NATURESERVE & NH NATURAL HERITAGE BUREAU

LEVEL 2
ECOLOGICAL INTEGRITY ASSESSMENT MANUAL FOR NEW HAMPSHIRE

WETLAND SYSTEMS

June, 2022

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This manual is a modification of the following document:

Faber-Langendoen, D., W. Nichols, K. Walz, J. Rocchio, J. Lemly, and L. Gilligan, 2016. NatureServe Ecological Integrity Assessment: Protocols for Rapid Field Assessment of Wetlands. NatureServe, Arlington, VA.

1. EXECUTIVE SUMMARY

Application of the method described in this manual requires a moderate level of ecological knowledge. The surveyor should classify the wetland system (the assessment area being evaluated) as early in the evaluation process as possible, either pre-field using GIS data layers, the wetland system key, and other information or during the field survey once dominant plant species are known. Once classified, it is important for the surveyor to then reference the system rank specifications (Nichols 2015) to review information specific to metrics being assessed and to better understand expected structure, composition, and function for naturally occurring examples of the system type. Referencing rank specifications for the classified system type will aid in properly assessing metrics and the ecological integrity of the wetland system.

This manual provides instructions for collecting field data and completing forms on Level 2 (rapid field based) ecological integrity assessments (EIAs) for wetland systems in New Hampshire. A land use index calculated with a GIS (or manually) is also described. Steps and forms involved in an EIA wetland evaluation include:

Pre-field:

- ***Landscape Context & Buffer Assessment***
- ***Level 2 Stressor Checklist***

Field:

- ***Level 2 Rapid Recon Form***
- ***Level 2 Metric Form***

For each of the EIA metrics described in this manual, see Faber-Langendoen et al. (2012) for additional information on background, rationale, rating, scaling, and citations.

2. ACKNOWLEDGEMENTS

NatureServe’s manual (Faber-Langendoen 2010) and protocols (Faber-Langendoen et al. 2012) have been adopted by NHB and adapted for New Hampshire, based on extensive testing since 2009. The design of this EIA wetland system manual is based on a broad effort 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 with federal partners, particularly, the Environmental Protection Agency (EPA), which provided funds to NatureServe to work on ecological integrity assessments for all wetland types in the U.S. This manual and New Hampshire based EIA projects were supported by EPA Region I Wetlands Program Development Grants.

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3. 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 historical 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 presence and 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 historical 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?" The EIA method builds on NatureServe and the Network of Natural Heritage Program's historical approaches to assessing condition. However, earlier methods are adapted by building on the variety of existing wetland rapid assessment methods, and the 3-level approach of the U.S. Environmental Protection Agency and others.

Characteristics of the EIA include:

- Reliance on a general conceptual model that:
    - Identifies the major ecological factors – landscape context, buffer, size, vegetation, soil, and hydrology
    - Provides a narrative description of declining integrity levels based on changes to ecological factors
    - Uses a metrics-based approach to assess the levels of integrity
- Use of a Level 2 rapid ground-based approach (see Faber-Langendoen et al. 2012; Faber-Langendoen 2010)
- A remote sensing approach for assessing landscape context and buffer using GIS prior to a site visit
- Ratings and thresholds for each metric based on "normal' or "natural range of variation" benchmarks
- Use of ecological classifications to refine assessment of metrics and overall ecological integrity
- 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 EIA method enables consistent and repeated assessment of biodiversity sites to determine if value is conserved, enhanced, or diminished. For each of the EIA metrics described in this manual, see Faber-Langendoen et al. (2012) for additional information on background, rationale, rating, scaling, and citations.

4. PRE-FIELD ASSESSMENT AND PLANNING

4.1. Identify EIA Level 2 Assessment Area

Using data layers in GIS (e.g., NWI and most recent aerials) and the wetland system key, identify the wetland system of interest. Draw a polygon around the wetland system perimeter.

4.2. Landscape Context

Evaluating landscape context is primarily a pre-field office assessment using one metric:

a) Land Use Index

4.2.1. Land Use Index

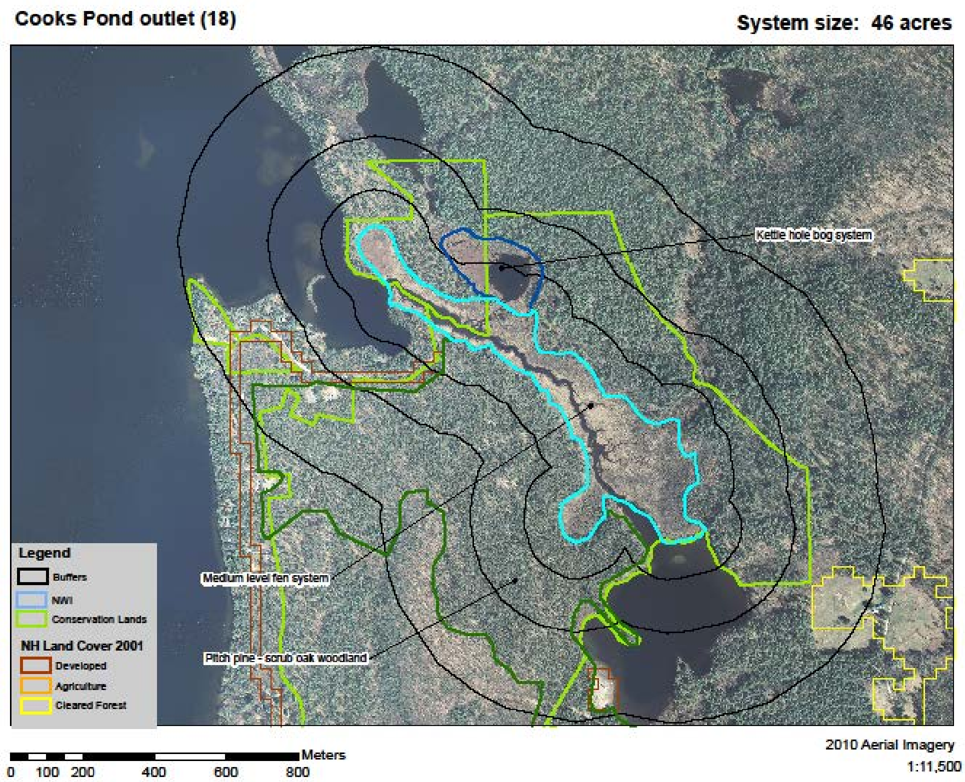
Calculate the Land Use Index score using Landsat land cover data in a GIS following the guidelines below and instructions in appendix (the Land Use Index can also be calculated manually in a straightforward manner by using aerial photography and the Land Use Coefficient table below). ***Important Note:*** If calculated in a GIS, the Land Use Index score may be adjusted based on review of the most current aerial photographs and/or additional data collected in the field (use comment field to document any adjustments).

1. Use values in the "Land Use Coefficient Table" below to score land use surrounding the wetland system (proportional average of all land uses in the 0-500 meter zone).

