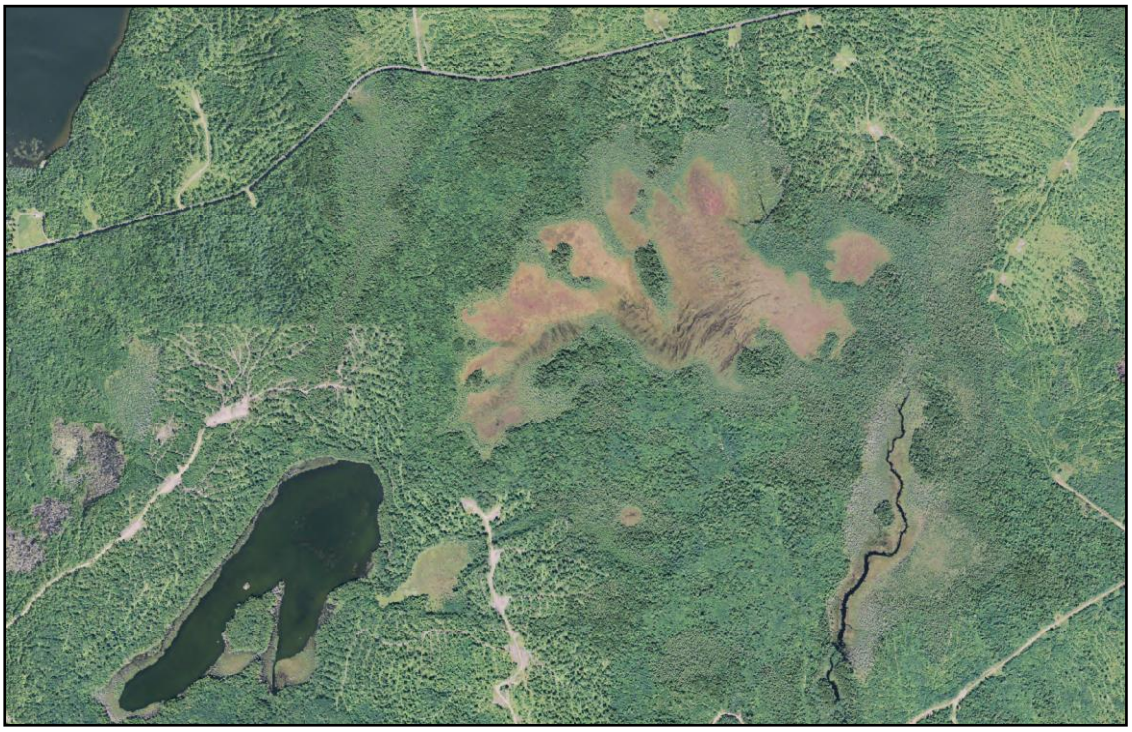
MAINE NATURAL AREAS PROGRAM

LEVEL 2.5
ECOLOGICAL INTEGRITY ASSESSMENT
MANUAL V1.0



Marble Fen, northeast of Baxter State Park

WETLANDS

MAINE NATURAL HERITAGE PROGRAM

LEVEL 2.5
WETLANDS ECOLOGICAL INTEGRITY ASSESSMENT
MANUAL V1.0

This manual is based on the following documents:

Faber-Langendoen, D. 2010. Wetlands Ecological Integrity Assessment Field Manual, Version 1.1. NatureServe, Arlington, VA.

New Hampshire Natural Heritage Inventory Bureau and NatureServe. 2011. Level 2.5 Ecological Integrity Assessment Manual. Concord NH.

1. EXECUTIVE SUMMARY

This document provides a basic guide to conducting Level 2.5 field and office assessments of ecological integrity for wetland systems in Maine. Maine Natural Areas Program Level 2.5 protocols are intermediate between NatureServe's Level 2 rapid ground-based approach and Level 3 intensive ground-based approach (Faber-Langendoen 2010). A Level 1 remote sensing approach is also applied, in part, to evaluate landscape context during Level 2.5 assessments.

Application of methods described in this manual requires a moderate to advanced level of ecological expertise and experience, not unlike that needed to understand and conduct wetland delineations. For that reason, surveyors document the ecological context and classify natural community and system types first, in order that a basic understanding of the wetlands structure, composition, and function are established.

This manual gives instructions and guidelines for collecting field data and completing office forms on L2.5 ecological integrity assessments (EIA) for wetland systems. It provides detailed, field-by-field coding conventions for the primary data forms to be used in the field and office. Steps and forms involved in a Level 2.5 assessment include:

Pre-field:

- Landscape analysis, field site determination

Field:

- EIA 2.5 Rapid Recon Field Form

Post-field:

- Land use index calculation (GIS)
- FQA data entry
- Metrics ranking in EIA database
- Print or export ranking form

2. ACKNOWLEDGEMENTS

This manual is based of the following documents:

Faber-Langendoen, D. 2010. Wetlands Ecological Integrity Assessment Field Manual, Version 1.1. NatureServe, Arlington, VA, and

Faber-Langendoen, D., Nichols, W., Walz, K. S., Rocchio, J., Lemly, J., & Gilligan, L. (2016). *Assessing the Conservation Value of Ecosystem Occurrences: Integrating Ecological Integrity Assessments with NatureServe's Core Methodology.* Arlington, VA: Natureserve.

Faber-Langendoen, D., Nicohols, B., Walz, K., Rocchio, J., Lemly, J., & Gilligan, L. (2016). *NatureServe Ecological Integrity Assessment: Protocols for Rapid Field Assessment of Wetlands. V2.* Arlington, VA: Natureserve.

New Hampshire Natural Heritage Inventory Bureau and NatureServe. 2011. Level 2.5 Ecological Integrity Assessment Manual. Concord NH.

Modifications to these documents primarily stem from:

- adapting existing NatureServe and NH methods to the existing protocols of Maine Natural Areas Program
- the development of new components to the existing EIA methods developed by NatureServe

The components of this manual are based on extensive efforts by NatureServe and the Natural Heritage Network to improve core methodology by using an ecological integrity framework. These improvements draw on the experience and collaboration with partners, including The Nature Conservancy and Environmental Protection Agency. NatureServe's work has been supported by the EPA, National Park Service, U.S. Army Corps of Engineers, and the U.S. Forest Service.

This manual and the EIA project were supported by EPA Region I Wetlands Program Development Grant CD96165701 and Maine Outdoor Heritage Fund Grant #122-01-01.

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3. OVERVIEW

Data collected in the field will be used to evaluate wetland condition using an ecological integrity assessment method (Faber-Langendoen, et al., 2016 a & b). This data will be used for a number of purposes:

- Adapt and apply EIA methods to critical wetlands
- Assess soil conditions
- Provide information on rare species and exotics
- Upgrade the EO rank for wetland polygons tracked by the Maine Natural Areas Program.
- Enable remote identification of wetland condition
- Develop an interpreted landscape analysis map of predicted wetland types
- Add critical wetlands to the MNAP database
- Inform conservation planning and environmental review
- Identify and establish benchmark wetlands
- Inform mitigation, stewardship, and protection
- Enhance information on wetland condition and importance
- Improve agency, local government, and nongovernmental organization conservation, watershed planning, land protection, and stewardship activities
- Improve Maine Department of Environmental Protection status and trend evaluation
- Update Maine natural communities and systems classification
- Develop EIA training materials
- Develop workshop presentations

The following pages describe each of the EIA protocols and forms. For digital versions of MNAP natural community recon forms, please contact the Maine Natural Areas Program (207-287-8044).

4. BACKGROUND

Building on the related concepts of biological integrity and ecological health, ecological integrity is a broad and useful endpoint for ecological assessment and reporting (Harwell et al. 1999). "Integrity" is the quality of being unimpaired, sound, or complete. An ecological integrity assessment can be defined as "an assessment of the structure, composition, and function of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historic disturbance regimes" (adapted from Lindenmayer and Franklin 2002; Young and Sanzone 2002; Parrish et al. 2003). To have ecological integrity, an ecosystem should be relatively unimpaired across a range of ecological attributes and spatial and temporal scales. The notion of naturalness depends on an understanding of how the impact of human activity relates to natural ecological patterns and processes (Kapos et al. 2002). Identification of reference or benchmark conditions based on natural or historic ranges of variation, although challenging, can provide a basis for interpretation of ecological integrity (Swetnam et al. 1999). These general concepts need greater specificity to become a useful guide for conducting ecological integrity assessments. This manual addresses some of those needs.

The scientific community has a strong interest in developing approaches to ecological integrity assessment (EIA) methods to assist in conservation and management of ecosystems. Concerns have evolved from "how much of it is out there?" and "is it protected?" to "how is it doing?" and "what condition is it in?" MNAP's EIA method builds on NatureServe and the Network of Natural Heritage Program's historic approaches to assessing condition. We reviewed a variety of existing wetland rapid assessment methods and the 3-level approach of the U.S. Environmental Protection Agency and others. The MNAP method emphasizes metrics that are both condition-based, distinct from stressor-based approaches.

