GEI Consultants

Project Report

Payne Road Adaptation Pilot Project

Scarborough, Maine

Submitted to:
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Scarborough, ME 04070

Submitted by:
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Project No. 2403961

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Executive Summary

The Payne Road Adaptation Pilot Project evaluates strategies to mitigate coastal flood risks along a critical transportation corridor in Scarborough, Maine. This planning-level analysis, conducted by GEI Consultants, Inc., identifies and assesses adaptation alternatives to address increasing flood exposure due to sea level rise and storm surge, while maintaining vital connectivity across the Town of Scarborough.

Payne Road serves as a key alternate route to U.S. Route 1, which is frequently inundated during high tides and storm events. However, Payne Road itself is vulnerable to flooding, particularly at three low-lying tidal crossings—Dunstan River, Finnerd Brook, and Beaver Brook.

Three adaptation alternatives were evaluated:

1. **Elevate to 10.0 feet NAVD88**: Reduces flood risk through 2050 and partially through 2100.
2. **Elevate to 12.0 feet NAVD88**: Offers longer-term risk reduction through 2100, including during 500-year storm events.
3. **Do-Nothing**: Maintains current conditions, exposing the road to increasing flood damage, access disruptions, and long-term maintenance costs.

Environmental and permitting constraints are significant due to the road's location within the Scarborough Marsh, a region of high ecological value and regulatory sensitivity. The project area includes critical habitats for endangered species and is subject to local, state, and federal permitting requirements.

Key findings highlight that proactive adaptation of Payne Road can:

- Enhance climate resilience and transportation reliability.
- Reduce long-term infrastructure costs.
- Improve tidal connectivity and marsh health through culvert upgrades.

Next Steps for the Town of Scarborough include:

- Selecting a preferred alternative through community engagement.
- Securing funding through state and federal grants.
- Contracting consultants for design, permitting, and construction oversight.

This report provides a foundation for informed decision-making and supports future funding applications to advance climate-resilient infrastructure in coastal Maine.

1. Introduction

GEI Consultants, Inc. (GEI) has undertaken a planning-level alternatives analysis for a flood adaptation project along Payne Road in the Town of Scarborough, Cumberland County, Maine (Figure 1-1). We have evaluated alternatives for the reconstruction of Payne Road with the goal of reducing the impacts of coastal flooding and rising sea levels which may include damage and loss of transportation assets and/or impacts to vehicular access along Payne Road.

Figure 1-1. Payne Road Location

The memo provides an overview of the flood risk; introduces adaptation design alternatives; and provides information on design feasibility, relative costs, permitting constraints, right of way constraints, and next steps for design implementation. The findings of the alternatives analysis will serve to inform ongoing applications for state, federal, and nongovernment funding for continued engineering and design of the selected adaptation design alternative.

The North American Vertical Datum of 1988 (NAVD88) was the reference datum for elevations in this report unless otherwise specified.

2. Project Area Description

Payne Road is in the Town of Scarborough, Cumberland County, Maine. The southern end of the road stems from Route 1, approximately 0.2 miles north from its intersection with Route 9, and the road extends northeast approximately 4.7 miles until it transitions to the Maine Mall Road in the City of South Portland. Payne Road is a two-lane roadway that is approximately 24 feet wide. The stretch of Payne Road that this project is focused on spans from Milliken Road to just north of the Beaver Brook crossing near the Scottow Hill Road and Beech Ridge Road intersections.

Along this stretch of Payne Road, there are three river crossings: Dunstan River, Finnerd Brook, and Beaver Brook. The three waterways intersect in the Scarborough Marsh, between Payne Road and Route 1, where they join the main stem of the Dunstan River and continue south to the Atlantic Ocean. This area of the marsh is tidally influenced, so depending on the tide, the direction of flow could go either way through the crossings.

According to publicly available LiDAR data (USGS, 2020), Payne Road is at its lowest elevation approximately 170 feet south of the Finnerd Brook crossing. At this point, the road is at an approximate El. 6.7 feet. The road reaches another low point of El. 6.8 feet approximately 120 feet south of the Dunstan River crossing. The road dips to a third low point of approximately El. 9.7 feet near the intersection with Scottow Hill Road and Beech Ridge Road near the Beaver Brook crossing. Figure 2-1 shows an image of the roadway facing south near the Finnerd Brook crossing.

Figure 2-1. Payne Road near Finnerd Brook

Source: Google (2024)

Culverts provide conveyance underneath Payne Road at the Dunstan River, Finnerd Brook, and Beaver Brook crossings. According to the Maine Coastal Program (MCP) Tidal Restriction Atlas (MCP, 2019), the Dunstan River crossing consists of twin 3.0-foot-diameter corrugated metal culverts (Figure 2-2). The Finnerd Brook crossing consists of twin 4.4-foot-diameter corrugated metal culverts (Figure 2-3). The Beaver Brook crossing consists of three 4.9-foot-diameter corrugated metal culverts (Figure 2-4). These dimensions should be considered approximate, and it is recommended to verify them with field survey.

These three crossing locations are listed as "Tidal Road Crossing Restrictions" within the MCP Tidal Restriction Atlas, indicating that they likely restrict tidal exchange and limit saltwater and sediment from moving throughout the marsh system, which could impair the resilience of the marsh overall.

Figure 2-2. Dunstan River Crossing at Payne Road

Source: Maine Coastal Program (2019)

Figure 2-3. Finnerd Brook Crossing at Payne Road

Source: Maine Coastal Program (2019)

Figure 2-4. Beaver Brook Crossing at Payne Road

Source: Maine Coastal Program (2019)

Payne Road is often used as an alternate travel route to U.S. Route 1 for traveling north and south across the Scarborough Marsh. During periods of astronomically high tides and/or coastal storm events, U.S. Route 1 can be impassible due to flood inundation. Users could avoid inundated areas of U.S. Route 1 by traveling along Payne Road, Scottow Hill Road, and the Haigis Parkway, which would add approximately 0.9 miles to their trip. However, Payne Road is also subject to coastal flood inundation. Since December 23, 2022, Payne Road has been reported or observed to be closed due to flood inundation on at least four separate occasions up to the date of this report. During periods of inundation, travelers would need to use either Holmes Road or Interstate-95, which would add a minimum of seven miles to a trip. Figure 2-5 shows a photograph of Payne Road experiencing coastal flood inundation on January 10, 2024.

Figure 2-5. Payne Road Flood Inundation on January 10, 2024

Source: Town of Scarborough (2024)

3. Environmental Considerations

3.1. Wetlands

According to the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory, an Estuarine and Marine Deepwater and an Estuarine Marine Wetland is located to the north and south of the Dunstan River and Finnerd Brook Crossings. The Beaver Brook crossing is indicated to have an Estuarine and Marine Deepwater Wetland and an Estuarine Marine Wetland to the south of the crossing and a Freshwater Pond to the north of the crossing (USFWS, 2025a). Estuarine Marine Wetlands are typical in tidal areas along the Maine coast. A figure of these mapped wetlands is provided in Appendix A.

The National Wetlands Inventory can be useful in understanding the general area or presence of wetlands. However, a wetland scientist should confirm the type and boundaries of wetlands present in the project area for detailed design and permitting. A wetland delineation by a wetland scientist would likely be required by regulatory agencies as part of the permitting process depending on the adaptation alternative selected.

3.2. Site Geology

The Surficial Geology of the Old Orchard Beach Quadrangle, Maine, prepared by the Maine Geological Survey (MGS) in 1999, indicates the surficial material in the area of Payne Road is Presumpscot Formation, which consists of glaciomarine silt, clay, and sand; and saltmarsh wetland, which consists of peat and fine-grained inorganic sediments. Actual conditions should be verified using a geotechnical investigation. The scope of geotechnical investigation required will depend on the design alternative selected but may consist of shallow test pits, drilled borings, and rock cores along with sampling and laboratory testing of recovered sediment and rock samples.

3.3. Endangered Species and Critical Habitats

The Maine Department of Inland Fisheries & Wildlife (Maine DIFW) has identified the Scarborough Marsh as a “Focus Area of Statewide Ecological Significance” because it is the largest contiguous salt marsh system in Maine, and it helps filter pollutions and provides habitat for birds, fish, mammals, and shellfish (Maine DIFW, 2025). The Maine DIFW highlights the importance of maintaining tidal connectivity throughout the marsh, noting that culverts restricting tidal flow are currently impacting the hydrology of the marsh and its sedimentation patterns.

The Maine DIFW Beginning with Habitat (BwH) tool specifies that the project is within the Scarborough Marsh Wildlife Management Area, conserved land owned by Maine DIFW. The BwH tool indicates the presence of the Saltmarsh Sparrow and the Least Bittern near Payne Road, both of which are endangered species. The project area is identified as a Tidal Waterfowl / Wading Bird Habitat. Additionally, Spartina (“Salt-hay”) Saltmarsh and a Tidal Marsh Estuary Ecosystem are identified as present near the project area. The crossings are listed Riparian Connectors.

In addition to the Maine DIFW, the United States Fish & Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool has identified 5 species that are either endangered, proposed endangered, or proposed threatened status; and 25 types of migratory birds, including bald eagles, that may be present in the area (USFWS, 2025b). The threatened and endangered species include Northern Long-eared Bats, Tricolored Bats, and Monarch Butterflies. The 25 migratory birds include the American Oystercatcher, Bald Eagle, Black Skimmer, Black-billed Cuckoo, Blue-winged Warbler, Bobolink, Canada Warbler, Chimney Swift, Eastern Whip-poor-will, Grasshopper Sparrow, Hudsonian Godwit, Least Tern, Lesser Yellowlegs, Long-eared Owl, Pectoral Sandpiper, Prairie Warbler, Ruddy Turnstone, Rusty Blackbird, Saltmarsh Sparrow, Scarlet Tanager, Semipalmated Sandpiper, Short-billed Dowitcher, Whimbrel, Willet, and the Wood Thrush.

