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Applying NatureServe's Conservation Status Rank Methodology to New Hampshire Wetland Systems

A Final Report to
NH Department of Environmental Services

Submitted by
NH Natural Heritage Bureau
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Advancing Wetland Assessment, Classification, and Permit Review in NH

Overview of the NH Natural Heritage Bureau's Purpose and Policies

The NH Natural Heritage Bureau (NHB) finds, tracks, and facilitates the protection of New Hampshire's rare plants and exemplary natural communities. As a bureau within the NH Department of Resources and Economic Development's Division of Forests & Lands, NHB works with landowners and land managers to help them protect New Hampshire's natural heritage while meeting their land-use needs.

The New Hampshire Native Plant Protection Act (RSA 217A) authorizes NHB to collect and analyze data on state lands about the status, location, and distribution of rare or declining native plant species and exemplary natural communities and maintain that information in a comprehensive database.

The Natural Heritage database contains information about more than 7,000 plant, animal, and natural community occurrences in New Hampshire.

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Cover photo: Cedar Swamp Pond, Kingston, NH (photo by Bill Nichols).

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INTRODUCTION

Wetland system state conservation status ranks, a series of S-Ranks ranging from S1 to S5 (critically imperiled to secure at the state level), assess extirpation risk for different wetland types in the state. Previously, these conservation status ranks were primarily based on number of occurrences and the rank assignment process was subjective, leading to potential issues with consistency, repeatability, and transparency. Training and review had been used to minimize these issues, but the assessments were nevertheless influenced by personal judgments, perceptions of risk, and systemic biases. A more objective approach has been developed by NatureServe, documented in NatureServe's Conservation Status Rank Methodology (Faber-Langendoen et al. 2012) and including an Excel-based Rank Calculator (NatureServe 2014) to address these issues. We used the new approach to re-evaluate the conservation status of NH's 27 wetland systems (Sperduto 2011).

BACKGROUND

Using NatureServe's revised protocols, S-Ranks for each wetland system type are calculated using seven core status rank factors directly relevant to risk assessments (two other rank factors were available if other factors were null; a tenth factor, Population Size, is applied only to species). The rank factors are grouped into three categories: rarity, threats, and trends. Table 1 illustrates the organization of these status factors, and provides brief definitions.

Table 1. NatureServe Conservation Status Rank Factors (source: Faber-Langendoen et al. 2012). A rank factor (Population Size) and language pertinent to species evaluations (not applicable to system evaluations) was removed from the table.

Factor Category	Sub-category	Factor	Definition
Rarity	Range/ Distribution	**Range Extent**	Minimum area that can be delimited to encompass all present occurrences of a system, typically excluding extreme disjuncts.
		Area of Occupancy	Area within the range extent that a system actually occupies. Areas can be measured or estimated directly based on the best available information. Area of Occupancy for systems is assessed based on selecting the typical spatial pattern of the type (small patch, large patch, matrix).
	Abundance/ Condition	**Number of Occurrences**	Number of extant locations (stands) of a system.
		Number of Occurrences or Percent Area with Good Ecological Integrity	1) Number of occurrences (locations or stands) that have excellent-to-good ecological integrity (A or B occurrence ranks), such that there is the likelihood of persistence if current conditions prevail; OR 2) Percent of the total area occupied by a system that has excellent-to-good ecological integrity.
		Environmental Specificity	The degree to which a system depends on a relatively scarce set of abiotic and/or biotic factors within the overall range. Relatively narrow requirements are thought to increase the vulnerability of a system.
Threats		**Overall Threat Impact**	Degree to which the integrity of a system is affected by extrinsic factors (stressors) that degrade integrity, and which are characterized in terms of scope and severity. Threats are typically anthropogenic, having either direct (e.g., habitat destruction) or indirect (e.g.,

		introduction of invasive species) impact.
	Intrinsic Vulnerability	Degree to which intrinsic or inherent characteristics, such as likelihood of regeneration or recolonization for systems, make it susceptible or resilient to natural or anthropogenic stresses or catastrophes.
Trends	**Long-term Trend**	Degree of past directional change in extent of occurrence, area of occupancy, number of occurrences, and/or ecological integrity of occurrences over the long term (ca. 200 years).
	Short-term Trend	Degree of past directional change in extent of occurrence, area of occupancy, number of occurrences, and/or ecological integrity of occurrences in the short-term, considered to be typically within 50 years for systems.

