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# Managing and Restoring Native Ecosystems:

## A Guide for New Hampshire Towns


**USDA - Natural Resources Conservation Service**

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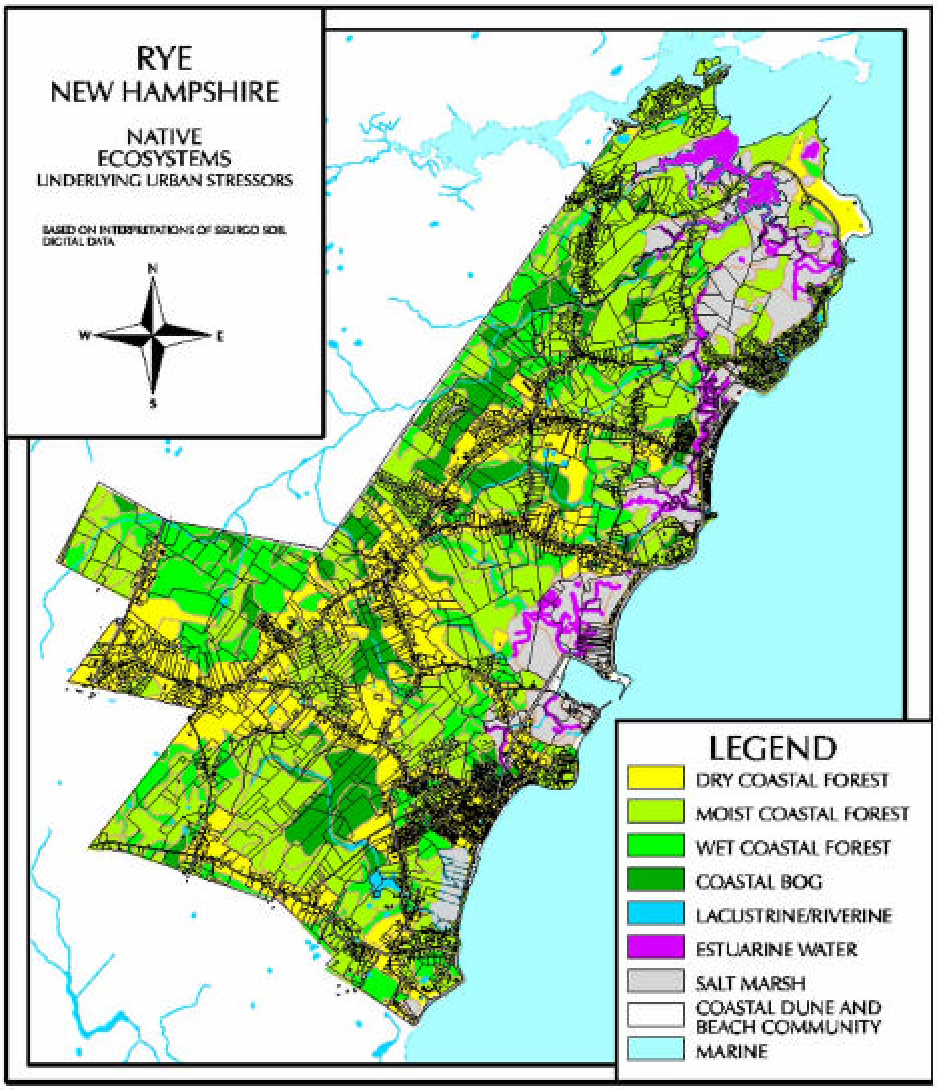



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## INTRODUCTION

To the casual observer, nature seems relatively undisturbed in most of New Hampshire. Outside our few cities and large towns, one finds mostly pastoral and forested landscapes. A closer look, however, shows us that these landscapes are much changed from those that our ancestors first found here. These original landscapes were comprised of a pattern of ecosystems whose development was dictated by natural forces such as climate, soil, nutrient supplies, fire, and the influence of plants and animals. Following the retreat of the most recent glaciers, these ecosystems responded to climatic changes, changes in sea level and other forces in the absence of strong human interference. Each ecosystem, whether old growth forest, salt marsh, bog or swamp was suited to and evolved with the changing landscape. In most cases, this process of ecosystem development was slow by human standards. Except for major disturbances such as storms and fires, plant and animal communities developed slowly as the climate warmed and sea levels fluctuated.

The arrival of humans, and in particular the arrival of European settlers in the 17$^{th}$ century, greatly affected both the nature and the time scale of the forces acting upon our ecosystems. Although the indigenous peoples of New England both cleared and burned, the rate and extent of this activity was greatly accelerated by the arrival of Europeans. By the middle of the 19$^{th}$ century, settlers had cleared about 85% of the land south of the White Mountains for agriculture. After 1850, agriculture shifted to other parts of the country, and most the fields and pastures that had been so laboriously cleared, slowly became forested again. Logging was also widespread during the latter part of the 19$^{th}$ century. By 1910, almost all of the remaining forests of New Hampshire were logged.

In this century, logging continues to impact forested ecosystems throughout the state. While some of our second growth forests are reaching the century mark, the increasing demand for forest products makes the possibility of widespread old growth forests problematic. Even in the absence of harvest, the introduction of alien plant species and diseases, the affects of global warming, acid rain, and a host of other human impacts would profoundly change the nature of future old growth forests. In southern New Hampshire, dramatic increases in population and development have put severe pressure on many natural ecosystems.

All of this human activity in New Hampshire has had a significant impact on many important ecosystems within the state. Some ecosystems, such as old growth forests, have virtually disappeared, while others such as Pine Barrens have been greatly reduced. Certainly, our impacts have not been as dramatic as in other parts of the country, but a reasonable level of concern about the current state and future condition of our natural ecosystems is warranted.

Why did we make so many changes to ecosystems of the state? Mostly, we did it to meet our immediate needs. We cut down the great forests for timber and agriculture. We dammed rivers and developed the shorelines of lakes. We filled swamps and salt marshes to build houses and stores. What we did not change directly, we fragmented with roads and other human infrastructure.

Our ability to alter ecosystems has been a two-edged sword. Certainly, we would not have the complex social structure called civilization without altering some ecosystems. Altering ecosystems for agriculture, for example, has freed most of us from the constant need to search for food. For human populations overall, agriculture has been very successful. This is despite the fact that in many civilizations agriculture has not always been sustainable.

Agriculture has allowed a significant increase in human population over that possible in a hunting gathering society. On the other hand, agriculture has damaged natural ecosystems both directly and indirectly. A forest or grassland cleared for agriculture ceases most of its natural functions. Increased sediment from agricultural fields can impact downstream rivers and lakes. In addition, the increase in population brought about by the agricultural revolution has put severe stress on many natural ecosystems that may be necessary for human survival.

However, agriculture is not the only human activity that negatively altered natural ecosystems. Almost all of the things that humans routinely do from clearing land, to building houses, to disposing of wastes, affect natural ecosystems to some extent.

The real question is; how much of the natural infrastructure of the state do we need? Do we need 90%, 10%, or 0%? No one really knows. What we do know is that we need some percentage of it. This is not simply a moral or philosophical question. It is not just about trying to live in harmony with nature. Rather, it is a very practical question about our prospects for survival. Scientific research increasingly indicates that natural systems are much more important to the long-term survival of life (including ours) on earth than previously thought. We have reached a point that the long-term sustainability of some of New Hampshire's natural ecosystems is threatened. A few of our more fragile ecosystems such as Pine Barrens have largely disappeared. A significant portion of other ecosystems such as salt marshes have been so severely degraded that they no longer perform their usual variety of valuable functions for society such as wildlife habitat.

Certainly, few would argue, and less would accept, that we humans should stop living in New Hampshire. We are here to stay. What can be argued, however, is that we can significantly reduce our impact on natural processes. Much can be done at relatively low cost and without significant disruption of human activity. For example, many salt marshes are degraded simply because road culverts along the coast were sized for freshwater drainage rather than for tidal flow. Experience has shown us that many of these can be safely, and relatively cheaply, enlarged to allow tidal flow. A bonus is often a reduction in flooding from upland runoff impounded behind inadequate culverts.

### Purpose of this manual

This manual is designed to help town officials and other laypersons protect, manage, and restore the native ecosystems of New Hampshire. It is not intended to be a detailed technical manual but rather a guidebook for the restoration process. Users of this manual will need to call upon professionals in several disciplines to carry out many of the tasks outlined. Much, however, can be done by volunteers. Indeed, we recognize that significant restoration cannot be done without the direct involvement of interested citizens.

### What is a native ecosystem?

Let's start by defining an ecosystem. If a system is an assemblage of parts forming a whole, then an ecosystem is a system consisting of organisms and their environment. In other words, ecosystems have two components, a living (biotic) component consisting of all of the plants, animals, and microbes and a non-living (abiotic) component consisting of the physical environment that the living organisms inhabit.. That is simple enough.

