Maquoit & Middle Bay Habitat Plan

An Ecological Landscape Assessment & Geographic Prioritization

Final Report | Spring 2026

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Acknowledgements

Project Team

This plan would not have come to fruition without the involvement of many people and organizations. Below are a sampling of those who directly participated in the process. Those who participated in the **Work Group**, which met regularly throughout the duration of the project, are indicated with an asterisk*.

Although not direct authors of this work, the workshop participants listed were crucial to the project's development—many took time away from busy schedules to dedicate an entire day (or multiple) to participate in the process. Thank you to Maine Coast Heritage Trust who helped facilitate a two-day "charrette" on-site at their offices in Topsham. The geospatial methodologies used for this project owe a good deal of their development to the following people from previous conservation mapping work: Jeff Howarth, Bill Hegman, Janet McMahon, Pete Nichols, Matt Markot, and Steven Hufnagel.

Sources

All references may be found at the end of the document. The body text makes no indications for works that are of very high usage—some familiarity is expected with these resources (*see "Further Reading" in the Appendix*). More particular or unique points of interest are cited chronologically (*see "References" in the Appendix*). Map data layers numbered in the hundreds. Key layers have been directly cited in the text, while supporting layers are recorded in the final table (*see "Data Sources" in the Appendix*).

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Funding

This document has been funded by the U.S. Environmental Protection Agency under Cooperative Agreements #CE00A00682-0 and #CE00A00844-0 with the University of Southern Maine.



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Section 01

Project Overview

Executive Summary

Purpose

The Casco Bay Estuary Partnership (CBEP), in partnership with the U.S. Fish and Wildlife Service's Gulf of Maine Coastal Program (GOMCP) and Maine Coast Heritage Trust (MCHT), has consulted with Haley Ward, Inc. to develop an Ecological Landscape Assessment and Geographic Prioritization for Middle and Maquoit Bays (hereafter called the "Habitat Plan"). This project, funded by the U.S. Environmental Protection Agency (EPA), is the inaugural effort to implement **Action 1.1.A** of the Casco Bay Plan 2024, to:

> *"...(D)evelop science-based regional plans that integrate aquatic habitat protection, restoration, continuity, and resilience priorities;"*

serving to implement **Strategy 1.1**, which aims to:

> *"...(I)dentify places and initiatives that are most important for the protection, restoration, and enhancement of key habitats."*

Through science-based assessments, standardized geospatial analysis, and collaboration with local subject-matter-experts, this Habitat Plan will provide a high-level overview of the known aquatic environment of Middle and Maquoit Bays (hereafter called "Bays"), summarize priorities based on specific rationales, and then offer general strategies for future resilience, restoration, and protection. In addition to this Habitat Plan, a template has been developed to serve as a prototype for future subregional habitat plans for other parts of the Casco Bay watershed.

Goals of the Habitat Plan

The Habitat Plan will serve mostly as strategic guidance to assist coordinated efforts between different organizations. Unlike other plans, this product is not intended to be officially adopted by the organizations involved in its creation. The strategies listed in Section 05, therefore, should be seen as the particular recommendations of this Plan's Work Group and not the opinions of the other parties involved. Rather, the Plan intends to inspire the actions of the organizations and entities invested in this landscape, ideally to achieve four core objectives:

Conserve - Preserve and protect resources that provide value and security to the area's aquatic ecosystems and natural communities.

Mitigate - Prevent further harm to natural ecosystems and reverse human impacts by systematically addressing impairments using best-practices.

Restore - Augment the functioning of existing and threatened systems by restoring and enhancing natural processes that have been altered by human influences.

Study - Fill critical gaps in knowledge, identify phenomena in need of further monitoring or sampling, and engage with others performing similar work.

To achieve this, the Plan will demonstrate a prioritization framework and then present recommendations based on those priorities. See the following section for a discussion of the framework. More generally, however, the intention of this Plan is to be used broadly as an interdisciplinary resource between organizations. In addition to this Plan's process, prioritization, and recommendations, the intention is also for this document to provide:

Evidence - Individuals or organizations using this content should be able to point to data, visuals, and other information to substantiate their understanding of the ecological context and its value.

Resources - Researchers should be able to find basic figures, statements, and analytical metrics for the Bays.

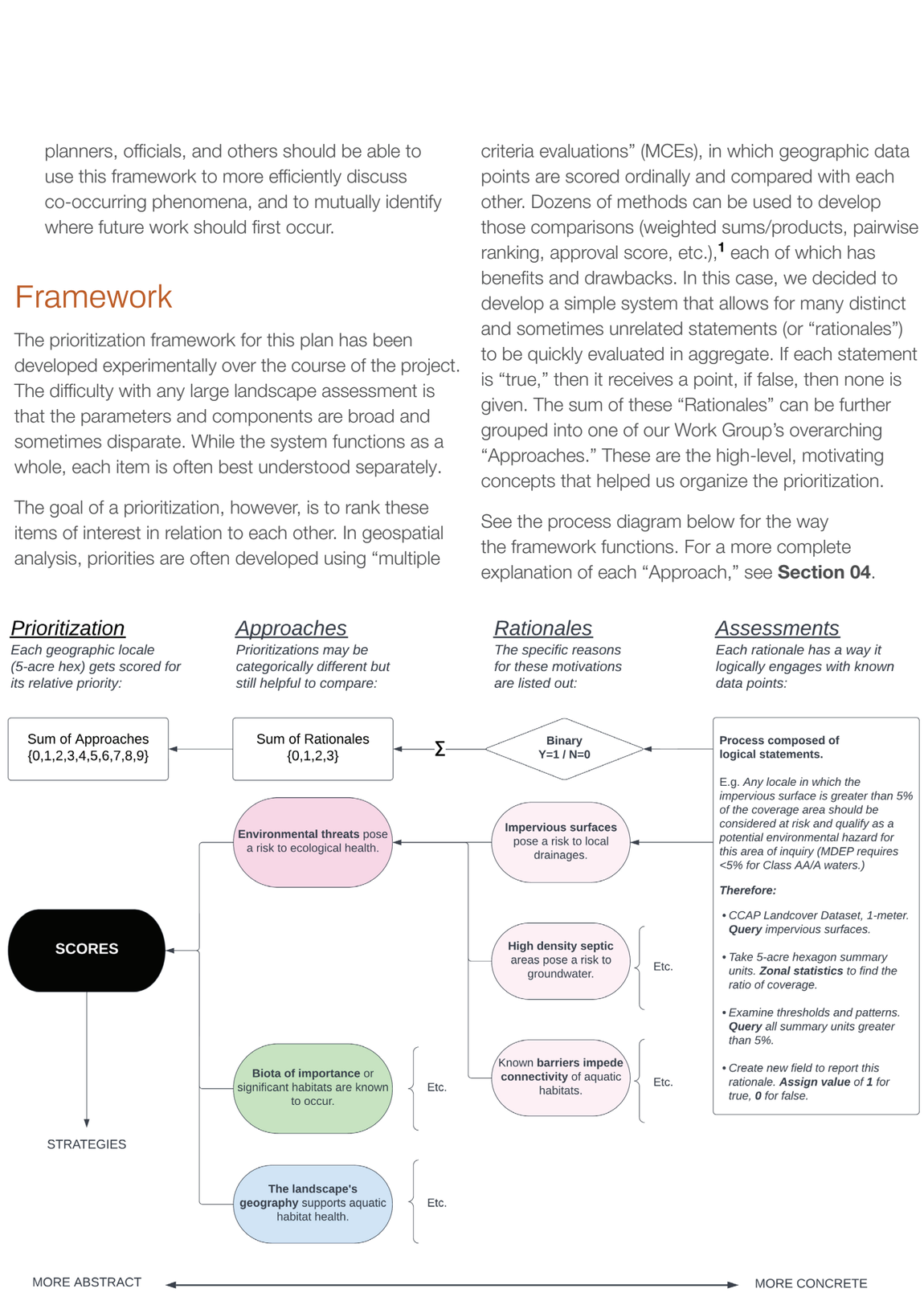
Touchpoint - Most importantly: conservationists, researchers, fieldworkers, planners, officials, and others should be able to use this framework to more efficiently discuss co-occurring phenomena, and to mutually identify where future work should first occur.

Framework

The prioritization framework for this plan has been developed experimentally over the course of the project. The difficulty with any large landscape assessment is that the parameters and components are broad and sometimes disparate. While the system functions as a whole, each item is often best understood separately.

The goal of a prioritization, however, is to rank these items of interest in relation to each other. In geospatial analysis, priorities are often developed using "multiple criteria evaluations" (MCEs), in which geographic data points are scored ordinally and compared with each other. Dozens of methods can be used to develop those comparisons (weighted sums/products, pairwise ranking, approval score, etc.),[1] each of which has benefits and drawbacks. In this case, we decided to develop a simple system that allows for many distinct and sometimes unrelated statements (or "rationales") to be quickly evaluated in aggregate. If each statement is "true," then it receives a point, if false, then none is given. The sum of these "Rationales" can be further grouped into one of our Work Group's overarching "Approaches." These are the high-level, motivating concepts that helped us organize the prioritization.

See the process diagram below for the way the framework functions. For a more complete explanation of each "Approach," see **Section 04**.



Process

Literature Review & Geospatial Data Inventory

The initial research process consisted of a literature review to inform the consulting team on the ecological conditions, stressors, and priorities in the study area. Multiple document types were evaluated, including but not limited to: comprehensive management plans, technical reports, peer-reviewed studies, and organizational resources from state agencies, research institutions, and regional conservation partnerships.

Critical documents included the CBEP's updated Comprehensive Conservation and Management Plan: Casco Bay Plan (2024), CBEP's State of Casco Bay (2021), CBEP Draft Habitat Plan (2022), and Maine's Wildlife Action Plan (2015). These planning documents established the regulatory and conservation context, identifying Species of Greatest Conservation Need (SGCNs), priority habitats, and stressor categories that informed subsequent research priorities.

The following themes emerged across the literature: climate change, habitat loss, invasive species, water quality stressors, and aquatic habitat connectivity. The literature review also revealed data deficiencies including limited temporal monitoring of key indicator species, insufficient watershed-scale pollutant source characterization, incomplete assessment of climate adaptation potential for priority habitats, and minimal evaluation of restoration intervention effectiveness. These gaps informed subsequent discussions with the project's stakeholders.

Following the literature review, multiple geospatial inventories and desktop analyses were conducted on the study area. Our preliminary analysis focused on five key topic areas, including: Human Systems, Aquatic Geographies, Watershed Connectivity, Stressors, and Biota (*see Section 03*). The maps created in this process served as a foundation for discussion at a planning charrette where participants later identified their concerns, insights, and interests. The team then analyzed the feedback derived from this planning charrette to compile a comprehensive prioritization analysis.

Planning Charrette

Our project operated on a highly compressed timeline. In order to gather as much information as possible in an efficient manner, the Work Group decided to host a two-day charrette (October 28-29 of 2025) held at MCHT's Topsham offices in order to convene interested parties and experts. Unlike other stakeholder meetings and events, a charrette is different in that it normally has the following characteristics: 1) it is hosted by a dispassionate and/or neutral party, 2) the meeting's outcomes are not always predefined and are instead decided via the engagement process by the end, and 3) the participants and their opinions are not beholden to any individual organization's rules, protocols, or special interests. The "charrette" differed still further than the typical format. While the workshops normally held at these planning events act primarily to communicate complex ideas via consultant expertise to a decision-making audience for input, in our case the workshops instead facilitated discovery for the consulting team. The audience for these events were themselves the experts, and their input helped inform the consulting team's decisions.

Geospatial Summarization & Prioritization

Once all of the ideas were gathered from the engagement process, the consulting team then developed the prioritization framework in tandem with the Work Group. This prioritization segments the study area into a lattice of 5-acre locales across the region, using a series of geospatial queries and logical summaries to arrive at binary values that record "rationales." These rationales are direct statements of known value, grouped together to support the primary "approaches" that frame the prioritization. Each approach then supports a priority score, 0-12 (the maximum score in this Study Area was found to be 10).



Key Takeaways

The Bays Host Significant Estuarine Habitat that Supports a Wide Variety of Biota

In previous years, expansive eelgrass beds have been mapped in upper Maquoit Bay and near the mouth of the Harraseeket River. These underwater meadows stabilized sediments, improved water clarity, and served as critical nursery habitat for fish and shellfish, forming a foundational component of the estuarine ecosystem. These have declined significantly in the past several years—even to the point of largely disappearing from the Bays. Eelgrass occurrence is naturally dynamic, and there have been successful experiments to reintroduce eelgrass at a small scale, but the extensive loss of eelgrass beds in Maquoit and Middle Bays is one of the most concerning trends in this region.

Although locally abundant, the Maine Natural Areas Program classifies Spartina saltmarsh as an S3 natural community, considered "Vulnerable" in the State's conservation priority ranking.[2] These marshes act as transition zones from broad intertidal mudflats to the brackish and freshwater wetlands that connect freshwater streams to the Bays. They support a wide variety of wildlife: tidal mudflats teem with productive populations of marine worms and soft-shell clams; sheltered embayments provide nesting, roosting, and feeding habitat for coastal birds; diadromous fish migrate through connected streams; shorebirds and tidal waders and waterfowl forage along the shoreline; horseshoe crabs rely on protected shallows for spawning. In addition to several of the aforementioned species, this region supports other Species of Greatest Conservation Need (SGCN) outlined in Maine's State Wildlife Action Plan, including the saltmarsh sparrow.

Key Habitats are Highly Susceptible to Environmental Threats by Human Activity

One of the most visible indicators of ecosystem stress has been the decline of eelgrass beds. The species has often acted both as a "keystone species" (supporting other biota, as mentioned above), and as an "indicator species" (allowing environmental stress to be immediately observable). While eelgrass is susceptible to numerous interacting environmental stressors, research suggests that sediment bioturbation by green crabs and warming water temperatures are key eelgrass stressors in this region.[3] Eelgrass is also highly sensitive to nutrient enrichment, sedimentation, physical disturbance, and changes in water clarity, and therefore activities such as dredging, shellfishing, propeller scarring, storms, and mussel dragging have the potential to cause long-lasting damage, with recovery times measured in decades.

Although saltmarshes remain extensive in the area, these are also becoming increasingly vulnerable: historic use of tidal wetlands for agriculture has altered the natural marsh hydrology; modern disturbances have introduced invasive plant species; and physical stream barriers and tidal restrictions prevent natural salinity, drainage, and sediment movement, affecting their vitality.

Because eelgrass meadows and salt marshes provide crucial function for the ecological landscape, and because both are sensitive to the environmental stresses they have encountered, preserving and restoring these should be considered of the highest priority.

The Impacts of Development on Water Quality and Climate Stressors Raise Concerns About the Future

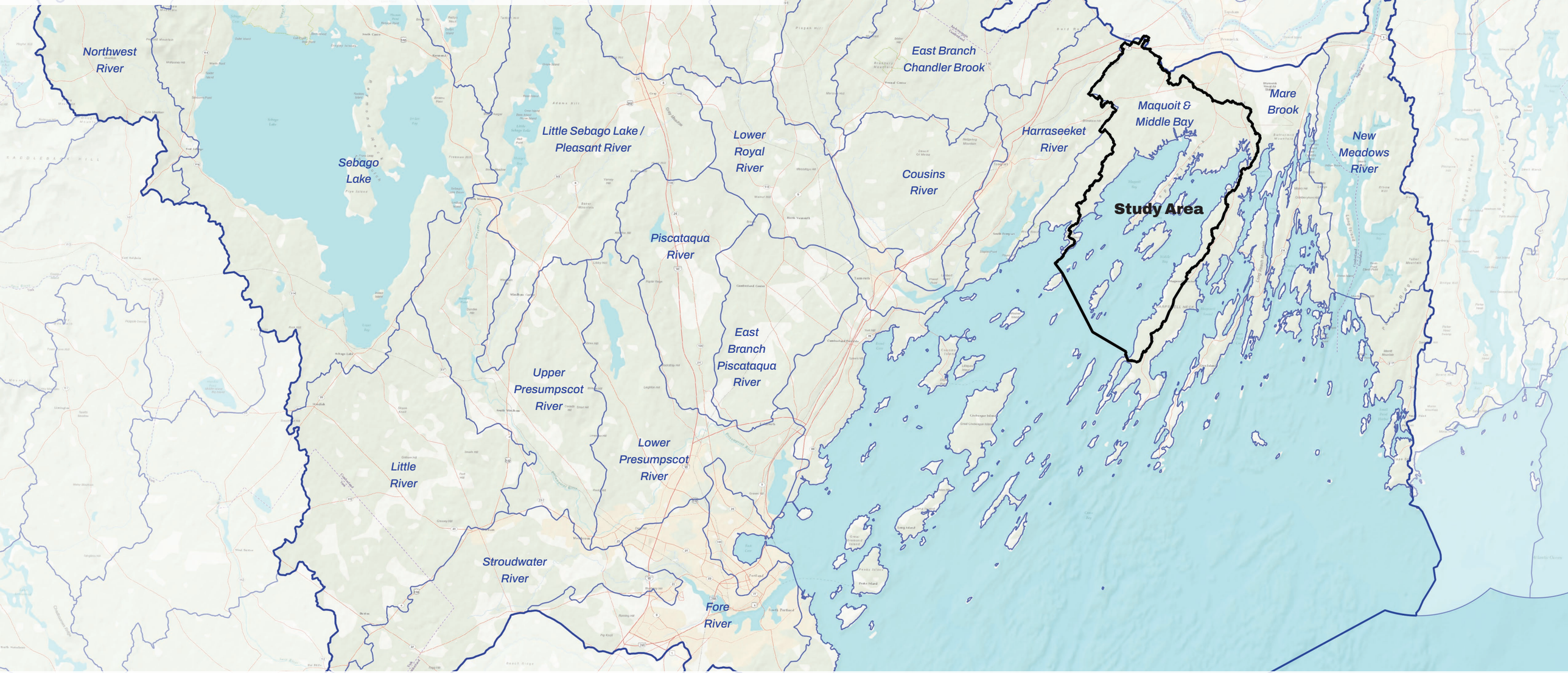
Expanding residential development—both inland and along the shoreline—threatens to further reduce natural vegetation and increase impervious surfaces, increasing both runoff volumes and pollution loads to coastal waters. Similarly, the construction of seawalls and riprap, while protecting individual properties, is likely to further disrupt natural sediment transport and alter the hydrology of adjacent tidal zones. Over time, these changes to marine and local freshwater hydrology will alter and impact the habitat's structure, likely diminishing the ecological resilience of the shoreline. Climate-related stressors including sea level rise, ocean acidification, and warming waters compound the cumulative impacts of shoreline hardening, residential development, and pollution, threatening the resilience of dynamic coastal ecosystems. In working with municipal partners, all collaborators should favor those development efforts that work to prevent these issues. Where possible, artificial barriers and other human impacts should be mitigated and/or restored to natural processes.



Section 02

Existing Conditions

Map #01: *Regional Context*



Geophysical Setting

The Maquoit Bay and Middle Bay Study Area forms one of the most ecologically important coastal landscapes in southern Maine. Part of a broader coastal system, extending from Harpswell Neck to the lower Royal River, the region is designated as a Focus Area of Statewide Ecological Significance (Beginning with Habitat). This interconnected estuarine system supports a wide range of habitats and species while providing substantial ecological and economic benefits to surrounding communities.

Perhaps one of the most standout characteristics of this system is that the Bays offer a unique geophysical setting for this part of the coastline, which supports many interdependent groups of species and natural communities. Most of the southern Maine coast consists of high-energy shorelines like ledges, boulders, and rocky beaches that are exposed to the erosive forces of waves or high velocity tidal rivers and currents. In contrast, the northeastern corner of Casco Bay provides a protected, low-current environment where benthic habitats rise through the sublittoral, intertidal, estuarine, saltmarsh, and riverine systems in a broad gradient. This setting allows for an exchange of nutrients and organisms not found elsewhere in the region.

What follows is a set of thematic maps and summaries to help further describe the character of the study area.

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Study Area Overview

General Characteristics

Maquoit and Middle Bays sit at the northeastern corner of Casco Bay. They are protected, broad estuaries that benefit both human and natural communities due to their valuable ecological resources. In terms of human value, the Bays themselves are common sites for aquaculture and lobstering, and the intertidal areas are regular spots for clamming and worming. The area is also famous for its recreational value. Ecologically, the area is considered regionally significant due to its protected and relatively undisturbed nature, as well as the broad intertidal flats that transition to saltmarshes—a rare and gentle ecotone not commonly found in a region where the neighboring coastline is dominated by rocky shores and tidal rivers.

The islands contained within these bays are sparsely populated or completely unpopulated and are popular recreation destinations for locals. The Goose Islands and White Island provide uninterrupted habitat for coastal species, while Birch Island and many of the ledges and smaller islands provide additional shelter to both Bays from exposure to Broad Sound.

The shoreline along Maquoit Bay is partially developed. Along the northwest side of the Bay, settled areas are interspersed with conserved natural areas. The head of the Bay—from Bunganuc Point to the northern section of Merepoint Neck—is the least developed/disturbed, with the exception of a large mowed field at Wharton's Point. Stretching southwest along Merepoint Neck, the level of development increases significantly with shorefront homes.

The shoreline along Middle Bay follows a similar pattern. Starting at the tip of Merepoint Neck, the shoreline consists of interspersed developed and undisturbed areas until it reaches the head of the Bay, where Middle Bay Cove presents a largely protected and undisturbed area. Following Harpswell Neck along the southern part of Middle Bay, the shoreline is a similar patchwork until it reaches Lookout Point. From here to Whites Point, development increases, reaching its highest density along Sunset Cove.

