



# United States Department of the Interior

FISH AND WILDLIFE SERVICE



Umbagog National Wildlife Refuge

2756 Dam Rd

PO Box 240

Errol, NH 03579-240

Phone: 603-482-3415 fax: 603-482-3308

## UMBAGOG NATIONAL WILDLIFE REFUGE

### **FOREST MANAGEMENT PLAN**





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Submitted by:

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11/7/12

Date

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11-7-12

Date

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# **I. Introduction and Background**

## **A. Introduction**

The mission of the National Wildlife Refuge System (NWRS) is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The landmark 1997 National Wildlife Refuge System Improvement Act initiated a renewed vision for the future of the refuge system in which

- wildlife comes first
- refuges are anchors for biodiversity and ecosystem-level conservation
- lands and waters of the System are biologically healthy
- refuges are national and international leaders in habitat management and wildlife conservation

Meeting the wildlife conservation challenges of the 21<sup>st</sup> century, and fulfilling the System mission and vision requires planning and partnerships. A variety of conservation strategies and tools are needed to address these challenges. Two such tools, required of each National Wildlife Refuge (NWR), are the Comprehensive Conservation Plan and Habitat Management Plan.

Completed in 2009 the Umbagog Comprehensive Conservation Plan (CCP) established the conservation design and strategy for Umbagog National Wildlife Refuge (Refuge). To facilitate implementation of this overarching conservation plan more detailed “step-down” plans are created. The Umbagog Habitat Management Plan (HMP), completed in 2010, is one such step-down plan that provides more detail regarding the biological and ecological goals of the CCP. This Forest Management Plan (FMP) is designed to implement the HMP on forested uplands.

The CCP, HMP, and FMP are 15 year planning documents and will be reviewed and updated in 2024. Amendments will be made to this FMP before the review in 2024 if better information becomes available that will improve the success of achieving goals and objectives, or as needed to adapt to changes in the environment, in land ownership, available data, or scientific developments.

## **B. Refuge Location**

Umbagog National Wildlife Refuge (Refuge) straddles the border of New Hampshire and Maine in the counties of Coos (NH) and Oxford (ME), approximately 30 miles south of the U.S. and Canada border. The Refuge is in the Upper Androscoggin watershed in northern New England, one of the most rugged landscapes in the region. Lake Umbagog is an impounded lake and is the centerpiece of the refuge. It is the western most lake in a series that make up the Rangeley lakes drainage. Major tributaries to Lake Umbagog include the Magalloway River which originates at Aziscohos Lake, and the Rapid River which drains a series of lakes including Rangeley Lake and Richardson Lake. Other tributaries are the Dead and Swift Diamond Rivers located northwest of Lake Umbagog and the Dead Cambridge River located southeast.

## **C. General Description**

Encompassing 29,000 acres, the Refuge provides regional breeding and migratory habitat for waterfowl and land birds and protects endangered species and rare plants. The Refuge contains a mosaic of spruce-fir, spruce-fir-hardwood, and northern hardwood forest communities that provide important habitat for species of conservation concern, including the Blackburnian warbler (*Dendroica fusca*), Canada warbler (*Cardellina canadensis*), Black-throated green warbler (*Setophaga virens*), and American woodcock (*Scolopax minor*).

The Emergency Wetland Protection Act of 1979 allowed for the original acquisition of land in the Lake Umbagog area by the U.S. Fish and Wildlife Service in 1992. As a result, most of the initial purchases were in wetland areas, including emergent and forested wetlands, and contained relatively little upland forest. In recent years, the Refuge has acquired additional upland acreage surrounding these wetland areas and thus has enlarged its holdings of forested land. Fee-owned forested land totals 26,331 acres 85% (22,379 acres) are forested uplands and 15% are forested wetlands (Table 1).

**Table 1: Forested land acreages**

Forest Type	Area (acres)	%
Forested Upland	22,379	85%
Forested Wetland	3,952	15%
<b>Total</b>	<b>26,331</b>	<b>100%</b>

Umbagog National Wildlife Refuge is within a transition zone between boreal and deciduous forests and as a result contains a variety of tree and plant species associated with those ecosystems. At a stand level, the canopy, shrub, and herbaceous layers have distributions and mixtures of species born of site-specific conditions and disturbances (Rapp 2003). Forested wetland communities thrive on soils with a peat component and those saturated for prolonged periods of time. These include black spruce woodland bogs, northern white cedar swamps, floodplain forests, and spruce-fir-tamarack wetlands. With the exception of cedar swamps, most forested wetlands were avoided, or perhaps lightly harvested. On dryer nutrient rich soils, forest composition and structure differ quite dramatically. These sites have been managed intensively, creating even-aged systems, where age variation occurs between stands rather than within stands, as is associated with uneven-aged systems. No upland areas considered to be ecologically mature (old-growth) are known to occur on the Refuge, but a few conifer stands are reported to contain late-seral stage characteristics such as large diameter trees, large diameter snags, and large diameter rotten logs on the forest floor.

Coniferous species are growing on sites they are best suited for although past management practices have shifted species composition and structural diversity away from what would have occurred naturally. In particular, balsam fir is more prevalent in areas that historically supported greater proportions of red spruce. Spruce-fir stands considered mature are scarce. White pine remains a component of the forest, but once abundant shoreline stands have been reduced to scattered groups and individual trees. Softwood stands on the Refuge are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) mixed with red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), quaking and bigtooth aspens (*Populus tremuloides* and *P. grandidentata*), and mountain ash (*Sorbus americana*). Low-elevation spruce-fir forest is a common community type on the Refuge, forming large stands in lower elevation areas on gentle slopes and flats.

Deciduous species are growing on sites they are best suited for although past management practices have shifted species composition and structural diversity away from what would have occurred naturally. The predominant tree species in the Refuge's hardwood forest are Beech (*Fagus grandifolia*), paper and yellow birches (*Betula papyrifera* and *B. alleghaniensis*), red and sugar maple (*Acer rubrum* and *A. saccharum*), quaking and bigtooth aspens (*Populus tremuloides* and *P. grandidentata*), and mountain ash (*Sorbus americana*). Beech trees provide important habitat and food for wildlife but are under-represented in hardwood forests (Charles Cogbill, personal communication). Beech is declining in northern New England at a rapid rate due to forest site conversion and beech bark disease (Chuck Hulsey, personal communication), albeit overabundance of diseased beech is a concern where forest management that encourages shade-tolerant species is used.

The transition zone between the two broad coniferous and deciduous communities is where site characteristics are most variable, giving rise to a mosaic of these community types. These “mixed species” zones are difficult to maintain through forest management, often favor deciduous species when manipulated, and once altered are difficult to restore. Past forest management has led to the most dramatic change in species composition associated with mixed zones. Mixed forest communities are unique to the northern New England region and include both boreal and southern species.

## II. Management of Forested Lands

### A. Introduction

Managing habitats, especially forested habitats, is a long term endeavor that requires monitoring, adaptation, and patience. These efforts can be thought of as falling along a continuum, or gradient related to their intensity. At one end of the gradient are heavily engineered systems, designed to benefit species with specific habitat requirements. And at the opposite end of the gradient are those areas protected from management as reserves. The history of the New England landscape is important in guiding land management decisions. By embracing a historical perspective, managers gain insights into the inherent variability in ecological processes and ecosystem responses over time, allowing the informed development of conservation strategies across the region (Foster 2000). Furthermore, to ensure biological diversity and ecological integrity are preserved, new and evolving science such as conservation biology, restoration ecology, and landscape ecology must be incorporated into the decision making associated with adaptive management. Lastly, to make good decisions today and initiate strategies that move dynamic ecosystems towards desired long term future conditions it is important to project into the future and predict changes in ecosystems from stressors like climate change, shifts in land use practices, and introductions of invasive species.

According to Foster (2000), three conservation directions—wilderness preservation, natural resource use (e.g., timber harvesting), and “cultural restoration”—are valid and compatible given the history of New England’s landscape. He refers to grasslands, heathlands, and shrublands as elements of our cultural history, influenced by recent (past 400 years) human land use practices. Latham (2003) suggests that most shrublands in the northeast originated after European settlement, although some shrublands, such as those exposed to marine salt spray appear relatively stable. Intensive practices such as grazing, mowing, and timber cutting may replicate the land use patterns that created these habitats rather than natural processes such as fire (Foster 2000).

Active vegetation management is needed to maintain the diversity of wildlife endemic to New England (DeGraaf and Yamasaki 2001). Land use in the last 250 years has clearly shaped the current condition, structure, and function of New England’s forests. As habitat was altered by rapid changes in land use across New England, populations of wildlife and plant species associated with grassland, shrub land, young forest, and mature forest species fluctuated. In addition, forest composition in present day New England reflects long-term climate change, elimination or reduction of specific species by introduced pathogens (e.g., chestnut blight), the introduction of invasive weedy species, and historic and current land use practices (Foster 2000). Furthermore, there are no accurate species lists for 2,500 or 250 years ago in New England - no baseline population information to serve as a template for current management (Foster 2000, DeGraaf and Yamasaki 2001). Litvaitis (2003) summarizes the differences between current and historic conditions. Today we have dense human settlements, the loss of dominant plants such as chestnut, changes in ecosystem dynamics, restriction in the extent of beaver flowages, and the loss of stable native shrubland habitats to development. If management of New England’s wildlife populations is to consider these changes, it must remain flexible and creative.

Lorimer and White (2003) and others (e.g., DeGraaf and Yamasaki 2003) suggest managing populations within a natural range of variability rather than returning population numbers to an arbitrary point in time. Cogbill (personal communication) suggests that mimicking or accelerating natural disturbance regimes through forest management is difficult. The ideal “mimic” is not to do anything. Seymour et al. (2002) suggest that multi-aged silvicultural systems (e.g., single tree selection at 100-150 year rotations; group selection using 0.04-0.1 ha openings on 80-120 year rotations) fall within natural disturbance patterns. The use of small (1-3 ha) patch cuts does not fit within natural disturbance patterns unless the rotation age



is lengthened (>100 years) or some structural diversity is left in the patch cut (Seymour et al. 2002). Seymour et al. (2002) conclude that emulating infrequent, catastrophic disturbance has no ecological justification since those disturbances will occur naturally and early-successional habitat will be created during those events.

## **B. Goals, Objectives, Strategies**

The Umbagog CCP and HMP define the conservation design and strategy for the Refuge. Within these documents **Goal 3** addresses conservation of upland forests, and **Objective 3.1** addresses the mixed spruce-fir/northern hardwood matrix forest that occurs on the Refuge. This Forest Management Plan (FMP) is designed to achieve Goal 3 and Objective 3.1:

**Goal 3:** *Manage upland forest habitats, consistent with site capability, to benefit Federal trust species and other species of conservation concern.*

**Objective 3.1:** *...sustain well-distributed, high quality breeding and foraging habitat for species of conservation concern....Also, where consistent with management for those refuge focal species, protect critical deer wintering areas and provide connectivity of habitat types for wide-ranging mammals."*

In the CCP and HMP, Objective 3.1 is further expanded into four sub-objectives (Appendix C). Three of these sub-objectives address the Spruce-fir, Conifer-Hardwood, and Northern Hardwood forest types that occur within the mixed spruce-fir/northern hardwood matrix forest; and the fourth sub-objective addresses the habitat needs of the American woodcock (*Scolopax minor*). In the HMP, strategies are listed for each sub-objective. The goals, objectives, sub-objectives, and strategies are the foundation for forest management on the Refuge.

For forest management planning all the goals, objectives, sub-objectives, and strategies were considered to either define desired forest conditions or describe the methods used to achieve desired forest conditions. Within this FMP, information considered to define desired forest conditions is further described as Focal Species, Habitats, and Forest Characteristics (Ch. II, section C); the methods used to achieve desired forest conditions are incorporated in Implementation (Ch. IV) and Prescription Guidelines (Ch. V), and will be further addressed in the prescriptions developed for each treatment area.

In general, the Refuge will utilize forest management that restores site-capable plant communities, with the long-term goal of converting even-aged forests toward multi-aged forests with complex forest structures to benefit Focal Species. Even-age forest management will be limited to strategic locations where site characteristics present the greatest opportunity to manage for high quality habitat suited for Focal Species.

