

**Maine Infrastructure Adaptation Fund and
Municipal Stream Crossing Application**

Section 1: General Information

| | | |
|---|---|--|
| Applicant Name(s): Town of Casco | | |
| Contact Person: Anthony Ward | | |
| Mailing Address: 635 Meadow Road | | |
| City: Casco | State: Maine | Zip: 04015 |
| Daytime Phone No.: 207-627-4515 Ext. 201 | Email: award@cascomaine.org | |
| Has this project received FEMA or Insurance funds? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| <p>NOTE: The following sections of this application request specific project-related information. If warranted, pictures, maps, exhibits, diagrams, survey summaries, etc., should be included with the application. Please be concise. If additional space is required, please attach supplemental sheets.</p> <p>For those applying for Municipal Stream Crossing Program, Section 2, parts A, B, and F have additional information that is required, fill out the lines that say “<u>Additional information needed for MSC</u>”. That information is not applicable for Maine Infrastructure Adaptation Fund.</p> | | |

Section 2: Project Information

A. Project Location

Provide latitude/longitude (decimal degrees), abutting street name(s), and additional project location references. Feel free to attach designs/ diagrams, maps, etc. that will help provide a clear description of the proposed scope and location.

See attached location map. The project is located on Edwards Road adjacent to Davis Brook Road. Latitude/Longitude: 43.992902 N, -70.458570 W

Additional information needed for MSC:

Review MaineDOT public [MapViewer](#) to ensure structure is located on a municipal owned facility (town way) and provide the MaineDOT Bridge Number.

Edwards Road is considered a Townway on the MaineDOT Public Map Viewer. The existing structure does not appear to have a MaineDOT Bridge Number.

B. Project Summary

Describe the proposed crossing replacement/ infrastructure adaptation project including vulnerable assets, asset age and condition, as well as the natural hazards magnified by climate change, potential risk to system, and proposed improvements.

To reduce frequent flooding and road damage at the culvert. The Town of Casco notes that the road has overtopped at least 5 times in the previous 2 years. The existing culverts regularly becomes obstructed by debris, with Town officials being forced to clean out the debris 4 times in the previous 2 years. Hydraulic and hydrologic modeling confirms the reported capacity issues and the modeling shows that the existing crossing is undersized for the flows the culvert receives. The Edwards Brook watershed is 1.78 square miles with peak 100-year flows at Edwards Road of 521 cfs. The stream channel is relatively steep upstream of Edwards Road and then flattens significantly before discharging to Crescent Lake, approximately 1,200 feet downstream of the road.

Additional information needed for MSC:

Please include the following information in your project summary:

Structure type, shape, material, streambed material in structure, number of culverts at crossing, length, width, height, age of structure, and clearance (distance between material at bottom of culvert or streambed and top of inside of culvert).

The existing culvert crossing includes two (2) HDPE round culverts. One culvert is 48” in diameter while the other culvert is 24” in diameter. The crossing length is approximately 50 feet long. The existing structures do not appear to have streambed material in the structure. Exact age of the existing structures is unknown, but it appears they were built before 2010 (date of the Maine Stream Habitat Viewer survey). The clearance is 48”, which matches the diameter of the larger culvert.

If available also include the identification of crossing (Crossing ID#) found in the [Maine Stream Habitat Viewer](#). If not present in stream habitat viewer, provide accurate coordinates (in decimal degrees).

8768

C. Infrastructure Resiliency and Future Climate Conditions

Demonstrate climate change impacts or vulnerability to hazards and provide documentation of historic events.

As mentioned above, the Town has records of Edwards Road overtopping at least 5 times

since 2021. The Town Manager does not have access to documentation prior to 2021, but it likely has overtopped the road before 2021 as well. Approximately 200 feet upstream of this crossing, Edwards Brook crosses under the private Davis Brook Road. This crossing has washed out multiple times, with the residents of Davis Brook Road responsible for repairing the culvert to allow passage on Davis Brook Road.

Describe how the proposed project will reduce the asset's vulnerabilities.

The proposed project will replace the two culvert barrels with a single, larger box culvert, sized to meet 1.2 times the bankful width and the MaineDOT 100 year headwater standard. The 100-year peak flow design flow is 521 cfs based on Streamstats. This will reduce the risk of failure on Edwards Road by allowing stormwater to flow more naturally through the crossing structure.

Provide details on how climate change projections and data have or will be considered and incorporated into the project design. (i.e. How will the crossing be upsized, or facility be raised in elevation.)

The crossing has been upsized based on the 1.2x bankfull width standard and the MaineDOT 100-year headwater standard. The roadway will be raised in elevation by approximately three (3) feet over the new culvert to accommodate the additional structure rise, to improve cover depth above the culvert, and to reduce the risks of more frequent heavy rainstorms overtopping the roadway from climate change.

Additional Resources:

[Maine Geological Survey: Maine's Geological Hazards, Sea Level Rise/Storm Surge](#)
[The Nature Conservancy: Culvert Flood Risk Explorer](#)
[Maine Flood Hazard Map](#)

D. Public Safety and Emergency Management

Describe the risk to public safety associated with vulnerable infrastructure and which groups (business, general public etc.) will benefit from the project.

The risk to public safety arises from heavy rainfall events overtopping the road and making the road impassable. Additional risk arises from stormwater backing up on the inlet side of the culvert and affecting the drainage of the upstream Davis Brook Road culvert, which has washed out entirely multiple times and cuts off access to the dead end Davis Brook Road. Residents living adjacent to the culvert and the general public would benefit from the project because it will reduce the risk of road failure on Edwards Road and Davis Brook Road. Residents of both Casco and Raymond use Edwards Road to

access Route 11, Crescent Lake, and the Town of Casco to the west, and Raymond, Gray, and Interstate 95 to the east. An underground communications conduit is located in Edwards Road over the culvert. This conduit could be damaged during flooding events if the road washes out.

Additional Resources:

[The Nature Conservancy: Resilient Land Mapping Tool](#)

Describe (if applicable) the safety and impact to communities including detour lengths, identifying any critical infrastructure cut-off from access if the vulnerable infrastructure were to fail, number of businesses and home cut-off, average annual daily traffic (AADT) using MaineDOT's Public Viewer.

The detour length would be approximately 10 miles, cutting off a valuable thoroughfare for residents of both Casco and Raymond. Commuters from Casco toward I-95 may have a much longer commute to access the highway. Consolidated Communications could lose a communications conduit if the vulnerable culvert were to fail. If the culvert on Davis Brook Road failed, at least 5 Casco residences would be cut off from Town services, including emergency services. The factored AADT from the MaineDOT's Public Map Viewer is 370.

Additional Resources:

[MaineDOT's MapViewer](#)

Describe (if applicable) how this project will benefit public health.

Increasing the flow capacity of this culvert will reduce flood damage and access limitation. The larger culvert would also reduce the discharge of sediment contamination into Crescent Lake.

Provide documentation and description of flooding or overtopping and any associated damage.

According to the Town, the roadway has been overtopped at least 5 times since 2021, including December 23, 2022, and more recently on May 1, 2023; August 8, 2023; December 8, 2023; and December 28, 2023. The crossing regularly becomes obstructed by debris and requires cleaning/debris removal: this occurred at least three times in 2023 and once in 2022. The upstream culvert on Davis Brook Road has failed several times, requiring the residents of Davis Brook Road to pay for roadway and culvert repairs. In 2017, the Town spent \$411,224 to repair a separate culvert on Edwards Road in a similar watershed.