In the NatureServe calculator, rank factors are scaled and weighted according to their impact on risk (see Faber-Langendoen et al. 2012). Numerical scores are assigned to each of the seven core factors, then the five factors within rarity (0.7 weight) and threats (0.3 weight) are combined to create an initial status score. That score is then adjusted by addition or subtraction of the trends score to yield a revised status score, which is translated into a calculated rank.

METHODS

ASSIGNING RANK FACTOR SCORES

RARITY/RANGE DISTRIBUTION: RANGE EXTENT AND AREA OF OCCUPANCY

The NHB database of biodiversity elements in NH had a total of 252 exemplary occurrences of the 27 wetland systems (0-62 per system). Few if any of the systems, however, had their full range in NH represented in the database. Only a fraction of the state has ever been surveyed for exemplary natural communities, and non-exemplary occurrences (those that have been heavily impacted by human activities for rare types, or any but the most pristine occurrences of common types) are not added to the NHB database.

Satellite imagery and other Geographic Information System (GIS) data have the potential to allow comprehensive delineation of different ecological systems. The Nature Conservancy used a combination of satellite imagery, NWI, other GIS data layers, and Natural Heritage Program data in 2012 to create a raster of systems that are roughly equivalent to NH ecological systems. However, an analysis of NHB exemplary occurrences found a high diversity of TNC systems within a single NHB system, including clearly non-matching types. An examination of the problem by TNC staff (Ferree 2014, pers. comm.) found that the contributing factors included (a) inaccuracies in the mapping of NWI polygons, (b) inability of the imagery to detect some vegetation types, and (c) vegetation classification issues (e.g., some NHB classified wetlands used to develop the model were in the end mismatches to final modeled wetland types). Our conclusion was that the TNC systems raster could not be used to determine the range extent or area of occupancy of NH systems.

Another source of high-resolution data on the location of ecological systems in NH is occurrences of diagnostic component natural communities. Many such natural communities have been documented where a wetland system is present at the site of the natural community, but does not appear in the NHB database as a separate occurrence because as a system it does not meet the criteria to be considered exemplary[1]. We identified 429 natural *community* occurrences that occur only within wetland systems, where the system was not exemplary. For natural communities that are one of the diagnostic natural communities of more than one type of system (e.g., highbush blueberry - mountain holly wooded fen), descriptions of individual occurrences were reviewed by the NHB ecologist and assigned to the appropriate system. Six natural community occurrences were excluded as being peripheral to rather than a component of a wetland system. When combined with the system exemplary occurrences, we had a total of 673 mapped locations for the 27 wetland systems.

Looking at exemplary occurrences for both systems and component natural communities provided a more complete database of the distribution and extent of wetland systems in the state. However, it was still incomplete, and inconsistently so for different systems; some are known to be well surveyed and documented, while others are known to be under-represented, i.e. have many occurrences that do not qualify for inclusion as exemplary in the NHB database.

The approach we used was to first determine ranks for the range extent and area of occupancy factors based solely on the exemplary occurrence data. Then we applied expert knowledge to shift ranks for individual system types, particularly for those whose initial values were close to a cutoff between different ranks. The expert decisions were made by one reviewer, with 24 years of field experience including surveys of all the wetland types. Each time a rank was shifted, notes were used to document the reasons.

For Range Extent, the initial rank calculations were based on the total area in square kilometers of minimum convex polygons (MCPs) for each system, drawn around the combination of system and diagnostic natural community exemplary occurrences. A MCP encloses all known observations in such a way that all interior angles are less than 180 degrees (all corners point outwards).

For Area of Occupancy (AOO), the mapped extent of each system occurrence was summed over all the exemplary systems and natural communities for that system. Mapped extent in the NHB database is based on a combination of field surveys to identify the ecological element and boundary delineation using high-resolution aerial and infrared imagery. The NatureServe rank estimator uses different thresholds for assigning AOO ranks to systems depending on whether their spatial pattern type is small patch, large patch, or matrix. All 27 NH wetland systems had already been assigned to a more detailed breakdown of spatial pattern types (see the provided Excel file for the specific patch assignments). For the purposes of the rank estimator, we grouped these as shown in Table 2 (no wetland system occurs in NH as a matrix).