The boundary of an ecosystem can be drawn to suit the purpose at hand. For example, a leaf can be considered an ecosystem, as can the whole tree or the whole forest. In the natural resources profession, we usually use the term ecosystem to mean a geographic area (e.g. a field, a forest, watershed) and all of its associated plants, animals (including humans), and other organisms.

A native ecosystem is simply one that is composed of native organisms in a native habitat. Native ecosystems in New Hampshire are those ecosystems that have been here since the end of the last ice age approximately 10,000 years ago. Native plants and animals are those species that either originated in a particular geographic area or have been there so long that they are fully integrated into local ecosystems.

By being fully integrated, we mean that its habits are indistinguishable from a native species. One important characteristic that often distinguishes native species from alien species is the tendency for alien species to invade native ecosystems and crowd out native species. Purple loosestrife, a wetland plant introduced from Asia in the last century, has a tendency to crowd out native plants. This is because its natural enemies were left behind.

American bison, on the other hand, also came here from Asia but became so integrated into prairies and other North American ecosystems, that it now seems to be the quintessential American species. One difference between purple loosestrife and Bison is that Bison came here between upwards of 800,000 years ago, and have had ample time to evolve and adapt to our ecosystems.

### The physical environment of native ecosystems

As we stated in the introduction, ecosystems have a living (biotic) community housed in a nonliving physical environment. We will first discuss the physical environment of ecosystems. Your town has a variety of natural physical environments. In New Hampshire, most of these physical environments are the result of the continental glaciers, which retreated some 10,000 years ago. Humans, of course, can cause great changes in the physical environment. For now, we are going to just deal with native landscapes. Later, when we discuss ecosystem stressors we will look more closely at the changes humans have made to the natural physical environment.

The grinding action of these glaciers, as well as the great torrents of melt flowing from them as they retreated, shaped and molded the landscape we see around us. Since the glacial retreat, other forces of nature, including at least one period of inundation of much of the state to the Merrimack River by the Atlantic, refined the topography our present landscape.

Each of these physical environments supports (or once supported) a characteristic plant and animal community. Each of these physical environments and its associated biotic community is (or was until humans changed it) a native ecosystem. One of your most important tasks in using this manual is to identify these existing, or potentially existing,, native ecosystems.

### The impact of humans on native ecosystems

Because humans exert such profound influence on some ecosystems, it is useful to distinguish between native ecosystems under natural conditions and highly disturbed native ecosystems. An example of a highly disturbed native ecosystem would be forest that has been cut down to build a city. Remnants of the forest may still be present (e.g. forested river corridors and wetlands) but most of its structure and function has been lost. Another example would be a tall grass prairie in the Midwest that has been plowed up and planted in corn. Some of the native ecosystem remains, at least for a while, such as the deep rich soil; but the diverse plant and animal communities that once inhabited the grassland are largely gone.

This is not to imply that the presence of humans somehow makes an ecosystem unnatural. It is simply to emphasize that the presence of humans typically changes the structure, function and future evolution of native ecosystems. For example, a managed forest will have a population of trees of certain species, sizes and ages, that reflect management decisions based on profitability and other considerations. In a "natural" state, the same forest would probably have a very different population of trees that reflected such processes as plant succession, disturbance, and animal activity.

The time scale of these two forests would also be different. Human activity usually happens over a relatively short time span. For example, a timber harvest or land clearing for agriculture. Natural processes such as glacial recession and plant succession generally happen over longer periods. There are exceptions such a fires and storms, but even in these instances the presence of humans tends to greatly alter the time scale of natural processes. For example, we prevent forest fires until the fuel builds up and a catastrophic wildfire develops, or we "salvage" timber following a storm rather than allowing the slow recycling of downed limbs and trees. Under natural conditions, some plant communities require periodic fires, flooding, grazing, or other natural processes to sustain them. When we prevent these processes, we can significantly alter these ecosystems.

Ideally, the term native ecosystems would mean those ecosystems in which human influence is zero. In practice, this is not possible. In the real world, we cannot simply walk away from most ecosystems and expect them to function naturally. This is because we have so changed ecosystems at the local, regional, and global level, that the physical, chemical, and biological conditions necessary for an ecosystem to function on its own are missing. We must recreate these conditions. In many cases, this will require active management. For example, Pine Barrens need periodic fires, salt marshes need tidal flow. Since humans generally suppress natural wildfires, we must use controlled fires to manage Pine Barrens. Since humans have restricted tidal flow to many salt marshes, we must restore it. In other words, our management of natural ecosystems is aimed at restoring, or at least mimicking, those natural conditions under which the system once flourished.

It is important to understand that by "natural" does not necessarily mean pristine. A pristine ecosystem is one that has always been relatively free of human interference. By our definition, pristine ecosystems are native but not every native ecosystem is pristine. The nativeness of an ecosystem is the degree to which it functions as though it was free of human interference.

For example, a crop field is obviously not a native ecosystem under natural conditions. Rather it is a native ecosystem highly disturbed by human activity. Crop fields depend on human inputs for seed, lime, fertilizer, weed control, etc., and these inputs do not mimic natural conditions. Quite the opposite, human inputs to crop fields are generally intended to create a monoculture of hybrid plants quite unlike anything found in nature. Native ecosystems, on the other hand, furnish their own seed, nutrients, and weed control through complex physical, chemical, and biological processes.

One aim of this manual is to help you think about human activity in the context of native ecosystems. Much of our activity has been to alter existing native ecosystem, be it forest or prairie, to some condition that is more immediately suitable to humans. In doing so, however, we have often ignored the fact that native ecosystems are important for long term human needs, such as keeping the climate within acceptable limits for human habitation.

By our definition, the few pristine ecosystems left in New Hampshire are native ecosystems under natural conditions. However, other ecosystems in the state are essentially native but are not pristine. An example would be a salt marsh that requires occasional cleaning of tidal creeks and culverts for the maintenance of tidal flow. It is not pristine because of past human activity. It can, however, be considered native by our definition, if is consists predominantly of native plants and functions with very little human interference. What little interference exists is intended to mimic natural conditions.

**Why are native ecosystems important?**

Native ecosystems are important because they perform many valuable functions for us such as fish and wildlife habitat, recreational and educational opportunity, producing forest products, supplying oxygen, and improving water quality. At a global level, natural ecosystems, particularly forests, are important in maintaining the earth's temperature and controlling carbon dioxide levels. In addition to these obvious functions, scientists have a deeply held belief that natural ecosystems are vital to the long-term support of life on earth, in ways we are only beginning to understand.

**What is ecosystem management/restoration?**

Perhaps it is best to begin by stating what ecosystem management/restoration is not. Simply put, it is not returning the landscape to a pristine condition. Most ecosystems have undergone such significant changes that they can never be put back exactly as they were. Extinction, climate changes, sea level fluctuations, and a myriad of other reasons make returning most native ecosystems to a historically pristine state impossible. Wolves, American chestnut, elm, passenger pigeons and a host of other plants and animals are gone, or nearly so. Our restored native ecosystems must get along without them.

Does this mean that we can do nothing? No, it means that we must be satisfied with restored native ecosystems that are as natural as practical but not necessarily pristine. It also means that we should reduce human stressors on highly disturbed native ecosystems that underlie urban areas and cropland as much as feasible. In practice, it means that we attempt to create conditions that allow a target ecosystem to function and evolve with as little human help or interference as possible. It is restoring and maintaining the physical, chemical, and biological conditions necessary to allow natural ecosystems to function and evolve over time. Simply, it is reducing and reversing unnecessary human impacts on native systems. This is the heart of ecosystem restoration.

We recognize that native ecosystems are not static. There is no “balance of nature.” Everything changes over time. It is more a question of the causes of ecosystem change. Ecosystem restoration recognizes that ecosystems have been changing since life arose on this planet. The changes that humans cause in ecosystems are different in several ways than those which occur naturally. First, humans work over very short time scales compared to the slow pace of the geologic time scale. A wetland that might change and evolve over eons can be destroyed in a few days. Of course, nature also has cataclysmic events, earthquakes, volcanoes and the like. The difference is that these are often localized events, plant and animal species, which might be destroyed in a Mount St. Helens type eruption, survive in refugia outside the zone of destruction.

Natural events, for example, were known to have destroyed thousands of passenger pigeons at one time, but other flocks existed elsewhere which could repopulate an area. When humans, on the other hand, destroyed thousands of passenger pigeons at one location, they would follow the flock and destroy thousands more at another. While this is an oversimplification, the point is that native ecosystems can generally recover from natural disturbance. In fact, some ecosystems require periodic disturbance. Recovery from human disturbance is more problematic.

