

# Rhode Island Ecological Communities Classification

By

**Richard W. Enser**



*Coastal Plain Peatland, Graminoid Fen, Great Swamp Management Area*

## **Project Collaborators:**

RI Natural History Survey  
David Gregg

RI Department of Environmental Management  
Janet Coit, Cathy Sparks, Chris Raithel, Brian Tefft, Paul Jordan, Bruce Payton, Charles Brown

University of Rhode Island  
Peter August, Charles LaBash

The Nature Conservancy  
Scott Comings, Kevin Ruddock

## **Supported by:**

Rhode Island Conservation Stewardship Collaborative

Citation Format: Enser, R., D. Gregg, C. Sparks, P. August, P. Jordan, J. Coit, C. Raithel, B. Tefft, B. Payton, C. Brown, C. LaBash, S. Comings, and K. Ruddock. 2011. Rhode Island Ecological Communities Classification. Technical Report. Rhode Island Natural History Survey, Kingston, RI. (available at: [www.rinhs.org](http://www.rinhs.org))

4 October 2011

# **Rhode Island Ecological Communities Classification**

*Richard W. Enser*

October 4, 2011

## **Contents**

### **Introduction**

### **Rhode Island Ecological Communities Classification – Outline Version**

### **Community Descriptions**

### **Discussion**

### **Questions/Comments Received**

### **Appendix I. Crosswalk of RIECC and NTHC Classifications**

### **Appendix II. Crosswalk of NTHC Classification and Rhode Island SWAP Habitats**

## Introduction

The Rhode Island Ecological Communities Classification (RIECC) has been prepared to support development of a detailed ecological communities map and database to serve multiple conservation needs in Rhode Island including, but not limited to, the State Forest Assessment and State Wildlife Action Plan. The classification is a predecessor of a project to acquire aerial photography (6" pixel resolution, 4-band orthophoto) and LIDAR elevation data for the state of Rhode Island and produce a digital ecological communities GIS database. When complete, the digital ecological communities GIS database will serve the entire conservation community, resource managers, and cities and towns in the state.

The RIECC is an amalgamation of two previously published classifications:

Gawler, S.C. 2008. Northeastern Terrestrial Wildlife Habitat Classification (NTHC). Report to the Virginia Department of Game and Inland Fisheries on Behalf of the Northeast Association of Fish and Wildlife Agencies and the National Fish and Wildlife Foundation. NatureServe, Boston, Massachusetts. 102p.

Enser, R.W. and J.A. Lundgren. 2006. Natural Communities of Rhode Island (NCRI). A Joint project of the Rhode Island Department of Environmental Management Natural Heritage Program and The Nature Conservancy of Rhode Island. Web published by Rhode Island Natural History Survey, Kingston, RI. ([www.rinhs.org](http://www.rinhs.org))

The NTHC is a broadly defined classification (i.e., "coarse filter") that was designed to be applied across the entire Northeast landscape from Virginia to Maine as a standard classification to facilitate interstate approaches to wildlife conservation. Adoption of this classification by all states within the region will enable region-wide assessments of broadly-defined habitats, a process that is aided by a "crosswalk" to each state's list of "Habitats of Primary Concern" as published in state Wildlife Action Plans. Appendix II of this report includes the Rhode Island portion of this crosswalk which is based on the listing of key habitats identified in the Rhode Island Comprehensive Wildlife Conservation Strategy (DFW 2005).

Ecological systems developed by NatureServe were chosen as the basic classification scale for the NTHC. Ecological systems are defined as recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes. They are intended to provide a classification unit that can be readily mapped, often from digital imagery, and readily identified by conservation and resource managers in the field. They are defined based on biogeographic region, landscape scale, dominant cover type, and disturbance regime. Examples of ecological systems occurring in Rhode Island include Central Appalachian Dry Oak-Pine Forest, Northern Atlantic Coastal Plain Sandy Beach, and Laurentian-Acadian Freshwater Marsh.

Ecological systems are vegetation-based and are tied to, while not part of, the US National Vegetation Classification (USNVC). Each ecological system is described as a collection of USNVC associations that occur together in some combination on the ground. Associations are relatively fine-scale units that can be useful in characterizing a specific area and

driving local management decisions, but often not amenable to mapping at a regional scale, or mapping that relies on remote data.

To apply a “fine filter” in Rhode Island, the NTHC is supplemented by the NCRI. This classification was developed by conducting on-site ecological surveys to describe the natural communities (associations) within Rhode Island. As such, site-based descriptions can provide the detail that would not otherwise be identifiable from remote imagery. Development of the NCRI was a joint project of The Nature Conservancy and the Natural Heritage Program to define the ecological diversity of natural communities in Rhode Island as a guide for conserving the full array of biodiversity in the state.

Essentially, the NCRI is a catalog of the natural communities that occur in Rhode Island based on the physical environment, climate, and natural disturbance regimes inherent to this small part of the North American continent. Theoretically, this catalog represents how the Rhode Island landscape would appear without the influence of man. As *natural* ecosystems, the 94 communities described by the NCRI have all undergone various degrees of degradation by human actions, and as a result there has been a nearly complete loss of some communities (e.g., freshwater tidal marsh) and various degrees of recovery of others.

The NCRI does not provide a classification of anthropogenic communities (those created by and persisting under the influence of man). However, the NTHC does provide categories within which to assign anthropogenic (cultural) communities. Again, these categories are broadly defined and for the purposes of the RIECC have been broken down into identifiable, mappable divisions. For example, the NTHC identifies a general habitat system called “urban and recreational grasses” that includes all regularly managed (mowed) grasslands; the RIECC identifies the types of mowed grasslands as individual mappable units - lawns, airports, golf courses, etc.

Although the entire Rhode Island landscape has been altered by anthropogenic processes to varying degrees, a particular feature of natural communities is a lack of naturalized, non-native plants. In fact, the best examples of most natural communities contain only native species. For land managers the appearance of an exotic species in a natural community, especially those known to be invasive, can serve as an early warning of potential threats to that community’s ecological integrity. For example, the relatively small patch of *Phragmites* on the coastal plain shoreline of Tucker Pond, South Kingstown (about 50 yards from the only Rhode Island population of *Scirpus etuberculatus*); or, the larger patch of this same invasive at the Worden’s Pond, South Kingstown, boat ramp.

In contrast, a high percentage of introduced, invasive species in a habitat is indicative of a degraded natural community, and perhaps one that may never be restored. Notable in this regard is most of the land on Block Island where a large number of rapidly proliferating invasive plants are clearly preventing the reestablishment of forested habitats that originally existed on the island.

Introduced, non-native plants comprise 24% (about 400 taxa) of the Rhode Island flora. Only a small percentage of these are considered invasive, but introduced plants dominate recently disturbed sites and it is this distinction that can provide the basis for identifying

anthropogenic (cultural) habitats. (Note: In 1998, when the *Flora of Rhode Island* was published, 38 naturalized plants were listed as invasive but that number did not include *Carex kobomugi*, *Trapa natans*, *Microstegium vimineum*, or *Persicaria perfoliata*, all recent discoveries with potentially large effects on habitats in the state.)

The development of the RIECC was aided by the advice of several individuals familiar with Rhode Island ecology and remote sensing of ecological information. A meeting was convened on April 15, 2011 to solicit comments on a draft version of the RIECC with the following in attendance:

Peter August, University of Rhode Island  
David Gregg, Rhode Island Natural History Survey  
Catherine Sparks, Rhode Island Division of Fish and Wildlife  
Paul Jordan, RI Department of Environmental Management  
Charles Brown, RI Division of Fish and Wildlife  
Christopher Raithel, RI Division of Fish and Wildlife  
Brian Tefft, RI Division of Fish and Wildlife  
Charles LaBash, University of RI, Environmental Data Center  
Kevin Ruddock, The Nature Conservancy

Following this meeting several changes were made to reflect comments of the attendees and the classification was circulated for additional review. No additional comments were received, although several nomenclatural changes have been made in the classification hierarchy to help facilitate the subsequent mapping project.