Land Use Coefficient Table*

Current Land Use	Coefficient
Paved roads; parking lots; domestic or commercially developed buildings; mining (gravel pit, quarry, open pit, strip mining)	0
Unpaved roads (driveway, rural, logging); abandoned mines	1
Agriculture (tilled crop production); intensively developed vegetation (golf courses, lawns)	2
Vegetation conversion (clearcut)	3
Heavy grazing on pasture lands	3
Heavy logging with 50–75% of trees >30 cm dbh removed	4
Intense recreation (ATV, camping, sport fields, popular fishing spot); military training areas	4
Permanent crop agriculture (vineyards, orchards, nurseries, berry production, introduced hay field and pastures)	4
Commercial tree plantations; holiday tree farms	5
Dam sites and flood disturbed shorelines around water storage reservoirs	5
Recent old fields and other disturbed fallow lands dominated by ruderal and exotic species	5
Moderate grazing on pasture lands	6
Moderate recreation (high-use trail)	7
Formerly fallow mature old fields and other fallow lands with natural composition	7
Selective logging with less than 50% of trees >30 cm dbh removed	8
Native grassland with light grazing or haying; natural area with light recreation (low-use trail)	9
Natural area; land managed for native vegetation	10

* Modified from Hauer et al. 2002.



Land Use Index zones: Adjacent Land Use, Nearby Land Use, and Distant Land Use zones around a medium level fen system.

2. Calculate the overall Land Use Index score, making adjustments as needed based on review of the most current aerial photographs and/or additional data collected in the field (document any adjustments in comment field on ***Metric Form***). Determine the overall Land Use Index rank (letter grade) for the wetland system using the rating table below.

Land Use Index Rating Table				
Overall Land Use Index Score	10–9.5	9.49–8.0	7.99–4.0	<4.0
Overall Land Use Index Rank	A (Excellent)	B (Good)	C (Fair)	D (Poor)

4.3. Buffer

Evaluating buffer is primarily a pre-field office assessment using two metrics:

a) Perimeter with Natural Buffer
b) Width of Natural Buffer

4.3.1. Perimeter with Natural Buffer

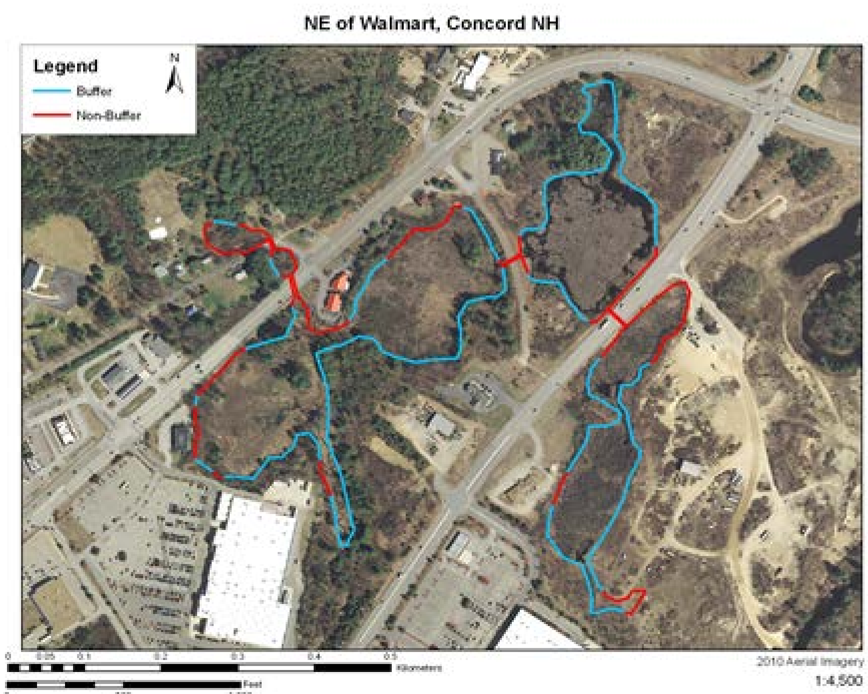
Estimate the percent of the wetland system perimeter with a vegetated, natural buffer. Use a 10 m minimum buffer width and length. Once you have estimated the percent of the wetland system perimeter with a buffer, determine the rank (letter grade) by referencing the A–D rating criteria on the ***Metric Form***.

Open water adjacent to the wetland system (e.g., lake, large river, or lagoon) is included as a buffer. See guidelines and figure below.

Guidelines for Identifying Wetland Buffers & Non-Buffers/Breaks in Buffers*

Examples of Land Covers Included in Buffers	Examples of Land Cover that are Non-Buffer & Create a Break in Buffer
Natural upland or wetland habitats; open water; vegetated levees; swales and ditches with natural substrate; foot, bike, or horse trails; pastures subject to light grazing; small power lines; non-intensive plantations**	Land cover not listed under "Examples of Land Covers Included in Buffers" is considered non-buffer and a break in buffer when ≥5 meters in length and width with exceptions for narrower structures such as sound walls or inhibiting fences (see below). If other exceptions are encountered that should be considered non-buffer, document as such and note new exception in comment field on Metric Form. Examples of Non-Buffers/Breaks in Buffers include: Dirt and paved roads; other paved areas; ATV/dirt bike/snowmobile trail; bridges; culverts; railroads; residential areas; sound walls; fences that interfere with movements of water, sediment, or wildlife critical to overall wetland functions; agriculture; intensive plantations; orchards & vineyards; pastures subject to heavy grazing pressure; lawns, sports fields, & golf courses; moderate to major power transmission lines; wind farms.

*Adapted from Collins et al. 2007.
**These include plantations where the overstory is allowed to mature and may regain some native component and where 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 more typical of intensive plantations).



Example calculation of Perimeter with Natural Buffer: In this case, about 64% of the system perimeter has buffer (metric rank = C+).

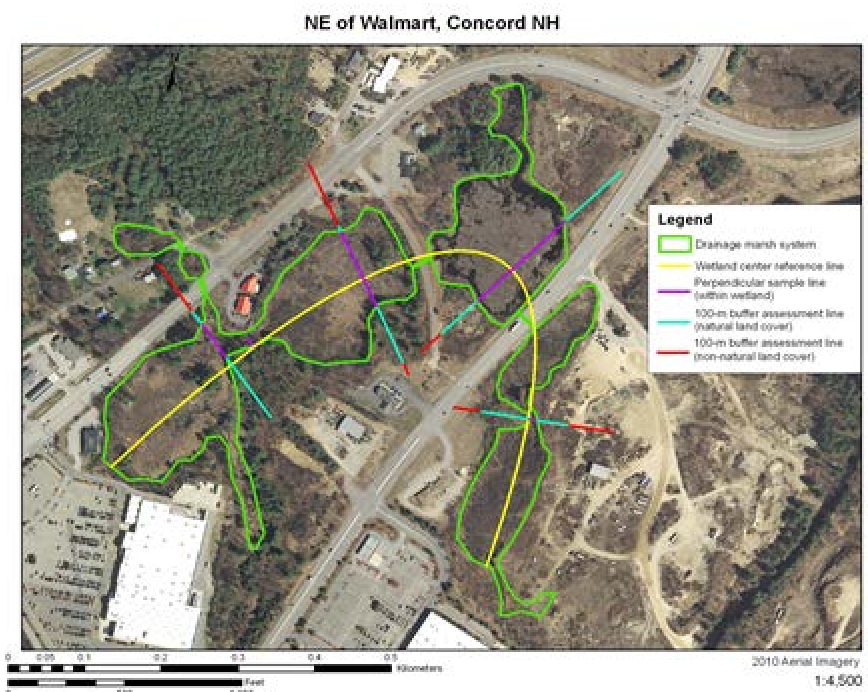
4.3.2. Width of Natural Buffer

1. Using the most recent aerials, draw on a printout eight straight lines radiating out from the approximate center of the wetland system, each extending 100 m beyond the edge of the system. If the polygon is very long or large, more spokes may be needed to adequately measure the average

width of the natural buffer.