What we are attempting to do is create the conditions whereby ecosystems can proceed at their own pace. To do this we need to remove as many human stressors as possible, such as habitat fragmentation or overgrazing. We must also create any necessary conditions such as periodic fire or tidal flow, and monitor the restored ecosystem to insure conditions remain favorable for the ecosystem in the future.

We define a potential native ecosystem as the expected ecosystem at a given location following restoration of the physical, chemical, and biological conditions existing prior to European settlement. For example, if a wooded swamp has been cleared, filled and built upon, its potential native ecosystem is still wooded swamp. In other words, it would be possible, though costly, to restore it, more or less, to pre-colonial conditions. This means that every square inch of New Hampshire inherently has a native ecosystem associated with it because of its physical characteristics such as location, climate, proximity to the ocean, etc. Any given area would exhibit its characteristic native ecosystem in the absence or removal of human influence.

In the case of highly disturbed areas, this potential native ecosystem is based on the underlying natural features that existed prior to European settlement. By describing these parameters at any point on the ground, we can predict the ecosystem, which would exist under natural conditions. Imagine, for example, a landform that is an isolated glacial depression that has a wet (hydric) moisture regime, and substrate of muck and peat. This physical environment would result in the development, under natural conditions, of a characteristic plant and animal community that we commonly call a kettle hole bog.

### Why restore and manage native ecosystems?

- Accept responsibility for the earth's native ecosystems commensurate with our ability to alter them.
- Increase the level of beneficial ecosystem function (e.g. fish and wildlife habitat, recreational opportunity, water quality improvement, and landscape aesthetic quality).
- Reduce the adverse effects of human caused (anthropogenic) climate change (e.g. global warming).
- Improve the ecological health of connected ecosystems within a geographic area.
- Improve the chances for long term human survival by restoring the earth's natural infrastructure.

### How can I help?

To use an old cliché, you can help by getting involved. Begin by learning about the native ecosystems in your town. Many state and federal agencies, and private nonprofit environmental organizations in New Hampshire, have information about the native ecosystems in your community. Public and private colleges and universities may also be sources of information. Contact them.

Second, seek out those agencies and non-profit organizations that share your concern about the declining state of native ecosystems. In New Hampshire, your local town Conservation Commission is a logical place to start. Generally, Conservation Commissions are made up of citizen volunteers like you. You can also volunteer with your county conservation district. Many state and federal agencies as well as private non-profit organizations also accept volunteers.

Third, use this manual as a guide through the management/restoration process.

### Steps in using this manual

We use the term steps to indicate that there is a logical flow to this process. Essentially, there are two interconnected phases, town-wide (strategic) planning and site-specific (tactical) planning. The process begins with the identification and mapping of native ecosystems at a town wide scale, progresses to the inventory and evaluation of management/restoration sites, and leads ultimately to the development, funding, and implementation of individual projects.

- Town wide management/restoration planning
    - Identifying the native ecosystems in your town
    - Documenting the ecological history of each native ecosystem
    - Preparing a native ecosystem map
    - Preparing human land use and stressors overlay
    - Preparing a land ownership overlay
    - Preparing a protected land overlay
    - Developing a management/restoration strategy for your town
    - Inventory potential management/restoration sites
    - Identifying and encouraging local support
- Site specific management/restoration planning
    - Field evaluation of specific restoration sites
    - Developing a management/restoration plan for one or more identified sites

- Identifying sources of funding
- Implementing management/restoration plan(s)
- Monitoring the results
- Using adaptive management to make any necessary changes in the plan based on monitoring and accumulated experience

These steps should be viewed as guidelines. The flow from one step to another is like the flow of a river with all of its twists, turns, and counter currents. We have deliberately not numbered the steps to indicate that you will not necessarily do the steps in the exact order presented. In practice, you will probably work on several steps at the same time. You may also have to repeat certain steps in more detail or even go through the whole process more than once as personnel and priorities change. Keep in mind that those who manage and restore native ecosystems should be flexible and adaptive. Their's is a voyage of discovery, not a scheduled cruise to a familiar port. The goal of this whole process is to build a body of knowledge about the native ecosystems in your town and to use this knowledge in making land use decisions.

## PRINCIPLES OF AN ECOSYSTEM BASED APPROACH

Every worthwhile endeavor should be based on sound fundamental principles. These principles should help us "grasp the big picture" and understand how the details of what we are doing fit together. Below is our attempt to describe the basic principles underlying the method described in this document.

### Native ecosystems are hierarchial

Every restorable ecosystem is nested within larger ecosystems, and in turn nests smaller ecosystems within it.

Planners should look at ecosystems at many scales. For example, there may be important ecosystems such as a vernal pool or kettle hole bog nested within a field or farm. What ecosystem is the restoration site nested in at the landscape and watershed scale? What ecosystems provide inputs to and receive outputs from the ecosystem to be restored?

**Native ecosystems are complex**

The living and non-living components of ecosystems are interconnected and interdependent. These connections are as important as the components themselves. Traditionally, we have focused on the components (resources) of ecosystems, rather than on the ecosystems themselves.

**Native ecosystems are dynamic**

Even under natural conditions, they change over time due to climatic and other changes. When you visualize an ecosystem, imagine a movie rather than a snapshot. What you see today is not necessarily what you will see tomorrow.

Planners should understand the ecological history of the planning area. How did the ecosystems we see today come to be? How closely do they match the expected native ecosystems of the area. What forces have shaped them? How have humans affected them? What will the future condition of the ecosystems be, with and without human intervention? What is the potential for restoration?

**Native ecosystems perform critical life-support functions**

Most people are aware that highly managed ecosystems, such as cropland, have a vital life-support function for humans. Fewer people are aware that natural ecosystems (e.g. old growth forests) perform important life-support functions such as oxygen production and climate stabilization.

**Humans are an integral part of native ecosystems**

Humans exist as part of native ecosystems. Every aspect of our lives is supported by the physical, chemical, or biological components and processes of these ecosystems. Our digestion is aided by the microbial ecosystem in our intestines. We breathe the oxygen produced by green plants and bacteria. We are able to incorporate atmospheric nitrogen into our protein because we eat plants that have fixed nitrogen with the aid of nitrogen fixing bacteria. These are only a few examples of our dependence on ecosystems at various scales.

The very condition of the earth's surface, including its soil, weather, oceans, atmosphere, and much of its geology have been shaped by the ecosystems in which we exist. Now, humans are the most powerful biological forces on the planet. We are in the process of reshaping the earth's surface in ways intended to benefit our species. The jury is out on the long-term impacts of these changes. Ecologists believe that the maintenance of native ecosystems, and the proper management of farmland and other human directed ecosystems, is vital to the survival of human life.

### Knowledge of native ecosystems is incomplete

For many ecosystems, we are running out of time. If we are to save much of our natural heritage, we must act now; however, we must not act in haste or in ignorance. We must make use of the best knowledge available. This is not always easy. In spite of the fact that ecological knowledge is rapidly increasing, we have a long way to go before we really understand the complexities of ecosystems.

As we restore degraded ecosystems, we must practice adaptive management. As our understanding of ecosystems improves, so must our actions. We must be flexible in our approach to planning and implementation. We must respond to new information, and change directions if necessary. We must learn from our failures as well as our successes.

## IDENTIFYING THE NATIVE ECOSYSTEMS IN YOUR TOWN

### Background

To manage or restore the native ecosystems of New Hampshire, we must be able to identify and map them. To do this, we have developed a simple classification scheme based on five pieces of readily obtainable information.

- Ecoregion
- Elevation
- Landform and landscape position
- Substrate
- Moisture regime

The system draws heavily from existing classification systems such as the "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin *et al*., 1979). The reason we have developed a new system of classification is that existing classification systems are generally designed for a single type of ecosystem such as wetlands or forestland. For our purposes, we need a classification that covers the entire spectrum of ecosystems found in nature. This classification is designed to be flexible and extendible. What we present here is an outline. The system can, and should, be adapted to the particular task at hand. The system can be expanded to provide a detailed classification, for example, where it is necessary to separate out rare plant communities. Conversely, it can be simplified even further for use as a county-wide or region-wide planning tool.

## The building blocks of the simplified ecosystem classification scheme

### *Ecoregion*

It is obvious to anyone who lives in New Hampshire that climate, soils, etc., vary greatly from place to place. For example, the ocean moderates air temperature near the coast. New Hampshire has been divided into several ecological units based on these differences. In this document, we will use the following ecological sub-units as described in Keys et. al. (1995).

- M212Ad - White Mountain Subsection
- M212Ae - Mahoosic-Rangely Lakes
- M212Af - Connecticut Lakes
- M212Ba - Vermont Piedmont
- M212Bb - Northern Connecticut River Valley
- M212Bc - Sunapee Uplands
- 221Ai - Gulf of Maine Coastal Plain
- 221Ak - Gulf of Maine Coastal Lowland
- 221Al - Sebago-Ossipee Hills and Plain

### *Elevation*

Within a given ecoregion, many factors influence native ecosystems. One of the most important of these is elevation. In New Hampshire, elevations range from below sea level to the top of Mt. Washington at 6,288 feet. As most people know, elevation can have a profound effect on many of the physical and biological components of ecosystems. As elevations increase, the climate is generally harsher and the terrain less hospitable.