Each of these storms has similar causes and effects: the lack of capacity of the culverts contribute to flooding in the area north of the roadway (between Edwards Road and Davis Brook Road). No damage has occurred to Edwards Road, yet, but Davis Brook Road is repeatedly washed out by flooding.

See photos of flooding in Attachment #2. The Town also has video footage of high-water events at this crossing.

Additional Resources:

[Culvert Flood Risk Explorer | Maine \(tnc.org\)](https://www.tnc.org/)

Describe whether a new design will eliminate or greatly reduce current maintenance costs.

The new design, adhering to StreamSmart guidance and the MaineDOT 100-year headwater criteria, will greatly reduce maintenance costs of clearing debris at the undersized existing culverts. Backed up water on the inlet side should be able to flow more freely and reduce concerns of culvert failure on Davis Brook Road. The new design may not eliminate future flooding but it should greatly reduce maintenance costs and the frequency of road closures.

Amount of money spent on maintenance or failures of the vulnerable infrastructure and description and documentation of maintenance history or recent damage, if applicable.

No funds have been expended at this crossing, aside from staff costs for time spent on maintenance at this crossing.

E. Community, Economic, and Environmental Benefits

Describe how this project directly improves physical, social, and economic development within the community. (i.e. How would this project support the goals of a town's comprehensive plan or improve the overall function of the community?)

This project is located close to Crescent Lake, an important resource for Casco, Raymond, and the surrounding community. The Casco Town Beach on Crescent Lake is located less than half a mile away from this crossing, and several summer camps, campgrounds, and private residences utilize Crescent Lake. Failure of the crossing could result in sedimentation of Crescent Lake, affecting water quality for this important resource. The Nonpoint Source (NPS) Watershed Projects identified Crescent Lake as a Priority Watershed, Most at Risk. The Crescent Lake Watershed Association, formed in 2009, has leveraged Maine DEP, the Towns of Raymond and Casco, adjacent summer camps, and environmental consultants to complete two separate projects to improve the watershed and water quality of Crescent Lake. The first watershed project, completed between 2011 and 2013, noted that the Town of Casco has assisted in improving the Crescent Lake Watershed by replacing undersized culverts on Edwards Road with concrete box culverts, improving public safety,

fish passage, and water quality. The Crescent Lake Watershed Association notes that the direct watershed covers 6.1 square miles, with Crescent Lake ultimately flowing to Sebago Lake, a public water source for over 45,000 households in Maine. This culvert project aligns with the goals of the Crescent Lake Watershed Association in reducing sediment and pollutant (phosphorus) loading to Crescent Lake.

The roadway is one of three roads that connect the Towns of Raymond and Casco. The loss of this roadway would force the residents of Raymond to drastically alter their transportation routes with a detour of approximately 10 miles. The repairs of this culvert would additionally positively affect the residents of Davis Brook Road and minimize the continued flooding of their private roadway.

Describe how the project will improve community resilience at, adjacent to, and beyond the project site, and how outcomes will benefit the public.

This project will improve resilience of the road for Casco and Raymond residents. With the adjacency to Crescent Lake, the project should improve water quality and fish passage for Edwards Brook and Crescent Lake. Improvement to Crescent Lake benefits all users of the lake and also benefits the water quality of Panther Pond and Sebago Lake, which ultimately receive the waters of Crescent Lake. According to the Crescent Lake Watershed Association, the lake is developed with over 290 seasonal and year-round homes, a commercial campground, several private youth camps, two public beaches, one formal boat access and an extensive network of private unpaved camp roads. Each of these groups should benefit from the project by improving the resiliency of Edwards Road and Davis Brook Road, while improving the water quality of the important Crescent Lake.

Describe the presence of environmental resources nearby such as significant wildlife habitats, vernal pools, endangered species presence, etc.

See attached for a wetland delineation report and for the endangered species list from the United States Department of the Interior. The wetland delineation report identified and mapped seven (7) wetlands within the survey area adjacent to the Edwards Road culvert. Each wetland was identified preliminarily as Wetlands of Special Significance, because of their presence of being within 25 feet of a stream. One potential vernal pool was identified within the survey area adjacent to Davis Brook Road, however, a determination of significance could not be made without further consultation with the Maine Department of Inland Fish and Wildlife. The endangered species list did not identify any critical habitats within the project area. As described previously, the culvert crossing is located just upstream of the Edwards Brook outlet into Crescent Lake, with water quality of Edwards Brook directly affecting the water quality of Crescent Lake.

Additional Resources:

[BwH Map Viewer](#)

[Maine Stream Habitat Viewer](#)

F. Project Scoping and Design

Describe whether the project is scoping and design, or implementation/construction.

The project will be for implementation and construction. The Town of Casco has already hired a consultant to complete design plans and permitting through the United States Army Corps of Engineers.

Note: Municipal Stream Crossing projects must result in completed construction.

Provide a bulleted list of proposed specific improvements organized by task, including work to be completed, methodology, deliverables, and project team members.

Work completed by the awarded Contractor will include:

- **Mobilization**
- **Implementation of Traffic Control Plan**
- **Implementation of Erosion and Sedimentation Control Plan**
- **Clearing of brush and debris**
- **Trench excavation of Edwards Road**
- **Implementation of Dewatering Plan and Stream Bypass Plan**
- **Removal of the existing culverts.**
- **Subgrade preparation for new box culvert.**
- **Installation of New Box culvert.**
- **Backfill of excavation areas.**
- **Re-grading of embankments.**
- **Site restoration, including proposed grading, installation of riprap, and Edwards Road restoration.**
- **Installation of new guardrail.**

Describe (if applicable) design efforts that have been completed to date on the proposed project and attach any completed design information, and proposed schedule for design or implementation completion.

- All projects must at least provide an estimated construction start and end date.
- Commitment that applicant has or will obtain necessary Army Corps of Engineers and Maine DEP Natural Resources Protection Act permits for this project.
- Photos of the project area that demonstrate facility condition. For stream crossings, photos should be provided looking at the crossing from downstream and upstream, inside of the structure, and any safety conditions.

See attached for the following:

- Plan over Profile drawing for Edwards Road
- Opinion of probable construction cost.
- Project Site Photos

It is our understanding that the project would be exempt from Maine DEP permitting per the Maine DEP NRPA 38 MRSA Section 480-Q.2-D (Existing Crossings). However, if DEP does require permitting, the applicant commits to obtaining the necessary permits.

The proposed schedule for design completion depends on if grant funding is awarded. The plans are currently almost complete, pending review of the plans and permit application by the United States Army Corps of Engineers. The consultant is prepared to finalize the design plans after review of the plans and permit application by United States Army Corps of Engineers.

Additional information needed for MSC:

Please include the following information in your project scoping and design:

Stream Measurements and field work (measured bankfull width, estimated/modelled bankfull width, preliminary crossing width. If fieldwork has not been completed, provide date when it will be completed. For fieldwork techniques, refer to [Stream Smart Field Work Video](#) and [Maine Stream Smart Road Crossing Pocket Guide](#).

See attached for bankfull width measurements taken in the field.

Bankfull width estimates and modelling resources: [Maine Stream Habitat Viewer](#) Any crossing projects must meet [MaineDOT's 100-year flood standard](#) and will be sized to be 1.2 times bankfull width.