The freshwater drainages bear almost no lacustrine habitat; the drainages also have only one freshwater wetland complex of significant size which straddles the watershed boundary with Mare Brook. Otherwise, freshwater systems are typified by small riverine wetlands, several stormwater ravines, farm ponds, perennial brooks, and intermittent and ephemeral streams.

The surrounding terrestrial landscape varies from fully protected natural areas through sparsely settled rural areas to low-density suburban residential neighborhoods. The only significant suburban residential developments are found in the northern part of the Study Area as it borders the Town of Brunswick's residential areas. Although these suburban lands are not yet large, they represent a growing potential risk to water quality, as houses in these areas are not all served by municipal sewers. Recent efforts to limit the Town of Brunswick's Growth Zone, however, may help to curb this pattern in the future.[4]

The only large areas of non-impervious, disturbed lands can be found in the Bungunuc and Upper Maquoit Bay watersheds: these are primarily agricultural fields and mowed lawns, with several instances of recreational fields and blueberry barrens.

Definition of Study Area

The area was defined with charrette participant guidance, but largely followed the preparatory work performed by the Work Group. The terrestrial edge of the study area boundary matches the freshwater drainage basins that empty into the Bays. The upper edges of these basins were defined using a surface runoff model. This was derived from a hydrologically-corrected, LiDAR-derived digital elevation model (DEM). Related flowlines and the associated drainage basins can be seen in the following section on hydrology. The marine boundary line of the study area runs from Flying Point in Freeport to Goose Ledge, excluding Bustin's Island, and from there to the southernmost point of Curtis Cove.



Hydrology

Freshwater Basins

The majority of the freshwater drainage systems are small: normally intermittent and/or ephemeral. While these may and often do contribute to sedimentation—as in the case of the ravines on the northwest side of upper Maquoit Bay—many are predominantly dry and only active in stormwater events.

The exceptions here are Bunganuc Stream and Miller Creek watersheds. The Bunganuc Stream watershed is the largest basin by far, with an area equalling the next three largest combined. With a mosaic of small riverine, freshwater emergent, and forested wetlands throughout its basin, Bunganuc Stream has a perennial outlet with many intermittent and ephemeral tributaries. Although only half of the catchment area by comparison, Miller Creek is fed by a substantial wetland and aquifer at its headwaters. These two drainages are the only two notable riverine areas considered perennial streams.[5] The other drainages at the head of Maquoit Bay and Middle Bay Cove contain functional estuaries and display notable freshwater stream morphology, but are fed by intermittent stream systems only, and they are mostly devoid of substantial wetlands and/or open water.

Aquifers

The Brunswick-Topsham aquifer is unique in that it originated at a glaciomarine terminus, where the retreating Laurentide Ice Sheet met the submerged Maine coastline approximately 16,000-17,000 years ago.[6] Unlike the till or simple outwash plains common elsewhere in the state, this system features stratified sand and gravel deposits. Differing from fractured bedrock aquifers, sand and gravel aquifers like this one are considered significant for their high yield—often greater than 10 gallons per minute in a typical well. This is due to their high porosity and permeability.[7]

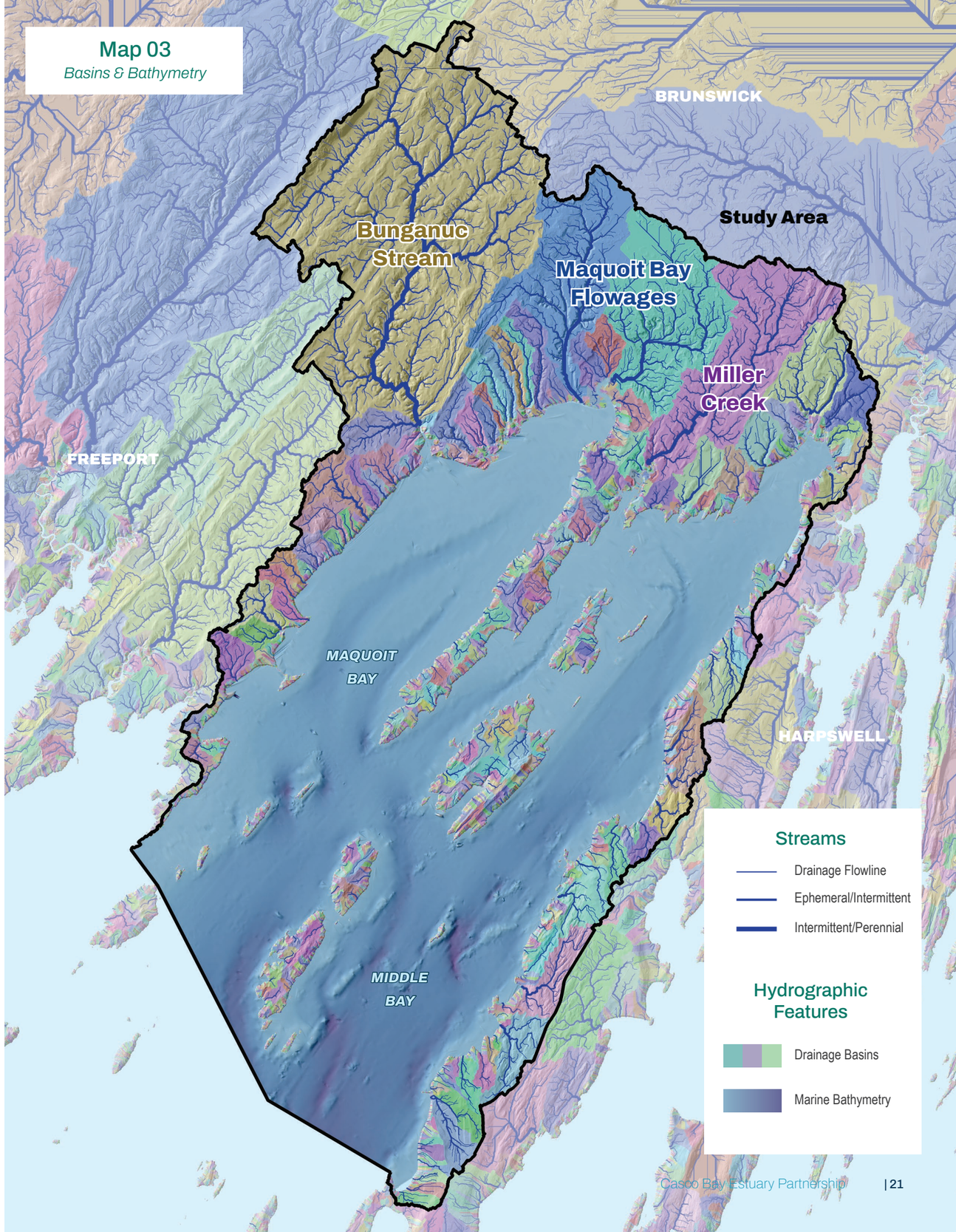
As a result of this highly porous substrate, subsurface water movement in the Brunswick-Topsham area likely differs from the surface flow derived via the digital elevation model. This means that the hydrological boundary between the headwaters of Miller Creek and Mare Brook is an approximation that is reasonably representative of direct surface flows, but does not necessarily account for infiltration and subsurface groundwater movements. During the charrettes, participants raised questions about whether there may be cross-contamination from Mare Brook's well-documented water quality issues,[8] particularly in landscapes that are known to be areas of recharge and transmission. This is worthy of further investigation as is later noted.

Marine Currents & Benthic Zones

According to the Northeastern Regional Association of Coastal Ocean Observing Systems' (NERACOOS) Finite-Volume Community Ocean Model (FVCOM), Maquoit Bay and Middle Bay experience very low tidal energy.[9] While the predicted tide ranges vary from approximately 9.1 to 9.9 feet (MHW-MLW vs. MHHW-MLLW, see NOAA datums),[10] the maximum modeled current for both ebb and flood tides rarely exceeds 0.25 m/s (0.5 knots). The most significant current can be found between White Island and Harpswell Neck, where the peak velocity approaches this figure.

The benthic landscape is primarily littoral (intertidal), shallow-sublittoral (just below MLLW), and infralittoral areas (down to about 30-40 feet below). Some circalittoral depths are reached (>40 feet below), but the focus of this work is to examine the maximum depths to which eelgrass is expected to grow—generally to no more than 20 feet below MLLW.[11]

The unique character of this region is that these marine landscapes present large, soft gradients that connect one zone to the next, from deepwater estuarine through littoral areas, coastal marshes, up through the brackish and freshwater water systems that feed them. Many of the other places along the coast are typified by more abrupt distinctions between zones, or are strongly influenced by higher velocity hydrology.



Surficial Geology

Formation

Merepoint Neck, Harpswell Neck, and the Bays between represent a drowned glaciated lowland where exposed ridges form the spines of narrow peninsulas. The intervening valleys were hollowed by the Laurentide Ice Sheet approximately 20,000 years ago. As the ice retreated, post-glacial sea-level rise triggered sediment aggradation within river channels, drowning them to form Maquoit and Middle Bays. Maquoit Bay acts as a low-energy sediment trap; its expansive mudflats are the result of hydrological energy and its action upon the Presumpscot Formation.[12] The Presumpscot Formation is a glacial-marine clay created during the melting and retreat of the Laurentide Ice Sheet and is typified by fine sand, silt, and clay, often blanketing coarser materials.[13] The erosion and deposition of the Presumpscot Formation and its organic overburden are ecologically important for the sediment they supply the habitats in this study area. It should be noted that there have also been naturally occurring “mass movement” events (slumping and landslides) that are part of this process. Middle Bay, in contrast, is deeper and more exposed to tidal scouring and wave fetch. This results in ledges and bouldered shores where bedrock is exposed and where the higher-energy environment keeps finer particles in suspension.

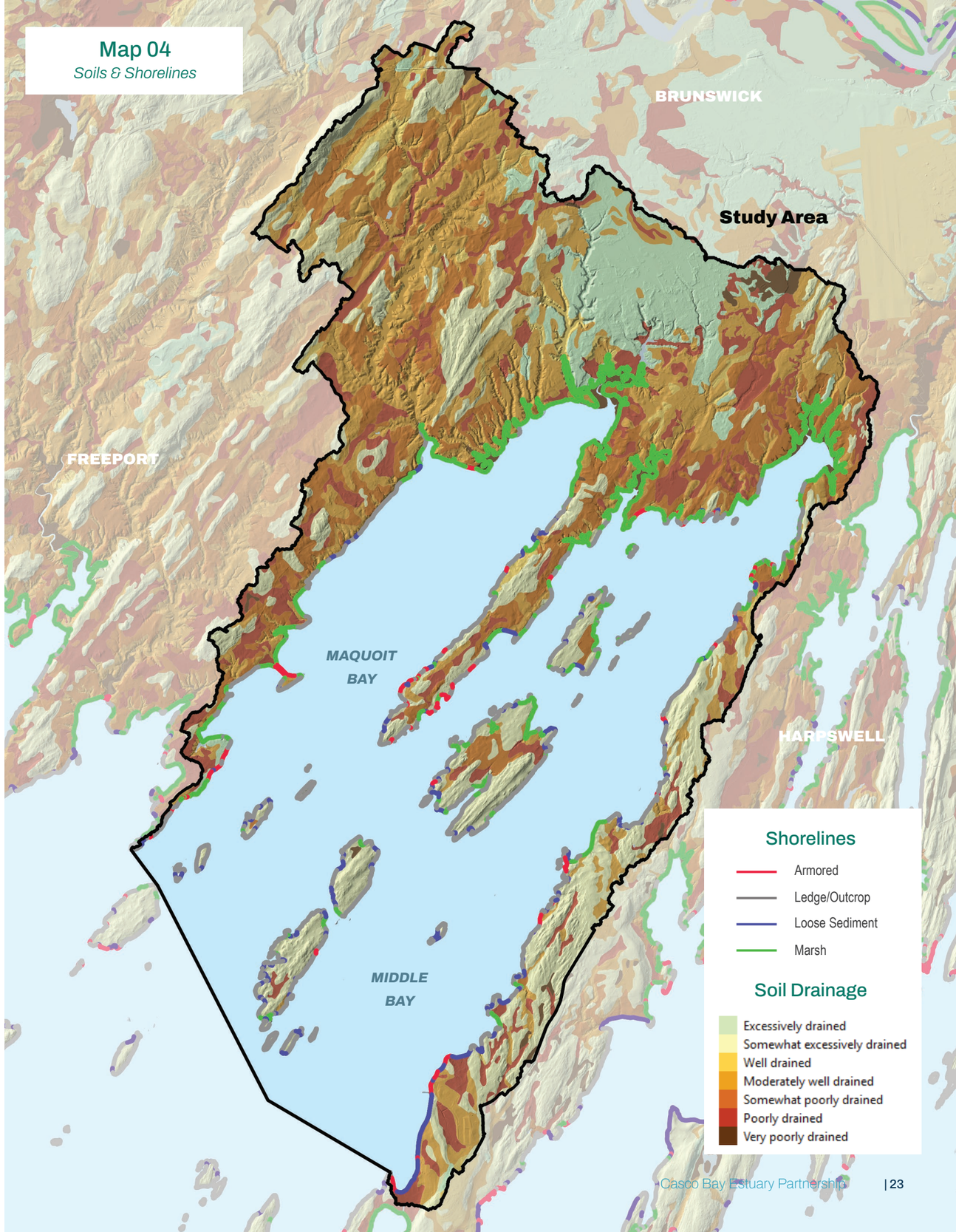
Shoreline

The current shoreline is therefore typified largely by: 1) fringing marshes in the northern parts of the Bays, where the sedimentation process naturally supports this type of landscape; 2) ledges along Merepoint and Harpswell Necks, 3) beaches where sand and coarser materials are present (called “loose sediment” in Maine’s Coastal Bluffs Maps), and 4) armored shorelines in areas where land development practice requires erosion mitigation.[14] This armoring and mitigation, of course, directly conflicts with these natural processes.

Soil Composition

The study area is characterized by functionally distinct zones where the soil composition fosters different hydrological processes: runoff, recharge, and retention. The Lyman soils form the thinly covered, somewhat-excessively draining spines, shedding water off of the peninsula’s high elevations. The Windsor sands allow for water infiltration and recharge, where freshwater is excessively drained from the surface into the Brunswick-Topsham aquifer. Between these extremes lies a transitional belt of Buxton and Nicholville soils, occupying the moderate slopes and terraces that bridge the uplands and lowlands before transitioning to a matrix of Lamoine and Scantic soils.[15] These latter two soil consociations represent nearly 30% of the landscape and are terrestrial expressions of the Presumpscot Formation. Organic material has long developed in these lowland soils and therefore allows water to be retained at the surface, supporting a variety of wetland communities.[16]

KEY	NAME	SLOPE	ACRES	%TOTAL	DRAINAGE CLASS	GROUP
Au	Au Gres loamy sand	*n/a*	40.20	0.33%	Poorly drained	A/D
Bo	Biddeford mucky peat	*0-3%*	11.82	0.10%	Very poorly drained	D
BuC2	Buxton silt loam	*8-15%*	650.71	5.30%	Moderately well drained	C/D
Cu	Cut and fill land	*n/a*	53.38	0.43%	Moderately well drained	
DeA	Deerfield loamy fine sand	*0-3%*	37.81	0.31%	Moderately well drained	A
DeB	Deerfield loamy fine sand	*3-8%*	483.83	3.94%	Moderately well drained	A
EmB	Elmwood fine sandy loam	*0-8%*	64.33	0.52%	Moderately well drained	B
HfD2	Hartland very fine sandy loam	*15-25%*	130.02	1.06%	Well drained	B
HfB	Hartland very fine sandy loam	*3-8%*	15.45	0.13%	Well drained	B
HfC2	Hartland very fine sandy loam	*8-15%*	111.32	0.91%	Well drained	B
HlB	Hinckley loamy sand	*3-8%*	7.51	0.06%	Excessively drained	A
BuB	Lamoine silt loam	*3-8%*	2,118.11	17.24%	Somewhat poorly drained	C/D
Ls	Limerick-Saco silt loams	*n/a*	10.04	0.08%	Poorly drained	B/D
LzE	Lyman loam	*15-35%*	99.61	0.81%	Somewhat excessively drained	D
LzC	Lyman loam	*8-15%*	812.00	6.61%	Somewhat excessively drained	D
LyB	Lyman loam	*3-8%*	310.84	2.53%	Somewhat excessively drained	D
LzB	Lyman loam	*3-8%*	264.95	2.16%	Somewhat excessively drained	D
LyC	Lyman loam	*8-15%*	99.84	0.81%	Somewhat excessively drained	D
HsB	Lyman-Abram complex	*0-8%*	22.68	0.18%	Somewhat excessively drained	D
HsC	Lyman-Abram complex	*8-15%*	30.46	0.25%	Somewhat excessively drained	D
HrB	Lyman-Tunbridge complex	*0-8%*	609.66	4.96%	Somewhat excessively drained	D
HrD	Lyman-Tunbridge complex	*15-35%*	67.77	0.55%	Somewhat excessively drained	D
HrC	Lyman-Tunbridge complex	*8-15%*	669.23	5.45%	Somewhat excessively drained	D
MeC	Melrose fine sandy loam	*8-15%*	3.01	0.02%	Well drained	C
BgB	Nicholville very fine sandy loam	*0-8%*	1,075.93	8.76%	Moderately well drained	C
BgC2	Nicholville very fine sandy loam	*8-15%*	142.15	1.16%	Moderately well drained	C
PbB	Paxton fine sandy loam	*3-8%*	68.68	0.56%	Well drained	C
PbC	Paxton fine sandy loam	*8-15%*	49.19	0.40%	Well drained	C
Tm	Pemaquid	*n/a*	185.99	1.51%	Very poorly drained	A/D
PlB	Peru fine sandy loam	*0-8%*	52.81	0.43%	Moderately well drained	C/D
PkB	Peru fine sandy loam	*3-8%*	46.03	0.37%	Moderately well drained	C/D
RbA	Ridgebury fine sandy loam	*0-3%*	14.93	0.12%	Poorly drained	C/D
RgA	Ridgebury very stony fine sandy loam	*0-3%*	5.04	0.04%	Poorly drained	C/D
Ru	Rumney fine sandy loam	*0-3%*	31.94	0.26%	Poorly drained	B/D
Sd	Saugatuck loamy sand	*n/a*	1.47	0.01%	Poorly drained	A/D
Sn	Scantic silt loam	*0-3%*	1,220.66	9.94%	Poorly drained	D
Sp	Sebago mucky peat	*n/a*	88.33	0.72%	Very poorly drained	A/D
SuD2	Suffield silt loam	*15-25%*	287.02	2.34%	Moderately well drained	C
SuE2	Suffield silt loam	*25-45%*	476.18	3.88%	Moderately well drained	C
SuC2	Suffield silt loam	*8-15%*	41.98	0.34%	Moderately well drained	C
Sz	Swanton fine sandy loam	*n/a*	21.51	0.18%	Poorly drained	C/D
Wa	Walpole fine sandy loam	*n/a*	315.93	2.57%	Poorly drained	A/D
Wg	Whately fine sandy loam	*n/a*	3.57	0.03%	Very poorly drained	C/D
WmB	Windsor loamy sand	*0-8%*	1,008.09	8.21%	Excessively drained	A
WmD	Windsor loamy sand	*15-35%*	113.83	0.93%	Excessively drained	A
WmC	Windsor loamy sand	*8-15%*	165.82	1.35%	Excessively drained	A
WrB	Woodbridge fine sandy loam	*0-8%*	117.62	0.96%	Moderately well drained	C
WsB	Woodbridge very stony fine sandy loam	*0-8%*	24.00	0.20%	Moderately well drained	C



Land Cover & Natural Communities

Land Cover Overview

Drawn from NOAA's Coastal Change Analysis Program (CCAP) 2021 high-resolution landcover dataset,[16] below is the generalized composition of the terrestrial landscape for our study area, including intertidal areas and excluding open water:

Human influence (*17%*):
Developed (*3%*), Disturbed (*14%*)
Naturally occuring (*83%*):
Forested (*53%*), Marine Wetland (*16%*), Palustrine Wetland (*12%*), and Estuarine Wetland (*1%*).

Although "Developed" and "Estuarine" land cover types are the smallest classes in terms of physical area, they play an outsized role in both ecosystem stress and health respectively. The former represents land areas that are known to cause higher impacts from human activity and the built environment, while the latter represents land areas that foster important ecological connections between the marine and freshwater systems.