The above summary of site environmental conditions is based on planning-level resource mapping. This data is useful for initial screening for site conditions and environmental resources, but site-specific information should be verified on site by qualified professionals. Upon selection of a preferred design alternative and determination of the scope and scale of construction, site investigations should be planned to verify site-specific and project-specific data in sufficient detail to undertake the regulatory permitting process.

The figure summarizing the BwH tool results is provided in Appendix B. The IPaC resource list is provided in Appendix C.

4. Flood Exposure

For this Pilot Project, we have estimated the coastal flood risk along Payne Road due to storm surge and sea level rise based on results from the town-wide Flood Vulnerability Assessment and field measurements of water surface elevations near Payne Road collected by the Maine Department of Transportation (DOT) in 2023 as part of the U.S. Route 1 Flood Adaptation Project. Additionally, we have commented on how flood risk may change along Payne Road if alternative crossing configurations along U.S. Route 1 are implemented. The following sections summarize the Scarborough town-wide Flood Vulnerability Assessment, our understanding of tidal attenuation from the mouth of the river to Payne Road based on the Maine DOT gage analysis, and a summary of flood risk along Payne Road.

4.1. Scarborough Town-Wide Flood Vulnerability Analysis

The town-wide Flood Vulnerability Analysis used a bathtub modeling approach to evaluate flood inundation extents for ten flood scenarios representing present-day and future water levels for both high tide and coastal storm surge scenarios. Details on the flood vulnerability methodology, results, and the limitations are provided in the 2025 Flood Vulnerability Analysis Results Memo (GEI, 2025a). The bathtub modeling approach allows for a streamlined high-level analysis that works well for a town-wide study. However, this approach does not account for tidal variation across the town, and specifically, tidal attenuation due to the tide traveling upstream through the marsh system and through tidal restrictions. For areas in the upper reach of the marsh, such as Payne Road, attenuation due to tidal restrictions at the Eastern Trail Bridge and the existing culverts at U.S. Route 1, along with the attenuating effects of the natural channel, would likely reduce the peak water surface elevation of the tide. The results of the high-level study using the bathtub modeling approach suggest that Payne Road would likely be inundated for all ten scenarios included in the study, which would begin as early as during highest astronomical tides by 2030. However, due to the bathtub modeling approach limitations, this approach is likely to overestimate the flood risk along Payne Road.

To account for the effects of tidal attenuation, we revised the water elevations for each of the ten flood scenarios in the town-wide Flood Vulnerability Analysis to represent an estimated attenuated peak tide at Payne Road. We did this by reducing the peak water surface elevations for the ten scenarios by an attenuation amount. The attenuation amount was based on peak water measurements taken near Payne Road by Maine DOT in 2023 compared with the corresponding peak water measurements collected at the NOAA gage in Portland (NOAA, 2024). This process is described in the sections below.

4.2. Maine DOT Gage Analysis

In 2023, Maine DOT deployed gages to measure water surface elevations throughout the upper reaches of the marsh, including downstream of Payne Road along the Dunstan River and Finnerd Brook. Measurements were collected between September and November.

The measured water surface elevations collected by Maine DOT near Payne Road reflect tidal attenuation that occurs between the mouth of the Scarborough Marsh near Pine Point and the upper reach of the marsh near Payne Road.

Using these measurements, GEI estimated an approximate attenuation value by comparing peak water surface measurements from the NOAA gage in Portland to the Maine DOT measurements along Dunstan River and Finnerd Brook downstream of Payne Road. The comparison was made for periods of time when high tides at the NOAA gage in Portland exceeded 6.0 feet.

To estimate an approximate attenuation value, we averaged the difference in peak water surface elevations between the Portland measurements and the measurements near Payne Road. Based on this comparison, the average difference in peak water surface elevations for tides greater than El. 6.0 feet between the NOAA Portland Tide gage and downstream of Payne Road is approximately 1.5 feet.

A summary of these water surface observations is provided in Table 4-1 below.

Table 4-1. Measured Water Surface Elevations

Date/Time	Peak Water Surface Elevations (ft NAVD88)				Difference Between NOAA Observation and Average Observation Downstream of Payne Road
	NOAA Tide Gage Portland ME	ME DOT Downstream of Payne Road Dunstan River	ME DOT Downstream of Payne Road Finnerd Brook	Average Observation Downstream of Payne Road	
9/28/2023 PM	6.20	4.69	4.60	4.65	1.56
9/29/2023 AM	6.04	4.64	4.55	4.60	1.45
9/30/2023 AM	6.06	4.67	4.57	4.62	1.44
9/30/2023 PM	6.33	4.78	4.69	4.74	1.60
10/1/2023 PM	6.28	4.79	4.70	4.75	1.54
10/2/2023 PM	6.08	4.67	4.62	4.65	1.44
10/29/2023 PM	6.29	4.73	4.69	4.71	1.58
10/30/2023 PM	6.42	4.93	4.89	4.91	1.51
10/31/2023 PM	6.04	4.71	4.68	4.70	1.35
11/1/2023 PM	6.22	4.78	4.74	4.76	1.46
				Average:	**1.49**

4.3. Flood Risk at Payne Road

Using the approximate attenuation value derived from reviewing the Maine DOT measured water surface observations, we revised the water surface elevations of the ten flood scenarios used in the Flood Vulnerability Analysis. For example, Flood Scenario 2 originally had a water surface elevation of 8.0 feet in the town-wide Flood Vulnerability Analysis, which represents highest astronomical tide in 2050 for 1.5 feet of sea level rise or a 10-yr storm for present-day sea levels. For flood risk at Payne Road, we revised this elevation to 6.5 feet due to an estimated attenuation of 1.5 feet, meaning that a highest astronomical tide level of 8.0 feet at the entrance to the marsh would likely attenuate to be only 6.5 feet by the time the tide propagates up to Payne Road.

The ten flood scenarios, corresponding water surface elevations, and the time horizon in which the water surface elevation would likely occur during coastal storm events and for high tides are summarized in Table 4-2. A description of the ten flood scenarios and under which event each scenario may be realized is provided in Table 4-3.

Table 4-2. Summary of Revised Flood Scenarios for Payne Road

Flood Scenario	Water Surface Elevation in Atlantic Ocean (ft)	Revised Water Surface Elevation at Payne Road (ft)	Flood Risk Time Horizon	
			Coastal Storm Event	"High Tide"
1	7.3	5.8	Now	2030
2	8.0	6.5	Now	2050
3	8.8	7.3	Now	2050
4	9.6	8.1	Now	2100
5	10.3	8.8	2030	2100
6	10.8	9.3	2050	2100
7	11.4	9.9	2050	2100
8	12.8	11.3	2100	2100
9	13.9	12.4	2100	2100
10	16.9	15.4	2100	2100

Notes: "High Tide" refers to mean-higher-high water and Highest Astronomical Tide elevations. "Coastal Storm Events" include coastal storms ranging from a 10-yr storm event to a 500-yr storm event. Sea level rise for the future time horizons is based on intermediate and high rates of sea level rise and Maine Climate Council guidance. Refer to the 2025 GEI memo (GEI, 2025a) for more detail on the flood scenario development.

Table 4-3. Description of Flood Scenarios

Flood Scenario	Description of When Flood Scenario Would be Met or Exceeded
1	HAT in present-day; HAT in 2030; MHHW in 2050
2	10-yr storm in present-day; HAT in 2050
3	100-yr storm in present-day; 10-yr storm in 2030; HAT in 2050; MHHW in 2100
4	500-yr storm in present-day; 100-yr storm in 2030; 10-yr storm in 2050
5	500-yr storm in 2030; 100-yr storm in 2050
6	100-yr storm in 2050; HAT in 2100
7	500-yr storm in 2050
8	100-yr storm in 2100 (4.0 ft of SLR); MHHW in 2100 (7.4 ft of SLR)
9	500-yr storm in 2100 (4.0 ft of SLR); HAT in 2100 (7.4 ft of SLR)
10	500-yr storm in 2100 (7.4 ft of SLR)

Note: HAT stands for highest astronomical tide. MHHW stands for mean-higher-high-water. The flood scenario elevations and corresponding flooding events are approximate. Refer to the 2025 GEI memo (GEI, 2025a) for more detail on the flood scenario development.

Using the revised water surface elevations and the three low point elevations along the roadway, we have estimated the depth of flooding along Payne Road for each of the ten flood scenarios included in the study. The results suggest that flood inundation would likely occur beginning in Flood Scenario 3, or when the water surface elevation near Payne Road reaches approximately El. 7.3 feet. This would likely occur during stillwater conditions (i.e., no wave action) for a 100-yr storm for present-day water levels, during stillwater conditions for a 10-yr storm for 0.8 feet of sea level rise (predicted to occur by 2030), during highest astronomical tide for 1.9 feet of sea level rise (2050 time horizon), or during mean-higher-high-water for 4.0 feet of sea level rise (predicted to occur by 2100).

A summary of flood depths along Payne Road for the ten flood scenarios is provided in Table 4-4.