# Rhode Island Ecological Communities Classification – Outline Version

## *Organizational Scheme and Classificatory Nomenclature*

I, II, III, etc: = "SYSTEM"

A., B., C., etc.: = "CLASS"

1., 2., 3., etc.: = "COMMUNITY"

a., b., c., etc.: = "TYPE"

(1), (2), (3), etc.: = "SUB-TYPE"

## **I. UPLAND SYSTEM**

### A. Open Uplands (Grassland and Shrubland)

1. Coastal Grassland
  - a. Maritime Beach Strand
  - b. Maritime Herbaceous Dune
  - c. Maritime Grassland
2. Coastal Shrubland
  - a. Maritime Shrub Dune
  - b. Maritime Shrubland
3. Ruderal Grassland/Shrubland
  - a. Old Field
  - b. Clearcut
  - c. Hedgerow
  - d. Utility Rights-of-Way
4. Sparsely Vegetated Rock
  - a. Inland Rocky Outcrop
  - a. Maritime Rocky Cliff
  - b. Maritime Bluff
5. Inland Sand Barren

### B. Deciduous Woodlands and Forests

1. Maritime Woodland
2. Oak Forest
  - a. Black Oak/Scarlet Oak - Heath Forest
  - b. White Oak – Mountain Laurel Forest
  - c. Chestnut Oak Forest
  - d. Mixed Oak - American Holly Forest
  - e. Mixed Oak/Hickory Forest

- 3. Northern Hardwood Forest
  - a. Beech/Sugar Maple/Red Oak Forest
  - b. Mixed Hardwood Riverside Forest
- C. Coniferous Woodlands and Forests
  - 1. Pitch Pine Woodland/Barrens
  - 2. Hemlock/Hardwood Forest
- D. Mixed Deciduous/Coniferous Forests
  - 1. Mixed Oak/Pitch Pine Forest
  - 2. Mixed Oak/White Pine Forest
  - 3. Hardwood/Hemlock Forest
- E. Plantation and Ruderal Forest
  - 1. Tree Plantation
  - 2. Ruderal Forest
- F. Agricultural
  - 1. Cropland
    - a. Vegetables
    - b. Turf
    - c. Nursery
    - d. Orchard
    - e. Vineyard
    - f. Christmas Trees
  - 2. Hayfields/Pasture
    - a. Hayfields
    - b. Pasture
- G. Developed Land
  - 1. Urban/Recreational Grasses
    - a. Lawn
    - b. Park
    - c. Golf Course
    - d. Cemetery
    - e. Airfield/Runway Margin
    - f. Highway Median
  - 2. Urban/Suburban Built \*
    - a. Residential High
    - b. Residential Medium
    - c. Residential Low
    - d. Residential Rural
    - e. Commercial/Industrial
    - f. Highways/Runways (pavement)
  - 3. Extractive Industry
    - a. Sand/Gravel Pit
    - b. Rock Quarry

\*the Urban/Suburban Built category is included for reference purposes only, as the suggested approach by the NTHC. It is expected that an alternative approach will be used in Rhode Island based on currently available GIS data.

## II. PALUSTRINE SYSTEM

- A. Open Mineral Soil Wetlands
  - 1. Coastal Plain Pondshore
    - a. Seasonally Flooded
    - b. Semi-permanently Flooded
  - 2. Emergent Marsh
    - a. Semi-permanently Flooded (Deep) Marsh
    - b. Seasonally Flooded (Shallow) Marsh
    - c. Freshwater Tidal Marsh
  - 3. Wet Meadow
  - 4. Shrub Swamp
  - 5. Modified/Managed Marsh
    - a. Impoundment
    - b. Ruderal Marsh
- B. Open Peatlands
  - 1. Northern Peatlands
    - a. Dwarf Shrub Bog/Fen
    - b. Black Spruce Bog
  - 2. Coastal Plain Peatlands
    - a. Graminoid Fen
    - b. Coastal Plain Quagmire
    - c. Sea Level Fen
- C. Forested Wetlands (Mineral and Peat Soils)
  - 1. Floodplain Forests
    - a. Silver Maple/Sycamore Floodplain Forest
    - b. Red Maple/Pin Oak Floodplain Forest
  - 2. Forested Swamp
    - a. Red Maple Swamp
      - (1) Red Maple – Deciduous Shrub
      - (2) Red Maple – Great Rhododendron
    - b. Swamp White Oak Swamp
    - c. Hemlock/Hardwood Swamp
    - d. Atlantic White Cedar Swamp
      - (1) White Cedar-Rhododendron Swamp
      - (2) White Cedar-Hardwood Swamp
  - 3. Seeps, Springs, Vernal Pools

### **III. ESTUARINE SYSTEM**

#### **A. Estuarine Intertidal**

1. Intertidal Shore
  - a. Mud Flat
  - b. Sand Flat
  - c. Rocky Shore
2. Salt Marsh
  - a. Low Salt Marsh
  - b. High Salt Marsh
  - c. Salt Panne
  - d. Salt Scrub
3. Brackish Marsh

#### **B. Estuarine Subtidal**

1. Tidal River/Stream
2. Tidal Creek
3. Brackish Aquatic Bed
4. Coastal Salt Pond

## Community Descriptions

**I. UPLAND SYSTEM.** This system consists of upland communities, forested and non-forested, which have well-drained soils that are xeric to mesic (never hydric) and a vegetated cover that is never dominated by hydrophytes, even if the soil surface is seasonally flooded or saturated.

**A. Open Uplands** (Grasslands and Shrublands). Upland communities dominated by shrubs or herbaceous plants. Trees may be present as scattered individuals or small clumps, but never more than 25% overall cover.

**1. Coastal Grassland.** Communities dominated by native herbaceous plants on or near the maritime coast and influenced by a dynamic disturbance regime of wind and salt spray.

**a. Maritime Beach Strand.** Sparsely vegetated sand beaches extending seaward from foredunes, but may include flats behind foredunes. Substrates are unconsolidated sand and shell sediments constantly shifted by winds and floods. Vegetation limited to pioneering, salt-tolerant, succulent annuals such as sea-rocket (*Cakile*) and orach (*Atriplex*).

**b. Maritime Herbaceous Dune.** Community dominated by beach grass (*Ammophila*) and other herbaceous plants on sandy dunes of barrier beaches. Includes sparsely vegetated sandy openings of backdunes characterized by beach heather (*Hudsonia*).

**c. Maritime Grassland.** Sparsely vegetated community of grasses and forbs on rolling morainal topography, generally on upper slopes and crests of hills exposed to wind and salt spray. Areas are small (<1 acre) and tend to be surrounded on downslope sides by a maritime shrubland community. Distribution of this community is limited to Block Island.

**2. Coastal Shrubland.** Communities dominated by shrubs on or near the maritime coast and influenced by a dynamic disturbance regime of wind and salt spray.

**a. Maritime Shrub Dune.** Community of medium height shrubs on backdunes and other protected portions of sandy dunes on barrier beaches. Bayberry (*Morella*) and beach plum (*Prunus*) are characteristic species; some areas may be dominated by non-native sand rose (*Rosa rugosa*).

**b. Maritime Shrubland.** Community of shrubs and scattered small trees on bluffs, headlands, and islands exposed to ocean winds and salt spray. Primary species include bayberry (*Morella*), shadbush

(*Amelanchier*), and arrowwood (*Viburnum*), and non-native invasives are often present including honeysuckle (*Lonicera*), bittersweet (*Celastrus*), and multiflora rose (*Rosa multiflora*).