*Landform and Landscape Position*

This parameter refers primarily to an ecosystem's three-dimensional form (landform) and position in the local landscape. Essentially this reflects the effects of geography at a local scale. Barrier dune ecosystems are different from a coastal bog or salt marsh because of its shape and landscape position. This is true despite of the fact that all three of these ecosystems are within the same ecoregion.

For the purposes of this document, we have divided landform and landscape position into the following types. Each of these types must be given with their elevation, which further refines their position on the landscape. In other words, a sandy shore may occur at a few feet above sea level, or along the edge of a mountain pond at several thousand feet. If further categories or sub-categories are needed for your particular purpose, feel free to add them.

- **Beach** - An expanse of sand and gravel adjacent to a waterbody
- **Rocky shore** - Rocks and bedrock outcrops bordering water bodies
- **Fringe** - A shallow submerged areas around the periphery of a waterbody.
- **Barrier dune** - Linear sand/gravel ridges along the coast generally connecting headlands. Generally, barrier dunes form a beach on the seaward side and the edge of a salt marsh on the landward side.
- **Headland** - A promontory extending into a body of water. Big Boars Head in Hampton is an example.
- **Tidal flat** - Areas formed by sedimentation in sheltered areas regularly flooded by tides. Typically occur behind barrier dunes and along the margins of tidal rivers and the Great Bay Estuary.
- **Closed Topographic Depression** - A topographic depression having no outflow.
- **Open Topographic Depression** - A topographic depression have outflow.
- **Drainage way** - A swale running down hill which carries runoff during high rainfall but is generally without a continuously flowing stream.
- **Flood plain** - Areas bordering stream and rivers subject to periodic inundation.
- **Stream terrace** - The remnant flood plain of a glacial river. Terraces were deposited by glaciers because glacial rivers carried much more water than today's rivers, terraces are higher than the present flood plain of a river and seldom if ever flood.

- **Glacial outwash plain** - Large, relatively flat deposits of sand and gravel washed out of glaciers.
- **Low Gradient (<3%) stream channel** - The actual eroded groove in the landscape in which a river flows.
- **High Gradient (>3%) stream channel** - The actual eroded groove in the landscape in which a river flows.
- **Hill (slope and summit)** - A topographic high point smaller than a mountain.
- **Ridge** - A relatively long and narrow hill or series of connected hills.
- **Mountain slope** - The sides of topographic high point larger than a hill.
- **Mountain Summit** - The top of a mountain.
- **Rock outcrop/ledge** - A place where a portion of the underlying bedrock protrudes above the soil surface.
- **Slope** - The land surface on the side of a hill or mountain.
- **Cliff** - A nearly vertical slope.
- **Flooded Valley** - Coastal river valleys flooded by rising sea level (*e.g.* Great Bay Estuary)
- **Flat** - an area having relatively little topographic relief and a nearly flat slope.

*Substrate*

The term substrate, as used in this manual, refers to that part of the earth's surface upon which a native ecosystem rests. It includes soil, as well as non-soil material, such as bedrock and stream bottoms. The substrate is important to an ecosystem because it is literally the foundation of life. It plays an important role in determining the moisture regime of the ecosystem, as well as influencing which, if any, plants take root.

The nature of the substrate also affects animals. . A mole cannot burrow in ledge. A sand bottom lake will have a different set of plants and animals than a bottom of muck and peat. Turtles prefer to lay their eggs in upland sandy areas. This is why even aquatic turtles are seen crossing the road in spring and summer. For the purposes of this document, we have divided substrate texture into the following major types. Each of these types can have subtypes such as silty clay loam or fine sandy loam. If further categories or sub-categories are needed for your particular purpose, feel free to add them.

- **Bedrock** - unbroken solid rock usually overlain by soil but sometimes exposed.
- **Boulders** - rock fragments larger than 24 inches in diameter.

- **Stones** - rock fragments from 10 and 24 inches in diameter.
- **Cobble/gravel** - rock fragments from 0.1 to 10 inches in diameter.
- **Sand** - rock or mineral fragments from 0.002 inches to 0.1 inches in diameter. As a soil textural class, a soil is considered to be sand if it is 85 percent or more sand and not more than 10 percent clay. Sand, as a textural class, can be modified as clayey sand, silty sand.
- **Silt** - mineral particles from 0.00007 inches to 0.002 inches in diameter. As a soil textural class, a soil is considered to be silt if it is 80 percent or more silt and less than 12 percent clay.
- **Clay** - soil particles less than 0.00007 of an inch in diameter. As a soil textural class, a soil is considered to be clay if it is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- **Loam** - soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.
- **Loamy soil** - sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, silty clay loam.
- **Peat** - unconsolidated material, largely undecomposed organic matter that has accumulated in a wet moisture regime.
- **Muck** - dark colored, finely divided, well-decomposed organic soil matter.

*Moisture regime*

Moisture regime refers to the availability of water for plants and animals. Obviously, the availability of water is a major factor in shaping an ecosystem. Water is the most important molecule for life. Without water, there is no life. The amount of water available for animals, plants and microbes has a profound effect on any given ecosystem.

Under natural conditions available moisture varies from very dry upland sites (e.g. an excessively well-drained sandy soil), through wet sites (e.g. hydric soil), to aquatic sites (e.g. lakes and rivers). In each particular case, a characteristic set of life forms has evolved to take advantage of the available moisture. All other factors being equal, the dryness or wetness of a place will determine what organisms will inhabit it. For the purposes of this document, we have broken down moisture regime into the following types. If further categories or sub-categories are needed for your particular purpose, feel free to add them.

- **Dry (xeric) upland** - Moisture regime of dry uplands.
- **Moist (mesic) upland** - Moisture regime of moist uplands.

- **Wetland (hydric)** - Moisture regime of wetlands.
- **Flowing fresh water (lotic)** - Moisture regime of fresh flowing water (e.g. streams and rivers).
- **Still fresh water (lentic)** - Moisture regime of fresh still water (e.g. lakes, ponds, and reservoirs).
- **Brackish tidal water (estuarine)** - Moisture regimes of estuaries and salt marshes.
- **Saline tidal water (marine)** - Moisture regime of the ocean, specifically the Gulf of Maine portion of the Atlantic Ocean.

*Vegetation Structural Types*

We classify plant communities on their potential dominant vegetation structure. We do this for several reasons. First, the character of the dominant vegetation layer is important ecologically, forests are very different from grasslands. Second, recognizing vegetation structure is much easier for lay people than recognizing subtle changes in the species composition of specific plant communities. Third, vegetation structure is generally apparent on the aerial photographs and satellite imagery available to towns.

In this manual, we recognize the following vegetation structure classes. Other classes may be added as needed.

- **Forest** - Areas dominated by trees which are or will be taller than 15feet. Includes regenerating forests dominated by seedlings and saplings less than 15feet in height. Also includes abandoned agricultural land in early successional forb/grasslands.
- **Shrubland** - Areas that persist in shrubby vegetation less than 15ft in height. May be dominated by either true shrubs or trees that are stunted by environmental conditions.
- **Grassland** - Areas dominated under natural conditions by grasses and/or other herbaceous vegetation. NOTE: True grassland is rare in New Hampshire and limited primarily to salt marshes, alpine meadows, sites maintained in grassland by fire or regular flooding.
- **Marshland** - Areas dominated by herbaceous emergents that normally have their basal portions annually, periodically or continually submerged.
- **Aquatic Bed** - Areas dominated by flowering plants growing on or below the surface of permanent water.
- **Non-vegetated** - Areas naturally and persistently devoid of vegetation. These include the naturally non-vegetated portions of beaches and rocky ledges. Does not include non-vegetated areas of human origin such as cropland.

- **Alpine tundra** - Mountain summits above tree line, dominated by adapted herbaceous vegetation.
- **Krummholz** - Ground hugging, shrubby conifers near alpine tree line.

### A simplified classification scheme for the native ecosystems of New Hampshire

In this document, classification of native plant communities is based on the dominant vegetation layer (e.g. forest) of persistent plant communities. Persistent plant communities are those that persist for long periods under natural conditions, either as climax or disturbance subclimax communities. Transient plant communities, which exist for a short time as a successional stage, are grouped with the appropriate climax or subclimax community. For example, a button-bush swamp would be considered a true wet shrubland because it can be expected to endure for an extended period. The shrubby stump-sprout/sapling community that occurs following a clear-cut would be considered as merely a successional stage of forest succession.