Several Natural Communities are listed below. Natural Communities are definitions of naturally occurring landscapes that help bridge our understanding of the local ecology—they represent groups of species that tend to occur together.[17] The rankings given here are based on the State's conservation priority, where S1 is "critically imperiled in Maine" and S5 is "secure in Maine." [2]

"SG" Sandplain Grassland (S1)

Once more common in Southern Maine, these natural communities are at very high risk of extirpation due to their dependence on fire and are classified as critically imperiled (S1) by MNAP. Situated on highly permeable glacial outwash, they function as vital aquifer recharge zones—their porous structure facilitates rapid groundwater infiltration and nitrogen sequestration. Examples of this natural community type statewide are known to host globally rare flora and provide essential nesting grounds for threatened birds, including the Upland Sandpiper and Grasshopper Sparrow. Historically maintained by fire—both naturally-caused and set by Wabanaki peoples—these open barrens are rare natural communities, preserving unique biodiversity for Maine's otherwise largely wooded and wet landscape. Due to European settlers' disruption of natural burn regimes, as well as these sites' easily dug soils, Maine is thought to have lost many examples of this natural community type to forest succession or development.[18]

"PPHB" Pitch Pine - Heath Barren (S1)

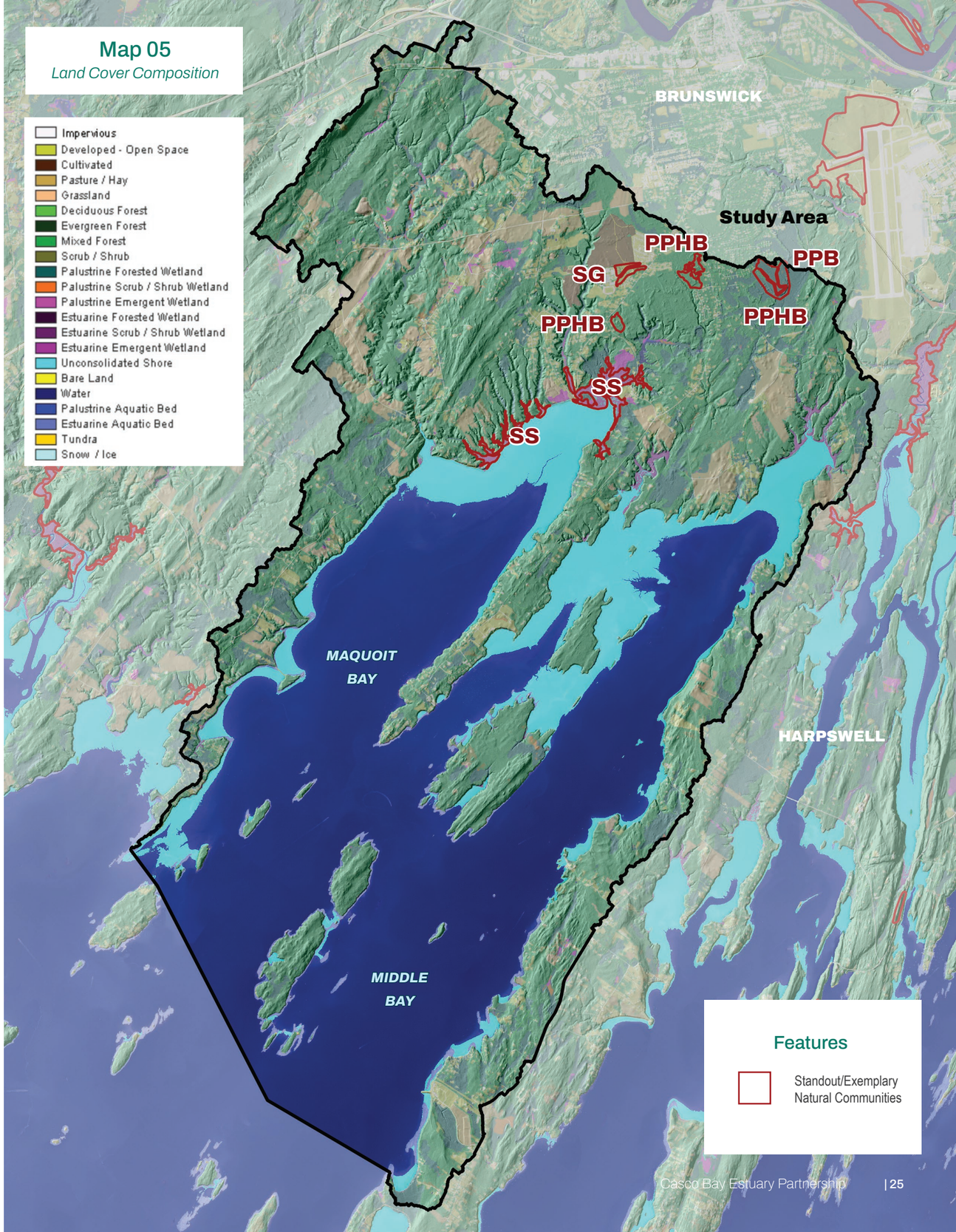
These communities are also critically imperiled (S1), open woodlands that function as primary aquifer recharge areas. Situated on excessively well-drained glacial outwash, these barrens allow rapid infiltration of precipitation directly into stratified-drift aquifers. Though occurring on similar soils as Sandplain Grasslands, Pitch Pine-Heath Barrens differ in that they foster an open canopy of pitch pines with a shrubby understory of blueberries and other heaths—a unique community composition which in turn is known to host habitat for endangered moths and butterflies at other sites in Maine. The community's specialized, fire-adapted vegetation regulates nutrient uptake in otherwise sterile soils, preventing nitrogen leaching and maintaining the exceptional water quality of some of Maine's most productive groundwater reservoirs. Similar to Sandplain Grasslands, these communities are highly susceptible to development pressure.[19]

"PPB" Pitch Pine Bog (S2)

This is an imperiled (S2) peatland that functions as a specialized ombrotrophic (rain fed) natural community. Occurring in stagnant glacial depressions, these bogs feature thick sphagnum peat that sequesters carbon and filters precipitation. Fed primarily by rainwater, their acidic, waterlogged environment can support uncommon species like the Dragon's Mouth Orchid. By regulating water chemistry and allowing slow vertical leakage, these bogs help to maintain the purity of the underlying groundwater aquifers.[20]

"SS" Spartina Saltmarsh (S3)

These are vulnerable (S3), high-productivity intertidal communities that function as critical hydrological buffers and essential estuarine nurseries, dominated by Spartina grasses. Beyond dissipating wave energy and mitigating saltwater intrusion, they trap sediments and sequester terrestrial nutrients. This supports a complex food web—providing essential habitat for endangered Saltmarsh Sparrows, foraging grounds for wading birds, and nutrient-rich detritus that sustains many invertebrates. As sea levels rise, these marshes—sensitive and balanced at the top of the tidal range—will either rapidly diminish or undergo an inland migration process.[21]



Notable Species

Saltmarsh Sparrow

Ammodramus caudacutus

This secretive songbird relies specifically on saltmarsh natural communities. Officially listed as State Endangered in 2023, the population has declined on the Atlantic coast by approximately 87% since 1998. Its unique 28-day nesting cycle is calibrated to lunar tidal rhythms, making nests vulnerable to the increasing variability of tidal patterns resulting from climate change. Its vitality therefore acts as an indicator for the health of the entire salt marsh ecosystem, particularly as related to sea-level rise and storm surge.[22]

Great Blue Heron

Ardea herodias

As a Species of Special Concern in Maine, the Great Blue Heron serves as an apex predator and bioindicator for wetland health. As colonial nesters, they are highly sensitive to human disturbance. Their rookeries, often sited in dead standing snags near open wetlands, are vital for nutrient cycling and maintaining the ecological balance of coastal and freshwater systems.[23]

Horseshoe Crab

Limulus polyphemus

As “living fossils,” Atlantic Horseshoe Crabs may have already shown their long-term resilience over some 500 million years. Despite this, they are currently considered a Priority 1 Species of Greatest Conservation Need (SGCN) according to the draft of Maine’s 2025 Wildlife Action Plan.[24] Horseshoe Crabs are important in that their nutrient-rich eggs help to feed shorebirds such as the federally-threatened red knot. Maquoit and Middle Bays serve as essential refugia for horseshoe crab in Casco Bay because their shallow, sun-warmed mudflats and protected, sandy beaches provide excellent conditions for spawning and larval development.[25]

Rainbow Smelt

Osmerus mordax

Rainbow Smelt were listed as a Species of Concern by the National Marine Fisheries Service at NOAA in 2004 due to a rapid decline across their range.[26] They are also listed as a Priority 1 Species of Greatest Conservation Need in the draft 2025 Maine State Wildlife Action Plan.[27] This vital forage fish feeds many of Casco Bay’s predators, transferring essential nutrients up the food chain. Their anadromous life habit means they naturally migrate between marine and riverine systems throughout their life cycle, transporting nutrients between these systems. Maquoit and Middle Bays are essential spawning strongholds with several known and active runs. A clean, cool freshwater environment is necessary for ensuring egg survival amid regional declines. Warming waters, barriers that block access to spawning grounds, and habitat degradation are all factors leading to the decline of this important species.

Eelgrass

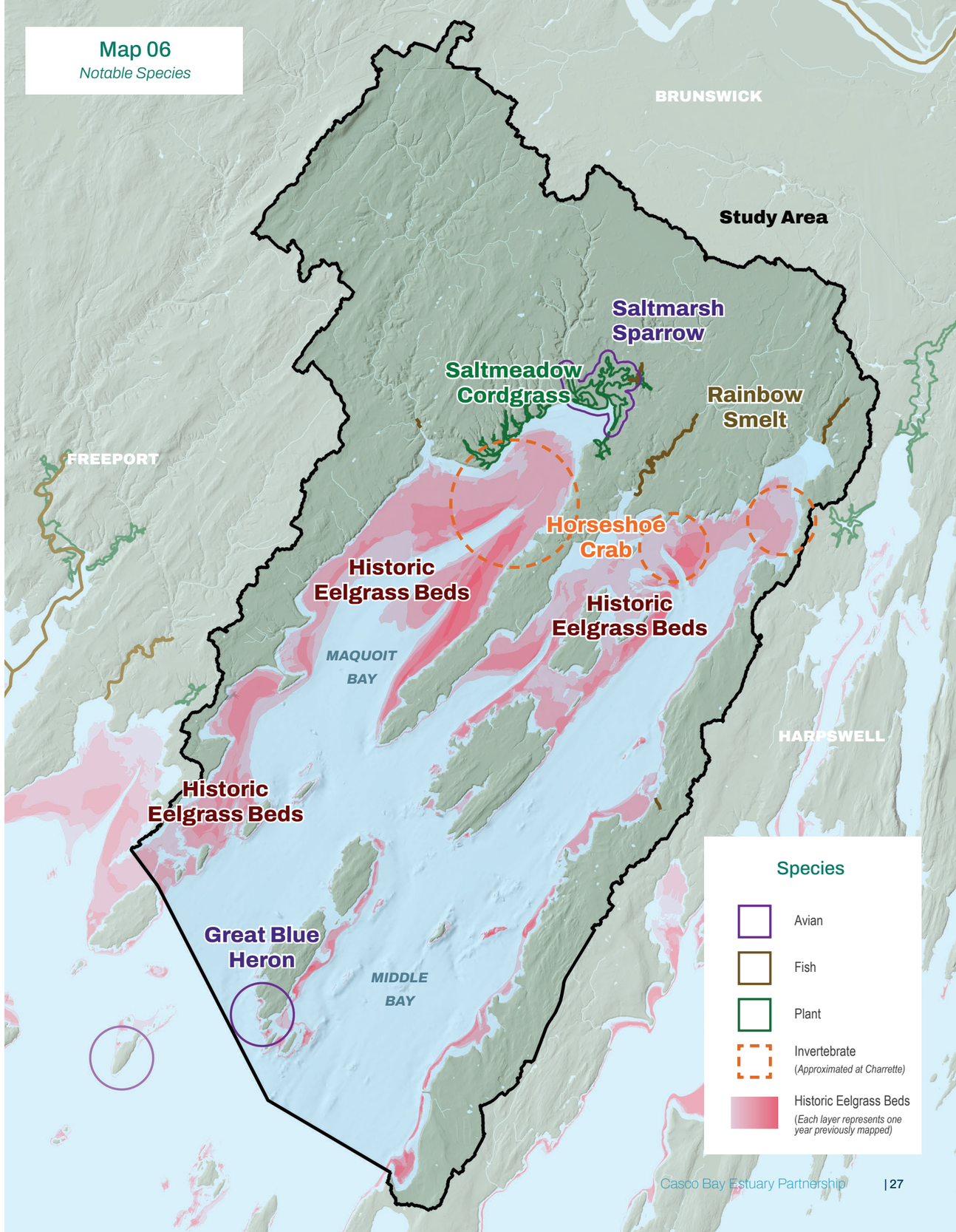
Zostera marina

Our expert panel considered eelgrass to be a foundational “keystone” species of Casco Bay’s subaqueous landscape. Eelgrass meadows stabilize sediments and provide indispensable nursery habitat for juvenile arthropods, shellfish, and fish species, but these functions are quickly lost when eelgrass density declines and once-continuous meadows become increasingly patchy. Highly sensitive to water quality (e.g. turbidity, temperature, nitrogen levels, and sedimentation), invasive species (e.g. green crabs), and human activities (e.g. boat propellers, mooring fields, fisheries), these beds have all but disappeared in the past decade. It will require a strong coordinated effort to address environmental threats to eelgrass and carry out restoration to allow eelgrass meadows to recover to their former extent and density.[28]

Saltmeadow Cordgrass

Sporobolus pumilus (formerly *Spartina patens*)

Also called a “keystone” species by our charrette’s attendees, this species defines the high marsh landscape of the Bays. Its dense mats provide the only viable nesting substrate for the Saltmarsh Sparrow. The meadows also act as vital nutrient filters and storm-surge buffers. As a result of rising sea levels, these thatch-forming plants are increasingly being swamped out and replaced by other grasses and herbs with less capacity to hold the marsh substrate soils together, reducing the resilience of these systems to storm surges. They are one of the primary species found in Spartina saltmarsh communities.[29]



Land Protection Status

Municipal Regulation

The Study Area is composed of three municipalities: the Town of Freeport, the Town of Brunswick, and the Town of Harpswell. Each of these municipalities has the standard 250-foot shoreland zoning and 75-foot stream protections as per the State of Maine guidelines.[30] In addition to this, however, Brunswick has additional resource protections and overlays, including a stormwater protection overlay, wildlife protection overlay, and wildlife corridors.[31] Although the efficacy of these have been called into question during the recent comprehensive planning process, Brunswick's decisionmakers and residents continue to support the stance that it is favorable to inhibit unbridled growth.

Development

There are approximately 2,142 structures in the Study Area,[32] the great majority of which are residential structures. The most highly developed areas are the residential areas bordering Brunswick's neighborhoods at the headwaters of Miller Creek and the Maquoit Bay flowages, as well as along the shorelines of Harpswell and Merepoint Necks. The largest undeveloped areas in the Study Area are within the Bunganuc Stream watershed, at the head of Maquoit Bay (a.k.a. Maquoit Woods), and on Birch Island in Middle Bay. There are 2,283 parcels that intersect the Study Area, of which 1,430 are in Brunswick, 287 are in Freeport, and 566 are in Harpswell.[33]

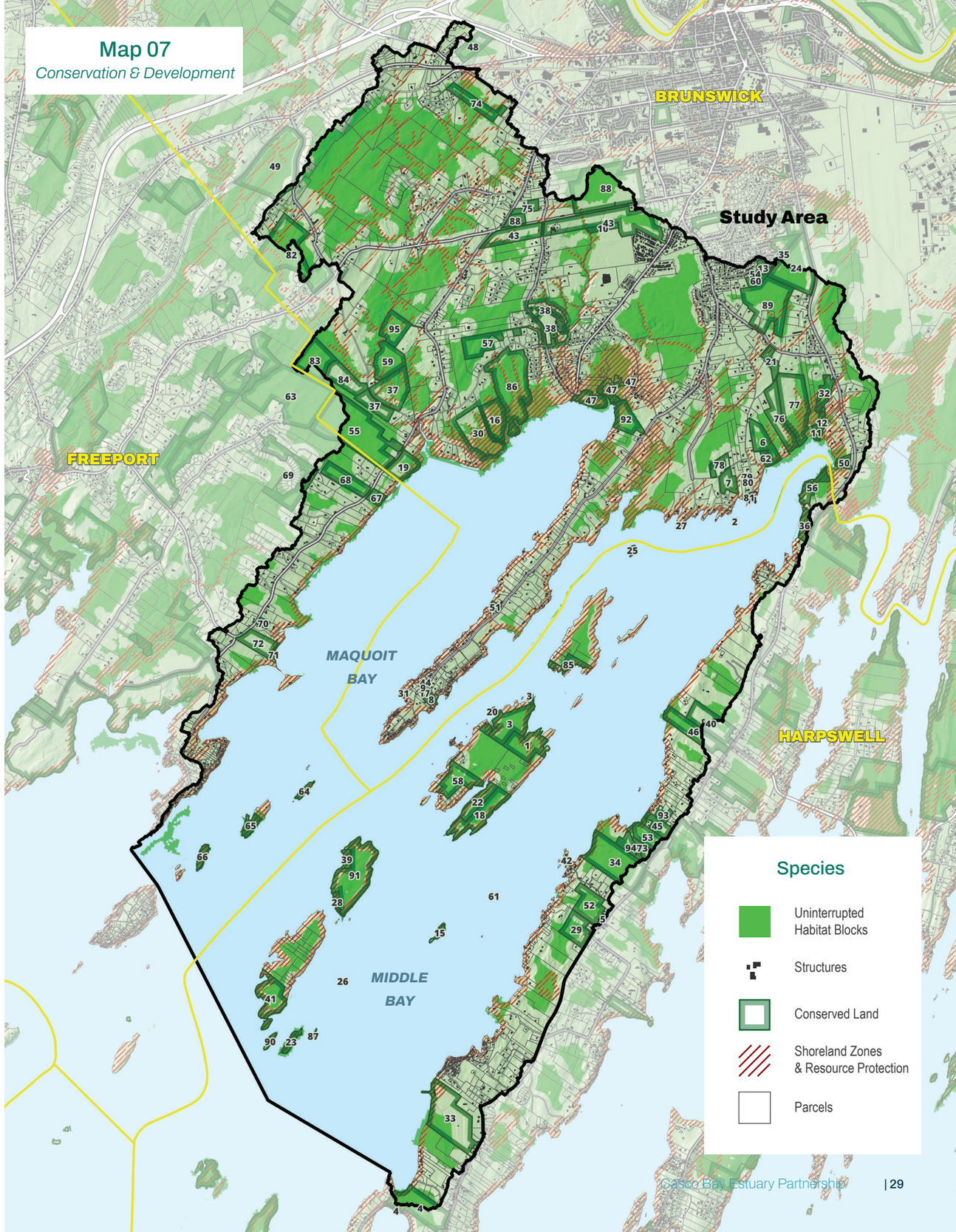
Conservation

The Study Area has five active land trusts: Harpswell Heritage Land Trust, Brunswick-Topsham Land Trust, Freeport Conservation Trust, Maine Farmland Trust, and Maine Coast Heritage Trust. Other conservation landowners include: The Nature Conservancy, Maine Bureau of Parks and Lands, Brunswick and Topsham Water District, and Maine Department of Inland Fisheries and Wildlife. See table of conserved lands to the right—parcel labels can be keyed in ascending order, top to bottom, using the ID column.[34]

The field called "Gap" refers to the conservation status:

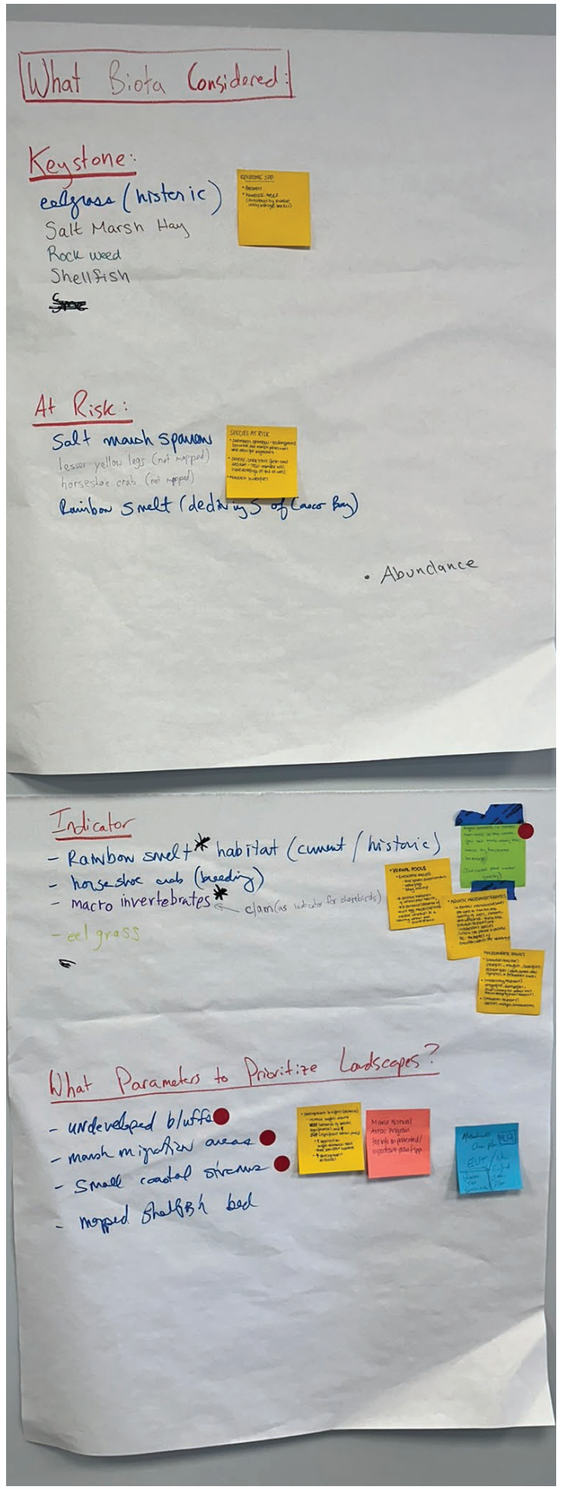
- "1" — **Permanent Protection** for Biodiversity.
- "2" — **Permanent Protection** to Maintain a Primarily Natural State.
- "3" — **Permanently Secured** for Multiple Uses and in Natural Cover.
- "4" — **Unsecured**. Temporary easements lands and/or municipal lands that are already developed (schools, golf course, soccer fields, ball fields).