3. **Ruderal Grassland/Shrubland.** Anthropogenic communities of herbaceous or mixed herb/shrub vegetation resulting from succession following complete removal of native woody cover.
  - a. **Old Field.** Community developing on areas originally cleared for agricultural purposes. Recently cleared fields are characterized by grasses and forbs, later stages include higher percentages of shrubs and scattered tree saplings. Some fields may be periodically mowed to maintain an herbaceous cover. Old fields are characterized by unnatural combinations of native and alien species; later shrubby stages often include exotic invasives.
  - b. **Clearcut.** Community developing on areas originally cleared by logging. Plant composition differs from old field habitats by retention of understory woody and herbaceous plants, including well-developed shrub layers.
  - c. **Hedgerow.** Linear patches of shrubs and small trees often maintained to separate agricultural fields.
  - d. **Utility Rights-of-Way.** Linear herb and shrub communities on managed utility corridors. Powerline rights-of-way tend to be maintained irregularly and include larger patches of shrubs, whereas gas pipelines are regularly mowed and dominated by herbs.
4. **Sparsely Vegetated Rock.** Herb and shrub communities on exposed bedrock or glacial till.
  - a. **Inland Rocky Outcrop.** Sparse community of exposed, primarily granitic, bedrock ledges.
  - b. **Maritime Rocky Cliff.** Community on exposed bedrock along the shore receiving direct impacts of wind and salt spray. Plant communities are most diverse where fresh water seepage emerges near the crest of cliffs and trickles down rock crevices.
  - c. **Maritime Bluff.** Community on exposed clay and glacial till on steep faces (bluffs) along the immediate coast, primarily on Block Island. Generally very sparsely vegetated with patches of herbaceous vegetation forming along freshwater seeps.
5. **Inland Sand Barren.** Sparsely vegetated community on open sands within pitch pine forests and woodlands. Examples are generally small (<2 acres)

and vegetation is patchy, usually covering <75% of the surface area. Lichens (especially *Cladonia*) and sand star fungus (*Astraeus*) are typically present.

**B. Deciduous Woodlands and Forests.** Communities comprised of 25-60% tree cover (woodlands) or >60% tree cover (forests), with >75% deciduous species.

1. **Maritime Woodland.** Community of tall shrubs and small trees (up to 6 m tall) near the coast, generally on the inland side of the maritime shrubland community. These two communities often intergrade and include the same species, but woodlands have more tree diversity with black cherry (*Prunus*), sassafras (*Sassafras*), oaks (*Quercus*), beech (*Fagus*) and red cedar (*Juniperus*).
2. **Oak Forest.** Forest communities dominated by oaks (*Quercus*). Species composition generally dependent on site conditions, especially soil type and hydrology. Variants include:
  - a. **Black Oak/Scarlet Oak – Heath Forest.** The predominant oak forest type in Rhode Island on well-drained, acidic soils. Chestnut oak and white oak may also be common constituents along with black birch (*Betula*), black gum (*Nyssa*), red maple (*Acer*), and sassafras (*Sassafras*). American chestnut (*Castanea*) was formally a common constituent. Understory is primarily ericaceous shrubs, especially huckleberry (*Gaylussacia*) and lowbush blueberries (*Vaccinium*).
  - b. **White Oak – Mountain Laurel Forest.** Typically found on well-drained coarse or gravelly soils such as on moraine deposits and eskers. Shrub layer is dominated by fairly dense cover of mountain laurel (*Kalmia*) with sparse herbaceous cover. Tends to occur in small patches within mixed oak and oak-pine forests.
  - c. **Chestnut Oak Forest.** Typically found on well-drained upper slopes and ridge tops with shallow soils. Red, black, and white oaks may also occur along with pitch pine (*Pinus*). The understory is ericaceous.
  - d. **Mixed Oak – American Holly Forest.** Typically found on moist, moderately well-drained silt and sandy loam soils, often at the upper edge of forested wetlands; upslope it often grades into oak – heath forest type. Black and scarlet oak are usually the dominant canopy trees, but red maple (*Acer*) may also be common; American holly (*Ilex*) is a prominent (>25% cover) sub-canopy tree. The understory shrub layer may be dense with highbush blueberry (*Vaccinium*) and pepperbush (*Clethra*) the predominant species.

e. **Mixed Oak/Hickory Forest.** This oak-dominated forest community is characterized by a greater representation of hickory (*Carya*). Typically found on well-drained loams and sandy loams of ridge tops and slopes, oak/hickory forests usually occupy more mesic and nutrient-rich sites than the more widespread oak-heath type. The richer habitats abet a more diverse flora in all layers: Overstory trees include white ash, tuliptree, and the shrub layer is multi-layered with tall witch hazel and flowering dogwood, medium-height maple-leaved viburnum, and short with sheep laurel and lowbush blueberry.

3. **Northern Hardwood Forest.** Deciduous forest communities dominated by a variety of species; red oak is usually a co-dominant.

a. **Beech/Sugar Maple/Red Oak Forest.** This community represents the southern extension of the northern hardwood forest. In Rhode Island, the overstory includes a higher percentage of red oak rather than the yellow birch that characterizes more northern forests. The better examples harbor many plants that have limited distributions in Rhode Island, primarily in the northwestern towns of Burrillville and Glocester. The list includes paper birch, hobblebush, striped maple, and a variety of herbaceous spring ephemerals.

b. **Mixed Hardwood Riverside Forest.** This community is found on the upper terraces of large rivers, on well-drained soils at the upper limits of periodic flooding. Canopy trees include American beech, sugar maple, white ash, red oak, and basswood. The shrub layer is limited, but there is a lush ground layer with an abundance of ferns.

C. **Coniferous Woodlands and Forests.** Communities comprised of 25-60% tree cover (woodlands) or >60% tree cover (forests), with >75% coniferous species.

1. **Pitch Pine Woodland/Barrens.** Pitch pine (*Pinus rigida*) communities may be characterized as woodlands with >50% tree cover, or barrens with <50% tree cover. As this community is maintained by periodic burning, the suppression of wild fire in Rhode Island in recent decades has resulted in a significant decline in the acreage of this type. Typically, pitch pine communities are characterized by well-drained sandy soils and widely open tree canopies with a dense shrub layer of scrub oak (*Quercus illicifolia*) and open sandy patches with bearberry (*Arctostaphylos*) and lichens. In the absence of fire pitch pine communities gradually succeed to mixed forests with oaks becoming successively more predominant (See: Pitch Pine/Oak Forest below).

2. **Hemlock/Hardwood Forest.** Forest community with >50% tree cover of Hemlock (*Tsuga*). (Similar forests with <50% cover of hemlock are covered below). This community typically occurs on middle to lower slopes of ravines,

cool mid-elevational slopes, and moist uplands at the edge of swamps. In stands with a closed hemlock canopy the shrub and herb layers are sparsely vegetated. Associated canopy hardwoods include beech (*Fagus*), sugar maple (*Acer*), yellow and black birch (*Betula*), red oak (*Quercus*), and occasionally tuliptree (*Lireodendron*).

#### **D. Mixed Deciduous/Coniferous Forests.**

- 1. Mixed Oak/Pitch Pine Forest.** Forest community on well-drained sandy soils of glacial outwash plains and moraines, and also on thin rocky soils of ridgetops. Dominant trees are pitch pine (*Pinus*) at >25% cover mixed with one or more oaks (*Quercus*), primarily white, black and scarlet. A well-developed shrub layer usually contains scrub oak, highbush blueberry (*Vaccinium*) and Huckleberry (*Gaylussacia*).
- 2. Mixed Oak/White Pine Forest.** Forest community on well-drained soils with a canopy of mixed oak and 40-50% cover of white pine (*Pinus*). Patches with >50% cover of white pine may also be found, but the overall pattern in larger stands is an even mix of oaks and pine. Shrub and ground layers are generally similar to oak-dominated forests, although understory cover is diminished in closed canopy stands of pine.
- 3. Hardwood/Hemlock Forest.** Forest community similar to the above-referenced Hemlock/Hardwood Forest except that in this mixed community hemlock occurs at <50% cover. The greater percentage of hardwoods, primarily yellow birch (*Betula*), beech (*Fagus*), and red and sugar maple (*Acer*), in the canopy layer encourages a more diverse understory than the closed canopy hemlock-dominated forests.

#### **E. Plantation and Ruderal Forests.**

- 1. Tree Plantation.** Land cover is apparently modified and appears as a managed tree plantation, usually coniferous, even-aged trees planted in rows. Species may be native or non-native and include various spruces (*Picea*), pines (*Pinus*), firs (*Abies*), and larch (*Larix*).
- 2. Ruderal Forest.** Undifferentiated upland forests, typically even-aged, resulting from succession following removal of native woody cover for agriculture or logging. Soil alteration from agriculture tends to lead to low-diversity forests, often with exotic species in the understory, that do not resemble natural forest systems. Generally, a ruderal forest is characterized by a combination of early-successional trees that can not be identified as natural ecological systems even in an incipient state. (If a forest has sufficient cover of indicator trees for a particular “natural” community, even with a presence of early-successional trees, it is classed as that forest system.) These

forests often contain substantial amounts of red maple (*Acer*), white pine (*Pinus*), red cedar (*Juniperus*), aspen (*Populus*), and gray birch (*Betula*), with associates of sassafras, (*Sassafras*), black locust (*Robinia*), hawthorn (*Crateagus*), apple (*Pyrus*), pin cherry (*Prunus*), and sometimes walnut (*Juglans*). Where soil disturbance has not been severe, many sites will follow a trajectory towards one of the later successional and more natural forest communities.