- **Upland (Terrestrial) Ecosystems**
    - **Non-vegetated -** Rock outcrops, ledges, and other areas naturally devoid of vegetation.
    - **Dry Grasslands -** A fire maintained community typically succeeding to dry shrubland and ultimately dry forest. Dominated by warm season grasses such as little blue stem and adapted herbaceous species such as bracken and sweet fern.
    - **Dry Shrubland -** A fire maintained stage of dry forest. Typical plants are seedlings and saplings of pitch pine, gray birch, white pine with adapted herbaceous species.
    - **Dry Forest -** Potential native vegetation depends on fire history and Ecological Unit. A Pine Barren is a dry forest community that is fire maintained. Pine Barrens are dominated by Pitch Pine with an understory of low bush blueberries, bracken, dogbane, sweetfern, and other dry land species. Oak/Pine Forests are a community that arises in the absence of fires. White pine and oaks eventually shade out any pitch pine community present. . Includes all successional stages (e.g. Oldfield, seedling/sapling stage, pole stage, mature, climax forest, and fire maintained subclimax).
    - **Moist Forest** - Occur throughout the state. Potential vegetation varies depending on the Ecological Unit, but is dominated by native trees larger than four inches in diameter. Includes all successional stages (e.g. Oldfield, seedling/sapling stage, pole stage, mature, climax forest).

- **Wetland (Palustrine) Ecosystems**
  - **Non-vegetated -** Mud flats associated with beaver dominated wetlands.
  - **Marshland (Palustrine Emergent) -** Areas of emergent aquatic plants. Generally, occur in areas where ponding prevents succession to forest. Typical plants are cattail, water lilies, sedges, rushes, and hydrophytic grasses. Includes meadow-like areas in beaver flowages dominated by grasses sedges, rushes, and cattails.
  - **Wet Shrubland (Palustrine Scrub-Shrub) -** Areas of persistent hydrophytic shrubs in areas wet enough to prevent succession to wet forest. Typical plant species are alders, silky dogwood, and willows. Ericaceous shrubs may dominate on peatlands.
  - **Wet Forest (Palustrine Forested Wetland) -** Occur throughout the state. Potential vegetation varies depending on the Ecological Unit, but is dominated by native trees larger than four inches in diameter.
  - **Vernal Pool -** Shallow depressions typically flooded briefly in spring but dry during the summer and fall.
- **Aquatic Ecosystems**
  - **Fresh Water Lake/Pond (Lacustrine) Ecosystems**
    - **Oligotrophic lake** - Low nutrient lakes typically at higher elevations. Often deep with very clear water and a cold water fishery. Lake Sunapee is an example.
    - **Mesotrophic lake** - Lakes of medium fertility. Lake Pawtuckaway is an example.
    - **Bog lake** - Generally small lakes with small watersheds. Water is tea stained and very acidic due to the abundance of sphagnum moss around edges. Moss may form a floating mat commonly called a quaking bog.
  - **Fresh Water Stream/River (Riverine) Ecosystems**
    - High gradient streams - swift moving streams with a stream channel gradient greater than 3 percent.
    - Low gradient streams - slower moving streams with gradients below 3 percent. Low gradient streams often have a significant flood plain.
- **Brackish Tidal Water (Estuarine) Ecosystems**
  - **Non-vegetated** - Subtidal areas**,** tidal flats.
  - **Tidal creeks –** Creeks affected by tides.
  - **Estuaries** - Waterbodies containing mixed ocean and fresh water (e.g. Great Bay ).

- **Saline marshland** (High and Low Salt Marsh) - Marshes dominated by salt tolerant species including salt marsh cord grass, salt meadow cord grass, spike grass, and black grass. Mostly along the coast and bordering the Great Bay estuary and its tributaries.

❑ **Saline Tidal Water (Marine) Ecosystems**

- **Non-Vegetated -** Ledges, intertidal beaches and rocky shores.
- **Aquatic Bed -** Beds of marine algae (e.g. kelp and other seaweeds).

To help you identify the ecosystems in your town, we have put together a key (Appendix 1) showing examples of potential native ecosystems in New Hampshire. This list is not exhaustive, but will serve as a good starting place for you to develop a list of native ecosystems in your town.

## TOWN WIDE PLANNING FOR THE MANAGEMENT AND RESTORATION OF NATIVE ECOSYSTEMS

### Preparing a native ecosystems map

This step is a good example of one that cannot be done in isolation from the other steps in this whole process. For example, as you attempt to prepare your ecosystem map based on the ecosystems you define, you will likely discover additional ecosystems in your town that you need to describe. It is really an iterative process. The best approach it is to begin with a simple list of the obvious ecosystems in your town (e.g. salt marshes, fresh water wetlands, forests, lakes, streams and rivers). Appendix 4 lists example ecosystems for New Hampshire. As you go through the planning process, you can refine this list by breaking down each of these ecosystems in to its constituent parts. Freshwater wetlands can be sub-divided into marshes, bogs, shrub/scrub, forested wetlands, etc. The point is to begin somewhere and keep working until your get to the level of detail that meets your objectives.

If you are just getting started, begin preparing the large scale ecosystem map of your town. As an example, let's consider a coastal New Hampshire town. Typically, such towns contain the following native ecosystems at the town level: salt marshes, dry, moist, and upland and wetland forest, freshwater marshes, urban land, suburban land, and agricultural land. These ecosystems can usually be delineated from existing maps. For example, delineate salt marshes from the National Cooperative Soil Survey or from NH Office of State Planning maps. Delineate urban land from USGS Topographic maps, tax maps, and local knowledge. Delineate freshwater wetlands using town wetlands maps (if available), hydric soils maps, aerial photographs, and National Wetlands Inventory maps. Continue through the restoration process to the "Developing and Analyzing Restoration Alternatives" step at the large scale ecosystem level. When you have finished, come back to this step and go through all of the steps at a more detailed level as described below.

This map will depict the potential native ecosystems in your town. In essence, it will show the natural infrastructure, which supports your town. The level of detail of this map will depend on your objectives. We suggest that you start with a GIS based with a map relatively low level of detail, a first approximation, and gradually refine it as you get further into the planning process. For example, you could start with a map that combines freshwater wetlands together. Later, break out various types of wetlands at a finer and finer scale.

In the introduction, we said that an ecosystem is a geographic area and all of its associated plants, animals, and other organisms. Your first map will delineate geographic areas that represent the large scale ecosystems in your town. For example, all wooded areas would be lumped together in a map unit called forested ecosystem. Obviously, not all wooded areas of your town are the same. Some have deciduous trees, some evergreen, and others a mixture of both. Some are wet and others are dry. Some areas have mature trees while other areas are dominated by saplings. The point is that while they differ in detail, at a large scale they are all forested ecosystems.

Using your large scale ecosystem map, proceed through the rest up to, and including, "Developing and Analyzing Restoration Alternatives." Specifically, you would identify the major stressors for each of your major ecosystem types (e.g. habitat fragmentation of forested ecosystems). You would also "Identify and Encourage Local Support" (e.g. hold an informational meeting and give an overview of the process) and you would "Develop and Analyze Restoration Alternatives" at the town level (e.g. increasing tidal flow to degraded salt marshes).

When you have completed the above steps, you have several options. You may want to target a specific ecosystem type for restoration. In that case, you would go through the entire process in detail for that ecosystem. If your target were forested ecosystems, you would first refine your large scale ecosystem map based on the types of forests in your town (e.g. forested wetlands, pine barrens, etc.). You would then locate potential restoration sites based on your refined map, work with willing landowners, develop restoration alternatives for individual restoration sites, obtain necessary funds, and perform actual restorations. A second approach would be to concentrate on finding potential restoration sites for all of the major ecosystems in your town, and do the implementation as part of a second phase of the project.

*Preparing a local watersheds overlay*

*Preparing an overlay of ecosystem stressors*

In this manual, we use the term ecosystem stressor to denote human activities that inhibit the normal operation of an ecosystem. Some ecosystems require specific conditions. Bogs, for example, require a naturally low level of nutrient input. Increases in the nutrient level of bogs due to pollution can cause a drastic change in the vegetation of bogs. High levels of nutrients have been known to convert bogs into cattail dominated marshes.

This overlay will depict human activity and anthropogenic (human caused) stressors occurring within each identified ecosystem.

*Preparing an overlay of land ownership*

Once a Potential Native Ecosystem map and stressors overlay has been prepared for the town, the next step is to prepare an overlay of land ownership. We strongly suggest that towns invest in digitized tax maps. Digitized tax maps make preparing a land ownership overlay a relatively simple task. A land ownership overlay can be prepared by hand, but is much more difficult and will probably not be as accurate.

## Developing a native ecosystem management/restoration strategy

As you are preparing the Potential Native Ecosystems map and overlays described above, it is likely that a strategy for managing and restoring the native ecosystems will begin to emerge.