2. For wetland polygons lacking a centroid from which eight spokes could reasonably radiate from, draw a line as near to the center of the wetland polygon's long axis as possible where the line follows the broad shape of the polygon, avoiding finer level twists and turns (see figure below). Once you have determined the length of the line along the wetland's long axis, divide the line by five to pinpoint four equally spaced locations along the axis. At each of the four points, draw a line perpendicular to the axis such that it extends out 100 m on both sides of the wetland system's perimeter. For some arching wetlands that close back in on themselves, see guidance and figure below to address situations that may arise from interior spokes (i.e., spokes radiating away from the wetland's interior arch):
   - When two spokes cross one another, eliminate the spoke with the longer natural buffer width and locate a new spoke at the more northerly end of the wetland system's long axis; extend the axis 100 m beyond the system perimeter to form new spoke.
   - When a spoke heads back into the wetland system in less than 100 m, eliminate the spoke and locate a new spoke at the more northerly end of the system's long axis.
   - If two spokes need to be relocated, use both ends of the wetland system's long axis.

   For spokes radiating out from the wetland system's exterior arch, if the spoke begins to cross a smaller lobe of the system in less than 100 m then allow the spoke to continue in the same direction through the lobe and measure buffer width where the spoke can be extended beyond the system for 100 m (see figure below).
3. For each of the eight spokes, determine the natural buffer width from the wetland's edge until either a non-buffer land cover is encountered in less than 100 m or 100 m of contiguous natural buffer width is measured.
4. Determine the average width of the buffer (see example below) and evaluate the metric by referencing the A–D rating criteria on the ***Metric Form***.



Example calculation of Width of Natural Buffer: The eight spokes or lines are assessed for the buffer width. Once measured, average the eight buffer widths to calculate the average width of the buffer (see table below). The average width of the buffer is then converted to an A–D rank (see ***Metric Form***) for the Width of Natural Buffer metric.

Measuring Width of Natural Buffer

Spoke or Line	Buffer Width (out to a maximum of 100 m)
West exterior spoke	19
West interior spoke	100
West-central exterior spoke	9
West-central interior spoke	84
East-central exterior spoke	100
East-central interior spoke	64
South-east exterior spoke	37
South-east interior spoke	64
Width of Natural Buffer (m)	**58**
Metric Rank	**C**

4.4. Size

4.4.1. Comparative Size

Comparative Size is an assessment of the wetland system's current size compared to reference sizes for the type throughout its global range. Most of New Hampshire's landscape is covered by only a few "matrix" forming systems (five of the 18 upland system types). Embedded within these upland matrix systems are other system types with spatial patterns that form large, small, or linear patches, including the majority of upland types (13 of 18) and all 27 wetland system types. The table below arranges the 27 wetland system types by spatial pattern to assist with rating the Comparative Size metric for any given wetland system example.

8/6/2021 DRAFT **– Comparative Size Rating Table**				
	Metric Rating			
Spatial Pattern Type Wetland System Type	**Excellent (A)**	**Good (B)**	**Fair (C)**	**Poor (D)**
Major Large Patch Salt marsh system Sparsely vegetated intertidal system Subtidal system	>1,250 ac	1,250–250 ac	250–25 ac	<25 ac
Minor Large Patch Black spruce peat swamp system (northern variant) Drainage marsh - shrub swamp system Medium level fen system Patterned fen system (acidic variant) Poor level fen/bog system	>250 ac	250–50 ac	50–5 ac	<5 ac
Major Small Patch Black spruce peat swamp system (southern variant) Coastal conifer peat swamp system Montane/near-boreal minerotrophic peat swamp sys. Temperate minerotrophic swamp system Temperate peat swamp system	>100 ac	100–20 ac	20–2 ac	<2 ac
Intermediate Small Patch Coastal salt pond marsh system Kettle hole bog system Montane sloping fen system Patterned fen system (circumneutral variant) Sand plain basin marsh system (coastal plain type)	>50 ac	50–10 ac	10–1 ac	<1 ac
Minor Small Patch Alpine/subalpine bog system Calcareous sloping fen system Forest seep/seepage forest system Sand plain basin marsh system (montane type)	>5 ac	5–1 ac	1–0.25 ac	<0.25 ac

Very Long Linear* Brackish riverbank marsh system (maj. riv.) Low-gradient silty-sandy riverbank system (maj. riv.) Major river silver maple floodplain system	>10 mi in length	10–3 mi in length	3–0.8 mi in length	<0.8 mi in length
Long Linear* Brackish riverbank marsh system (min. riv.) Low-gradient silty-sandy riverbank system (min. riv.) Moderate-gradient sandy-cobbly riverbank system Montane/near-boreal floodplain system Temperate minor river floodplain system	>5 mi in length	5–2 mi in length	2–0.5 mi in length	<0.5 mi in length
Intermediate Linear* High-gradient rocky riverbank system Sandy pond shore system (coastal plain type)	>3 mi in length	3–1 mi in length	1-0.3 in length	<0.3 mi in length
Short Linear Sandy pond shore system (montane type)	>0.4 mi in length	0.4–0.1 mi in length	0.1–0.02 mi in length *(160–30 meters)*	<0.02 mi in length *(<30 meters)*

*For riparian systems, measurements are based on the length of the floodplain corridor (rather than the length of the river meander within the floodplain corridor).

4.4.2. Change in Size

This metric is always used when an artificial change in size is detectable (*not used otherwise*). It is a measure of the current size of the wetland system divided by the historical wetland size (within most recent period of intensive settlement or 200 years), multiplied by 100. An artificial reduction in a wetland's size may result from human-related habitat loss (e.g., from filling) or vegetation conversion (e.g., conversion due to changes in hydrology from draining or flooding from roads, impoundments, development, human-induced inflow; or conversion caused by severe recent cutting). Wetland area can also artificially increase from impoundments, etc. Estimate using best available information (e.g., topographic maps, historical aerials, soils, and other relevant GIS data layers). Note: A change in size due to natural fluctuations can occur in several types of wetland systems and does not indicate a degraded condition when assessing this metric.

Below is how an artificial change in size is used to lower the Comparative Size rating:

- Occurrence has not been artificially reduced (0%) or increased from its original natural extent (any detectable change in size is due to natural fluctuations): No change in rating of Comparative Size.
- Occurrence is minimally reduced (1–4.9%) or increased from its original natural extent: Lower the Comparative Size rating by one-third of a letter grade (e.g., B+ to B).
- Occurrence is moderately reduced (5–30%) or increased from its original natural extent: Lower the Comparative Size rating by two-thirds of a letter grade (e.g., B+ to B-).
- Occurrence is substantially reduced (>30%) or increased from its original natural extent: Lower the Comparative Size rating by one letter grade (e.g., B+ to C+).

4.5. EIA Level 2 Stressor Checklist

Important Notes: When evaluating stressors, consider the susceptibility of the system type to each stressor present. For example, a kettle hole bog system is in general more susceptible to nutrient input than a drainage marsh - shrub swamp system (see rank specifications [Nichols 2015]). The ***Stressor Checklist*** is initially assessed pre-field using aerial photographs and then adjusted as needed in the field. If two stressors conceptually overlap as applied at a particular site, choose only one and note the overlap. Where possible, the ***Stressor Checklist*** is used to help inform completion of the ***Metric Form***. Completion of the ***Stressor Checklist*** should be a <u>relatively rapid evaluation</u>.