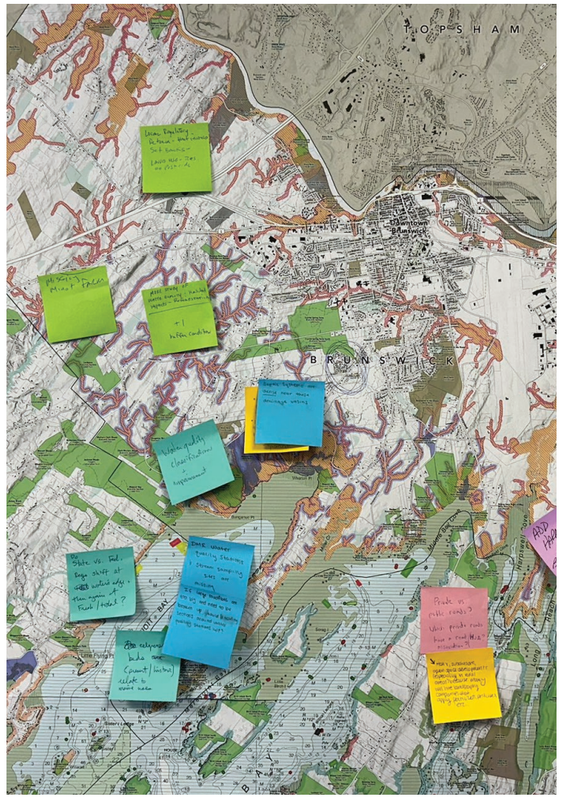
ID	Holder Name	Project	Conservation Type	Type	Acq. Date	Acre (Rep.)	Acre (GIS)	Gap
1	Harpswell Heritage Land Trust	Birch Island Preserve	Fee	Private	2016	43.3	45.4	2
2	Maine Bureau of Parks and Lands	Island	Fee	State		0	0.4	3
3	Harpswell Heritage Land Trust	Birch Island North	Easement	Private	2002	57	56.4	3
4	Harpswell Heritage Land Trust	Curtis Farm	Fee	Private	2011	72	72.0	2
5	Harpswell Heritage Land Trust	Tarr-Hackett House	Easement	Private	1983	2	2.2	3
6	Brunswick-Topsham Land Trust	Packard Farm	Easement	Private	2003	28	33.4	3
7	Brunswick-Topsham Land Trust	Pennellville Meadow	Easement	Private	1988	16	17.2	3
8	MDIFW	Northern Casco Bay Boat Access	Fee	State	1973	5	5.5	4
9	MDIFW	Northern Casco Bay Access	Easement	State		0	0.1	3
10	Brunswick-Topsham Land Trust	Favreau	Fee	Private	2010	6	8.7	3
11	MDIFW	Middle Bay	Easement	State	1996	7	4.3	3
12	MDIFW	Middle Bay	Easement	State	2001	10.3	7.6	3
13	Maine Minor Civil Division		Fee	Municipal		0	7.1	4
14	Maine Minor Civil Division	Pennellville Road Right-of-Way	Fee	Municipal		0	0.5	4
15	Harpswell Heritage Land Trust	Shelter Island	Easement	Private	1996	7	4.6	3
16	Brunswick-Topsham Land Trust	Maquoit Bay	Easement	Private	2007	43	42.1	3
17	MDIFW	Northern Casco Bay Access	Fee	State	2002	6.9	1.5	4
18	Maine Coast Heritage Trust	Birch Island- Duck Cove	Easement	Private	2011	0	51.9	3
19	Brunswick-Topsham Land Trust	Maquoit Bay	Easement	Private	2011	30	32.7	3
20	Harpswell Heritage Land Trust	Gallows Island	Easement	Private	2004	1	1.0	3
21	MDIFW	Middle Bay	Easement	State	1999	5	14.7	3
22	Maine Coast Heritage Trust	Birch Island - Duck Cove II	Easement	Private	2014	0	24.1	3
23	Maine Coast Heritage Trust	East Gosling Island	Fee	Private	2014	0	8.7	2
24	Maine Minor Civil Division		Fee	Municipal		0	81.9	4
25	Harpswell Heritage Land Trust	Crow Island	Fee	Private	2002	3.3	2.0	2
26	MDIFW	Alan E. Hutchinson WMA	Mng. Transfer Agreement	State	1983	0.115	0.1	3
27	Maine Minor Civil Division	Simpson's Point Public Access	Fee	Municipal		0	0.0	4
28	The Nature Conservancy	Upper Goose Island Easements	Easement	Private	1991	0	5.5	3
29	Harpswell Heritage Land Trust	Minot	Easement	Private	2009	34	34.7	3
30	Maine Coast Heritage Trust	Maquoit Bay - Bunganuc Point	Easement	Private	2010	0	54.3	3
31	Maine Bureau of Parks and Lands	Mere Point	Fee	State	1924	0.23	0.4	4
32	Maine Farmland Trust	Juniper Edge	Easement	Private	2007	0	18.4	3
33	Maine Minor Civil Division	George J. Mitchell Field	Fee	Municipal		0	106.3	4
34	Harpswell Heritage Land Trust	Lookout Lot	Easement	Private	2000	100	95.1	3
35	Maine Minor Civil Division		Fee	Municipal		0	3.7	4
36	Harpswell Heritage Land Trust	Liberty Farm	Fee	Private	2015	13.7	13.9	2
37	Brunswick-Topsham Land Trust	McKee Farm	Easement	Private	2003	79	78.9	3
38	Brunswick-Topsham Land Trust	Larrabee Farm	Easement	Private	1988	34	32.4	3
39	The Nature Conservancy	Upper Goose Island Easements	Easement	Private	1981	0	8.1	3
40	Harpswell Heritage Land Trust	Spy Rock Farm	Easement	Private	1999	50	51.0	3
41	Maine Coast Heritage Trust	Lower Goose Island	Easement	Private	2013	0	49.1	3
42	Maine Minor Civil Division	Lookout Point Town Landing	Fee	Municipal		0	0.5	4
43	Brunswick-Topsham Land Trust	Crystal Spring Farm South	Fee	Private	1994	160	151.7	3
44	MDIFW	Northern Casco Bay Access	Fee	State	1960	8	1.2	4
45	Harpswell Heritage Land Trust	Charles Norton	Easement	Private	2005	17	18.7	3
46	Harpswell Heritage Land Trust	Wilson's Point	Easement	Private	2000	50	49.0	3
47	MDIFW	Gamble Marsh	Fee	State	1983	5	33.9	3
48	Brunswick and Topsham Water District		Fee	Other		0	26.9	2
49	Brunswick-Topsham Land Trust	Morse Farm	Easement	Private	1991	145	141.2	3
50	Brunswick-Topsham Land Trust	Skolfield Preserve	Fee	Private	1990	8.4	8.5	2
51	Maine Minor Civil Division		Fee	Municipal		0	4.1	4
52	Harpswell Heritage Land Trust	Hackett Land	Fee	Private	2007	40	39.8	2
53	Maine Coast Heritage Trust	Wilson Cove	Easement	Private	2011	0	27.2	3
54	Maine Minor Civil Division		Fee	Municipal		0	1.4	4
55	Brunswick-Topsham Land Trust	Maquoit Bay	Easement	Private	2011	164	164.0	3
56	Harpswell Heritage Land Trust	Skolfield and Mackeral Cove	Fee	Private	2002	32	19.2	3
57	Maine Minor Civil Division		Fee	Municipal		0	42.0	4
58	Harpswell Heritage Land Trust	Birch Island South	Fee	Private	1988	43	40.8	2
59	Brunswick-Topsham Land Trust	Bunganuc Woods	Easement	Private	2008	40	41.8	3
60	Maine Minor Civil Division		Fee	Municipal		0	8.9	4
61	MDIFW	Alan E. Hutchinson WMA	Mng. Transfer Agreement	State	1983	0.166	0.2	3
62	Brunswick-Topsham Land Trust	Silverman	Easement	Private	2011	5.48	5.4	3
63	Freeport Conservation Trust	Jackman Woods	Easement	Private	2005	0	164.7	3
64	Freeport Conservation Trust	Sister Island	Easement	Private	1994	0	5.5	2
65	Freeport Conservation Trust	Williams Island	Easement	Private	1986	0	12.1	2
66	Freeport Conservation Trust	Pettengill Island	Easement	Private	2003	0	9.0	2
67	Freeport Conservation Trust	Calderwood	Fee	Private	1987	25	10.5	2
68	Freeport Conservation Trust	Calderwood	Fee	Private	1987	69	34.9	2
69	Freeport Conservation Trust	Newfield	Fee	Private	2008	127.470987	66.2	3
70	Freeport Conservation Trust	Trub Orchard	Easement	Private	2007	0	4.7	3
71	Freeport Conservation Trust	Means Massacre Field	Fee	Private	1983	0	2.5	3
72	Freeport Conservation Trust	Means Massacre Field	Easement	Private	1983	0	31.0	3
73	Maine Coast Heritage Trust	Wilson Cove - Skassen	Conservation Easement	Private	2018	12.6	13.8	2
74	Brunswick-Topsham Land Trust	Meadow Rose Farm	Fee	Private	2016	0	32.5	2
75	Brunswick-Topsham Land Trust	Crystal Spring Farm	Fee	Private	2015	0	10.5	2
76	Brunswick-Topsham Land Trust	Coleman Farm	Easement	Private	2017	0	46.3	3
77	Brunswick-Topsham Land Trust	Coleman Farm	Easement	Private	2013	0	84.0	3
78	Brunswick-Topsham Land Trust	Dunbar	Easement	Private	2013	0	10.2	3
79	Brunswick-Topsham Land Trust	Peggy Coffin Pond Preserve	Easement	Private	2015	0	1.8	3
80	Brunswick-Topsham Land Trust	Pennell Brothers-Coffin Preserve	Easement	Private	2014	0	2.0	3
81	Brunswick-Topsham Land Trust	Pennellville Shipyard	Easement	Private	2016	0	1.8	3
82	Brunswick-Topsham Land Trust	Lachance	Easement	Private	2020	133.7	132.8	3
83	Brunswick-Topsham Land Trust	Western Clark Woods	Easement	Private	2012	0	51.9	3
84	Brunswick-Topsham Land Trust	Clark Western Woods	Easement	Private	2012	0	39.8	3
85	Harpswell Heritage Land Trust	White Island-Wilson's Cove	Fee	Private	2013	15.8	16.2	2
86	Maine Minor Civil Division	Maquoit Bay	Fee	State	2007	126	120.0	3
87	Maine Coast Heritage Trust	Irony Island	Fee	Private	2014	0	1.1	2
88	Brunswick-Topsham Land Trust	Crystal Spring Farm	Fee	Private	2007	0	155.4	3
89	Maine Minor Civil Division	Brunswick to the Ocean	Fee	Municipal	2002	0	97.7	4
90	Maine Coast Heritage Trust	West Gosling Island	Fee	Private	2014	0	4.1	2
91	The Nature Conservancy	Upper Goose Island Preserve	Fee	Private	2003	50	94.9	1
92	Brunswick-Topsham Land Trust	Maquoit Bay	Fee	Private	2024	32	32.1	3
93	Harpswell Heritage Land Trust	Charles Norton	Easement	Private	2024	8	8.3	3
94	Harpswell Heritage Land Trust	Lookout Lot	Easement	Private	2018	16.5	18.4	3
95	Brunswick-Topsham Land Trust	Clark 2	Easement	Private	2012	128	35.4	3



Section 03

Engagement & Topics of Inquiry









Stakeholder Charrette

Planning for the Workshops

Over the course of two days in late October of 2025, the consulting team led a small panel of local experts in a participatory process to delve into the details of how a prioritization should be created in support of the Plan.

Below are several summaries that were used to help frame the topics for each workshop. A version of these summaries was originally sent out in advance to participants to help frame the intended purpose for the workshops and to encourage participants to join the session most relevant to them. Each workshop centered around a theme, illustrated by a large format map; these maps were annotated and marked up as the discussion for each developed.

On the pages that follow these introductory summaries below, individual workshop descriptions and snapshots of the large format maps are provided for context. These maps were printed at 72" x 96" and are therefore scaled down considerably for this document. At the end of this section, the results of the process are also summarized according to the outcomes for each workshop.

Workshop #1:

Defining aquatic geographies.

In order to create a systematic prioritization, our team aimed to create spatial units to describe the type of landscapes in question. The higher-level categories for these landscapes are fairly well known: riverine, estuarine, marine, lacustrine, wetland, riparian, etc. But we needed a way to subdivide the study area into more detailed demarcations that provided meaningful spatial units for summarization at multiple scales. An analogous example and inspiration for this concept is the U.S. Census, which uses blocks, block groups, tracts, and counties as tools to tally and manage data for different scales of analysis. The spatial units for the census match the geographic phenomena found in human and urban settings. Our aim for this workshop, therefore, was to use a similar analytical framework, with the exception that we would attempt to employ geomorphological parameters to match the environmental and hydrological settings in question.

Workshop #2:

Defining watershed connectivity.

Because water is always in motion—downhill, tidally, and seasonally—and because we couldn't completely model this dynamism all at once, we aimed to use this session to capture a basic understanding of how these elements are directly connected. In short, we sought to understand: how do hydrological connections influence each of the other basin areas? We used high-resolution drainage[35] and bathymetric patterns to analyze the connectivity and structure of freshwater and marine systems. We used these structures to discuss, influence, and organize the concepts for the landscape prioritization.

Workshop #3:

Assessing ecosystem stressors.

The State of the Bay report discusses six categories affecting the bays. For this workshop, we focused on run-off for the region's sub-watersheds and their basins (related mostly to Sections A, B, and D). Topics included: parsing through the Environmental and Geographic Analysis Database (EGAD) database[36] to identify known versus perceived hazards, septic densities and their potential risks, impervious surfaces, agricultural fields, riparian areas, change in land cover over time, etc. We also discussed how to best prioritize actions that help mitigate and/or systematically improve these stressors and hazards in the coming decades.

Workshop #4:

Assessing ecological priority.

Although each natural community and/or species may have a variety of reasons for being considered "important" or "critical," our team used this workshop to envision ways to systematically prioritize the ecological landscape's value for the entire study area—scores that could be applied regionwide and were queryable at each location. The map we used included most known instances of mapped biota: shellfish, birds, rare and endangered species, natural communities, etc. We were interested, however, in finding ways to characterize the importance of the landscapes themselves, not focusing on particular species alone. We explored whether keystone and/or indicator species could speak for the landscapes they support in general; or, whether certain groups of species might be deemed more important because they represented large, contiguous natural communities and/or aqueous habitat blocks that could be directly delineated, defined, and assessed.

Map 08: *Human Systems*

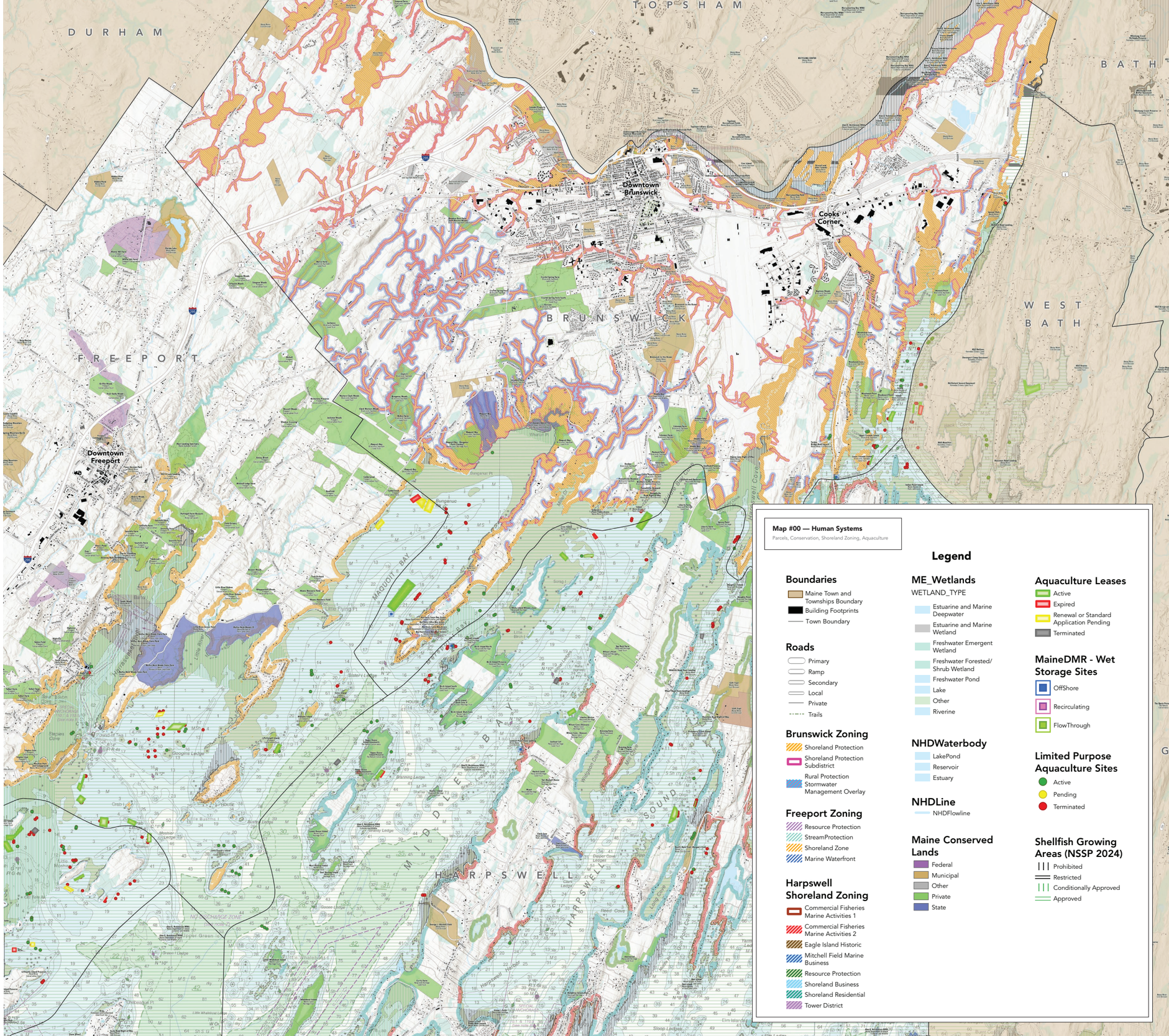
General Reference

Although no single workshop centered around this map, it was referenced throughout and hung on the wall for the duration of the charrette. The “Human Systems Map” illustrated the landscape of human activities that both directly and indirectly interact with Middle and Maquoit Bays’ aquatic landscapes. The map included building footprints, municipal zoning, parcel data, conservation status, roadway infrastructure, town boundaries, conserved lands, and marine regulatory areas.

The purpose of this map was also to facilitate conversations around the land use, conservation, and regulatory efforts currently at play on the landscape around and on the Bays. Each conservation project showed the project name and the holding organization; navigational charts were overlaid with current aquaculture leases; shoreland zoning is differentiated by municipality; etc.

Much of the discussion and notes written on this map were centered around the efficacy of regulations and strategies for how to either enforce or incentivize compliance, specifically with shoreland zoning.





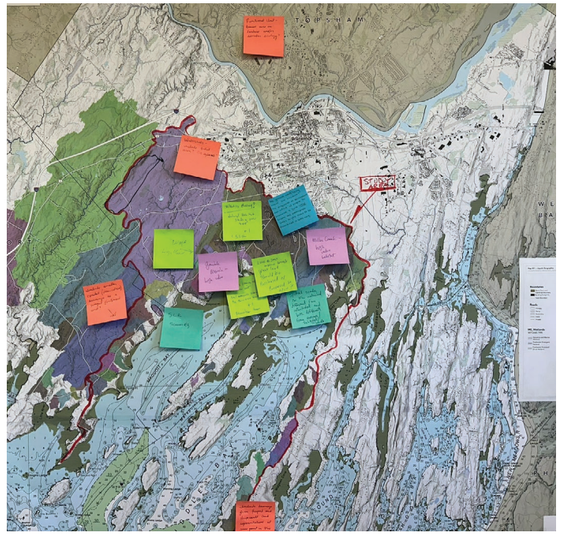
Map 09: *Aquatic Geographies*

Workshop #1

The first workshop was designed to facilitate a discussion on how to spatially represent the Study Area's aquatic systems. The Aquatic Geographies Map highlights the composition of the watersheds and sub-basins that flow into Middle and Maquoit Bays. The map includes intertidal zones, watershed boundaries, modeled flowlines, water depth, and the basic infrastructure for reference.

By comparing the watershed map with the human systems map, the purpose of this first workshop was to directly draw and define the study area on the map with input from the participants, as well as consider other spatial units for summarization.

Notes provided by the participants of the charrette indicated the following concerns and items of interest: impacts of sea level rise to specific watersheds and intertidal zones, high-value habitats, missing data, the importance of certain basins, and questions on whether or not the spatial units might be better suited if they were based on land use or conservation potential rather than hydrology or ecology.