Simply looking at the ecosystems map and discovering where development, roads, and other human infrastructure affect these systems, will naturally lead planners in the direction of developing a coherent strategy. Several tasks will help formalize this process and ensure that a wide range of local input has been obtained. This is also a good time to seek the assistance of professionals to help with the analysis.

- Compute statistics, such as the percentage of each potential native ecosystem, that have been affected by various land uses. For example, the percentage of dry forest that has been destroyed by urban development.
- The relationship of protected land to the town's potential native ecosystems.
- Identify significant sub-watersheds that have rare ecosystems, unfragmented blocks, etc.
- Hold public meetings to obtain landowner input. These meetings could be organized by sub-watershed.

**Identifying potential management/restoration sites**

Finding degraded ecosystems is easy, they are all around us. What is not so easy is to find degraded ecosystems for which restoration is practical. Ecosystem restoration is both a technical/scientific and a social/political endeavor. You must accommodate both aspects into your plans. For example, if you wish to restore a beaver dominated wetland in an urbanizing area, consider both the technical aspects of restoration and the attitudes, desires, visions, etc., of the landowners and others affected by the project.

Once you have completed your analysis at the large scale ecosystem level, it is time to conduct a targeted inventory of restoration sites. First, within each delineated ecosystem on your large scale ecosystem map, delineate the component sub-ecosystems. For example, forest ecosystems can be typically subdivided into such sub-ecosystems as, deciduous forest, Pine Barrens, evergreen forest, forested wetland, riparian forest, wooded residential, etc.

This will require using several different maps in concert. For example, a first cut at delineating Pine Barrens can be done by overlaying a map of excessively drained soils onto the large scale ecosystem map. Potential Pine Barrens restoration sites are those forested areas on excessively drained soils. Next, identify specific potential restoration sites for each targeted ecosystem type. This needs to be done on the ground. A potential restoration site would be a discrete area within a given ecosystem that could be restored as a unit. An example might be a degraded salt marsh upstream of a restrictive culvert. This could be treated as a single site because the treatment (enlarging the culvert) would affect the entire area. Likewise, a restoration site for Pine Barrens might be a 5-acre patch of excessively drained soil within a larger deciduous forest.

### Identifying and encouraging local support

Local support for ecosystem restoration is critical to its success. As in all human endeavors, unanimity is not required, and some opposition may be acceptable. Nevertheless, a broad base of local support from residents and town officials is necessary.

How do you go about getting such support? This should be done at several levels. First, work with your neighbors. Explain the importance of ecosystem restoration. If the ecosystem you would like to restore is on more than one property, try to work out a cooperative agreement between landowners. It might help to hold an informational meeting. You might invite a resource professional to discuss the ecosystem to be restored. Allow plenty of time for residents to express their concerns.

## SITE SPECIFIC PLANNING FOR THE MANAGEMENT AND RESTORATION OF NATIVE ECOSYSTEMS

### Developing a management/restoration plan

This will require some professional help. The good news is help is available from a number of government agencies and private non-profit groups that are in business to help citizens solve natural resource problems. Bring in agencies such as the town Conservation Commission or County Conservation District (see list in Appendix A where to get help). Private consultants are also available for many types of projects.

An individual, or entity, must make the decision to implement the restoration alternative or not. This is essentially a political step; that is, the decision is made through the political process. Who makes the decision depends on the nature of the project. In general, the decision is made by the person who owns or controls the land. However, landowners do not make such decisions in a vacuum, many factors need to be taken into account. The cost of the project must be weighed against the environmental benefits. Local customs and attitudes should be considered.

**Identifying sources of funding**

Money is the grease that makes the project go round. Ultimately, someone must pay the cost or restoration. Obviously, it is better to line up funds for a particular project at the start, but that is often not possible. Many good projects were first planned and then the plan was used to find funding. Because funding and grant programs change from year to year, and new programs are periodically introduced, we have not included a specific list of such programs. The best way to identify sources of funding is to contact resource agencies directly. The resource professional advising you on your project can help you identify potential sources of funding that would apply to your particular project.

**Implementing a management/restoration plan**

Depending on the complexity of the project, this step may require professional input. Simple jobs like fencing a stream bank can be done by an experienced landowner. Projects that are more complex, such as restoring tidal flow, will need to be planned with the help of qualified—professionals. In the case of a project that spans several landowners, a cooperative agreement of some type will probably be needed. An important step is to make sure that local, state, and federal regulations have been complied with, and all necessary permits obtained. Some permits require several months to obtain, so give yourself plenty of lead time.

**Monitoring the results**

Monitoring a restoration site is important because it allow us to see if the ecosystem is recovering as predicted. Monitoring plans need to be developed by a qualified professional. Volunteers, however, can carry out many monitoring tasks.

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## GLOSSARY

## APPENDIX 1 - KEY TO THE POTENTIAL NATIVE ECOSYSTEMS OF NEW HAMPSHIRE (FOR USE IN GIS MAPPING AND RESTORATION SITE EVALUATION)

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **221Ak** | Intertidal below mean high tide | Flooded valley | Any | Brackish tidal water | **Estuary** | Great Bay, Little Bay and coastal harbors | Fringe of *spartina alterniflora* |
| | Intertidal from mean high tide to -2 ft | Tidal flat | Muck and peat | Brackish tidal water | **Low salt marsh** | Saline organic soils | *Spartina alterniflora* |
| | Intertidal from -2 ft to mean low tide | Tidal flat | Muck and peat | Brackish tidal water | **Non-vegetated tidal flat** | Labeled tidal flats on USGS | Non-vegetated |
| | Up to mean high tide | Low gradient Stream channel | Muck and peat, marine clays, sand | Brackish tidal water | **Tidal creek** | USGS streams within salt marsh soil map units | Fringe of *spartina alteriflora* |
| | Mean high tide | Tidal flat | Muck and peat | Brackish tidal water | **High salt marsh** | Saline organic soils | *Spartina patens* |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **221Ak (cont.)** | Mean high tide to ~ 20 ft | Ridge between ocean and salt marsh or tidal flat | Sand, boulders, cobble - gravel | Dry upland | **Barrier dune community** | Excessively and somewhat excessively drained soils seaward of salt marshes | American beach grass |
| | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **221Ak (cont.)** | <2500 ft | Low gradient Stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrogrophy | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water | **Coastal high gradient stream** | USGS hydrogrophy | Aquatic mosses |
| | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry upland | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist upland | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **221Al** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **221Al (Cont.)** | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrography | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrography | Aquatic mosses |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **221Al (Cont.)** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **221Ai** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrogrophy | Fringe of emergent aquatic plants |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrogrophy | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient Stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrogrophy | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrogrophy | Aquatic mosses |
| **221Ai (Cont.)** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **M212Ad** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient Stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrography | Fringing aquatic emergents |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrogrophy | Aquatic mosses |
| **M212Ad** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **M212Ae** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrography | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrography | Aquatic mosses |
| **M212Ae** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **M212Ba** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Low gradient stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrography | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrography | Aquatic mosses |
| **M212Ba (Cont.)** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **M212Bb** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrography | Fringe of emergent aquatic plants |
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrography | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrography | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrography | Aquatic mosses |

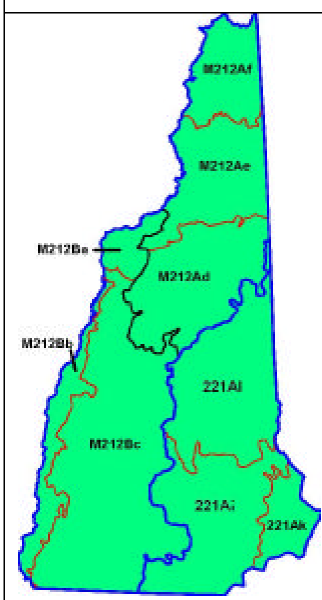
| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| **M212Bb (Cont.)** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |
| **M212Bc** | <2500 ft | Open and closed depressions, drainageway, floodplain | Muck and peat | Wetland | **Coastal bog** | Non-saline organic soils | Heaths, Atlantic white cedar, black spruce, pitch pine |
| | <2500 ft | Open and closed depressions, drainageway, hill | All mineral substrates | Wetland | **Wet coastal forest** | Mineral hydric soils | Elm, ash, red maple, or fire maintained Atlantic white cedar swamp |
| | <2500 ft | Open depression | Any | Still fresh water | **Mesotrophic lake** | USGS hydrogrophy | Fringe of emergent aquatic plants |

| 1. Ecological Sub-unit | 2. Elevation | 3. Landform | 4. Substrate | 5. Moisture Regime | 6. Potential Native Ecosystem | Mapping Convention | Potential Dominant Plants Under Natural Conditions |
|---|---|---|---|---|---|---|---|
| | <2500 ft | Closed depression | Muck and peat | Still fresh water | **Bog lake** | USGS hydrogrophy | Fringe of sphagnum bog |
| | <2500 ft | Floodplain | All mineral substrates | Wetland or moist upland | **Coastal floodplain forest** | Mineral alluvial soils within floodplain | Silver maple, beech |
| | <2500 ft | Low gradient Stream channel | Any | Flowing fresh water | **Coastal low gradient stream** | USGS hydrogrophy | Fringing aquatic emergents |
| | <2500 ft | High gradient stream channel | Any mineral | Flowing fresh water (lotic) | **Coastal high gradient stream** | USGS hydrogrophy | Aquatic mosses |
| **M212Bc (Cont.)** | <2500 ft | Hill, stream terrace, outwash plain | Sands, gravels, sandy loams | Dry (xeric) | **Dry coastal forest** | Excessively and somewhat excessively drained soils | White pine/oak or fire maintained pitch pine barren |
| | <2500 ft | Hill, mountain slope | Loam | Moist (mesic) | **Moist coastal forest** | Well and moderately well drained soils | Sugar maple, beech, yellow birch, hickory, white pine, hemlock |