Table 4-4. Payne Road Flood Risk Exposure Summary

Payne Road	1	2	3	4	5	6	7	8	9	10
Water Surface Elevation at Payne Road, ft NAVD88	*5.8*	*6.5*	*7.3*	*8.1*	*8.8*	*9.3*	*9.9*	*11.3*	*12.4*	*15.4*
Depth of Flooding near Dunstan River Crossing[1], ft	-	-	0.5	1.3	2.0	2.5	3.1	4.5	5.6	8.6
Depth of Flooding near Finnerd Brook Crossing[2], ft	-	-	0.6	1.4	2.1	2.6	3.2	4.6	5.7	8.7
Depth of Flooding near Beaver Brook Crossing[3], ft	-	-	-	-	-	-	0.2	1.6	2.7	5.7

Notes:
1. Based on a road low point El. 6.8 ft
2. Based on a road low point El. 6.7 ft
3. Based on a road low point El. 9.7 ft

4.3.1. Implications of the Maine DOT U.S. Route 1 Adaptation Project

GEI was contracted by the Maine DOT, as part of a separate project, to undertake a 2-D hydrologic and hydraulic modeling analysis of the upper reach of the Scarborough Marsh, including Payne Road. The analysis included evaluating peak water levels for existing and proposed crossing configurations of U.S. Route 1 for present-day and future rates of sea level rise and highest astronomical tide conditions (GEI, 2025b). The study involved evaluating the peak water surface elevation along Payne Road for the existing crossing consisting of four culverts and for a proposed single-span bridge. The preliminary results of the study suggest that if the Route 1 crossing is reconstructed to a single-span bridge with a 75.0-foot-wide opening, thus increasing the tidal transparency throughout the upper reach of the marsh, peak water surface elevations at Payne Road could increase by approximately 1.0 foot for highest astronomical tides and 4.0 feet of sea level rise (GEI, 2025b). As of the writing of this report, plans for the reconstruction of the U.S. Route 1 crossing, including the decision to replace the existing crossing with a bridge and the hydraulic opening of potential bridge, have not been finalized. The implications of the adaptation of U.S. Route 1 for Payne Road will likely be studied in more detail as the project advances to preliminary and final design.

5. Adaptation Design Alternatives

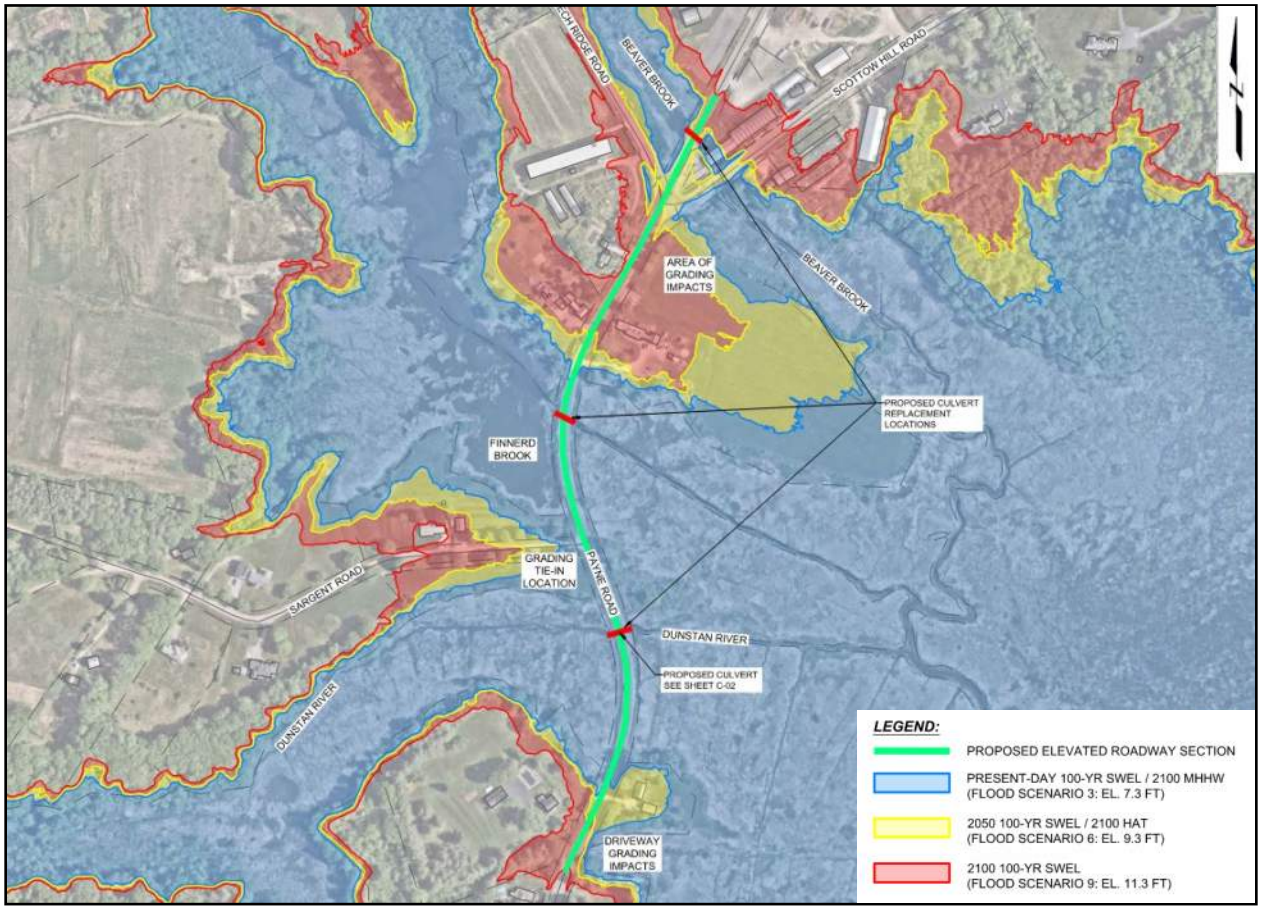
We have provided a high-level analysis of considerations for reconstructing Payne Road to minimize the risk of overtopping and flooding of the road during coastal storm events and for increased sea levels. Three alternatives were evaluated:

1. Raise Payne Road to a minimum top of pavement elevation of 10.0 feet.
2. Raise Payne Road to a minimum top of pavement elevation of 12.0 feet.
3. Do-nothing option.

For each option, we evaluated design considerations, the impact to coastal flood risk, and permitting constraints. Figure 5-1 shows a diagram of the proposed roadway segment that would be elevated under design alternatives 1 and 2. Appendix D provides figures showing the proposed roadway segments, flood inundation boundaries, and locations of upgraded tidal crossings.

These alternatives are conceptual in nature and the actual design of a reconstruction effort may be influenced by the existing property ownership and right-of-way acquisition potential, as well as site conditions and avoidance of environmental resource impacts.

Figure 5-1. Payne Road Proposed Elevated Area



5.1. Elevate Payne Road

5.1.1. Elevate to 10.0 feet

This option would involve elevating Payne Road to a minimum top of pavement El. 10.0 feet, which would increase the road profile of Payne Road by up to 3.3 feet at the Finnerd Brook crossing, 3.2 feet at the Dunstan River crossing, and 0.3 feet at the Beaver Brook crossing.

This alternative could include constructing new culvert crossings along Payne Road at the Finnerd Brook and Dunstan River crossing locations, which could be designed to reduce the tidal restriction and promote habitat connectivity. Upgrading the culvert crossings to increase tidal transparency, through the use of large box culverts or a single-span bridge openings, would be favorable for permitting agencies and potential funding sources through state and/or federal agencies. Elevating Payne Road by a minimum of 0.3 feet near the Beaver Brook crossing could likely be accomplished without replacing the existing culverts in place, however replacing this structure would further promote tidal connectivity throughout the marsh.

Elevating the road to El. 10.0 feet would likely prevent flooding for the following scenarios:

- Mean higher-high water and highest astronomical tide for present day sea levels, sea levels in 2030 considering 0.8 feet of sea level rise, sea levels in 2050 considering up to 1.9 feet of sea level rise, and sea levels in 2100 considering up to 4.0 feet of sea level rise
- Coastal storm surge stillwater conditions (i.e., no wave action) for coastal storm events up to the 0.2% annual chance event (i.e., 500-yr storm) for present-day sea levels, sea levels in 2030 considering 0.8 feet of sea level rise, and sea levels in 2050 considering up to 1.9 feet of sea level rise

Under this alternative, the roadway would likely experience flood inundation due to still water conditions (i.e., standing water) during 1% annual chance coastal events (i.e., 100-yr storms) by 2100 and beyond, considering at least 4.0 feet of sea level rise. The depth of flooding during a 1% annual chance coastal event for 4.0 feet of sea level rise would be approximately 1.3 feet during the peak high tide of the coastal storm event.

5.1.2. Elevate to 12.0 feet

This option would involve elevating Payne Road to a minimum top of pavement El. 12.0 feet, which would increase the road profile of Payne Road by up to 5.3 feet at the Finnerd Brook crossing, 5.2 feet at the Dunstan River crossing, and 2.3 feet at the Beaver Brook crossing.

Elevating the road to El. 12.0 feet would likely prevent flooding for the following scenarios:

- Mean high-high water and highest astronomical tide for present day sea levels, sea levels in 2030 considering 0.8 feet of sea level rise, sea levels in 2050 considering up to 1.9 feet of sea level rise, and sea levels in 2100 considering up to 4.0 feet of sea level rise

- Coastal storm surge stillwater conditions (i.e., no wave action) for coastal storm events up to the 0.2% annual chance event (i.e., 500-yr storm) for present-day sea levels, sea levels in 2030 considering 0.8 feet of sea level rise, sea levels in 2050 considering up to 1.9 feet of sea level rise, and sea levels in 2100 considering up to 4.0 feet of sea level rise

Under this alternative, the roadway would likely experience flood inundation due to highest astronomical tide conditions by 2100 considering 7.4 feet of sea level rise, with a flood depth up to 0.4 feet during the peak high tide.

