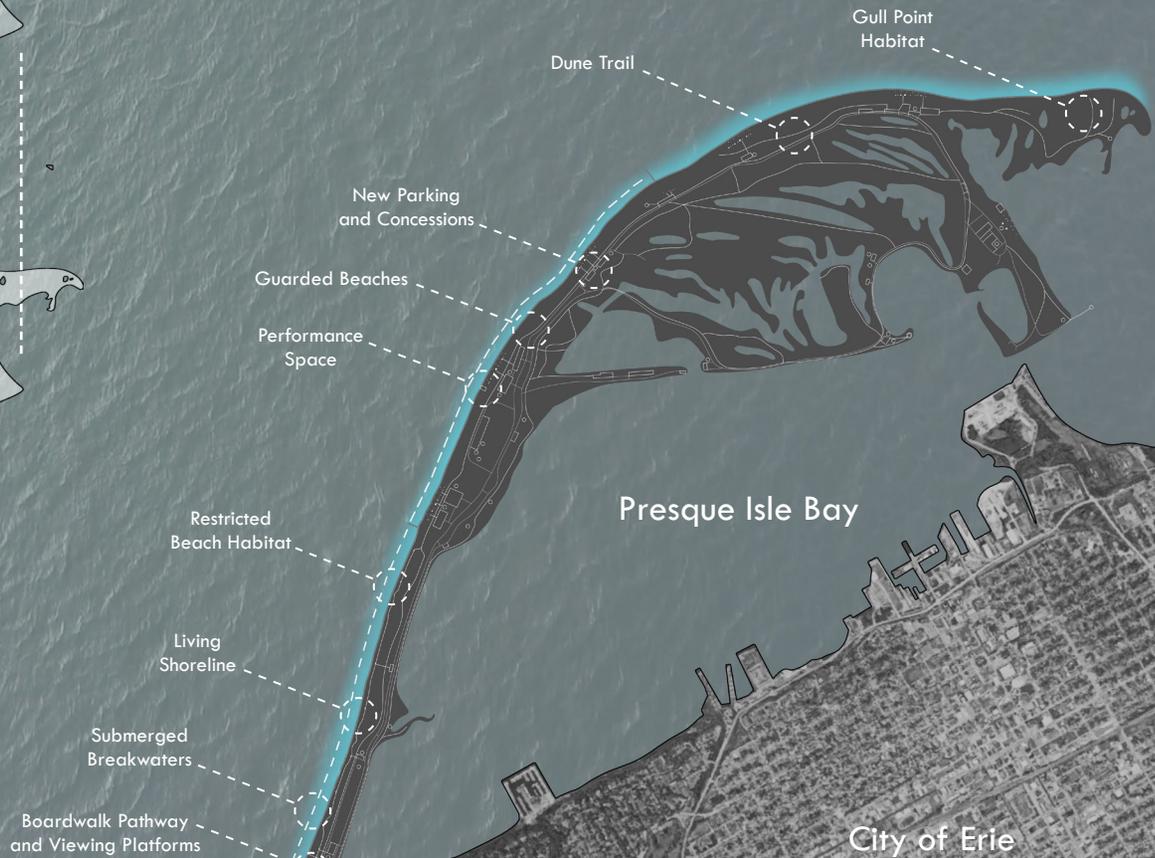
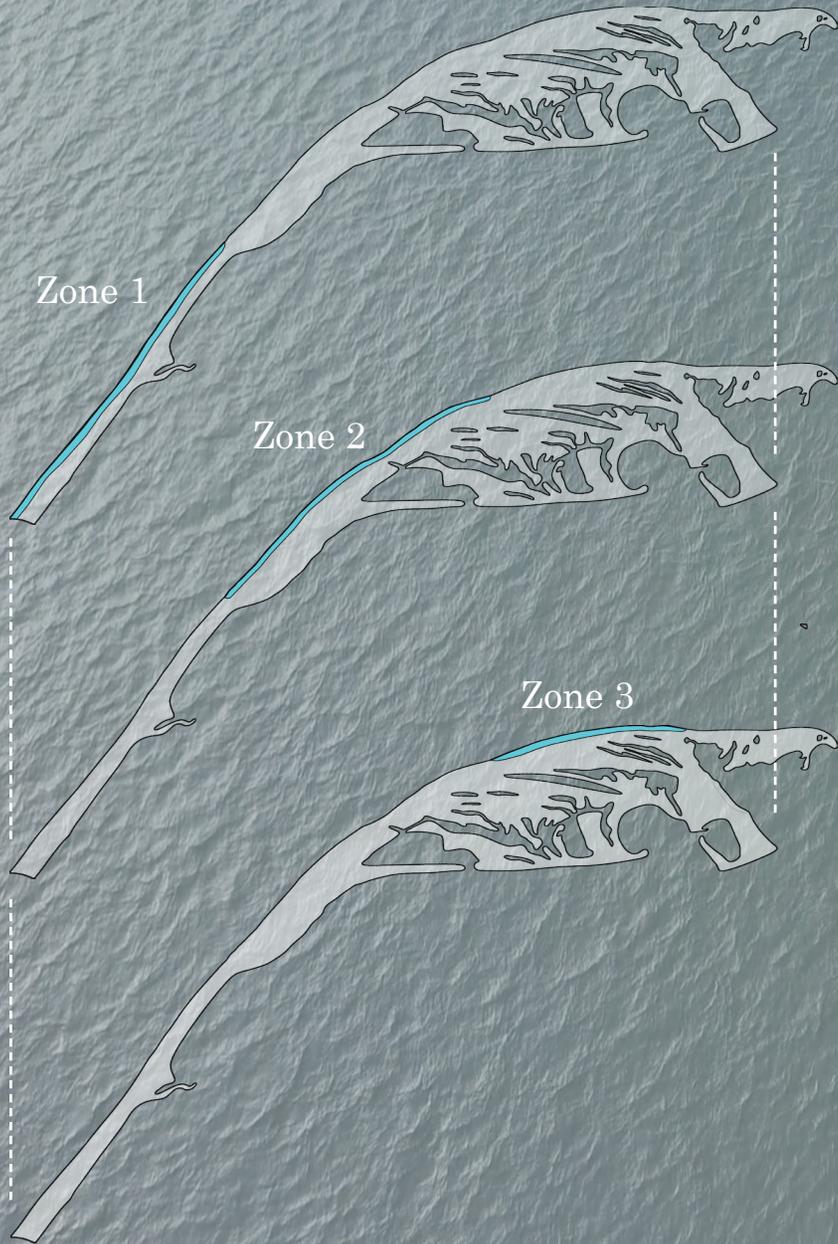