Forested land beyond the scope of this FMP will be evaluated at a future time to determine if forest management strategies are needed to achieve future desired conditions but in general the Refuge will allow regenerating forests and forests with a sparse overstory (<60% crown closure) to grow.

## **C. Focal Species, Habitats, and Forest Characteristics**

The Umbagog CCP identifies species, habitats, and forest characteristics that are conservation priorities. These priorities are used to determine the desired forest condition and type of forest management used to enhance, maintain, or create it. For the mixed spruce-fir/northern hardwood forest, four migratory bird species were selected as a high priority for conservation. These species, referred to as "Focal" species, were selected to represent a variety of avian species and taxa of conservation concern that utilize similar

habitats. Although further research is needed to better understand representation, providing suitable habitat for Focal species provides habitat for the variety of associated species. Also of high priority for conservation are habitat conditions and forest characteristics that may not be inherent in Focal species habitats, yet are critical for other species of conservation concern. Examples include raptor/colonial bird nest trees, deer wintering areas, complex forest structures, and within stand features. Providing these conditions and forest characteristics are necessary to achieve the full range of biological and ecological goals within the CCP.

### ***Focal Species:***

**Blackburnian warbler** is associated with mature conifer habitats (> 80% canopy cover) of spruce, fir, hemlock, and pines, and in spruce-fir/hardwood mixed habitats including deciduous stands with patches of conifers. It nests and gleans insects in the upper canopy of conifers, especially spruce and hemlock, if present, and rarely pines (DeGraaf and Yamasaki 2001). Males sing from the tops of the tallest conifers, preferably over 60 feet. It is considered a forest interior species, susceptible to forest fragmentation and short rotation timber harvesting (50 years or less) (Hagen et al. 1996; Morse, 2004). Blackburnians are found in higher densities in more upland mixed forest with a high conifer component than in wet, bottomland spruce-fir forest. Removal of large conifers decreases populations of this species. Managing mixedwood forests for a high conifer component is an important habitat requirement for Blackburnian warbler.

**Canada warbler** is found throughout the watershed, and is not tied specifically to any particular upland habitat type, but may be tied more directly to a well-developed understory or shrub layer. The Canada warbler breeds in a range of habitat types including deciduous forested swamps, cool, moist, mature forest or riparian areas and swamps with dense undergrowth, and cedar bogs. On the White Mountain National Forest in New Hampshire and Maine, they occur in northern hardwoods with a softwood understory (DeGraaf and Yamasaki 2001). In central Maine, Collins (1983) found the Canada warbler in forests with a high percent shrub cover (70%), moderate canopy cover (64%), and minor component of conifers in the canopy. Forests with dense understory particularly along streams, swamps, bogs, or other moist areas are important to Canada warblers (DeGraaf and Yamasaki 2001). Some site disturbance that promotes development of dense deciduous shrub layer is beneficial to Canada warblers. Introducing canopy openings in forests associated with moist soils and riparian areas, and especially those with canopies approximately 20-30 ft in height may create the habitat where high densities of Canada warbler were found in research at Silvio O. Conte NWR, Nulhegan Basin Division (Chace, Dr. Jameson; personal communication, 2011). Site conditions within Woodcock Focus Areas (Umbagog CCP, sub-objective 3.1d) may provide unique opportunities to manage for Canada warbler and thus, initially, an emphasis is placed on doing such until more can be learned about the habitat needs of the Canada warbler.

**Black-throated green warbler** is one of the forest-interior species most closely associated with a mixed forest, although it occupies a wide range of forested habitat types, in the Northeast, it occurs at highest densities in closed canopy mid-to-mature forest with a significant conifer component. This foliage-gleaning warbler generally forages high in the canopy, but at a lower height than blackburnian warblers (Morse, 1967). Spruce (particularly red spruce) and paper birch are favored foraging substrates. Although it will nest in deciduous trees, preferred nest sites are in dense conifer foliage on a limb or tree fork, at a height of about 20 ft. (DeGraaf and Yamasaki, 2001; Foss, 1994). Large spruce trees are favored male singing perches (Morse, 1993). Black-throated green warblers appear to require fairly large forest patches and a generally forested landscape (Norton, 1999). Askins and Philbrick (1987) found that they disappeared from a 250 acre forest tract that became isolated from other forested habitat. Black-throated green warbler densities also decline in heavily thinned forest

(Morse, 1993). However, structurally heterogeneous forests that include small gaps provide improved foraging opportunities for this warbler (Smith and Dallman, 1996). Managing mixedwood forests for a high conifer component is an important habitat requirement for Black-throated green warbler.

**American Woodcock** require several different habitat conditions that should be in close proximity to one another, and can consist of both uplands and wetlands habitat types. These include clearings for courtship (singing grounds), large openings for night roosting, young, second-growth hardwoods (15-30 years) for nesting and brood-rearing, and foraging areas (Sepik et al. 1981; Keppie and Whiting 1994). These habitat conditions occur naturally on the refuge and can be expanded through habitat manipulation. Lorimer and White (2003) estimate that natural disturbances in the pre-settlement forests created about 1-3% early successional habitat in mixed woods and northern hardwood forests and up to 7% in spruce flats that are more susceptible to blowdown. Woodcock courtship begins in March or April as males perform displays at dawn and dusk on “singing grounds” that are diverse and include natural openings, clearcuts, roads, pastures, lawns, cultivated fields, or reverting farmlands. The use of an opening by a male depends on the quality of the surrounding brood and nesting cover. Females choose nest sites near good brood cover and tend to nest within 150 m of a singing ground. Females typically nest in young, open, second growth hardwood stands. Good brood cover includes high stem densities of hardwood trees or shrubs in areas with high earthworm numbers such as in moist soils under alder or aspen (USFWS 1996). The American woodcock utilizes a mosaic of second growth hardwoods, dense sapling-sized stands, open fields, and clearings. It prefers stands dominated by deciduous trees with loamy soils that are more likely to harbor earthworms. The Refuge has designated several Woodcock Focus Areas (Umbagog CCP, sub-objective 3.1d) based on soil type and proximity to diverse conditions, including fields adjacent to Refuge ownership.

### ***Priority Habitats and Forest Characteristics:***

**Site Capability:** Abiotic environmental features (e.g. soil, hydrology, aspect, and topography) have a significant influence on the type and succession of a plant community that occurs on a site. Thus, site capability is the plant community that is most capable and best suited to thriving vigorously on the various combinations of abiotic features that compose a site. Managing for site capability is critical for achieving the biological and ecological goals of the Refuge. Goal 3 of the Umbagog CCP states the Refuge will “manage upland forest habitats, consistent with site capability, to benefit federal trust species and other species of conservation concern.”

**High Conifer Mixedwood Habitats:** One of the highest priorities, and considered the most important ecological contribution the refuge could make to the Upper Androscoggin River watershed, the Northern Forest, and the Refuge System is management that sustains a mature mixed forest, with a high conifer component and high structural diversity (USFWS, 2009). Furthermore, managing mixedwood habitats for a high conifer component is important to provide habitat for the Blackburnian and Black-throated green warblers.

**Complex Forest Structure:** Complex forest structure is a conservation priority of the Refuge. Complex forest structure is not easily defined but can be characterized by attributes that are commonly found in older forests that have developed with little human intervention or manipulation. For forest management purposes complex forest structure includes >70% canopy closure, a range of tree ages including some >120 years old, shade-tolerant plant species, large diameter trees, cavity trees, snag trees, super canopy trees, and coarse woody debris on the forest floor.

**Deer wintering areas:** White-tailed deer (*Odocoileus virginianus*) are at the northern edge of their range on the Refuge and are limited by harsh winter conditions. Deer survival depends on access to adequate shelter and food. The New Hampshire Fish and Game Department and Maine Inland

Fisheries and Wildlife have identified several areas of lowland conifer forests on and adjacent to the Refuge that provide critical winter cover for deer. These deer wintering areas have two important components: (1) a core area of softwoods with high crown closure and (2) patches of mixed hardwood or softwood providing accessible browse within or near the core of the area. Functional wintering areas tend to be in stands that reduce wind exposure and have relatively low snow depths and higher night temperatures. Such stands commonly have softwood cover > 35 feet tall, > 100 sq. ft. per acre total basal area, and at least 70% crown closure (Flatebo *et al.* 1999; Reay *et al.* 1990). The Refuge seeks to manage and maintain deer wintering areas and sheltered travel corridors in its management of upland forest. Other wide-ranging wildlife will utilize these habitats including marten (*Martes americana*), fisher (*M. pennanti*), bobcat (*Lynx rufus*), lynx (*Lynx canadensis*), and Blackburnian warbler.

**Habitat Connectivity:** Connectivity corridors are important ecosystem links that provide avenues between patches of large intact habitats for organisms, such as plants and wildlife, to travel. Connectivity is important at both coarse and fine scales. It provides safe movement, particularly for rare species that may suffer from inbreeding or loss of genetic variation if movements between isolated populations are restricted. (Flatebo *et al.* 2008). Where possible the Refuge will manage forests so that they provide connectivity within and across the Refuge.

**Raptor / Colonial Bird nests:** Colonial birds, such as the great blue heron (*Ardea herodias*), and raptors, including the bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*), are birds of conservation concern on the Refuge that utilize mature dominant trees or snags for nesting, perching, and hunting. Trees that are taller than the surrounding canopy (super canopy trees) within a close proximity (~250 feet) to ponds, lakes, and large rivers are critical habitat components for these species. Super canopy trees within 1 mile of waters that provide a consistent food source is important for continued protection of these species.

**Within-Stand Features:** Within stand features are unique attributes that contribute to the biological diversity of forested habitats. Examples include vernal pools, seeps, fens and bogs, cliff, caves, talus woodlands, trap-rock ridges, and other various biologic and geologic features. Many of these features are protected through restrictive management zones, but those not addressed specifically will be protected during implementation using the best information available.

**Rare, Exemplary, and Unique plants and communities (REU):** All rare, exemplary, and unique plants and communities are a conservation priority on the Refuge. Floodplain and lakeshore pine-hemlock communities are relatively rare occurrence on the Refuge. These communities have a protective status and will not be the target of harvesting operations. Most rivers have been dammed or developed in New Hampshire, and consequently, floodplain communities are rare in the state. The Magalloway River floodplain, dominated by silver and red maple has a New Hampshire Natural Heritage ranking of S2 (Appendix A). Jack pine (*Pinus banksiana*) communities occur on the refuge in low elevation areas and have a NH Natural Heritage ranking of S1 because of their extreme rarity in the state.