## **F. Agricultural Land.**

- 1. Cropland.** Land used for the production of annual-cycle crops including (corn, potatoes, small grains, vegetables, flowers, etc.), and perennial crops associated with orchards, vineyards, nurseries, sod farms, and Christmas tree farms. Plant cover may vary by season or from time to time depending on farm activities but in Rhode Island types that can commonly be described include: a. Vegetables, b. Turf, c. Orchard, d. Vineyard, e. Christmas trees.
- 2. Hayfields/Pasture.** Land with perennial herbaceous cover (usually in recognizable fields) used for livestock grazing or the production of hay. May be distinguished by type as either a. Hayfields or b. Pasture.

## **G. Developed Land.**

- 1. Urban/Recreational Grasses.** Managed grasslands planted in developed settings for recreation, erosion control, aesthetic, or other purposes. Examples of types that may be distinguished include a. Lawn, b. Park, c. Golf Course, d. Cemetery, e. Airfield/Runway Margin, f. Highway Median, etc.
- 2. Urban/Suburban Built.** [included for reference purposes only, as the suggested approach by the NTHC. It is expected that an alternative approach will be used in Rhode Island based on currently available GIS data.] Types include: a. Residential High, b. Residential Medium, c. Residential Low, d. Residential Rural, e. Commercial/Industrial, f. Highway/Runway (Pavement)
- 3. Extractive Industry.** Surface mining operations including these types: a. Sand/Gravel Pit and b. Rock Quarry.

**II. PALUSTRINE SYSTEM.** Non-tidal perennial wetlands characterized by emergent vegetation, including wetlands permanently saturated by seepage, permanently flooded, and those seasonally or intermittently flooded and seasonally dry. Vegetated cover composed of hydrophytes and soils are hydric.

**A. Open Mineral Soil Wetlands.** Trees absent or <50% cover, dominant vegetation is shrub and/or herbaceous. Substrates are mineral soils (not peat or muck) or close to bedrock.

**1. Coastal Plain Pondshore.** The gently sloping sandy/gravelly shores of ponds in morainal kettle holes and depressions in glacial outwash plains.

**a. Seasonally Flooded.** Ponds receive no overground flow and demonstrate widely fluctuating water levels in response to water table change. During low water periods, wide pondshores are exposed that support a lush community of herbaceous plants.

**b. Semi-permanently Flooded.** Ponds maintain relatively constant water levels from perennial stream inflow and more permanent emergent plant communities develop along shorelines.

**2. Emergent Marsh.** These freshwater emergent and/or submergent marshes are dominated by herbaceous vegetation, occurring in basins that are most often flat-bottomed and shallow, or forming a ring around the periphery of deeper basins. They are associated with lakes, ponds, slow-moving streams, impoundments or ditches. The herbaceous vegetation does not persist through the winter. Scattered shrubs are often present and usually total less than 25% cover. Trees are generally absent and, if present, are scattered. The substrate is typically muck over mineral soil.

**a. Semi-permanently Flooded (Deep) Marsh.** Water depths range from 15 cm to 2 m. The species composition of deep marshes is highly variable depending on hydrologic regime, topographic position, and substrate and several community types have been identified including those dominated by cattail (*Typha*), pickerelweed (*Pontedaria*), and *Phragmites*.

**b. Seasonally Flooded (Shallow) Marsh.** Water depths range from 15 cm to 1 m. Generally characterized by a mix of grasses, sedges, and associated broad-leaved emergents.

**c. Freshwater Tidal Marsh.** An emergent marsh community at the upper limits of tidal flow on streams and rivers. Salinity levels are <0.5 ppt. and water levels are <2m. This community forms a transition between brackish marsh and nontidal freshwater marsh and includes a combination of species typical of both, including narrow-leaved cattail (*Typha angustifolia*), bulrushes (*Scirpus*), and other broad-leaved emergents, and several indicator species, most notably wild rice (*Zizania*).

**4. Wet Meadow.** Graminoid and forb dominated meadows on soils that are seasonally saturated or flooded, but drier and without standing water through

most of the year. In a natural setting the high water table prevents woody species from becoming established; however, wet meadows are often associated with agricultural settings where woody species are kept at bay by grazing or mowing practices. Characteristic plants include Joe-pye-weed (*Eupatorium*), wool grass (*Scirpus*), soft rush (*Juncus*), tussock sedge (*Carex*), bluejoint (*Calamagrostis*), and goldenrods (*Solidago*). Scattered shrubs may occur, but comprise <30% cover.

4. **Shrub Swamp.** Wetland communities dominated by shrubs 0.5 to 5 m tall that occur along the margin of a pond or river, isolated in a wet depression or valley, or as a transition community between a marsh and upland communities. This type is highly variable with the dominant shrub species dictated by local conditions, including water depth, topographic position, and microclimate. At wetter sites buttonbush (*Cephalanthus*) or water willow (*Decodon*) may dominate with over 90% cover. Sites not permanently flooded may support a mix of shrubs with characteristic species including highbush blueberry (*Vaccinium*), sweet pepperbush (*Clethra*), winterberry (*Ilex*), alders (*Alnus*), silky dogwood (*Cornus*), maleberry (*Lyonia*), spicebush (*Lindera*), spiraea (*Spiraea*), and swamp azalea (*Rhododendron*).
5. **Modified/Managed Marsh.** Anthropogenic marsh communities created and obviously managed that have resulted from water diversion.
  - a. **Impoundment.** Deep and shallow water marshes created by diking/damming of small streams and mostly created as waterfowl habitat in state and private wildlife management areas.
  - b. **Ruderal Marsh.** Wetland communities created by water diversion along highways and other urbanized land uses characterized by unnatural combinations of native and alien plants, including invasive species such as purple loosestrife (*Lythrum*) and *Phragmites*.

**B. Open Peatlands.** Wetlands with substrates consisting of accumulated organic deposits consisting of coarse fibrous or woody peat, or well-decomposed organic soils (mucks). Permanent saturation reduces aeration of the substrate, slowing decomposition of litter and favoring peat accumulation. Open peatlands have <50% tree cover.

1. **Northern Peatlands.** These open “bogs” occur in basins south of the coldest regions of the Northeast down to near the glacial boundary. They are found mostly in areas where glacial stagnation left coarse deposits and glacial depressions (many are “kettleholes”). The basins are generally closed, i.e., without inlets or outlets of surface water. The nutrient-poor substrate and the reduced throughflow of water create conditions fostering the development of peat and peatland vegetation. In deeper basins, the vascular vegetation grows on a peat mat over water, with no mineral soil development. Although these

are often called bogs, in most cases they are technically fens (albeit nutrient-poor ones), as the vegetation remains in contact with the groundwater

- a. Dwarf Shrub Bog/Fen.** Dominated by a sphagnum cover with >50% cover of woody shrubs, the characteristic species being leatherleaf (*Chamaedaphne*) with sheep laurel (*Kalmia*), cranberry (*Vaccinium*), and dwarf huckleberry (*Gaylussacia*), and patches of patches of sedges and forbs.
  - b. Black Spruce Bog.** Dominated by a sphagnum cover with >50% cover of black spruce (*Picea*), with most individuals <5m tall. Black spruce is a rare plant in Rhode Island and only one example of this community type remains in the state at the Arcadia Management Area.
- 2. Coastal Plain Peatlands.** This group is comprised of dwarf shrub and herbaceous bogs that typically occur in isolated glacial kettle holes or in areas of deep sands supporting a pitch pine barrens landscape. These bogs develop in acidic, tannic water supporting a floating or grounded peat mat. Taller shrubs, especially highbush blueberry (*Vaccinium*) may occur at the periphery of the bog, and water willow (*Decodon*) often forms a distinct zone adjacent to open water. Aquatic plants such as water lily (*Nymphaea*) occur in open water.
  - a. Graminoid Fen.** A weakly minerotrophic peatland fed by groundwater containing minerals obtained during passage through or over mineral soils and aquifers. The substrate is peat composed primarily of sphagnum. Sedges are the dominant vegetation, including several species of *Carex* and twig-rush (*Cladium*), often with scattered shrub islands of leatherleaf (*Chamaedaphne*), cranberry (*Vaccinium*) and sweet gale (*Myrica*) at <25% overall cover.
  - b. Coastal Plain Quagmire.** Community on shallow depressions with permanently flooded muck soils, water depths ranging from 6cm to 0.6 m. Deeper water sections may support only aquatic vegetation, but shallow areas develop dense patches of emergent herbaceous plants including twig-rush (*Cladium*), beak-rushes (*Rhynchospora*), spikerushes (*Eleocharis*), bulrushes (*Scirpus*), and yellow-eyed grass (*Xyris*).
  - c. Sea Level Fen.** A rare emergent wetland community that develops at the upper edge of tidal marshes at the point of freshwater influx from groundwater seepage. Characteristic species are twig-rush (*Cladium*), bulrush (*Scirpus*) and spike-rush (*Eleocharis*).