As noted in the above, see attached for bankfull width measurements taken in the field. Additionally, see attached for a hydraulic capacity check from MaineDOT. The design will adhere to both the 1.2 times bankfull width standard and the MaineDOT's 100-year flood standard.

An engineer has or will be retained to assist with project design, note whether existing plans for project are available, final plans must be stamped by Maine Licensed Engineer prior to construction.

Gorrill Palmer – An LJB Engineering Company has been retained to assist with project design. The current plan and profile of the design is attached. Final plans will be stamped by a Professional Engineer licensed in the State of Maine.

Commit that structure design will be shared with and reviewed by MaineDOT's bridge maintenance office during the design process for any structure spans proposed greater than 10FT. This is to provide any additional advice that should be considered during design. Maine DOT's Bridge Maintenance Division (ben.foster@maine.gov or ron.taylor@maine.gov) will be assessing those projects. For more information, refer to [MaineDOT's Bridge Design Guide](#) and [MaineDOT's Policies and Laws related to Bridges in Maine](#).

The structure design will be shared with and reviewed by Maine DOT's Bridge Maintenance Office for the proposed 12' span structure.

Additional resources:

[StreamStats](#)

G. Schedule:

Provide detailed timeline of project tasks with anticipated completion dates for the project, including deliverables, likelihood of project success based on support of landowners and public, funding feasibility, technical, financial, and management capacity, and regulatory hurdles.

The project design will be finalized this summer, 2024. The implementation of construction hinges on the allocation of funding from this grant program. If grant funding for this project is allocated, we anticipate the construction would begin in July 2025. A new source of funding would need to be identified to construct this project if grant funding is not allocated. The Town is committed to replacing this culvert because of the ongoing flooding issues and public safety concerns.

We are confident in the likelihood of project success, with adjacent landowners supporting the project. Gorrill Palmer has designed and permitted several culvert crossings similar to this project; we do not anticipate regulatory hurdles with this project.

Provide all applicable public meeting dates including Town Council or Select Board meeting for the project, for the budgetary approvals of funding, and local match.

The Town of Casco Selectboard has met regarding this project at least three (3) times, on the following dates: May 16, 2023; January 9, 2024; and February 6, 2024.

According to the Town Manager, the Town will fund 100% of the project if over \$200,000. If the project is under \$200,000, the Town proposes a \$25,000 funding match.

Provide any public engagement activities that have occurred to date.

The Town Manager has conducted public outreach regarding this culvert on the following

dates: **May 2, 2023; June 1, 2023; August 8, 2023; December 28, 2023; January 5, 2024; March 1, 2024; and March 12, 2024.**

H. Budget:

Provide detailed budget by completing table below.

| | | |
|--|--|-------------------|
| Estimated Cost of Infrastructure Project | Preliminary or Final Design, Engineering, and Environmental Permitting | \$ 34,510 |
| | Construction | \$ 405,200 |
| | Construction Engineering and Oversight (CE) | \$ 8,500 |
| | Total Value of Project (add lines 1 through 3) | \$ 448,210 |
| Sources of Funds | Funds from FEMA or Insurance | \$ 0 |
| | Total Cash or In-kind Contributions ¹ | ≥ \$25,000 |
| | Total funds leveraged ² from other sources | \$ 0 |
| | Funds Requested from MaineDOT ³ | \$ 200,000 |

- ¹ Local Match Contributions:
- Local match cash is those funds that are raised and or appropriated by the town.
 - For Maine Infrastructure Application Fund projects, a minimum match of 5% of total project cost is required.
 - For Municipal Stream Crossing projects, a minimum \$5,000 match is required.
- ² Ability to leverage other funds: The benefit to the community is such that other funding sources are being garnered in support of this project. Projects not covered by Federal Emergency Management Agency (FEMA) disaster funds, and that demonstrate that damage is not covered by insurance, where all emergency relief available has been exhausted, will be prioritized.
- ³ Funds available to be requested from DOT:
- For Maine Infrastructure Application Fund projects, applicants may request up to \$75,000 to support scoping and design, and \$4,000,000 to support match for construction or for direct construction costs.
 - For Municipal Stream Crossing projects, applicants may request up to \$200,000.

Please detail the source of local match.

The source of the local match comes from the Town of Casco's Capital Improvement funding.

Attachments:

- Attachment 1
 - o Location Map
- Attachment 2
 - o Project Site Photos
- Attachment 3
 - o Bankfull Width Measurements (taken in the field)
- Attachment 4
 - o Wetland Report and Delineation
- Attachment 5
 - o IPAC Official Species List – U.S. Department of the Interior
- Attachment 6
 - o Plan and Profile Drawing – Edwards Road Culvert Replacement
- Attachment 7
 - o Opinion of Probable Construction Cost
- Attachment 8
 - o Hydraulic Capacity Check – MaineDOT 100-Year Flood Standard

Attachment 1



Location Map
Edwards Road - Casco, Maine

| | |
|---------------------------------|--------------------|
| Design: XXX | Date: January 2024 |
| Draft: GJH | Job No.: 3769.08 |
| Checked: WCH | Scale: None |
| File Name: 3769.08-LOCATION.dwg | |



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Figure

1

Attachment 2

Existing Conditions Photographs
Edwards Road Culvert, Casco, Maine



Inlet – 18" and 48" HDPE Culverts (taken May 4, 2023)



Inlet – Looking Upstream (taken May 4, 2023)



Outlet – 18” and 48” HDPE Culverts (taken May 4, 2023)



Outlet – Looking Downstream (taken May 4, 2023)

Flooding Photographs
Edwards Road Culvert, Casco, Maine



High Water – Looking at Culvert Inlet from Davis Brook Road (taken December 11, 2023)



High Water – Looking at Culvert Inlet from Davis Brook Road (taken December 2023)



High Water – Looking at Culvert Inlet from Davis Brook Road (taken December 2023)



High Water – Looking at Culvert Inlet from Edwards Road (taken December 2023)