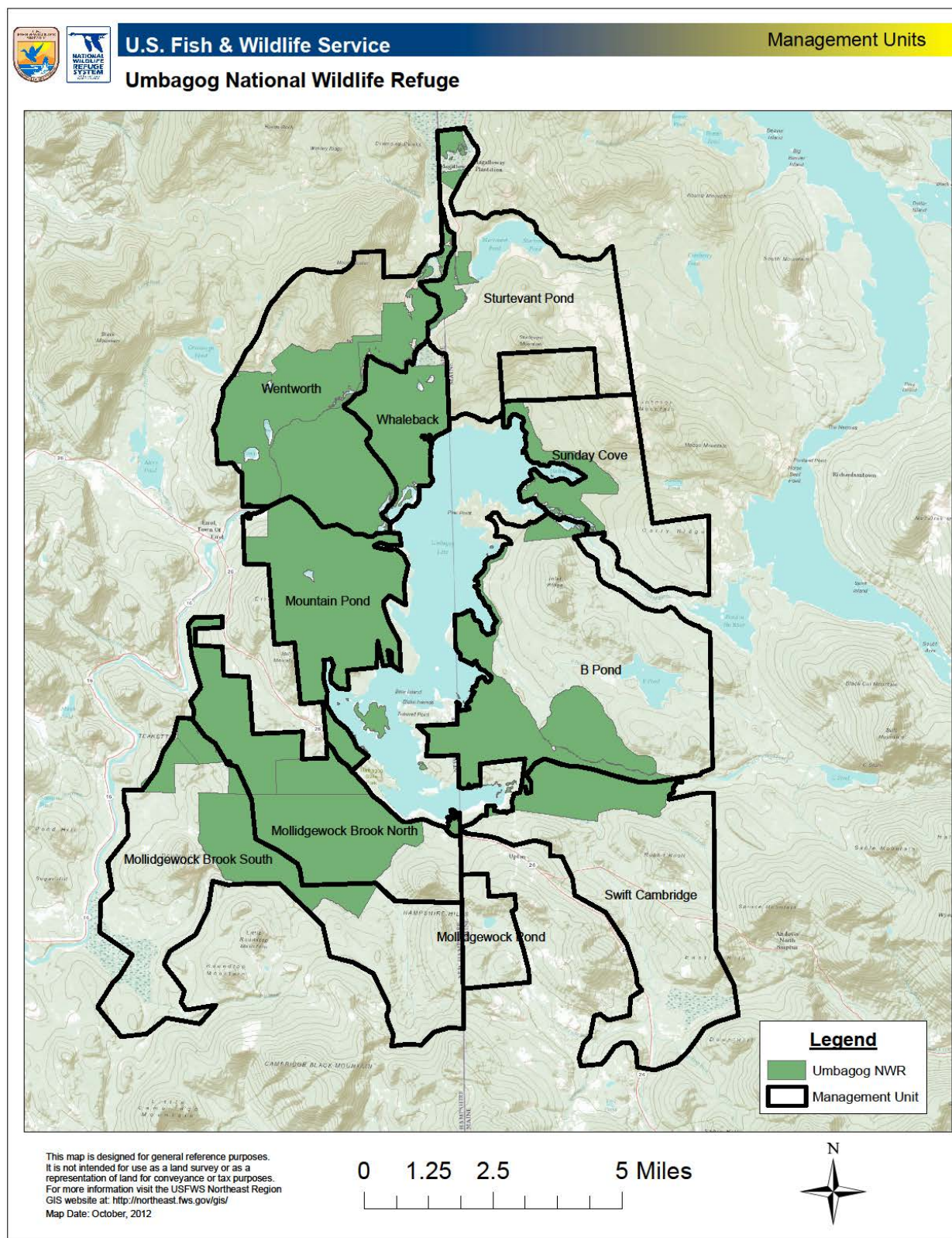
## D. Management Units

Management Units (MU) provide a means to aid communication and organization. The Refuge is divided into ten MUs (Map 1). MU boundaries follow topographic and geographic features such as roads and waterways, but occasionally political boundaries are used. The MUs include lands currently owned by USFWS, and lands within the expansion boundary in the preferred alternative of the Umbagog CCP (Umbagog CCP, Alternative B). To facilitate analysis, in a few locations, lands are included that are not



owned or within the expansion boundary. Management units are not acquisition boundaries and they do not infer authority by the USFWS.

## Map 1: Management Units



## E. Management Zones

Management zones are areas that govern the type of resource management that can be used. Management zones provide protection for a variety of forest and non-forest resources identified and further discussed in the Umbagog CCP. In the CCP, Refuge lands are categorized into four management zones (Appendix B) but for forest management purposes they are consolidated into three categories: General Management, Special Management, and Restricted Management.

**1. General Management:** Forest management may occur, following best management practices (BMP) for the states of New Hampshire and Maine. Where general management areas surround or abut sensitive areas, general management prescriptions may be modified to protect or enhance the value of sensitive areas. This includes areas defined as Low Resources Sensitive Zone in the CCP.

**2. Special Management:** Forest management may occur but must consider limitations of heavy equipment, areas deemed important for species of concern, and areas otherwise considered unique or exemplary (Table 2). This includes areas defined as Moderate Resource Sensitivity Zone in the CCP, deer wintering areas, and sensitive resource outer management buffers (Table 3).

**3. Restricted Management:** Generally no heavy equipment or harvest may occur, although individual trees may be felled, girdled or otherwise treated for the benefit of wildlife. This includes areas defined as High Resource Sensitivity Zone and Forest Industry Inoperable Zone in the CCP, sensitive resource inner management buffers (Table 3), and those otherwise considered unique, exemplary, or inoperable with heavy equipment (Table 2). Inoperable lands are those as having excessively steep slopes (>30% based on geospatial data) and/or hydric soils (based on data from the Natural Resources Conservation Service).

**Table 2: Examples of Resources Considered Under Restricted and Special Management**

Restricted Management	Special Management
Hydric soils	Deer wintering areas
Slopes over 30% grade	Thin soils over bedrock/ easily erodible soils (per NRCS guidelines)
Forested wetlands: cedar, black spruce, hardwood swamps, floodplain forest†	Ridge tops (Red spruce rocky summit vegetation community)†
Rare plant locations (+ 100 ft. from site)	Upland forest types of concern: hemlock, jack pine, semi-rich/rich northern hardwood†
	Mature forest structure

**Table 3: Protective Zones around Environmentally Sensitive Areas\***

Sensitive Area Type	Inner Management Buffer (Restricted Management Zone)	Outer Management Buffer (Special Management Zone)
Vernal Pools	100 ft (from pool edge)	1000 ft
1 <sup>st</sup> & 2 <sup>nd</sup> Order streams	50 ft (from stream bank)	150 ft
3 <sup>rd</sup> Order streams	100 ft. (from stream bank)	400 ft.
4 <sup>th</sup> order or higher stream	100 ft. (from stream bank)	1000 ft.
Seeps	50 ft (from seep edge)	100 ft
Non-forested wetlands or ponds < 10 acres	100 ft. (from wetland or pool edge)	1000 ft
Non-forested wetlands or ponds > 10 acres	300 ft (from wetland or pool edge)	1000 ft
Raptor/ Great Blue Heron nests (seasonal)	600 ft (from nest site)	1/4th mile

\* These are general guidelines only: the size of ‘restricted’ and ‘special’ management zones may be adjusted depending on specific wildlife, habitat, or topographic/ landscape concerns at particular sites.

† These types are of special concern due to their relative rarity on the refuge and/or in New Hampshire, sensitivity to disturbance, value to wildlife, and/or high proportion of rare plants.

- *Example 1: Forest management in an area with a vernal pool is constrained to:*
  - (a) *treatments of individual trees (as required under inoperable / restricted management guidelines) within 100 ft of the pool edge, and*
  - (b) *limited harvest (as required under special management guidelines) between 100 and 1,000 ft of the pool edge.*
- *Example 2: Forest management in stands with mature forest structure must follow special management guidelines, including the maintenance of closed canopy conditions and the retention of downed wood. However, management in these areas need not follow the guidelines required of restricted management zones.*

## F. Guiding Documents

Forest management on the refuge will generally follow the recommendations of the following publications:

- Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire (Cullen 2000)
- Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire (NHFSSWT 1997)
- Biodiversity in the Forests of Maine: Guidelines for Land Management (Flatebo *et al.* 1999)
- Forestry Habitat Management Guidelines for Vernal Pool Wildlife in Maine (Calhoun & deMaynadier 2003)
- Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities (Chase *et al.* 1995)

## G. Archeological and Cultural Resources

Archaeological and cultural resources are an irreplaceable part of the Nation’s heritage, and therefore must be protected to prevent their loss and destruction. The Refuge has legal obligation to protect these resources according to the Archaeological Resources Protection Act of 1979 as amended (Public Law 96-95; 16 U.S.C. 470aa-mm).

Heavy machinery used to conduct forest management can adversely affect these resources. Appropriate actions will be taken to protect known sites. In the event that unrecorded archeological or cultural resources are discovered while conducting forest management operations, the operation shall cease at that specific location and all reasonable efforts to avoid or minimize damage to the site shall be made. The USFWS Region 5 Cultural Resources Department will be immediately notified and advised of the nature of the discovery.

## **H. Northern Forest Land Management Research and Demonstration Program**

The U.S. Fish and Wildlife Service (Service) developed “Fulfilling the Promise,” a strategic guiding document for the National Wildlife Refuge System in October 1998. This document identified a pathway for the Refuge System to improve its role as a model for land management techniques that maintain and restore fish and wildlife populations and their habitats. One of its foremost strategies called for the establishment of designated Land Management Research and Demonstration (LMRD) sites throughout the Refuge System.

The National Wildlife Refuge System LMRD program was developed by a cross regional team as part of the “Fulfilling the Promise” implementation plan. The Northern Forest LMRD (NF LMRD) is one of fourteen national LMRDs selected by the Service. The LMRD program has **four principal objectives: 1)** to demonstrate sound land management techniques that identify, maintain and/or restore natural processes for sustaining habitats for fish, wildlife and plants; **2)** to research, test and develop new habitat management and restoration techniques and approaches; **3)** to communicate its findings on habitat management techniques and technology to professional, academic and private land manager groups; and **4)** to foster cooperative partnerships with both public and private audiences.

Umbagog Refuge is within the eco-regional boundary of the NF LMRD. Cross programmatic communication, collaboration, and contribution is mutually beneficial to the Refuge and the NF LMRD program. Where and when possible the Refuge will work closely with the NF LMRD to serve as a demonstration site and become an outstanding center for research and development of applied management practices to sustain and enhance the natural resources in the Northern Forest (USFWS, 2009).



### III. Uplands Considered for Forest Management in the Next 15 Years

#### A. Introduction

Uplands considered for forest management in the next 15 years are those within general and special management zones that contain enough commercial timber value for an economically viable management action that achieves Refuge management goals and objectives. Using tree height and density from aerial photo interpretation as a proxy for merchantability (>30 feet in height and >60% canopy crown closure), 4,773 acres (43%) of forested uplands are merchantable and within general and special management zones. This is less than the total amount of forested uplands owned, but includes all land for which data is available for such analysis. This management plan will be amended as inventory data is gathered for lands not included.

Lands considered for forest management were divided into softwood, hardwood, and mixedwood categories based on species occurrence in the forest canopy. Canopies with >75% coniferous species were categorized as **Softwood**; >75% deciduous species categorized as **Hardwood**; 25% -75% mix of deciduous and coniferous species categorized as **Mixedwood**. Hardwood accounts for 2,149 acres (45%), softwood 527 acres (11%), and mixedwood 2,097 acres (44%) (Table 4).

**Table 4: Uplands considered for forest Management in the next 15 years**

Forest Type	Forest Type Description	Acres	%
Softwood	>75 % coniferous species	527	11%
Hardwood	>75% deciduous species	2,149	45%
Mixedwood	25-75% coniferous species	2,097	44%
<b>Total</b>		<b>4,773</b>	<b>100%</b>

#### B. Growth, Yield, and Retention

Growth, yield, and retention are variables that help inform and administer forest management. Growth is the quantity of wood that accumulates in the forest from the development and maturation of trees. Yield is the amount of wood available for removal during implementation. Retention is the amount of wood that is not removed, nor intended to be removed at a future date.

Estimating current and future growth, yield, and retention requires many mathematical variables that vary depending on forest type, site characteristics, and the forest management being used. Much of the data needed to calculate growth, yield, and retention for the Refuge, especially for individual forest stands is not available. As this information becomes available additional calculations and reporting will be completed. In the interim, general estimates can be made regarding long-term sustainable harvests.

Long-term sustainable harvest for all forested uplands is considered annual growth, minus retention. Much of the forested uplands occur on fertile and productive soils, and thus average or better growth is expected. Timber harvests on the 4,773 acres considered in the next 15 years are estimated to produce approximately 953 cords annually (Table 5). Volume removed during initial harvest entry will vary depending on forest type, current stocking, and future desired condition. Because of the manner in which these lands were selected, the current stocking is expected to be similar to the amount projected for each harvest entry, thus, initial harvests are expected to yield approximately the amount of volume projected for long-term sustainable harvest.

For softwood forest types managed using uneven-aged management and 15 year harvest intervals, expected yield is 6 cords/acre with 2 cords/acre retained and 4 cords/acre harvested at each entry. The volume remaining post-harvest will be approximately 20-25 cords/acre. Projected growth is .40 cords/acre/year.

For hardwood forest types managed using uneven-aged management and 15 year harvest intervals, expected yield is 4.5 cords/acre with 2 cords/acre retained and 2.5 cords/acre harvested at each entry. The volume remaining post-harvest will be approximately 18-23 cords/acre. Projected growth is .30 cords/acre/year.

For mixedwood forest types managed using uneven-aged management and 15 year harvest intervals, expected yield is 5 cords/acre with 2 cords/acre retained and 3 cords/acre harvested at each entry. The volume remaining post-harvest will be approximately 18-23 cords/acre. Projected growth is .35 cords/acre/year.

The use of even-age management can include various applications that impact growth and yield. For all forest types managed using even-aged management and 100 year rotations, expected yield is 25-50 cords per acre (including regeneration and release harvests).