Characteristics of the MNAP EIA include:

- Reliance on a general conceptual model that:
    - Identifies the major ecological attributes – landscape context, size, and the condition of vegetation, soils, and hydrology
    - Provides a narrative description of declining integrity levels based on changes to ecological attributes
    - Uses a metrics-based approach to assess the levels of integrity
- Use of ecological classifications at multiple scales to guide the development of the conceptual models, thereby enhancing attribute assessment
- Use of an approach intermediate to Level 2 rapid ground-based and a Level 3 intensive ground-based assessments (see Faber-Langendoen 2010)
- A Level 1-like remote sensing approach for assessing landscape context using GIS prior to a site visit
- Ratings and thresholds for each metric based on "normal' or "natural range of variation" benchmarks
- A scorecard matrix for rating and integrating metrics into an overall set of indices of ecological integrity
- A mechanism for adapting metrics over time as new information and methods are developed

The MNAP EIA enables consistent and repeated assessment of biodiversity sites to determine if ecological value is maintained, enhanced, or diminished.

5. PRE-FIELD ASSESSMENT AND PLANNING

5.1. IDENTIFY EIA LEVEL 2.5 ASSESSMENT AREA

Using data layers in GIS, identify the wetland system of interest.

5.2. PREPARING FOR THE FIELD

5.2.1. Maps and Aerial Photographs

The goal of reviewing maps and aerial photos is to enhance efficiency by prioritizing which areas of the wetland system and surrounding landscape appear most important to visit in the field, and also to determine the easiest access.

Field crews should review the following maps and aerial photographs before leaving the office:

- Topographic maps
- Air photos at the best scale and resolution possible
- Ecological systems maps
- National Wetland Inventory polygons
- Element occurrence boundaries for mapped exemplary systems and natural communities, plants, and animals
- Conservation lands
- Ownership boundaries (to determine access from landowners who have granted permission)
- Review and identify questionable land cover buffer polygons that require field check

5.2.2. Other Equipment, Materials, and Supplies

Field checklist:

- GPS receiver (set to **NAD 83** and with sufficient memory and batteries!)
- camera (with sufficient memory)
- communication radios if out of cell phone coverage
- back-up batteries for all electronic needs
- field forms, clipboard pencils
- aerial photos, topo maps, road/trail maps
- compass, hand lens, binoculars, pocket knife
- tape measure, flagging
- one of the following: shovel, soil auger, trowel
- plastic bags for plant collections
- increment borer, wax, straws
- botany manual, natural community manuals
- head-net, insect repellant
- orange hat/vest (during hunting season)
- food, water, extra clothing, rain gear, first-aid kit
- write in the rain notebook

5.2.3. Level 2.5 EIA Forms

Review the **EIA** metrics to ensure you are prepared to rank them after collecting field data using the ***EIA Level 2.5 Rapid Recon Form***.

6. FIELD SAMPLING

Application of the EIA field methods requires a moderate to advanced level of ecological experience, not unlike that needed to understand and conduct wetland delineations. Ecologists should document the ecological context and classify natural community and system types in advance, using remote means, to establish a basic understanding of the wetlands structure, composition, and function. This step will aid in properly assessing the ecological integrity of wetland systems.

6.1. EIA LEVEL 2.5 RAPID RECON FORM

6.1.1. Overview

Conduct an initial reconnaissance in the areas of the wetland system and surrounding landscape you identified as most important to visit. Collect vegetation within a fixed 400m^2 plot representative of the site or a meander approach that also classifies most common vegetation and indicator species for each natural community type using the ***EIA Level 2.5 Rapid Recon Form***. Rely on your field skills and aerial photographs to identify types in greatest need of plot data (i.e., most uncertain photo signatures, rare types, etc.). Do not feel you have to survey the entire wetland system; rather take a *moderate risk approach*, presuming that the area you can see nearby and/or interpret as being similar using an aerial photograph is the same as what are you walking through.

- If you find two or more Ecological System types in the wetland, collect natural community data in each system.

- Note: At the office, complete the remaining EIA metrics using the EIA database as soon as possible after the ***EIA Level 2.5 Rapid Recon Form*** has been completed in the field.

6.1.2. Organizing the Field Crew

Data collection can be completed by one person. However, if there is a field crew of two people, responsibilities for completing the ***EIA Level 2.5 Rapid Recon Form*** can be divided as follows:

- One person takes photographs and collects soil profile, forest structure profile, pH (optional), and GPS data.
- One person collects plant species composition data.

6.1.3. Establishing Natural Community Plots

- Using an ***EIA Level 2.5 Rapid Recon Form***, complete plots for all dominant natural community types (and all peripheral types if possible) in the wetland system. Locating natural community plots is a subjective process. Choose an area that seems to be both relatively **homogenous** and **representative** of the vegetation and condition of the community type. In other words, avoid areas where the vegetation appears to be transitioning from one community type to another and areas with anomalous or heterogeneous structure or species composition.
- If a fixed area plot method is chosen, lay out the plot: 20 x 20 m or 40m x 10m in swamps (forested); 10 x 20 m or 10 x 10 m for more homogenous, open wetlands (e.g., shrub and or herb dominated communities). Measure plots and lay out tapes in dense vegetation; in open vegetation, plot corners may be estimated by pacing and compass.
- Time-meander or community-wide cover estimates may be used to document the most dominant vegetation, and relative abundance of invasive plants.

6.1.4. Species Profile for Plot

- In the natural community plot section on the ***EIA Level 2.5 Rapid Recon Form***, identify the natural community type, list all plant species occurring in the plot, and estimate percent cover of each species by strata.
- Estimate foliar cover, that is % of ground covered by vertical portion of plants as viewed from above; the vertical projection of the shoots, stems, and leaves (vs. canopy cover: % of ground covered by the vertical projection of the *outermost perimeter* of the natural spread of foliage of plants). Document plant species cover by selecting from the following cover scale:

Percent cover range	Midpoint
<1%	
1%	1%
1-5%	3%
5-13%	9%
13-25%	19%
25-50%	37%
50-75%	63%
75-99%	87%
>99%	99%

- Always use absolute cover, not relative cover. Absolute cover is the actual cover of a plant species, so total cover of all plants can exceed 100%. (Note: relative cover is the cover of a plant species as a percentage of total plant cover; relative cover will always tally up to 100%, even when absolute cover is quite low).
- Strata include:
    - **T1:** Supra-canopy (e.g., emergent white pine)
    - **T2:** Canopy
    - **T3:** Subcanopy >5 m (>16 ft)
    - **S1:** Tall tree/shrub 1 – 5 m (3 – 16 ft.)
    - **S2:** Short tree/shrub < 1 m (< 3 ft.)
    - **H:** Herbaceous no height limit
    - **N:** Non-vascular (mosses, lichens, and macro-algae; describe each growth form separately)

      Note: treat percent cover of each woody vine species as you would for a tree species (i.e., provide cover in each stratum it occurs in).

- Enter plot dimensions under "**Plot size**." For time meander or overall cover estimates, enter the amount of time surveyed.
- Except in very diverse plots, don't spend more than **30 minutes** collecting species data in a plot. Remember that these plot data are to be used to classify the overall vegetation and characterize its condition; a diagnostic, semi-comprehensive list is needed, not an exhaustive complete species list.
    - If you can't identify a plant to species…
        - Record it on your form as "unknown species 1," "unknown species 2," "unknown *Carex* sp. 1," etc.
        - Record associated cover class and other data for the unknown as you would for any other species.

- Take a sample of the species with as much of the plant as possible, especially intact flowers and fruits, if present. Place the sample in a plastic bag and label it (or specimen) with the plot code and the name you gave it on the data form.
- If you don't need the plant keyed right away, press it. Mark the pressed specimen with the plot code and the name you gave it on the data form.
- Store specimens in a cool, dry place. Bagged specimens will keep fresh longer in the refrigerator or ice chest until pressed or identified.

- Collecting vegetation plot data requires a certain level of botanical expertise and experience. Minimally, a surveyor should have the ability to identify dominant and other diagnostic plant species needed to accurately classify a setting to natural community and system type.
    - You can, of course, key some of these plants in the field if you want to, but don't let plant keying get in the way of your primary responsibility – field data collection.
        - A quick prioritization of what to key and/or collect and press may be made based on the recurrence of the species in samples and on the cover value estimate of the species in a particular plot. If the species has a cover value >1%, it is more of a priority to identify in the field or to collect and key out later.

6.1.5. Soil Profile

- Using an ***EIA Level 2.5 Rapid Recon Form***, complete a soil profile. Highly Detailed soil profiles are not necessary for EIA metric ranking, but may be useful for other purposes. The goal of soil surveys is to identify disturbance, either from human land use or invasive species. This can often be done with shallow soil pits. Complete soil texture key, and document depth of uppermost layers.