**C. Forested Wetlands** (Mineral and Peat Soils). Seasonally flooded forests and permanently flooded or saturated swamps on mineral soils, peat substrates (accumulated organic deposits of coarse fibrous or woody plant material) or well-decomposed organic soils (mucks). Dominated by >60% canopy cover of woody vegetation >5m in height.

**1. Floodplain Forests.** Hardwood forests on river floodplains where lowest areas receive annual overbank flooding, usually in the spring but also occasionally in the fall. The water table may be well below ground surface for much of the growing season. A broadly defined community, floodplain forests are variable based on frequency and duration of flooding, size of river, topography, and substrate.

**a. Silver Maple/Sycamore Floodplain Forest.** Typical of floodplains along the main stems of larger rivers in northern part of Rhode Island. Silver maple (*Acer*) almost always present along with sycamore (*Platanus*) box elder (*Acer*), cottonwood (*Populus*), and American elm (*Ulmus*).

**b. Red Maple/Pin Oak Floodplain Forest.** Typical of floodplains in the lower Pawcatuck River system. Dominant trees are red maple (*Acer*), pin oak (*Quercus palustris*), and green ash (*Fraxinus*).

**2. Forested Swamp.** Wet forests not generally associated with flowing water other than small streams, found in basins with permanently flooded or saturated mineral soils.

**a. Red Maple Swamp.** Dominated by hardwoods with dominant species being red maple (*Acer*). Some conifers may be present at less than <25% cover. Two communities have been described based on understory shrub vegetation.

**(1) Red Maple – Deciduous Shrub.** Understory is mixed deciduous shrubs including highbush blueberry (*Vaccinium*), pepperbush (*Clethra*), spicebush (*Lindera*), winterberry (*Ilex*), and swamp azalea. Skunk cabbage (*Symplocarpus*) and cinnamon fern (*Osmunda*) are common ground cover plants. Two variants of this community have been described based on associated trees: Red Maple/Black Ash Circumneutral Swamp; Red Maple/Black Gum Swamp; and, Red Maple/Ash Swamp in which white and green ash are the co-dominants.

**(2) Red Maple – Great Rhododendron.** Red maple (*Acer*) dominates the overstory with white cedar (*Chamaecyparis*) usually present. The understory is dominated by great rhododendron (*Rhododendron maximum*).

- b. Swamp White Oak Swamp.** A hardwood forested swamp dominated by swamp white oak (*Quercus bicolor*). Red maple (*Acer*) and black gum (*Nyssa*) are usually present with an open understory of highbush blueberry (*Vaccinium*) and swamp azalea (*Rhododendron*). Water levels are seasonally high but draw down for most of the year.
  - c. Hemlock/Hardwood Swamp.** A mixed coniferous/deciduous swamp on mineral soils in depressions receiving groundwater discharge. Characterized by a closed canopy (75-100%), sparse shrub layer, and low species diversity. The canopy is dominated by hemlock (*Tsuga*) at >50% with lesser amounts of yellow birch (*Betula*) and red maple (*Acer*).
  - d. Atlantic White Cedar Swamp.** An evergreen or mixed swamp occurring in poorly-drained depressions and occasionally along streams. Atlantic white cedar (*Chamaecyparis*) comprises >50% of the canopy cover with red maple (*Acer*) sometimes a co-dominant. Two variants have been described.

    - (1) White Cedar – Rhododendron Swamp.** Shrub layer is dominated by great rhododendron (*Rhododendron maximum*).
    - (2) White Cedar – Hardwood Swamp.** Although white cedar predominates in the canopy, several other hardwoods are commonly found including red maple (*Acer*), yellow birch (*Betula*), and hemlock (*Tsuga*). The shrub layer is diverse with swamp azalea (*Rhododendron viscosum*), highbush blueberry (*Vaccinium*) and pepperbush (*Clethra*) predominating.
- 3. Seeps, Springs, Vernal Pools.** Small wetland communities generally found within upland forest communities. These wetlands are important habitats for amphibians, but are frequently too small to easily delineate using remote means.

**III. ESTUARINE SYSTEM.** Deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by land but that open, partly obstructed, or ephemeral access to the open ocean, and in which ocean water is partially diluted by freshwater influx. This system extends from the upstream limit of tidal influence seaward to an imaginary line closing the mouth of a bay or river. Salinity is >0.5 ppt.

**A. Estuarine Intertidal.** Includes areas between the highest and lowest tide levels where the substrate is regularly exposed and flooded by semi-diurnal tides. Some areas are irregularly exposed at low tides; other areas are only irregularly flooded at high tides.

**1. Intertidal Shore.**

**a. Mud Flat.** Usually located in quiet pockets of bays and protected by headlands. Sand-sized particles are mixed with silt and clay. These flats can be highly productive of clams and other invertebrates and are important feeding areas for shorebirds. During the summer, green macroalgae such as sea lettuce and hollow green weed can cover these flats.

**b. Sand Flat.** Usually located in embayed areas where rocky or sandy barriers help create protected sounds and lagoons. Local habitats range from small guts, shallow tributary creeks, and large saline pools to shallow estuarine bays and tidal creeks. Eelgrass (*Zostera*) is characteristic in saline habitats, but not all sand flats are vegetated.

**c. Rocky Shore.** Intertidal zones of solid rock that experience extreme exposure to wind, waves, currents, and ice-scour. Often covered with seaweeds with blue-green algae common in the high zones, barnacles are found in the mid zones, and mussels in the lower zones. Tide pools are frequently found in these habitats.

**2. Salt Marsh.** This system encompasses the intertidal marshes of the North Atlantic Coastal Plain from Chesapeake Bay north to Cape Cod, and sporadically to the southern Maine coast. It includes a number of different broad vegetation types including salt pannes, salt marshes, and salt shrublands. This system occurs on the bay side of barrier beaches and the outer mouth of tidal rivers where salinity is not much diluted by freshwater input. The typical salt marsh profile, from sea to land, features a low regularly flooded marsh strongly dominated by salt marsh cordgrass (*Spartina alterniflora*); a higher irregularly flooded marsh dominated by saltmeadow cordgrass (*S. patens*) and saltgrass (*Distichlis*); low hypersaline pannes characterized by saltwort (*Salicornia*); and a salt scrub ecotone characterized by marsh elder (*Iva*), groundsel-tree (*Baccharis*), and switchgrass (*Panicum*). Salt marsh "islands"

of slightly higher elevation also support red-cedar. Each of these so-called “zones” of vegetation can be treated as separate community types that can easily be remotely discerned: a. Low Salt Marsh, b. High Salt Marsh, c. Salt Panne, d. Salt Scrub.