Expressed in Basal Area (BA), for all forest types managed using 15 year harvest intervals, expected yield is 30-40 ft<sup>2</sup>/acre with 7 ft<sup>2</sup>/ acre (approximately 6 trees/acre) retained and 23-33 ft<sup>2</sup>/acre harvested at each entry. Projected annual growth across all forest types is 2 ft<sup>2</sup>/acre/year. Residual basal is 100 ft<sup>2</sup>/ acre for softwood and mixedwood forest types, and 70 ft<sup>2</sup>/ acre for hardwood forest types.

**Table 5: Projected Growth and Yield**

Forest Type	Growth Projection cords/acre/year	Annual Growth (11,052 acres) cords/year	Harvest reduction (6,279 acres)		Considered In next 15 years (4,773 acres)		
			Restricted Zone (3,987 acres) cords/year	Regenerating and Understocked (2,292 acres) cords/year	Annual Growth cords/year	Retention cords/year	Annual Harvest cords/year
Softwood	0.40	728	420	96	211	70	141
Hardwood	0.30	1,308	324	340	645	287	358
Mixedwood	0.35	1,705	650	321	734	280	454
All	0.34	3,741	1,394	758	1,589	636	953

## C. Inventory

Much of Umbagog National Wildlife Refuge land has not been thoroughly inventoried. Additional inventories are needed to better assess current conditions and monitor change. In this regard future inventory and monitoring in the context of Refuge goals and objectives will be instrumental for future forest management decisions. In the interim, information can be gleaned from available geospatial data and various inventories conducted in the past.

Past inventories were conducted at various times, covering only portions of the Refuge, and designed to meet the information needs of resource managers at that time. None of the past inventories can be used solely for assessing current conditions, but collectively some insight is garnered for much of the land considered for forest management in the next 15 years.

### 1. Baseline Habitat Inventory (2005)

The most recent inventory, completed in 2005, included 4,041 acres of forested uplands most of which are lands considered for forest management in the next 15 years. This inventory followed the Umbagog Habitat Inventory protocol (unpublished) and was designed to assess baseline habitat conditions to inform habitat management planning. The format in which the data was collected and stored for this survey allows it to be extracted and analyzed in varying ways, and thus can provide useful information for implementation at a future date. Consulting this inventory and data associated with it is suggested for future implementation and monitoring. The data associated with the lands considered for forest management in the next 15 years was extracted and analyzed for each forest type. Statistical validity cannot be derived for much of the data collected using rapid assessment methodologies. Use of the data should be limited to general information purposes only.

#### *Hardwood Forest Type*

Results from 46 data collections points indicate hardwood forest types in general have 21-60% ground coverage of herbaceous ferns, canopy crown closure of 71-100%, overstory height class of 66-80 feet, predominately absent understory, overstory age class of 51-70 years, an overstory structure class considered small sawtimber (Trees with a 9.5-14 inch mean diameter), a low fuel load (predominately hardwood; very little understory; combustible fuels minimal), a Forested Timberland land use class (area that currently supports or may support upland timber types and offers a reasonable amount of growth potential based on soil), a low quantity (<20%) of unhealthy or poor forest health conditions (mostly diseased beech and moose browse), and a moderate (11-50%) presence of downed wood. Results from core samples indicate the most common age of the overstory trees is 60 years old. Seedling inventory indicates approximately 9,000 seedlings per acre comprised of 84% hardwood species (38% striped maple, 25% red maple, 16% sugar maple, 5% miscellaneous), and 16% softwood species (11% balsam fir, 4% red spruce, 1% cedar). Sapling inventory indicates approximately 1,000 saplings per acre comprised of 54% hardwood species (23% red maple, 9% yellow birch, 9% striped maple, 8% sugar maple, 5% miscellaneous) and 46% softwood species (40% balsam fir, 6% red spruce).

#### *Mixedwood Forest Type*

Results from 50 data collections points indicate mixedwood forest types in general have 21-60% ground coverage of herbaceous ferns, canopy crown closure of 71-100%, overstory height class of 66-80 feet, predominately absent understory, overstory age class of 71-90 years, an overstory structure class considered small sawtimber (Trees with a 9.5-14 inch mean diameter), a moderate fuel load (mixed hardwood/softwood; softwood understory minimal; combustible fuels minimal), a Forested Timberland land use class (area that currently supports or may support upland timber types and offers a reasonable amount of growth potential based on soil), a low quantity (<20%) of unhealthy or poor forest health conditions (mostly diseased beech and moose browse), and a moderate (11-50%) presence of downed

wood. Results from core samples indicate the most common age of the overstory trees is 90 years old. Seedling inventory indicates approximately 11,000 seedlings per acre comprised of 37% hardwood species (20% striped maple, 6% red maple, 5% yellow birch, 3% sugar maple, 3% miscellaneous), and 63% softwood species (45% balsam fir, 17% red spruce, 1% cedar). Sapling inventory indicates approximately 900 saplings per acre comprised of 33% hardwood species (13% yellow birch, 13% striped maple, 3% red maple, 2% beech, 2% miscellaneous) and 67% softwood species (49% balsam fir, 18% red spruce).

#### *Softwood Forest Type*

Results from 12 data collections points indicate softwood forest types in general have 21-60% ground coverage of herbaceous ferns (closer to the low end of the range though), canopy crown closure of 71-100%, overstory height class of 66-80 feet, predominately absent understory, overstory age class of 51-70 years, an overstory structure class considered small sawtimber (Trees with a 9.5-14 inch mean diameter), a high fuel load (mixed softwood/hardwood; softwood understory abundant; combustible fuels abundant, Forested Timberland land use class (area that currently supports or may support upland timber types and offers a reasonable amount of growth potential based on soil), a low quantity (<20%) of unhealthy or poor forest health conditions (balsam dieback), and a moderate (11-50%) presence of downed wood. Results from core samples are inconclusive as only 4 trees were sampled each of which varied in age. Seedling inventory indicates approximately 14,000 seedlings per acre comprised of 22% hardwood species (12% red maple, 6% striped maple, 3% yellow birch, 1% white birch), and 78% softwood species (39% red spruce, 37% balsam fir, 2% white pine). Sapling inventory indicates approximately 1,200 saplings per acre comprised of 20% hardwood species (8% yellow birch, 8% red maple, 4% white birch) and 80% softwood species (70% balsam fir, 8% red spruce, 2% white pine).

## **2. National Vegetation Classification System Mapping (Rapp, 2003)**

In 2003 the ecological communities on the Refuge were mapped using the National Vegetation Classification System (NVCS). The NVCS is a hierarchical system that provides classifications that range from broad ecoregions to very detailed plant associations. All of the lands considered for forest management in the next 15 years have been mapped using NVCS. Information relevant to the lands considered for forest management in the next 15 years includes:

- The largest area of lowland spruce-fir on the refuge is found in the Mountain Pond area, and includes some patches of mature spruce-fir. This area of spruce-fir is in close proximity to the Mountain Pond wetland complex, which includes cedar swamps and black spruce bogs. Larger blocks of lowland spruce-fir also occur in the Sunday Cove area and some small patches of lowland spruce-fir with late successional characteristics are also found in the Tidswell Point wetland complex area.
- Pine lakeshore forest: The eastern shore of Lake Umbagog is dominated by pine forest. Scattered jack pines occur here. Jack pine is extremely rare in New Hampshire, where it is at the southern limit of its range (NH Heritage rank S1). The community on Umbagog is the only low elevation occurrence in New Hampshire. A northern occurrence of hemlock mesic forest is found along the lake on Tyler Point. Some of the most mature upland forest in the area is found on Tyler Point (including 2-3 ft. diameter trees), but is on land currently outside of the refuge acquisition boundary.



- Semi-rich northern hardwood forest: A small patch of this type, unique to the refuge area, occurs in the vicinity of C Bluff. Some unusual forested talus communities also occur in this area. C Bluff is within the refuge acquisition boundary and is currently protected by a New England Forestry Foundation easement.
- Floodplain forests: Floodplain forests occur primarily along the Magalloway River and Dead and Swift Cambridge Rivers. This type is rare in New Hampshire and the Magalloway floodplain forest is listed in the New Hampshire Heritage Program database. Red maple floodplain forest approaches its northern limit on the Magalloway
- Northern white cedar swamps: The largest northern white-cedar swamp in New Hampshire occurs north of Whaleback Ponds and is also listed in the New Hampshire Heritage Program database. A number of New Hampshire listed rare plants are found in this area. Much of this swamp is within the refuge acquisition boundary but is not currently under refuge ownership. Northern white cedar swamps have the highest plant species diversity of any of the refuge's plant community types. This type is also found in the Mountain Pond drainage and along the Dead Cambridge River.
- Red maple-black ash swamp: An unusual northern occurrence of this type is found along the Dead Cambridge River.
- Tidswell Point: An extremely rare example of a circumneutral patterned fen is found near the center of Tidswell Point (only a few of this type are known to occur in New England). The fen is surrounded by a wetland complex, including northern white cedar swamp and black spruce bog. Much of the surrounding forested area, including some of the forested wetlands, has been recently harvested. The harvest of adjacent forest lands may be impacting the fen and associated wetlands. The fen and surrounding forest lands are currently under US Fish and Wildlife Service and state of New Hampshire ownership. Areas under US Fish and Wildlife Service ownership were acquired from Hancock Timber Resources in 2002.

### 3. Aerial Photography Interpretation (2000)

Aerial photo interpretation, completed for the Refuge in the year 2000, is a primary source of information for evaluating forest composition and structure. This data is available for approximately 16,400 acres of which 11,051 acres are forested habitats within the General, Special, or Restricted management zones (see Part II, Section E, Management Zones). Using this data the Refuge was assessed to better understand the breadth of habitat conditions associated with forest type, height, and canopy closure (Table 6).

**Table 6: Umbagog NWR aerial photo interpretation of 11,051 acres of forested habitats**

Height Class	Crown Class	Hardwood				Mixedwood				Softwood				Total			
		Operable		Inoperable		Operable		Inoperable		Operable		Inoperable		Operable		Inoperable	
		Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable	Acres	% Total Operable & Inoperable
0 - 10 ft	A*	27	0%	15	0%	36	0%	41	0%	0	0%	0	0%	63	1%	56	1%
	B*	51	0%	17	0%	64	1%	59	1%	0	0%	0	0%	115	1%	76	1%
	C*	0	0%	0	0%	33	0%	4	0%	0	0%	0	0%	33	0%	4	0%
	D*	51	0%	2	0%	0	0%	0	0%	34	0%	15	0%	85	1%	17	0%
	Total	129	1%	34	0%	133	1%	104	1%	34	0%	15	0%	296	3%	153	1%
10 - 30 ft	A	257	2%	64	1%	126	1%	99	1%	0	0%	0	0%	383	3%	163	1%
	B	80	1%	11	0%	42	0%	20	0%	23	0%	87	1%	145	1%	118	1%
	C	33	0%	3	0%	4	0%	21	0%	2	0%	143	1%	39	0%	167	2%
	D	0	0%	0	0%	0	0%	1	0%	2	0%	7	0%	2	0%	8	0%
	Total	370	3%	78	1%	172	2%	141	1%	27	0%	237	2%	569	5%	456	4%
30 - 50 ft	A	1,428	13%	240	2%	973	9%	290	3%	101	1%	140	1%	2,502	23%	670	6%
	B	366	3%	152	1%	1,122	10%	825	7%	425	4%	371	3%	1,913	17%	1,348	12%
	C	178	2%	27	0%	394	4%	306	3%	105	1%	262	2%	677	6%	595	5%
	D	49	0%	23	0%	149	1%	68	1%	36	0%	18	0%	234	2%	109	1%
	Total	2,021	18%	442	4%	2,638	24%	1,489	13%	667	6%	791	7%	5,326	48%	2,722	25%
50+ ft	A	8	0%	0	0%	0	0%	0	0%	0	0%	0	0%	8	0%	0	0%
	B	347	3%	147	1%	2	0%	70	1%	0	0%	7	0%	349	3%	224	2%
	C	369	3%	371	3%	71	1%	53	0%	33	0%	0	0%	473	4%	424	4%
	D	38	0%	6	0%	0	0%	0	0%	7	0%	0	0%	45	0%	6	0%
	Total	762	7%	524	5%	73	1%	123	1%	40	0%	7	0%	875	8%	654	6%
Total		3,282	30%	1,078	10%	3,016	27%	1,857	17%	768	7%	1,050	10%	7,066	64%	3,985	36%
* Canopy closure values: A = 81-100%, B = 61-80%, C = 31-60%, D = 0-30%																	
considered in the next 15 years																	

### 4. Ecological Survey and Timber Inventory (Publicover, Bryce, et al; 1997)

In 1997 an ecological survey and timber inventory was completed for lands now managed by the Refuge. The survey area is greater than the lands considered for forest management in the next 15 years, but include the majority of them. Thus the results are, for the most part, relevant to lands considered in the next 15 years. Results from these inventories indicate:

- Late successional stands: No areas that could be considered true old-growth were located. However, several softwood stands showed significant late successional characteristic, such as relatively large diameter trees (especially white pine, red spruce, or hemlock) and large diameter snags and down rotten logs. Two of the wetland complexes (Mountain Pond and Tidswell Point) contain islands of late-successional lowland spruce-fir communities. Another area (mapped as High Terrace community and dominated by spruce, hemlock, and white pine) is located along the east bank of the Magalloway River just south of the oxbow pond across the river from the Refuge headquarters.
- Deeryard: The late successional softwood stand along the east bank of the Magalloway River (discussed above) contain a high density of winter deer pellets and appear to have been used as a

yard. This area was adjacent to hardwood stands and shrub swamps that could provide a source of browse.