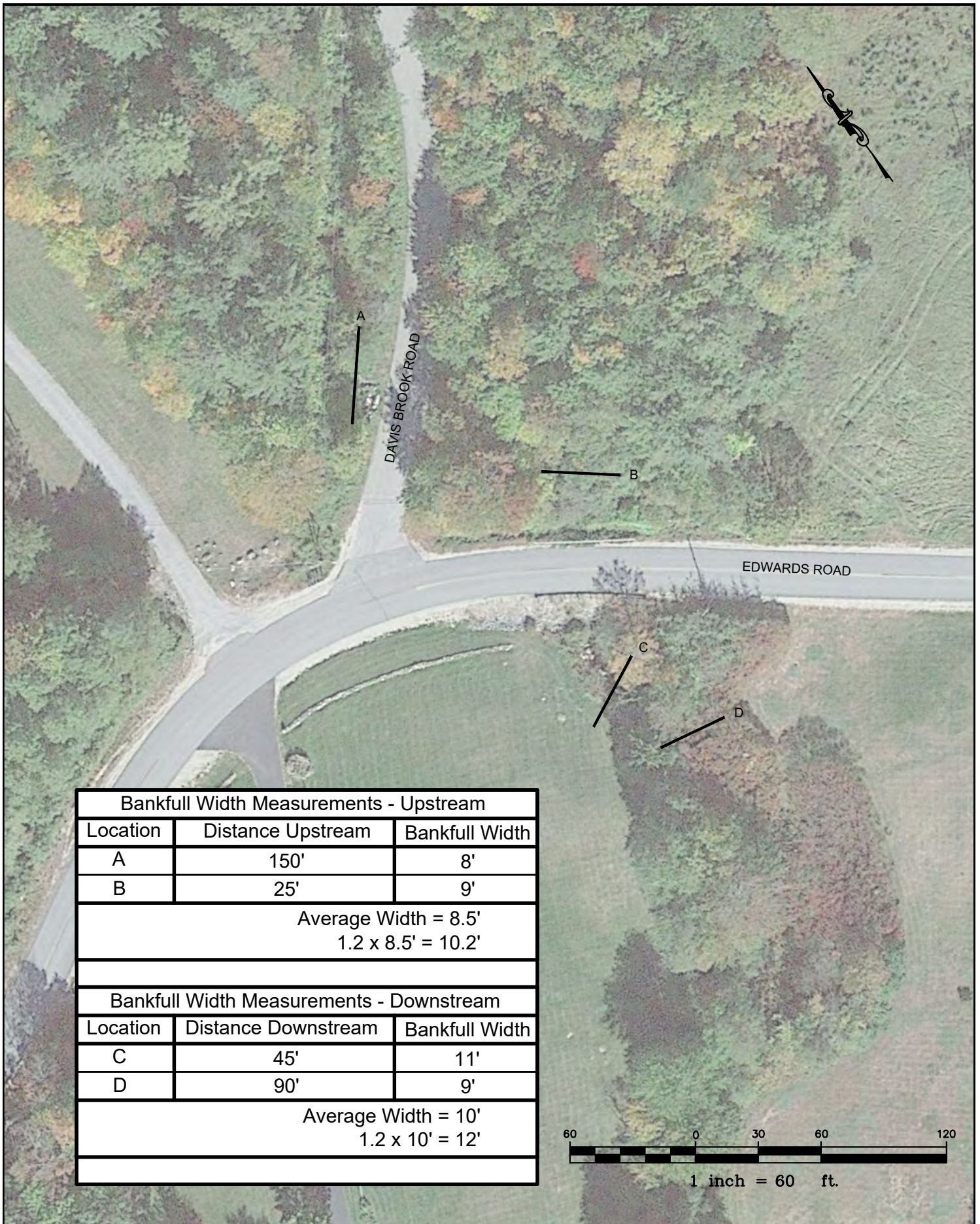


High Water - Looking at Culvert Inlet and Toward Davis Brook Road (taken December 2023)

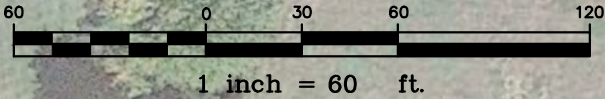


High Water – Looking at Culvert Outlet from Edwards Road (taken December 2023)

Attachment 3



| Bankfull Width Measurements - Upstream | | |
|--|---------------------|----------------|
| Location | Distance Upstream | Bankfull Width |
| A | 150' | 8' |
| B | 25' | 9' |
| Average Width = 8.5' 1.2 x 8.5' = 10.2' | | |
| Bankfull Width Measurements - Downstream | | |
| Location | Distance Downstream | Bankfull Width |
| C | 45' | 11' |
| D | 90' | 9' |
| Average Width = 10' 1.2 x 10' = 12' | | |



| | |
|---------------------------------|---------------------|
| Design: XXX | Date: November 2023 |
| Draft: GJH | Job No.: 3769.08 |
| Checked: WCH | Scale: None |
| File Name: 3769.08-LOCATION.dwg | |



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Figure

Attachment 4

Memorandum of Findings

Date: January 23, 2024

To: Will Haskell, PE (Gorrill Palmer)

From: Rue Thurrell (Flycatcher LLC)

Cc: Rich Jordan (Flycatcher)

Subject: Edwards Brook – Natural Resource Survey Results: Casco, Maine

On December 22, 2023, Flycatcher completed a wetland, waterbody, and potential vernal pool survey on approximately 1.2-acres, at the intersection of Edwards Brook and Edwards Road, in Casco, Maine (the Survey Area). The Survey Area location is shown on Figure 1 – USGS Location Map, and natural resource survey results are shown on Figure 2 – Natural Resources Map, in Attachment 1. Summary wetland and stream data is provided in Attachment 2. Photographs of representative mapped wetlands, potential vernal pools, and streams are presented in Attachment 3.

Methods

Wetlands

Wetland delineations were conducted in accordance with the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual¹ and the Northcentral and Northeast Regional Supplement (Version 2.0).² The manual and supplement provide a repeatable methodology to identify wetland areas and are the accepted wetland delineation methodology of the Maine Department of Environmental Protection (MDEP) and the USACE.

The Survey Area was investigated by a wetland scientist via a meander survey. When a location was observed to have the requisite three factors that constitute a wetland (i.e., hydrophytic vegetation, indicators of hydrology, and the presence of hydric soils) the boundaries were marked with pink survey flagging labelled with the words “Wetland Delineation,” numbered in sequential order, and collected via GPS.

Waterbodies

The boundary of a waterbody is identified by an “Ordinary High-Water Mark”, as defined by the USACE as “that line on the shore established by the fluctuations of water and indicated by physical characteristics such as: 1) a clear, natural line impressed on the bank; 2) shelving; 3) changes in the character of soils; 4) destruction of terrestrial vegetation; or 5) the presence of litter and debris. If a waterbody meeting the above definition was observed, blue survey flagging was hung, and GPS data collected, along the top of the bank.

¹ Environmental Laboratory. (1987). *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, U.S. Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS.

² USACE (2011). *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast region (Version 2.0)*, ed. J.S. Wakely, R.W. Lichvar and C.V. Noble, and J.F. Berkowitz. ERDC/EL TR-08-27. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Streams

Stream identification followed the Natural Resources Protection Act (NRPA) definition of a “river, stream or brook” (38 M.R.S. §. 480-B9). If a stream meeting the above definition was observed, blue survey flagging was hung, and GPS data collected, along the centerline for streams less than six feet in width, or along the top of the bank for streams six feet or wider.

Potential Vernal Pool Survey

Since the on-site mapping was conducted outside the vernal pool breeding season, the Maine Association of Wetland Scientists (MAWS) Vernal Pool Technical Committee Vernal Pool Survey Protocol for performing non-breeding season potential vernal pool (PVP) surveys was followed (April 2014)³. If a PVP was observed, the center point was collected by GPS.

GPS Location

Features (e.g., wetlands and streams) mapped during the survey were geolocated using a mapping grade global positioning system (“GPS”) unit (Juniper Systems’ Geode GPS Antenna and ESRI’s ArcGIS Collector software). The data are collected using real-time correction and standards specified by the manufacturer to achieve sub-meter accuracy.

Results

Survey Area Description

The Survey Area is located at the intersection of Edwards Road, Edwards Brook, and Davis Brook Road, in Casco, Maine. The Survey Area is located 0.15 miles north of Crescent Lake. Topography is generally higher along the Edwards Road and Davis Brook Road fill extensions, and slopes down to areas containing streams and wetlands within the Survey Area. The surrounding land use is a mix of residential and undeveloped forested areas.

Wetlands

Seven wetlands were mapped within the Survey Area. Summary descriptions of wetlands including cover type⁴, vegetation, hydrology, hydric soil indicators, and preliminary WoSS determinations, are provided in Table 1, below. The location of wetlands mapped within the Survey Area are depicted on Figure 2, in Attachment 1.