5.1.3. Design Considerations and Challenges

We have compiled a list for the Town to consider when evaluating this alternative:

- This alternative would require elevating up to approximately 2,300 linear feet of roadway. The actual amount of roadway to be elevated would be determined further in the design process.
- Elevating the roadway in its existing alignment would increase the footprint of the roadway and drainage requirements and likely require right-of-way acquisition or easements. Additionally, the footprint of the roadway would encroach into the saltmarsh which is regulated by permitting agencies.
- This alternative could have upstream impacts to private property. An elevated roadway will alter the existing drainage flow patterns upstream.
- There are currently overhead electric power lines along the north and south side of Payne Road. Coordination with the utility owners will be required for accommodation of construction impacts to these utilities. Relocation and/or bracing of the power poles may likely be required.
- This alternative would require protection of the roadway, such as a stone revetment or retaining wall, to contain the fill from the elevated road and reduce the damage potential of scour through tidal or riverine flow and/or wave action.
- Global stability and settlement issues within the soil are likely when raising the road grade due to the presence of soft cohesive soils in the Presumpscot formation and salt marsh deposits. Ground improvement methods, such as preloading with wick drains or rigid inclusions, or deep foundation elements such as driven H-piles could be used to reduce global stability and settlement issues during and after construction. Engaging with a geotechnical engineer will be important throughout the design process.
- New culverts at the three crossings should be designed to provide conveyance for a design rainfall event and take into consideration the tidal nature of the crossing. The analysis and design process should follow the CoastWise Approach for crossing design, which was developed with tidal crossings in mind (MCP, 2023). Large box culverts can increase tidal connectivity throughout the marsh while remaining more cost effective than single-span bridge options. Consideration should be given to whether the existing culvert along Beaver Brook under Scottow Hill Road should be replaced concurrently with the one for Payne Road. Completing a hydrologic and hydraulic evaluation of opening alternatives is recommended. Examples of wide tidal crossings, such as box culverts, from the CoastWise Approach are provided in Figure 5-2.

- Elevating Payne Road would require regrading of existing driveways and road tie-ins, such as Sargent Road, Beech Ridge Road, and Scottow Hill Road.
- This alternative would be subject to several local, state, and federal permitting regulations. An overview of permitting considerations is provided in Section 6.0.

Figure 5-2. Wide Tidal Crossing Examples

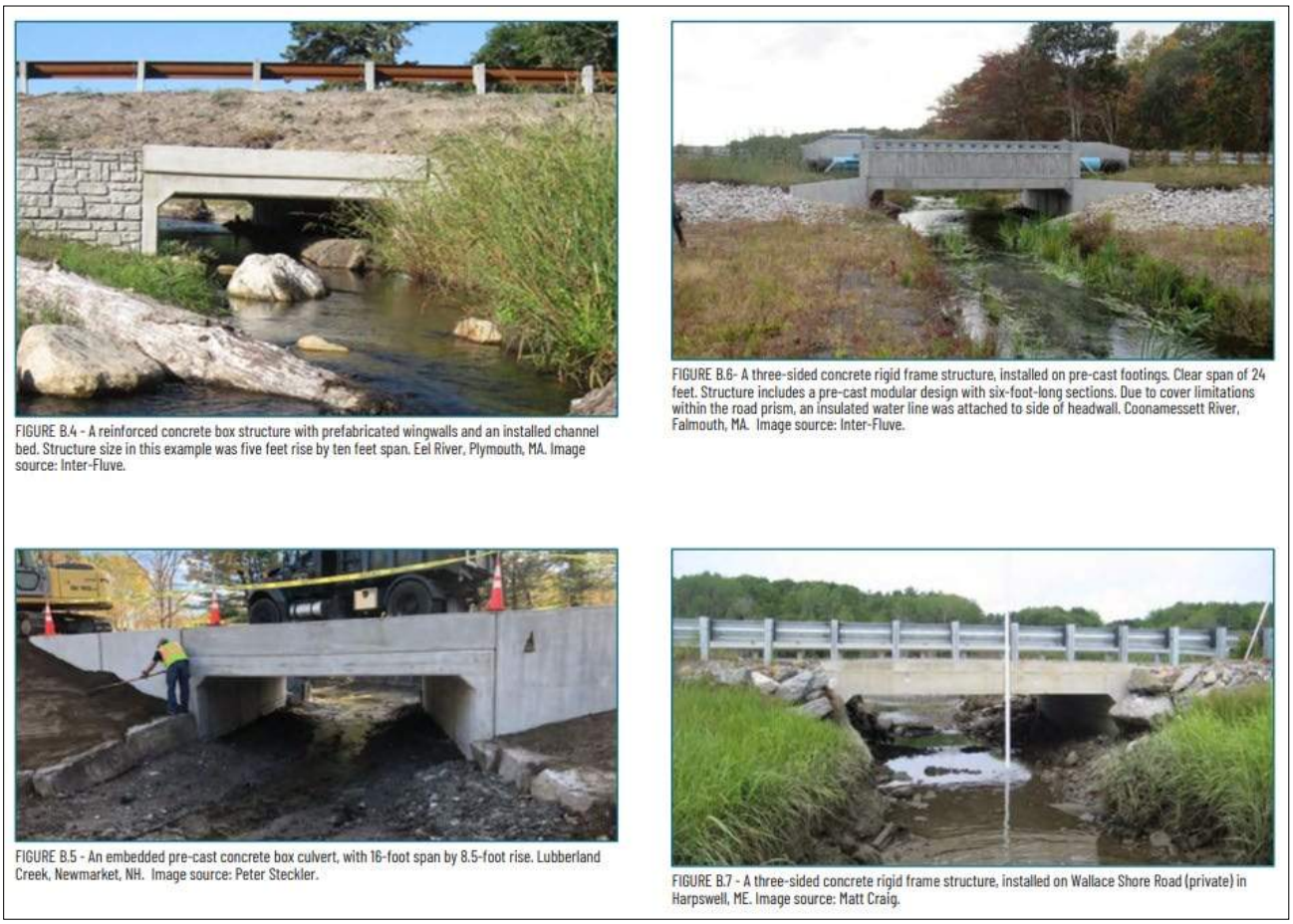


FIGURE B.4 - A reinforced concrete box structure with prefabricated wingwalls and an installed channel bed. Structure size in this example was five feet rise by ten feet span. Eel River, Plymouth, MA. Image source: Inter-Fluve.

FIGURE B.6- A three-sided concrete rigid frame structure, installed on pre-cast footings. Clear span of 24 feet. Structure includes a pre-cast modular design with six-foot-long sections. Due to cover limitations within the road prism, an insulated water line was attached to side of headwall. Coonamessett River, Falmouth, MA. Image source: Inter-Fluve.

FIGURE B.5 - An embedded pre-cast concrete box culvert, with 16-foot span by 8.5-foot rise. Lubberland Creek, Newmarket, NH. Image source: Peter Steckler.

FIGURE B.7 - A three-sided concrete rigid frame structure, installed on Wallace Shore Road (private) in Harpswell, ME. Image source: Matt Craig.

Source: The CoastWise Approach (MCP, 2023)

5.2. Do-Nothing Alternative

For the Do-Nothing alternative, the existing roadway alignment and elevation of Payne Road would be maintained. Flood inundation due to storm surge during coastal storm events for present-day and future sea levels would likely occur. Flood inundation events would likely increase in frequency and floodwaters would likely get deeper and extend further inland as seas rise. Vehicles and residents could be stranded during periods of roadway inundation and/or damage from storms. The cost of repeated roadway reconstruction, maintenance, and repair over time would likely exceed the cost of proactively adapting the roadway. The National Institute of Building Sciences (NIBS) reported that every $1 invested in lifeline retrofit, such as roadways, results in $4 of avoided disaster damage (NIBS, 2019).

6. Permitting Considerations

Adapting Payne Road by elevating the road would be subject to local, state, and federal permitting requirements. We have outlined federal, state, and local permits that would likely be required for adaptation of this roadway considering the following features of the site location:

- The existing alignment of Payne Road is located adjacent to the Scarborough Marsh (a coastal wetland under Maine DEP regulations and waters of the United States under the Army Corps of Engineers (ACOE).
- The coastal wetland is mapped in Tidal Waterfowl and Wading Bird Habitat – a Significant Wildlife Habitat as defined by the MDEP regulations.
- The site is mapped in a FEMA AE Zone (FEMA, 2024).
- The project area is mapped in Rural Residence Farming (RF), Resource Protection (RP), and the Shoreland Overlay (SO) of the Town of Scarborough Zoning Map.
- It is anticipated that the work would require a permit from Maine DEP under the Natural Resource Protection Act (NRPA), from the ACOE under the Maine General Permit, and from the Town of Scarborough under local shoreland zoning regulations.

In addition to the permits described below, the Town will need to demonstrate they have sufficient title, right, or interest (TRI) in the project area in order to advance roadway adaptation. For alternatives that can be constructed fully within Town-owned right-of-way, TRI can be anticipated to currently exist. For projects that would increase the footprint of construction outside of the existing town-owned right-of-way, or for reconstruction of the road on an alternate alignment, property acquisition will be necessary to obtain the required right-of-way.