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[1] The NH Natural Heritage Bureau tracks "exemplary" natural community and system occurrences. To qualify as exemplary, a natural community or system in a given place must be a rare type or a relatively undisturbed occurrence of a common community in good condition. Exemplary natural communities and systems represent the best remaining examples of New Hampshire's biological diversity.

Table 2. Groupings of Spatial Pattern Types.

Spatial Pattern Type	
Original	**Grouped**
Very Large Patch, Large Patch, Medium Patch, Linear (Large)	Large Patch
Small Patch, Very Small Patch, Linear (Small)	Small Patch

RARITY/ABUNDANCE/CONDITION: NUMBER OF OCCURRENCES AND NUMBER OF OCCURRENCES WITH GOOD ECOLOGICAL INTEGRITY

We determined Number of Occurrences based on exemplary system and natural community occurrences in the NHB database (n = 673 for the 27 systems). As with other factors, the calculated rank values were evaluated by NHB staff, using knowledge of (a) unsurveyed areas in the state and (b) the abundance of non-exemplary occurrences for each system type. We also reviewed existing state ranks (S1-S5), to take advantage of previous expert assessments of the frequency of each system in the state.

The Number of Occurrences with Good Ecological Integrity is the subset of all occurrences that have a Good or Excellent integrity rank (B or A). Most of the system and natural community occurrences in the NHB database (96%) had been assigned integrity ranks on an A to D scale, using an earlier NatureServe methodology. For this analysis, we grouped existing ranks into Excellent or Good (AB), Not Good (CD), and NA (Not Available - Historical and unknown). Borderline ranks (BC and BC?) were re-evaluated to determine which could be assigned a B or a C, using GIS data layers to apply the new Level 2 Ecological Integrity Assessment method (Faber-Langendoen and Nichols 2014). Records that remained on the border between B or C (BC or BC?) were not included in the Excellent or Good (AB) group to avoid over-estimating the number of high-quality occurrences.

THREAT: OVERALL THREAT IMPACT

Eleven major threats were considered when evaluating this rank factor. We used the Level 2 Ecological Integrity Assessment Land Use Index (Faber-Langendoen and Nichols 2014) to account for the first four threats listed in Table 3. For each wetland system type in the NHB data base, an average Land Use Index (LUI) score was calculated using GIS.

The National Land Cover Database for 2011 (NLCD2011) raster was reclassified to group land cover types into four major categories: developed (scored as 0), somewhat disturbed (4 or 5), and natural cover (10). For each system or diagnostic natural community occurrence, ring buffers were created around the mapped polygon at distances of 100 m, 250 m, and 500 m. Within each buffer, an average value was calculated for the Land Use scores. The Land Use Index (LUI) was then calculated for each occurrence as a weighted average of the three buffers. For each system, we then calculated an average LUI value as a simple average of all the system or natural community occurrences (n = 1 to 66). Each system average LUI was converted to an alphabetic rank (A-D) using cutoffs from the metric form (see appendix for L2 Metric Form_Version 8/11/2014):

Table 3. Major threats considered when evaluating Overall Threat Impact.

Threat	Reference
Residential & commercial development	LUI
Agriculture & aquaculture	LUI
Energy production & mining	LUI
Transportation & service corridors	LUI
Biological resource use	NHB staff expertise
Human intrusions & disturbance	NHB staff expertise
Natural system modifications	NHB staff expertise
Invasive & other problematic species, genes & diseases	NHB staff expertise
Pollution	NHB staff expertise
Geological events	NHB staff expertise
Climate change & severe weather	New Hampshire Fish & Game 2013
Other options	NHB staff expertise

For "Climate change & severe weather" threat, we reviewed "Ecosystems and Wildlife Climate Change Adaptation Plan: Amendment to the New Hampshire Wildlife Action Plan" (New Hampshire Fish & Game 2013). The remaining threats were evaluated and scored based on NHB staff expertise.