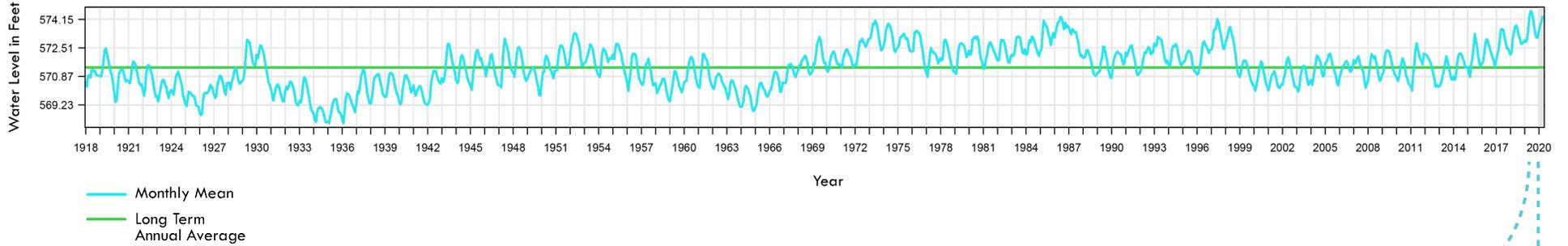
Design Strategy

To combat the accelerated erosion and loss of recreational beach space on the Lake Erie shoreline at Presque Isle, design is divided into three zones according to the appropriate erosion control strategy for that area.



Lakefront Erosion

Great Lakes Water Levels (1918-2020)

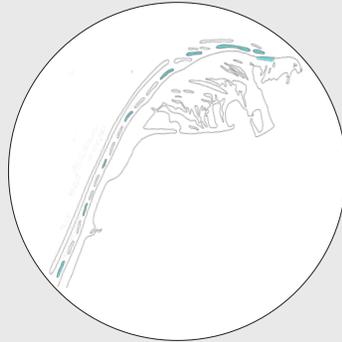


Lake Erie experiences occasional periods of high water levels, which are becoming more frequent due to climate change. High water levels create deeper waters along shore which allow aggressive waves to be carried closer to the shoreline.

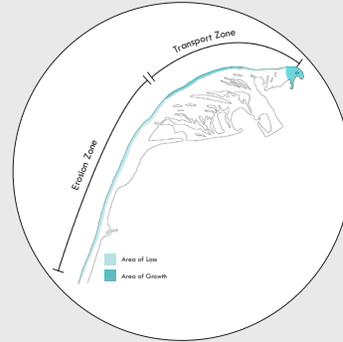
Shoreline Physical Processes



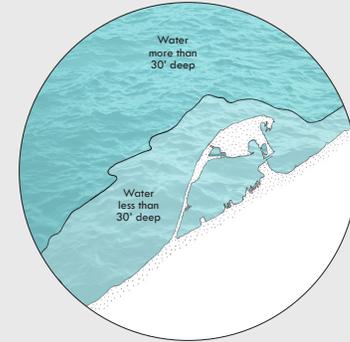
Predominantly westerly winds and waves expose the narrow neck of the park to the most direct wave action.



A series of migrating inner bars carry sediment from west to east, which reconnect with shore at the eastern end.

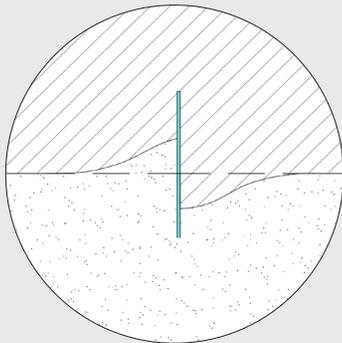


Aggressive wave action causes erosion in parts, while migrating bars cause growth elsewhere.

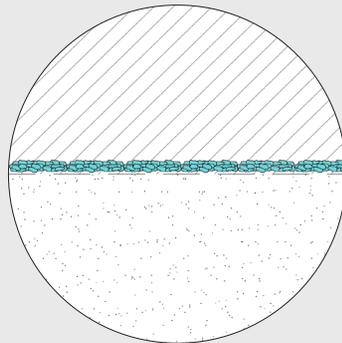


Natural processes cause the western end to shrink and the eastern end to grow. If this continues, the park will fall off the shelf on which it sits.

