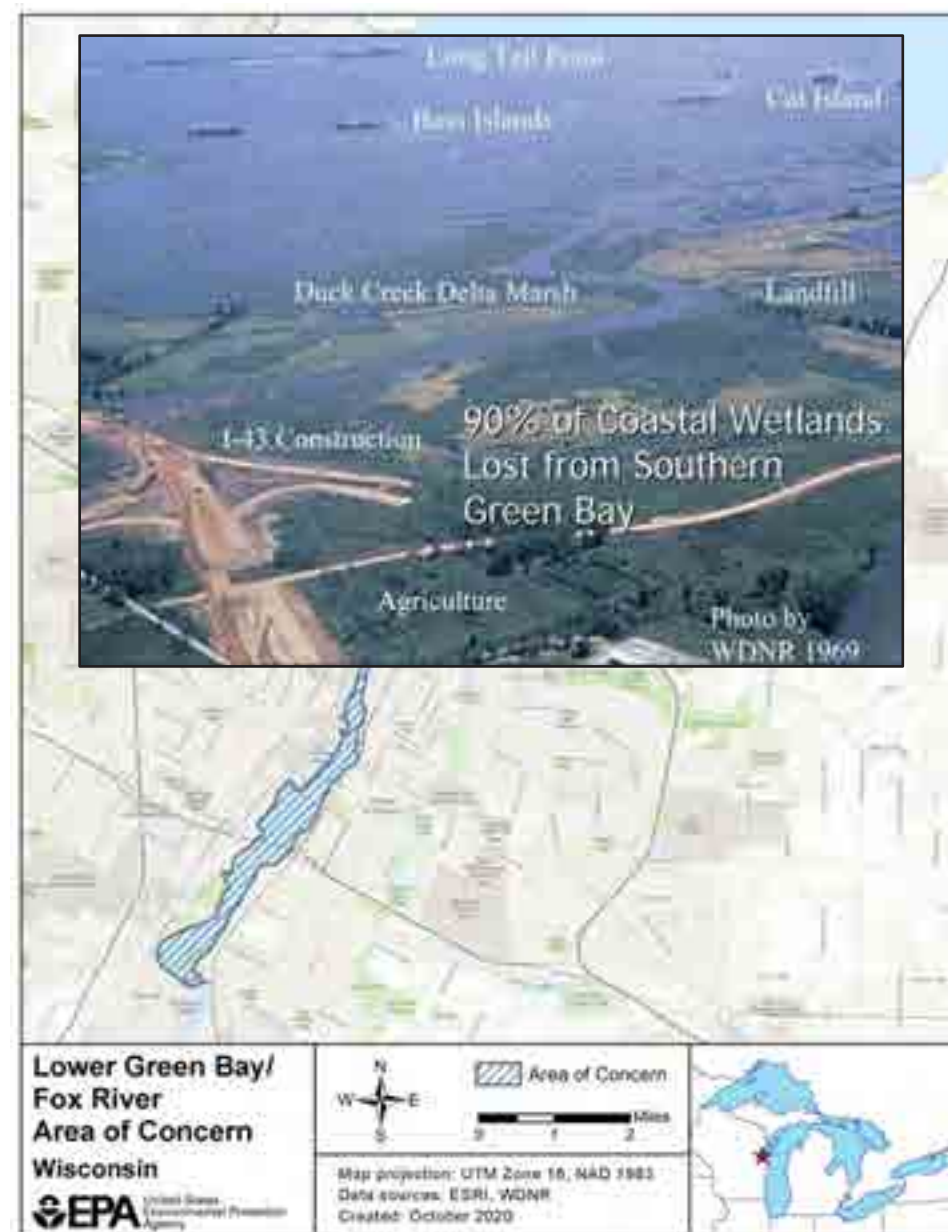
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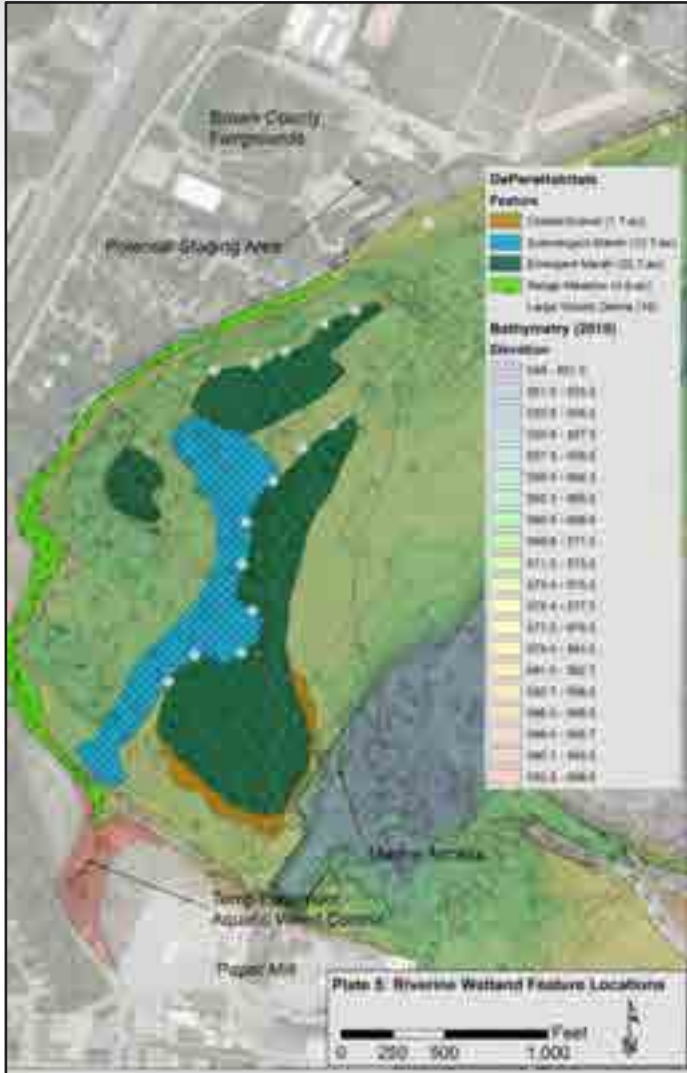