TRENDS: SHORT- AND LONG-TERM TRENDS

These factors address the degree of past directional change in extent of occurrence, area of occupancy, number of occurrences, and/or ecological integrity of occurrences in the short-term (last 50 years) and long-term (last 200 years). The trends factors were completed based on NHB staff expertise, guidance provided in the NatureServe methodology, and review of trends/justifications for wetland systems in New York (see Quality Control section below).

QUALITY CONTROL OF ASSIGNED RANK FACTOR SCORES

As a way of double-checking our rank factor scores, we cross-walked the 70 wetland community types in New York (Edinger et al. 2014) with New Hampshire's 27 wetland systems, then compared New York conservation status rank factor scores and justifications with ours. New York is the nearest state to ours known to have used NatureServe's conservation status rank calculator for assigning S-Ranks to ecological vegetation types (New York Natural Heritage Program 2014). In general, the conservation status rank factor scores and justifications for both states were comparable, with occasional minor differences in New Hampshire based on more current data, slight interpretation differences by heritage ecologists, and relevant ecological differences between comparable system types in each state.

RESULTS

We reviewed the ranks assigned to each wetland type by the Rank Calculator to determine if any adjustments were needed, and recorded adjusted values as the final assigned conservation status rank (Table 4).

Table 4. New vs. previous conservation status ranks for 27 wetland systems in New Hampshire.

System Name	New Rank	Previous Rank
Alpine/subalpine bog system	S1	S1
Coastal salt pond marsh system	S1	S1
Montane sloping fen system	S1	S1
Patterned fen system	S1	S1
Brackish riverbank marsh system	S1	S1S2
Sand plain basin marsh system	S1	S2
Sandy pond shore system	S1	S2
Salt marsh system	S1	S3
Calcareous sloping fen system	S1S2	S2
Coastal conifer peat swamp system	S1S2	S2
Sparsely vegetated intertidal system	S1S2	S3
Major river silver maple floodplain system	S2	S2
Montane/near-boreal floodplain system	S2	S2
Kettle hole bog system	S2	S2S3
Montane/near-boreal minerotrophic peat swamp system	S2	S2S3
Subtidal system	S2	S3
Black spruce peat swamp system	S2S3	S3
High-gradient rocky riverbank system	S3	S3
Poor level fen/bog system	S3	S3
Temperate minor river floodplain system	S3	S3
Low-gradient silty-sandy riverbank system	S3	S3S4
Moderate-gradient sandy-cobbly riverbank system	S3	S3S4
Medium level fen system	S3S4	S3S4
Temperate minerotrophic swamp system	S3S4	S4
Temperate peat swamp system	S3S4	S4?
Forest seep/seepage forest system	S4	S3S4
Drainage marsh - shrub swamp system	S5	S5

Eleven of the 27 wetland systems with revised S-Ranks remained the same as the previous ranks. The ranks of 15 wetland systems shifted from less at risk to more at risk. The rank for the salt marsh system shifted the most (from S3 to S1) due to the degree of threat associated with sea level rise and other effects of climate change (e.g., storm surges, influxes of freshwater, reduced ice scour, increased temperatures accelerating peat breakdown, and increased susceptibility to invasion). Finally, only one of the 27 wetland systems with a revised S-Rank shifted slightly from more at risk to less at risk: forest seep/seepage forest system (S3S4 to S4). This shift resulted from a better understanding of the system's distribution patterns in the state (it is more frequent and widely distributed than previously accounted for) and low threat levels compared to many other wetland system types. Details on rank factor scores and comments for each of the 27 wetland system types are documented in the provided Excel spreadsheet:

FINAL 2015_NH Wetland System Ranks_v3185.xlsx

To review the assigned values and comments for the 27 wetland systems, view the "Calculator Table" tab in the spreadsheet.

NHB will make these revised ranks available to inform biodiversity conservation, land protection, land use decisions, natural resource management, and environmental assessments (e.g., the 2015 revision to the original Wildlife Action Plan [New Hampshire Fish & Game 2005] is taking into consideration these revised conservation status ranks).

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APPENDIX: L2 METRIC FORM_VERSION 5B

Site Name: **Site Code:**   **Date** (yyyy-mm-dd)**:**
System: **Primary Surveyor:**
Overall EIA Rank:

LANDSCAPE CONTEXT

LAND USE INDEX

Calculate Land Use Index score using Landsat land cover data in a GIS (or calculate manually) following guidelines in manual; convert score to appropriate A–D rank.