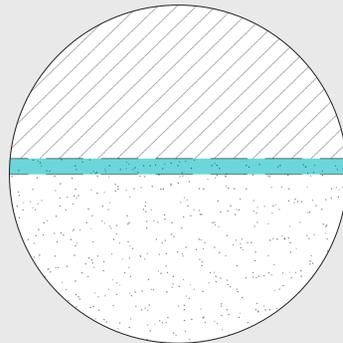
Current Erosion Mitigation Strategies



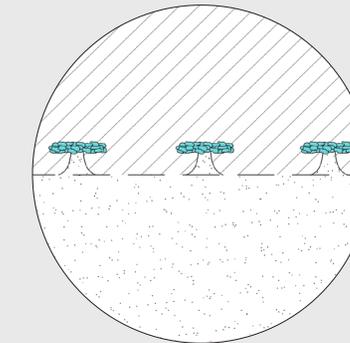
Groins cause accumulation of sediment on one side and downdrift erosion on the opposite side.



Seawalls allow aggressive waves to be carried closer to shore, and do not dissipate their energy soon enough.



Beach sand nourishment needs to be completed yearly, and can become expensive and unsustainable.



Emergent breakwaters deflect water around the ends. Tombolos can form in the lee and disrupt flow in the longshore current.

Project Goals

1 Protect the Neck

The narrowest area of the park also receives the most direct wave action, making its protection a priority.

2 Reduce Erosion on the Lake Shoreline

Current erosion mitigation strategies have not effectively managed erosion along the park's shoreline.

3 Maintain a Positive Human Experience on the Park

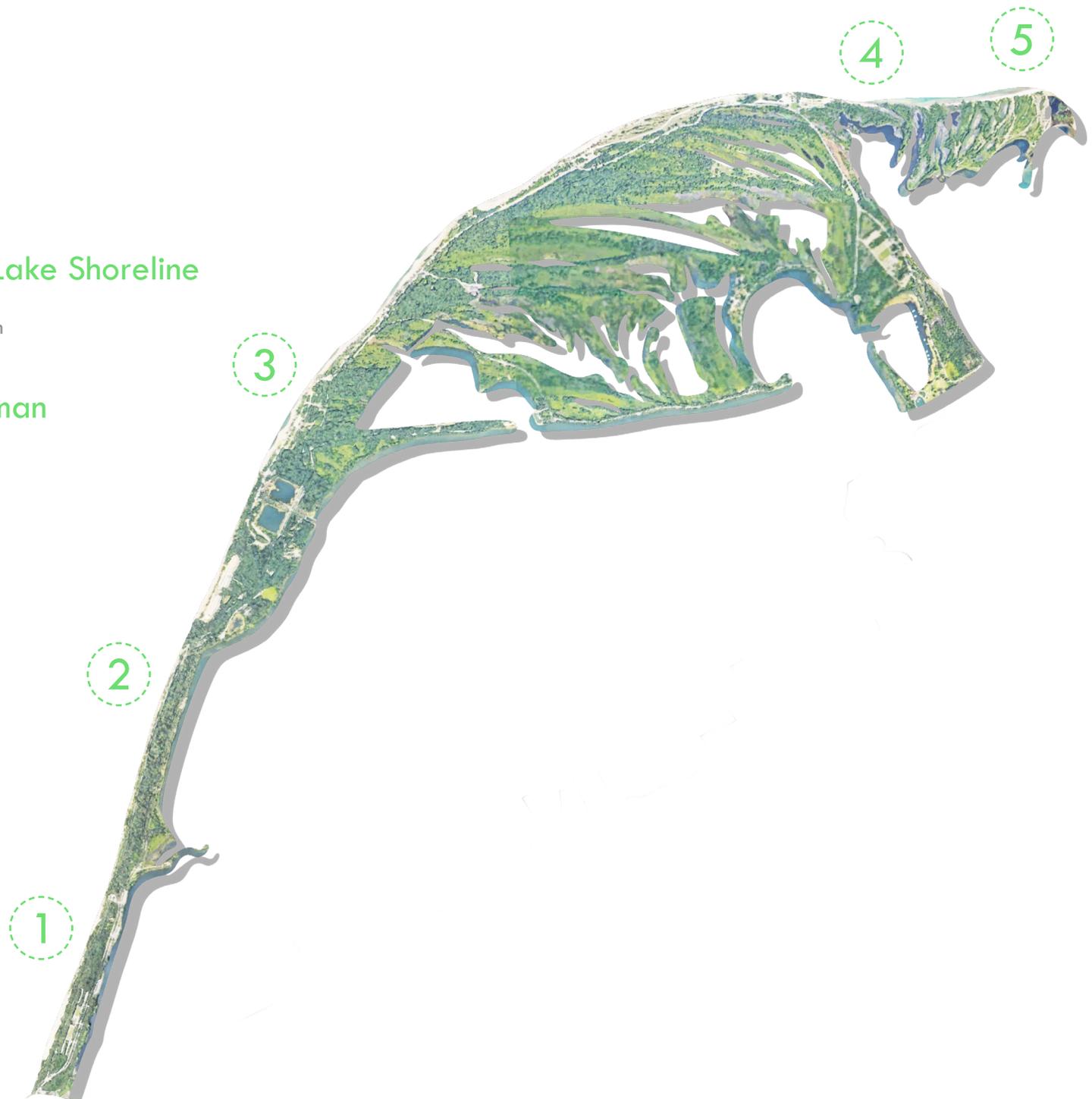
Strategies that address erosion on the park should not compromise the human experience.