6.1. Federal Permits

The ACOE regulates waters of the US under Section 404 of the Clean Water Act and navigable waters of the US under Section 10 of the Rivers and Harbors Act. The limit of ACOE jurisdiction for tidal waters is the Highest Astronomical Tide (HAT) Line, which is indicated as El. 6.5 feet for this site (MGS, 2024). If no fill is proposed to be placed at or seaward of this line and assuming no other waters of the U.S. are present in the project area, then the ACOE does not have jurisdiction. ACOE jurisdiction also includes freshwater wetlands, tributaries to navigable waters, intermittent streams, vernal pools and other adjacent wetlands and waters. The National Wetlands Inventory (NWI) dataset maintained by USFWS identifies an Estuarine and Marine Deepwater and an Estuarine Marine Wetland near Payne Road in the project area. The proposed project area would need to be delineated by a wetland scientist to determine if these resources are present. An ACOE permit may be required for adaptation of Payne Road depending on final design selection and a site-specific wetland delineation.

Currently, linear transportation projects fall under General Condition #10 of the USACE Maine General Permit; however, the Maine General Permit is set to expire and be replaced in October 2025.

If the project is federally funding, a National Environmental Policy Act (NEPA) review may be required. The level of NEPA review depends on the scale and potential impacts of the project and can fall under Categorical Exclusion (CE), Environmental Assessment (EA), or an Environmental Impact Statement (EIS).

6.2. State Permits

Scarborough Marsh is defined as a coastal wetland by the Natural Resources Protection Act (NRPA). Similar to the ACOE, the HAT line is the defining boundary line that determines the landward extent of the coastal wetland. Under the NRPA, the MDEP jurisdiction extends from the coastal wetland to 75 feet landward of the HAT. In addition, based on the ME DIFW Environmental Review Mapper, there are several Significant Wildlife Habitats (SWHs) mapped within Scarborough Marsh at the project area. This includes the Tidal Waterfowl and Wading Bird Habitat (TWWH) and State Endangered and Threatened species. As discussed in Section 3.3, these species include Saltmarsh Sparrow and Least Bittern.

Activities that require a permit under the NRPA include dredging, bulldozing, removing or displacing soil, sand, vegetation, or other materials, draining or otherwise dewatering, filling, including adding sand or other material to a sand dune, and construction, repair, or alteration of any permanent structure. Any potential improvements to the road within 75 feet of the Scarborough Marsh and/or potential impacts to delineated wetlands, significant vernal pools, streams, brooks, or rivers may require a permit under the NRPA.

Given the potential presence of two state-listed endangered species, it is important to conduct early outreach with regulatory and resource agencies that include MDEP and ME DIFW. The project design should carefully consider efforts to avoid and/or minimize impacts to both Scarborough Marsh and significant wildlife habitat areas in order to minimize challenges during regulatory permitting.

6.3. Local Permits

The project is mapped within AE Zone, El. 9 feet on the west side of Payne Road and El. 12 feet on the east side of Payne Road according to effective FEMA FIRM (2024). A permit for improvements to the roadway will be required under Chapter 405A of the Town's Floodplain Management Ordinance.

7. Next Steps

The report presents conceptual options for adapting Payne Road in the Town of Scarborough, Maine. The options are based on available online background information of the wetlands and endangered species and critical habitats present at the site. Additionally, the adaptation alternatives took into consideration site specific flood risk due to present-day and future high tides and coastal storms. This adaptation alternatives analysis provides a high-level summary of options.

We have provided a summary of the recommended next steps for the Town to advance the adaptation of Payne Road if the Town chooses to move forward with elevating the roadway. Next steps for this project could include:

- **Pursue relevant funding options.** Elevating Payne Road may require support from multiple grants, over multiple funding cycles, to complete. The Town should continue to explore grant opportunities focused on implementation of flood adaptation measures. Some of the grant programs available for coastal infrastructure projects in Maine include:
    - Maine Coastal Program Grants (note: not available in 2025)
    - Governors' Office of Policy Innovation and the Future (GOPIF) Community Action Grants
    - Maine DOT Maine Infrastructure Adaptation Fund
    - Maine DOT Municipal Stream Crossing Grants
    - FEMA Building Resilient Infrastructure Communities (BRIC) grants
    - U.S. DOT Bipartisan Infrastructure Law Grants
    - National Fish and Wildlife Foundation Coastal Resilience Fund
- **Contract with a consultant to develop preliminary and final designs, procure the necessary permits, and oversee construction.** Contracting with a consultant to advance designs around an alternative would allow for a refinement of roadway elevations based on site constraints. The consultant(s) should be responsible for several tasks. These tasks could be part of separate contracts, funded through various grant programs, and take several years to complete. The tasks that the consultant(s) could be responsible for include:
    - **Conduct field investigations.** This would include scope items such as coordinating topographical and parcel boundary surveys of the area, performing wetland delineation, and carrying out hydrologic and hydraulic modeling studies and a geotechnical investigation, as applicable.
    - **Develop preliminary and final designs.** The selected alternative would need to be advanced through preliminary and final phases of design development. This process would likely involve hydrologic and hydraulic modeling of the crossing openings to design crossing alternatives in alignment with the CoastWise Approach.
    - **Procure permits.** The consultant would help prepare and submit regulatory permits required for the selected design. Permitting agencies would likely be involved in this project from the onset given the location of the project within an area of environmental significance.

- **Coordinate with a community engagement process.** As designs are developed, the consultant could undertake a community engagement process to keep the public informed of the project.
- **Prepare construction bid documents and oversee the bid process.** The consultant could help prepare construction plans and bid documents and assist in the selection of a contractor for the construction of the project.
- **Oversee construction.** The consultant could oversee the construction of the project to document progress and compliance with design plans and specifications.

8. Limitations

This report summarizes our work for the Town of Scarborough. The purpose of this work was to provide a high-level overview of the adaptation of Payne Road to reduce the risk of flood inundation due to coastal storms and sea level rise. The project did not include field data collection and relied on readily available online information, field data from other projects, published references, and our professional judgement.

The flood extents and peak water surface elevations near Payne Road were based on FEMA still water elevations along the Scarborough Coast, sea level rise projections, and an estimated attenuation amount based on measured data. The flood extents and peak water surface elevations should be considered approximate. Actual storm surge elevations and rates of sea level rise will vary from what has been presented in this report.

This study does not include an evaluation of the structural integrity of the roadway or culverts. We recommend site survey and site-specific design be completed for any infrastructure project the Town pursues. Because the methods, procedures, and assumptions used to develop the analysis are approximate, the results should be used only as guidance.

Reuse of this report for any purposes, in part or in whole, is at the sole risk of the user.

9. References

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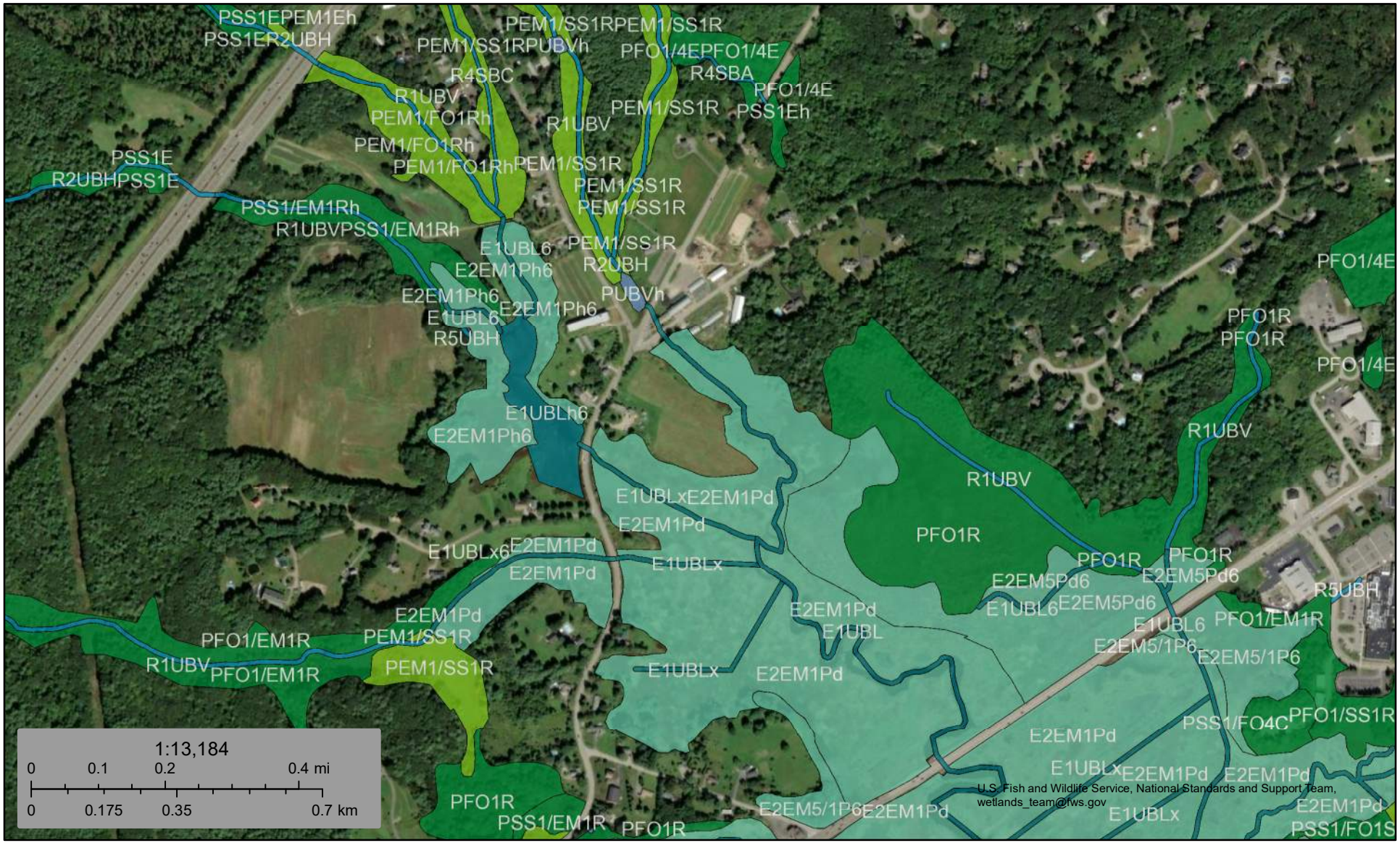
Appendix A Payne Road National Wetlands Inventory