Land Use Index Score	10–9.5	9.4–8	7.9–4	<4
Land Use Index Rank	**A**	**B**	**C**	**D**
Explain rank if adjusted:				

PERCENT OF PERIMETER HAVING BUFFER [estimate using 10 m minimum buffer width and length]		**AVERAGE BUFFER WIDTH** [average width measured along 8 spokes in 100 m zone surrounding wetland]	
Natural buffer is 100%	**A**	Average natural buffer width is ≥100 m	**A**
Natural buffer is 75–99%	**B**	Average natural buffer width is 75–99 m	**B**
Natural buffer is 25–74%	**C**	Average natural buffer width is 25–74 m	**C**
Natural buffer is <25%	**D**	Average natural buffer width is <25 m	**D**
Explain rank if adjusted:		Explain rank if adjusted:	

SIZE

COMPARATIVE SIZE ***SEE WETLAND SYSTEM DESCRIPTION***		**CHANGE IN SIZE**	
Very large compared to other examples of the same type (see system description or Comparative Size Rank Table in manual)	**A**	Occurrence has not been artificially reduced (0%) from its original, natural extent; any detectable change in size is due to natural fluctuations Note: Reduction in size for metric ratings A-D can include conversion or disturbance (e.g., changes in hydrology due to roads, impoundments, development, human-induced drainage; or changes caused by recent cutting); assigning a metric rating depends on the degree of reduction	**A**
Large compared to other examples of the same type (see system description or Comparative Size Rank Table in manual)	**B**	Occurrence is minimally reduced (1-5%) from its original natural extent	**B**
Medium to small compared to other examples of the same type (see system description or Comparative Size Rank Table in manual)	**C**	Occurrence is moderately reduced (5-30%) from its original, natural extent	**C**
Small to very small compared to other examples of the same type (see system description or Comparative Size Rank Table in manual)	**D**	Occurrence is substantially reduced (>30%) from its original, natural extent	**D**
Explain rank if adjusted from one given in system description or Comparative Size Rank Table:		Explain rank if B, C, or D:	

VEGETATION

VEGETATION STRUCTURE ***SEE WETLAND SYSTEM DESCRIPTION*** [vertical layers and horizontal patches]

FORESTED FLOODPLAIN & SWAMP		NON-FORESTED WETLAND	
Canopy a mosaic of patches of different ages or sizes; gap sizes also vary; # of live tree stems 12-20" and >20" dbh well within expected range; *using a quick qualitative approach and where applicable to type*, there exists a very wide size-class diversity of downed logs and standing snags and characteristic woody species are regenerating with expected abundance and diversity, so no human-related degradation to vegetation structure evident	**A**	Characteristic woody species present with expected abundance and diversity, so no human-related degradation to vegetation structure evident; some very wet peatlands or marshes may naturally not have any woody vegetation or only scattered stunted individuals; standing tree snags, dead shrubs, downed woody debris, and litter due to natural factors	**A**
Canopy largely heterogeneous in age or size; # of live tree stems of medium and large size slightly below expected range; wide size-class diversity of downed logs and standing snags; characteristic woody species regenerating but present in somewhat lower abundance and/or diversity than expected due to human-related factors, so slight degradation to vegetation structure evident (e.g., low levels of cutting, browsing, and/or grazing)	**B**	Characteristic woody species somewhat lower in abundance and/or diversity than expected due to human-related factors, so slight degradation to vegetation structure evident (e.g., low levels of cutting, browsing, grazing, and/or mowing); standing tree snags, dead shrubs, downed woody debris, and/or litter with minor alterations from human disturbances	**B**
Canopy somewhat homogeneous in age or size; # of live tree stems of medium and large size moderately below expected range; moderate size-class diversity of downed logs and standing snags; characteristic woody species with noticeably reduced regeneration, abundance, and/or diversity than expected due to human-related factors, so moderate degradation to vegetation structure evident (e.g., intermediate levels of cutting, browsing, and/or grazing)	**C**	Characteristic woody species moderately lower in abundance and/or diversity than expected due to human-related factors, so moderate degradation to vegetation structure evident (e.g., intermediate levels of cutting, browsing, grazing, and/or mowing); standing tree snags, dead shrubs, downed woody debris, and/or litter with moderate alterations from human disturbances	**C**
Canopy very homogeneous in age or size; # of live tree stems of medium and large size substantially below expected range; low size-class diversity of downed logs and standing snags (or absent); characteristic woody species with severely reduced regeneration, abundance, or diversity than expected due to human-related factors, so substantial degradation to vegetation structure evident (e.g., high levels of cutting, browsing, or grazing)	**D**	Characteristic woody species strongly altered in abundance or diversity than expected due to human-related factors, so substantial degradation to vegetation structure evident (e.g., high levels of cutting, browsing, grazing, or mowing); standing tree snags, dead shrubs, downed woody debris, or litter with substantial alterations from human disturbances	**D**