4.5.1. Role of Stressor Checklist

The ***Stressor Checklist*** is used only for informative purposes, as an aid to further understanding the overall condition of the wetland (helps inform completion of the ***Metric Form***). The term "stressor" is defined as “the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes” (from Salafsky et al. 2008). Here we restrict our focus to those stressors that have caused or are causing impacts, whenever the effects of the stressors are evident. For example, a stressor may be recent tree removal or mowing. Less recent mowing or tree removal would be included only if the effect of those stressors is still currently evident (e.g., old tree stumps). The term is synonymous with” *direct threats*” as defined by Salafsky et al. (2008) or with “stressors” as used by the U.S. EPA (Young and Sanzone 2002).

For the most part, direct threats are related to human activities, but they may be natural. The impact of human activity may be very conspicuous (e.g., destruction of habitat) or more inconspicuous (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, or flooding) may be especially important when the wetland system type is concentrated in one location or has few occurrences, which may be a result of human activity. Strictly speaking, these natural phenomena may be part of natural disturbance regimes; but they need to be considered a threat if a habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky et al. 2008).

For purposes of ecological integrity assessments, threat impact is calculated considering only present observed or inferred stressors. If inferred, the reason for the inference should be clearly stated. Stressors that do not occur yet but are projected to occur in the near term are not included.

In some cases, where stressors appear to be having a negative impact on the site, but the condition metrics do not reflect these impacts, it may be important to over-ride the overall calculated condition score. This should only be done in exceptional circumstances. The need for manual over-rides may suggest that the current condition metrics may be insensitive to degradation of certain stressors, and future adjustments to the metrics may be needed.

Stressors may be characterized in terms of *scope* and *severity*. Scope is defined as the proportion of the wetland system (or 100 m zone adjacent to the system) that can reasonably be expected to be affected by the stressor within 10 years given continuation of current circumstances and trends (out to 20 years if confident in assessment of stressor). The ten-year time-frame can be extended for some longer-term stressors, such as global warming, that need to be addressed today. Scope is measured as the proportion of the system or 100 m zone adjacent to the system affected by the stressor.

Within the scope (as defined spatially and temporally in assessing the scope of the threat/stressor), severity is the level of damage to the wetland system or 100 m zone adjacent to the system from the stressor that can reasonably be expected with continuation of current circumstances and trends. Note that severity of stressors is assessed within a ten-year time-frame. Severity is typically measured as the degree of degradation caused by the stressors. See appendix for instructions on how to evaluate stressor “impact” from scope and severity.

4.6. Preparing for the Field

4.6.1. Maps and Aerial Photographs

Produce and review the following maps and aerial photographs before leaving the office:

- Topographic map (if possible 1:12,000 or larger scale) delineating:
    - Targeted wetland system (if system type is unknown, make inference informed by GIS data layers, wetland system key, and other relevant sources); relevant GIS data layers (e.g., NWI, dams, conservation lands, and other layers as needed)
- Aerial photographs (see example of aerial in Section 4 above) drawn at same scale as topographic map and delineating:
    - Wetland system; NWI polygons; conservation lands (a fairly “clean” aerial for vegetation zone interpretation)

- Wetland system; Land Use Index zones; color coded Landsat land cover polygons; NWI polygons (use this aerial if any questionable Landsat land cover polygons require field check)
- Wetland system; Perimeter with Natural Buffer; Width of Natural Buffer spokes; NWI polygons; conservation lands (use this aerial if any questionable buffers or non-buffers require field check)

Review map and aerials to identify areas in the wetland system and surrounding landscape that appear most important to visit in the field.

4.6.2. Other Equipment, Materials, and Supplies

Field checklist:

- GPS receiver (set to NAD 83 and with sufficient memory)
- Camera (with sufficient memory)
- EIA forms (Stressor, Rapid Recon, & Metric), clipboard, pencils
- Topographic map and Land Use Index aerial
- Compass

4.6.3. Mission Planning

Considerations for mission planning include existing access routes, topography, density and complexity of vegetation, and priority needs.

4.6.4. Level 2 EIA Forms

Review the ***Metric Form*** to ensure you are prepared to complete it in the field after collecting field data using the ***Rapid Recon Form***.

5. EIA LEVEL 2 RAPID RECON FORM

Application of the field method described below requires a moderate level of ecological knowledge. The surveyor should classify the wetland system as early in the evaluation process as possible, either pre-field based on GIS data layers, the wetland system key, and other relevant information or during the field survey once dominant plant species (≥10% relative cover [or most frequent otherwise]) are known. Once classified, the surveyor then references the system's rank specifications (Nichols 2015) for expected structure, composition, and function for naturally occurring examples of the system type.

5.1. Overview

Visit as much as the wetland (and surrounding landscape) as needed to properly evaluate the wetland system's condition, especially targeting those areas identified as survey priorities during pre-field review of the site map and aerial. List dominant plant species (≥10% relative cover or the most frequent species if none are dominant with a relative cover ≥10%) on the ***Rapid Recon Form*** to inform accurate wetland system classification using the system key. See the simplified wetland system key in appendix or a more detailed key in Natural Community Systems of New Hampshire report (Sperduto 2011). In areas of a system characterized by forested swamp, document dominant species in the tree canopy, shrub, and herbaceous layers. For "open" wetland systems, document dominant species in each vegetation zone present (e.g., shrub thicket, emergent marsh, peat mat, aquatic bed, etc.). Note: Also list all invasive plant species (no matter their cover) and any readily identifiable plant species with relative cover <10% in each vegetation zone (or stratum for forested swamps). Vegetation zones, characterized by differing life forms (i.e., trees, shrubs, or herbs), most often correspond to differences in the wetland system's flood regime and are associated with specific natural community types (Sperduto and Nichols 2011). Classifying vegetation zones within the wetland system to specific natural community types could be helpful when evaluating system condition but not necessary to achieve meaningful assessments.

Modify your survey route as needed based on field findings and interpretation of the aerial photograph to minimize collecting data in vegetation zones already surveyed at other locations. 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 you are walking through. Complete the ***Metric Form*** after the ***Rapid Recon Form*** has been completed in the field.

5.1.1. General Information

Site Name

If a site name has not already been assigned, provide one using relevant label on a topographic map.

Surveyor(s)

Name of surveyor(s): primary surveyor listed first, then assistant (if applicable).

Site Code

Enter site code (if applicable).

Date

Date the field data was collected.

Town

Record town(s) wetland system occurs in.

Directions (if not clear on map)

If good GPS coordinates are taken, this field can be used only to track issues of how to get into a site (e.g., landowner issues, avoiding cliffs, indicating river crossings, etc.). If GPS data were not collected in the wetland system, provide directions to the site.

Site Summary
Record the following information in the "**Site Summary**" section:

- **Wetland System:**
  - Name the wetland system type being evaluated.
    - To classify to system type, see the simplified wetland system key in appendix or a more detailed key in Natural Community Systems of New Hampshire (Sperduto 2011).
- **Interesting Features Associated with System:**
  - List each vegetation zone (natural community) that was documented in the system on separate lines (e.g., forested swamp, shrub thicket, emergent marsh, peat mat, aquatic bed, etc.).
  - Beneath the vegetation zones you list, document each of the following features on separate lines when present:
    - Rare, uncommon, and/or invasive species.
    - Anthropogenic features (e.g., cellar holes, ditches, trails, refuse dumping, etc.).
- **Status:**
  - Use the following codes for rare, uncommon, and/or invasive species.
    - SE: state endangered.
    - ST: state threatened.
    - SW: state watch.
    - Ind: indeterminate.
    - Inv: invasive.
  - Use the following code for anthropogenic features.
    - Anthro: anthropogenic.
- **% in sys:**
  - Estimate the percent cover of each vegetation zone within the system (total cover of zones within a system = 100%).
- **WP:**
  - Note the GPS waypoint number for each vegetation zone; rare, uncommon, and/or invasive species; anthropogenic feature; etc.