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PROJECT AREAS



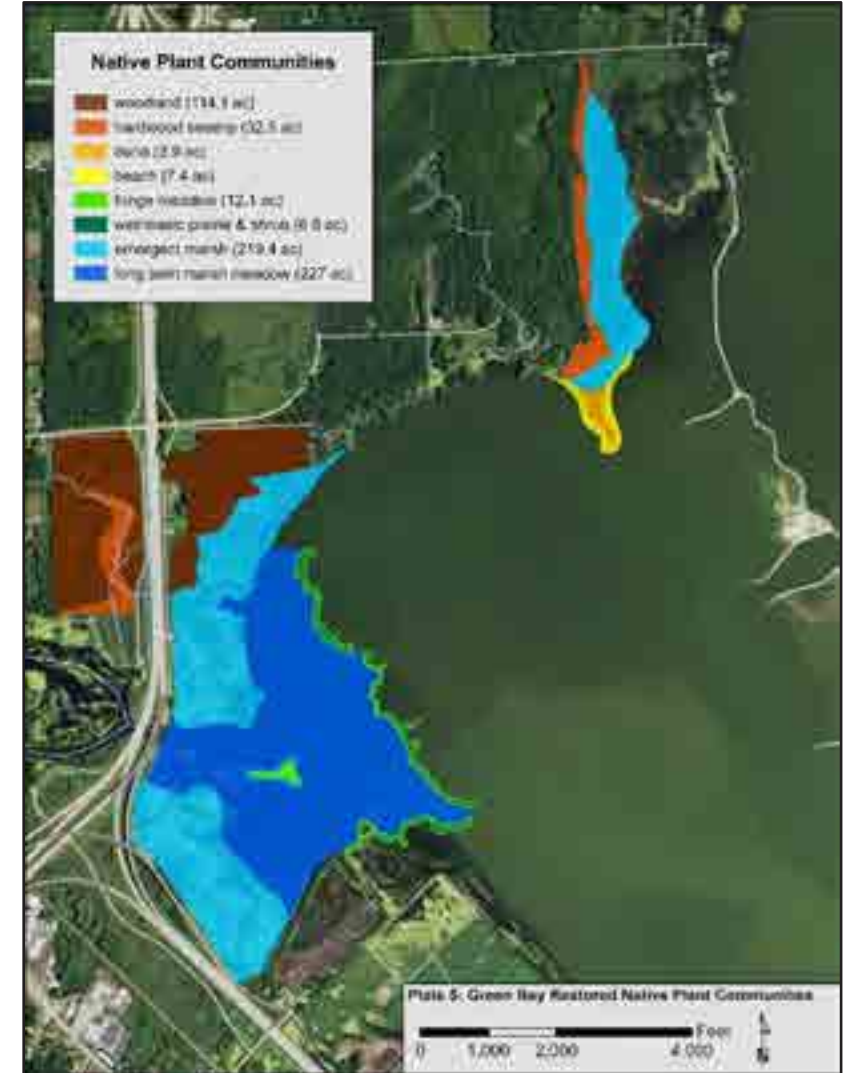
De Pere Dam



Longtail Point



Duck Creek Delta



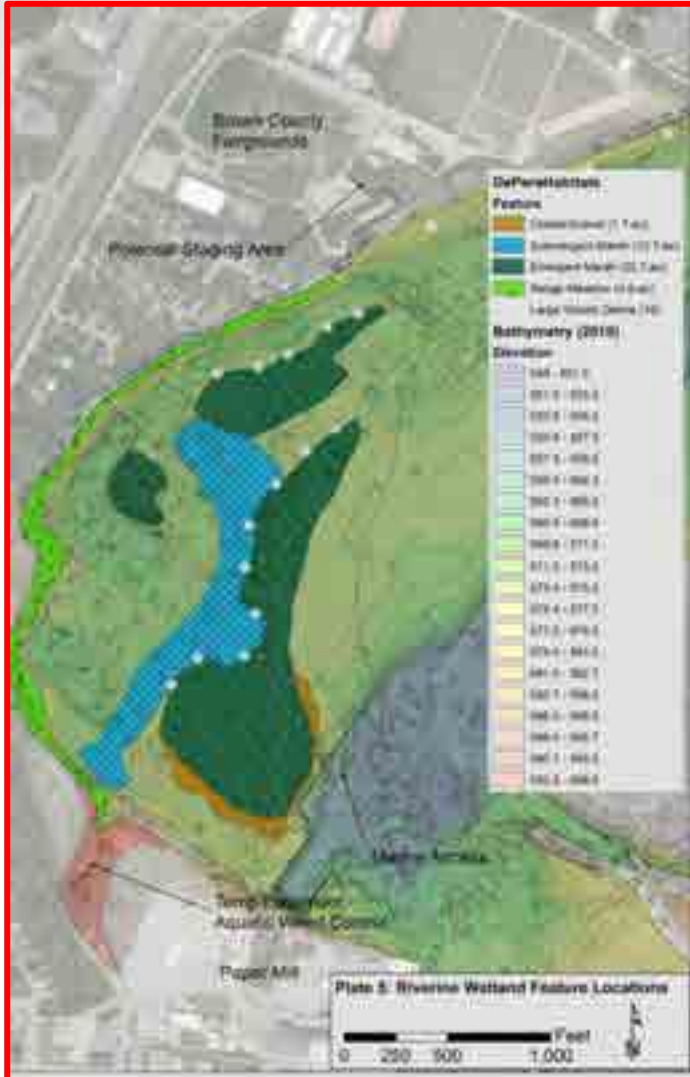


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PROJECT AREAS



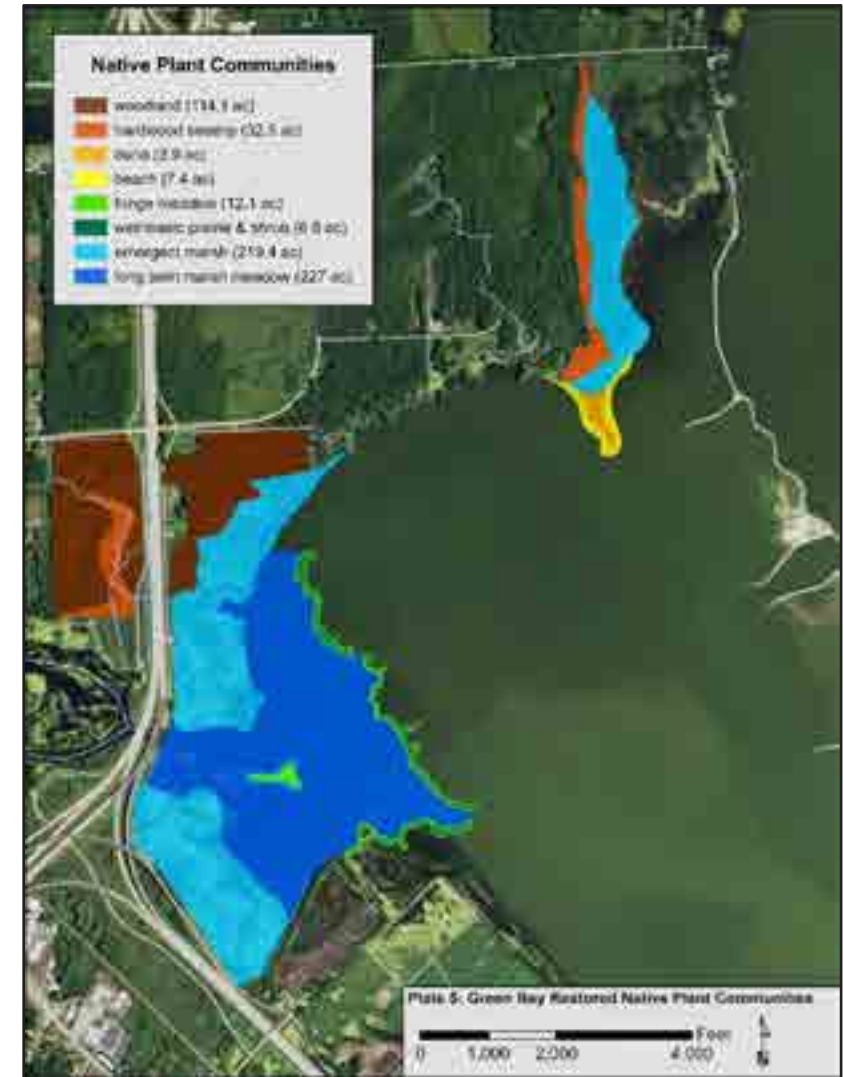
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DE PERE DAM

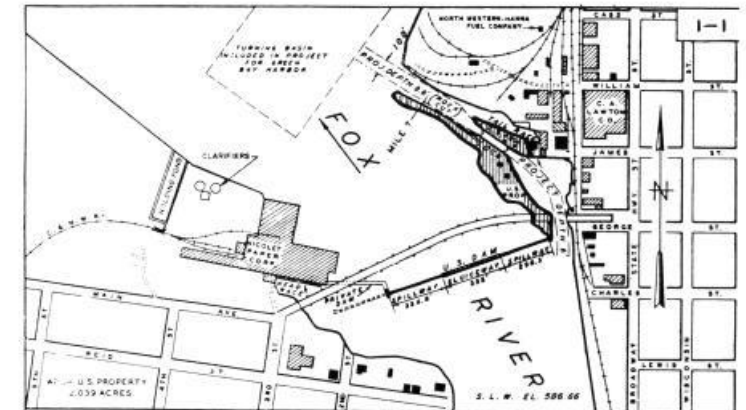
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- Located on the Fox River 7 miles upstream from Green Bay
- One of few sites where Lake Sturgeon can be observed spawning
- Formerly a shallow riverine wetland complex below and just west of the dam
 - Wetlands have been extirpated from the area
 - ❖ Much of footprint of the area was dredged to remove contaminated sediments



Photo credit: WI Historical Society



DE PERE LOCK AND DAM
FOX RIVER
WISCONSIN

IN 1 SHEET SCALE OF FEET SHEET NO. 1
0 100 200
CORPS OF ENGINEERS CHICAGO, ILLINOIS
30 JUNE 1972



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DE PERE DAM

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RIVERINE WETLAND RESTORATION