- 3. Brackish Marsh.** A marsh community that occurs where water salinity ranges from 0.5 – 18.0 ppt and water levels range up to 2 m. Consists of a combination of freshwater and brackish water species including narrow-leaved cattail (*Typha angustifolia*), fresh cordgrass (*Spartina pectinata*), marsh fleabane (*Pluchea*), rose mallow (*Hibiscus*), bulrushes (*Scirpus*) and spike-rushes (*Eleocharis*). This community occurs in several situations including the edges of tidal rivers, coastal ponds that maintain breachways to the ocean, and small barrier ponds that receive salt spray and occasional overwash.
- B. Estuarine Subtidal.** Includes the area below the lowest tide where the substrate is permanently flooded and continuously submerged.
- 1. Tidal River/Stream.** The aquatic community of continuously flooded substrates that supports no emergent vegetation.
  - 2. Tidal Creek.** The aquatic community of a continuously flooded creek that drains the tidal waters of a coastal salt marsh. Water levels fluctuate with the tides; the creek bottom is permanently flooded, but the banks are exposed at low tide. Characteristic plants include widgeon grass (*Ruppia*) and several cyanophyta.
  - 3. Brackish Aquatic Bed.** Community of continuously flooded substrates supporting rooted vegetation and associated macroalgae. Water is generally <2 m deep at low tide and salinity ranges from 0.5 – 18.0 ppt. A characteristic plant of higher salinity beds is eelgrass (*Zostera*); lower salinity beds support widgeon grass (*Ruppia*), wild celery (*Vallisneria*), horned pondweed (*Zannichellia*), pondweeds (*Potamogeton*), and naiads (*Najas*).
  - 4. Coastal Salt Pond.** A coarsely defined type that includes intertidal and subtidal habitats. These ponds occur along the coast and are partially closed off from the sea by barrier beaches. Salinity may vary from nearly fresh to nearly saline depending on duration and extent of connection to the sea. Vegetation is comprised of finer scale communities nested within this type, including Brackish Marsh, Brackish Aquatic Bed, and Brackish Intertidal Flat.

## Discussion

### A. Crosswalks.

As previously described, the RIECC is an amalgamation of two previously published classifications – the Natural Communities of RI and the Northeast Terrestrial Habitat Classification. The former classification provides a framework for understanding those ecosystems that naturally occur in Rhode Island, the second provides an assessment of how the state’s natural communities are situated within the wider regional context of the Northeast, and also suggests a way to classify anthropogenic communities. As such, the NTHC is a guide for conducting regional analyses, especially concerning those habitats considered to be of greatest conservation concern as identified by State Wildlife Action Plans. To assist with these analyses, a crosswalk is provided in Appendix I of the RIECC and NTHC; in Appendix II an additional crosswalk is included of the NHTC and the Rhode Island Wildlife Action Plan Habitats of Conservation Concern – this crosswalk was originally prepared as part of the NHTC.

### B. Systems Not Covered.

Three systems, Riverine, Lacustrine, and Marine, are not included in the RIECC. Habitats of these three systems are essentially unvegetated, open water communities that can not be characterized using a methodology that relies on vascular plants as the principal descriptors. However, there are other methodologies available for classifying these habitats that utilize various physical parameters that are currently available as GIS datasets.

Riverine and lacustrine habitats have been classified and mapped by the Northeast Aquatic Habitat Classification (Olivero and Anderson 2008). For complete information see: <http://rcngrants.org/node/38>. The methodology used is outlined as follows:

**Riverine.** Habitats are classified according to a “simplified taxonomy” of four classes of physical characteristics:

#### A. Size Class:

1. Headwater/Creek
2. Small River
3. Medium River
4. Large/Great River

#### B. Temperature Class

1. Warm
2. Transitional Cool
3. Cold

#### C. Gradient Class

1. Low
2. Medium
3. High
4. Very High

D. Geology (for headwater and small river only)

1. Low Buffered: Acidic
2. Moderately Buffered: Neutral
3. Highly Buffering: Calciphytic Neutral

**Lacustrine:** The NAHC does not provide a detailed habitat classification for ponds and lakes; however, a simple analysis is presented that is based initially on size of the water body, as follows:

<10 acres:	pond
10-99 acres:	small lake
100-999 acres	medium lake
1000-9999 acres	large lake
10,000+ acres	very large lake

Water bodies are then mapped according to a set of four attributes:

1. Geology (geologic type underlying the polygon)
2. Elevation
3. Shoreline sinuosity (scale of 1-7, from round/less complex shorelines, etc.)
4. Connectivity to streams and other water bodies.

**Marine.** Mapping of marine communities presents an interesting challenge that may best be approached using recent analyses of aqueous soils conducted by the Natural Resources Conservation Service and the University of Rhode Island. There is considerable work underway in developing a classification system for marine environments by federal agencies and academic partners participating in the CMECS (Coastal and Marine Ecological Classification Standard; <http://www.csc.noaa.gov/benthic/cmecs/>).initiative.

**Developed Land.** The NTHC provides some guidance for classifying developed lands within an “Urban/Suburban Built” category, which is subdivided into “commercial/industrial” and four levels of “residential” based on the percentage of impervious surface within a subject area. Based on comments offered by Paul Jordan and others, developed land in Rhode Island is probably best addressed using other, currently available studies and GIS coverages. Therefore, the NTHC scheme will not be adopted for the RIECC; however, mapping standards for “natural” habitats within highly developed areas are addressed in the next section.

**C. Considerations for Mapping Communities.**

A primary goal of the RIECC project is to provide the framework for identifying and delineating ecological communities/habitats using recent aerial photography. Inherent in this process is the ability, or inability, to remotely identify community types, especially those that are separated by subtle differences. A solution to this problem is inherent in the hierarchical nature of the classification which permits mapping of habitat blocks at varying scales depending on the detail of imaging, as well as the availability and quality of supplemental information from field surveys.

For example, there are five community types identified under the habitat class - Oak Forest. In some situations, the specific type of oak forest may be evident because of the presence of an easily observed understory of evergreen shrubs, mountain laurel (*Kalmia*) or holly (*Ilex*). In other instances such understory details may not be evident to assign a community name, but the habitat block may still be mapped as "Oak Forest." In rarer cases, deciding between the two basic Deciduous Forest classes, Oak Forest and Northern Hardwood Forest, may not be possible and the habitat block would simply be labeled, "Deciduous Forest."

Using the more broadly-defined elements in the classification hierarchy may also be an advantage given the time available to conduct initial habitat mapping projects. For example, salt marshes are comprised of several readily identifiable communities (low marsh, high marsh, panes, etc.) where plant composition and appearance are essentially governed by the degree of daily salt water intrusion and consequent level of salinity. Although these "sub-communities" are relatively easy to delineate on aerial photographs, the work needed to complete this level of mapping for all salt marsh habitats in Rhode Island is probably best left for a future independent project.

**Minimum Mapping Units:** Because classification details and interpretive technologies differ among the northeastern states, the Northeast Terrestrial Habitat Classification does not provide mapping standards. As a general guideline, rarer natural communities should be mapped according to the smallest unit that can be remotely identified, but decisions on distinguishing polygon size for more common forested communities may require further thought.

An important consideration in this regard is adequately measuring habitat remaining in urbanized/developed portions of the state where even small, ¼-acre habitat blocks provide significant wildlife value. An unknown in this regard is the identification of minimum habitat standards for "natural" habitat patches ensconced within the urban matrix. Various studies have demonstrated that small woodlands, wooded swamps, stream corridors, and other similar undeveloped sites surrounded by developed land serve as habitat for a fairly diverse group of plant and animal species that are capable of tolerating the negative impacts associated with intense human presence. Even areas devoid of vegetation provide habitat in an urban setting, an example being Northern rough-winged swallows nesting in the "burrows" of pipes in the walls of the Moshassuck Canal in downtown Providence or common nighthawks nesting on the flat roofs of buildings within sight of the State House. Starting with these rather stark conditions, there are progressively more vegetated areas - parks, vacant lots, small wetlands, vernal ponds, and even larger backyards - where biodiversity dramatically increases in direct proportion to acreage and degree of vegetative cover. As such, even small pieces of woodland, wet or dry, provide unique refugia for a variety of organisms. Furthermore, vegetated areas in urban settings provide important ecosystem services beyond acting as habitat for biodiversity; for example, reducing storm water runoff or moderating high temperatures in urban environments.