Map #01 — Aquatic Geographies
Hydrography, Bathymetry, Watershed Basins, Definitions

Legend

Boundaries
- Maine Town and Townships Boundary
- Building Footprints
- Town Boundary

Roads
- Primary
- Ramp
- Secondary
- Local
- Private

ME_Wetlands
WETLAND_TYPE
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/ Shrub Wetland

NHDArea
- SeaOcean
- StreamRiver

NHDWaterbody
- LakePond
- Reservoir

Flowlines
grid_code
- 5
- 6
- 7
- 8
- 9
- 10
- 11

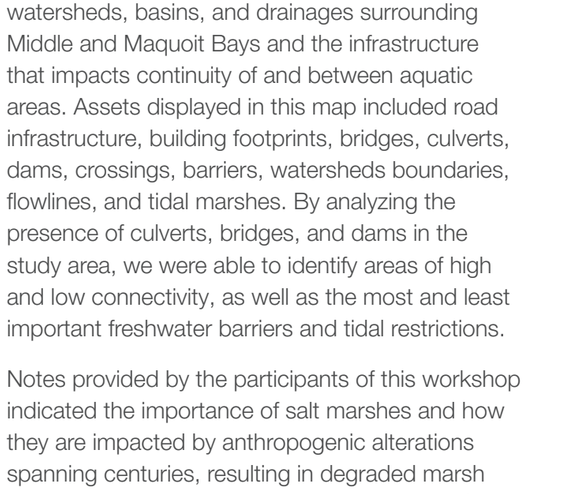
drain_outfall_basin

Map 10: *Watershed Connectivity*

Workshop #2

The Watershed Connectivity Map highlighted the watersheds, basins, and drainages surrounding Middle and Maquoit Bays and the infrastructure that impacts continuity of and between aquatic areas. Assets displayed in this map included road infrastructure, building footprints, bridges, culverts, dams, crossings, barriers, watersheds boundaries, flowlines, and tidal marshes. By analyzing the presence of culverts, bridges, and dams in the study area, we were able to identify areas of high and low connectivity, as well as the most and least important freshwater barriers and tidal restrictions.

Notes provided by the participants of this workshop indicated the importance of salt marshes and how they are impacted by anthropogenic alterations spanning centuries, resulting in degraded marsh resilience to stressors including sea level rise. Some participants mentioned the impact of agricultural ditches and dyking, as well as the urgent need for "runneling," a practice of restoring the natural tidal flooding and draining cycles of the marsh surface to restore peat-building processes. Feedback also indicated areas of specific concern such as Wharton's Point, missing tidal impoundments data, and the presence of at risk species.



Map 11: *Stressors*

Workshop #3

The Stressors Map demonstrated the presence of human impacts on the surrounding landscape, highlighting sources of potential contamination and where focus should be directed for prioritization. Data assets in this map included: septic systems, the Environmental and Geographic Analysis Database (EGAD) Sites, per- and polyfluoroalkyl substances (PFAS) testing locations, road infrastructure, building footprints, impervious surface, disturbed land, watershed boundaries, flowlines, and basic topography. By analyzing the interactions between developed, undeveloped, high intensity, and low intensity areas, we were able to identify many of the sources of watershed stressors deemed of highest concern by the participants.

Notes from the participants touched on the following topics: rapid residential development, poorly maintained septic systems that negatively impact certain areas, the importance of soil type in understanding septic risk, road salting, and the potential impacts by marine activities. Other stressors indicated by the participants were biological and climatic ones not shown on this map, including invasive species, storm events, and sea-level rise.



Map 12: *Biota*

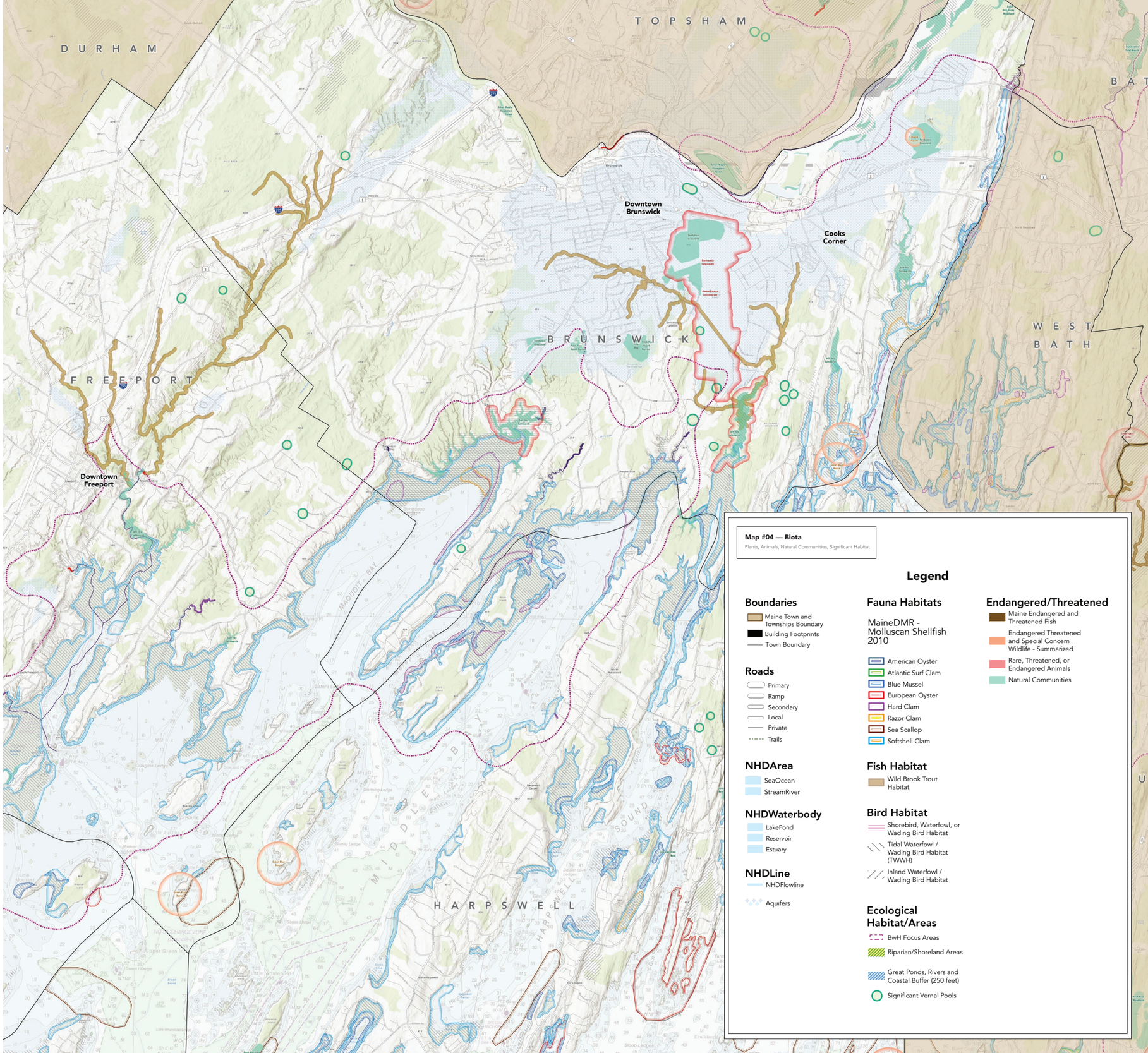
Workshop #4

The Biota Map highlighted the presence of known aquatic species with mappable data and their habitats. The data in this map included Maine's Endangered and Threatened Fish, natural communities, rare species, wading bird habitat, Beginning With Habitat Focus Areas, significant vernal pools, aquifers, shellfish beds, and rainbow smelt runs.

In observing the locations of various aquatic habitats, we compared these data against the Human Systems map to assess the vulnerabilities and possible impacts that may affect different species. Analyzing the distribution of rare and endangered species provided additional points of conversation that influenced the development of the prioritization framework.

Notes from the participants of the charrette indicated specific areas of concern (e.g. protection between Bunganuc and Wharton's Point for the outflows found there (these are valuable to sediment deposition washes), Miller Creek for smelt, and the drainage between Maquoit and Woodside Roads which is an important coldwater aquifer, etc.) and missing data points (e.g. lack of occurrence polygons for horseshoe crabs, green crabs, and other macroinvertebrates). Some participants described highly-productive intertidal areas, especially those that represented gradients between neighboring habitats. This provided a more nuanced, qualitative understanding than our initial data review provided at the outset.





Workshop Outcomes

Workshop 1: Defining Aquatic Geographies

The first workshop established the foundational framework for how this assessment attempts to understand, organize, and ultimately prioritize work across the Study Area. The discussion also clarified the core goals of the assessment, which necessarily extend beyond conservation alone. In addition to conserving high-value resources, participants identified the importance of mitigating harmful human activities, studying and filling data gaps, and making restoration efforts a central pillar of the plan. The goal is to aspire to increase the vitality of degraded or threatened systems, not simply maintain their current status.

A central focus of the workshop was a discussion of the project's approach to prioritization. The group concluded that although broad landscape categories are well understood (such as riverine, estuarine, marine, wetland, riparian, and lacustrine systems), they are not sufficiently similar enough to each other to create a streamlined prioritization format. To support systematic prioritization, the participants concluded that the assessment may need to instead consider how to subdivide the study area into nested, functional spatial units that can be analyzed at multiple scales.

The group also recognized that functional units will likely need to differ by setting—for example, intertidal and estuarine systems versus freshwater systems—and that the scale of analysis will define the unit. The smallest unit for prioritization would likely need to be an aquatic basin or defined waterbody, while on-the-ground actions may occur at the parcel or project level within those larger units.

Several important considerations emerged regarding boundary definitions. Sea level rise will alter hydrology over time, which suggested to participants that there would be a need to define the intended lifespan of both the plan and the spatial units used to describe the prioritization, seeing as aquatic and terrestrial landscapes which will undoubtedly change over time.

Participants also recommended refining the geographic scope of the study area and using natural features—such as the Harraseeket River, Harpswell Sound, and Broad Sound—as logical boundaries. Questions were raised about how to treat the water column as a three-dimensional space, and about issues that may arise using watershed or sub-basin boundaries that somewhat arbitrarily overlap with adjacent land uses.

TAKEAWAYS:

- Clarified goals beyond conservation, including mitigation, knowledge building, and restoration.
- Broad landscape categories alone are insufficient for prioritization.
- Use nested, functional spatial units, perhaps based on geomorphology and hydrology to support multi-scale analysis.
- Natural systems should define reporting units, with human boundaries used to inform recommendations.
- Functional units and appropriate scales may vary by ecological setting.
- Identified key boundary issues to address, including: sea-level rise, plan lifespan, geographic scope, and overlapping watershed boundaries.

Workshop 2: Defining Watershed Connectivity

The second workshop focused on understanding watershed and hydrological connectivity. An initial geospatial analysis using high-resolution drainage and bathymetric data was conducted to assess the connectivity between aquatic systems and how they may influence habitat quality, sediment movement, and habitat access for diadromous fish. The map displayed at the workshop served as a visual reference for the group to discuss. The participants evaluated whether mapped watersheds, flowlines, and barriers accurately reflect real conditions, and identified where important hydrological processes may be missing or underrepresented—particularly in the case of groundwater movement.

The group identified barriers—including road crossings, tidal restrictions, and impoundments—as critical leverage points for restoration, noting that perhaps prioritization should rely on expert judgment rather than overly complex quantitative models. Restoration opportunities were viewed as inherently opportunistic and most effective when coordinated with infrastructure replacement or landowner projects. The group highlighted gaps in existing mapping, including tidal impoundments that were not included in the charrette preparations as well as limited head-of-tide data for smaller drainages.

Discussion emphasized that watershed ecological characteristics are not always directly comparable to each other quantitatively, and that sediment deposition plays a key role in sustaining healthy habitats. For instance, even small, steep drainages—particularly along northeastern Maquoit Bay—contribute meaningfully to sediment delivery through repeated runoff events, despite lacking defined streams. Participants also stressed that hydrology and ecology are inseparable, and that long-term ecological resilience depends on understanding evolving hydrological patterns.

Sea-level rise emerged as a major driver of future change, with projections suggesting that Harpswell Neck could eventually become an island, fundamentally altering local hydrology. Incorporating existing marsh migration analyses and broader aquatic resilience studies, including work by The Nature Conservancy, was identified as most important.

TAKEAWAYS:

- Focused on watershed structure and hydrological connectivity between freshwater and marine systems.
- Reviewed geospatial analysis using drainage and bathymetric data to assess habitat quality, sediment movement, and fish passage.
- Evaluated how mapped watersheds, flowlines, and barriers reflect actual conditions and identified missing or underrepresented processes.
- Identified important barriers (e.g., road crossings, tidal restrictions, impoundments) as key restoration leverage points, with prioritization guided by expert judgment.
- Restoration projects are most effective when coordinated with infrastructure or landowner projects.
- Significant data gaps exist in the presented materials, including tidal impoundments and limited head-of-tide information.
- Highlighted the importance of sediment delivery from small or steep drainages and the close linkage between hydrology and ecological resilience.

Workshop 3: Assessing Ecosystem Stressors

The third workshop focused on identifying and evaluating ecosystem stressors, with particular attention paid to runoff-related impacts across sub-watersheds and basins, as outlined in the State of the Bay. Participants reviewed mapped stressors such as septic system density, impervious surfaces, agricultural land use, riparian areas, and land-cover change, while also assessing the adequacy of existing data.

The group emphasized that many significant stressors extend well beyond drainage and runoff alone. Changing water characteristics—including rising temperatures, sea level rise, storm intensity, and ice conditions—were identified as major drivers of ecosystem stress, along with biotic pressures such as algae blooms, green crabs, and other invasive or dominant species. Participants noted that runoff impacts may need to be reclassified to better reflect cumulative, diffuse sources rather than relying solely on mapped point or linear features.

Discussions highlighted that while fertilizers and pesticides are a concern, the aggregate impacts from small residential parcels likely pose a greater risk than nearby agricultural uses, which were generally viewed as lower impact in this region. Stormwater infrastructure was widely portrayed as currently inadequate to retain or treat runoff, and riparian protections, though regulated, are often enforced reactively due to limited municipal capacities.

The participants suggested that attempting to influence new development, providing stronger enforcement of ordinances, promoting best management practices, encouraging neighborhood-based approaches, and investing in education may be more effective for changing behavior and reducing impacts than simply developing added regulations. Similarly, unregulated individual actions—such as vegetation clearing, pet waste, and yard treatments—were recognized as significant but often unrecorded contributors to stress.

Groundwater emerged as a complex but critical factor, with septic system risk influenced by soil type and groundwater elevation as much as or even more than system age. Participants highlighted Brunswick's septic inventory as a model for addressing cumulative risk and noted the importance of considering groundwater and aquifer flow alongside surface runoff. While the MDEP EGAD database provides a useful starting point for identifying hazards, the group recommended simplifying and refining these data sets into clearer risk categories that support prioritization.

TAKEAWAYS:

- Evaluated ecosystem stressors, focusing on runoff across sub-watersheds while identifying other mechanisms.
- Reviewed mapped stressors (septic density, impervious cover, land use, riparian areas) and noted the need to better represent cumulative, diffuse impacts.
- Identified major non-runoff stressors, including climate-driven changes and invasive species.
- Cumulative impacts from small residential parcels often exceed those from agriculture in this Study Area.
- The Study Area has inadequate stormwater infrastructure and largely reactive riparian enforcement.
- Unregulated individual actions are significant and unknown and/or under-documented contributors to stress.
- Groundwater and soil conditions are critical to understand septic risk and ecosystem health.
- The point sources hazard data should be made into clearer risk categories to support prioritization.

Workshop 4: Assessing Ecological Priority

The fourth workshop centered on developing a systematic approach to prioritize the ecological value of the Study Area's biotic landscapes. The discussion emphasized evaluating the broader landscapes and contiguous natural communities while also considering how keystone or indicator species might reflect overall ecosystem health. Participants reviewed existing mapped biota, including: fish, shellfish, birds, rare and endangered plants and animals, and standout natural communities. They then identified where data were missing, outdated, or required improvement.

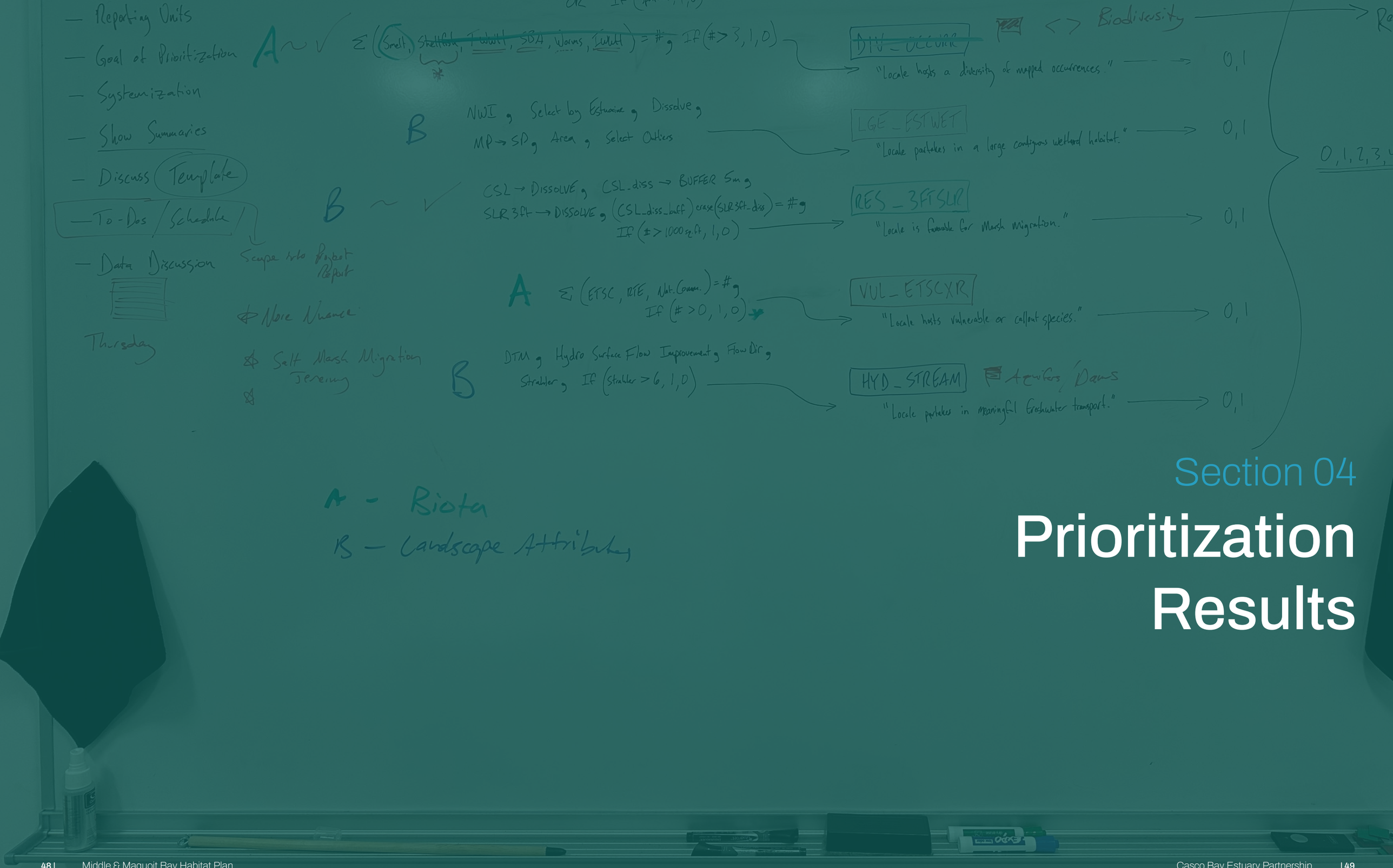
The workshop highlighted the interconnected and dynamic nature of the system. Subdividing areas into more or less significant parts proved challenging, especially in marine and estuarine habitats where each element depends on and blends with its neighbors. Maquoit and Middle Bays were also recognized as regionally significant components of a larger, low-velocity hydrological system that supports broad, contiguous ecotones. Seasonally-abundant and spatially-fluctuating species, such as horseshoe crabs, migratory birds, and eelgrass, underscore the system's complexity, while eelgrass beds and Spartina saltmarshes emerged as keystone habitats essential to the vitality of other species. Rare and at-risk species, including the Saltmarsh Sparrow, Lesser Yellowlegs, Smelt, Brook Trout, and Monarch Butterflies, further highlight the area's ecological significance.

Participants discussed prioritization methods, acknowledging that a uniform approach across the landscape is perhaps limited by data gaps and system complexity. Instead, co-occurrence and/or other data summaries could guide relative value assessments, and a rapid, user-friendly way to provide actionable guidance. The team concluded that priorities must be used to help inform specific, implementable actions that ensure meaningful conservation outcomes.

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TAKEAWAYS:

- Focused on developing a systematic approach to prioritize ecological value at the landscape and community scale, rather than by individual species alone.
- Reviewed mapped biota (shellfish, birds, rare species, natural communities) and reviewed data completeness and outdated information.
- The highly interconnected and dynamic nature of marine and estuarine systems make fine-scale subdivision difficult.
- Maquoit and Middle Bays are regionally significant parts of a larger, low-velocity hydrological system that supports contiguous ecotones.
- Identified eelgrass beds and Spartina saltmarshes as critical habitats types that support broader ecosystem health.
- Highlighted the presence of certain rare and at-risk species as indicators of ecological vulnerability and significance.
- Inconsistent data coverage and system complexity may limit a uniform prioritization approach.
- Recommended using co-occurrence and data summaries to develop a rapid, user-friendly tool tied to clear, implementable actions.