U.S. Fish and Wildlife Service

National Wetlands Inventory

Payne Road NWI



April 7, 2025

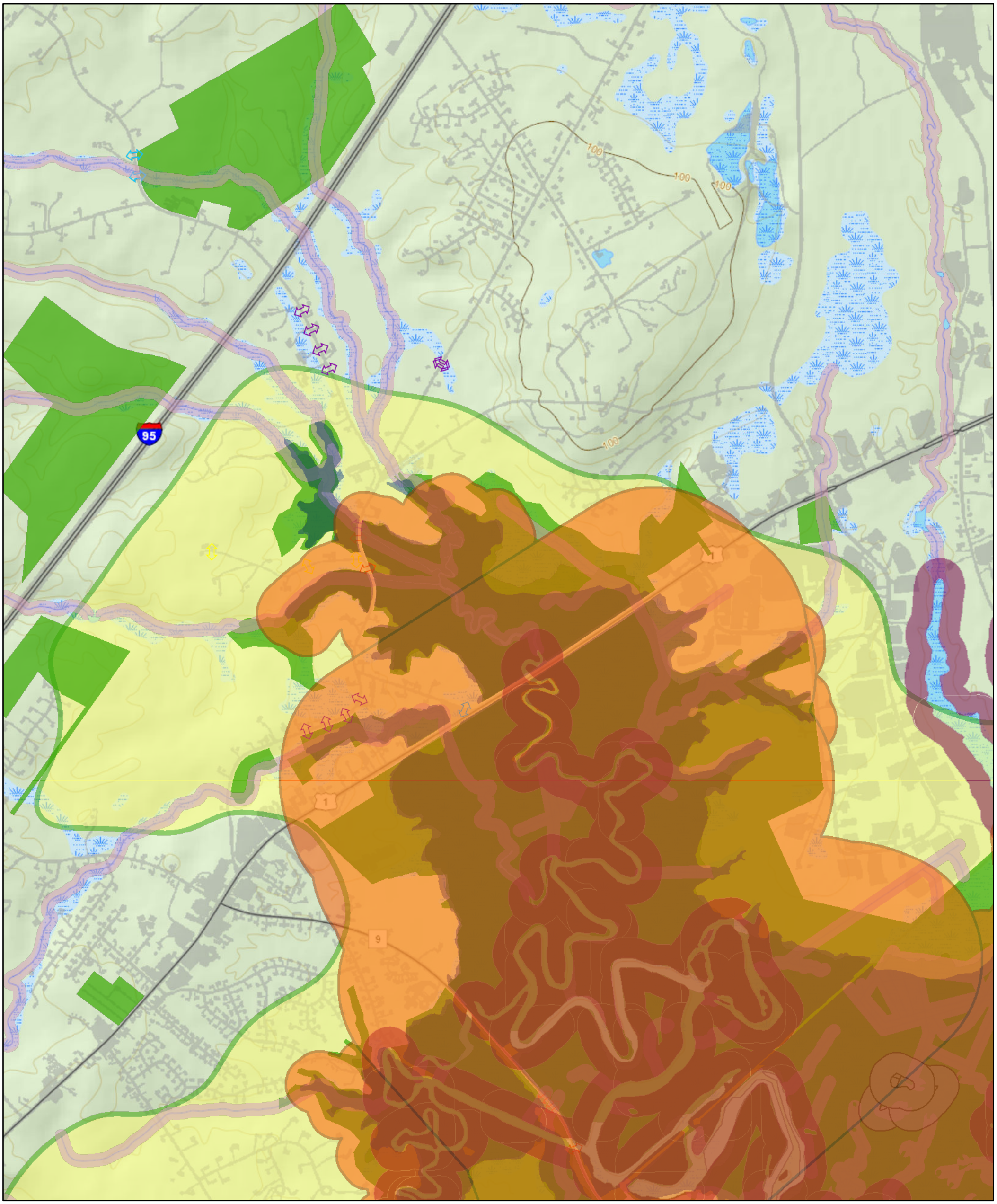
Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Appendix B Payne Road Beginning with Habitat

Beginning With Habitat: Payne Road



May 21, 2025

- Shellfish Beds
- Stream Buffer (75 feet)
- Great Ponds, Rivers and Coastal Buffer (250 feet)
- Atlantic Salmon Habitat
- Shorebird Habitat
- Seabird Nesting Island
- Tidal Waterfowl / Wading Bird Habitat
- Inland Waterfowl / Wading Bird Habitat
- Significant Vernal Pools
- Deer Wintering Areas
- Endangered, Threatened, and Special Concern Species
- Natural Communities
- Highway Bridge Connectors

Riparian Connectors
- Less than 2000 Vehicles/Day
- More than 2000 Vehicles/Day

Undeveloped Block Connectors
- Less than 2000 Vehicles/Day
- More than 2000 Vehicles/Day
- Focus Areas- Overlapping Organized Towns
- Conserved Lands

1:18,056

0 0.15 0.3 0.6 mi

0 0.23 0.45 0.9 km

Beginning with Habitat Program for Planning Purposes Only
Map Created With BWH Map Viewer

Appendix C Payne Road IPaC

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Cumberland County, Maine

Local office

Maine Ecological Services Field Office

(207) 469-7300
(207) 902-1588

MAILING ADDRESS
P. O. Box A
East Orland, ME 04431

PHYSICAL ADDRESS
306 Hatchery Road
East Orland, ME 04431

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Northern Long-eared Bat Myotis septentrionalis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat Perimyotis subflavus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds

- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts
For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete
If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

Review the FAQs
The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Oct 15 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and

Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

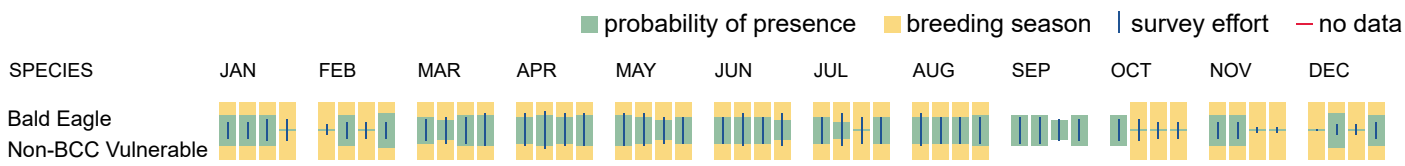
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report

On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:

The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The Service interprets the MBTA to prohibit incidental take.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Measures for Proactively Minimizing Migratory Bird Impacts

Your IPaC Migratory Bird list showcases birds of concern, including Birds of Conservation Concern (BCC), in your project location. This is not a comprehensive list of all birds found in your project area. However, you can help proactively minimize significant impacts to all birds at your project location by implementing the measures in the Nationwide avoidance and minimization measures for birds document, and any other project-specific avoidance and minimization measures suggested at the link Measures for avoiding and minimizing impacts to birds for the birds of concern on your list below.

Ensure Your Migratory Bird List is Accurate and Complete

If your project area is in a poorly surveyed area, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles document, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON

American Oystercatcher Haematopus palliatus — Breeds Apr 15 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8935

Bald Eagle Haliaeetus leucocephalus — Breeds Oct 15 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Black Skimmer Rynchops niger — Breeds May 20 to Sep 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5234

Black-billed Cuckoo Coccyzus erythropthalmus — Breeds May 15 to Oct 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9399

Blue-winged Warbler Vermivora cyanoptera — Breeds May 1 to Jun 30
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Bobolink Dolichonyx oryzivorus — Breeds May 20 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Canada Warbler Cardellina canadensis — Breeds May 20 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Chimney Swift Chaetura pelagica — Breeds Mar 15 to Aug 25
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Eastern Whip-poor-will Antrostomus vociferus — Breeds May 1 to Aug 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Grasshopper Sparrow Ammodramus savannarum perpallidus — Breeds Jun 1 to Aug 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/8329

Hudsonian Godwit Limosa haemastica — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Least Tern Sternula antillarum antillarum — Breeds Apr 25 to Sep 5
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Long-eared Owl asio otus — Breeds Mar 1 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3631

Pectoral Sandpiper Calidris melanotos — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prairie Warbler Setophaga discolor — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Ruddy Turnstone Arenaria interpres morinella — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Rusty Blackbird Euphagus carolinus — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Saltmarsh Sparrow Ammospiza caudacuta — Breeds May 15 to Sep 5
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9719

Scarlet Tanager Piranga olivacea — Breeds May 10 to Aug 10
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Semipalmated Sandpiper Calidris pusilla — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Whimbrel Numenius phaeopus hudsonicus This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5
Wood Thrush Hylocichla mustelina This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