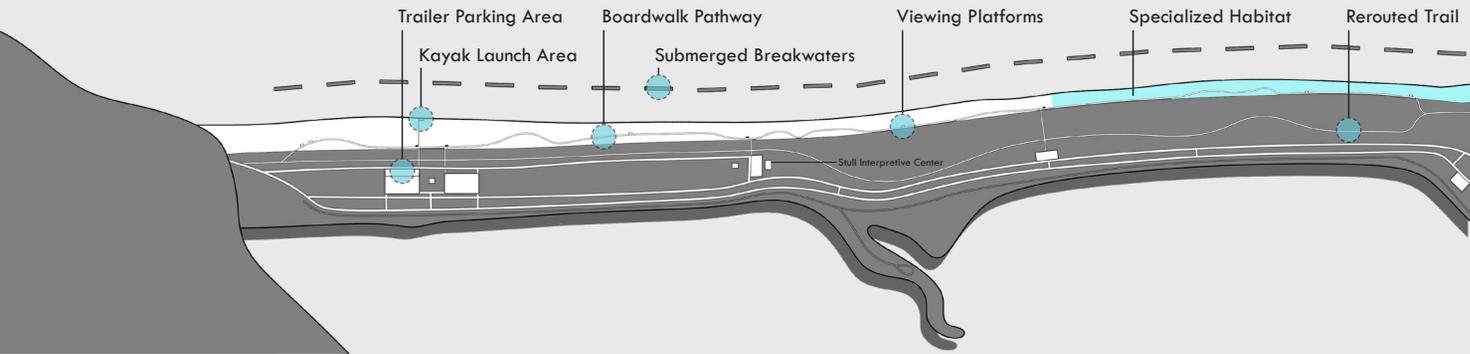
4 Preserve Gull Point

Gull Point is a valuable habitat and is currently at risk of becoming detached from the rest of the park.

5 Provide Habitat for Rare Species

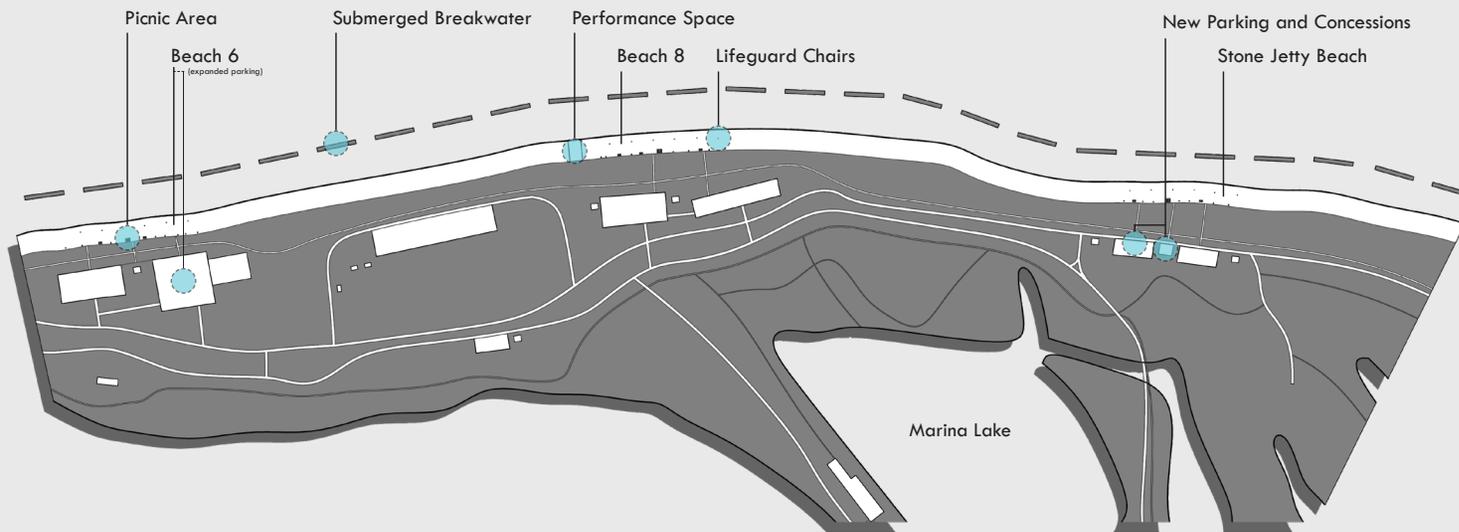
The habitat in certain areas of the park can be enhanced to support rare or endangered species.