General Comments (as needed)
For the wetland system, write general notes as needed.

Diagram (as needed)
Illustrate as needed important features poorly depicted on the topographic map and aerial.

5.1.2. Documenting Vegetation Zones

NC or Veg Zone
Write the name of the natural community (if known, following Sperduto and Nichols 2011) or vegetation zone (e.g., forested swamp, shrub thicket, emergent marsh, peat mat, aquatic bed, etc.) you are currently surveying. Note: There may be one to several vegetation zones in a wetland system.

Record the following in each natural community (NC) or vegetation zone (Veg Zone):

- **WP:**
  - Collect a GPS "waypoint" in each zone sampled.
  - Collect additional GPS locational data within a zone for rare, uncommon, and/or invasive species; anthropogenic features; etc.

- As needed, write notes on each vegetation zone and other important features in the “Comments” field and list them in the “Site Summary” section of the form.

- **Woody Species:**
  - List dominant woody species (≥10% relative cover [or most frequent otherwise]) and check off each stratum they are dominant in (as applicable):
    - Tree stratum: After listing a tree species, check this box if listed species is dominant in the tree stratum (taller than 6 m [20 ft]).
    - Shrub stratum: Check this box for each dominant shrub you list as well as for each seedling and sapling tree species whose cover is dominant in this stratum (< 6 m [20 ft]).

- **Herb Species:**
  - List dominant herbaceous species (≥10% relative cover [or most frequent otherwise]).

- **NonVasc:**
  - List/describe non-vascular dominants as needed (mosses, lichens, and macro-algae ≥10% relative cover [or most frequent otherwise]).

Note: If you cannot identify a dominant plant species…
  - Record the species on your form as “unknown#1”.
  - 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 zip-lock bag and label the bag with the name you gave it on the data form.
  - Press the plant if you do not intend to key it out right away. Mark the newspaper the plant specimen is pressed in with the name you gave it on the data form; also document date, location, vegetation zone, and collector.
  - Bagged specimens will keep fresh longer in the refrigerator until pressed or identified.

- **Stand Profile**
  - For forested swamp zones, complete a brief stand profile, estimating the following in a few minutes or less:
    - **Avg canopy dbh:** average canopy dbh in inches (e.g., 11”).
    - **Canopy dbh range:** canopy dbh range in inches (e.g., 7-18”).
    - **Avg canopy ht:** average height of canopy in feet (e.g., 60’).
    - **Stand age est:** estimate of stand age (see information in footer of field form for guidance).

- **Plot size**
  - For surveyors who choose to complete a vegetation plot (not necessary for general assessment).

- **Comments**
  - For each vegetation zone in the wetland system, write notes in the “Comments” field as needed on vegetation, soils, hydrology, landscape context, buffer, wildlife, anthropogenic features, land use, etc.

Note: A wetland system may support one to several natural communities or vegetation zones (e.g., forested swamp, shrub thicket, emergent marsh, peat mat, aquatic bed, etc.). For each vegetation zone, repeat the steps in this section in separate plots.

After completing the ***Rapid Recon Form***, complete the ***Metric Form*** in the field.

6. EIA LEVEL 2 METRIC FORM

Important Notes:

- When evaluating metrics, review the system rank specifications (Nichols 2015) for information specific to metrics being assessed and to better understand expected structure, composition, and function for naturally occurring examples of the system type. The ***Stressor Checklist*** should be completed before the ***Metric Form***, to help inform completion of the latter.

- For each metric, an A, B, C, or D rank is selected, informed by rating criteria descriptions on the ***Metric Form***, the system rank specifications (Nichols 2015), field observations, useful GIS data, etc. If a range of uncertainty exists when evaluating a metric, a range rank may be used (i.e., AB, BC, or CD). Assignment of a range rank should be considered a fallback used only after double-checking relevant data to see if a specific rank could be applied. Note: A range rank ***does not*** indicate an intermediate rank. For example, BC indicates it could be B or C and not an intermediate rank between B and C.

- A plus (+) or minus (-) may be assigned to a specific rank, especially for quantifiable metrics (i.e., Land Use Index, Perimeter with Natural Buffer, Width of Natural Buffer, Comparative Size, Change in Size, and Invasive Nonnative Plant Species Cover) using the following guideline:
    - If the measure associated with the metric is within 25% of the upper or lower range for an A, B, C, or D rank, assign a ±rank. Take for example the metric Perimeter with Natural Buffer. The C range for this metric is 25–74.9% (a range of 50 where 25% of range equals ~13) so…

      25–38% = C-
      38–62% = C
      62–75% = C+

- If a metric is assigned B, C, D, or a range rank (i.e., a rank other than A), explain why in the space provided by the metric on the form.

- Post-field, use the automated EIA Metric Scorecard to calculate an overall ecological integrity rank for the wetland system once the ***Metric Form*** has been completed and data entered into the digital scorecard.

6.1. Landscape Context

Land Use Index

A pre-field office assessment adjusted in the field as needed (see Section 4: Pre-field Assessment and Planning).

6.2. Buffer

Perimeter with Natural Buffer

A pre-field office assessment adjusted in the field as needed (see Section 4: Pre-field Assessment and Planning).

Width of Natural Buffer

A pre-field office assessment adjusted in the field as needed (see Section 4: Pre-field Assessment and Planning).

6.3. Size

Comparative Size

A pre-field office assessment adjusted in the field as needed (see Section 4: Pre-field Assessment and Planning).

Change in Size
A pre-field office assessment adjusted in the field as needed (see Section 4: Pre-field Assessment and Planning). This metric is always used when an artificial change in size is detectable (*not used otherwise*).

6.4. Vegetation

Vegetation Structure
First, select on the ***Metric Form*** the broad habitat type the wetland system is found in:

- **Forested Floodplain & Swamp**
- **Non-Forested Wetland**

Then for the wetland system, assess the overall structural complexity of the vegetation layers and growth forms (vertical layers and horizontal patches) including woody regeneration and coarse woody debris (used when a quick qualitative evaluation is applicable to system type); presence of multiple strata, age and structural complexity of canopy layer; and evidence of the effects of disease or mortality on structure. When evaluating this metric, reference the system rank specifications (Nichols 2015).

Invasive Nonnative Plant Species Cover
For the wetland system, estimate the percent cover of invasive nonnative plant species. Reference the list of invasive species in the wetland system rank specifications or at Invasive Plant Atlas of New England (IPANE website: http://www.eddmaps.org/ipane/ipanespecies/ipanespecies.htm).

Native Plant Species Composition
This metric assesses the overall native plant species composition and diversity, including by layer, and evidence of species-specific diseases or mortality. As a result of anthropogenic stressors, some native plant species can be in certain settings aggressive (negatively impacting the character, condition, form, or nature of wetland systems). Others can be weedy (species that respond favorably to increasing human stressors but compared to more aggressive species, to a lesser degree and without the “transformative” negative ecological impact). When evaluating this metric, reference the system rank specifications (Nichols 2015).

6.5. Hydrology

Water Source
First, select on the form the broad habitat type the wetland system is found in:

- **Non-Tidal**
- **Tidal**

Then, assess 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 water sources are perennial or seasonal, alterations 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.

Hydroperiod
Select the appropriate broad habitat and assess the characteristic frequency and duration of inundation or saturation of a wetland system. In the field, check for the presence of a nearby human-built dam that may have altered the wetland system's natural hydroperiod (or check pre-field using dam data layer in a GIS).