Explain rank if B, C, or D:

INVASIVE NON-NATIVE PLANT SPECIES COVER ***SEE WETLAND SYSTEM DESCRIPTION***

Invasive plant species apparently absent	**A**
Cover of invasive plant species <1–3%	**B**
Cover of invasive plant species 4–30%	**C**
Cover of invasive plant species >30%	**D**

Explain rank if B, C, or D:

NATIVE PLANT SPECIES COMPOSITION ***SEE WETLAND SYSTEM DESCRIPTION***

Native vegetation composition with expected species abundance and diversity: • Typical range of native diagnostic species present, including those native species sensitive to anthropogenic degradation, and • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) absent to minor	**A**
Native vegetation composition with minor alterations from expected due to human factors: • Some native diagnostic species absent or substantially reduced in abundance (including those sensitive to anthropogenic degradation), and/or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in low cover	**B**
Native vegetation composition moderately altered from expected due to human factors: • Many native diagnostic species absent or substantially reduced in abundance (including those sensitive to anthropogenic degradation), and/or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in moderate cover	**C**
Native vegetation composition substantially altered from expected due to human factors: • Most or all native diagnostic species absent (including those sensitive to anthropogenic degradation), a few may remain in very low abundance, or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in high cover	**D**

Explain rank if B, C, or D:

HYDROLOGY

WATER SOURCE ***SEE WETLAND SYSTEM DESCRIPTION***
[evaluation of the nature of water inputs]
[evaluate the effects of human constructed dams under Hydroperiod]

Non-Tidal			Tidal	
Water source is natural; hydrology is dominated by precipitation, groundwater, natural runoff, and/or overbank flow; there is no indication of direct artificial water sources; land use in the wetland's local drainage area is primarily open space or low density, passive uses	**A**		Tidal and non-tidal water sources are natural with no artificial alterations to natural salinity; no indication of direct artificial water sources (e.g., 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 wetland	**A**
Water source contains slight amounts of inflow from anthropogenic sources; indications of anthropogenic input include developed land (<20%) in the immediate drainage area of the wetland, some road runoff, small storm drains, and/or minor point source discharges into or adjacent to the wetland	**B**		Tidal and non-tidal water sources are slightly altered by human impacts; wetland directly receives slight amounts of inflow from anthropogenic sources; indications of anthropogenic input include developed land (<20%) in the immediate drainage area of the wetland, some road runoff, small storm drains and/or minor point source discharges into or adjacent to the wetland	**B**
Water source contains moderate amounts of inflow from anthropogenic sources; indications of anthropogenic input include 20-60% developed land adjacent to the wetland, moderate amounts of road runoff, moderately-sized storm drains, and/or moderate point source discharges into or adjacent to the wetland	**C**		Tidal and non-tidal water sources are moderately altered by human impacts; wetland directly receives moderate amounts of inflow from anthropogenic sources; indications of anthropogenic input include 20-60% developed land adjacent to the wetland, moderate amounts of road runoff, moderately-sized storm drains, and/or moderate point source discharges into or adjacent to the wetland	**C**
Water source contains substantial amounts of inflow from anthropogenic sources; indications of anthropogenic input include >60% developed land adjacent to the wetland, large amounts of road runoff, large-sized storm drains, or major point source discharges into or adjacent to the wetland	**D**		Tidal and non-tidal water sources are substantially altered by human impacts; wetland directly receives substantial amounts of inflow from anthropogenic sources; indications of anthropogenic input include >60% developed land adjacent to the wetland, large amounts of road runoff, large-sized storm drains, or major point source discharges into or adjacent to the wetland	**D**
Explain rank if B, C, or D:				