Note: This table will be expanded to include all ecological sub-units

## APPENDIX 2 - RESTORATION SITE EVALUATION DATA SHEETS

| **Ecosystem Restoration Site Evaluation Sheet - Page 1 of 5** | |
|---|---|
| **1. SITE NAME/CODE** | **2. Date** |
| **Part 1 - Site data** | |
| **1. Location:** | |
| **2. Site description** | |
| | |
| | |
| | |
| | |
| **3.Location map** | **4. Site map** |



## Ecosystem Restoration Site Evaluation Sheet - Page 2 of 5

| **Site Name/Code** | **Date** |
|---|---|

### Part 1 - Site data (cont.)

| **5. Structure of existing vegetation** | Forest | Shrubland | Marshland |
|---|---|---|---|
| | Grassland | Aquatic bed | Non-vegetated |
| | Krummholz | Alpine tundra | |

**6. Dominant plant species by layer (existing vegetation)**

Tree layer

Shrub layer

Herbaceous layer

Aquatic bed

**7. Soils**

8. Dominant land use at site:

9. Dominant land use surrounding site

10. Other observations and notes

# Ecosystem Restoration Site Evaluation Sheet - Page 3 of 5

| **Site Name/Code:** | **Date:** |
|---|---|

## Part 2 - Classification of potential native ecosystem at site

Circle one item in each of Columns 1 - 5 that best describes the site. Then determine the potential native ecosystem of the site by matching your responses to the appropriate columns in Appendix - 3. Record potential native ecosystem at site in Space 6 below. If it appears that more than one item in a column applies, consider subdividing the site as it may contain more than one ecosystem.

| **1. Ecological Sub-unit** | **2. Elevation** | **3. Landform and Landscape Position** | | **4. Substrate** | **5. Moisture Regime** |
|---|---|---|---|---|---|
| M212Ad | Below low tide | Beach | Low gradient stream channel (<3% slope) | Bedrock | Dry upland |
| M212Ae | Between mean low and high tides | Rocky shore | High gradient stream channel (>3% slope) | Boulders | Moist upland |
| M212Af | Mean high tide | Fringe | Hill (slope and summit) | Cobble-gravel | Wetland |
| M212Ba | Mean high tide to 2500 ft | Barrier dune (ridge between ocean and tidal flat) | Ridge | Sand | Intermittent flowing fresh water |
| M212Bb | 2500 ft to tree line | Headland | Mountain slope | Loamy sand | Perennial flowing fresh water |
| M212Bc | Above tree line | Tidal flat | Mountain summit | Sandy loam | Still fresh water |
| 221Ai | | Closed depression | Rock outcrop/ledge | Silt | Brackish estuarine) tidal |
| 221Ak | | Open depression | Cliff | Sandy clay loam | Water |
| 221Al | | Drainage way | | Sandy clay | Saline (ocean) tidal-water |
| | | Flood plain | | Clay | |
| | | Flooded valley | | Peat | |
| | | Stream terrace | | Muck | |
| | | Glacial outwash plain | | | |

**6. Potential Native Ecosystem:**

## Ecosystem Restoration Site Evaluation Sheet - Page 4 of 5

| **Site Name/Code** | **Date** |
|---|---|

### Part 3 - Restoration/management needs

**1. Stressors placed on potential native ecosystem by humans**

| | | | |
|---|---|---|---|
| Habitat fragmentation | Human encroachment | Fill/paving | Sedimentation |
| Loss of native plant species | Loss of native animal species | Pollution: nutrient or toxic | Impairment of wetland hydrology through drainage |
| Stream channelization or rip-rap | Human-built dams | Tidal flow restriction | Fire suppression in fire maintained ecosystem |
| Invasive or exotic plants | Exotic animals | Protection from coastal storm over-wash | accelerated erosion |
| Deforestation | | | |
| | | | |

**2. Potential methods for relieving identified stressors (circle one or more)**

| | | | | |
|---|---|---|---|---|
| Prescribed fire | Selective cutting of vegetation | Chemical control of invasive plants | Planting native vegetation | Habitat defragmentation (wildlife corridors) |
| Establish riparian buffer | Fish ladder | Dam removal | Watershed protection | Restoration of tidal flow |
| Restoration of natural flooding | Reduction of nutrient pollution | Live stock exclusion | Exclusion of off road and other vehicles | Exclusion of all human vehicle and foot traffic |
| Stream bank protection | Stream channel restoration | Removal of fill | Management of beavers | Land acquisition or easement |
| | | | | |

**3. Notes:**

## Ecosystem Restoration Site Evaluation Sheet - Page 4 of 5

| **Site Name/Code** | **Date** |
|---|---|

### Part 4 - Social-political constraints and opportunities

| | | | | |
|---|---|---|---|---|
| **1. Owner** | | | | |
| **2. Owner address** | | | | |
| | | | | |
| **3. Phone** | AM: | PM: | Other: | |
| **4. Ownership** | Private | Corporate | Town | State |
| | Federal | Non-profit | Other | |
| **5. Landowner decision on restoration** | Yes | Yes if cost shared | Wants more time | Wants more info. |
| | No | Maybe in future | | |
| **6. Zoning** | Agriculture | Residential | Urban | Industrial |
| **7. Local support** | Strongly favor | Favor | Oppose | Strongly oppose |

**8. Notes:**

## Ecosystem Restoration Site Evaluation Sheet - Page 5 of 5

| **Site Name/Code** | **Date** |
|---|---|
| | |

### Part 5 - Project status and planned action as of date:

| | | | | |
|---|---|---|---|---|
| **1. Local support for restoration** | Strongly favor | Favor | Oppose | Strongly oppose |
| **2. Landowner support for restoration** | Yes | Yes if cost shared | Wants more time | Wants more info. |
| | No | Maybe in future | | |

**3. PROJECT ACTIONS AS OF ABOVE DATE**

| | | | |
|---|---|---|---|
| Project appears feasible | Project does not appear feasible | Project on hold | Continue to seek necessary information |
| Call in professional to evaluate and prepare restoration plan | Place site on inactive list | Reevaluate in 1,2,3,4,5 years | |

**4. Notes**

## Ecosystem Restoration Site Evaluation Sheet - Continuation Sheet

| Site Name/Code | Date |
| --- | --- |

### Part 5 - Project status and planned action as of date:

| | | | | |
| --- | --- | --- | --- | --- |
| **1. Local support for restoration** | Strongly favor | Favor | Oppose | Strongly oppose |
| **2. Landowner support for restoration** | Yes | Yes if cost shared | Wants more time | Wants more info. |
| | No | Maybe in future | | |

**3. PROJECT ACTIONS AS OF ABOVE DATE:**

| | | | |
| --- | --- | --- | --- |
| Project appears feasible | Project does not appear feasible | Project on hold | Continue to seek necessary information |
| Call in professional to evaluate and prepare restoration plan | Place site on inactive list | Reevaluate in 1,2,3,4,5 years | |

**4. Notes**

| Ecosystem Restoration Site Evaluation Sheet - Continuation Sheet | |
|---|---|
| **Site Name/Code:** | **Date:** |
| **Notes:** | |

## APPENDIX 3 - REPRESENTATIVE FUNCTIONS, TYPICAL STRESSORS, AND POTENTIAL RESTORATION MEASURES FOR SELECTED NATIVE ECOSYSTEMS IN NEW HAMPSHIRE.