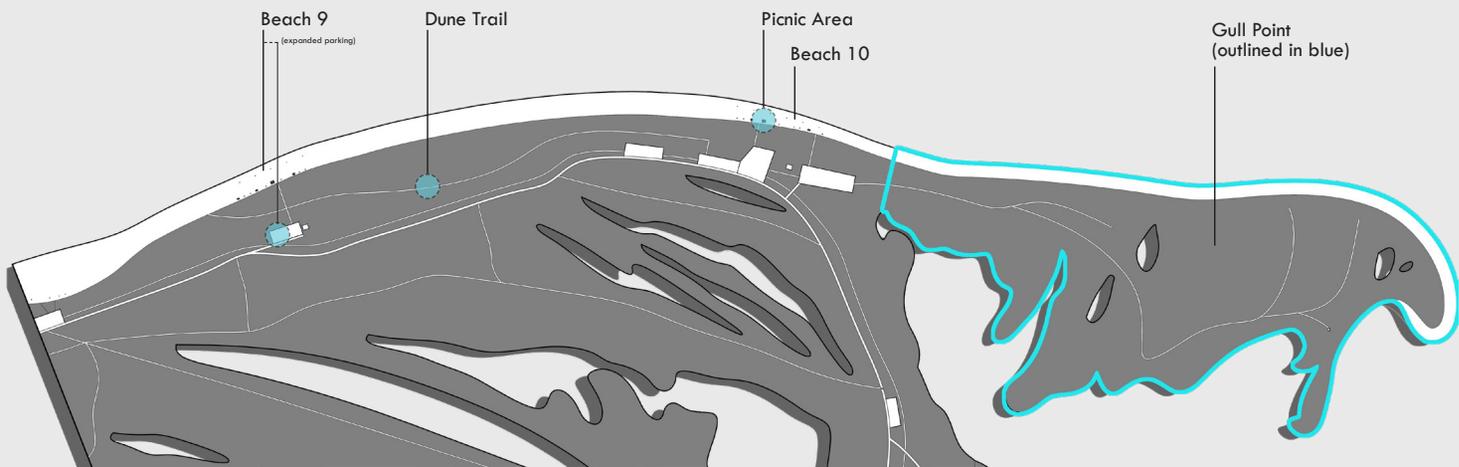
Zone 1

Zone one includes the narrowest part of the park and receives the most direct wave action. This zone will receive the most aggressive erosion mitigation plan, which includes a series of submerged breakwaters in conjunction with a living shoreline.



Zone 2

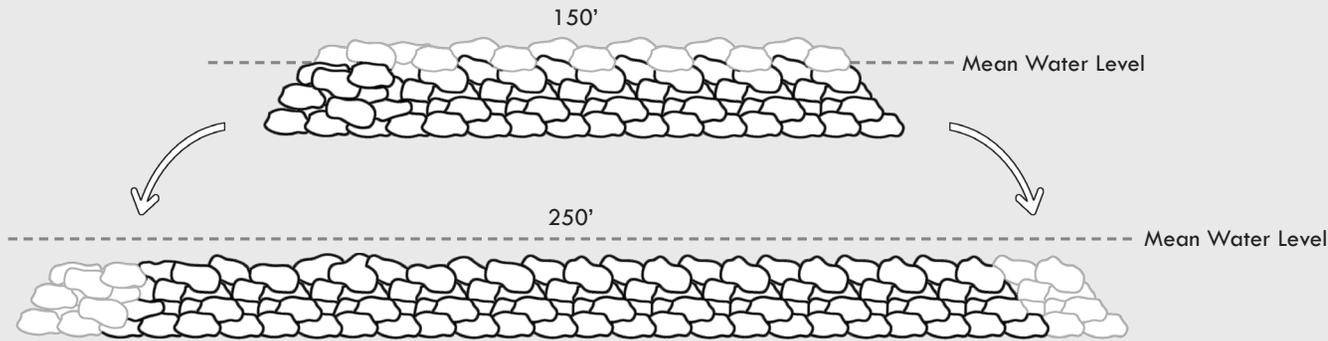
Due to the parallel nature at which waves reach the shore in zone two, erosion is less of an immediate concern. A series of submerged breakwaters will be used without the addition of a living shoreline so that beaches in this zone may function as recreational beaches. Amenities will become a focus of design in order to promote beaches in zone two for recreational use.



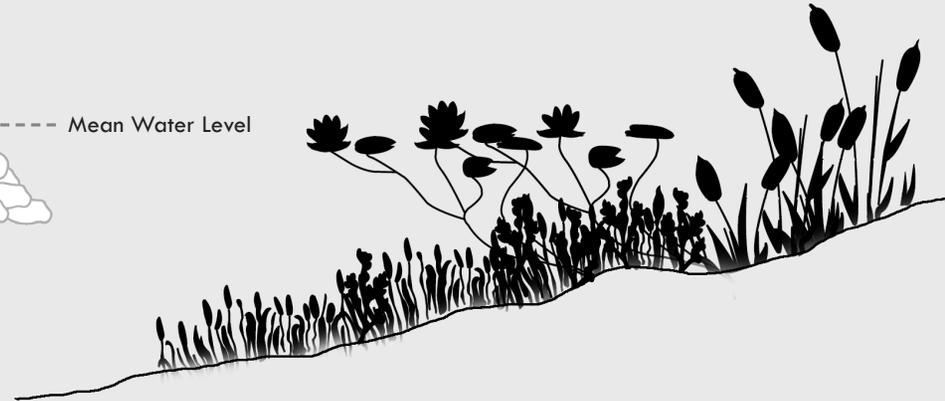
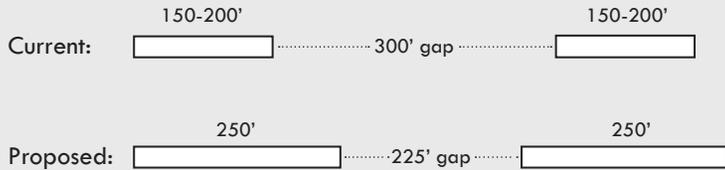
Zone 3

Zone three is in the transport zone, meaning erosion is less of a concern. The base of Gull Point, however, encounters erosion due to the current emergent breakwater system. No breakwaters will be employed in this zone in order to combat the erosion at the base of Gull Point.