HYDROLOGY

HYDROPERIOD

SEE WETLAND SYSTEM DESCRIPTION

[evaluation of water patterns within the wetland system, regardless of source]
[assessment of the characteristic frequency, duration, degree, and/or timing of inundation, saturation, and/or drawdown]
[includes assessment of the effects dams may have on wetland system hydroperiod even when the dam is located a considerable distance up- or downstream from the wetland]

Riverine/Lacustrine **[channels, open & forested floodplains, shores]**		**Non-Riverine Enriched** **[rich swamps, medium & rich fens, drainage marshes]**		**Nutrient-Poor Isolated Wetlands** **[bogs & poor fens, poor swamps, basin marshes]**		**Tidal** **[salt & brackish marshes, tidal flats, subtidal]**	
Natural patterns of flood frequency, duration, level, and/or timing; stressors that impact the natural hydroperiod absent; channel/riparian zone characterized by equilibrium conditions, with no evidence of severe aggradation or degradation indicative of altered hydroperiod (see field indicators in manual)	**A**	Natural patterns of inundation & drawdown, saturation, and/or seepage discharge; stressors that impact the natural hydroperiod absent	**A**	Naturally stable and saturated hydrology, or natural cycles of saturation and partial drying; stressors that impact the natural hydroperiod absent	**A**	Full natural 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	**A**
Flood frequency, duration, level, and/or timing deviate slightly from natural conditions due to stressors (e.g., flood control dams upstream or downstream slightly effect hydroperiod, small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions); outlets may be slightly constricted by dam (if managed water levels, they closely mimic natural hydroperiod patterns); shore/bank with minor aggradation or degradation indicative of altered hydroperiod	**B**	Deviates slightly from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions); outlets may be slightly constricted by dam (if managed water levels, they closely mimic natural hydroperiod patterns)	**B**	Deviates slightly from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions)	**B**	Slightly muted tidal prism (although two daily minima and maxima are observed) and/or slightly inadequate drainage such that a small part of the marsh remains flooded during low tide	**B**
Flood frequency, duration, level, and/or timing deviate moderately from natural conditions due to stressors (e.g., flood control dams upstream or downstream moderately effect hydroperiod, ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions); outlets may be moderately constricted by dam, but flow still possible (if managed water levels, they less closely mimic natural hydroperiod patterns); shore/bank with moderate to severe aggradation or degradation indicative of altered hydroperiod	**C**	Deviates moderately from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions); outlets may be moderately constricted by dam, but flow still possible (if managed water levels, they less closely mimic natural hydroperiod patterns)	**C**	Deviates moderately from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions)	**C**	Moderately muted tidal prism and/or moderately inadequate drainage such that a significant portion of the marsh remains flooded during low tide	**C**
Flood frequency, duration, level, and/or timing deviate substantially from natural conditions due to stressors (e.g., flood control dams upstream or downstream substantially effect hydroperiod, diversions >3 ft. deep that withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions); outlets may be significantly constricted by dam, blocking most flow (if managed water levels, they are disconnected from natural seasonal fluctuations); shore/bank with severe aggradation or degradation indicative of altered hydroperiod	**D**	Deviates substantially from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., ditches/diversions >3 ft. deep & withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions); outlets may be significantly constricted by dam, blocking most flow (if managed water levels, they are disconnected from natural seasonal fluctuations)	**D**	Deviates substantially from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., ditches/diversions >3 ft. deep that withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions)	**D**	Substantially muted tidal prism or inadequate drainage such that most or all of the marsh remains flooded during low tide	**D**

Explain rank if B, C, or D:

HYDROLOGY

HYDROLOGIC CONNECTIVITY

[assessed of alteration to overbank flooding, channel migration, channel incision, and geomorphic modifications]
[evaluation of water exchange between wetland and surrounding systems, regardless of water patterns within the wetland system]