## Questions Received Regarding the Classification

- 1) *I see that Rick has split wetlands into mineral soil and peat and into open and forested, but how fast a difference is that when you get out to do mapping? In other words, in this scheme Atlantic White Cedar Swamp and Red Maple Swamp are actually at different levels of the classification because "Forested Swamp" comes between Forested Mineral Soil Wetland and Red Maple Swamp, whereas there is no "Forested Swamp" before AWC Swamp.*

I agree, there is this confusion when splitting wetlands based on soil type. The peat/mineral soil dichotomy is fair when looking at open wetlands, but given that Atlantic White Cedar swamps are typically the only peat-based forested type, and that these often grade into and sometimes succeed to red maple swamps, it is probably less confusing to change the classification of wetland types as follows:

A. Open Mineral Soil Wetlands

B. Open Peatlands

C. Forested Wetlands, including A. White Cedar swamps as (e) under Forested Swamps.

- 2) *I have a question about the Extractive Industry--sand/gravel borrow pit category. Is the only difference between this and "inland sand barren" the length of time since it was last used or the degree to which it is an extraction activity that keeps it open versus more varied sorts of chronic disturbance that are typical of these sandy pits...clean fill stockpiles, stump dumps and mulch piles, rock dumps, concrete mixing, etc. And the uses of this or that acre of these sites varies from day to day depending on the whim of the owner or operator. Or does the latter specifically refer to a naturally occurring sand patch? But then wouldn't that mean that you need an "abandoned earth moving site" classification for abandoned quarries, discontinued land fills, etc.? Just as a practical matter it could be hard to tell these all apart when it comes to mapping them if our only choices are active gravel pit and inland sand barren. Think about how you'd map the half-abandoned/half utilized sand pit north of Slocum, east of Dry Bridge Road, for instance, or Timpson's mess across from the Rose Hill Landfill site?*

In a basic sense, there is a difference in borrow pits and inland sand barrens based on origin. Inland sand barrens are typically found within pitch pine communities where the thin overlying organic soil layer has been worn away by a natural, or more likely an historic manmade disturbance (usually grazing, tilling, or fire followed by erosion). Remaining examples of inland sand barrens in Rhode Island are generally small and because they are rare, we know where they are. Most borrow pits have a relatively recent origin (within the last 50 years or so) and generally are the results of the removal of a varying depth of overburden to get to the sand/gravel/rock resources below. Currently active quarries and gravel pits are obvious features on the landscape, and once abandoned can remain relatively unvegetated for long periods. Although revegetating pits may still be discernible remotely as former extraction sites they could be treated (mapped) as old fields given similarities in pioneer species composition and successional patterns.

- 3) *Where do white pine forests sit? They don't have a line in the coniferous forest (1.C.x) category. I see they make it in the mixed category (1.D.2). Aren't some of our white pine stands homogeneous enough to not be mixed?*

As a natural community, white pine forests apparently were not a component of the pre-colonial landscape and therefore a white pine coniferous forest type is not recognized in natural community classifications in New England. Rather, the mixed oak (or other hardwood)-white pine type is identified, recognizing that pure white pine stands may naturally occur as small features within the wider mixed type. Pure white pine forests (of which large portions are certainly present within Arcadia and other management areas) are the results of planting for various reasons (wildlife, forestry, water protection) similar to the plantings of red pine and other conifers carried out in the state especially during the CCC era. These pure stands should be mapped separately under the Tree Plantation designation (Plantation and Ruderal Forest) which recognizes their anthropogenic origin.

## Appendix I

### Crosswalk

#### Rhode Island Ecological Community Classification and Northeast Terrestrial Habitat Classification

#### Rhode Island Ecological Community Classification --- Northeast Terrestrial Habitat Classification

##### I. UPLAND SYSTEM

###### A. Open Uplands (Grassland & Shrubland)

- |                                |                                                              |
|--------------------------------|--------------------------------------------------------------|
| 1. Coastal Grassland           |                                                              |
| a. Maritime Beach Strand       | North Atlantic Coastal Plain Sandy Beach                     |
| b. Maritime Herbaceous Dune    | North Atlantic Coastal Plain Dune                            |
| c. Maritime Grassland          | North Atlantic Coastal Plain Heathland & Grassland           |
| 2. Coastal Shrubland           |                                                              |
| a. Maritime Shrub Dune         | North Atlantic Coastal Plain Dune                            |
| b. Maritime Shrubland          | North Atlantic Coastal Plain Heathland & Grassland           |
| 3. Ruderal Grassland/Shrubland |                                                              |
| a. Old Field                   | Ruderal Upland – Old Field                                   |
| b. Clearcut                    | N/A                                                          |
| c. Hedgerow                    | N/A                                                          |
| d. Utility Rights-of-Way       | Powerline Right-of-Way                                       |
| 4. Sparsely Vegetated Rock     |                                                              |
| a. Inland Rocky Outcrop        | Northern Appalachian-Acadian Rocky Heath Outcrop             |
| b. Maritime Rocky Cliff        | Acadian-N. Atlantic Rocky Coast                              |
| c. Maritime Bluff              | Northeastern Erosional Bluff                                 |
| 5. Inland Sand Barren          | Northern Atlantic Coastal Plain Pitch Pine Barrens (in part) |

###### B. Deciduous Woodlands & Forests

- |                                       |                                              |
|---------------------------------------|----------------------------------------------|
| 1. Maritime Woodland                  | North Atlantic Coastal Plain Maritime Forest |
| 2. Oak Forest                         | Central Appalachian Dry Oak-Pine Forest      |
| a. Black Oak-Scarlet Oak/Heath Forest | do                                           |
| b. White Oak/Mountain Laurel Forest   | do                                           |

- c. Chestnut Oak Forest
- d. Mixed Oak – American Holly Forest
- e. Mixed Oak/Hickory Forest
- 4. Northern Hardwood Forest
  - a. Beech/Sugar Maple/Red Oak Forest
  - b. Mixed Hardwood Riverside Forest

**C. Coniferous Woodlands & Forests**

- 1. Pitch Pine Woodland/Barrens
- 2. Hemlock/Hardwood Forest

**D. Mixed Deciduous/Coniferous Forests**

- 1. Mixed Oak/Pitch Pine Forest
- 2. Mixed Oak/White Pine Forest

**E. Plantation & Ruderal Forest**

- 1. Tree Plantation
- 2. Ruderal Forest

**F. Agricultural**

- 1. Cropland
- 2. Hayfields/Pasture

**G. Developed**

- 1. Urban/Recreational Grasses
- 2. Extractive Industry

do  
 North Atlantic Coastal Plain Hardwood Forest  
 do

Appalachian-Northern Hardwood Forest  
 N/A

Northern Atlantic Coastal Plain Pitch Pine Barrens  
 Laurentian-Acadian Pine-Hemlock-Hardwood Forest

Central Appalachian Dry Oak-Pine Forest  
 do

Managed Tree Plantation  
 Northern & Central Hardwood and Conifer Ruderal Forest

Cultivated Crops  
 Pasture/Hay

Urban/Recreational Grasses  
 Extractive

**II. PALUSTRINE SYSTEM**

**A. Open Mineral Soil Wetlands**

- 1. Coastal Plain Pondshore
- 2. Emergent Marsh
- 3. Wet Meadow
- 4. Shrub Swamp
- 5. Modified/Managed Marsh

North-Atlantic Coastal Plain Pond  
 Laurentian-Acadian Freshwater Marsh  
 Laurentian-Acadian Wet Meadow-Shrub Swamp  
 do  
 Modified/Managed Marsh

**B. Forested Mineral Soil Wetlands**

- 1. Floodplain Forest
  - a. Silver Maple/Sycamore Floodplain Forest
  - b. Red Maple/Pin Oak Floodplain Forest

Central Appalachian River Floodplain  
 Central Appalachian Stream & Riparian

- |                                 |                                                      |
|---------------------------------|------------------------------------------------------|
| 2. Forested Swamp               |                                                      |
| a. Red Maple Swamp              | North-Central Appalachian Acidic Swamp               |
| b. Red Maple/Ash Swamp          | North-Central Interior & Appalachian Rich Swamp      |
| c. Swamp White Oak Swamp        | North-Central Appalachian Acidic Swamp               |
| d. Hemlock/Hardwood Swamp       | do                                                   |
| 3. Seeps, Springs, Vernal Pools | N/A                                                  |
| <b>B. Open Peatlands</b>        |                                                      |
| 1. Northern Peatlands           |                                                      |
| a. Dwarf Shrub Fen/Bog          | North-Central Interior & Appalachian Acidic Peatland |
| b. Black Spruce Bog             | do                                                   |
| 2. Coastal Plain Peatlands      |                                                      |
| a. Graminoid Fen                | North-Central Appalachian Seepage Fen                |
| b. Sea Level Fen                | do                                                   |
| c. Coastal Plain Quagmire       | do                                                   |
| <b>C. Forested Peatlands</b>    |                                                      |
| 1. Atlantic White Cedar Swamp   | North Atlantic Coastal Plain Basin Peat Swamp        |