6.1.6. Stand Profile

- Using an ***EIA Level 2.5 Rapid Recon Form***, after recording plant species presence and cover for a given natural community, complete a stand profile for forested wetlands.
    - Record the following:
        - **T2 dbh ave:** average canopy tree dbh in centimeters—this may be done by measuring representative trees.
        - **T2 dbh range:** canopy dbh range in inches—this may also be done by measuring representative trees.
        - **T2 height:** average height of canopy.
        - **Pit/Md (E+-):** Describe pit and mound microtopography (relative to benchmark conditions) as "E"= expected; "E+"= greater than expected; "E–**"**= less than expected.
        - **Stand age est:** Core representative trees to document an estimate of stand age.
    - If you are doing a 400m^2 plot, record in the rows labeled "**Live stem**", "**Snags>6**", and "**Downed**" the following (note: complete for forest or woodland types, but you can choose to complete it where trees are establishing in shrub or herb types):
        - **6-12"** (15 – 30 cm) column: Describe relative to benchmark conditions as "E"= expected; "E+"= greater than expected; "E–**"**= less than expected.
            - Keep in mind that in fire-dependent systems, or in forest types where smaller trees are the norm (e.g., tamarack swamps, xeric pine sites) less coarse woody debris is expected under natural conditions.
        - **12-20"(30-51 cm)** column: Count the number of stems, snags, or downed in the 20 x 20 m area with a dbh between 12-20"
        - **>20"(>51 cm)** column: Count the number of stems, snags, or downed in the 20 x 20 m area with a dbh greater than 20"

6.1.7. Comments

- Using an ***EIA Level 2.5 Rapid Recon Form***, write in the "**Comments**" field as needed notes on vegetation, soils, hydrology, land use, surrounding landscape, wildlife, etc. for each natural community plot completed.

6.1.8. Other Plot Data

- Take at least one diagnostic photo in each natural community plot. The purpose of the photo is to get a good representation of the vegetation of the plot, not individual species. Take the photograph looking across the contour if plot is steep.

7. POST-FIELD

7.1. EIA LEVEL 2.5 METRICS SCORING

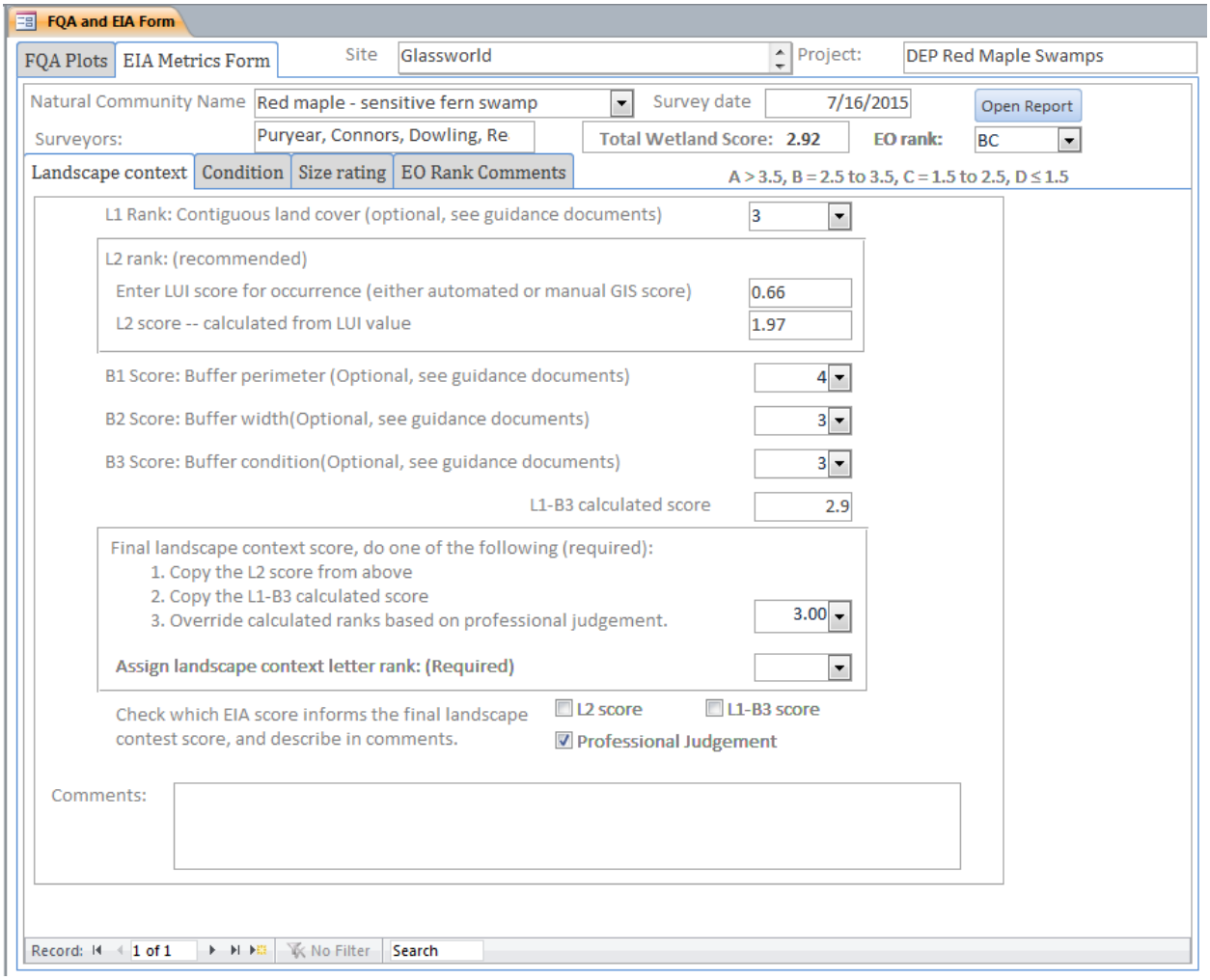
Ranking of the following metrics is to be done within the MNAP EIA database, or independently on field forms to be integrated in a final roll-up. Prior to ranking, digitize your assessment area or wetland feature. Metrics are adapted from Faber-Langendoen, et al., 2016b.

EIA primary rank factors, major ecological factors and metrics used to score wetlands in Maine.

PRIMARY RANK FACTOR	MAJOR ECOLOGICAL FACTOR	Metric Name
LANDSCAPE CONTEXT	LANDSCAPE	L1. Contiguous Natural Land Cover
		L2. Land Use Index
	BUFFER	B1. Perimeter with Natural Buffer
		B2. Width of Natural Buffer
		B3. Condition of Natural Buffer
CONDITION	VEGETATION	V1. & V3. Native Plant Species cover/composition
		V2. Invasive Nonnative Plant Species Cover
		V4. Vegetation Structure
	HYDROLOGY[1]	H1. Water Source
		H2. Hydroperiod
		H3. Hydrologic Connectivity
	SOIL	S1. Soil Condition
SIZE	SIZE	Z1. Comparative Size (using ME EO specs)
		Z2. Change in Size

7.2.1. Landscape Context

Landscape context values may be entered into Maine's EIA database. Final landscape context score can be a composite of all metrics L1-B3, just the L2 score or a professional judgment score (override). The full L1-B3 landscape context score should be used in highly fragmented landscapes.



Screen capture of landscape context page, within Maine's EIA database.

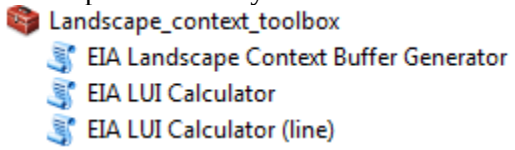
L1. Contiguous Natural Land Cover

Rank the **contiguous natural land cover** within a 500m envelope (buffer) connected to the wetland using the following options—

Metric Rating	***Contiguous Natural Land Cover: ALL WETLANDS***
EXCELLENT (A)	**Intact:** Embedded in 90–100% natural habitat around AA.
GOOD (B)	**Variegated:** Embedded in 60–90% natural habitat.
FAIR (C)	**Fragmented**: Embedded in 20–60% natural habitat.
POOR (D)	**Relictual**: Embedded in <20% natural habitat.

L2. Land Use Index

Utilize Maine's **EIA LUI Calculator** in ArcGIS to calculate the 0-1 Land Use Index score, using your digitized wetland feature. This tool calculates land use index values for 'buffer' areas (0-100m from wetland features) and 'landscape connectivity' areas (100m -500m), weighting human impacts by values in the Land Use Coefficient Table (below). Buffer areas account for 2/3 of the overall LUI score, while landscape connectivity areas account for 1/3 of this score.

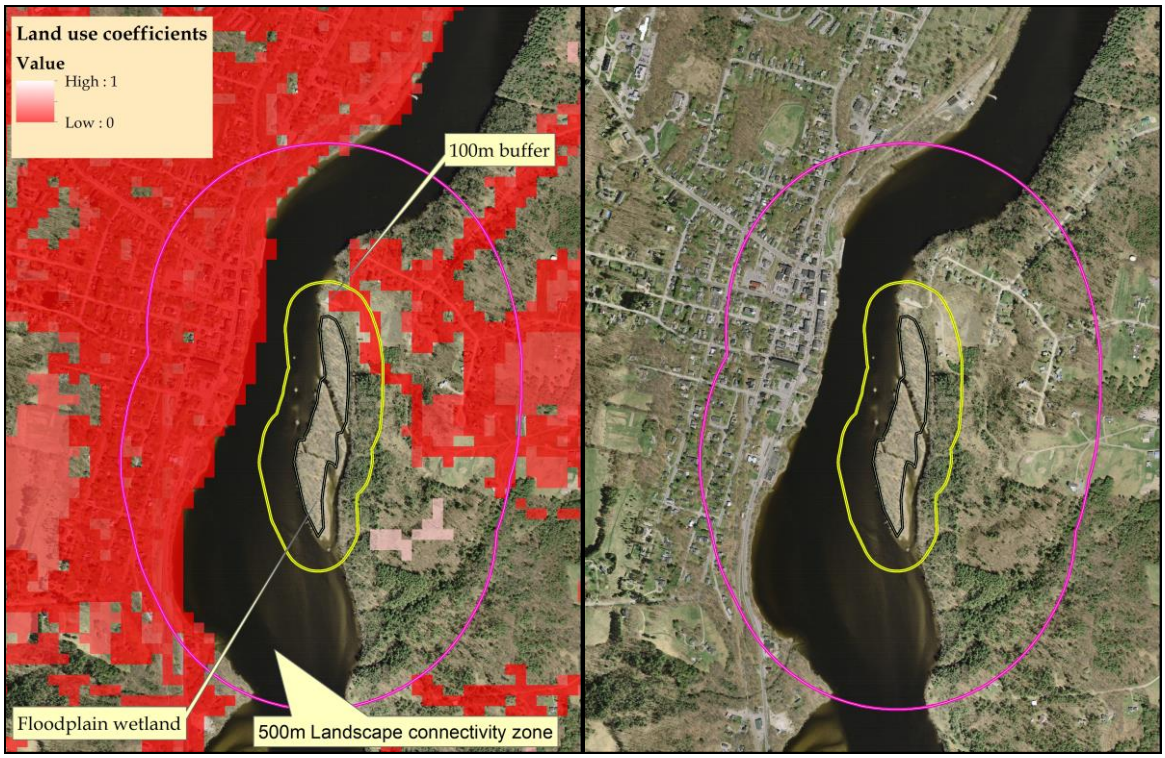


Toolbox displaying landscape context tools for Maine wetlands.