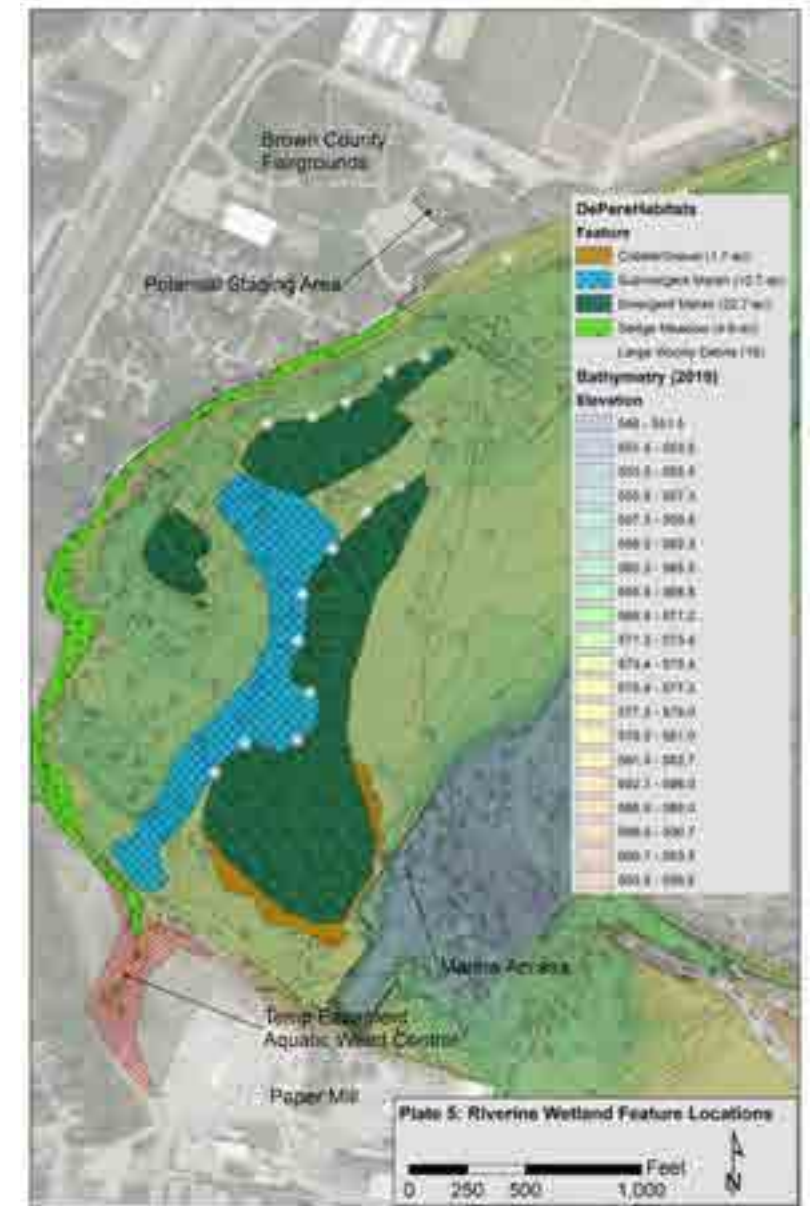


▪ Riverine wetland problems:

- Hydrologic instability
- Altered flow and velocity patterns
- Altered geomorphology
- Altered sediment transport
- Growing substrate degradation; chemical and physical
- Depredation of recruiting plants

▪ Recovery opportunities:

- Address elevations and geomorphologies to achieve hydrogeomorphic setting
 - ❖ Provide growing mediums/substrates for native riverine emergent and submergent plant species
- Address eliminated or degraded spawning habitats
 - ❖ Flow vectors and velocities of tailwater conditions needed for spawning habitats
 - ❖ Enhance and sustain native riverine wetland plant species associated with spawning
- Address hydrologic instability of existing/proposed habitats
- Address depredation issues for newly recovering wetland plants





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RIVERINE WETLAND RESTORATION

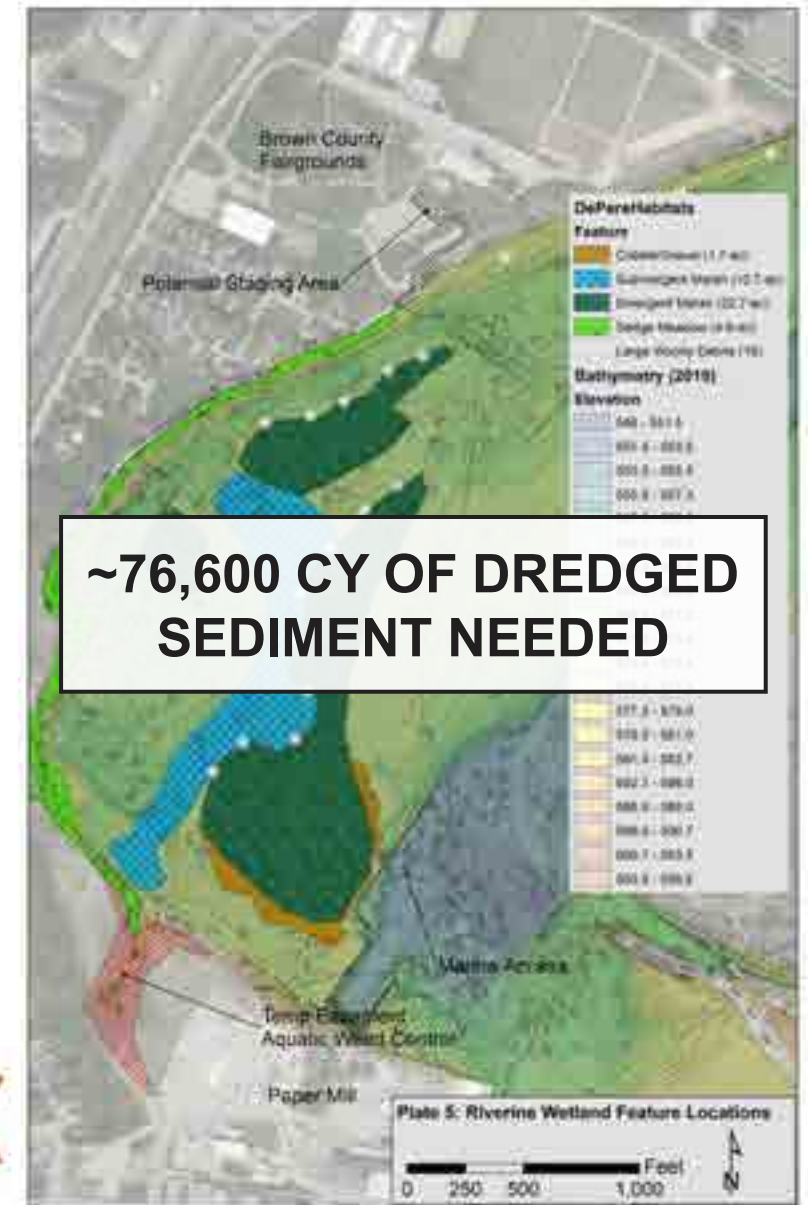


Objective:

- Restore grasslands and riverine submergent, emergent, and hardwood swamp wetlands
 - ❖ Improvement measured by increased coverage and richness of native plants, increased species richness of insect, fish, and/or marsh birds

Design Criteria:

- Hydrogeomorphology
 - ❖ Depths and elevations
 - ❖ Flood pulses, hydrologic connectivity, inundation frequency
 - ❖ Morphologies to achieve diversity of wetland types
- Hydraulics
 - ❖ Water velocities associated with riverine wetland types and substrates/ growing mediums
- Substrates/ Growing Mediums
 - ❖ Parent layer to build up elevations for wetland establishment
 - ❖ Growth layer for establishment of plant plugs
 - ❖ Surface layer where water/substrate interact and seeds are deposited/germinated
- Species
 - ❖ Native plant communities, fish species requirements