| Ecosystem | Representative Functions | Typical Stressors | Restoration Methods |
|---|---|---|---|
| **Estuary** | Wildlife habitat<br>Finfish and shellfish habitat<br>Storm surge protection<br>Water quality maintenance<br>Aesthetic quality<br>Educational potential | Nutrient pollution<br>Sedimentation<br>Encroachment | Sediment and erosion control in watershed.<br>Lawn fertilizer reduction |
| **High salt marsh** | Wildlife habitat<br>Finfish and shellfish habitat<br>Shoreline anchoring<br>Water quality maintenance<br>Aesthetic quality<br>Educational potential | Restriction of tidal flow<br>Invasive plants<br>Nutrient pollution<br>Human encroachment<br>Fill | Enlarging road and other restrictive culverts<br>Removal of fill |
| **Low salt marsh** | Wildlife habitat<br>Finfish and shellfish habitat<br>Shoreline anchoring<br>Water quality maintenance | Restriction of tidal flow<br>Invasive plants<br>Nutrient pollution<br>Human encroachment | Enlarging road and other restrictive culverts<br>Removal of fill |

| Ecosystem | Representative Functions | Typical Stressors | Restoration Methods |
|---|---|---|---|
| | Aesthetic quality<br>Educational potential | Fill | |
| **Non-vegetated tidal flat** | Wildlife habitat<br>Finfish and shellfish habitat<br>Shoreline anchoring<br>Water quality maintenance<br>Educational potential | Restriction of tidal flow<br>Nutrient pollution<br>Human encroachment<br>Fill | Enlarging road and other restrictive culverts<br>Removal of fill |
| **Tidal creek** | Wildlife habitat<br>Finfish and shellfish habitat<br>Shoreline anchoring<br>Water quality maintenance<br>Educational potential<br>Aesthetic quality | Restriction of tidal flow<br>Nutrient pollution<br>Human encroachment<br>Fill | Enlarging road and other restrictive culverts<br>Removal of fill |
| **Barrier dune** | Wildlife habitat<br>Shoreline anchoring<br>Educational potential<br>Salt marsh protection<br>Aesthetic quality | Human encroachment<br>Seawalls, jetties, and rip-rap<br>Prevention of over-wash during storms | Planting native species<br>Fencing bird nesting sites<br>Purchase and removal of buildings |
| **Bog** | Rare plant habitat<br>Educational potential<br>Aesthetic quality | Nutrient pollution<br>Suppression of wildfires (in Atlantic white cedar swamps) | Watershed protection.<br>Prescribed burning (in Atlantic white cedar swamps). |

| Ecosystem | Representative Functions | Typical Stressors | Restoration Methods |
|---|---|---|---|
| **Wet forest** | Wildlife habitat<br>Water quality maintenance<br>Educational potential | Improper timber harvest<br>Deforestation<br>Fill<br>Drainage | Livestock exclusion.<br>Management to allow beaver activity. |
| **Mesotrophic lake** | Wildlife habitat<br>Finfish and shellfish habitat<br>Shoreline anchoring<br>Water quality maintenance<br>Educational potential<br>Aesthetic quality | Nutrient pollution<br>Sedimentation<br>Human encroachment<br>Exotic fish and other animal species<br>Invasive plants | Watershed protection.<br>Measures to keep sediment out of lake. |
| **Oligotrophic lake** | Wildlife habitat<br>Finfish and shellfish habitat.<br>Shoreline anchoring<br>Water quality maintenance<br>Educational potential<br>Aesthetic quality | Nutrient pollution<br>Sedimentation<br>Human encroachment<br>Acid rain | Watershed protection.<br>Measures to keep sediment out of lake. |
| **Bog lake** | Wildlife habitat<br>Shoreline anchoring<br>Water quality maintenance<br>Educational potential<br>Aesthetic quality | Nutrient pollution<br>Sedimentation<br>Human encroachment | Watershed protection.<br>Measures to keep sediment out of lake. |
| **Flood plain forest** | Wildlife habitat | Deforestation | Planting native plants |

| Ecosystem | Representative Functions | Typical Stressors | Restoration Methods |
|---|---|---|---|
| | Shoreline anchoring<br>Water quality maintenance<br>Educational potential<br>Aesthetic quality | Human encroachment | Livestock exclusion |
| | | | |
| | | | |
| | | | |
| | | | |

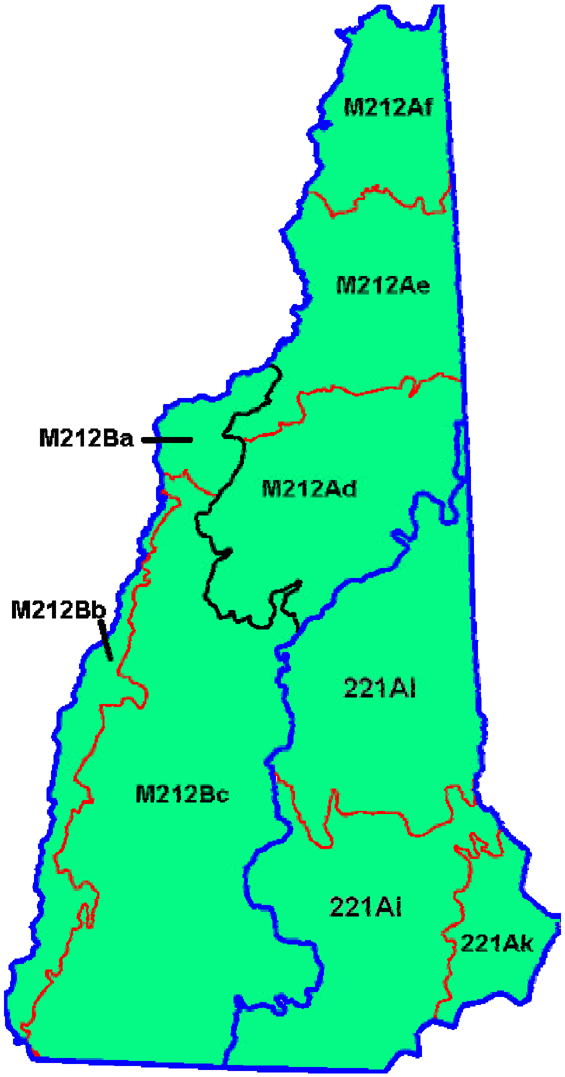
# APPENDIX 4 - MAP UNITS AND OTHER MAPPING CONVENTIONS FOR THE NATIVE ECOSYSTEMS OF NEW HAMPSHIRE

| Ecosystem Name | Mapping Convention |
|---|---|
| Coastal Dune and Beach Community | 26A, 26B, 298, 299, 599, 510A, 510B and 510C polygons within 100 feet of the ocean |
| Dry Forest | 26A, 26B, 298, 299, 599, 510A, 510B and 510C except in 221Ak, 221Al and 221Ai |
| Moist Forest | 29A, 30B, 32A, 32B, 38A, 38B, 42B, 42C, 43B, 43C, 43C, 62B, 63B, 66B, 66C, 67B, 129B, 140B, 140C, 313A, 313B, 446A, 446B, 447A, 447B, 447C, 460B, 531B |
| Bog | 97, 115, 125, 295, 395, and 495 |
| Wet Forest | 33A, 134, 314A, 533, 538A, 546A, 547B, 656A and 657B Plus all other soil types currently flooded by beaver. |
| High Gradient Stream | Selected streams from USGS hydrogrophy (e.g. streams with a gradient greater than 3%) |
| Low Gradient Stream | Selected streams from USGS hydrogrophy (e.g. streams with a gradient less than 3%) |
| Oligotrophic Lake | Selected water bodies from USGS hydrogrophy (e.g. lakes identified as oligotrophic by the NH DES or the UNH Lakes Lay Monitoring Program) |
| Mesotrophic Lake | Selected water bodies from USGS hydrogrophy |
| Estuarine Tidal Creek | Streams and ditches within salt marshes |

| Ecosystem Name | Mapping Convention |
| --- | --- |
| Tidal flats | Areas so identified on USGS hydrogrophy |
| Salt Marsh | 397, 495, 597 and 997 plus polygons of 299 identified as former salt marshes |
| Salt Marsh Panne | Open water within functioning salt marshes (digitize USGS Ortho Photo Quads) |

# APPENDIX 5 - ECOREGIONS OF NEW HAMPSHIRE

**200 Humid Temperate Domain**




| Division | Province | Code | Name |
|---|---|---|---|
| **210 Warm Continental Division** | **M212 New England-Adirondack Province** | **M212Ad** | **White Mountain Subsection** |
| | | **M212Ae** | **Mahoosic-Rangely Lakes** |
| | | **M212Af** | **Connecticut Lakes** |
| | | **M212Ba** | **Vermont Piedmont** |
| | | **M212Bb** | **Northern Connecticut River Valley** |
| | | **M212Bc** | **Sunapee Uplands** |
| **220 Hot Continental Division** | **221 Eastern Broadleaf Forest (Oceanic) Province** | **221Ai** | **Gulf of Maine Coastal Plain** |
| | | **221Ak** | **Gulf of Maine Coastal Lowland** |
| | | **221Al** | **Sebago-Ossipee Hills and Plain** |