Alternatively, users may manually digitize human impacts within buffer and landscape connectivity zones. The **EIA Landscape Context Buffer Generator** tool may be used to identify these zones after digitizing core wetland features.

Land Use Coefficient table, modified from Hauer et al. 2002.

Current Land Use	Coefficient
Paved roads; parking lots; domestic or commercially developed buildings; mining (gravel pit, quarry, open pit etc)	0
Unpaved roads (e.g., driveway, maintained logging road); abandoned gravel pits	0.1
Agriculture (tilled crop production); intensively developed vegetation (golf courses, lawns, sports fields, etc.)	0.2
Heavy grazing on pasture lands	0.3
Permanent crop agriculture (vineyards, orchards, nurseries, berry production, Christmas tree farms, etc.)	0.4
Moderate recreation (high-use trail)	0.4
Fields and other disturbed fallow lands dominated by ruderal and exotic species	0.4
Old fields and other fallow lands with natural composition	0.5
Forest plantations of non-native species	0.5
Forest plantations of native species	0.6
Recent clearcut (<5 years old) regenerating to native vegetation	0.6
Moderate grazing on pasture lands with native species	0.6
Recent heavy logging (<5 years) with 50-75% of trees >30 cm dbh removed (e.g., overstory removal)	0.7
Recent selective logging (<5 years) with <50% of trees >30 cm dbh removed	0.8
Mature forestland selectively harvested 5-20 years ago	0.9
Mature, intact forestland with few or no invasive species	1



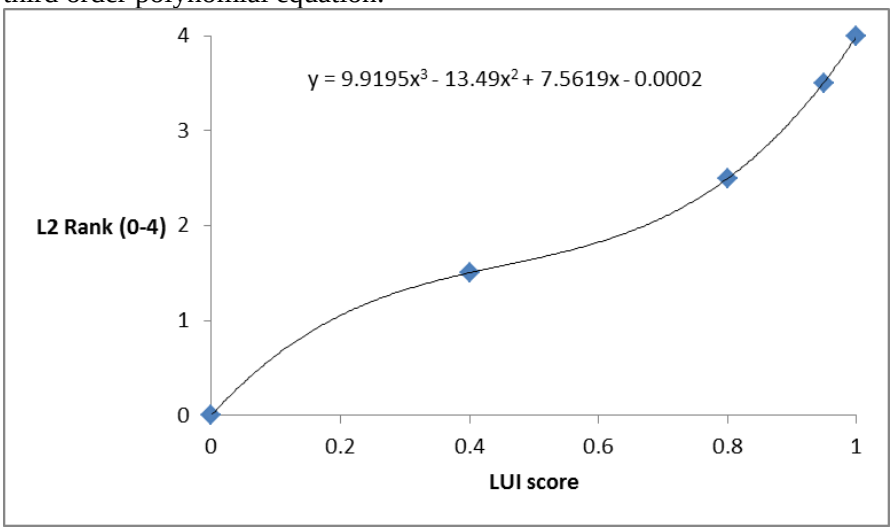
Landscape context: buffer and landscape connectivity surrounding a wetland system, with land use coeficients displayed on map on left, and air photo only displayed in map on right.

LUI scores translate to the following categorical ranks.

Landscape Context Scoring Table

Metric Rating			
Poor (D)	**Fair (C)**	**Good (B)**	**Excellent (A)**
< 0.4	0.4 - 0.79	0.80 - 0.94	0.95 - 1.0

However, using Maine's EIA database, continuous metric scores are calculated from LUI scores using a third order polynomial equation:



B1. Perimiter with Natural Buffer

The following was directly excerpted from (Faber-Langendoen, et al., 2016b):

Measurement Protocol: Metric is adapted from Collins et al. (2006) and USA RAM (2011). Estimate the length of the AA perimeter contiguous with a natural buffer. Use a 10 m minimum buffer width and length. Perimeter includes open water (see Table 4.1). For example, following Table 4.1, natural buffer is counted if it is at least 10 m width and 10 m in extent. Thus 6 m of non-buffer + 8 m buffer + 7 m non-buffer = 25 m non-buffer.

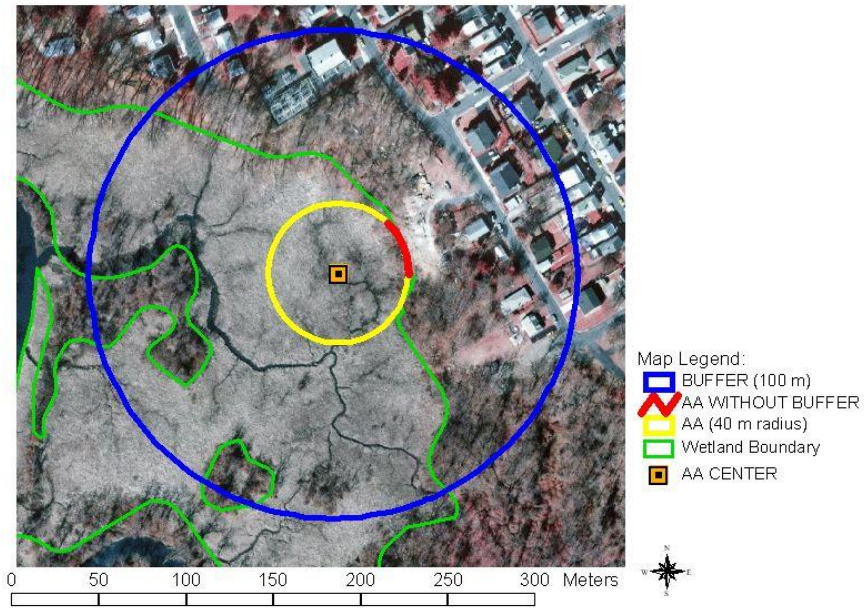
Guidelines Table for identifying wetland buffers and breaks in natural buffers (adapted from Collins et al. 2006, Table 3.3).

Examples of Land Covers Included in Natural Buffers	Examples of Land Covers Excluded from Natural Buffers	Examples of Land Covers Crossing and Breaking Natural Buffers
Natural upland habitats and plant communities; open water[1]; vegetated levees; old fields; naturally vegetated rights-of-way; rough meadows; natural swales and ditches; native or naturalized rangeland non-intensive plantations[2]	Parking lots; commercial and private developments; roads (all types), intensive agriculture; intensive plantations†; orchards; vineyards; dry-land farming areas; railroads; planted pastures (e.g., from low intensity to high intensity horse paddock, feedlot, or turkey ranch); planted hayfields; lawns; sports fields; traditional golf courses; Conservation Reserve Program pastures	Bike trails; foot trails; horse trails; dirt, gravel, or paved roads; residential areas; bridges; culverts; paved creek fords; railroads; sound walls; fences that interfere with movements of water, sediment, or wildlife species that are critical to the overall functions of the wetland

[1]Open water: Open water adjacent to the wetland site, such as a lake, large river, or lagoon, is excluded from the buffer by some wetland protocols because the water quality or water disturbance regimes (natural waves vs. boat traffic waves) may or may not be in good condition (e.g., Collins et al. 2006). Here we include open water as part of the buffer, and if desired, the condition of the open water can be assessed using the Buffer Condition metric (metric B3).

[2]Plantations: These include plantations, in which the overstory is allowed to mature and may regain some native component, and in which the understory of saplings, shrubs, and herbs are native or naturalized species and not strongly manipulated, i.e., they are not "row-crop tree plantings" with little to no vegetation in the understory typical of intensive plantations.

[3]Land cover that breaks natural buffers: These land covers are added to the land covers excluded from natural buffers, so that, collectively, they may contribute to a 5 m break in the buffer.



Example of calculation for Perimeter with Natural Buffer, with simple AA. The wetland boundary is marked by a thin green line. The assessment area (AA) is shown by the inner circle; yellow indicates portions of the AA perimeter that contain buffer land cover (see "Measurement Protocol" text for definitions) The red indicates that part of AA perimeter lacking a buffer. In this case, about 86% of the AA perimeter has buffer.