Zone 1: Erosion Mitigation

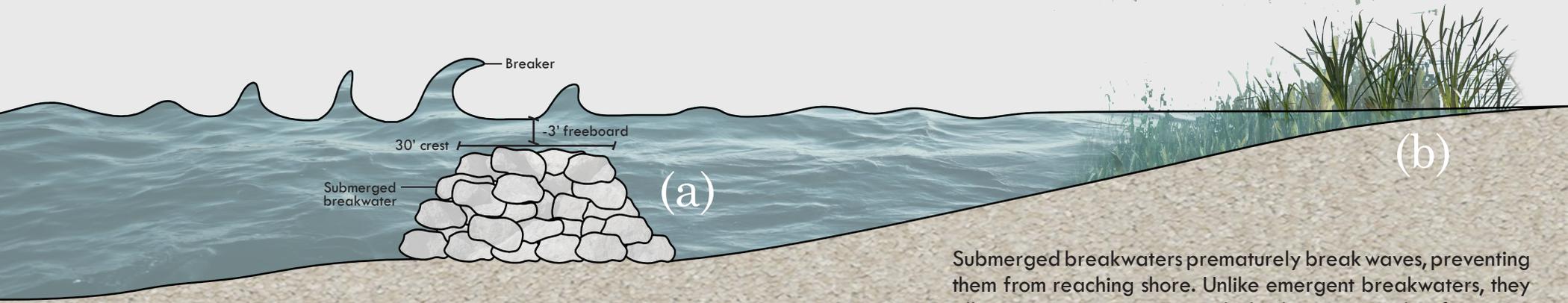


Submerged Breakwaters (a)



Living Shoreline (b)

Submerged Aquatic	Emergent Aquatic
<i>Elodea canadensis</i>	<i>Eleocharis spp.</i>
<i>Najas gracillima</i>	<i>Juncus effuses</i>
<i>Potamogeton perfoliatus</i>	<i>Sagittaria spp.</i>
<i>Valisneria americana</i>	<i>Sparganium spp.</i>
Floating Aquatic	Dunes and Dry Beaches
<i>Brasenia schreberi</i>	<i>Ammophila breviligulata</i>
<i>Nelumbo lutea</i>	<i>Elymus canadensis</i>
<i>Nuphar advena</i>	<i>Panicum virgatum</i>
<i>Nymphaea odorata</i>	<i>Spartina patens</i>



Submerged breakwaters prematurely break waves, preventing them from reaching shore. Unlike emergent breakwaters, they allow wave overtopping which discourages the formation of tombolos and promotes improved water circulation and function of the longshore current. Reallocation of current materials would be an effective construction strategy.

Zone 1: Living Shoreline



Submerged breakwaters are not visible, improving the aesthetic value of the shoreline

Stems of floating aquatic vegetation help with wave attenuation

A portion of beach is blocked off during nesting season to support piping plovers

Emergent vegetation helps stabilize the beach

The stems and leaves of aquatic vegetation create drag which assists with wave attenuation. The roots of emergent and dune vegetation help stabilize the beach and mitigate erosion. These measures protect the beach and create a unique experience for visitors.

Zone 1: Boardwalk Pathway



A boardwalk pathway along the edge of the dunes creates a designated pathway for visitors that discourages them from straying into areas of specialized habitat. Portions may be roped off during nesting season to encourage the return of rare birds.

Zone 2: Picnic Area



Emergent breakwaters are converted into submerged breakwaters

Zone two includes three guarded beaches

Picnic pavilions include grills and picnic tables

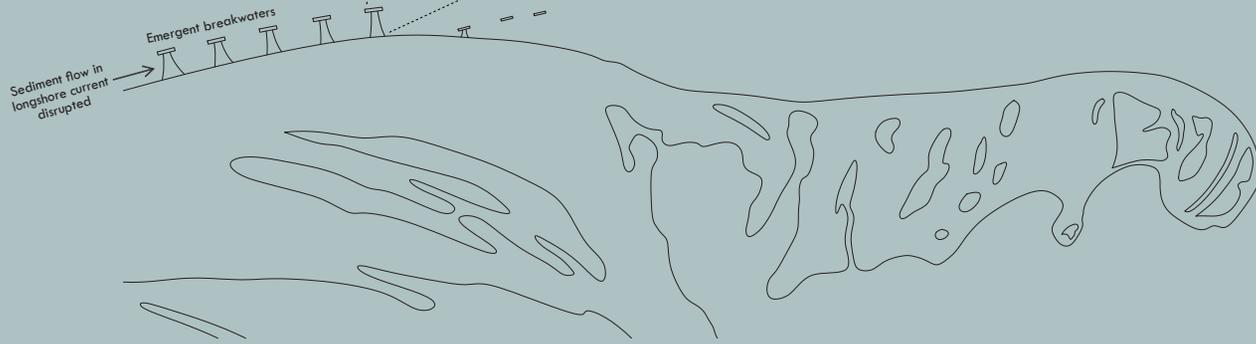
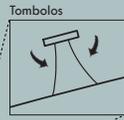
Zone two becomes the primary area for use as recreational beaches. This zone includes three guarded beaches with picnic areas, complete with tables, outdoor sinks, grills, and trash receptacles.