Waterbodies

No waterbodies were identified within the Survey Area.

Streams

Two streams were mapped within the Survey Area. Summary descriptions are provided in Table 2, below. The location of each stream is depicted on Figure 2, in Attachment 1.

Potential Vernal Pools

One potential vernal pool (PVP) was identified within the Survey Area. Davis Brook Road created an area of ponded water which has the potential to be a vernal pool. As the origin of the pool appears to be human made, it is unlikely

³ MAWS (2014). *Vernal Pool Technical Committee Vernal Pool Survey Protocol*. Section 3.4.4. April 2014.

⁴ Wetland classifications per USFWS’ Cowardin et al. 1979 (<https://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf>).

that this pool would be determined to be significant, however a determination of significance cannot be made without further consultation with the Maine Department of Inland Fish and Wildlife. The PVP is approximately ten by seven feet and was six inches deep at the time of this delineation. The PVP is located in wetland W-MFT-7. The location of the potential vernal pool is depicted on Figure 2, in Attachment 1.

Thank you for the opportunity to assist you with natural resource surveys for this project. If you have any questions regarding the results provided in this report, please do not hesitate to contact me or Rich Jordan (rich@flycatcherllc.com).

Respectfully submitted,

Rue Thurrell

Rue Thurrell, Biologist and Environmental Scientist
Flycatcher LLC

Attachment (3)

ATTACHMENT 1



Figure 1. USGS Location Map
Figure 2. Natural Resources Map



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.



PROJECT: **GORRILL PALMER
EDWARDS BROOK
CASCO, CUMBERLAND COUNTY, MAINE**

LEGEND:
 SURVEY AREA
 USGS 7.5-MINUTE QUADRANGLE BOUNDARY

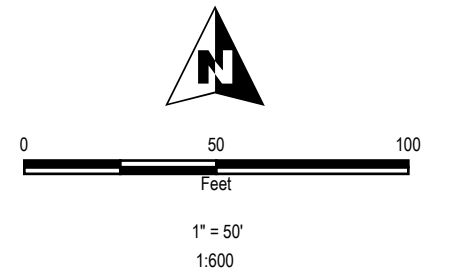
DRAWN BY: G. BOZEK
 CHECKED BY: R. THURRELL
 MONTH: JANUARY
 YEAR: 2024
 PROJ. NO.: 20F-032
 CLIENT: GORRILL PALMER

FIGURE 1 - USGS LOCATION MAP

Coordinate System: NAD 1983 StatePlane Maine West FIPS 1802 Feet



- LEGEND**
- SURVEY AREA
 - DELINEATED PERENNIAL STREAM BANK
 - DELINEATED WETLAND BOUNDARY
 - UPLAND DRAINAGE
 - DELINEATED PERENNIAL STREAM
 - DELINEATED WETLAND
 - CULVERT
 - POTENTIAL VERNAL POOL



PROJECT: **GORRILL PALMER
EDWARDS BROOK
CASCO, CUMBERLAND COUNTY, MAINE**

TITLE: **NATURAL RESOURCES MAP**

| | | | |
|-------------|-------------|-----------------|---------|
| DRAWN BY: | G. BOZEK | PROJ NO.: | 20F-032 |
| CHECKED BY: | R. THURRELL | FIGURE 2 | |
| MONTH: | JANUARY | | |
| YEAR: | 2024 | | |

| | |
|-----------|---------------------------|
| | |
| FILE NO.: | 20F-032_EDWARDS_BRK_CASCO |

ATTACHMENT 2

Delineated Natural Resource Summary Tables

Table 1. Wetland Summary

| Resource ID | Dominant Covertypes ¹ | Hydrology Indicators | Dominant Vegetation | Hydric Soil Indicators | WoSS ² | Description |
|-------------|----------------------------------|--|---|----------------------------------|---|--|
| W-MFT-1 | PSS | A3. Saturation, B9. Water-stained leaves, B2. Sediment Deposits, B3. Drift Deposits, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Speckled alder (<i>Alnus incana</i>), common winterberry (<i>Ilex verticillata</i>), red osier dogwood (<i>Cornus sericea</i>), broad-leaf meadowsweet (<i>Spiraea latifolia</i>), reed canary grass (<i>Phalaris arundinacea</i>), sensitive fern (<i>Onoclea sensibilis</i>), bristly dewberry (<i>Rubus hispids</i>) | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian wetland to S-MFT-1. Located south of Edwards Road. |
| W-MFT-2 | PFO/PSS | A3. Saturation, B9. Water-stained leaves, B2. Sediment Deposits, B3. Drift Deposits, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple (<i>Acer rubrum</i>), green ash (<i>Fraxinus pennsylvanica</i>), speckled alder, common winterberry, Morrow's honeysuckle (<i>Lonicera morrowii</i>), sensitive fern | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian wetland to S-MFT-1. Located south of Edwards Road. Continues out of the Survey Area to the south. |
| W-MFT-3 | PFO | A2. High water table, A3. Saturation, B2. Sediment Deposits, B3. Drift Deposits, B9. Water-stained leaves, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple, green ash, American elm (<i>Ulmus americana</i>), black ash (<i>Fraxinus nigra</i>), speckled alder, Morrow's honeysuckle, sensitive fern | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian floodplain wetland to S-MFT-1 and S-MFT-2. Located north of Edwards Road. Continues out of the Survey Area to the north. |
| W-MFT-4 | PFO | A2. High water table, A3. Saturation, B9. Water-stained leaves, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple, green ash, American elm, speckled alder, Morrow's honeysuckle, sensitive fern | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian floodplain wetland to S-MFT-1 and S-MFT-2. Located east of Davis Brook Road. Continues out of the Survey Area to the north. |

| Resource ID | Dominant Covertypes ¹ | Hydrology Indicators | Dominant Vegetation | Hydric Soil Indicators | WoSS ² | Description |
|-------------|----------------------------------|---|--|----------------------------------|---|---|
| W-MFT-5 | PFO | A2. High water table, A3. Saturation, B9. Water-stained leaves, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple, green ash, American elm, speckled alder, common winterberry Morrow's honeysuckle, sensitive fern | F6. Redox Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian wetland to S-MFT-1. Located northeast of the intersection of Davis Brook Road and Edwards Road. |
| W-MFT-6 | PFO/PSS | A2. High water table, A3. Saturation, B9. Water-stained leaves, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple, American elm, black ash, speckled alder, Morrow's honeysuckle, sensitive fern | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian wetland to S-MFT-1. Located northwest of the intersection of Davis Brook Road and Edwards Road. |
| W-MFT-7 | PFO | A2. High water table, A3. Saturation, B9. Water-stained leaves, B10. Drainage patterns, C4. Presence of reduced iron, D2. Geomorphic position, D5. FAC-neutral test | Red maple, green ash, speckled alder, white pine (<i>Pinus strobus</i>), eastern hemlock (<i>Tsuga canadensis</i>), Morrow's honeysuckle, sensitive fern | A11. Depleted Below Dark Surface | Yes, Portions within 25 ft of a stream. | Riparian wetland to S-MFT-1. Located west of Davis Brook Road. Continues out of the Survey Area to the north. |

1. Wetland classifications per USFWS' Cowardin et al. 1979 (<https://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf>).

2. WoSS determinations per MDEP. Natural Resources Protection Act. Chapter 310. Wetlands and Waterbodies Protection Rules. Section 4. A. Wetlands of Special Significance.