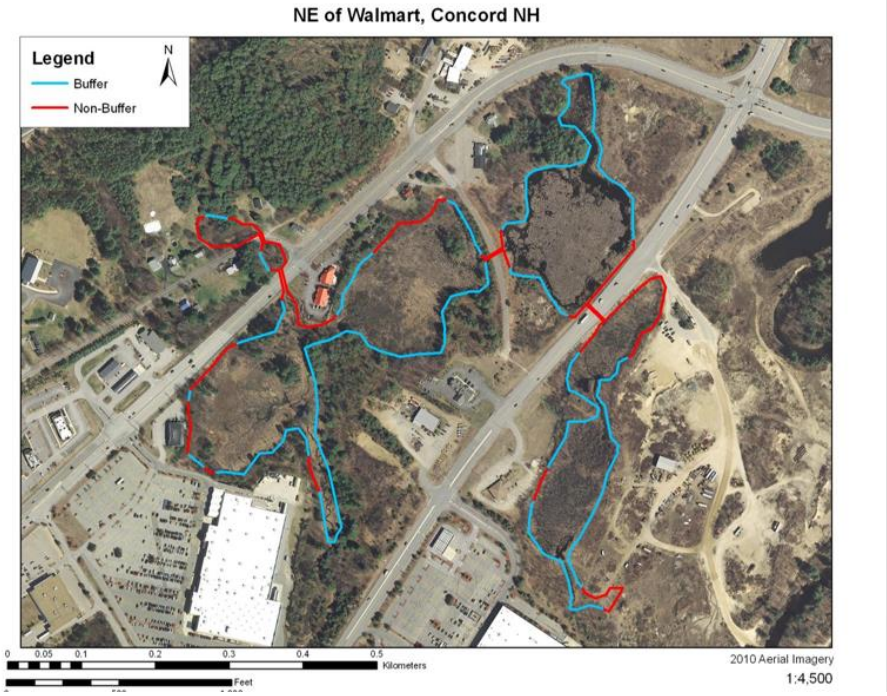


Figure B1.2. Example calculation of Perimeter with Natural Buffer, with a complex polygon: In this case, about 65% of the system perimeter has buffer.

Metric Rating:

Perimeter with Natural Buffer rating.

Metric Rating	Perimeter with Natural Buffer (%)
EXCELLENT (A)	Natural buffer is 100% of perimeter
GOOD (B)	Buffer is 75–99% of perimeter
FAIR (C)	Buffer is 25–74% of perimeter
POOR (D)	Buffer is <25% of perimeter

B2. Width of Natural Buffer

Estimate the average width of natural buffer to 100m, and assign one of the following ranks.

Metric Ratings	Width of Natural Buffer (m)
EXCELLENT (A)	Average buffer width is ≥100 m, adjusted for slope.
GOOD (B)	Average buffer width is 75–99 m, after adjusting for slope.
FAIR (C)	Average buffer width is 25–74 m, after adjusting for slope.
POOR (D)	Average buffer width is <25 m, after adjusting for slope.

B3. Condition of natural buffer

Assign one of the following ranks:

Metric Ratings	Natural Buffer Condition
EXCELLENT (A)	Buffer is characterized by abundant (>95%) cover of native vegetation, with intact soils, no evidence of loss in water quality and little or no trash or refuse.
GOOD (B)	Buffer is characterized by substantial (75–95%) cover of native vegetation, intact or moderately disrupted soils, minor evidence of loss in water quality, moderate or lesser amounts of trash or refuse, and minor intensity of human visitation or recreation.
FAIR (C)	Buffer is characterized by a low to moderate (25–75%) cover of native vegetation, and either moderately to highly compacted or otherwise disrupted soils, moderate to strong evidence of loss in water quality, with moderate or greater amounts of trash or refuse, and moderate or greater intensity of human visitation or recreation.

POOR (D)	Very low (<25%) cover of native plants, dominant (>75%) cover of nonnative plants, extensive barren ground and highly compacted or otherwise disrupted soils, moderate - great amounts of trash, moderate or greater intensity of human visitation or recreation, OR no buffer at all.

7.2.2 Condition

7.2.2.1 Vegetation

V1 & V3. Native Plant Species Composition and Cover

In Maine, we have combined native plant species composition and percent cover metrics into a single metric.

A = Vegetation composition minimally to not disturbed; native species sensitive to anthropogenic degradation are present; functional groups indicative of anthropogenic disturbance (increasers, weedy or ruderal species) absent to minor; full range of diagnostic species present

B = Vegetation composition with minor disturbed conditions; some native species indicative of anthropogenic disturbance (increasers, weedy or ruderal species) are present but minor, and some diagnostic species absent

C = Vegetation composition with moderately disturbed conditions; species are still largely native and characteristic of the type, but they also include increasers, weedy or ruderal species; many diagnostic species absent

D = Vegetation composition with severely disturbed conditions; species from entire strata may be absent or species are dominated by ruderal ("weedy") species, or comprised of planted stands of non-characteristic species, or unnaturally dominated by single species; most or all diagnostic species absent

V2. Invasive Nonnative Plant Species Cover

Assign one of the following ranks.

Metric Rating	***Invasive Nonnative Plant Species Cover*: ALL WETLANDS**
EXCELLENT (A)	Invasive nonnative plant species apparently absent.
GOOD (B)	Invasive nonnative plant species in any stratum present but sporadic (1–3% cover).
FAIR (C)	Invasive nonnative plant species in any stratum somewhat common (4–10% cover).
FAIRLY POOR (C-)	Invasive nonnative plant species in any stratum common (10–30% cover).
POOR (D)	Invasive nonnative plant species in any stratum abundant (>30% cover).

V4. Vegetation Structure

Assign metrics by one of the following NVC formations. Note: vegetation structure for non-forested types has not been adequately tested in Maine.

Metric Rating	*v1: Vegetation Structure Variant: FLOODED & SWAMP FOREST*
EXCELLENT (A)	**FLOODED & SWAMP FOREST**: Canopy a mosaic of small patches of different ages or sizes, including old trees and canopy gaps containing regeneration, AND number of live stems of medium size (30–50 cm / 12-20"dbh) and large size (>50 cm / >20" dbh) well within expected range.
GOOD (B)	**FLOODED & SWAMP FOREST:** Canopy largely heterogeneous in age or size, but with some gaps containing regeneration or some variation in tree sizes, AND number of live stems of medium and large size within or very near expected range.
FAIR (C)	**FLOODED & SWAMP FOREST:** Canopy somewhat homogeneous in age or size, AND number of live stems of medium and large size below but moderately near expected range.
POOR (D)	**FLOODED & SWAMP FOREST:** Canopy very homogeneous, in size or age OR number of live stems of medium and large size well below expected range.

Metric Rating	*V3: Vegetation Structure Variant: FRESHWATER MARSH, WET MEADOW & SHRUBLAND [metric variant under development]*
EXCELLENT (A)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.
GOOD (B)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure shows minor alterations from minimally altered from minimally disturbed natural conditions. Structural indicators of degradation are minor (e.g., levels of grazing, mowing).
FAIR (C)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND:** Vegetation structure is moderately altered from minimally disturbed natural conditions. Structural indicators of degradation are moderate (e.g., levels of grazing, mowing).
POOR (D)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong (e.g., levels of grazing, mowing).

Metric Rating	*v4: Vegetation Structure Variant: SALT MARSH (salt/brackish marsh & shrubland) [Metric variant under development]*
EXCELLENT (A)	**SALT MARSH:** Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.
GOOD (B)	**SALT MARSH:** Vegetation structure shows minor alterations from minimally disturbed natural conditions. Structural indicators of degradation are minor.
FAIR (C)	**SALT MARSH:** Vegetation structure is moderately altered from minimally disturbed natural conditions. Structural indicators of degradation are moderate.
POOR (D)	**SALT MARSH:** Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong.

Metric Rating	*v5: Vegetation Structure Variant: BOG & FEN*
EXCELLENT (A)	**BOG & FEN**: Peatland is supporting structure with little to no evident influence of negative anthropogenic factors. Some very wet peatlands may not have any woody vegetation or only scattered stunted individuals. Woody vegetation mortality is due to natural factors. The site meets near minimally disturbed condition.
GOOD (B)	**BOG & FEN**: Generally, peatland structure has only minor negative anthropogenic influences present or the site is still recovering from major past human disturbances. Mortality or degradation due to grazing, recreational vehicles, limited timber harvesting, peat mining, or other anthropogenic factors may be present although not widespread. The site can be expected to meet minimally disturbed condition in the near future if negative influences do not continue.
FAIR (C)	**BOG & FEN**: Peatland structure has been moderately influenced by negative anthropogenic factors. Expected structural classes are not present. Human factors may have diminished the condition for woody vegetation. The site will recover to minimally disturbed condition only with the removal of degrading influences and moderate recovery times.
POOR (D)	**BOG & FEN:** Expected peatland structure is absent or much degraded due to anthropogenic factors such as peat mining. Woody regeneration is minimal and existing structure is in poor condition, unnaturally sparse, or depauperate. Recovery to minimally disturbed condition is questionable without restoration or will take many decades.