Section 04

Prioritization Results

Rationales to Priorities

Developing the Framework

The purpose of any plan is to promote good, collective action by consensus. Although plans differ greatly in their methods of creation and scope—from a general shopping list to the directives of "Maine Won't Wait"—the power of such plans is always the same. They can only be realized if they are: 1) efficiently created, 2) easily understood, 3) adopted by consensus, 4) acted on in a timely manner, and 5) measurably achieved.

What follows is one approach to address the question:

> *Where should we focus our efforts to improve the health and vitality of this particular natural landscape?*

Before developing our specific recommendations (Section 05) we developed this "Prioritization Framework"—an attempt to create one unified picture of how the concepts should ideally contribute to future decisions and the allocation of resources. Without such priorities, creating focused strategies and implementing them would have proven difficult.

For this project, the engagement process resulted in the development of a few larger themes, or "Approaches." These are general value statements that aim to improve aquatic habitats, under which our Work Group felt most collaborators could reach general agreement. The "Approaches" were then further broken down into "Rationales," each of which are observable as specific and testable statements that can be evaluated at the local level and yet also applied homogeneously across the entire study area. See the following page for the full set of rationales created to support the resulting priorities for each approach.

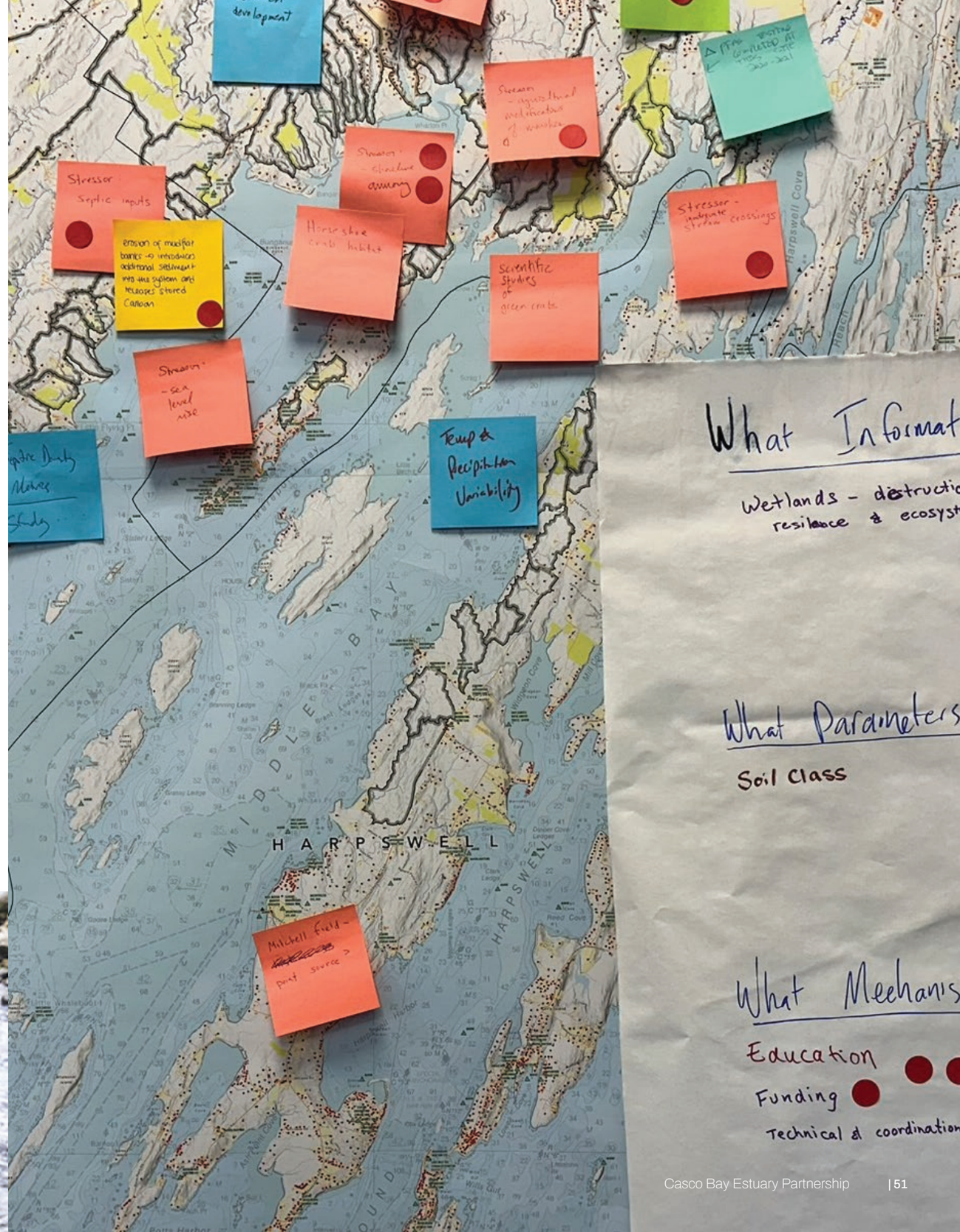
The larger vision behind this exercise was to examine multiple sets of disparate goals at the same time, to get a sense for which parts of the landscape will likely require the most action and coordinated effort.

Following a review of this prioritization process, the Work Group then developed the strategies in Section 05. The two efforts are part of the same ethos, but they represent different things. The "Prioritization" represents which locales deserve the most attention and allocation of resources according to the results of the framework as a whole, whereas the "Strategies" represent the Work Group's 20 most important recommendations for the Study Area based on that process—actionable ways for collaborators to help improve the habitat health.

Overall Priorities

The highest priority locales are situated at the head of the Bays where freshwater and marine systems meet. These marsh and estuarine lands act as a hinge between the interdependent aquatic systems. The locales with the most significant impacts on these areas are therefore the next highest priorities. See the following pages for a breakdown for how the rationales were applied to the landscape.





Prioritization

"We should look at this locale (5-acre hex) because it has a score of ..."

Sum of Approaches
{0,1,2,3,4,5,6,
7,8,9,10}

Approaches

"We're motivated by several common approaches; we want to prioritize ... "

Sum of Rationales
{0,1,2,3,4}

Σ

Rationales

"We should pursue this specific locale as a priority because ..."

Binary
Y=1 / N=0

Assessments

"The criteria for each locale meeting this rationale is ..."

Specific logical statements and/or queries that are testable against the rationales.

SCORES

STRATEGIES

GEOPHYSICAL
SETTINGS
The locale's geomorphology or geographic situation promotes resilience and/or vitality.

IMPORTANT BIOTA
The locale's biological attributes are significant individually or in aggregate.

ECOLOGICAL THREATS
The locale's stressors may pose hazards to the ecosystem, but remediation is actionable.

Resilient to SLR:
Marshes can migrate to this locale.

Based on a 3.9-foot Sea-Level Rise (SLR) scenario (estimate for 2100), there is a shoreline likely to support suitable landscape for future marsh migration in this locale.

Aquifers present:
Habitats may benefit from aquifer presence.

According to the Maine Geological Survey, there has been an aquifer mapped in this locale.

Hydrological transport:
Water movement connects aquatic habitats.

This locale is part of active hydrological transport and energy—either as a substantial freshwater drainage flowline or an area where marine tidal action takes place.

Landform diversity:
Multiple aquatic landscapes exist.

There are two or more types of active and mapped aquatic systems at this locale.

Keystone Species:
Integral to natural communities as a whole.

This locale hosts at least one of the two keystone species identified for this region: *Sporobolus pumilus* (Saltmeadow cordgrass), or frequent historical occurrences of *Zostera marina* (Eelgrass).

Important Species:
RTE, ETSC, etc.; this species matters.

This locale hosts at least one of the three officially mapped species of local importance: *Ammodramus caudacutus* (Saltmarsh Sparrow), *Ardea herodias* (Great Blue Heron), or *Osmerus mordax* (Rainbow Smelt).

Large, Contiguous Wetlands:
The size of the complex is import to preserve.

This locale partakes in a large wetland complex, either estuarine or freshwater, that is contiguous and 100 acres or greater in size.

Standout Habitats/Communities:
These communities are important to preserve.

This locale hosts standout natural communities or groups of biota: MNAP designated natural communities or mapped shellbeds of two or more molluscan species.

High Percentage Impervious:
This locale's runoff may be compromised.

The impervious surface coverage of this locale exceeds the 5% coverage threshold for Total Maximum Daily Load—Class AA/A waters must be under this threshold.

High Density Septic:
Septic densities may pose groundwater risk.

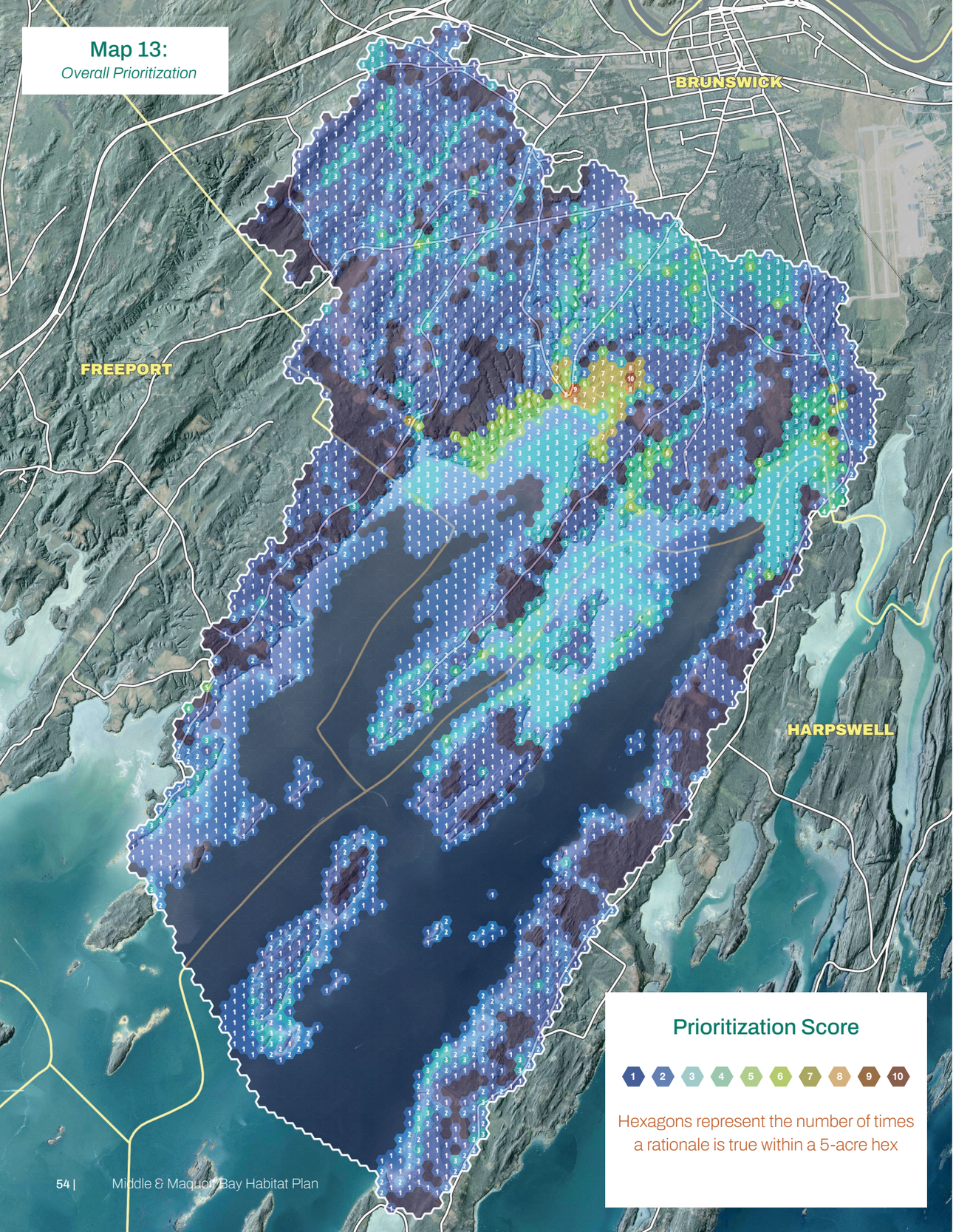
The average density of septic systems in this locale exceeds 1 for every 4 acres—the EPA suggests 1 for every 16 acres.

At Risk of Development:
Undisturbed land not yet conserved/developed.

This locale has valuable land at risk of development: unfragmented habitat, not currently conserved, not a wetland (generally protected), and greater than 20 acres in contiguous size.

Known Hydrological Impediments:
These artificial barriers restrict aquatic flow.

This locale is within 100 feet of a site where watershed connectivity is disrupted artificially: either a barrier or a tidal restriction.



Overall Prioritization by Locale

Spatial Units

Although considerable time and thought was spent developing hydrological and geographic spatial units for summarization, as indicated in the previous sections, we arrived at the decision to abandon them to discretize the landscape in a more geometrically regular fashion. There were three reasons for this:

1) The geographic phenomena we wished to summarize were too disparate and did not cohesively match the hydrological units. Meaning, while certain phenomena (like species locations, natural community locations, or others, etc.) are certainly affected by hydrology, their own expression on the landscape is seldom wholly tied to watershed basins. Our "isobasin" methodology for segmenting the landscape—from flowline node to flowline node—created geographic shapes that carried non-applicable meanings in many cases.

2) The freshwater and marine environments pose completely different hydrological processes—one in which topographic slope composes the main structure for waterflow, and the other in which tidal forces do. This was something that no single set of units could effectively capture; the geomorphology of the underlying aquatic landscapes for both of these systems were too dissimilar to create one set of functional shapes.

3) The "isobasins" form inconsistent shapes and variable physical sizes. For strict hydrological summaries, this method can prove useful, but we found this to be incredibly cumbersome for geoprocessing. The geographic summaries, maps, visuals, and reporting units required for this report were made immensely more streamlined and intelligible by abandoning these shapes in favor of a standard geometry.

As such, we decided to proceed with a regularized grid. While this does limit the ability to perform nested summaries as previously envisioned, it makes geoprocessing more manageable. Each hexagon represents a 5-acre "locale" in which different summaries are recorded. For the most part, summaries represent presence/absence and true/false returns from logical inequalities. In some cases (as with the density metrics for septics and impervious surfaces), several zonal or focal statistics were also calculated (where count or nominal data are summarized by a geographic area to present a meaningful ratio or summed figure).

Scores by Locale

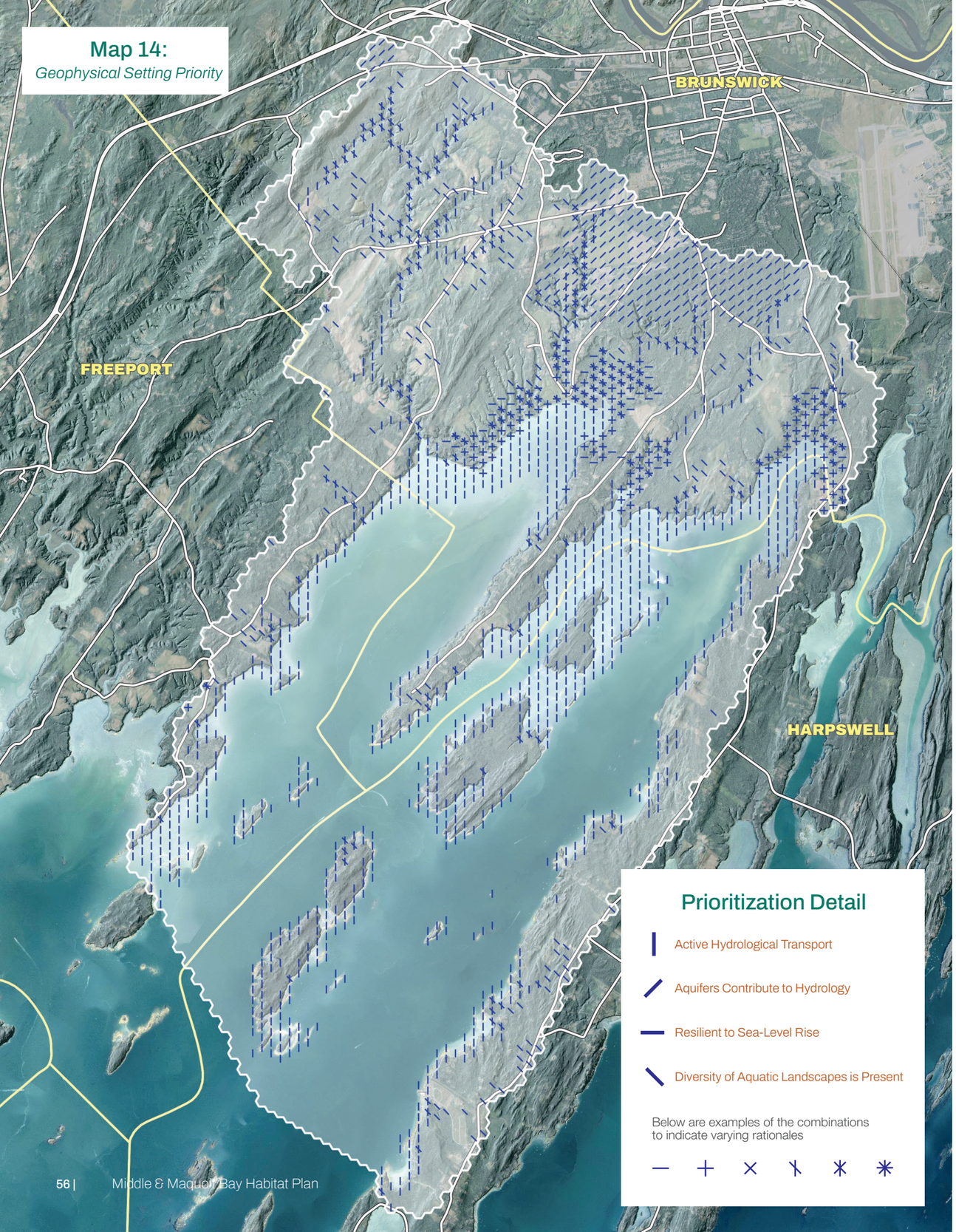
"How many rationales are true for each 5-acre locale given our three Approaches?"

At the left you will see the prioritization grid filled out with numbers from 1 through 10. Each of these digits represents the total number of times that any individual statement in the prioritization framework is considered "true" for that particular locale. See the process diagram of the framework for additional explanation. Although a score of 12 could be possible given this structure, 10 is the highest value that was actually found within the Study Area.

The sums for this first map represent the total number of "true" rationales for each 5-acre hex given all Approaches considered, with 0-4 points possible for each: geophysical setting, important biota, and ecological threat. It should be noted that these unrelated areas of interest are intentionally being added together. This strategy assesses importance across disparate topics, identifying areas in which multiple concerns or values co-occur. High scoring locations, therefore, are likely to be important areas to consider first when coordinating efforts between organizations and collaborators. The number should generally be thought of as a way to indicate "where to look first" to coordinate effort.

For instance, if two locales are determined to be of equally high value—let's say each has a score of "6" (geophysically +3 and biologically +3)—but then there also happens to be an ecosystem hazard in one of the two locales (+1), then this system suggests that the one with the hazard (score=7) should take priority over the one without (score=6). The more rationales that can be attributed to the locale, the more it adds to that locale's priority status.

For nuance, and to trace each score back to its component statements, see the subsequent maps. Each map breaks down the scores for each Approach into the rationales that compose them.



I. Geophysical Setting

How to Use this Map

At the left you will see lines marking the locations where each locale is fulfilled by one or multiple of the rationales stated below. Compare with the other maps to see how each contributes to the overall summary.