- **Riverine/Lacustrine (channels, open & forested floodplains, shores)**
  Estimate the degree to which channel and shore stability is intact.

  Indicators of channel equilibrium, degradation, aggradation (Collins et al. 2007):
  Channel Equilibrium
    - channel (or multiple channels) has a well-defined usual high water line, or bankfull stage that is clearly indicated by an obvious floodplain, topographic bench that represents an abrupt change in the cross-sectional profile of the channel throughout most of the site
    - usual high water line or bankfull stage corresponds to the lower limit of riparian vascular vegetation
    - channel contains embedded woody debris of the size and amount consistent with what is available in the riparian area
    - little or no active undercutting or burial of riparian vegetation

  Degradation
    - portions of the channel are characterized by deeply undercut banks with exposed living roots of trees or shrubs
    - abundant bank slides or slumps, or the banks are uniformly scoured and unvegetated
    - riparian vegetation may be declining in stature or vigor, and/or riparian trees and shrubs may be falling into the channel
    - channel bed lacks any fine-grained sediment
    - recently active flow pathways appear to have coalesced into one channel (i.e., a previously braided system is no longer braided)

  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 the floodplain
    - partially buried, or sediment-choked, culverts

- **Non-Riverine Enriched (rich swamps, medium & rich fens, drainage marshes)**
  Indicators of reduced extent and duration of inundation or saturation (Collins et al. 2007):
    - 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
    - organic soils occurring well above contemporary water tables

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
- 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

- **Nutrient-Poor Isolated Wetlands (bogs & poor fens, poor swamps, basin marshes)**
  Assess the degree of alteration (if any) to expected natural patterns of saturation, inundation, or drawdown.

- **Tidal (salt & brackish marsh, tidal flats, subtidal)**
  Assess the degree of alteration (if any) to expected natural tidal patterns.

  Indicators of alterations to the estuarine hydroperiod (Collins et al. 2007):
  - changes in the relative abundance of plants indicative of either high or low marsh
  - preponderance of shrink cracks or dried pannes indicative of decreased hydroperiod
  - inadequate tidal flushing indicated by algal blooms or by encroachment of freshwater vegetation
  - dikes, levees, ponds, ditches, and tide control structures indicate altered hydroperiod resulting from management for flood control, salt production, waterfowl hunting, boating, etc.

Hydrologic Connectivity
Assessment of the ability of water to flow into or out of the wetland system, or to inundate adjacent areas.

- **Riverine/Lacustrine (channels, open & forested floodplains, shores)**
  For the wetland system, estimate by observing signs of overbank flooding, channel or shore migration or incision, and geomorphic modifications.

- **Non-Riverine Enriched (rich swamps, medium & rich fens, drainage marshes)**
  This metric is scored by assessing the degree to which the lateral movement of floodwaters 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).

- **Nutrient-Poor Isolated Wetlands (bogs & poor fens, poor swamps, basin marshes)**
  Assess the degree of alteration (if any) to expected natural patterns of water movement into and out of the wetland system.

- **Tidal (salt & brackish marsh, tidal flats, subtidal)**
  Assess the degree of alteration (if any) to expected natural patterns of tidal water movement.

6.6. Soil

Soil Condition
First, select either the "Non-Tidal" or "Tidal" category on the form. Then evaluate human-related impacts to the soil and surface substrates. Impacts include filling, grading, plowing, pugging, vehicle use, sedimentation, dredging, and other mechanical disturbances.

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8. APPENDIX

8.1. Simplified Wetland System Key

1a. Tidal systems
- 2a. Vascular plant cover moderate to high
  - 3a. Supratidal; isolated brackish basin marshes (regularly receive fresh water plus salt water during severe storms from overwash or berm infiltration)………………...…………..**Coastal salt pond marsh system**
  - 3b. Intertidal; marshes with regular tidal flooding
    - 4a. Marshes with moderate to high salinities (18–50 ppt) ……………...………...….**Salt marsh system**
    - 4b. Marshes with lower salinities (0.5–18 ppt)……………………..**Brackish riverbank marsh system**
- 2b. Sparsely vegetated to unvegetated
  - 5a. Intertidal ...………..……………………………………………..**Sparsely vegetated intertidal system**
  - 5b. Subtidal………………..…………….……………………………………………………….**Subtidal system**

1b. Non-tidal systems
- 6a. Forested floodplains and open riverbanks and shores
  - 7a. Open systems below bankfull
    - 8a. Low gradient riverbanks; substrate silty to sandy……**Low-gradient silty-sandy riverbank system**
    - 8b. Moderate- to high-gradient riverbanks; substrate sandy to rocky
      - 9a. Moderate gradient riverbanks; substrate sand, gravel, and cobble …………….…………… …………………………….…………………**Moderate-gradient sandy-cobbly riverbank system**
      - 9b. High-gradient riverbanks; substrate boulders and bedrock …………………..………….. ………………………………………..……………**High-gradient rocky riverbank system**
  - 7b. Forested systems above bankfull
    - 10a. Floodplains of montane and n. NH rivers; sugar maple or balsam fir are diagnostic; when silver maple present, not dominant and may be limited to river edges ………………………………………..........................**Montane/near-boreal floodplain system**
    - 10b. Floodplains of c. and s. NH rivers
      - 11a. Forests of major rivers; silver maple dominant ...**Major river silver maple floodplain system**
      - 11b. Forests of minor rivers; red maple dominant (occasionally sycamore or swamp white oak) ....…..**Temperate minor river floodplain system**
- 6b. Wetlands not directly associated with rivers or large streams (third order or higher)
  - 12a. Peatlands; organic soils (muck or fibrous peat >16" deep); hummocks and hollows often well developed; *Sphagnum* mosses almost always present, often abundant; sedges or heath shrubs usually more abundant than grasses and forbs
    - 13a. Peat swamps (tree cover >25%)
      - 14a. Nutrient-rich peat swamps in n. NH with northern white cedar…………………………….. …………………………………..**Montane/near-boreal minerotrophic peat swamp system**
      - 14b. Nutrient-poor peat swamps, generally without northern white cedar or black ash
        - 15a. Peat swamps dominated by hardwoods………………...**Temperate peat swamp system**
        - 15b. Peat swamps dominated by conifers
          - 16a. Peat swamps in c. and s. NH; dominated by Atlantic white cedar or occasionally pitch pine ……………………………………**Coastal conifer peat swamp system**
          - 16b. Peat swamps in c. and n. NH; dominated by black spruce (eastern larch and red spruce occasional to locally abundant)…………**Black spruce peat swamp system**
    - 13b. Open peatlands (trees cover <25%)
      - 17a. Peatlands usually above 2,500'
        - 18a. Nutrient-poor peatlands in subalpine and alpine areas……**Alpine/subalpine bog system**
        - 18b. Weakly enriched sloping fens in montane settings ………..**Montane sloping fen system**
      - 17b. Peatlands usually below 2,500'
        - 19a. Peatlands patterned; only in extreme n. NH……………………….**Patterned fen system**
        - 19b. Peatlands not patterned
          - 20a. Nutrient-rich peatlands
            - 21a. Weakly to moderately enriched peatlands……..…..**Medium level fen system**
            - 21b. Strongly enriched peatlands; only in n. NH….**Calcareous sloping fen system**
          - 20b. Nutrient-poor peatlands

22a. Peatlands in kettle holes, usually lack significant inlet or outlet stream; *Cladopodiella fluitans* mud bottoms usually present .**Kettle hole bog system**