Metric Rating	*v6: Vegetation Structure Variant: AQUATIC VEGETATION [Metric variant under development]*
EXCELLENT (A)	**AQUATIC VEGETATION**: Vegetation structure is at or near minimally disturbed natural conditions. No structural indicators of degradation evident.
GOOD (B)	**AQUATIC VEGETATION:** Vegetation structure shows minor alterations from minimally disturbed natural conditions. Structural indicators of degradation are minor.
FAIR (C)	**AQUATIC VEGETATION**: Vegetation structure is moderately altered from minimally disturbed natural conditions. Structural indicators of degradation are moderate.
POOR (D)	**AQUATIC VEGETATION**: Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong.

7.2.2.2 Hydrology

H1. Water Source

This is an assessment of the extent, duration, and frequency of saturated or ponded conditions within a wetland system, as affected by the kinds of direct inputs of water into, or any diversions of water away from, the system.

The natural sources of water for freshwater wetlands are mainly direct rainfall, groundwater discharge, runoff, and riverine flows. Whether the wetlands are perennial or seasonal, alterations in the water

sources result in changes in either the high water or low water levels. Such changes can be assessed based on the patterns of plant growth along the wetland margins or across the bottom of the wetlands. For sloped wetlands, such as seeps and springs, ground water is the primary source of water. It is generally expected that the source is perennial and relatively constant in volume throughout most years. The water source can be assessed, therefore, based on plant indicators of its permanence and consistency (Collins et al. 2007).

The natural source of water for estuarine wetlands is primarily tidal; other sources are direct rainfall, runoff, and riverine flows.

Metric Ratings:

Metric Rating	***V1: Water Source variant: RIVERINE (Non-tidal) Wetlands***
EXCELLENT (A)	Water source is natural, site hydrology is dominated by precipitation, groundwater, or overbank flow. There is no indication of direct artificial water sources. Land use in the local drainage area of the wetland is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but wetland directly receives occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic input include developed or agricultural land (<20%) in the immediate drainage area of the wetland, some road runoff, small storm drains or other minor point source discharges emptying into the wetland.
FAIR (C)	Water source is moderately impacted by anthropogenic sources. Indications from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage basin or moderate point source discharges into or adjacent to the site, such as many small storm drains or a few large ones.
POOR (D)	Water source is substantially impacted by anthropogenic sources. Indications of anthropogenic sources include >60% developed or agricultural land adjacent to the wetland, and major point source discharges into or adjacent to the wetland.

Metric Rating	***V2: Water Source variant: DEPRESSION, LACUSTRINE, SLOPE***
EXCELLENT (A)	Water source is natural: site hydrology is dominated by precipitation, groundwater, natural runoff from an adjacent freshwater body. There is no indication of direct artificial water sources. Land use in the local drainage area of the site is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but site directly receives occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic input include developed land or agricultural land (<20%) in the immediate drainage area of the site, small storm drains or other local discharges emptying into the site, or some road runoff. No large point sources discharge into or adjacent to the site.
FAIR (C)	Water source is moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage basin or many small storm drains or a few large ones, or moderate road runoff.
POOR (D)	Water source is substantially impacted by anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or other artificial hydrology). Indications of substantial artificial hydrology include >60% developed or agricultural land adjacent to the site, and the presence of major point sources that discharge into or adjacent to the site, or large amounts of road runoff.
Metric Rating	***V3: Water Source variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS***
EXCELLENT (A)	Water source is natural, and site hydrology is dominated by precipitation. There is no indication of direct artificial water sources. Land use in the local drainage area of the site is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but site directly receives occasional or small amounts of inflow from anthropogenic sources, or is ditched, causing peatland to dry out more quickly. Indications of anthropogenic input include developed land or agricultural land (<20%) in the immediate drainage area of the site; or the presence of small storm drains, ditches, or other local discharges emptying into the site; road runoff; or the presence of scattered homes along the wetland that probably have septic systems. No large point sources discharge into or adjacent to the site.
FAIR (C)	Water source is moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage basin, the presence of a many small storm drains or a few large ones, or moderate amounts of road runoff.
POOR (D)	Water source is substantially impacted by anthropogenic sources, indications of anthropogenic sources include (>60% developed or agricultural lands in the immediate drainage basin), large amounts of road runoff, impoundments or diversions of water or other input into or withdrawals directly from the site and its encompassing wetland, or from areas adjacent to the site or its wetland.

H2. Hydroperiod

Assessment of the natural condition of a wetland system's hydroperiod.

- **Riverine**
  Estimate the degree to which channel stability is intact.

  Indicators of channel equilibrium, degradation, aggradation (Collins et al. 2007):
  Channel Equilibrium
  - well-defined high water line corresponds to lower limit of vegetation
  - bankfull stage clearly indicated by an obvious floodplain
  - little or no active undercutting or burial of riparian vegetation

  Degradation
  - deeply undercut banks with exposed living roots of trees or shrubs
  - abundant bank slides or slumps
  - channel bed appears scoured to bedrock or dense clay
  - channel bed lacks any fine-grained sediment
  - riparian vegetation may be declining in stature or vigor

  Aggradation
  - channel lacks a well-defined usual high water line
  - active floodplain with fresh splays of sediment covering older soils or recent vegetation
  - partially buried tree trunks or shrubs
  - cobbles and/or coarse gravels recently deposited on floodplain
  - partially buried, or sediment-choked, culverts

- **Palustrine Wetlands**
  Assess the degree of alteration (if any) to expected natural patterns of saturation, inundation, or drawdown. Indicators of reduced extent and duration of inundation or saturation (Collins et al.2007):
  - upstream spring boxes, diversions, impoundments, pumps, ditching or draining from the wetland
  - evidence of aquatic wildlife mortality
  - encroachment of terrestrial vegetation
  - stress or mortality of hydrophytes
  - compressed or reduced plant zonation
  - excessive exotic vegetation along perimeter
  - desiccation when comparable wetlands are typically inundated or saturated

  Indicators of increased extent and duration of inundation or saturation (Collins et al. 2007):
  - berms, dikes, or other water control features that increase duration of ponding
  - pumps, diversions, ditching or draining into the wetland
  - late-season vitality of annual vegetation
  - recently drowned riparian or terrestrial vegetation
  - extensive fine-grain deposits on wetland margins

- **Estuarine**
  Assess the degree of alteration (if any) to expected natural tidal patterns.

Metric ratings:

Metric Rating	*V1: Hydroperiod variant: RIVERINE (Non-tidal)*
EXCELLENT (A)	Hydroperiod (flood frequency, duration, level, and timing) is characterized by natural patterns, with no major hydrologic stressors present. The channel/riparian zone is characterized by equilibrium conditions, with no evidence of severe aggradation or degradation indicative of altered hydroperiod (see field indicators table).
GOOD (B)	Hydroperiod inundation and drying patterns (flood frequency, duration, level, and timing) deviate slightly from natural conditions due to presence of stressors such as: flood control dams upstream or downstream, small ditches or diversions; berms or roads at/near grade; minor trampling by livestock; or minor flow additions. If wetland is artificially controlled, the management regime closely mimics a natural analog (it is very unusual for a purely artificial wetland to be rated in this category). The channel/riparian zone is characterized by some aggradation or degradation, none of which is severe, and the channel seems to be approaching an equilibrium form (see field indicators table).
FAIR (C)	Hydroperiod filling or inundation and drying patterns (flood frequency, duration, level, and timing) deviate moderately from natural conditions due to presence of stressors such as: flood control dams upstream or downstream moderatelyaffect hydroperiod; ditches or diversions 1–3 ft. deep; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. If wetland is artificially controlled, the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels. The channel/riparian zone is characterized by severe aggradation or degradation (see field indicators table).
POOR (D)	Hydroperiod filling or inundation and drawdown (flood frequency, duration, level, and timing) deviate substantially from natural conditions because of high intensity alterations such as: flood control dams upstream or downstream moderately to substantially affect hydroperiod; a 4-lane highway; diversions >3ft. deep that withdraw a significant portion of flow; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be substantially constricted, blocking most flow. If wetland is artificially controlled, the site is actively managed and not connected to any natural season fluctuations, but the hydroperiod supports natural functioning of the wetland. The channel is concrete or artificially hardened (see field indicators table).

Metric Rating	*V2: Hydroperiod variant: DEPRESSION, LACUSTRINE, SLOPE (including Playas)*
EXCELLENT (A)	Hydroperiod characterized by natural patterns associated with inundation – drawdown, saturation, and seepage discharge. There are no major hydrologic stressors that impact the natural hydroperiod (see field indicators table).
GOOD (B)	Hydroperiod filling or inundation patterns deviate slightly from natural conditions due to presence of stressors such as: small ditches or diversions; berms or roads at/near grade; minor pugging by livestock; or minor flow additions. Outlets may be slightly

	constricted. Playas are not significantly impacted pitted or dissected. If wetland is artificially controlled, the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).
FAIR (C)	Hydroperiod filling or inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: ditches or diversions 1–3 ft. deep; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; shallow pits within playas; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. If wetland is artificially controlled, the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.
POOR (D)	Hydroperiod filling or inundation and drawdown of the AA deviate substantially from natural conditions from high intensity alterations such as: a 4-lane highway; large dikes impounding water; diversions >3 ft. deep that withdraw a significant portion of flow, deep pits in playas; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be substantially constricted, blocking most flow. If wetland is artificially controlled, the site is actively managed and not connected to any natural season fluctuations, but the hydroperiod supports natural functioning of the wetland.