- **Timber Stocking:** Live trees with cavities average .4 trees/acre and include hemlock, cedar, beech, and yellow birch and range in size from 9” to greater than 23” DBH. An additional 1.4 trees/ac are considered potential wildlife trees, the majority of which are cedar. Diameter distribution across all forest types approximates a diminution quotient (Q-factor) of 1.4. Total (>1”DBH) timber stocking average 29 cords and 118 square feet of basal area per acre (ft<sup>2</sup>/acre). Merchantable (>4.5”, excluding wildlife and cull tree, including tops and limbs) timber stocking average 21 cords per acre. Average Basal Area stocking for northern hardwood-spruce-fir community is 113 ft<sup>2</sup>/acre, beech-birch-maple community is 110 ft<sup>2</sup>/acre, lowland spruce-fir community is 120 ft<sup>2</sup>/acre, and mountain spruce-fir community is 140 ft<sup>2</sup>/acre.
- Over two-thirds of the stocking is in five species: red spruce, balsam fir, yellow birch, and red and sugar maple. Red spruce comprises 50% of the basal area of Mountain Spruce-Fir community (versus 6% for balsam fir) but only 22% of the Lowland Spruce-Fir community (versus 31% for balsam fir) (Table 7). Also, some species (such as red spruce, balsam fir, red maple, and yellow birch) are common in a wide variety of communities, while other species (such as black spruce, beech, and white ash) are found primarily in one community.

**Table 7: Overstory composition by species for major natural communities (percent of total community basal area of trees >1” DBH)**

Species	Natural Community					
	Northern Hardwood- Spruce-Fir	Beech- Birch- Maple	Lowland Spruce-Fir	Mountain Spruce-Fir	Cedar Swamp	Hardwood- Conifer Swamp
Balsam Fir	23	3	31	6	18	24
Red Spruce	16	10	22	50	16	17
White Spruce	<1		2		3	1
Black Spruce			3		19	
Hemlock	<1	2	<1		<1	1
White Pine	2	<1	5		<1	1
Northern white-cedar	6	<1	14		28	19
Larch	<1		<1		1	
Beech	3	18		2		
White birch	7	3	5	9	<1	12
Yellow birch	13	16	6	12	5	9
Red maple	22	6	8	2	7	13
Sugar maple	<1	33	<1	13		
Aspen	4	1	1		<1	1
White ash		2				
Other hardwoods*	3	5	3	6	1	1
Total	100	100	100	100	100	100
*pin cherry, striped maple, black ash						

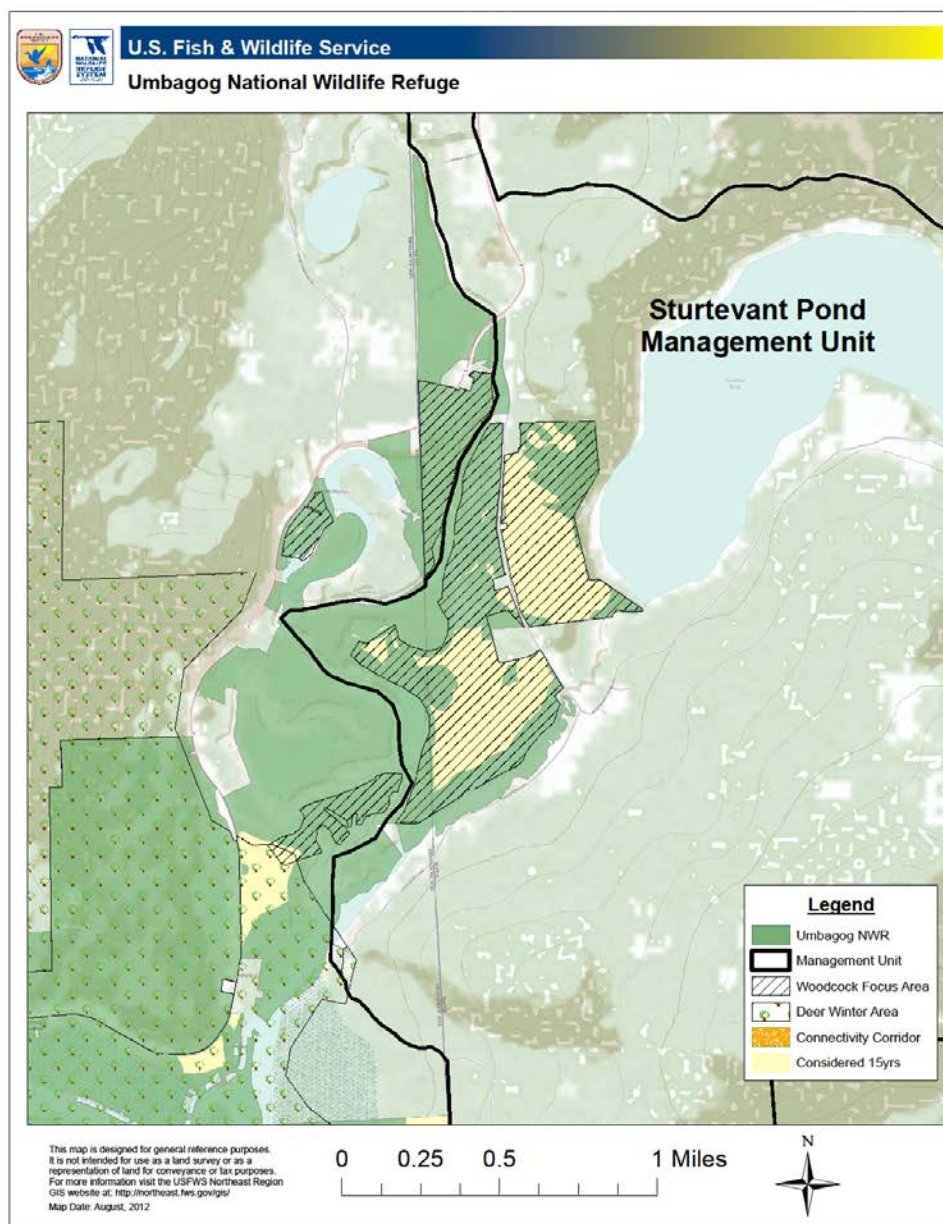
## **IV. Implementation**

To facilitate implementation, the uplands considered for forest management in the next 15 years were evaluated using a combination of GIS data, and consultation with Refuge staff and other experts. GIS data used for analysis include datasets used for the CCP and new or updated versions since it's completion in 2009. The following Management Unit (MU) profiles have been created to inform resource managers and assist with prioritization and preparation of forest management treatments.

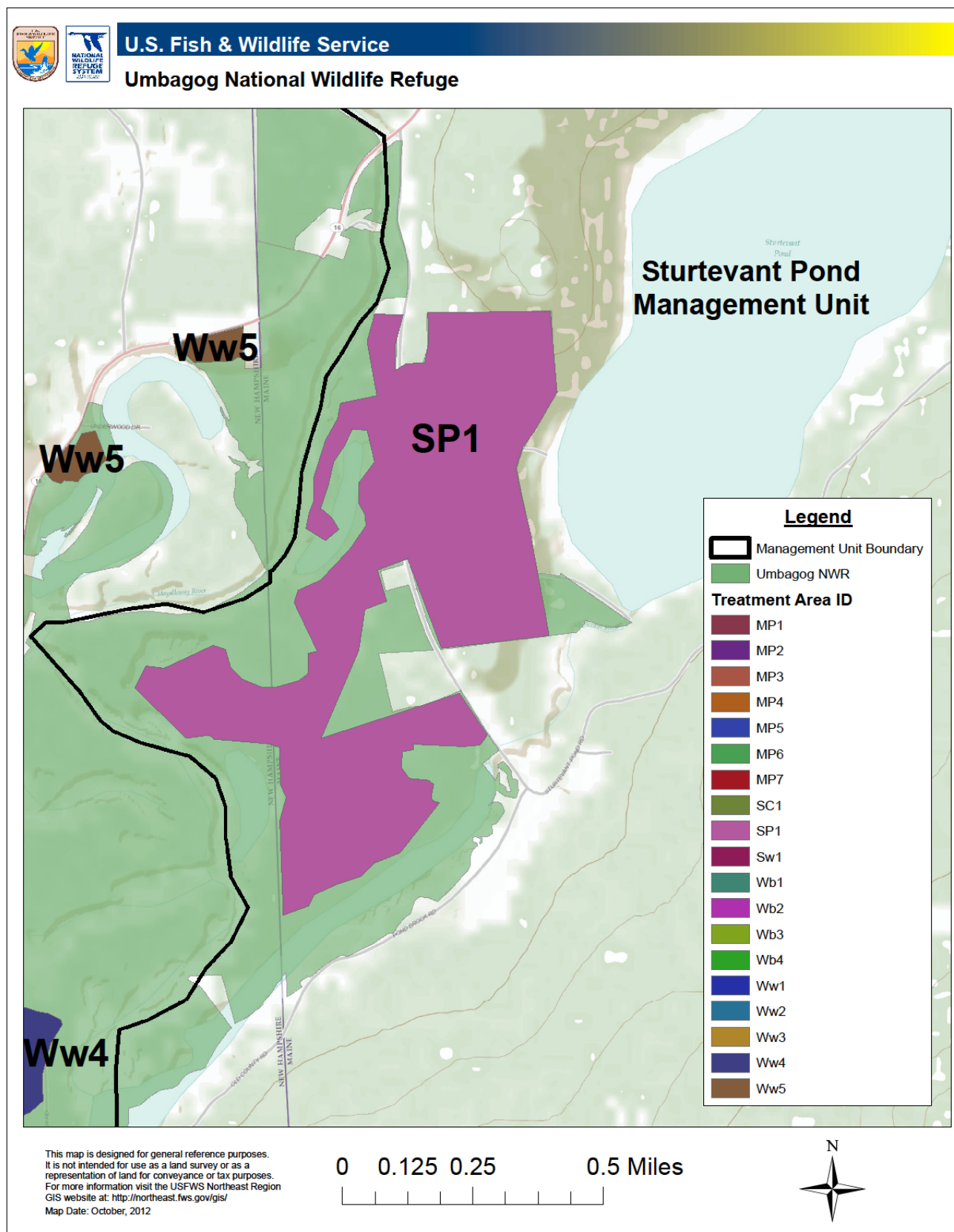
## **A. Sturtevant Pond Management Unit**

Approximately 660 acres of land in this management unit are fee-owned lands managed by the Refuge - 227 acres are within the special and general management zones, and 147 acres are uplands considered for forest management in the next 15 years (Map A-1). The majority of these lands are within the town of Magalloway Plantation, in Oxford County, Maine. Portions to the east extend into New Hampshire, in the Town of Wentworth Location, in Coos County. Pond Brook Rd is the primary access for these lands. To the west of Pond Brook Rd, most of the uplands considered for forest management appear to have been farmed for unknown agricultural products, leaving forests characteristic of old field succession. The forests to the east of Pond Brook Rd, appear to have been managed primarily for forest products at varying intensities - most recently through partial harvesting approximately 30 years ago (circa 1980).