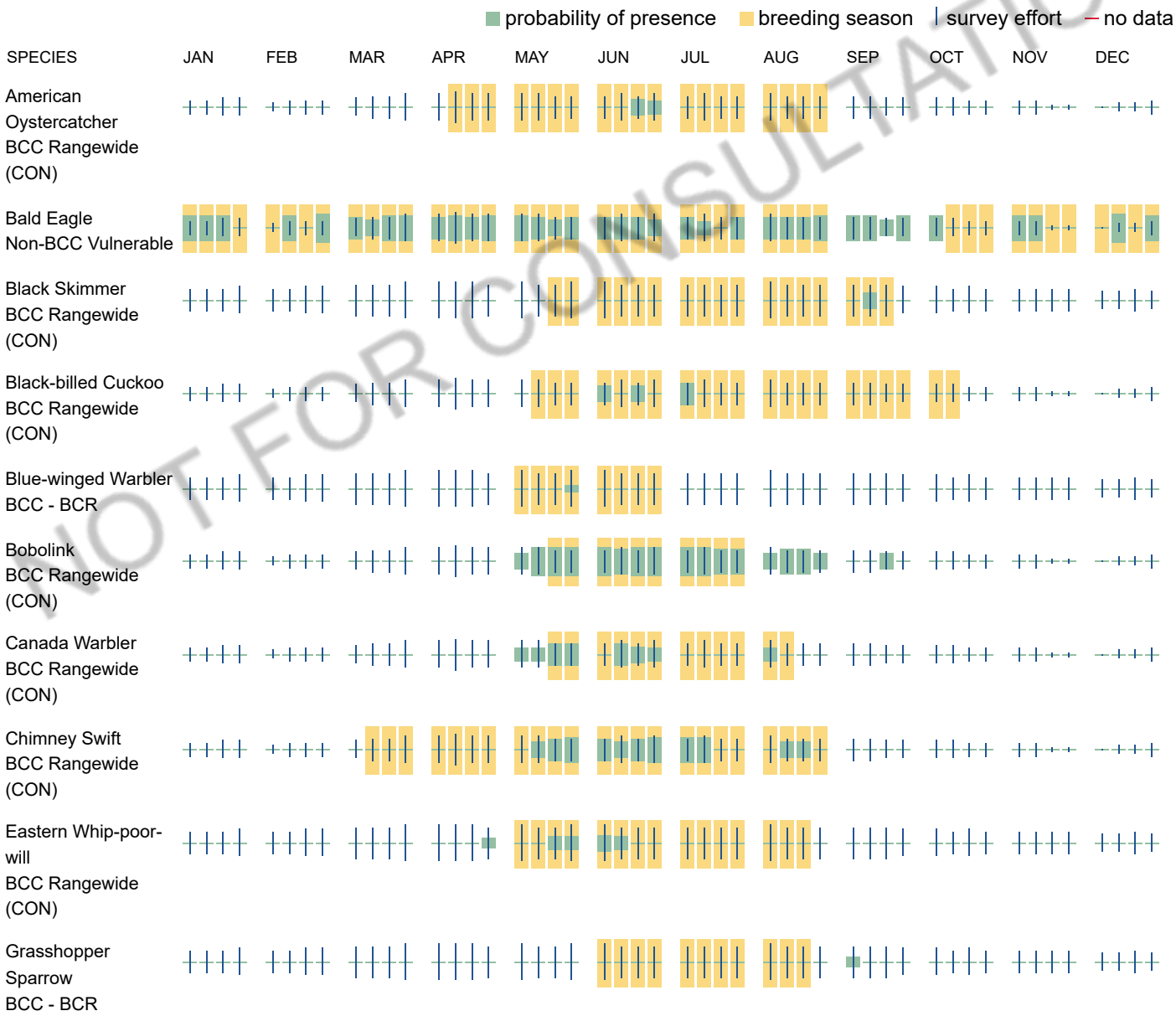
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

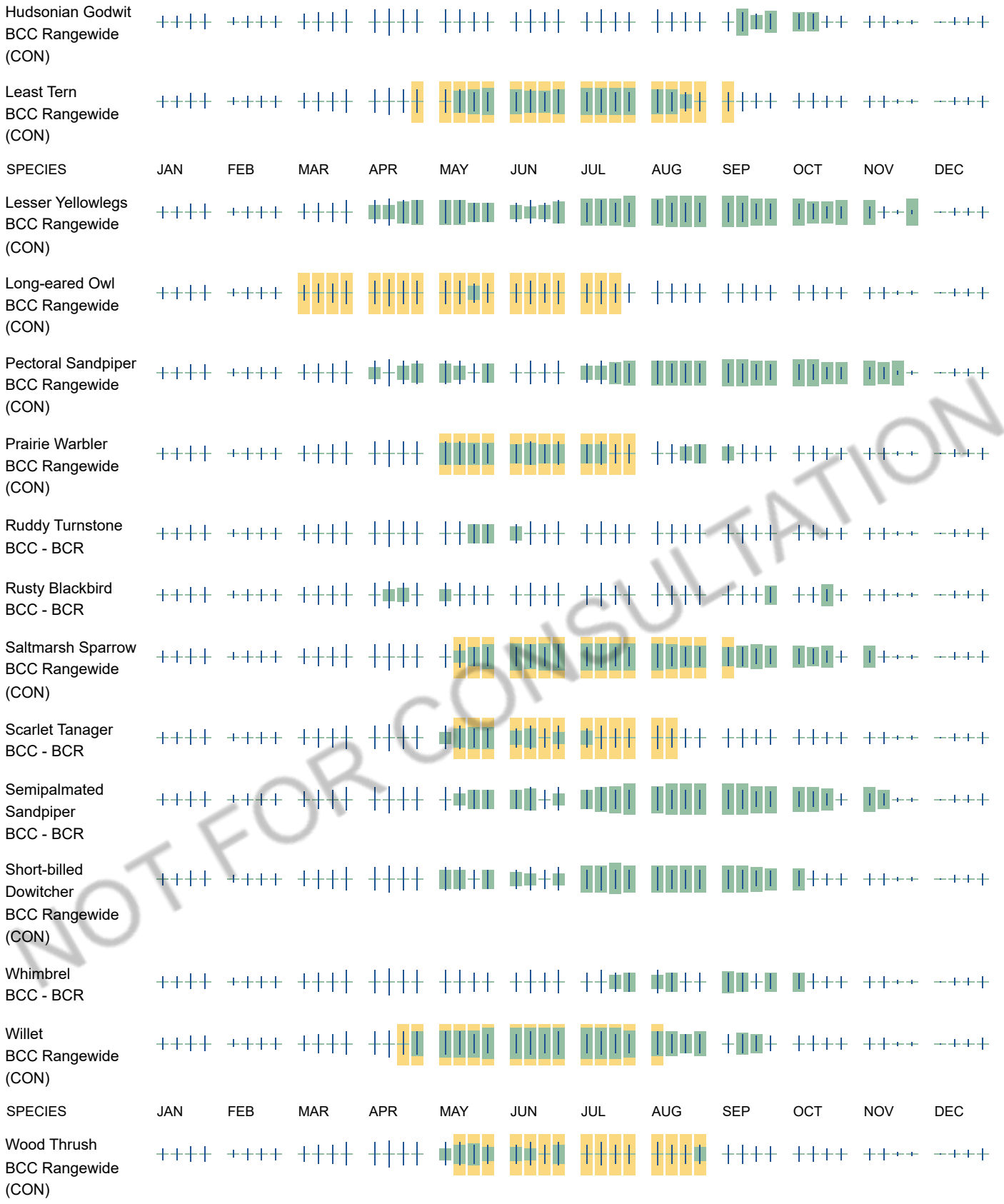
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and

3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ “Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds”.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs
Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE DEEPWATER
- E1UBL
- E1UBLh6
- E1UBLx
- E1UBLx6