Metric Rating	***V3: Hydroperiod variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS***
EXCELLENT (A)	Hydroperiod is characterized by natural patterns of filling, inundation saturation and drying or drawdowns. There are no major hydrologic stressors that impact the natural Hydroperiod (see field indicators table)
GOOD (B)	Hydroperiod filling or inundation patterns deviate slightly from natural conditions due to presence of stressors such as: small ditches or diversions; berms or roads at/near grade; minor pugging by livestock; or minor flow additions. Outlets may be slightly constricted. If wetland is artificially controlled, the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).
FAIR (C)	Hydroperiod filling or inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: ditches or diversions 1–3 ft. deep; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. If wetland is artificially controlled, the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.
POOR (D)	Hydroperiod filling or inundation and drawdown deviate substantially from natural conditions from high intensity alterations such as: a 4-lane highway; large dikes impounding water; diversions >3ft. deep that withdraw a significant portion of flow; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be significantly constricted, blocking most flow. If wetland is artificially controlled, the site is actively managed and not connected to any natural season fluctuations, but the hydroperiod supports natural functioning of the wetland. Hydroperiod is dramatically different from natural. Upstream diversions severely stress the wetland. If wetland is artificially controlled, hydroperiod does not mimic

	natural seasonality.

Metric Rating	*V4: Hydroperiod variant: ESTUARINE FRINGE (Tidal)*
EXCELLENT (A)	Area is subject to the full tidal prism, with two daily tidal minima and maxima. Storm tides, tidal river flooding and onshore wind-maintained high tides causing short-term changes in tidal amplitude are within the expected norm. Lagoons: Area subject to natural inter-annual tidal fluctuations (range may be severely muted or vary seasonally) and is episodically fully tidal by natural breaching or overwash due to fluvial flooding, storm surge or wind-driven tides (extreme highs or lows).
GOOD (B)	Area is subject to minor reduced, or muted, tidal prism, although two daily minima and maxima are observed. Lagoons: Area is subject to full tidal range more often than would be expected under natural circumstances due to artificial breaching of the tidal barrier.
FAIR (C)	Area is subject to moderately muted tidal prism, with tidal fluctuations evident only in relation to extreme daily highs or spring tides. Lagoons: Area is subject to full tidal range less often than would be expected under natural circumstances due to management of the breach to prevent its opening.
POOR (D)	Area is subject to substantially muted tidal prism; there is inadequate drainage, such that the marsh tends to remain flooded during low tide. Lagoons: Area appears to have no episodes of full tidal exchange.

H3. Hydrologic Connectivity

Assessment of the natural condition of a wetland system's hydrologic connectivity.

- **Riverine**
  For the wetland system, estimate by observing signs of overbank flooding, channel migration, channel incision, and geomorphic modifications.

- **Palustrine Wetlands**
  Assess the ability of the water to flow into or out of the wetland system, or to inundate adjacent areas (or lack thereof in the special case of bogs). This metric is scored by assessing the degree to which the lateral movement of flood waters or the associated upland transition zone of the wetland system is restricted by unnatural features such as levees or road grades (Collins et al. 2007).

- **Estuarine**
  Assess the degree of alteration (if any) to expected natural patterns of tidal water movement.

Metric Rating:

Metric Rating	*V1: Hydrologic Connectivity variant: RIVERINE (Non-tidal)*
EXCELLENT (A)	Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain. Channel is not unnaturally entrenched.
GOOD (B)	Minimally disconnected from floodplain. Up to 25% of stream banks are affected due to dikes, rip rap and/or elevated culverts. Channel is somewhat entrenched (overbank flow occurs during most floods).
FAIR (C)	Moderately disconnected from floodplain due to multiple geomorphic modifications. Between 25 and 75% of stream banks are affected (e.g., dikes, tide gates, rip rap, concrete, and elevated culverts). Channel is moderately entrenched ((overbank flow only occurs during moderate to severe floods).
POOR (D)	Channel is severely entrenched and entirely or extensively disconnected from the floodplain; >75% of stream banks are affected due to dikes, tide gates, rip rap, concrete, and elevated culverts. Channel is substantially entrenched (overbank flow never occurs or only during severe floods).

Metric Rating	*V2: Hydrologic Connectivity variant: DEPRESSION, LACUSTRINE, SLOPE including Playa variant*
EXCELLENT (A)	No unnatural obstructions to lateral or vertical movement of ground or surface water. Rising water in the site has unrestricted access to adjacent upland, without levees, excessively high banks, artificial barriers, or other obstructions to the lateral movement of flood flows. If perched water table, then impermeable soil layer (fragipan or duripan) intact. Playa: Surrounding land cover / vegetation does not interrupt surface flow. No artificial channels feed water to playa.
GOOD (B)	Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks. Less than 25% of the site is restricted by barriers to drainage. Restrictions may be intermittent along the site, or the restrictions may occur only along one bank or shore. Flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment. If perched then impermeable soil layer partly disturbed (e.g., from drilling or blasting). Playa: Surrounding land cover / vegetation does not interrupt surface flow. Artificial channels may feed minor amounts of excess water to playa.
FAIR (C)	Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks. Between 25–75% of the site is restricted by barriers to drainage. Flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment. If perched, then impermeable soil layer moderately disturbed (e.g., by drilling or blasting). Playa: Surrounding land cover / vegetation may interrupt surface flow. Artificial channels may feed moderate amounts of excess water to playa.
POOR (D)	Essentially no hydrologic connection to adjacent wetlands or uplands. Most or all water stages are contained within artificial banks, levees, sea walls, or comparable features. Greater than 75% of wetland is restricted by barriers to drainage. If perched, then impermeable soil layer strongly disturbed. Playa: Surrounding land cover / vegetation may dramatically restrict surface flow. Artificial channels may feed significant amounts of excess water to playa.

Metric Rating	*V3: Hydrologic Connectivity variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS*
EXCELLENT (A)	Groundwater connectivity reflects the peatland type (i.e., ombrotrophic bogs have little to no connectivity; fens indicate some connectivity…) Surrounding land cover / vegetation does not interrupt surface flow. No artificial channels feed water to wetland.
GOOD (B)	Minor hydrological connectivity, as caused by human activity (e.g., ditching). Surrounding land cover / vegetation does not interrupt surface flow. Artificial channels may feed minor amounts of excess water to wetland.
FAIR (C)	Moderate connectivity caused by human activity (e.g., ditching). Surrounding land cover / vegetation may interrupt surface flow. Artificial channels may feed moderate amounts of excess water to wetland.
POOR (D)	Substantial to full connectivity caused by human activity. Surrounding land cover / vegetation may dramatically restrict surface flow. Artificial channels may feed significant amounts of excess water to wetland.

Metric Rating	*V4: Hydrologic Connectivity variant: ESTUARINE FRINGE (Tidal)*
EXCELLENT (A)	Tidal channel sinuosity reflects natural processes; absence of channelization. Marsh receives unimpeded tidal flooding. Total absence of tide gates, flaps, dikes culverts, or human-made channels.
GOOD (B)	Tidal channel sinuosity minimally altered: marsh receives essentially unimpeded tidal flooding, with few tidal channels blocked by dikes or tide gates, and human-made channels are few. Culvert, if present, is of large diameter and does not significantly change tidal flow, as evidenced by similar vegetation on either side of the culvert.
FAIR (C)	Tidal channel sinuosity moderately altered: marsh channels are frequently blocked by dikes or tide gates. Tidal flooding is somewhat impeded by small culvert size, as evidenced in obvious differences in vegetation on either side of the culvert.
POOR (D)	Tidal channel sinuosity extensively altered: tidal channels are extensively blocked by dikes and tide gates; evidence of extensive human channelization. Tidal flooding is totally or almost totally impeded by tidal gates or obstructed culverts.

7.2.2.4 Soil / Substrate

Definition: An indirect measure of soil condition based on stressors that increase the potential for erosion or sedimentation of the soils, assessed by evaluating intensity of human impacts to soils on the site.
Metric rating:

Metric Rating	*V1: Soil Condition variant: ALL FRESHWATER NON-TIDAL WETLANDS* (FLOODED & SWAMP FOREST, FRESHWATER MARSH, WET MEADOW & SHRUBLAND, BOG & FEN, AQUATIC VEGETATION)
EXCELLENT (A)	Little bare soil, OR bare soil and soil disturbed areas are limited to naturally caused disturbances such as flood deposition or game trails, OR soil is naturally

	bare (e.g., playas). No disturbances are evident from trampling, erosion, soil compaction, ruts, sedimentation, invasive earthworms, or boat traffic.
GOOD (B)	Small amounts of bare or disturbed soil are present, but the extent and impact is minimal. Examples include disturbance from cattle (trampling or heaving grazing that leads to erosion), compaction or trampling by machinery, ruts or other disturbances from ATV or other vehicular activity, sedimentation due to human causes, invasive earthworms, or effects of boat traffic. The depth of disturbance is limited to only several centimeters (a few inches) and does not show evidence of ponding or channeling of water.
FAIR (C)	Moderate amounts of bare or disturbed soil are present, and the extent and impact is moderate. Examples include disturbance from cattle (trampling or heaving grazing that leads to erosion), compaction or trampling by machinery, ruts or other disturbances from ATV or other vehicular activity, sedimentation due to human causes, invasive earthworms, or effects of boat traffic. The depth of disturbance may extend 5–10 cm (2–4 inches), or localized deeper ruts, and shows some evidence of ponding or channeling of water.
POOR (D)	Substantial amounts of bare or disturbed soil are present, with extensive and long lasting impacts. Examples include disturbance from cattle (trampling or heaving grazing that leads to erosion), compaction or trampling by machinery, ruts or other disturbances from ATV or other vehicular activity, sedimentation due to human causes, invasive earthworms, or effects of boat traffic. The depth of disturbance extends > 10 cm (4 inches), or deeper ruts are widespread, and show some evidence of extensively altering hydrology, e.g., ponding or channeling of water.