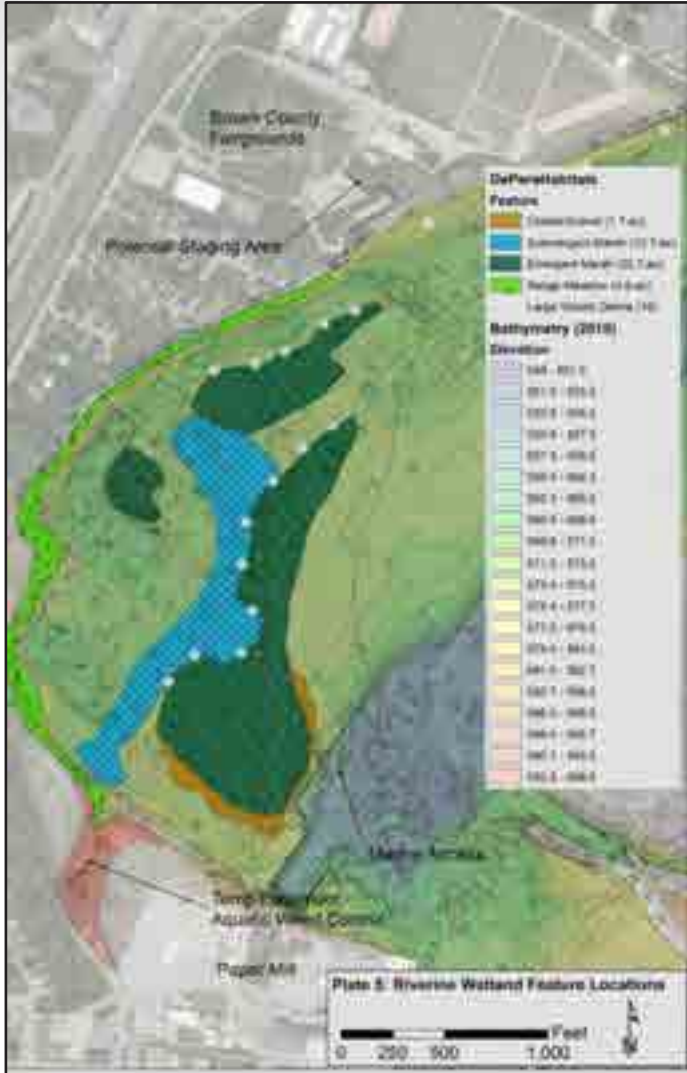


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PROJECT AREAS



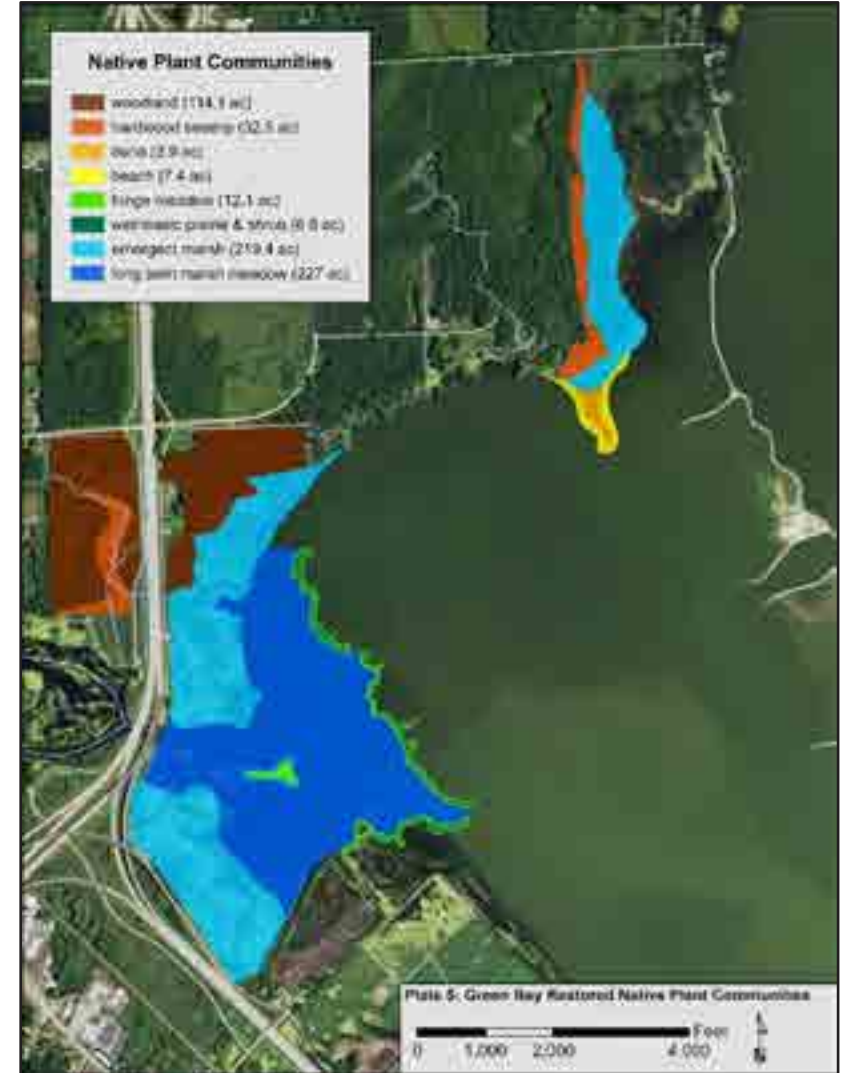
De Pere Dam



Longtail Point



Duck Creek Delta





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LONGTAIL POINT



- 138-acre narrow sand spit peninsula extending ~3 miles into Lower Green Bay
- Northwestern-most border of the LGB-FR AOC
- Managed by WI as the Longtail Wildlife Unit within the Green Bay West Shores Wildlife Area
 - Contains coastal emergent marsh and small patches of hardwood swamp and sedge meadow
- Subject to Lake Michigan coastal dynamics
 - Can be largely submerged when water levels are high, dry and sandy when water levels are low
- Shoreline has gradually eroded over the last century



Photo credit: USACE 2005



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Photo credit: USACE 2005



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LONGTAIL POINT RESTORATION

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■ Potential biological problems:

- Invasive plant species, primarily *Phragmites australis*
- Depredation of recruiting plants
- Invasive aquatic species, primarily *Dreissenids* and Round Goby

■ Speculated physical problems:

- Altered wave, current, and erosive patterns
- Altered littoral drift and reduced littoral drift sources
- Substrate degradation

■ Recovery opportunities:

- Address resiliency of Longtail Point
 - ❖ Establish necessary dune crest heights and widths
- Address lacustrine littoral sediment transport and replenishment
- Address lacustrine current vectors, wave vectors and attack contributing to erosion
- Address spatially reduced habitats and increase habitat heterogeneity

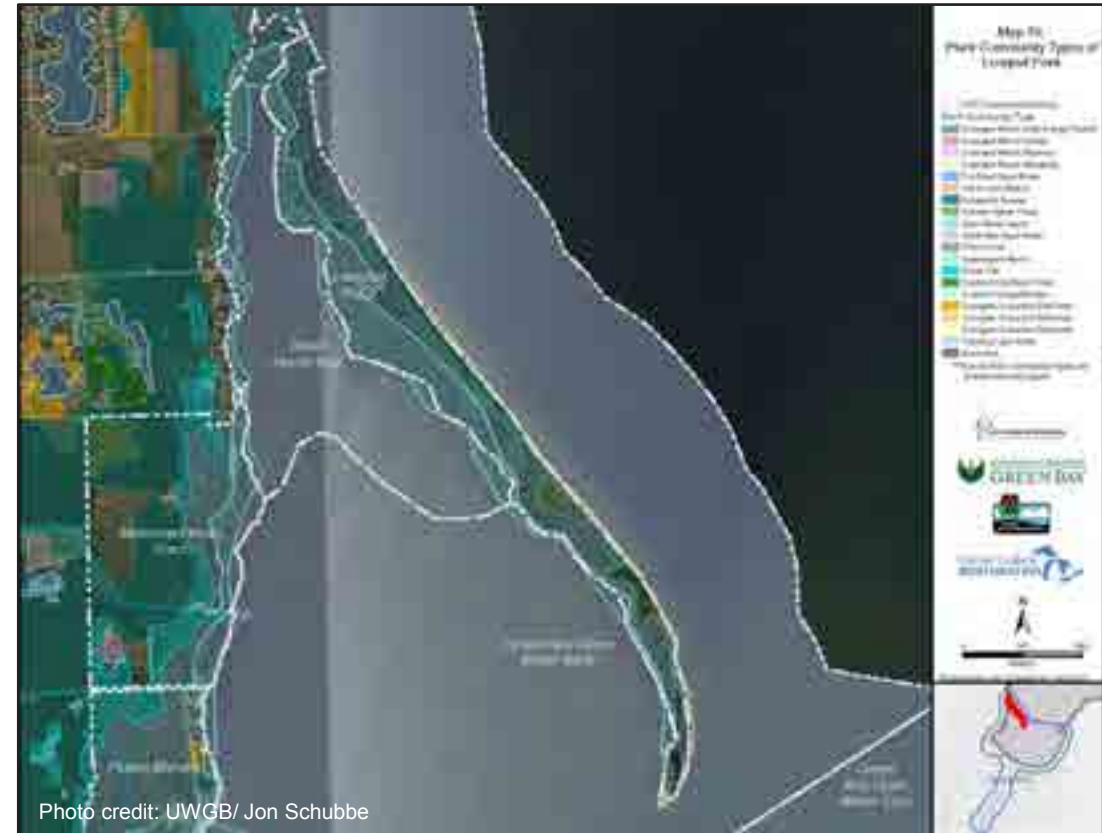


Photo credit: UWGB/ Jon Schutte



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LONGTAIL POINT RESTORATION

20



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LONGTAIL POINT RESTORATION

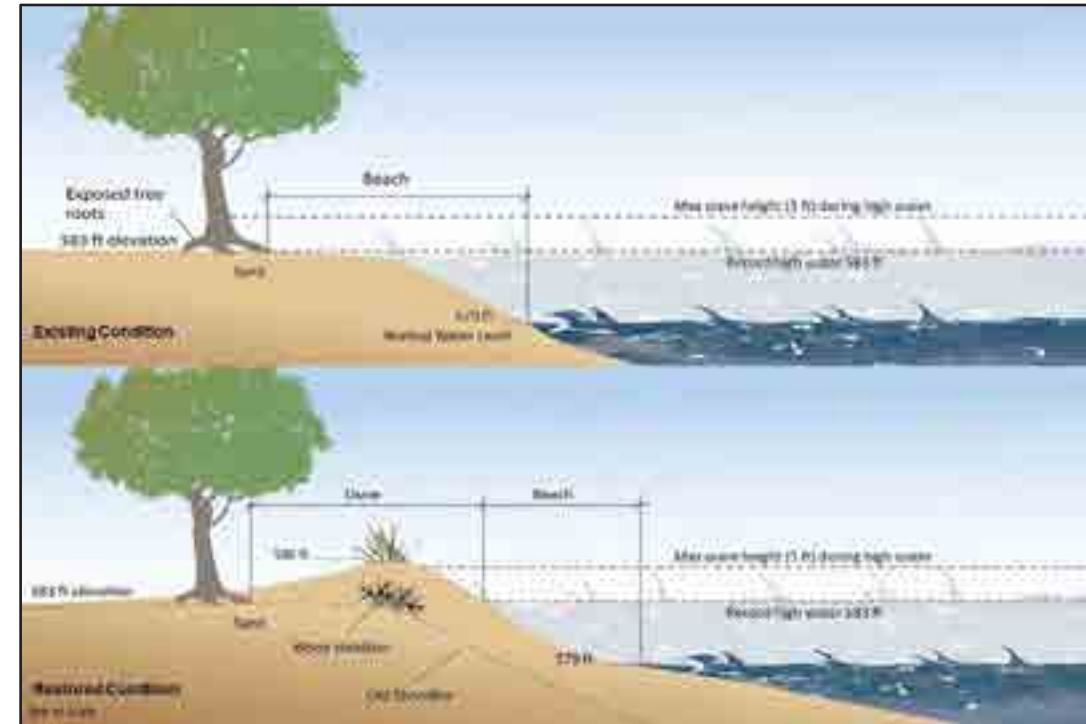


Objective:

- Sustain/ restore lacustrine spit geomorphic feature that supports diverse coastal wetlands and aquatic habitats
 - ❖ Target location is an ~1,200-acre area of the existing/ former breadth of Longtail Point spit wetland complex
 - ❖ Increased coverage and richness of native plants, increased species richness of insect, fish, and/or marsh birds, or increased abundance of mussels