**Map A-1: Sturtevant Pond; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



## Map A-2: Sturtevant Pond (SP); Treatment Area





### **Management Considerations: Focal Species**

- American Woodcock: Approximately 212 acres of land within a **Woodcock Focus Area** (Umbagog CCP, sub-objective 3.1d) (Map A-1) are included in a Sturtevant Pond woodcock management treatment area plan (Appendix D). Within this treatment area, approximately 40 acres of land adjacent to the forested uplands and along the Magalloway River are in a grassy and woody shrub condition.

### **Management Considerations: Priority Habitats and Forest Characteristics**

- Site Capability: The majority of the forested uplands are suited for mixedwood forest types; areas along the Magalloway River and the existing open field are suitable for softwood forest types.
- Raptor / Colonial Bird nests: Recorded nest sites are absent; near the confluence of Sturtevant Stream and the Magalloway River there are dominant white pines that have the potential for nesting. Perpetuating dominant white pine in this area is a goal. Encourage dominant white pine development by removing or girdling adjacent trees - preferably leave girdled trees to provide snags.
- Rare, Exemplary, and Unique plants and communities (REU): An imperiled Silver maple-false-nettle-sensitive fern floodplain forest (S2) plant community occurs along the Magalloway River. The Satin Willow (*Salix pellita*) is a critically imperiled plant (S1) that was present at one time along the banks of the Magalloway River, but is believed absent of this writing. Exclude from harvesting all existing Silver maple-false-nettle-sensitive fern floodplain forest communities.

### **Management Considerations: Other**

- One building owned and managed by the refuge is located west of Pond Brook Rd. The dwelling is not occupied at this time and beyond general lawn care and maintenance does not hamper management of the surrounding refuge lands. Numerous buildings outside of Refuge ownership are along Pond Brook Rd, most of which are permanent residences.
- An existing overhead utility line and associated corridor (maintained) crosses over refuge lands and provides electric power and telephone utilities to the buildings located along the shoreline of Sturtevant Pond; the buildings served and land are private. No easement of record was found by Civil Consultants for the overhead utility line. The line is low hanging and requires careful thought and planning to minimize safety hazards if logging is to occur within the vicinity of the utility line.
- Two gravel roads traveling easterly from Pond Brook Rd cross refuge-owned lands and provide access to private lands and buildings. Records provided by Civil Consultants indicate “others have rights of usage for ingress and egress”. A single gravel road, called “Transfer Station road”, crosses refuge-owned land providing access to a private lot and building.
- A water well and water line are located on refuge lands in the southerly portion of the management area, west of Pond Brook Rd. These supply a neighboring landowner with water.
- A snowmobile trail crosses refuges land, portions of which following an existing gravel road.
- The Maine/NH State boundary bisects the management unit. The presence of blazed trees or other boundary markers is unknown. Harvesting laws and taxation differ between the two states.

- There are small isolated upland areas within the Magalloway River floodplain, and adjacent to the woodcock focus areas. These areas are not being considered for forest management. Active management of these areas is not critical for achieving Refuge goals, and it is recommended they are not actively managed in the future. Do not harvest island upland areas that are not included in woodcock management.
- A gravel pit is located on Refuge land off of the Transfer Station Rd. Do not extract gravel from gravel pits, utilize the existing area as a log landing, and allow embankments and perimeter to revegetate.
- The floodplain forest adjacent to the Woodcock Focus Area serves as important vernal pool habitat. The Magalloway floodplain in general is a significant vernal pool breeding area on the Refuge. Forest management should avoid impacts to vernal pools, and vernal pool amphibians by avoiding rutting, and maintaining shade adjacent to the pools.

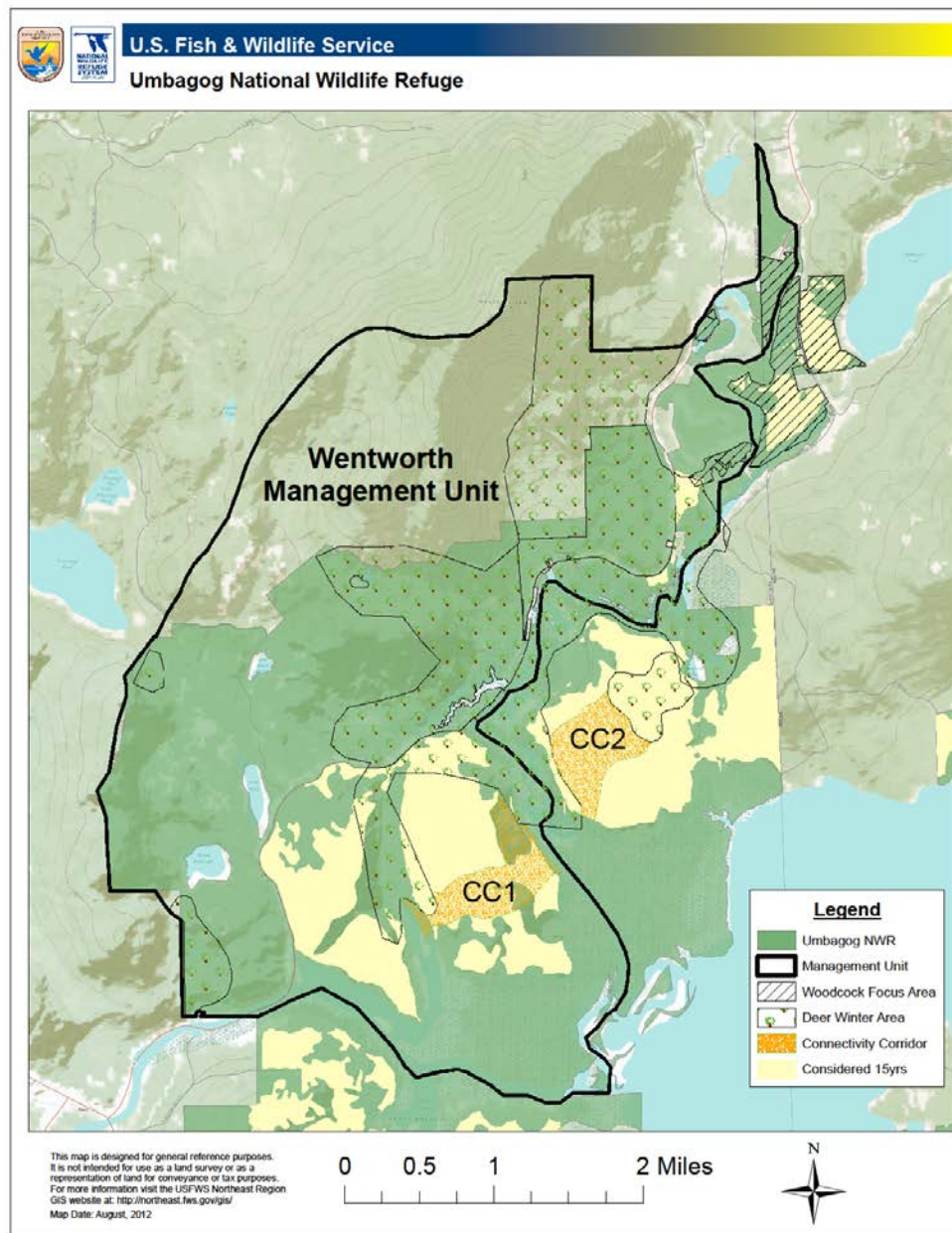
### **Forest Management**

- In treatment area SP1 implement even-age forest management utilizing clearcutting in nesting and brood-rearing habitat according to the harvest schedule outlined in the Sturtevant Pond woodcock management treatment area plan (Appendix D).
- In treatment area SP1 implement non-commercial habitat management in roosting and feeding habitat according to the Sturtevant Pond woodcock management treatment area plan (Appendix D).

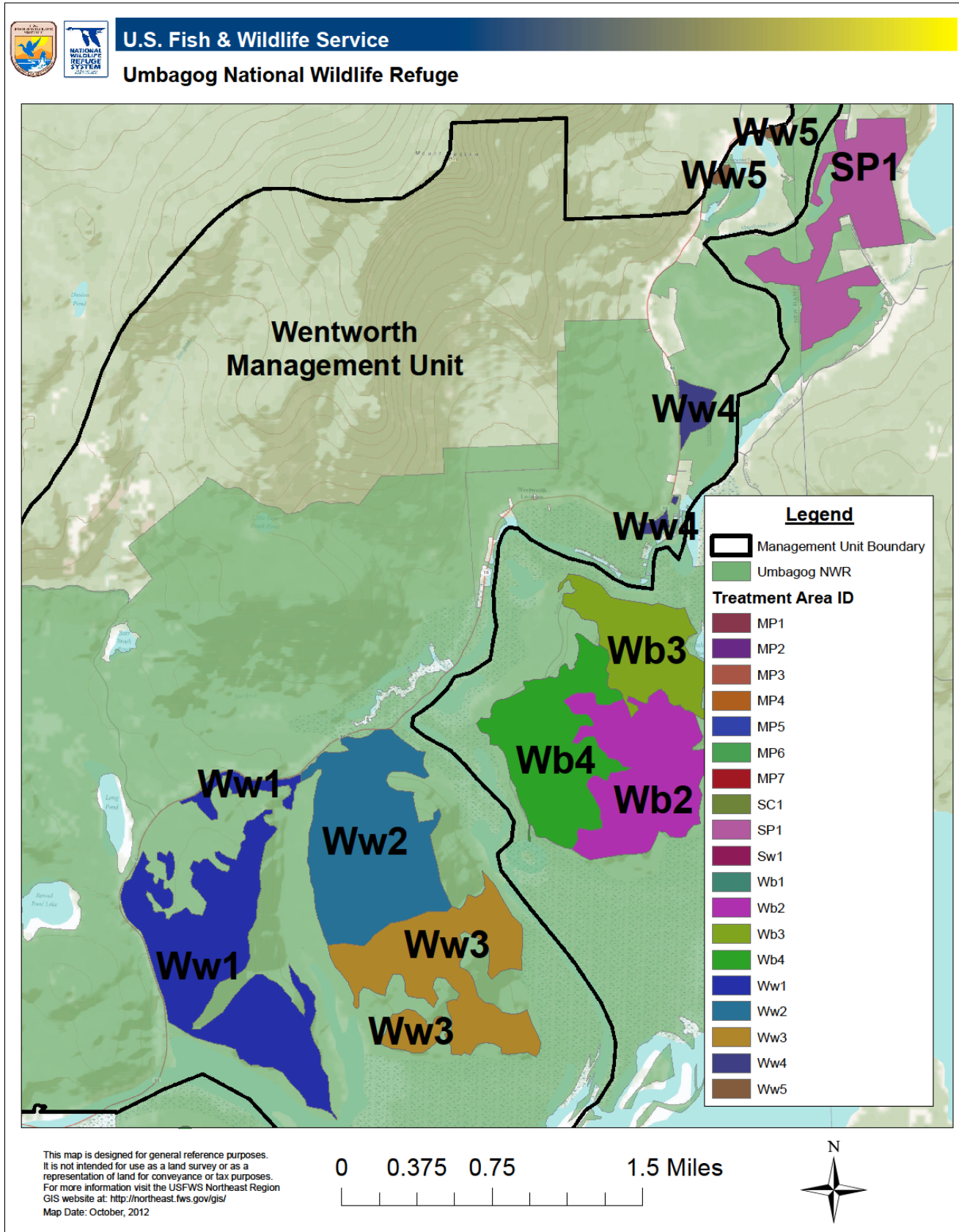
## **B. Wentworth Management Unit**

Approximately 6,437 acres of land in this management unit are fee-owned lands managed by the Refuge - 1,287 acres are within the special and general management zones, and 1,065 acres are uplands considered for forest management in the next 15 years (Map B-1). Inventory data is not available for 3,300 acres of recently acquired land, located to the north of NH Route 16. The majority of these lands are in the towns of Wentworth Location and Errol in Coos County, New Hampshire. Portions to the north extend into Maine in the town of Magalloway Plantation in Oxford County. NH Route 16 is the primary access for these lands. With the exception of a few satellite areas along Route 16, most of the uplands considered for forest management appear to have been managed for forest products at varying intensities. The satellite areas along Route 16 in the northern portion of the MU are grassy openings.