22b. Peatlands usually with inlet or outlet stream; mud bottoms usually not present ………………………………………………...…….**Poor level fen/bog system**

12b. Wetlands on mineral or muck soils (fibrous peat absent or <16” deep); hummocks and hollows usually poorly developed; *Sphagnum* mosses if present, generally not abundant; sedges and heath shrubs usually less abundant than grasses and forbs

23a. Open nutrient-poor wetlands in sand plain settings along lake/pond shores or closed basins with widely fluctuating water levels

24a. Wetlands on sandy shores……………………………………..…..**Sandy pond shore system**

24b. Wetlands in shallow, closed basins with widely fluctuating water levels……………….….. …………………………………………………………….……**Sand plain basin marsh system**

23b. Nutrient-rich wetlands (forest, shrubland, or herbaceous)

25a. Open wetlands………………….……………….……**Drainage marsh - shrub swamp system**

25b. Forested swamps

26a. Small (<5 ac) forested wetlands at slope bases or along drainages; characterized by seepage ………………………………………….……..**Forest seep/seepage forest system**

26b. Larger forested wetlands, not characterized by seepage

27a. Mosaic of wetland and upland softwood forest; mostly n. of White Mts …………………………………….………**Lowland spruce - fir forest/swamp system**

27b. Primarily hardwood swamps……..…..**Temperate minerotrophic swamp system**

8.2. Assessing Stressor Impact

Below is a description of the process involved in the assessment of scope and severity of stressors (modification of Faber-Langendoen et al. 2012 and Faber-Langendoen 2010; adapted from Master et al. 2009).

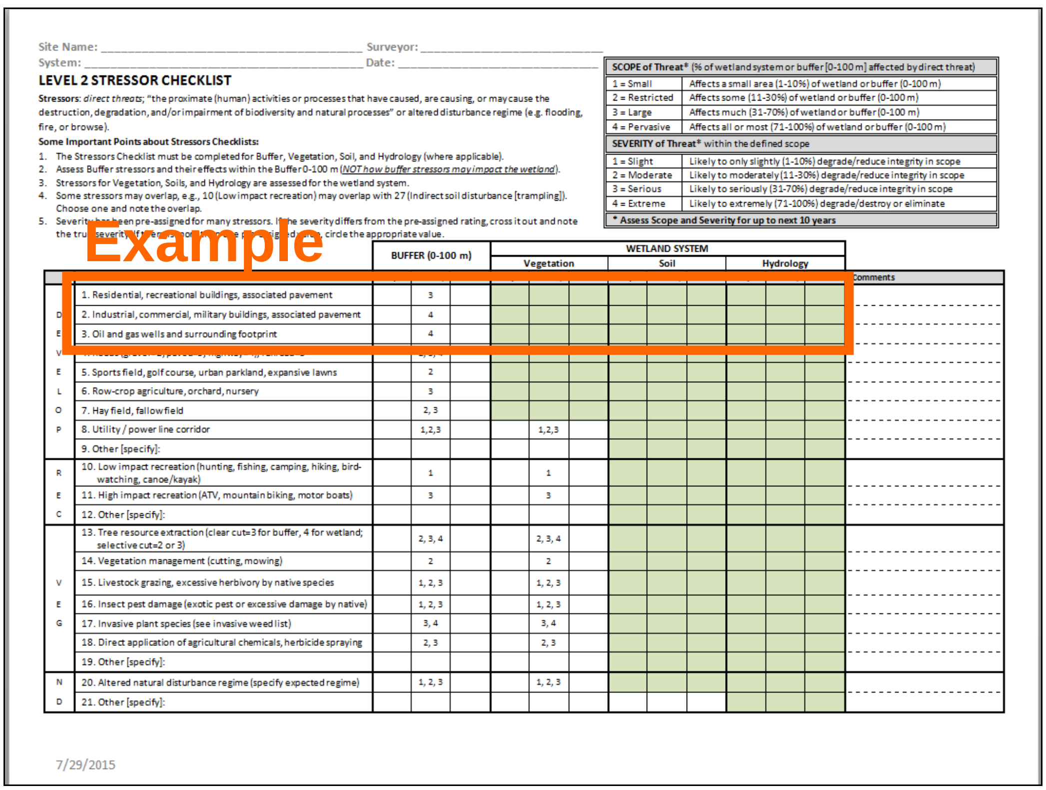
Important Points about the Stressor Checklist

- Completion of the ***Stressor Checklist*** should be a relatively rapid evaluation (initially assessed pre-field using aerial photographs and then adjusted as needed in the field).
- Where applicable, the ***Stressor Checklist*** must be completed for the following major ecological factors: buffer, vegetation, soil, and hydrology.
- Assessment of buffer is here limited to stressors found in the entire area from system perimeter out to 100 m (not for stressors beyond 100 m or the degree to which buffer stressors may impact the wetland system being evaluated).
- Stressors for vegetation, soil, and hydrology are assessed within the wetland system.
- If two stressors conceptually overlap as applied at a site, choose only one and note the overlap.
- Severity has been pre-assigned for many stressors. If there is more than one pre-assigned score, circle the appropriate score. If your severity score differs from those pre-assigned, cross out pre-assigned score(s) and note your score.

Step 1. Estimation of scope and severity of each stressor.

Estimate the scope and (if a single pre-assigned severity number is not provided), severity for applicable individual stressors to the major ecological factors, both within the wetland system and the 100 m zone (buffer) adjacent to the system using the rating table below.

Example: subset of three stressors:



Site Name: ______________________ Surveyor: ______________________
System: ______________________ Date: ______________________

LEVEL 2 STRESSOR CHECKLIST

Stressors: *direct threats*; "the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes" or altered disturbance regime (e.g. flooding, fire, or browse).

Some Important Points about Stressors Checklists:

1. The Stressors Checklist must be completed for Buffer, Vegetation, Soil, and Hydrology (where applicable).
2. Assess Buffer stressors and their effects within the Buffer 0-100 m (*NOT how buffer stressors may impact the wetland*).
3. Stressors for Vegetation, Soils, and Hydrology are assessed for the wetland system.
4. Some stressors may overlap, e.g., 10 (Low impact recreation) may overlap with 27 (Indirect soil disturbance [trampling]). Choose one and note the overlap.
5. Severity [illegible] been pre-assigned for many stressors. If the severity differs from the pre-assigned rating, cross it out and note the tru[illegible] severity. [illegible], circle the appropriate value.

SCOPE of Threat* (% of wetland system or buffer [0-100 m] affected by direct threat)	
1 = Small	Affects a small area (1-10%) of wetland or buffer (0-100 m)
2 = Restricted	Affects some (11-30%) of wetland or buffer (0-100 m)
3 = Large	Affects much (31-70%) of wetland or buffer (0-100 m)
4 = Pervasive	Affects all or most (71-100%) of wetland or buffer (0-100 m)
SEVERITY of Threat* within the defined scope	
1 = Slight	Likely to only slightly (1-10%) degrade/reduce integrity in scope
2 = Moderate	Likely to moderately (11-30%) degrade/reduce integrity in scope
3 = Serious	Likely to seriously (31-70%) degrade/reduce integrity in scope
4 = Extreme	Likely to extremely (71-100%) degrade/destroy or eliminate
*** Assess Scope and Severity for up to next 10 years**	