Zone 2: Beach Amenities



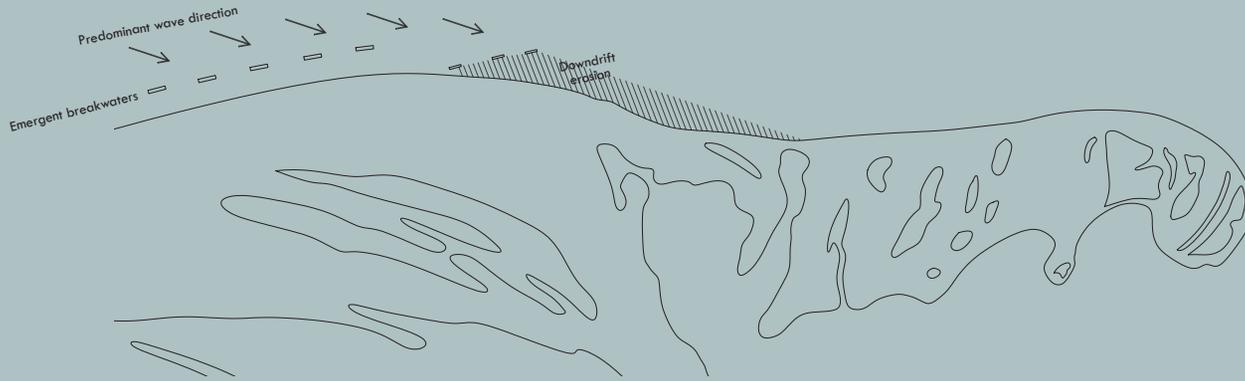
Zone two incorporates parking lots and amenities like concessions, restrooms, and bathhouses which promote beaches in zone two for recreational use. Parking lots are redesigned to support better infiltration and biodiversity, with permeable crushed stone and bioswales with native vegetation.

Zone 3: Erosion at Gull Point



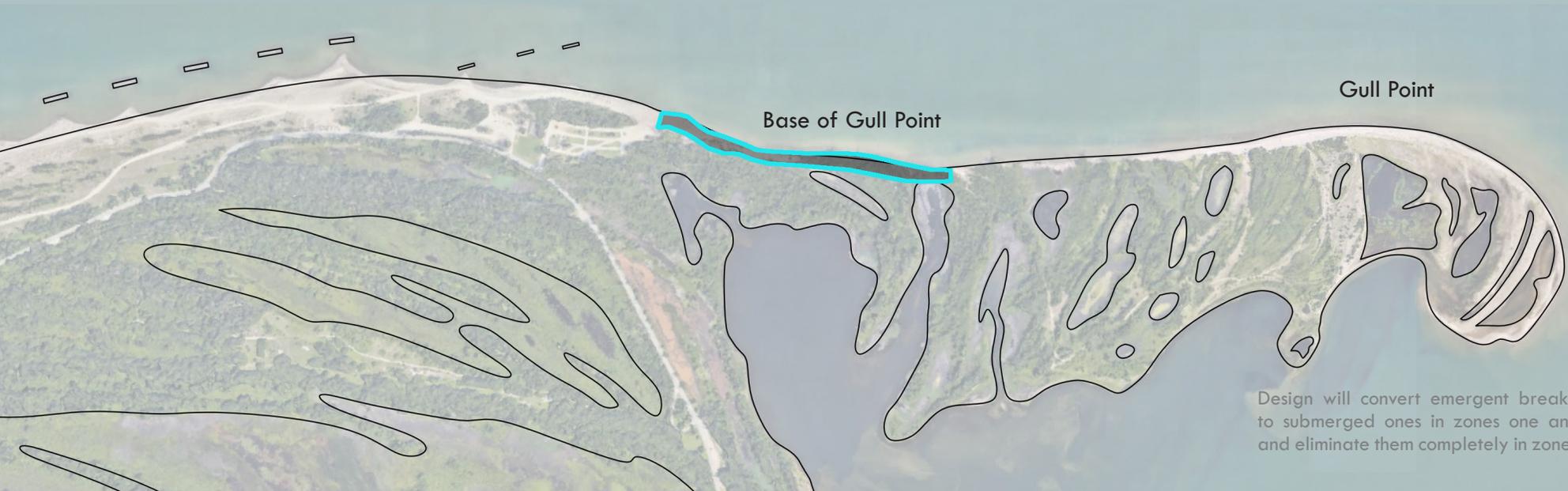
Tombolo Formation

Waves deflected around the ends of emergent breakwaters push sand toward the center of the lee, forming tombolos. Tombolos restrict the flow of sediment in the longshore current, preventing sand from being deposited at Gull Point.



Downdrift Erosion

Downdrift erosion occurs at the base of Gull Point where the system of emergent breakwaters ends. This causes the base of Gull Point to narrow, putting it at risk of becoming breached and detached from the rest of the park.



Design will convert emergent breakwaters to submerged ones in zones one and two, and eliminate them completely in zone three.