Table 2. Stream Summary

| <i>Resource ID</i> | <i>Flow Regime</i> | <i>Flow Direction</i> | <i>Dominant Substrates</i> | <i>Approximate Width (ft)</i> | <i>Approximate Water Depth (in)</i> | <i>Associated Resources</i> | <i>Description</i> |
|--------------------|--------------------|-----------------------|-----------------------------|-------------------------------|-------------------------------------|--|---|
| S-MFT-1 | Perennial | South | Boulder, rock, gravel, sand | 7 - 30 | 8 - 26 | S-MFT-2, W-MFT-1, 2, 3, 4, 5, 6, and 7 | Perennial Edwards Brook, a tributary to Crescent Lake. Enters the Survey Area from the northwest, travels through the Survey area and through culverts under Davis Brook and Edwards Roads and continues out of the Survey Area to the south. |
| S-MFT-2 | Perennial | South | Rock, gravel, sand | 9 - 14 | 8 - 12 | S-MFT-1, W-MFT-3, W-MFT-4 | Intermittent stream enters the Survey Area in the northeast and joins S-MFT-1. Located in northeast part of the Survey Area. |

ATTACHMENT 3

Representative Photographs

161–165 Edwards Rd Casco ME

☉ 120°SE (T) ● 43°59'34"N, 70°27'31"W ±32ft ▲ 322ft



Edwards Road where it crosses Edwards Brook.

161–165 Edwards Rd Casco ME

☉ 168°S (T) ● 43°59'34"N, 70°27'31"W ±32ft ▲ 309ft



View of wetland W-MFT-1 from Edwards Road.

145 Edwards Rd Casco ME

☉ 16°N (T) ☉ 43°59'33"N, 70°27'31"W ±32ft ▲ 308ft



WMFT1 and SMFT1

Wetland W-MFT-1 and stream S-MFT-1, Edwards Brook, south of Edwards Drive.

161 Edwards Rd Casco ME

☉ 262°W (T) ☉ 43°59'33"N, 70°27'30"W ±32ft ▲ 307ft



WMFT2 and SMFT1

Wetland W-MFT-2 and stream S-MFT-1, Edwards Brook, south of Edwards Road.



Wetlands W-MFT-3 (right) and W-MFT-4 (left) and stream S-MFT-2, north of Edwards Road.



Stream S-MFT-1 and wetlands W-MFT-4 (right) and W-MFT-5 (left), east of Davis Brook Road.



S-MFT-1 (right), S-MFT-2 (center), W-MFT-3 (left), W-MFT-4 (right) and W-MFT-5 (center back).



Same resources as above with more perspective.

2-198 Davis Brook Rd Casco ME

☉ 107°E (T) ☉ 43°59'35"N, 70°27'31"W ±16ft ▲ 318ft



WMFT5 and SMFT1

Edward's Road
22 Dec 2023, 12:59:08

Wetland W-MFT-5 and stream S-MFT-1, east of Davis Brook Road.

2-198 Davis Brook Rd Casco ME

☉ 347°N (T) ☉ 43°59'35"N, 70°27'31"W ±9ft ▲ 280ft



SMFT1

Edward's Road
22 Dec 2023, 13:41:33

Stream S-MFT-1, Edwards Brook, where it goes under Davis Brook Road.



Wetland W-MFT-6 (right), W-MFT-7 (left), and stream S-MFT-1, west of Davis Brook Road.



Wetland W-MFT-6 west of Davis Brook Road.



Wetland W-MFT-7 and potential vernal pool PVP-MFT-1, west of Davis Brook Road.



Wetland W-MFT-7 west of Davis Brook Road.



Culvert repair where Edwards Brook crosses Davis Brook Road.

Attachment 5



United States Department of the Interior



FISH AND WILDLIFE SERVICE
Maine Ecological Services Field Office
P. O. Box A
East Orland, ME 04431
Phone: (207) 469-7300 Fax: (207) 902-1588

In Reply Refer To:
Project Code: 2024-0040648
Project Name: Edwards Road Culvert Replacement

January 25, 2024

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: <https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf>

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see [Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service \(fws.gov\)](#).

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see <https://www.fws.gov/library/collections/threats-birds>.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit <https://www.fws.gov/partner/council-conservation-migratory-birds>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Maine Ecological Services Field Office

P. O. Box A

East Orland, ME 04431

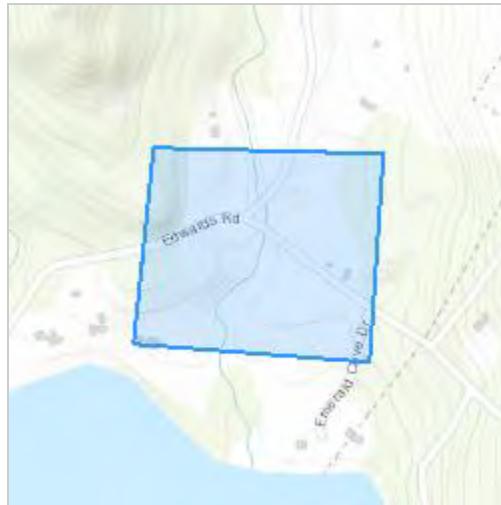
(207) 469-7300

PROJECT SUMMARY

Project Code: 2024-0040648
Project Name: Edwards Road Culvert Replacement
Project Type: Culvert Repair/Replacement/Maintenance
Project Description: Replacing 48" and 18" HDPE culverts with 9' rise by 12' span concrete box culvert

Project Location:

The approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/@43.99214685,-70.45874847095612,14z>



Counties: Cumberland County, Maine

ENDANGERED SPECIES ACT SPECIES

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

-
1. [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.

MAMMALS

| NAME | STATUS |
|--|------------|
| Northern Long-eared Bat <i>Myotis septentrionalis</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 | Endangered |

INSECTS

| NAME | STATUS |
|--|-----------|
| Monarch Butterfly <i>Danaus plexippus</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743 | Candidate |

FLOWERING PLANTS

| NAME | STATUS |
|--|------------|
| Small Whorled Pogonia <i>Isotria medeoloides</i> Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1890 | Threatened |