		BUFFER (0-100 m)			WETLAND SYSTEM: Vegetation			Soil			Hydrology			Comments
	1. Residential, recreational buildings, associated pavement		3											
D	2. Industrial, commercial, military buildings, associated pavement		4											
E	3. Oil and gas wells and surrounding footprint		4											
V	4. [illegible]		[illegible]											
E	5. Sports field, golf course, urban parkland, expansive lawns		2											
L	6. Row-crop agriculture, orchard, nursery		3											
O	7. Hay field, fallow field		2, 3											
P	8. Utility / power line corridor		1,2,3			1,2,3								
	9. Other [specify]:													
R	10. Low impact recreation (hunting, fishing, camping, hiking, bird-watching, canoe/kayak)		1			1								
E	11. High impact recreation (ATV, mountain biking, motor boats)		3			3								
C	12. Other [specify]:													
	13. Tree resource extraction (clear cut=3 for buffer, 4 for wetland; selective cut=2 or 3)		2, 3, 4			2, 3, 4								
	14. Vegetation management (cutting, mowing)		2			2								
V	15. Livestock grazing, excessive herbivory by native species		1, 2, 3			1, 2, 3								
E	16. Insect pest damage (exotic pest or excessive damage by native)		1, 2, 3			1, 2, 3								
G	17. Invasive plant species (see invasive weed list)		3, 4			3, 4								
	18. Direct application of agricultural chemicals, herbicide spraying		2, 3			2, 3								
	19. Other [specify]:													
N	20. Altered natural disturbance regime (specify expected regime)		1, 2, 3			1, 2, 3								
D	21. Other [specify]:													

7/29/2015

SCOPE of Threat* (% of wetland system or buffer [0-100 m] affected by direct threat)	
1 = Small	Affects a small area (1-10%) of wetland or buffer (0-100 m)
2 = Restricted	Affects some (11-30%) of wetland or buffer (0-100 m)
3 = Large	Affects much (31-70%) of wetland or buffer (0-100 m)
4 = Pervasive	Affects most or all (71-100%) of wetland or buffer (0-100 m)
SEVERITY of Threat* within the defined scope	
1 = Slight	Likely to only slightly (1-10%) degrade/reduce integrity in scope
2 = Moderate	Likely to moderately (11-30%) degrade/reduce integrity in scope
3 = Serious	Likely to seriously (31-70%) degrade/reduce integrity in scope
4 = Extreme	Likely to extremely (71-100%) degrade/destroy or eliminate
*** Assess Scope and Severity for up to next 10 years**	

Example

	BUFFER (0-100 m)		
STRESSORS CHECKLIST	Scope	Severity	IMPACT
1. Residential, recreational buildings, associated pavement	3	3	
2. Industrial, commercial, military buildings, associated pavement		4	
3. Oil and gas wells and surrounding footprint	1	4	

Step 2. Calculation of impact of scope and severity for each stressor.
For each stressor, combine scope and severity into an impact score (numeric) using the “Threat Impact Calculator” table below.

Threat Impact Calculator		Scope			
		4 = Pervasive	3 = Large	2 = Restricted	1 = Small
Severity	4 = Extreme	Very High = 10	High = 7	Medium = 4	Low = 1
	3 = Serious	High = 7	High = 7	Medium = 4	Low = 1
	2 = Moderate	Medium = 4	Medium = 4	Low = 1	Low = 1
	1 = Slight	Low = 1	Low = 1	Low = 1	Low = 1

Example

	BUFFER (0-100 m)		
STRESSORS CHECKLIST	Scope	Severity	IMPACT
1. Residential, recreational buildings, associated pavement	3	3	H=7
2. Industrial, commercial, military buildings, associated pavement		4	
3. Oil and gas wells and surrounding footprint	1	4	L=1

Step 3. Calculate a “stressor impact” for each of the four major ecological factors (MEFs).
After impact has been recorded for all applicable stressors, sum the numerical impact score for each MEF (Buffer, Vegetation, Hydrology, and Soil).

Example

	BUFFER (0-100 m)		
STRESSORS CHECKLIST	Scope	Severity	IMPACT
1. Residential, recreational buildings, associated pavement	3	3	H=7
2. Industrial, commercial, military buildings, associated pavement		4	
3. Oil and gas wells and surrounding footprint	1	4	L=1

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Step 4. Convert summed MEF scores into a Human Stressor Index (HSI) score and HSI rating for the wetland system.

a. Using the four MEF Stressor “Sum of Scores” for Buffer, Vegetation, Hydrology, and Soils, apply the following weights to calculate the HSI score:

Example:

MEF	Buffer	Vegetation	Soil	Hydrology	
Weight	0.3	0.3	0.1	0.3	
Sum of MEF score x weight	8 x 0.3=2.4	4 x 0.3=1.2	1 x 0.1=0.1	6 x 0.3=1.8	HSI score=5.5

b. Once the HSI score is calculated, use the table below to determine the HSI rating for the wetland system:

HSI Score	HSI Rating
10+	Very High
7 – 9.9	High
4 – 6.9	Medium
1 – 3.9	Low
0 – 0.9	Absent

HSI score = 5.5; HSI rating = Medium.

8.3. Calculating Land Use Index using ArcGIS 10.2

An Approach to Calculating the EIA Land Use Index using ArcGIS 10.2
(Requires the Spatial Analyst extension)

1) Create a raster of land cover types, with numeric values ranging from low (developed) to high (undisturbed).

   For example (NH): Starting with GRANIT’s 2001 NH Land Cover Assessment (http://www.granit.unh.edu/data/datacat/pages/nhlc01.pdf), the ArcGIS Spatial Analyst Reclass function was used to create a new grid with the original 23 codes reclassified to four broad categories:

   0 = Developed
   4 = Agriculture
   5 = Cleared Forest
   10 = Natural

2) Create a polygon for the extent of the wetland system being analyzed.
   a. Open an ArcMap project and add useful base layers.
      i. Highest priority: recent high-resolution aerial imagery.
      ii. Other possibly useful: NWI, roads, older aerial imagery, etc.
   b. Using a wetland system key, identify the bounds of the wetland system of interest, e.g., based on visible transitions in vegetation.
      i. Draw a polygon around the wetland system perimeter (do not include fill-in areas).

3) Create a polygon around the wetland system extending out 500 m from the wetland edge.

   Geoprocessing – Buffer (ArcGIS 10.2)

   Linear unit = 500 meters
   Side Type = FULL
   Dissolve Type = NONE

4) Calculate mean index for each buffer.

   Spatial Analyst Tools – Zonal – Zonal Statistics as Table

   Zone field = “Distance” field in buffer or, if processing multiple sites, the unique site-buffer code added manually to the buffers layer
   Input value raster = land cover raster from step (1)
   Ignore NoData in calculations = checked
   Statistics Type = MEAN

Example: Reclassification used for the NH Land Use Index.

Data source: New Hampshire Land Cover Index (2001) from Complex Systems Research Center, University of New Hampshire, Durham, NH. Based on imagery acquired by the Landsat Thematic Mapper between 1990 and 1999.

CLASS	LABEL	LU
110	Developed	0
140	Transportation	0
211	Row Crops	4
212	Hay/Pasture	4
221	Orchards	4
412	Beech/Oak	10
414	Paper Birch/Aspen	10
419	Other Hardwoods	10
421	White/Red Pine	10
422	Spruce/Fir	10
423	Hemlock	10
424	Pitch Pine	10
430	Mixed Forest	10
440	Krumholz	10
500	Open Water	10
610	Forested Wetland	10
620	Non-forested Wetland	10
630	Tidal Wetland	10
710	Disturbed	0
720	Bedrock/Veg	0
730	Sand Dunes	10
790	Other Cleared	5
800	Tundra	10

Land Use Reclassification (LU):

0 = Developed
4 = Agriculture
5 = Cleared forest
10 = Natural