Zone 3: Gull Point Habitat



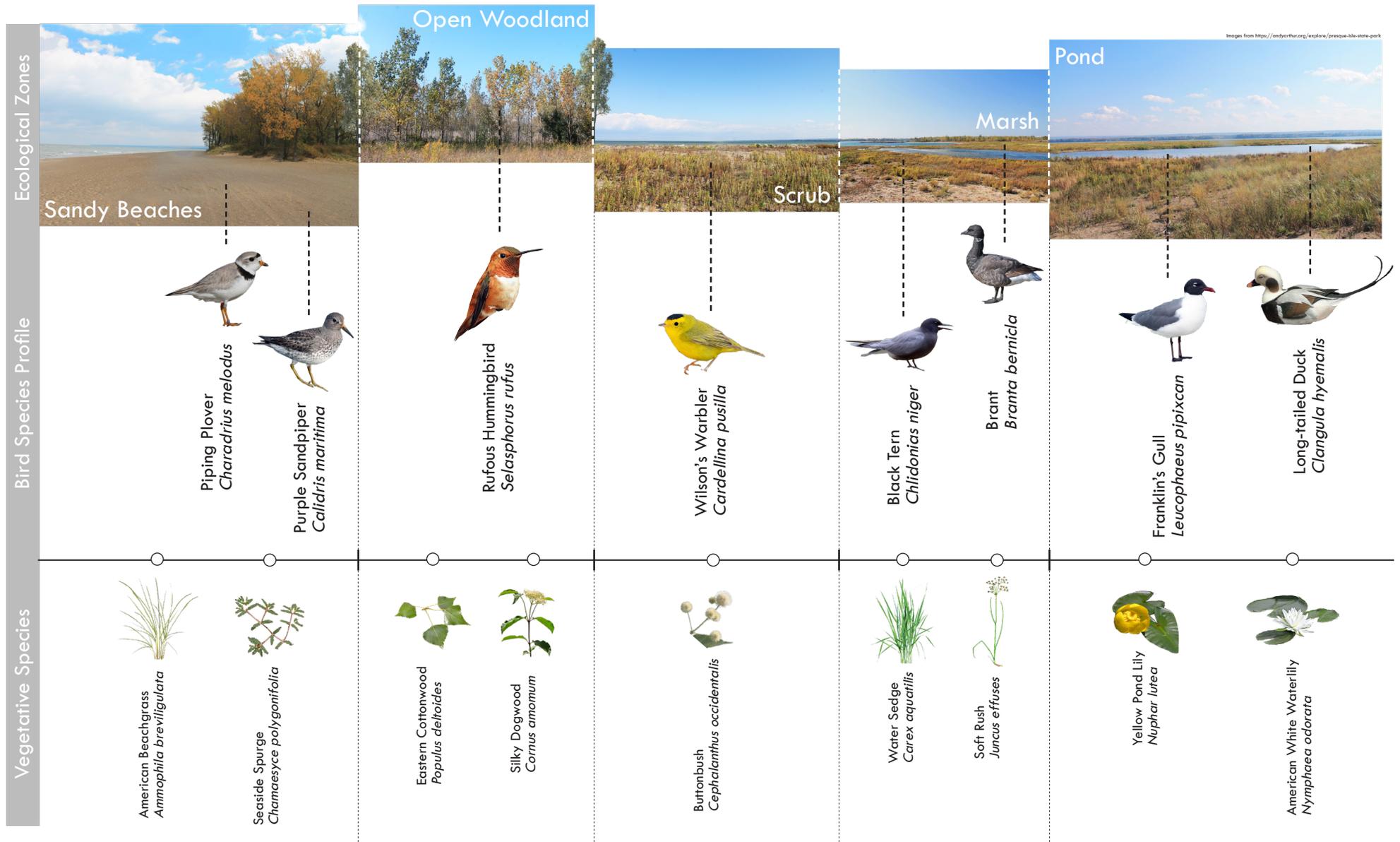
Submerged breakwaters support function of the longshore current and prevent further erosion at the base of Gull Point

Gull Point will have restricted access during periods of nesting and migration to reduce disturbances

Sandy Beaches	Open Woodlands and Scrubs	Marshes	Ponds and Lakes
Piping Plover	Wilson's Warbler	Black Tern	Red-necked Grebe
Ruddy Turnstone	Carolina Wren	American Bittern	Mute Swan
Black-bellied Plover	Rufous Hummingbird	Virginia Rail	Franklin's Gull
Whimbrel	Northern Shrike	Brant	Osprey
Purple Sandpiper	Alder Flycatcher	Common Gallinule	Long-tailed Duck

Ecological restoration initiatives will focus on re-establishing important species in each habitat type to create a functioning ecosystem that supports rare and endangered species of birds.

Zone 3: Gull Point Species Profile



Protection of rare and endangered species should be a priority. Vegetative species which support the habitat and dietary needs of these species should become a focus of management strategies to preserve Gull Point's value as a migration and nesting haven.

Planting Palette

Submerged Aquatic

Ceratophyllum demersum
Elodea canadensis
Najas flexilis
Nasturtium officinale
Potamogeton diversifolius
Potamogeton foliosus
Potamogeton pectinatus
Vallisneria americana

Rare species as noted in Rare Plants and Rare Plant Communities of Presque Isle (Bissell, 1993)¹:

Najas gracillima
Potamogeton illinoensis
Potamogeton natans
Potamogeton perfoliatus
Potamogeton richardsonii
Potamogeton zosteriformis

Floating Aquatic

Nelumbo lutea
Nuphar lutea

Rare species as noted in Rare Plants and Rare Plant Communities of Presque Isle (Bissell, 1993)¹:

Brasenia schreberi
Nuphar advena
Nymphaea odorata

Emergent Aquatic

Alisma triviale
Cyperaceae family
Eleocharis spp.
Hydrocotyle spp.
Juncus effuses
Ludwigia spp.
Polygonum spp.
Pontederia cordata
Sagittaria spp.
Scirpus spp.
Sparganium spp.

Rare species as noted in Rare Plants and Rare Plant Communities of Presque Isle (Bissell, 1993)¹:

Megalodonta beckii
Ranunculus longirostris
Utricularia intermedia
Utricularia minor

Dunes & Dry Beaches

Ammophila breviligulata
Artemisia campestris ssp. caudata
Cakile edentula
Chamaesyce polygonifolia
Elymus canadensis
Lathyrus japonicus
Panicum virgatum
Populus tremuloïdes
Ptelea trifoliata
Salix eriocephala
Salix exigua
Schizachyrium scoparium var. littoralis
Spartina patens
Triplasis purpurea

Tolerates heavy foot traffic; suitable for pathways or areas that visitors may stray off boardwalk path (Bissell, 1993)¹:

Cyperus schweinitzii
Sporobolus cryptandrus

¹ Bissell, James K. "Rare Plants and Rare Plant Communities of Presque Isle ." JSTOR, The Cleveland Museum of Natural History , 1993, www.jstor.org/stable/41610010?read-now=1&seq=1.