### III. ESTUARINE SYSTEM

#### A. Intertidal

- |                     |                                                      |
|---------------------|------------------------------------------------------|
| 1. Intertidal Shore |                                                      |
| a. Mud Flat         | North Atlantic Intertidal Mud Flat                   |
| b. Sand Flat        | North Atlantic Tidal Sand Flat                       |
| c. Rocky Shore      | North Atlantic Rocky Intertidal                      |
| 2. Salt Marsh       | Northern Atlantic Coastal Plain Tidal Salt Marsh     |
| 3. Brackish Marsh   | Northern Atlantic Coastal Plain Brackish Tidal Marsh |

#### B. Subtidal

- |                                  |     |
|----------------------------------|-----|
| 1. Tidal River/Stream            | N/A |
| 2. Tidal Creek                   | N/A |
| 3. Brackish Subtidal Aquatic Bed | N/A |
| 4. Coastal Salt Pond             | N/A |

## Appendix II

### Crosswalk between the Northeast Terrestrial Habitat Classification and Rhode Island List of Key Habitats of Conservation Concern.

(SWAP = State Wildlife Action Plan)

state	SWAP Habitat Unit (excluding aquatic)	NETHCS HABITAT SYSTEM
RI	Agricultural and Maintained Open Lands - Agricultural Cropland Hay	Cultivated Crops
RI	Agricultural and Maintained Open Lands - Agricultural Cropland Hay	Pasture/Hay
RI	Agricultural and Maintained Open Lands - Agricultural Grazing	Pasture/Hay
RI	Agricultural and Maintained Open Lands - Agricultural Land Unspecified	Introduced Shrubland
RI	Agricultural and Maintained Open Lands - Agricultural Land Unspecified	Powerline Right-of-Way
RI	Agricultural and Maintained Open Lands - Agricultural Land Unspecified	Ruderal Upland - Old Field
RI	Agricultural and Maintained Open Lands - Idle Agriculture	Cultivated Crops
RI	Deciduous Forests - Deciduous Forest Beech-Maple	Appalachian (Hemlock)-Northern Hardwood Forest
RI	Deciduous Forests - Deciduous Forest Oak/Heath	Northern Atlantic Coastal Plain Hardwood Forest
RI	Deciduous Forests - Deciduous Forest Oak/Heath	Central Appalachian Dry Oak-Pine Forest
RI	Deciduous Forests - Deciduous Forest Oak/Holly	Northern Atlantic Coastal Plain Hardwood Forest
RI	Deciduous Forests - Deciduous Forest Oak-Hickory	Central Appalachian Dry Oak-Pine Forest
RI	Deciduous Forests - Deciduous Forest Oak-Hickory	Northern Atlantic Coastal Plain Hardwood Forest
RI	Deciduous Forests - Deciduous Forest Unspecified	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Early Successional Habitats - Coastal Shrubland	Northern Atlantic Coastal Plain Heathland and Grassland
RI	Early Successional Habitats - Maritime Grassland	Northern Atlantic Coastal Plain Dune and Maritime Grassland
RI	Emergent Wetlands - Coastal Plain Pondshore	Northern Atlantic Coastal Plain Pond
RI	Emergent Wetlands - Coastal Plain Quagmire	Northern Atlantic Coastal Plain Pond
RI	Emergent Wetlands - Emergent Fen/Bog	North-Central Interior and Appalachian Acidic Peatland
RI	Emergent Wetlands - Emergent Marsh Deep	Laurentian-Acadian Freshwater Marsh
RI	Emergent Wetlands - Emergent Marsh Shallow/ Wet Meadow	Laurentian-Acadian Wet Meadow-Shrub Swamp

RI	Emergent Wetlands - Freshwater Wetland Unspecified	Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh
RI	Emergent Wetlands - Freshwater Wetland Unspecified	Laurentian-Acadian Freshwater Marsh
RI	Evergreen Forests - Evergreen Forest Hemlock	Laurentian-Acadian Pine-Hemlock-Hardwood Forest
RI	Evergreen Forests - Evergreen Forest Pine	Laurentian-Acadian Pine-Hemlock-Hardwood Forest
RI	Evergreen Forests - Evergreen Forest Red Cedar	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Evergreen Forests - Evergreen Forest Spruce (Plantation)	Managed Tree Plantation
RI	Evergreen Forests - Evergreen Forest Unspecified	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Forested Wetlands - Forested Coniferous Wetland Unspecified	
RI	Forested Wetlands - Forested Coniferous Wetland White Cedar	Northern Atlantic Coastal Plain Basin Peat Swamp
RI	Forested Wetlands - Forested Deciduous Red Maple Swamp	North-Central Appalachian Acidic Swamp
RI	Forested Wetlands - Forested Deciduous Wetland Unspecified	North-Central Appalachian Acidic Swamp
RI	Forested Wetlands - Forested Deciduous Wetland Unspecified	North-Central Interior and Appalachian Rich Swamp
RI	Intertidal - Estuarine Beaches Unspecified	Northern Atlantic Coastal Plain Sandy Beach
RI	Intertidal - Estuarine Bluff Clay	Northeastern Erosional Bluff
RI	Intertidal - Estuarine Intertidal Emergent Brackish Marsh	Northern Atlantic Coastal Plain Tidal Salt Marsh
RI	Intertidal - Estuarine Intertidal Emergent Brackish Marsh	Northern Atlantic Coastal Plain Brackish Tidal Marsh
RI	Intertidal - Estuarine Rocky Shore Bedrock	North Atlantic Rocky Intertidal
RI	Mixed Forests - Forest Unspecified	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Mixed Forests - Forest Unspecified	Introduced Upland Vegetation - Tree
RI	Mixed Forests - Mixed Forest Deciduous Unspecified	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Mixed Forests - Mixed Forest Evergreen Unspecified	Ruderal Forest - Northern and Central Hardwood and Conifer
RI	Pitch Pine Communities - Evergreen Forest Pitch Pine/Scrub Oak Barren	Northern Atlantic Coastal Plain Pitch Pine Barrens
RI	Pitch Pine Communities - Evergreen Forest Pitch Pine-Oak Barren	Northeastern Interior Pine Barrens
RI	Predator-free Islands	n/a
RI	Shrub Wetlands - Shrub Bog Unspecified	Introduced Shrubland

RI	Shrub Wetlands - Shrub Bog Unspecified	North-Central Interior and Appalachian Acidic Peatland
RI	Shrub Wetlands - Shrub Swamp Alder	Laurentian-Acadian Wet Meadow-Shrub Swamp
RI	Shrub Wetlands - Shrub Swamp Water Willow	North-Central Interior and Appalachian Acidic Peatland
RI	Sparsely Vegetated Habitats - Barren Land Unspecified	Quarries/Pits/Stripmines
RI	Sparsely Vegetated Habitats - Beach Grass Dune	Northern Atlantic Coastal Plain Dune and Maritime Grassland
RI	Sparsely Vegetated Habitats - Freshwater Beaches	Laurentian-Acadian Lakeshore Beach
RI	Sparsely Vegetated Habitats - Gravel Pits and Quarries	Quarries/Pits/Stripmines
RI	Sparsely Vegetated Habitats - Inland Dune / Cobble	Quarries/Pits/Stripmines
RI	Sparsely Vegetated Habitats - Inland Dune/ Sand Barren	Quarries/Pits/Stripmines
RI	Sparsely Vegetated Habitats - Natural Quartz Rock Outcrops	Northern Appalachian-Acadian Rocky Heath Outcrop
RI	Urban Habitats	Residential - Low Intensity
RI	Urban Habitats	Urban & Recreational Grasses
RI	Urban Habitats	Residential - Rural / Sparse
RI	Urban Habitats	Residential - Medium Intensity
RI	Urban Habitats	Commercial/Industrial
RI	Urban Habitats	Residential - High Intensity