**Map B-1: Wentworth; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



## Map B-2: Wentworth (Ww); Treatment Area



### Management Considerations: Focal Species

- Black-throated green and Blackburnian warbler: Both of these species utilize mature forests with a conifer component. Blackburnian warbler favors conifer dominant forests. Treatment areas Ww1, Ww2, and WW3 are within a tract of land that is approximately 1,600 acres of contiguous forest. Forest management that promotes the habitat needs of these species is a priority in treatment areas Ww1, Ww2, and Ww3.
- American Woodcock: Approximately 8 acres of land within a **Woodcock Focus Area** (Umbagog CCP, sub-objective 3.1d) are included in the Sturtevant Pond woodcock management treatment plan (Map B-1). The 8 acres of land are along Route 16 in the northern portion of the MU and are identified as treatment area Ww5. Maintaining Ww5 in a condition suited for woodcock roosting compliments the woodcock management occurring to the east of the Magalloway River, and provides roosting habitat for woodcock utilizing naturally occurring habitat in the floodplain areas of the Magalloway River. The grassy openings included in the treatment plan do not include former camp lots where restoration of riparian habitat is the greater priority.

### Management Considerations: Priority Habitats and Forest Characteristics

- Site Capability: Approximately 1/2 of the land capable of supporting mixedwood forest types are dominated by a hardwood forest type. Nearly 1/2 of the land capable of supporting softwood forest types are dominated by mixedwood and in some locations hardwood forest types.
- High Conifer Mixedwood Habitats: Restoring and managing for high conifer mixedwood habitats in Ww1, Ww2, and Ww3 is a high priority
- Complex Forest Structure: Recorded forests with complex forest structure are absent. Treatment areas Ww1, Ww2, and Ww3 are within approximately 1,600 acres of contiguous forest owned by the Refuge. Forest management that promotes complex forest structure is a priority in treatment areas Ww1, Ww2, and Ww3.
- Deer Wintering Area: A portion of this MU is identified as an important deer wintering area (Map B-1). Suitable shelter and available woody browse are critical components of a wintering area. Use by wintering deer has historically been concentrated on the westerly side of Magalloway River and Route 16, but recent observations suggest the easterly side of the river and Route 16 is also important.
- Habitat Connectivity: A small band of soils supportive of mixedwood forests provides opportunities to foster a softwood dominated habitat connectivity corridor, expanding the local range of species and organisms that utilize deer wintering area habitats (Map B-1).
- Rare, Exemplary, and Unique plants and communities (REU): An imperiled Silver maple-false-nettle-sensitive fern floodplain forest (S2) plant community occurs along the Magalloway River. The Satin Willow (*Salix pellita*) is a critically imperiled plant (S1) that was present at one time along the banks of the Magalloway River, but is believed absent of this writing.

### Management Considerations: Other

- A medium level fen system, known as Harper's Meadow, is located in the eastern portion of the management unit where the Magalloway River enters Lake Umbagog. Associated with this fen are a variety of species and communities that are of conservation concern, including dwarf ragwort, osprey, northern harrier, and pied-billed grebe. A single known osprey nest is located

within the fen, but it is probable that there are more. Portions of this fen and associated riparian areas are within the boundary of the U.S. Park Service, Floating Island National Natural Landmark. It is imperative that the hydrology of this fen system not be altered by barriers, channels, ditches, or altered surface run-off. Of similar concern is an upstream extension of this fen, and the associated wetland that feeds into Harper's Meadow. The entire drainage supports vernal pools, and a rare (for the Refuge) cedar-spruce wetland community. Many boreal habitat specific birds have been observed using this wetland, and refuge biologists speculate it may be used by pine marten.

- A number of residences - some seasonal, some permanent - are located along NH route 16. Six of these buildings are owned and managed by the Refuge. The Refuge headquarters, "Carmen House", and "Stranger House" are scheduled for long-term use. Two other Refuge buildings located along the Magalloway River near Pond Brook Rd are scheduled for removal. There are no buildings in the treatment areas.
- Two gravel roads traveling southerly and easterly from NH Route 16 remain from forest management prior to Refuge acquisition. These gravel roads provide access to treatment areas Ww1 and Ww2. They are in poor condition, and will need improving if used for future management. The historic location of Route 16 ("old route 16") provides the greatest potential for access to treatment area Ww3. Road improvements run the risk of altering existing hydrology. To the extent possible, limit improvements that would raise the road beds or increase ditching and use of culverts. Increases in road length and/or landing locations will be limited.
- Invasive plant species are found mostly along NH Route 16. Species include phragmites, Japanese knotweed, bittersweet, and purple loosestrife. Purple loosestrife was found and pulled from road ditches and the Magalloway River trail. As of 2012 all known patch occurrences were chemically or mechanically treated. Eradication is anticipated within two years of this writing.
- Ridge tops in this unit are known to be good pine marten habitat, and fisher frequently utilize sloping hardwood habitats adjacent to ridge tops.
- The Magalloway River trail and observation platform is within the MU. A proposed expansion of this trail is being considered. This area is commonly referred to as the "day flats". An old dump site is found in this area. Also proposed for this area is a forest wetland restoration project. A large moose wallow in this area is used extensively for observation and recreation.
- Vernal pools have been documented in the riparian areas between route 16 and Magalloway River north of the Refuge headquarters, and in the vicinity of the Errol/Wentworth Location town line (South of the headquarters). Impacts from timber harvesting on the adjacent hydrology is a significant concern.
- Use of softwood habitat by Rusty blackbird was confirmed in the vicinity of Greenough Pond adjacent to Route 16 on both the east and west side of the road.
- On the Northwest side of Route 16 Long Pond and Round Pond have breeding loons, and there is at least 1 osprey nest in the area. Pine marten and bobcats have been documented along the ridge tops traveling toward Mt Dustin.



- In treatment area Ww1 consider implementing harvesting during the summer or fall seasons when the ground is not frozen but dry enough to support logging equipment with minimal risk of rutting. Softwood areas on well drained uplands in close proximity to NH Route 16 have much potential for harvesting during this time period.

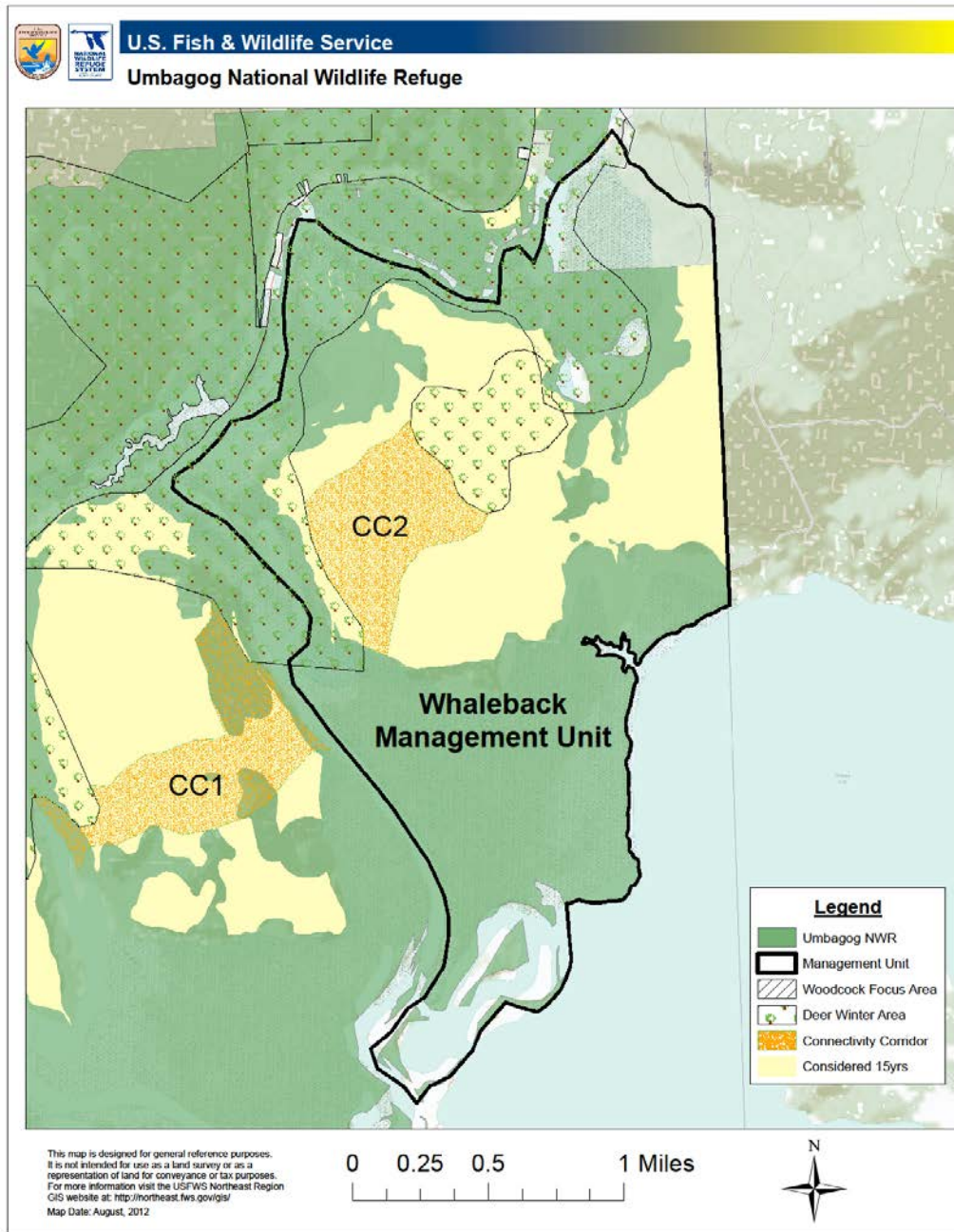
### **Forest Management**

- In treatment area Ww1, Ww2, and Ww3 utilize uneven-aged forest management, primarily single tree and group selection harvests following the hardwood, mixedwood, and softwood prescription guidelines. When warranted, introduce patch clearcuts approximately 1-2 acres in size in close proximity to deer winter shelter.
- In habitat connectivity corridor CC1 begin planting a mix of red spruce, white spruce, hemlock, and white pine in the understory, aggregated in groups that capitalize on current or potential canopy openings created through harvesting. In areas with adequate softwood regeneration and non-merchantable competing hardwood species, utilize habitat improvement techniques (e.g. timber stand improvement (TSI)) to release desired regeneration.
- In treatment area Ww4 utilize uneven-aged forest management, primarily single tree and group selection harvests following the softwood prescription guidelines with emphasis on removing tamarack and competing hardwood species. Use low-impact harvesting methods such as horse-logging, small mechanical equipment, or non-commercial techniques such as girdling and felling.
- In treatment area Ww5 implement non-commercial habitat management in roosting and feeding habitat according to Sturtevant Pond woodcock management treatment area plan (Appendix D).