CRITICAL HABITATS

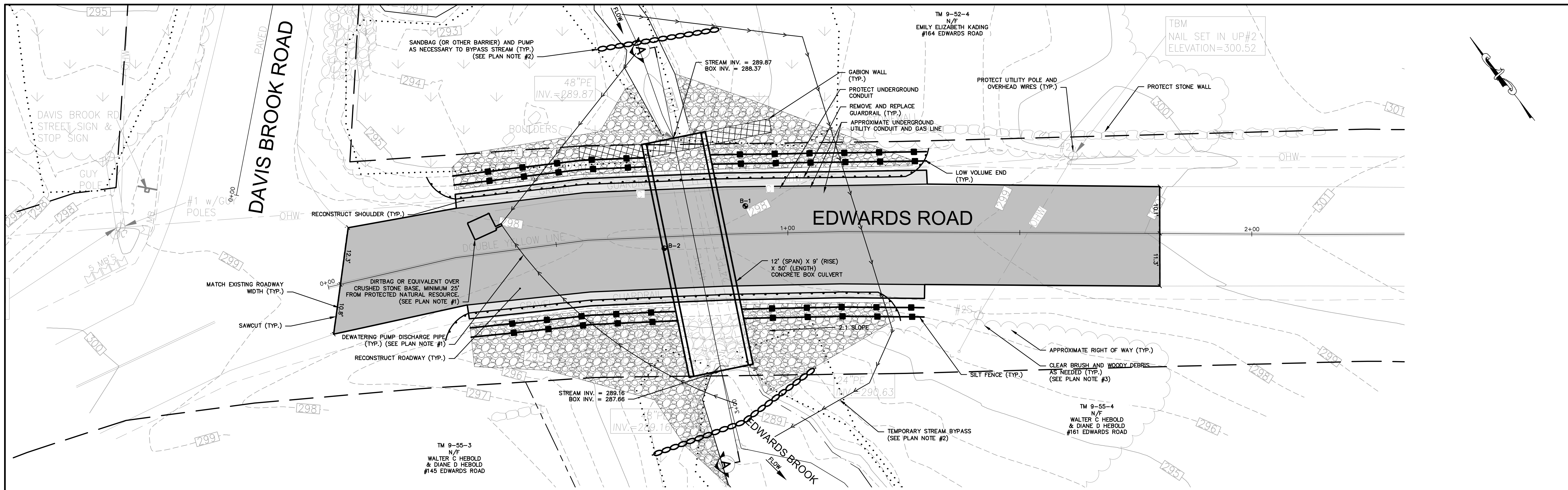
THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: South Portland city
Name: Thomas Lekousi
Address: 300 Southborough Drive, Suite 200
City: South Portland
State: ME
Zip: 04106
Email: tlekousi@gorrillpalmer.com
Phone: 2077722515

Attachment 6

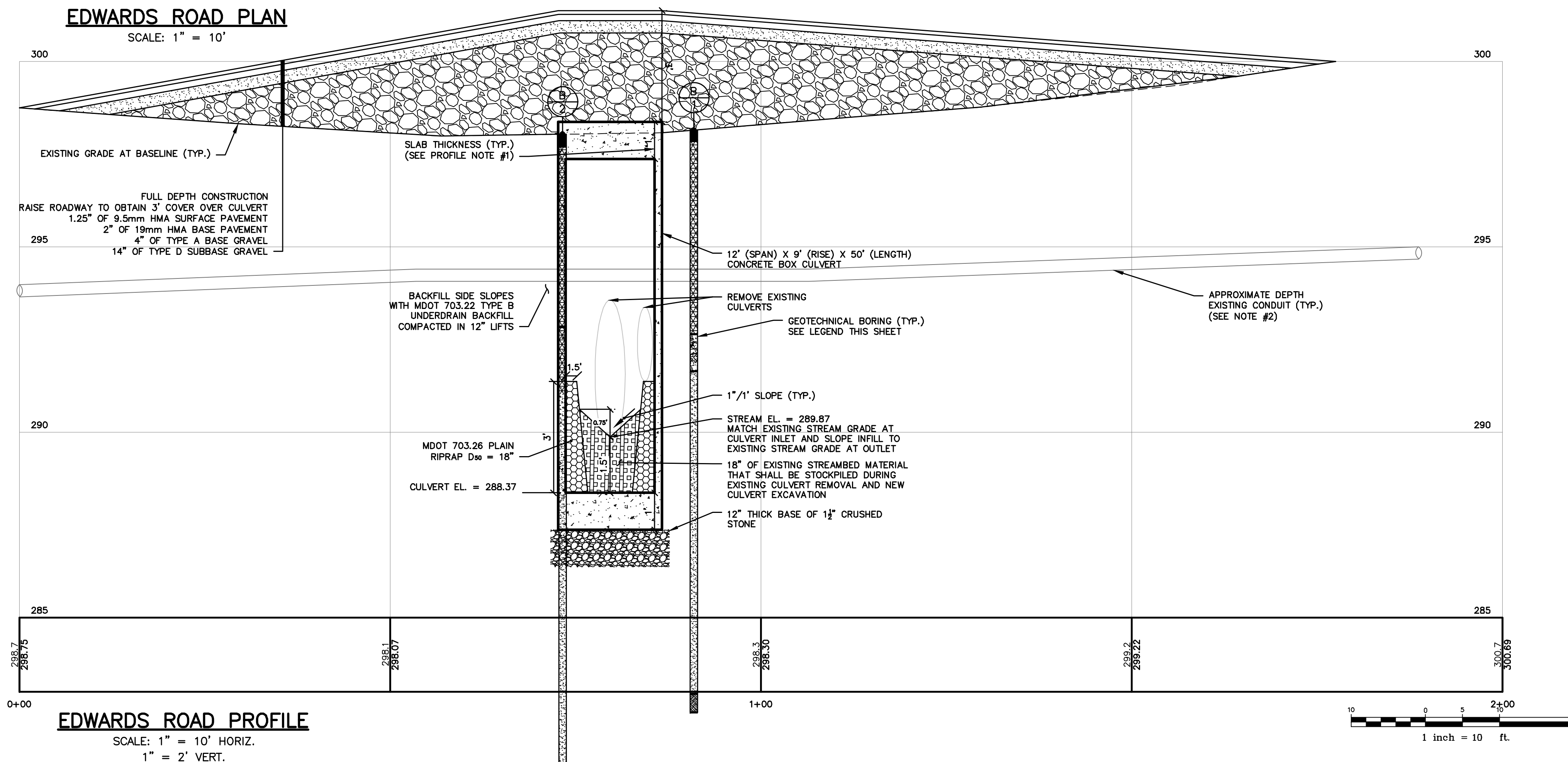


EDWARDS ROAD PLAN

SCALE: 1" = 10'

- PLAN NOTES**
- DEWATERING PLAN REPRESENTS ONE POSSIBLE OPTION FOR THE CONTRACTOR TO DEWATER THE WORK ZONE. DEWATERING PLAN IS ULTIMATELY THE RESPONSIBILITY OF THE CONTRACTOR. A DEWATERING PLAN SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO DEWATERING.
 - STREAM BYPASS PLAN REPRESENTS ONE POSSIBLE OPTION FOR THE CONTRACTOR TO BYPASS THE WORK ZONE. STREAM BYPASS PLAN IS ULTIMATELY THE RESPONSIBILITY OF THE CONTRACTOR. A STREAM BYPASS PLAN SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO STREAM BYPASS.
 - CLEARING OF BRUSH AND WOODY DEBRIS SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT. REMOVAL OF TREES SHALL BE PAID FOR AT THE UNIT PRICE FOR EACH, PER MAINE DOT STANDARD SPECIFICATION SECTION 201.

- PROFILE NOTES**
- TOP SLAB THICKNESS AND BOTTOM SLAB THICKNESS OF THE CULVERT SHALL BE SPECIFIED BY THE CULVERT MANUFACTURER. SLAB THICKNESS DIMENSIONS SHOWN SHOULD BE CONSIDERED APPROXIMATE.
 - DEPTH OF EXISTING UNDERGROUND CONDUIT IS BASED ON READINGS FROM UTILITY LOCATION EQUIPMENT AND SHALL BE CONSIDERED APPROXIMATE.



EDWARDS ROAD PROFILE

SCALE: 1" = 10' HORIZ.
1" = 2' VERT.

BORING LEGEND

- ASPHALT PAVEMENT
- [FILL] GRAVELLY SAND (XX)
- [TILL] SAND AND GRAVEL (XX)
- [RELIC ORGANICS] SAND WITH ORGANICS (XX)
- [BEDROCK] BEDROCK OR BOULDER (XX)

NOTE: THIS PLAN SET IS ISSUED FOR PERMITTING PURPOSES AND SHALL NOT BE USED FOR CONSTRUCTION.