[|] Active Hydrological Transport

This locale is part of active hydrological transport and energy—either as a substantial freshwater drainage flowline or an area where marine tidal action takes place.[35, 38]

[/] Aquifers Contribute to Hydrology

According to the Maine Geological Survey, there has been an aquifer mapped in this locale.[39]

[—] Resilient to Sea-Level Rise

Based on a 3.9-foot Sea-Level Rise (SLR) scenario models, approximately the 2100 anticipated risk, there is a shoreline likely able to support future marsh migration in this locale.[40]

[\ ] Diversity of Aquatic Landscapes is Present

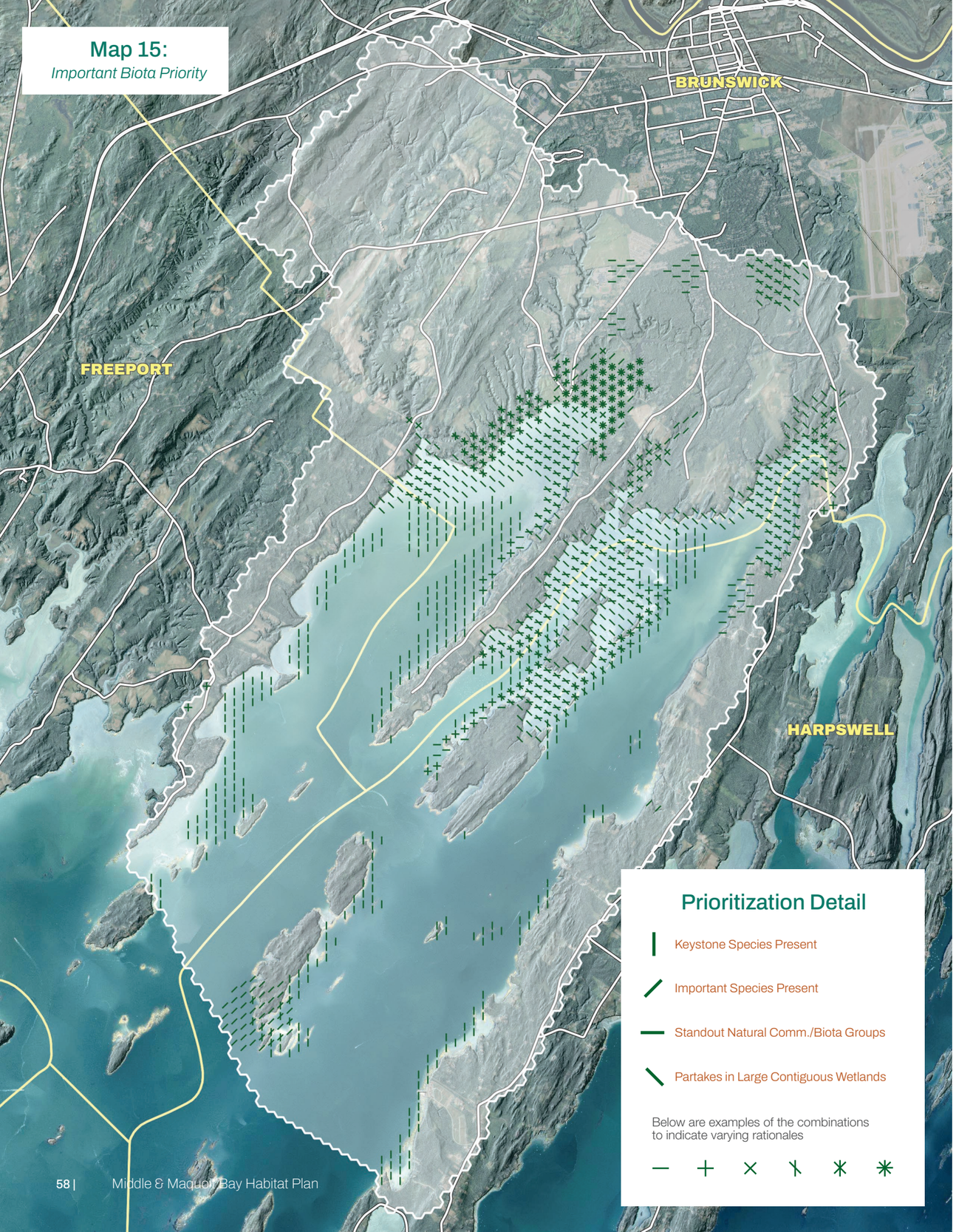
There are two or more types of active and mapped aquatic systems at this locale.[38]

Approach

"The locale's geomorphology or geographic situation promotes resilience and/or vitality."

The impetus for this approach was inspired by The Nature Conservancy's Resilient and Connected Landscapes for Terrestrial Conservation work. The TNC methodologies prioritize parts of the landscape based in part on considering the landscape as the "stage" and the species that occur there as the "actors." This perspective advances the idea that certain geophysical settings are significant long term because they will be more likely to support different types of natural communities as coastal ecosystems evolve and change. In contrast, prioritizing landscapes based on present day instances of singular species of interest would likely be a narrower, less advantageous strategy.

It is challenging to develop a simple way to emulate that concept in an aquatic setting, where the landscape processes are dynamic and, in some cases, difficult to generalize and abstract. The TNC report used many geomorphological summaries to influence its ranking to capture these landscape metrics. In our case we focused on simple concepts that directly relate to discrete, mappable phenomena. Although a higher volume of integrated hydrological and geomorphological concepts would likely have improved our prioritization, the four listed here were considered the most important given the time constraints of our work and were the most straightforward to model.



II. Important Biota

How to Use this Map

At the left you will see lines marking the locations where each locale is fulfilled by one or multiple of the rationales stated below. Compare with the other maps to see how each contributes to the overall summary.

[|] Keystone Species Present

This locale hosts at least one of the two mapped keystone species for this region: Sporobolus pumilus (Saltmeadow Cordgrass),[41] or the most frequently mapped historical occurrences of Zostera marina (Eelgrass).[42]

[/] Important Species Present

This locale hosts at least one of the three mapped species deemed to be of local importance to aquatic habitats: Ammodramus caudacutus (Saltmarsh Sparrow),[43] Ardea herodias (Great Blue Heron),[43] or Osmerus mordax (Rainbow Smelt).[44]

[—] Standout Natural Communities and Groups of Biota

This locale hosts standout natural communities or groups of biota: MNAP-designated standout natural communities[41] or the mapped shellbeds of two or more molluscan species.[45]

[\ ] Partakes in Large, Contiguous Wetlands

This locale partakes in a large wetland complex, either estuarine or freshwater, that is contiguous and 100 acres or greater in size.[38]

Approach

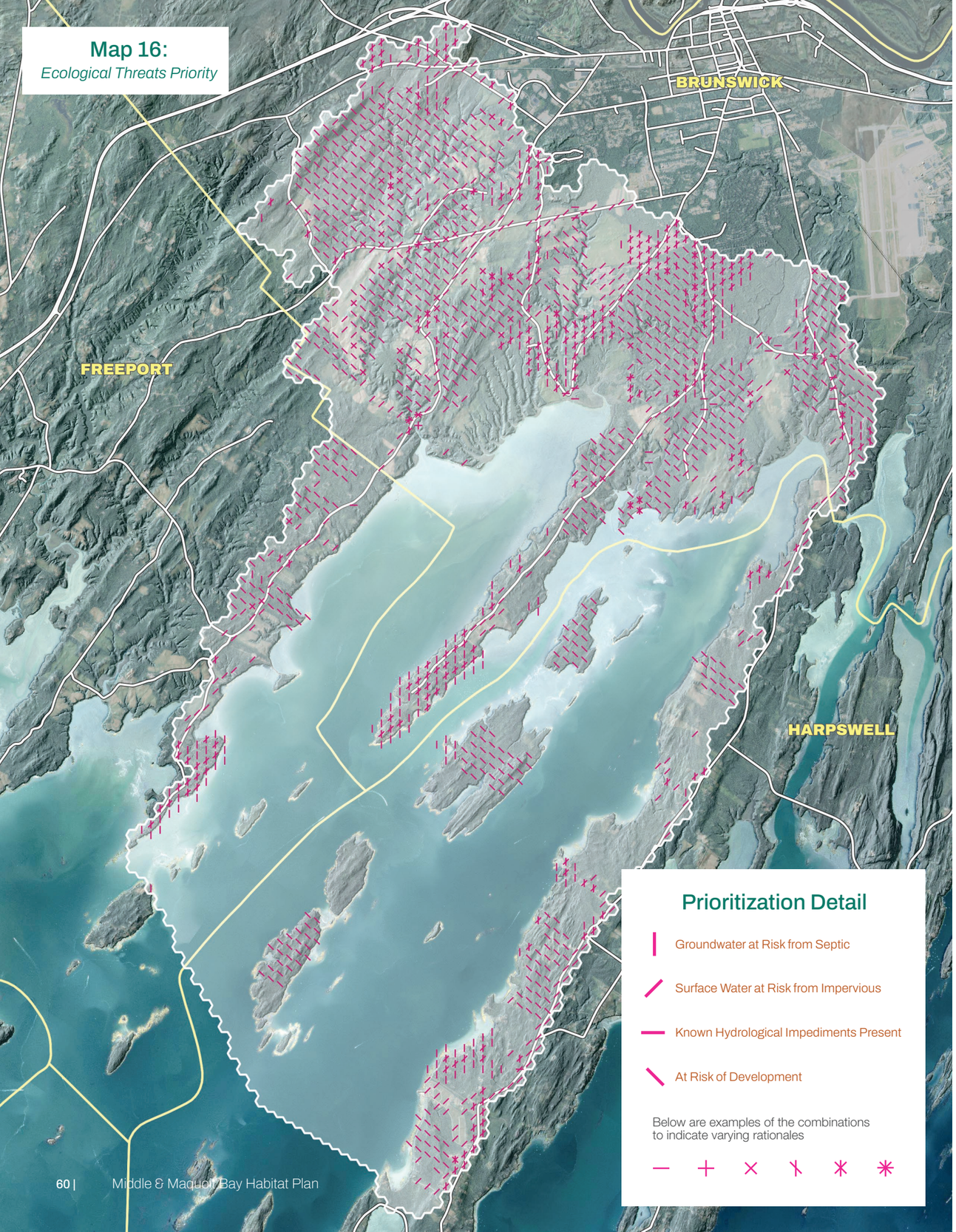
"The locale's biological attributes are significant individually or in aggregate."

Although this particular prioritization regarding important biota is essentially an abstracted co-occurrence model; our goal was to improve the concept by creating distinct value statements that support the reason for the inclusion of each point. We hope this allows readers and users to better understand the overall implications of the prioritization.

The problem with some co-occurrence models is that they tend to simply reflect what data density exists or what observations have been measured, enumerating similar layers redundantly without qualification for why each layer is important.

Data recording mapped habitats, for instance, tend to skew more toward those that have distinct geographic patterns that are easier to extract from topography and aerial imagery—often those related to wetlands. For our work, we deemed it less compelling to enumerate the normal layers that tend to be used for a landscape evaluation: wader and waterfowl habitat, deer wintering areas, shorebird areas, etc. While these are undoubtedly important to the ecosystems, these species are not obligates to the particular landscapes in question.

Instead, we have focused on keystone species (those upon which others rely), important species (rare, endangered, threatened, or special concern), natural communities (groups of species that form a valuable natural community), and large contiguous ecosystems (wetland habitat). The aim is to focus on the ecological features of greatest need, rather than places where we can find the most instances of similar recorded information.



III. Ecological Threats

How to Use this Map

At the left you will see lines marking the locations where each locale is fulfilled by one or multiple of the rationales stated below. Compare with the other maps to see how each contributes to the overall summary.

[|] Ground Water at Risk from High Density of Septic Systems

The average density of septic systems in this locale is high, exceeding 1 for every 4 acres—the EPA suggests 1 for every 16 acres.[37]

[/] Surface Water at Risk from Impervious Surface

The impervious surface coverage of this locale is high, exceeding the 5% coverage threshold suggested for lower Total Maximum Daily Loads—Class AA/A waters must be under this threshold.[16]

[—] Known Hydrological Impediments Present

This locale is within 100 feet of a site where watershed connectivity is disrupted artificially, either by a barrier[46] or a tidal restriction.[47]

[\ ] At Risk of Development

This locale has valuable land at risk of development: unfragmented habitat,[48] not currently conserved,[34] not a wetland (generally protected),[38] and greater than 20 acres in contiguous size.

Approach

"The locale's stressors may pose hazards to the ecosystem, but remediation is actionable."

Due to the importance of the aquatic landscapes in these two bays and their watersheds, we decided to prioritize locales that pose the greatest hazards to ecological health for these systems. Each of the rationales listed here relates to an expression of human development on the landscape that acts as a stressor to natural functions.

Although each of these rationales would benefit from deeper analysis, the metrics provided give a general overview to demonstrate areas of concern for comparison with the other items of interest. For instance, "known hydrological impediments present" could be compared with "hydrological transport" in the geophysical priority section. Or similarly, "groundwater at risk from a high density of septic systems," could be compared against "aquifers present."

Even though the designation "at risk of development" is abstract, limiting development and promoting conservation on the landscapes (terrestrial and aquatic alike) will be key in future years to preserving water quality for each watershed. This region is under significant development pressure due to expansion of new construction up the coast. Although buildout analysis can be complex—and it should be noted that zoning and economics were not taken into account as part of this analysis—each locale identified as "at risk" could hypothetically be developed in some form. Although disincentivizing suburbanization through appropriate zoning ordinances is worthwhile, long-term conservation is likely the most assured way to keep these lands from slowly becoming subdivided and developed over the next several decades.

Section 05

Recommendations & Strategies

Recommendation A:
Conserve

Preserve What is Valuable

Conservation efforts can take on many forms. We identified five main conservation strategies that would most benefit conservation planning in this Study Area. We recommend conserving lands that serve the broadest set of strategies first. In our area of interest, however, the landscape consists of a dense network of private land holdings. Turning conservation strategies into implementations will mean looking parcel by parcel within the priority areas identified to determine specific courses of action based on land owner concerns, current and future property use, and the situation in abutting properties. Different strategies will be better served by different actions, such as purchasing land outright, establishing conservation easements, looking to state/local governments to implement protection, or incentivizing individual land owners to adopt ecologically beneficial practices.

Collaborators:

Municipalities

Land Trusts

Conservation Advocates

State of Maine: BPL, IFW, LMF, DACF

Federal: NRCS, USFWS

Private Land Owners

CBEP Staff

Strategy A.1: *Habitat Continuity*

Through landscape conservation and policy, **maintain continuity among terrestrial and aquatic habitats**, including forests, coastal streams, tidal marshes, tidal flats, eelgrass beds, and undeveloped shoreline bluffs.

Strategy A.2: *Marsh Migration*

Develop relationships with landowners in order to **conserve geophysically advantageous areas** for current and future tidal wetlands.

Strategy A.3: *Aquifer Recharge*

Prioritize efforts to **protect important aquifer recharge areas**, particularly the landscapes at the head of Maquoit Bay that may be most imperiled by development pressure.

Strategy A.4: *Marine Protections*

Explore and develop **viable pathways for establishing marine protections** or regulating activities, specifically for areas in the sublittoral zone where eelgrass meadows are known to have historically flourished.

Strategy A.5: *Riparian Areas*

Through shoreland regulation, conservation efforts, education, and outreach initiatives, approach key land owners to **protect at-risk riparian areas** in order to accomplish water quality, ecological, and conservation goals.



Map 17: *Conservation Strategy Areas*

- #.# *Strategies*
- *Historic Eelgrass Beds*
- *Riparian Areas*
- *Aquifers*
- *Future Salt Marshes*
- *Habitat Blocks*

FLYING POINT
PETTINGILL ISLAND
WILLIAMS ISLAND
LITTLE FLYING POINT
GOOSE POINT
Maquoit Bay
SISTER ISLAND
MEREPOINT
LOWER GOOSE ISLAND
UPPER GOOSE ISLAND
MEREPOINT NECK
BUNGANUC POINT
WHARTONS POINT
BIRCH ISLAND
THE GOSLINGS
SHELTER ISLAND
Middle Bay
WHITE ISLAND
SERAG ISLAND
HARPSWELL NECK
LOOKOUT POINT
WHITES POINT
BARNES POINT

A.1 A.2 A.3 A.4 A.5

Study Area Boundary

Recommendation B:
Mitigate

Prevent Further Harm

In order to mitigate and prevent further harm, the collaborators must first fully understand the scope of each problem. That's why three out of these five strategies are focused on data collection and assessment (B.1, B.2, B.5). In terms of actually implementing measures that will successfully mitigate harm, this will most likely be successful when targeting future development and future activity instead of retroactively seeking compliance. Working with municipalities and developers to ensure Best Management Practices on new developments—to ensure water quality and ecological health—will likely be the most successful way to do this. It is still important, however, to identify any existing, severe detriments and address those head on.

Collaborators:

Municipalities

Land Trusts

State of Maine: DEP, DMR, IFW

Federal: NRCS, USFWS

Private Land Owners

Private Businesses

CBEP Staff

Strategy B.1: *Septic Inventory*

Work with municipalities to **inventory and identify all known septic systems** if they have not done so already. In particular, identify age, construction type, maintenance history, and the soil characteristics in the area of the system. Promote advanced treatment upgrades specifically where groundwater travel times to the Bays are short.

Strategy B.2: *Shoreland & Stream Protection Audit*

With input from each town, commission a study to **inventory and assess the efficacy of Shoreland Zones and Stream Protection districts** in the municipalities of the study area. This study should include an analysis of the land use and zoning regulations contained throughout, and include interviews and outreach to best understand the current use patterns.

Strategy B.3: *Prevent Watershed Degradation*

Work with the Town of Brunswick to study and implement watershed **Best Management Practices to reduce pollutant loads** from future developments in vulnerable watersheds—especially Bunganuc Stream and the head of Maquoit Bay—looking toward Mare Brook as a cautionary example.

Strategy B.4: *Encourage Low Impact Marine Activities*

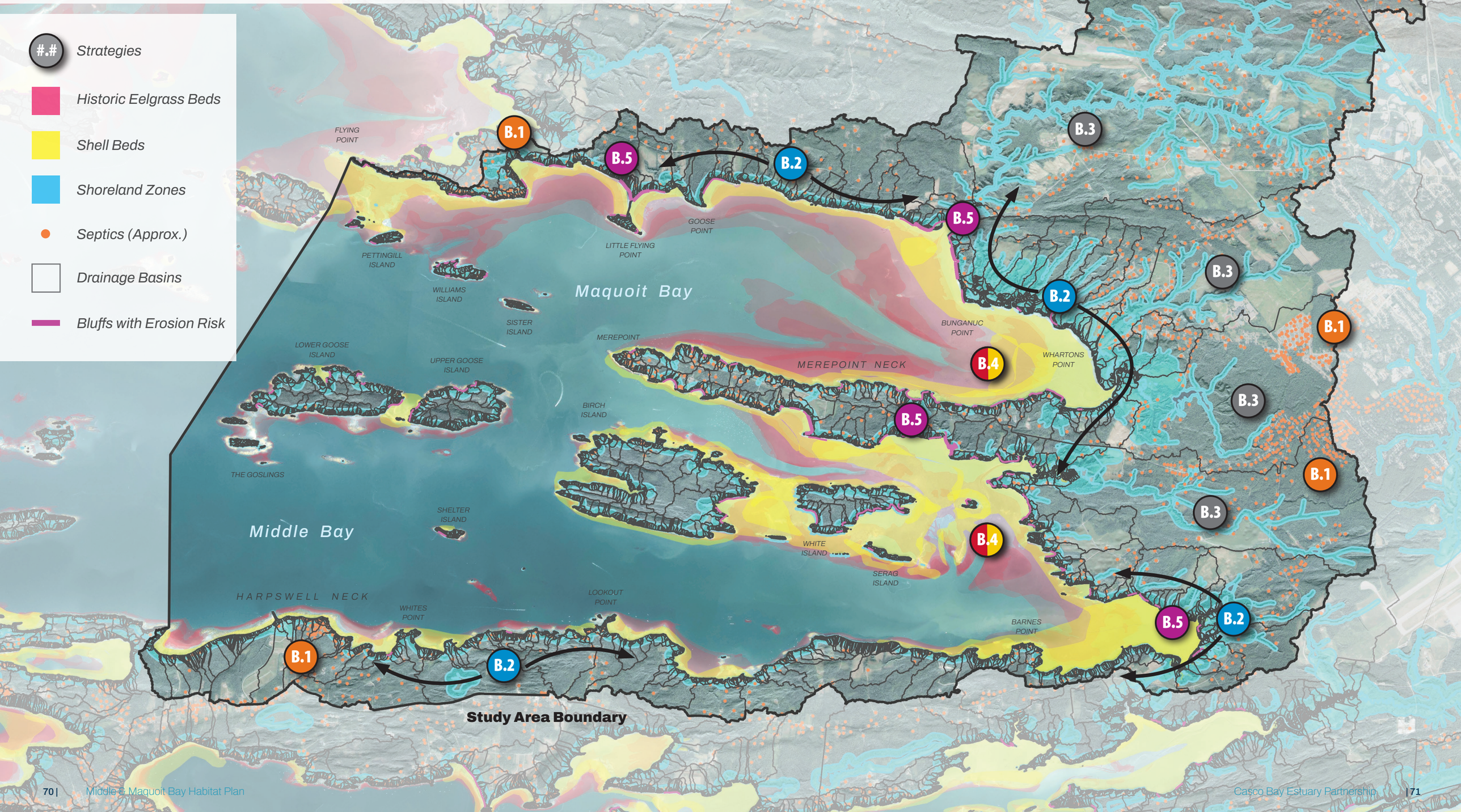
Incentivize marine stewardship of the most valuable benthic areas in the study region to limit the degradation of shellbeds, historical eelgrass beds, and other areas important for reproduction of aquatic and terrestrial organisms, species mobility, and nutrient transfer.

Strategy B.5: *Address Coastal Erosion*

Work with municipalities **to inventory and identify eroding coastal bluffs and shorelines** in order to assist landowners with nature-based solutions that maintain ecological values and processes while addressing erosion adjacent to vulnerable assets. Develop and continue to support high-visibility living shoreline demonstration projects to serve as templates for others.



Map 18: *Mitigation Strategy Areas*



Recommendation C:
Restore

Foster Increased Health

One of the most salient points to come out of the process was that any plan should not only seek to protect valuable resources, it should also restore natural ecological processes that contribute to the persistence and resilience of important and at-risk ecosystems. The strategies below attempt to encourage that for the aquatic habitat systems in this particular Study Area.

Collaborators:

Municipalities

Land Trusts

Conservation Advocates

State of Maine: BPL, IFW, DEP, DACF

Federal: NRCS, USFWS

Private Land Owners

CBEP Staff

Strategy C.1: *Revegetate Eelgrass*

As scientific research provides insights into the drivers of widespread eelgrass losses (e.g., high green crab abundance, increased water temperatures, elevated nutrient concentrations), a concerted effort to mitigate stressors and restore the Bays to a condition that can support eelgrass is warranted. Then, through environmental monitoring and test plots with eelgrass restoration practitioners, **identify suitable locations for an experimental revegetation program** to introduce eelgrass back into the ecosystem and establish a program for implementation.