E1UBL6

ESTUARINE AND MARINE WETLAND

E2EM1Pd
E2EM1Ph6
E2EM1/5P6

FRESHWATER EMERGENT WETLAND

PEM1/SS1R

FRESHWATER FORESTED/SHRUB WETLAND

PFO1R
PFO1/EM1R
PSS1/EM1Rh
PSS1/EM1R

FRESHWATER POND

PUBVh

RIVERINE

R1UBV
R2UBH

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

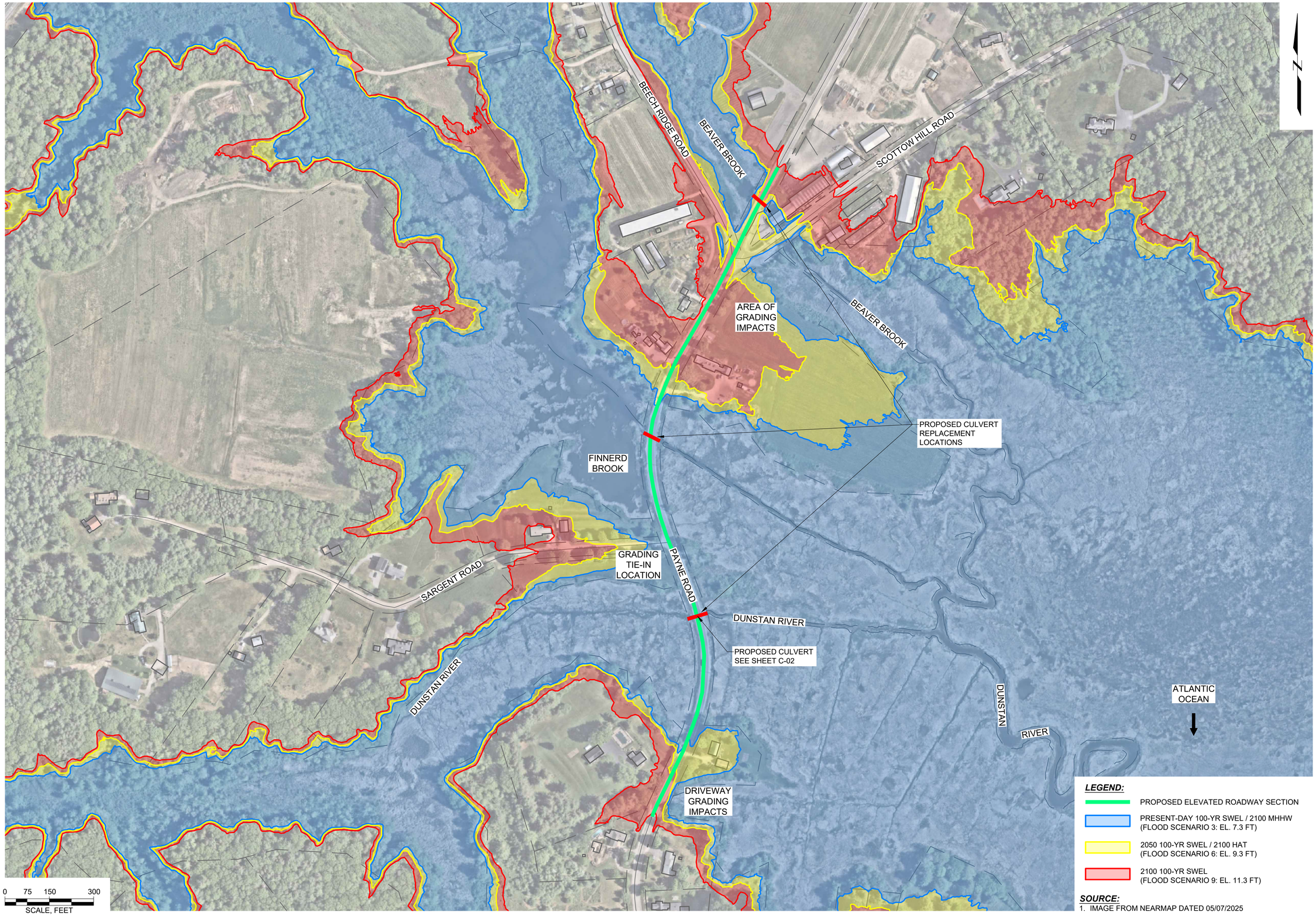
Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix D Project Drawings



GEI Consultants
GEI CONSULTANTS, INC.
5 MILK STREET
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(207)797-8901

TOWN OF SCARBOROUGH

SCARBOROUGH, MAINE

SCARBOROUGH VULNERABILITY ASSESSMENT

SCARBOROUGH, MAINE

CONCEPT PLANS NOT FOR CONSTRUCTION

P.E. No.:	
Approved:	
Checked:	
Drawn:	JLD
Designed:	
GEI Project	2403961

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
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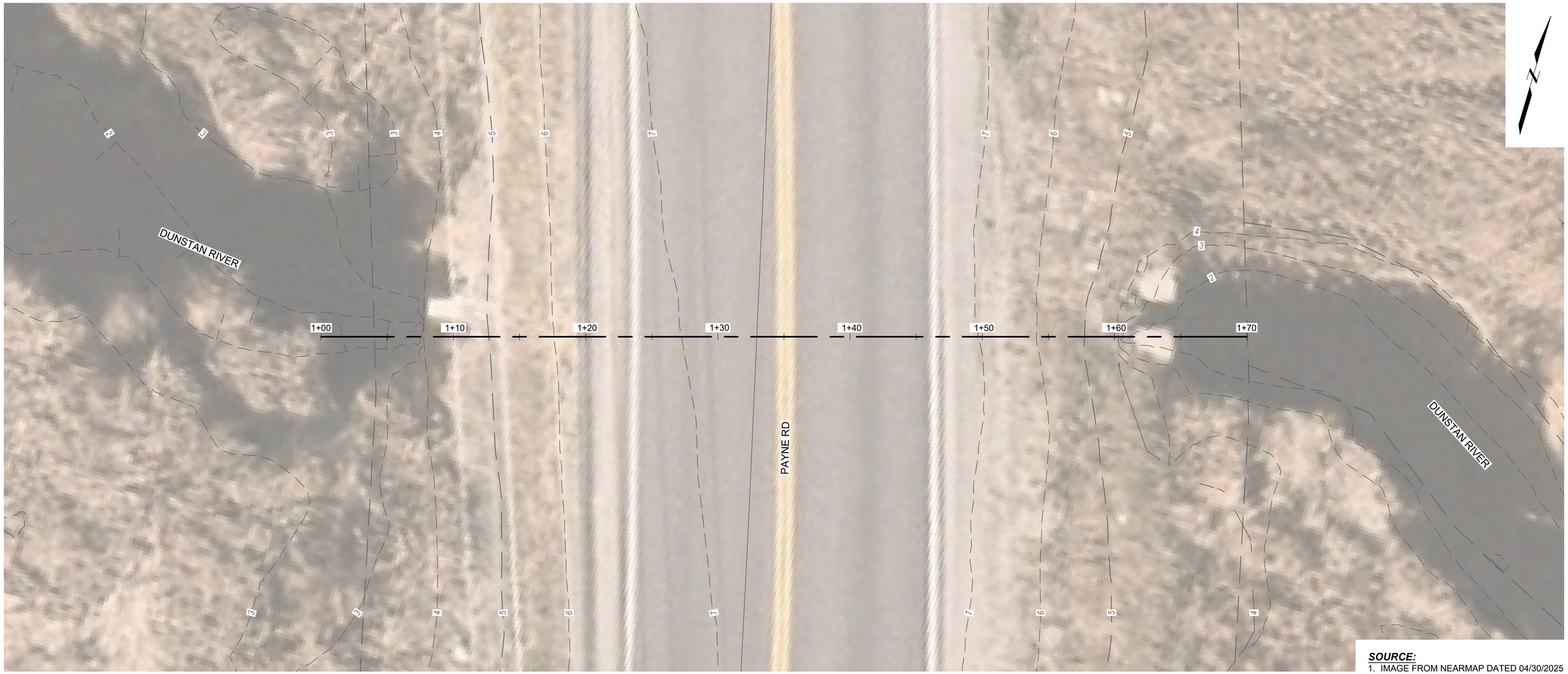
SHEET NAME

PAYNE ROAD ADAPTATION ALTERNATIVES

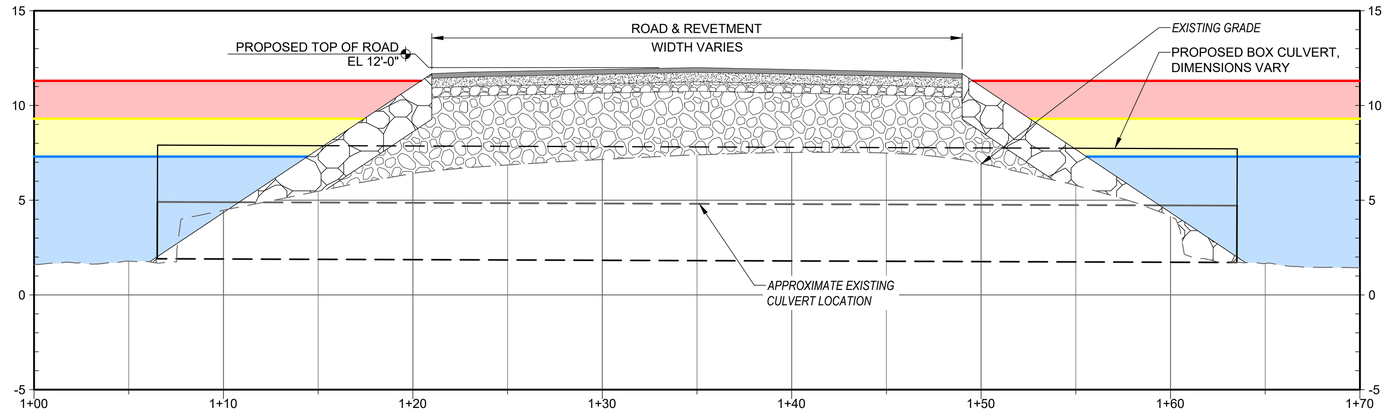
SHEET NO.

C-01



0 2 4 8
SCALE, FEET

PLAN
PROPOSED CULVERT SCALE: 1" = 4'



0 2 4 8
SCALE, FEET

PROFILE
CROSSING PROFILE CONCEPT SCALE: 1" = 4'

SOURCE:
1. IMAGE FROM NEARMAP DATED 04/30/2025

LEGEND:

- PRESENT-DAY 100-YR SWEL / 2100 MHHW (FLOOD SCENARIO 3: EL. 7.3 FT)
- 2050 100-YR SWEL / 2100 HAT (FLOOD SCENARIO 6: EL. 9.3 FT)
- 2100 100-YR SWEL (FLOOD SCENARIO 9: EL. 11.3 FT)

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TOWN OF SCARBOROUGH

SCARBOROUGH, MAINE

SCARBOROUGH VULNERABILITY ASSESSMENT
SCARBOROUGH, MAINE

CONCEPT PLANS NOT FOR CONSTRUCTION

P.E. No.:	
Approved:	
Checked:	
Drawn:	JLD
Designed:	
GEI Project	2403961

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If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
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SHEET NAME

PAYNE ROAD ADAPTATION ALTERNATIVES PLAN AND PROFILE

SHEET NO.

C-02