Design Criteria:

- Size
 - ❖ Depths and elevations
 - ❖ Fluctuation
 - ❖ Morphology
- Hydraulics
 - ❖ Wave climates that affect substrate/ growing medium mobility
- Substrates/ Growing Mediums
- Species
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LONGTAIL POINT RESTORATION

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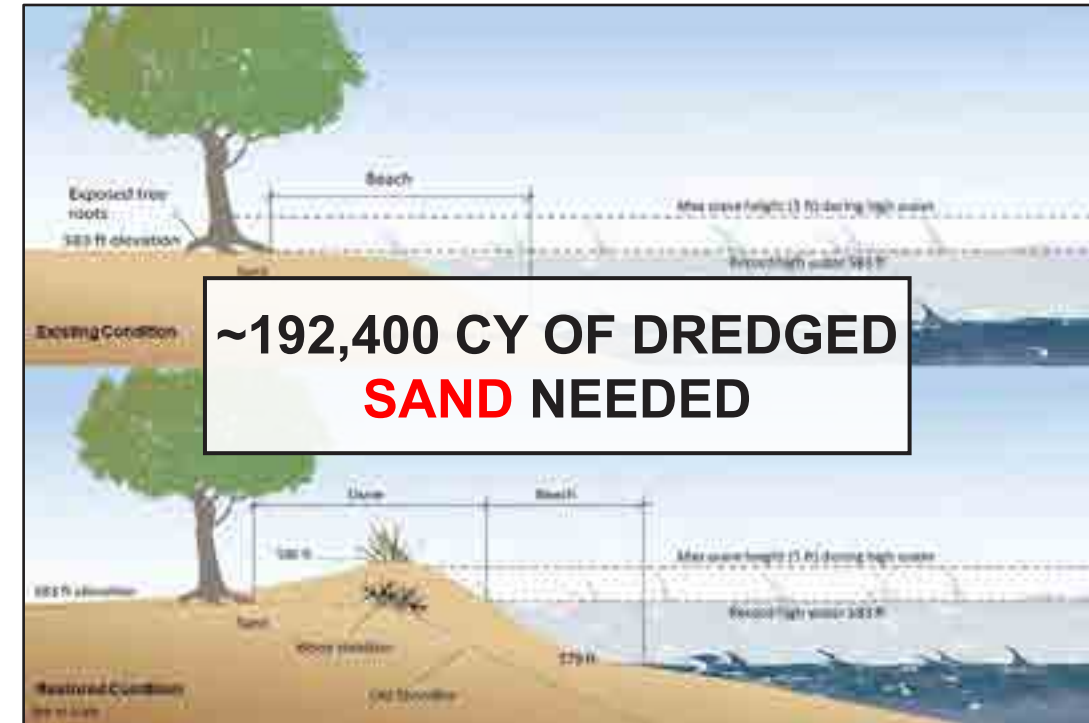


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DREDGING AND BENEFICIAL USE COORDINATION



■ Coordination Considerations

- Funding
- Project Schedules
- Sediment Characteristics
 - ❖ Chemical/Physical Quality
 - ❖ Quantity
- Transportation
 - ❖ Land (e.g., trucking) and/or water (e.g., barge)
 - ❖ Distance/cost over baseline placement option
- Dredging and Placement
 - ❖ Mechanical or hydraulic
 - ❖ Ease of access to placement sites
 - ❖ Distribution of dredged material





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THANK YOU!





DREDGED SEDIMENT NEEDS AND SOURCES



AOC Project	Sediment Feature	Sediment Type	Volume (CY)	Big Suamico	Oconto	Pensaukee	Sturgeon Bay (Lake Michigan Canal)	Green Bay Navigation Channel	Sturgeon Bay Utility Site	Borrow Pits	Commercial
De Pere	Riverine Wetland	Sand	76,611	\$\$	\$\$*	\$\$	\$\$	NA	NA	NA	\$\$
Duck Creek Delta	Sand Spit	Sand	135,920.23	\$\$	NA	NA	NA	\$\$	NA	NA	\$\$*
	Flow Splitter	Silt Muck Sand Clay	42,993.82	\$\$	NA	NA	NA	NA	\$\$*	\$\$	\$\$
	Barrier Islands (3 total)	Silt Muck Sand Clay	203,137.92	\$\$	NA	\$\$	\$\$	\$\$	\$\$*	\$\$	\$\$
Longtail Point	Dune/Beach North Reach	Sand	35,553	NA	\$\$	NA	NA	\$\$	\$\$	NA	\$\$
	Dune/Beach Mid Reach	Sand	83,002	NA	\$\$	NA	NA	\$\$	\$\$	NA	\$\$
	Dune/Beach South Reach	Sand	73,840	NA	\$\$	NA	NA	\$\$	\$\$	NA	\$\$

*Tentatively assumed sediment source



DE PERE DAM DESIGN CRITERIA



Priority Habitat	Acres	Position	Hydrogeomorphology				Hydraulics	Substrate Layers		
			Depths	Elevations	Flood	Morphology	Velocities	Parent Layer*	Growth Layer	Surface Layer
Submergent Marsh	30 -40	channel	12 to 36" below normal water surface elevation	Elevations to be added during next phase	subject to all river floods	flat to slightly undulating; slight to no slope	0 - .8 ft/s	rock, gravel, sand, clay	silt, muck, detritus, compost (6 -12")	fine gravel to coarse sand (2-3")
Emergent Marsh	30-40	channel	substrate elevation at 0 to 12" below the normal water surface elevation	Elevations to be added during next phase	subject to all river floods	flat to slightly undulating; minimal to no slope	0 - 0 .3 ft/s	rock, gravel, sand, clay	silt, muck, detritus, compost (12 -18")	fine sand, detritus, muck, silt (2-3")
Hardwood Swamp	15	off channel basin	substrate elevation at 0 to 12" below the normal water surface elevation	Elevations to be added during next phase	subject to all river floods	flat to slightly undulating; minimal to no slope; hummocky	NA	clay, sand	NA	detritus, muck, silt (6")
Wet Prairie (Grasslands)	6	off channel basin	water table elevation is 6" above to 6" below ground surface elevation	Elevations to be added during next phase	outside influence of 2-year flood	flat to slightly undulating; minimal to no slope; hummocky	NA	clay, sand	muck, compost (6 - 12")	topsoil (3")
Dry/Mesic Prairie (Grasslands) or Other Forest	6	transitional / bank / upland	water table elevation at 6" or > below ground elevation surface	Elevations to be added during next phase	outside influence of 5-year flood	undulating; transitional slopes; ridges, hills	NA	clay, sand	NA	topsoil (3 - 6")