U:\3769.08_Casco_Edwards Road Drainage\Z - CAD\DWG\3769.08-PBASE_9 foot rise.dwg 6/24/2024 7:09 PM

| Rev. | Date | Revision |
|------|------|----------|
| | | |

| Issued For | Date | By |
|------------|------|----|
| | | |

Design: HWH Draft: GJH Date: MAY 2024
 Checked: WCH Scale: 1"=10' Job No.: 3769.08
 File Name: 3769.08-PBASE_9 foot rise.dwg
 This plan shall not be modified without written permission from Gorrill Palmer. Any alterations, authorized or otherwise, shall be at the user's sole risk and without liability to Gorrill Palmer.



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 207.772.2515
 300 Southborough Drive - Suite 200
 South Portland, ME 04106

| | |
|---------------|---|
| Drawing Name: | Layout, Grading & Erosion Control Plan & Profile |
| Project: | Edwards Road Culvert Replacement Edwards Road, Casco |
| Client: | Town of Casco 635 Meadow Road, Casco, ME 04015 |

Drawing No.
3

Attachment 7

Gorrill-Palmer Consulting Engineers Inc.
Opinion of Probable Construction Cost

6/25/2024

Job Number: **3769.08**
 Project Location: **Edwards Road, Casco, Maine**
 Project Name: **Edwards Road Culvert Replacement**
 Price References: 2995.171 Old Webster Road Culvert Replacement, Lewiston
 Recently Bid MaineDOT projects.
 Date: 6/24/2024
 Calculated By: Wiley Hollen
 Notes:

1. In providing opinions of probable construction cost, the client understands that the Consultant has no control over the cost or availability of labor, equipment, or materials, or over market conditions or the Contractor's method of pricing, and that the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.
2. Opinion of cost does not include engineering or construction inspection costs.
3. Opinion of cost does not include right of way, environmental, or utility costs.
4. Unit pricing based on MaineDOT unit prices and recent bid pricing on similar scoped projects.
5. Opinion of cost does not include potential relocation of utility poles or underground utility conduit.
6. Opinion of cost assumes Edwards Road is raised 3 feet in elevation in the vicinity of the culvert.
7. Opinion of cost assumes the following road build-up for Edwards Road reconstruction:
 14" of subbase gravel (Type D), 4" of base gravel (Type A), 2" of 19 mm HMA (base), and 1.25" of 9.5 mm HMA (surface).
8. Opinion of cost includes all delivery, labor, material, and installation costs for the concrete box culvert, including culvert delivery and unloading, stream bypass plan, dewatering plan, excavation, bedding material, culvert installation, backfill, and any other labor and material costs to install the culvert.
 Road restoration is paid for under the gravel and pavement pay items.
9. Opinion of cost assumes gabion baskets are used on the upstream side to tie in proposed embankment grading.

| Item | Item Description | Unit | Unit Price | Quantity | Amount |
|--------------------------|--|------|---------------|----------|----------------------|
| 202.20 | REMOVE EXISTING BITUMINOUS CONCRETE PAVEMENT | SY | \$ 7.00 | 500 | \$ 3,500.00 |
| 202.203 | PAVEMENT BUTT JOINTS | SY | \$ 25.00 | 25 | \$ 625.00 |
| * 206.07 | STRUCTURAL ROCK EXCAVATION | CY | \$ 250.00 | 10 | \$ 2,500.00 |
| 304.10 | AGGREGATE SUBBASE COURSE - TYPE D GRAVEL | CY | \$ 50.00 | 200 | \$ 10,000.00 |
| 304.14 | AGGREGATE BASE COURSE - TYPE A GRAVEL | CY | \$ 60.00 | 55 | \$ 3,300.00 |
| 403.207 | HOT MIX ASPHALT 19.0 MM NOMINAL MAXIMUM SIZE | T | \$ 180.00 | 45 | \$ 8,100.00 |
| 403.210 | HOT MIX ASPHALT 9.5 MM NOMINAL MAXIMUM SIZE | T | \$ 200.00 | 30 | \$ 6,000.00 |
| 601.21 | GABIONS, GALVANIZED | CY | \$ 175.00 | 75 | \$ 13,125.00 |
| 603.401 | 9' (RISE) x 12' (SPAN) x 50' (LENGTH) CONCRETE BOX CULVERT | LS | \$ 210,000.00 | 1 | \$ 210,000.00 |
| 606.37 | GUARDRAIL, REMOVE AND REPLACE | LF | \$ 110.00 | 220 | \$ 24,200.00 |
| 610.08 | PLAIN RIPRAP | CY | \$ 100.00 | 120 | \$ 12,000.00 |
| 615.071 | LOAM, SEED, AND MULCH | SY | \$ 25.00 | 400 | \$ 10,000.00 |
| 652.39 | WORK ZONE TRAFFIC CONTROL | LS | \$ 15,000.00 | 1 | \$ 10,000.00 |
| 656.75 | TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL | LS | \$ 25,000.00 | 1 | \$ 25,000.00 |
| 659.10 | MOBILIZATION | LS | \$ 25,000.00 | 1 | \$ 30,000.00 |
| SUB-TOTAL | | | | | \$ 368,350.00 |
| CONTINGENCY (10%) | | | | | \$ 36,835.00 |
| ROUNDED TOTAL | | | | | \$ 405,200.00 |

* Undetermined Location

Attachment 8

Hydraulic Capacity Check – Box Culvert

This procedure estimates the box culvert open rise R_o needed to meet the hydraulic standard H_w/R_o at Q_{100} . In most cases, a minimum box rise of $R = 8'$ ($R_o = 6'$, assuming 2' streambed) should be used for constructability, regardless of calculations; $R = 6'$ or $7'$ may be necessary and is acceptable. When using Bankfull sizing for the box span (width) S , it rarely necessary to go taller than $R = 8'$ (assuming 2' streambed).

Procedure by Calculation:

1. Measure Bankfull Width (BFW) in the field. If measurement is unavailable, use calculated value $BFW_{calc} = 10.58 \times A_{ws}^{0.43}$: $BFW = \underline{10'} = S$

(BFW is the culvert Span (width) "S" used in the calculations below)

2. Obtain Q_{100} from StreamStats : $Q_{100} = \underline{521 \text{ ft}^3/\text{s}}$

3. Calculate normalized flow $Q^* = Q_{100} / \{S^2 \times (32.2 \times S)^{1/2}\}$: $Q^* = \underline{0.29}$

4. Calculate rise ratio "r" for Q^* value : $r = \underline{0.737}$
 $r = 1.682 \times Q^{*0.667}$

5. Calculate hydraulic open rise $R_o = S \times r = \underline{10'} \times \underline{0.737}$ $R_o = \underline{7.37}$

6. Use larger of R_o or 6' : $R_o = \underline{7.37}$

7. Add streambed thickness d_s to get culvert rise R ($R = R_o + d_s$; $d_s = 2'$ is a good preliminary value) $R = \underline{8.87'}$

8. BFW Span sizing multiplier: $S = 1.2 \times BFW$ $S = \underline{12'}$

9. Round calculated sizes to common box dimensions ($S \times R$) : $S \underline{12'} \times R \underline{9'}$