Strategy C.2: *Restore Shellbeds*

Work with local residents, shellfish harvesters, municipalities, DMR, and other organizations to **explore opportunities and methods to protect and restore wild shellfish populations.**

Strategy C.3: *Remediate Aquatic Organism Passage*

Remediate barriers to aquatic organism passage for native fish species at dams (such as sea-run brook trout and rainbow smelt), manmade stream barriers, and/or inadequate crossings.

Strategy C.4: *Restore Tidal Hydrology*

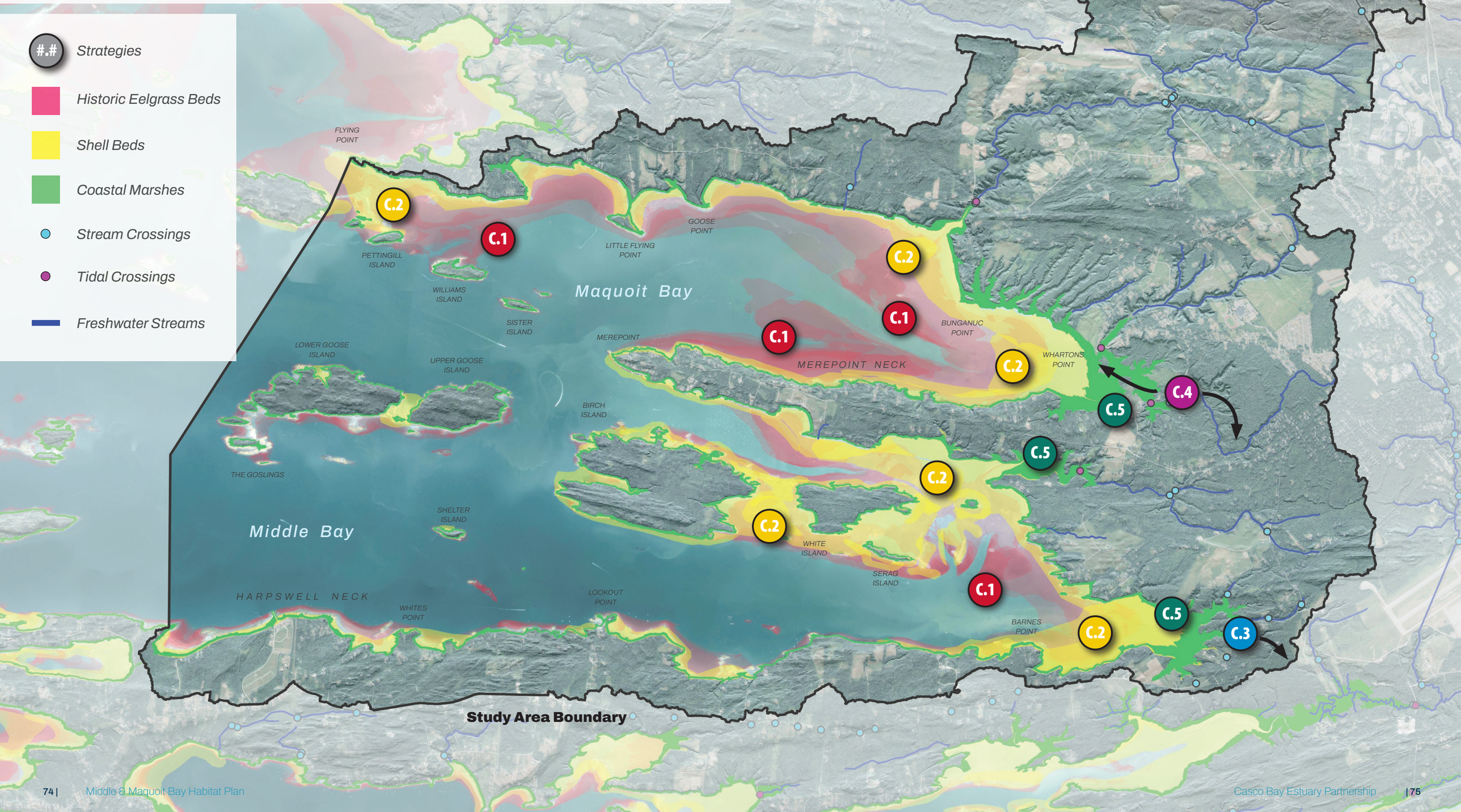
Where dams, roads and other infrastructure bisect salt marshes resulting in restrictions to tidal exchange, follow Maine's CoastWise best practices to **restore natural tidal hydrology while addressing community infrastructure priorities**. Focus on tidal restrictions that will allow for the most marsh migration and restore the largest marshes to allow them to adapt to sea level rise. Bookers Pond Dam (MCP 621; D3261), for instance, is a high priority site that blocks fish passage and is a barrier to salt marsh migration. Other potential tidal restrictions of interest include MCP Crossing ID 382, 618, 620 and 629.

Strategy C.5: *Remediate Historic Marsh Alterations*

Accelerate and coordinate efforts to **remediate historic agricultural marsh surface alterations causing present-day marsh subsidence and megapool expansion**. A significant amount of effort is needed to inventory anthropogenic impacts driving ecosystem degradation, such as hydrological modifications and shoreline armoring, to guide the need for restoration, remediation, revegetation, and similar activities that will improve conditions. Although restoration to pre-development conditions is typically not possible, efforts that restore natural processes such as tidal exchange, flood flows, and sediment transport will help build resilience for threatened habitats wherever it is possible.



Map 19: *Restoration Strategy Areas*



Recommendation D:
Study

Expand Existing Knowledge

Understanding ecological health is complex, interdisciplinary, and an area of active research and development. We should therefore not expect to simply take our current knowledge at face value and act on that alone; we should instead endeavour to improve our understanding of the existing and emerging conditions by prioritizing new research, data collection, and monitoring. While some of these pursuits can be conducted as academic research, others will need to be motivated, funded, and implemented by conservation initiatives, collaborative partnerships, community education, or citizen science.

Collaborators:

Land Trusts

State of Maine: MNAP

Universities/Colleges

CBEP Staff

Strategy D.1: *Groundwater Study*

Study groundwater flow in the headwaters of the Miller Creek and Mare Brook watersheds to better understand the potential for groundwater flow to transport contaminants in the region. In particular, Mare Brook, which has water quality problems and high levels of persistent contaminants, is underlain by sand and gravel aquifers that may pose a potential regional risk of invisible, below-ground contaminant movement.

Strategy D.2: *Sampling of Fish Runs*

Monitor mapped smelt streams through visual assessments and environmental DNA (eDNA) sampling to track status of spawning runs and distribution. Evaluate and identify factors impairing smelt spawning habitat. Explore opportunities to use eDNA to learn more broadly about ecological community composition of coastal streams.

Strategy D.3: *Monitor Coastal Marsh Health*

Work with partners to **monitor coastal marsh health and evaluate their trajectory** in comparison to the State's sentinel marshes. This effort should include such parameters as tidal hydrology, water quality, marsh accretion/elevation, vegetation cover/community structure, and the abundance and richness of fish and other aquatic species.

Strategy D.4: *Bird Surveys*

Conduct bird surveys throughout the region to update knowledge on the status and trends of shorebirds, wading birds, and target species of concern. Include priority habitats such as Middle Bay Marsh for Saltmarsh Sparrow and the Great Blue Heron rookery near the Goslings.

Strategy D.5: *Track and Monitor Invasives*

Look for opportunities to **monitor existing aquatic and terrestrial invasive species** and explore strategies for managing their impact. Monitor for early detection/rapid response (EDRR) to combat expansion of new invasive species.



Casco Bay Estuary Partnership

Map 20: *Areas for further Study*

- #.# *Strategies*
- *Aquifers*
- *Coastal Marshes*
- *Tidal Waterfowl & Wading Bird Habitat*
- *Notable Avian Species*
- *High Traffic Roads*
- *Fish Runs*

FLYING POINT
PETTINGILL ISLAND
WILLIAMS ISLAND
LITTLE FLYING POINT
GOOSE POINT
Maquoit Bay
SISTER ISLAND
MEREPOINT
BUNGANUC POINT
LOWER GOOSE ISLAND
UPPER GOOSE ISLAND
MEREPOINT NECK
WHARTONS POINT
BIRCH ISLAND
THE GOSLINGS
SHELTER ISLAND
Middle Bay
WHITE ISLAND
SERAG ISLAND
HARPSWELL NECK
WHITES POINT
LOOKOUT POINT
BARNES POINT

D.1 D.2 D.3 D.4 D.5

Study Area Boundary

Section 06

Resources

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Further Reading

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https://www.cascobayestuary.org/wp-content/uploads/2024/09/CBEP-Updated-CCMP-4.5_Final.pdf

This updated Comprehensive Conservation and Management Plan (CCMP) serves as the strategic blueprint for maintaining and improving Casco Bay's ecological integrity. The plan establishes five core goals including minimizing pollutant loading, protecting shellfish areas, and preserving ecological communities. As part of the National Estuary Program framework, this document provides essential context for subregional planning efforts including Middle and Maquoit Bays by outlining priority strategies and actions that align with federal and state conservation mandates.

Beginning With Habitat. (n.d.). Focus Areas of Statewide Ecological Significance: Maquoit and Middle Bay.
https://www.maine.gov/dacf/mnap/focusarea/maquoit_middle_bay_focus_area.pdf

This document designates Maquoit and Middle Bays as part of a Focus Area of Statewide Ecological Significance, documenting rare and exemplary natural features. The assessment identifies critical habitats including extensive eelgrass beds, saltmarsh complexes supporting saltmarsh sharp-tailed sparrows, and significant waterfowl and wading bird habitat. Notable features include Upper Goose Island's major heron rookery and multiple bald eagle nesting sites. This designation provides context and justification for prioritizing conservation investments in the study area, offering detailed species occurrence data and habitat classifications essential for the prioritization framework.

Maine Department of Inland Fisheries and Wildlife. (2015). Maine Wildlife Action Plan, 2015-2025.
https://www.maine.gov/ifw/docs/2015%20ME%20WAP%20All_DRAFT23.pdf

This comprehensive statewide conservation strategy identifies 378 Species of Greatest Conservation Need (SGCN) and outlines voluntary, non-regulatory conservation actions to prevent species declines. The plan employs both fine-filter (species-specific) and coarse-filter (habitat-based) approaches, linking species, habitats, stressors, and conservation actions. For Middle and Maquoit Bays, this document provides critical baseline data on priority species including waterfowl, wading birds, marine fish, and saltmarsh specialists. The action-oriented framework supports evidence-based prioritization decisions for habitat protection and restoration efforts in coastal ecosystems.

Casco Bay Estuary Partnership. (2021). State of Casco Bay: 6th Edition.
https://www.cascobayestuary.org/wp-content/uploads/2022/03/State-of-Casco-Bay-report-6th-edition-Dec.-2021.pdf

This comprehensive assessment synthesizes many years of scientific monitoring and research across 19 indicators organized as Drivers & Stressors, Condition of the Bay, and Human Connections. Key findings document eelgrass recovery post-2013 decline, coastal acidification patterns, combined sewer overflow reductions, and climate change impacts. For the habitat prioritization plan, this report provides critical baseline data on water quality, habitat coverage, invasive species distribution, and land use trends specific to the region. The indicators framework offers a model for tracking habitat condition changes and measuring conservation outcomes over time.

The Mudflat. (2022). Brunswick: A Collaborative Approach to Bolster Quahog Populations.
https://themudflat.org/brunswick-a-collaborative-approach-to-bolster-quahog-populations/

This case study documents Brunswick's innovative response to soft-shell clam decline by enhancing quahog (hard clam) populations through hatchery seed propagation and strategic transplanting. The project utilized floating nurseries in Middle and Maquoit Bays, demonstrating collaborative approaches involving municipal marine resources committees, harvesters, and research institutions. This model showcases practical techniques for shellfish population augmentation and adaptive management in response to climate-driven ecosystem changes. The success factors and challenges identified provide valuable lessons for future restoration efforts.

USDA Climate Hubs. (n.d.). Effects of Climate Change on Aquaculture in the Gulf of Maine.
https://www.climatehubs.usda.gov/hubs/northeast/topic/effects-climate-change-aquaculture-gulf-maine

This analysis examines climate change impacts on Gulf of Maine aquaculture systems, addressing warming waters, ocean acidification, and shifting species distributions. Relevant to Middle and Maquoit Bays' shellfish resources, the document discusses implications for hard clam (quahog) populations as waters warm and soft-shell clams face increased predation pressure. The assessment informs adaptation strategies for both wild fisheries and aquaculture operations, providing context for prioritizing climate-resilient habitats and species. This resource identifies knowledge gaps and climate vulnerabilities affecting aquatic systems.

Casco Bay Estuary Partnership. (2017). Casco Bay Economic Study: Final Report.
https://www.cascobayestuary.org/wp-content/uploads/2021/01/CBEP-Economic-Study-Final-Report-11.21.17.pdf

This detailed economic assessment quantifies the value of Casco Bay's ecosystem services, including commercial fishing, recreation, tourism, and property values. By documenting economic dependencies on healthy bay ecosystems, the study provides powerful justification for habitat conservation investments. For Middle and Maquoit Bays, this analysis supports the prioritization framework by identifying high-value resources (e.g., productive shellfish grounds) and demonstrating how habitat degradation translates to economic losses. The report strengthens the business case for proactive conservation and restoration funding.

Maine Department of Agriculture, Conservation and Forestry. (2024). Maine Won't Wait: Climate Action Plan - 2024 Update.
https://www.maine.gov/climateplan/sites/maine.gov.climateplan/files/2024-11/MWW_2024_Book_112124.pdf

Maine's comprehensive climate action plan addresses adaptation and mitigation strategies across sectors, including coastal and marine resources. The plan outlines priorities for protecting coastal habitats from sea level rise, storm surge, and temperature changes. For Middle and Maquoit Bay habitat prioritization, this document provides state-level policy context, identifies funding mechanisms for climate resilience projects, and establishes frameworks for incorporating climate projections into conservation planning. The plan's emphasis on nature-based solutions aligns with habitat restoration approaches for tidal wetlands and coastal buffers.

Maine Department of Environmental Protection. (n.d.). Casco Bay Seagrass Monitoring Report.
https://www.maine.gov/dep/water/monitoring/coastal/MEDEP_CB_Seagrass_Report.pdf

This technical report documents eelgrass distribution and trends in Casco Bay, providing essential data on one of the region's most critical marine habitats. Eelgrass beds support fish nurseries, stabilize sediments, and serve as indicators of water quality. The report addresses the significant eelgrass losses documented in Middle and Maquoit Bays around 2012-2013, potentially related to green crab predation. For habitat prioritization, this analysis identifies areas of historical eelgrass coverage for potential restoration, current distribution patterns, and monitoring protocols necessary for tracking habitat recovery or decline in response to management actions.

Manomet Center for Conservation Sciences. (2012). The Value of Maine's Intertidal Zone.
https://www.manomet.org/wp-content/uploads/old-files/Troy_2012_Value_of_Maine_FullReport.pdf

This comprehensive economic analysis quantifies ecosystem services provided by Maine's intertidal habitats, including commercial fisheries value, storm protection, water filtration, and recreation. The valuation framework supports cost-benefit analyses for conservation versus development scenarios, helping prioritize areas where habitat protection yields the highest return on investment for both ecological and economic outcomes.

Brunswick-Topsham Land Trust. (n.d.). Maquoit Bay Conservation Focus Area.
https://www.btlt.org/conserved-lands/maquoit-bay/

This conservation focus area description highlights Maquoit Bay's designation as a statewide ecological priority, documenting its Spartina saltmarshes, mudflats, eelgrass beds, and diverse wildlife communities. The land trust's easement properties along Bunganuc Stream and bay shorelines illustrate successful private land conservation strategies. For habitat prioritization, this information identifies where existing protections create opportunities for expanding conservation networks, connecting terrestrial and aquatic habitats, and implementing adaptive management for climate resilience, particularly regarding storm surge protection and sea level rise adaptation.

Brunswick-Topsham Land Trust. (n.d.). Middle Bay Conservation Focus Area.
https://www.btlt.org/conserved-lands/middle-bay/

This webpage describes the Brunswick-Topsham Land Trust's strategic conservation efforts in Middle Bay, documenting protected properties, ecological values, and management priorities. The land trust's focus on preserving shoreland buffers, tidal wetlands, and upland-to-intertidal gradients directly supports the habitat plan's conservation objectives. Understanding existing conservation lands and easements is essential for identifying protection gaps, connecting fragmented habitats, and leveraging partnerships for future land acquisition or stewardship. The BTLT model demonstrates successful community-based conservation approaches.

Casco Bay Estuary Partnership. (n.d.). Eastern Bay Watershed.
https://www.cascobayestuary.org/casco-bay/watersheds-of-casco-bay/eastern-bay/

This subregional overview describes the ecological characteristics, conservation status, and key issues for the Eastern Bay Watershed, which encompasses Middle and Maquoit Bays. The document discusses the 2012-2013 eelgrass decline, green crab predation impacts, fisheries productivity, and the region's long-standing recognition as a conservation priority. This contextual information establishes the broader landscape setting for the habitat prioritization plan, identifying how Middle and Maquoit Bays fit within larger bay-wide and watershed-scale conservation strategies and helping frame appropriate geographic scales for prioritization analyses.

Casco Bay Estuary Partnership. (n.d.). How Healthy is Casco Bay?
https://www.cascobay.org/casco-bay/how-healthy-is-casco-bay/

This public-facing website provides accessible summaries of bay health indicators, translating technical monitoring data into understandable information for diverse audiences. The resource supports the habitat plan's stakeholder engagement and education components by demonstrating effective science communication. By presenting both positive trends (e.g., CSO reductions) and ongoing challenges (e.g., eelgrass recovery, acidification), this approach models transparent reporting that builds public support for conservation investments and behavior changes necessary to protect aquatic habitats.

Friends of Casco Bay. (n.d.). PFAS Sampling Results in Casco Bay.
https://www.cascobay.org/pfas-sampling-results-in-casco-bay/

This resource documents monitoring results for per- and polyfluoroalkyl substances (PFAS), emerging contaminants of concern in Casco Bay waters and sediments. PFAS contamination can bioaccumulate in fish and shellfish, potentially affecting both ecosystem health and human consumption safety. For the habitat prioritization plan, understanding PFAS distribution patterns helps identify contaminated areas requiring remediation. This literature informs priorities for filling knowledge gaps about contaminant impacts on aquatic species and offers strategies for addressing pollution sources. This represents an evolving stressor requiring continued monitoring and adaptive management responses.

Maine Department of Environmental Protection. (2025). Water Quality Standards Reclassification: Technical Report.
https://www.maine.gov/dep/water/wqs/TR-Present_DEP-PublMtg_May2025_FINAL_woNotes.pdf

This technical report addresses Maine's water quality standards and potential reclassification of water bodies, providing regulatory context for habitat protection. The document likely discusses numeric criteria for pollutants, designated uses of waters (including shellfish harvesting), and the process for upgrading water quality classifications. For Middle and Maquoit Bays, understanding current and target water quality classifications will prove essential for prioritizing areas where improved protection or restoration could enable shellfish bed reopenings or enhanced ecological function.

Maine Aquaculture Association. (n.d.). Aquaculture in Maine.
https://maineaqua.org/aquaculture-in-maine/

This overview of Maine's aquaculture industry describes the regulatory framework, species cultivated, and economic contributions of marine farming. With aquaculture sites present in Middle and Maquoit Bays, understanding the industry's spatial footprint, environmental interactions, and development trends is essential for habitat planning. The resource helps identify potential conflicts or synergies between aquaculture operations and conservation objectives, informing strategies for sustainable use that protects wild shellfish populations and critical habitats while supporting working waterfront economies.

Map Data Sources

Map Number by Primary Data Sources			OVERVIEW	EXISTING CONDITIONS					
	SOURCE	DATASET	01	02	03	04	05	06	07
PRIVATE	Haley Ward	Derived / Created Data			X			X	
	ESRI	Basemap Service	X						
	Google	Basemap Service		X					
	Microsoft	U.S. Building Footprints							
FEDERAL	USGS	Digital Elevation Model & Derived Products		X	X	X	X	X	X
	USGS	National Hydrography Dataset	X			X		X	
	USDA	Soil Survey Geographic Database				X			
	USFW	National Wetlands Inventory							
	NOAA	Bathymetric Surveys			X				
	NOAA	Coastal Change Analysis Program Landcover					X		
	NOAA	Nautical Charts							
STATE OF MAINE	MGS	Maine Coastal Bluffs				X			
	MGS	Aquifers							
	MDEP	Env. & Geographic Analysis Database							
	MEGIS	Maine Orthos		X					
	MEGIS	Parcels							X
	MEGIS	Townships		X					X
	MEGIS	Conserved Lands							X
	DMR	Tidal Restrictions							
	DMR	Shellfish Growing Areas							
	DMR	Aquaculture							
	MDOT	Culverts							
	MDOT	Roads							X
	MNAP	Marsh Migration							
	MNAP	Stream Crossings & Barriers							
	MDIFW / MNAP / Beginning with Habitat	Species/Natural Communities Data					X	X	X
TOWN	Freeport, Brunswick, Harpswell	Shoreland Zoning / Resource Protection							X
	Brunswick	Septic Inventory							

WORKSHOPS					PRIORITIES				STRATEGIES			
08	09	10	11	12	13	14	15	16	17	18	19	20
	X	X	X		X	X	X	X		X		
X	X	X	X	X								
					X	X	X	X				
X	X		X									
	X	X	X		X	X	X	X	X	X	X	X
X		X	X	X					X		X	
		X									X	X
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X										X		
			X							X		



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