Metric Rating	***V2: Soil Condition variant: ESTUARINE WETLANDS*** (SALT MARSH, and tidal variants of FRESHWATER MARSH, WET MEADOW & SHRUBLAND)
EXCELLENT (A)	Excluding mud flats, bare or disturbed soils are naturally occurring and largely limited to salt pannes.
GOOD (B)	Small amounts of bare or disturbed soil areas caused by rafts of anthropogenic debris (killing marsh vegetation and creating artificial pannes), ditch spoils impounding water and forming artificial pannes, trampling by livestock, and erosion of marsh and channel banks due to excavation by marine traffic and/or altered current/tidal patterns resulting from deficient culverts (leading to erosion).
FAIR (C)	Moderate amounts of bare or disturbed soil areas caused by rafts of anthropogenic debris (killing marsh vegetation and creating artificial pannes), ditch spoils impounding water and forming artificial pannes, trampling by livestock, and erosion of marsh and channel banks due to excavation by marine traffic and/or altered current/tidal patterns resulting from deficient culverts (leading to erosion).
POOR (D)	Substantial amounts of bare or disturbed soil areas caused by rafts of anthropogenic debris (killing marsh vegetation and creating artificial pannes), ditch spoils impounding water and forming artificial pannes, trampling by livestock, and erosion of marsh and channel banks due to excavation by marine traffic and/or altered current/tidal patterns resulting from deficient culverts (leading to erosion).

7.2.4. Size

Comparative size:

Using Maine's size rank specs, (see size rank specs table), assign a rank to the assessed wetlands within the EIA database.

Change in size:

Using professional judgment and tools such as aerial imagery (historic or present) and local knowledge, make an assessment about the size of the current extent of the wetland compared to its historic extent.

A = Occurrence is at or only minimally reduced (<3%) from its original natural extent due to human activity
B = Occurrence is somewhat modestly reduced (3-10%) from its original natural extent
C = Occurrence is modestly reduced (10-30%) from its original natural extent
D = Occurrence is substantially reduced (>30%) from its original natural extent

8. EIA score roll-up

Final scores are automatically rolled up in EIA within the database following Faber-Langendoen, et al., 2016a. As of December, 2016, integrating size rank has been done through weighted averaging (12.5% of final score) although a categorical approach has been proposed by Faber-Langendoen, et al., 2016a.

8.1. ADAPTING METHODS OVER TIME

It is important to remember that our efforts to assess ecological integrity are approximations of our current understanding of wetland systems. In reality, these systems are far too complex to be fully represented by a suite of metrics and attributes. Moreover, our rapid metrics, indices, and scorecards must be flexible enough to allow change over time as our knowledge grows. What is important is that we present as clearly as possible methods used in conducting our assessments, so that communication and understanding is fostered among people with different backgrounds, goals, and points of view.

9. LITERATURE CITED

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10. APPENDICES
10.1. SOIL TEXTURE

Organic soil texture
Use the guide below to determine muck and peat types of organic soils. "

Determination of Peatlands vs. Mineral Soil Wetlands

Prepared by Greg Edinger, Ecologist, NY Natural Heritage Program, May 6, 2002

Definitions from Ecological Communities of NY State (Reschke 1990, Edinger et al. 2002)

Mineral soil: soil with less than 20% organic matter if the mineral fraction contains no clay; or less than 30% organic matter if the mineral fraction contains 50% or more clay. For more information see Appendix D in: Cowardin *et al.* (1979).

Muck - sapric: highly decomposed organic material in which the original plant parts are not recognizable; contains more mineral matter and is usually darker in color than peat (von Post H7 to H10; see below)

Peat - hemic: the partially-decayed remains of plant material accumulating on wet sites because of water-logging; unconsolidated soil material consisting of accumulated, slightly decomposed organic matter (von Post H4 to H6).

Peat - fibric: the partially-decayed remains of plant material accumulating on wet sites because of water-logging; unconsolidated soil material consisting of accumulated, undecomposed organic matter (von Post H1 to H3).

From Community Field Form Instruction (Edinger et al. 2000)

Average organic soil texture - average texture of the top meter of organic soil. See the Von Post decomposition scale below for organic soils.

von Post* scale of peat decomposition:

- H1: Completely undecomposed peat (but not "live"); only clear water can be squeezed out.
- H2: Almost undecomposed and mud-free peat; water that is squeezed out is almost clear and colorless.
- H3: Very little decomposed and very slightly muddy peat; when squeezed water is obviously muddy but no peat passes through fingers. Residue retains structure of peat.
- H4: Poorly decomposed and somewhat muddy peat; when squeezed, water is muddy. Residue muddy but it clearly shows growth structure of peat.
- H5: Somewhat decomposed, rather muddy peat; growth structure visible but somewhat indistinct; when squeezed some peat passes through fingers but mostly very muddy water. Press residue muddy.
- H6: Somewhat decomposed, rather muddy peat; growth structure indistinct; less than 1/2 of peat passes through fingers when squeezed. Residue very muddy, but growth structure more obvious than in unpressed peat.
- H7: Rather well-decomposed, very muddy peat; growth structure visible, about 1/2 of peat squeezed through fingers. If water is squeezed out, it is porridge-like.
- H8: Well-decomposed peat; growth structure very indistinct; about 2/3 of peat passes through fingers when pressed, and sometimes a somewhat porridge-like liquid. Residue consists mainly of roots and resistant fibers.
- H9: Almost completely decomposed and mud-like peat; almost no growth structure visible. Almost all peat passes through fingers as a homogeneous porridge if pressed.
- H10: Completely decomposed and muddy peat; no growth structure visible; entire peat mass can be squeezed through fingers.

Adapted from: Damman, A.W.H. and T.W. French. 1987. The ecology of peat bogs of the glaciated northeastern United States: a community profile. U.S. Fish and Wildlife Service. Washington, D.C.

Peatland and mineral soil wetlands are distinguished on the depth of peat. Peatlands generally should have at least 20 cm of peat. This depth allows occurrences with shallow peat over bedrock to be classified as peatlands (e.g., sliding fen, rich sloping fen, perched bog). This specification is workable in most cases. Classifying occurrences with muck soil poses a greater challenge, especially if the occurrence has deep muck, or shallow peat (<20 cm) over deep muck. Classification of muck soil wetlands is probably best done by looking at the dominant and characteristic vegetation and comparing to the closest peatland or mineral soil wetland community.

Mineral soil texture

For mineral soils, use the key below to assess soil texture of the A or top horizon. Focus on the broad categories only, as described below. Document the finer levels, only as needed to validate the higher level. For example, if you are unsure if texture is clay loam or silty clay loam, check both – the main thing is that you are sure it is CLAYEY.

Mineral Soils: soil with less than 20% organic matter if the mineral fraction contains no clay; or less than 30% organic matter if the mineral fraction contains 50% or more clay. For more information see Appendix D in: Cowardin et al. (1979). Four broad categories help group the individual textures (Sandy, Sandy Loam, Loamy, Clayey, as taken from Beckingham et al. 1996).

Simplified Key to Mineral Soil Texture (Brady and Weil 2002):

A1 Soil does not remain in a ball when squeezed.....**sand** (SANDY)

A2 Soil remains in a ball when squeezed.....B

B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon.....……**loamy sand** (SANDY)

B2 Soil makes a ribbon; may be very short.....C

C1 Ribbon extends less than 1 inch before breaking.....D

C2 Ribbon extends 1 inch or more before breaking.....E

D1 Add excess water to small amount of soil. Soil feels at least slightly gritty……**loam** (slightly gritty) (LOAMY) or **sandy loam** (grittiness prominent, grinding noise is audible) (SANDY LOAM)

D2 Soil feels smooth, floury.....**silt loam** (LOAMY)

E1 Soil makes a ribbon that breaks when 1- 2 inches long; cracks if bent into a ring.....F

E2 Soil somewhat shiny, makes a ribbon 2+ inches long; does not crack when bent into a ring……..……..(CLAYEY)…..…… ……G

F1 Add excess water to small amount of soil; soil feels at least slightly gritty.....……
sandy clay loam (grittiness prominent, grinding noise is audible (CLAYEY), or
clay loam (slightly gritty) (CLAYEY)

F2 Soil feels smooth, floury.…….....
silty clay loam (very smooth) (CLAYEY), or
silt (slightly gritty) (LOAMY)

G1 Add excess water to a small amount of soil; soil feels at least slightly gritty.…….……
sandy clay (grittiness is dominant feel, grinding noise audible) (CLAYEY), or
silt clay (slightly gritty, floury, very strong ribbon) (CLAYEY)

G2 Soil feels smooth, very sticky, very strong ribbon.....**clay** (CLAYEY)