DE PERE DAM MATERIAL NEEDS



Feature	Layer	Volume, CY	Proposed Sources
Cobble Gravel	Parent Layer (Cobble/boulders)	657	Commercial
	Incubation Layer (mixed gravel and sand)	461	Commercial
	Spawning Layer (small cobble and coarse gravel)	197	Commercial
Emergent Marsh	Parent Layer (clay or sand base material)	31,855	Beneficial use of sediment
	Growing Medium (sand + C POM*)	7,339 sand + 29,355 leaf litter	Beneficial use of sediment for sand + leaf compost or leaves from park/city sources
	Top layer (muck)	6,116	Leaf compost or leaves
Sedge Meadow	Parent Layer (clay or sand base material)	5,876	Beneficial use of sediment
	Growing Medium (sand + C POM)	320 sand + 214 leaf litter	Beneficial use of sediment for sand + leaf compost or leaves from park/city sources
	Top layer (muck)	1474	Leaf compost or leaves
Spawning Reef – Shoal A	Stone Blocks	244 each	Commercial
	Large Boulders	765 each	Commercial
	Angular Gravel	4,825	Commercial
	Sub-Angular Gravel Incubation Layer	4,480	Commercial
	Sub -Angular Cobble	866	Commercial
Spawning Reef – Shoal B	Stone Blocks	488 each	Commercial
	Large Boulders	700 each	Commercial
	Angular Gravel	4,728	Commercial
	Sub-Angular Gravel Incubation Layer	8,721	Commercial
	Sub -Angular Cobble	843	Commercial
Submergent Aquatic Vegetation	Parent Layer (sand and gravel)	24,100	Beneficial use of sediment
	Growing Medium (sand + C POM)	4,930 sand + 1,643 compost	Beneficial use of sediment for sand + leaf compost or leaves from park/city sources
	Top Layer (sand)	2,191	Beneficial use of sediment



LONGTAIL POINT DESIGN CRITERIA



Priority Habitat	Hydrogeomorphology									
	Acres	Position	Depths	Elevations	Fluctuation	Morphology	Hydraulics	Substrate Layers		
							Waves	Parent Layer*	Growth Layer	Surface Layer
Dune	5.7 +0.5km	Peninsula lakeward coastal	Substrate elevation 4' to 10' above normal water surface elevation (578.73 feet IGLD85)	583 ft to 589 ft IGLD85	No inundation or flooding upland zone of dune	flat to slightly undulating; high to slight slope	NA	sand **, stabilizing woody debris	sand **	sand **
Great Lakes Beach	5.7 + 0.5 km	Peninsula lakeward coastal, surf zone, foredune	Substrate elevation at -3' to 4' above normal water surface elevation	576 ft to 583 ft IGLD85	subject to all lake fluctuations	flat to slightly undulating; high to slight slope	small to white cap waves daily	sand **	sand**	sand / small gravel**
Emergent Marsh	116 + 40 - 50	Peninsula leeward coastal	substrate elevation at 0 to 12" below the normal water surface elevation	Elevations to be added during next phase	subject to all lake fluctuations	flat to slightly undulating; minimal to no slope	calm to small undulating waves	sand / gravel / hard clay	silt, muck, detritus, compost (12 -18")	fine sand, detritus, muck, silt (2-3")
Hardwood Swamp	16	Peninsula lakeward transitional / upland	substrate elevation at 0 to 12" below the normal water surface elevation	Elevations to be added during next phase	subject to lake-wide water levels, storm surges	flat to slightly undulating; minimal to no slope; hummocky	NA	clay, sand	NA	detritus, muck, silt (6")
Shrub carr	41	Mainland transitional / upland	water table elevation is 6" above to 6" below ground surface elevation	Elevations to be added during next phase	outside influence of 2-year flood	flat to slightly undulating; minimal to no slope; hummocky	NA	clay, sand	muck, compost (6 - 12")	topsoil (3")
Forest	20	Mainland transitional / upland	water table elevation at 6" or > below ground elevation surface	Elevations to be added during next phase	outside influence of 5-year flood	undulating; transitional slopes; ridges, hills	NA	clay, sand	NA	topsoil (3 - 6")



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LONGTAIL POINT PRIORITY HABITATS



Priority Habitats for Conceptual Restoration Design									
Priority Populations	Habitat Needs	Green Bay Open Water	Emergent Marsh HE	Great Lakes Beach	Hardwood Swamp	Shrub Carr	Forest		
Coastal Terrestrial Macroinvertebrates	native vegetation; healthy soils			X	X		X		
Native Freshwater Unionid Mussels	healthy substrates and plankton	X							
Shoreline Fish (Centrarchidae/Esox)	native vegetation; healthy substrates	X	X						
Anurans	connectivity between wetland and upland habitats; native vegetation		X		X	X	X		
Turtles	connectivity between wetland and upland habitats; native vegetation		X		X	X			
Migratory Waterfowl	diverse wetlands and open water	X	X		X	X	X		
Migratory Shorebirds	undeveloped beach, wetlands		X	X					
Migratory Landbirds	emergent marsh, shrub carr, lowland and upland forest		X		X	X	X		
Wooded Wetland Birds	hardwood swamp; healthy substrates				X				
Marsh Breeding Birds	diverse wetlands and tall native vegetation		X						
Breeding Shorebirds	undeveloped beach, wetlands		X	X					
Colonial Waterbirds	open water with islands	X	X						
Coastal Birds	open water with sandy beaches; dunes	X	X	X					
Bald Eagle/Osprey	open water with wooded margins	X			X		X		
Muskrat	emergent marsh key stone species		X						
Mustelids	large river with diverse fish, mussel and riparian zone	X	X		X		X		
Bats	hardwood swamp and wooded riparian zone				X		X		