Riverine/Lacustrine **[channels, open & forested floodplains, shores]**			**Non-Riverine Enriched** **[rich swamps, medium & rich fens, drainage marshes]**			**Nutrient-Poor Isolated Wetlands** **[bogs & poor fens, poor swamps, basin marshes]**			**Tidal** **[salt & brackish marshes, tidal flats, subtidal]**	
River or lake is completely connected to floodplain/shore, backwater sloughs, and channels; no geomorphic modifications made to contemporary floodplain/shore; channel is not unnaturally entrenched	**A**		No unnatural obstructions to lateral and vertical movement of ground or surface water; rising water in the wetland has unrestricted access to adjacent upland, without obstructions to the lateral movement of flood flows; if perched water table then impermeable soil layer intact	**A**		No unnatural barriers restricting water movement into or out of wetland from adjacent areas	**A**		Tidal channel sinuosity reflects natural processes; unimpeded tidal flooding; total absence of tide gates, flaps, dikes, culverts, and human-made channels	**A**
River or lake is slightly disconnected from floodplain/shore, backwater sloughs, and channels (<25% of banks affected) due to dikes, rip rap, and/or elevated culverts; channel is slightly entrenched (overbank flow occurs during most floods)	**B**		Slight restrictions (impacting <25% of the wetland) to the lateral and/or vertical movement of ground or surface waters by unnatural features (e.g., levees and/or excessively high banks); restrictions may be intermittent along the wetland, 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 slightly disturbed (e.g., by drilling or blasting)	**B**		Surrounding land use slightly restricts water movement into or out of wetland	**B**		Tidal channel sinuosity slightly altered; tidal flooding is slightly impeded by tide gates, flaps, dikes, culverts, and/or human-made channels	**B**
River or lake is moderately disconnected from floodplain/shore, backwater sloughs, and channels (25-75% of banks affected) due to dikes, rip rap, and/or elevated culverts; channel is moderately entrenched (overbank flow only occurs during moderate to severe floods)	**C**		Moderate restrictions (impacting 25-75% of the wetland) to the lateral and/or vertical movement of ground or surface waters by unnatural features (e.g., levees and/or excessively high banks); 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)	**C**		Surrounding land use moderately restricts water movement into or out of wetland	**C**		Tidal channel sinuosity moderately altered; tidal flooding is moderately impeded by tide gates, flaps, dikes, culverts, and/or human-made channels	**C**
River or lake is substantially disconnected from floodplain/shore, backwater sloughs, and channels (>75% of banks affected) due to dikes, rip rap, or elevated culverts; channel is substantially entrenched (overbank flow never occurs or only during severe floods)	**D**		Substantial restrictions (impacting >75% of the wetland) to the lateral or vertical movement of ground or surface waters by unnatural features (e.g., levees or excessively high banks); most or all water stages are contained within the obstructions; if perched then impermeable soil layer substantially disturbed (e.g., by drilling or blasting)	**D**		Surrounding land use substantially restricts water movement into or out of wetland	**D**		Tidal channel sinuosity substantially altered; tidal flooding is substantially impeded by tide gates, flaps, dikes, culverts, or human-made channels	**D**

Explain rank if B, C, or D:

SOIL

SOIL CONDITION

Non-Tidal		Tidal	
Disturbed or bare soil limited to natural causes such as flood deposition or wildlife trails	**A**	Disturbed soil limited to natural causes; bare soils are naturally occurring and largely limited to salt pannes, creek banks, and intertidal flats	**A**
Small amounts of disturbed or bare soil due to human causes (e.g., small areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; and/or ruts from vehicles); extent and impact is minimal	**B**	Small amounts of disturbed or bare soil due to human causes (e.g., small areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; and/or ruts from vehicles); extent and impact is minimal	**B**
Moderate amounts of disturbed/degraded soil due to human causes (e.g., moderate areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; and/or ruts from vehicles); extent and impact is moderate	**C**	Moderate amounts of disturbed/degraded soil due to human causes (e.g., moderate areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; and/or ruts from vehicles); extent and impact is moderate	**C**
Substantial amounts of disturbed/degraded soil due to human causes (e.g., substantial areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; or ruts from vehicles); extent and impact is substantial and long lasting	**D**	Substantial amounts of disturbed/degraded soil due to human causes (e.g., substantial areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; or ruts from vehicles); extent and impact is substantial and long lasting	**D**
Explain rank if B, C, or D:		Explain rank if B, C, or D:	