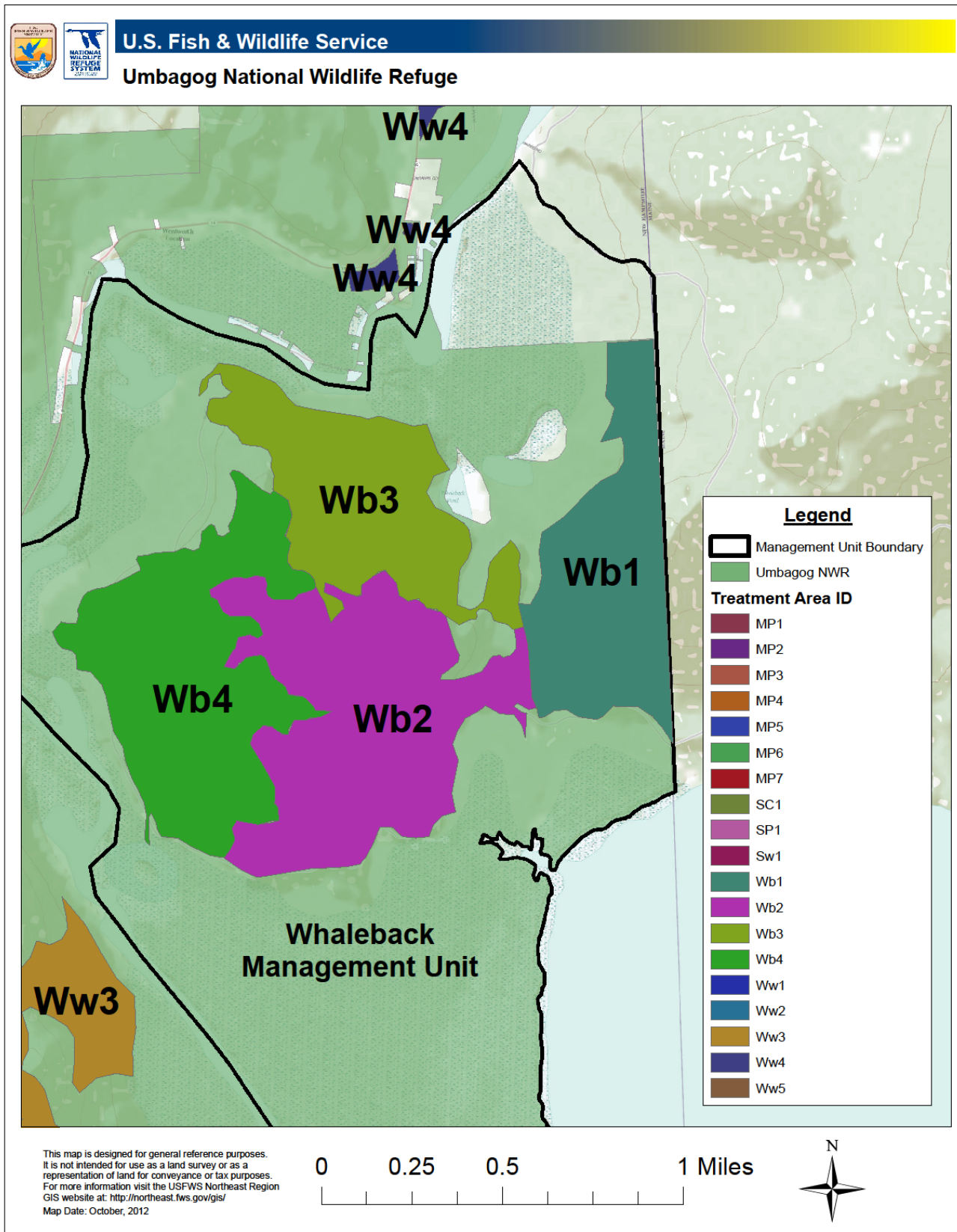
### **C. Whaleback Management Unit**

Approximately 2,137 acres of land in this management unit are fee-owned lands managed by Refuge - 938 acres are within the special and general management zones, and 864 acres are uplands considered for forest management in the next 15 years (Map C-1). The majority of these lands are in the town of Errol in Coos County, New Hampshire. Portions to the north extend into the town of Wentworth Location also in in Coos County. Access to this MU is from Pond Brook Rd in Magalloway Plantation, Maine, following onto a road referred to as the “Burke” road and continuing onto an unnamed gravel road. Most of the uplands considered for forest management appear to have been managed for forest products at varying intensities.

**Map C-1: Whaleback; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



Map C-2: Whaleback (Wb); Treatment Area



### **Management Considerations: Focal Species**

- Black-throated green and Blackburnian warbler: Both of these species utilize mature forests with a conifer component. Blackburnian warbler favors conifer dominant forests. All of the treatment areas are within a tract of land that has approximately 1,100 acres of contiguous forest. Forest management that promotes the habitat needs of these species is a priority in treatment areas Wb1, Wb2, and Wb4.

### **Management Considerations: Priority Habitats and Forest Characteristics**

- Site Capability: Approximately 1/3 of the land capable of supporting mixedwood forest types are dominated by a hardwood forest type. Nearly 1/2 of the land capable of supporting softwood forest types are dominated by mixedwood and in some locations hardwood forest types.
- High Conifer Mixedwood Habitats: Restoring and managing for high conifer mixedwood habitats in Wb1, Wb2, and Wb4 is a high priority
- Complex Forest Structure: Recorded forests with complex forest structure are absent. All of the treatment areas are within approximately 1,100 acres of contiguous forest owned by the Refuge. Forest management that promotes complex forest structure is a priority in Wb1, Wb2, Wb3, and Wb4.
- Deer Wintering Area: A portion of this MU is identified as an important deer wintering area (Map C-1). Suitable shelter and available woody browse are critical components of a wintering area. Most of the deer wintering area is within the restricted management zone, although an area of approximately 124 acres are within the upland area considered for forest management.
- Habitat Connectivity: A band of soils supportive of mixedwood forests provides opportunities to foster a softwood dominated habitat connectivity corridor, expanding the local range of species and organisms that utilize deer wintering area habitats (Map C-1).
- Rare, Exemplary, and Unique plants and communities (REU): The Satin Willow (*Salix pellita*) is a critically imperiled plant (S1) that was present at one time along the banks of the Magalloway River, but is believed absent of this writing. A large acidic northern white cedar swamp (S1) is located north of the Whaleback Ponds, most of it not owned by the Refuge. The northern white cedar swamp is the largest that occurs in New Hampshire (Rapp 2003).

### **Management Considerations: Other**

- A medium level fen system, known as Leonard Marsh, is in the south of the management unit where the Magalloway River enters Lake Umbagog. Associated with this fen are a variety of species and plant communities that are of conservation concern including dwarf ragwort, osprey, northern harrier, and pied-billed grebe. A single bald eagle nest, reportedly an old nest site not currently being used, is located at the very southern tip of the fen, in the vicinity of Leonard Pond. A small portion of this fen and associated riparian areas are within the boundary of the U.S. Park Service, Floating Island National Natural Landmark. Another fen and bog community lies adjacent to the southern shoreline of the Whaleback Pond (eastern pond of the two ponds).
- A high terrace community dominated by spruce, hemlock, and white pine is located along the east bank of the Magalloway River just south of the oxbow pond across the river from the Refuge headquarters.

- One private owned building on a lot leased from the USFWS, is along the Magalloway River in close proximity to the poor level fen. Occupants are allowed access throughout the year.
- Two campsites (R28 and R29) are in the vicinity of Leonard Pond and along the shore of Lake Umbagog. Campsites are managed by the NH Department of Resource and Economic Development, Division of Parks and Recreation. These campsites are not within the lands considered for forest management and can be accessed by water.
- The gravel road that provides access to this area of the Refuge is in fair condition and ends at a gravel pit located on the Refuge. The gravel pit suffices for a log landing, but is more than a mile from the western extent of the MU. A winter road, extending north and south from the gravel pit encompasses near the entire perimeter of the MU. The road remains from forest management prior to Refuge acquisition. It is in poor condition, and will need improving if used for future management. Road improvements run the risk of altering existing hydrology. To the extent possible, limit improvements that would raise the road beds or increase ditching and use of culverts. Increases in road length and/or landing locations will be limited.
- Between Whaleback Pond and Leonard Marsh is an esker that is geologically unique.
- A dog sled trail and winter camp site permitted by Special Use Permit is within this management unit.
- Red spruce occurring on the mountain top is noted to be on “thin” perhaps low productivity soils.
- A 3-toed woodpecker was reported in the vicinity of the “Whalebacks”.
- Several osprey nests are in the vicinity of Leonard Marsh and around Whaleback Ponds.
- Pine Martins occur and have been detected at baited camera stations.
- Lynx tracks have been reported but have not been confirmed.
- Southern bog lemmings occur, and potentially northern bog lemmings (NH species of concern).
- Rock cliffs and talus slopes are potential habitat for rock voles and small-footed bats, which are species of concern.
- Loss of sensitive species and impacts to the integrity of adjacent wetlands is a significant concern in the entire valley between the two Whaleback Ponds (including hillsides facing the ponds).

## **Forest Management**

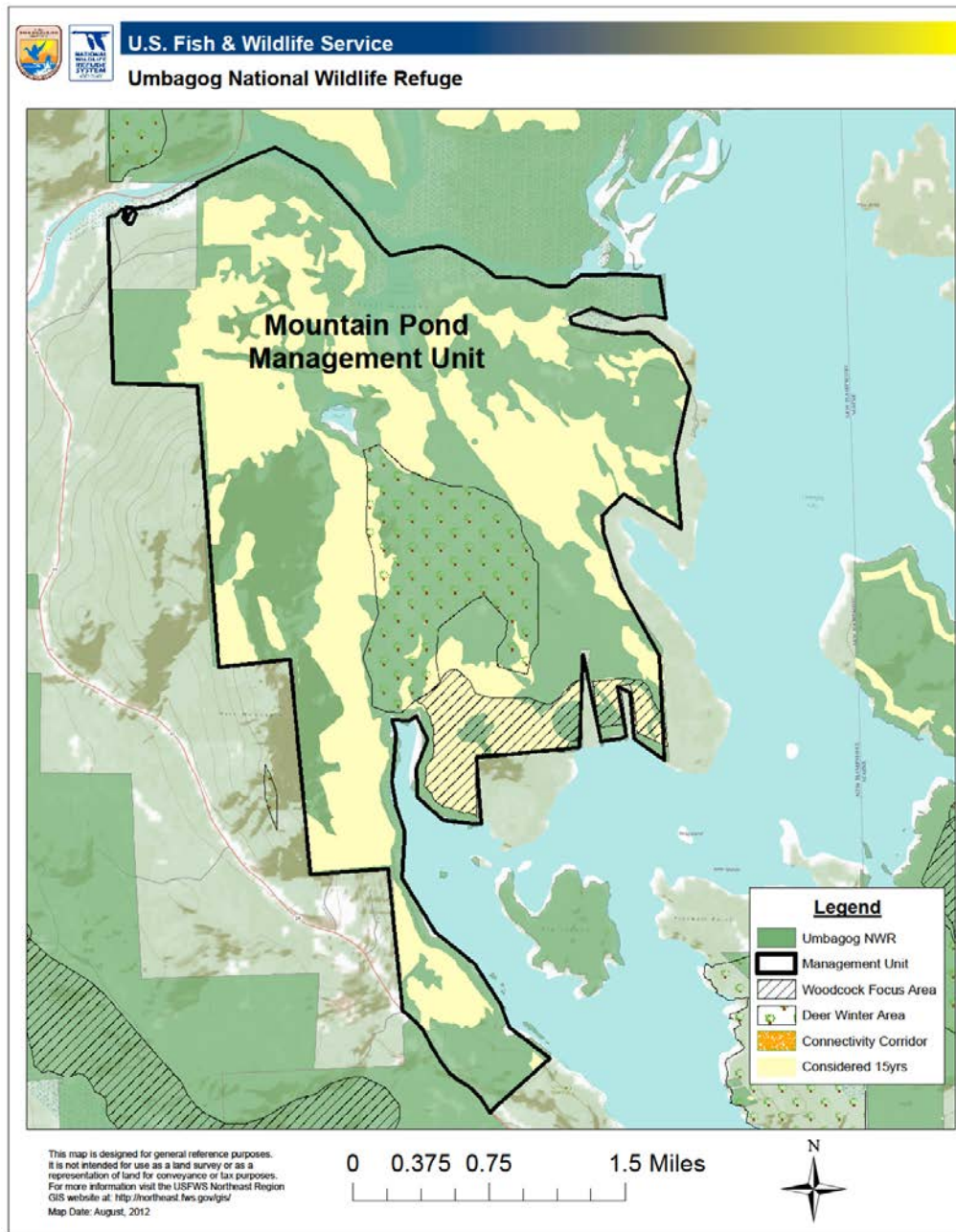
- In treatment area Wb1, Wb2, Wb4 utilize uneven-aged forest management, primarily single tree and group selection harvests following the hardwood, mixedwood, and softwood prescription guidelines. When warranted, introduce patch clearcuts approximately 1-2 acres in size in close proximity to deer winter shelter.
- In habitat connectivity corridor CC2 begin planting a mix of red spruce, white spruce, hemlock, and white pine in the understory, aggregated in groups that capitalize on current or potential canopy openings created through harvesting. In areas with adequate softwood regeneration and non-merchantable competing hardwood species, utilize habitat improvement techniques (e.g. timber stand improvement (TSI)) to release desired regeneration.
- In treatment area Wb3, do not conduct forest management in the next 15 years, with the intent of passive management in the foreseeable future.



## D. Mountain Pond Management Unit

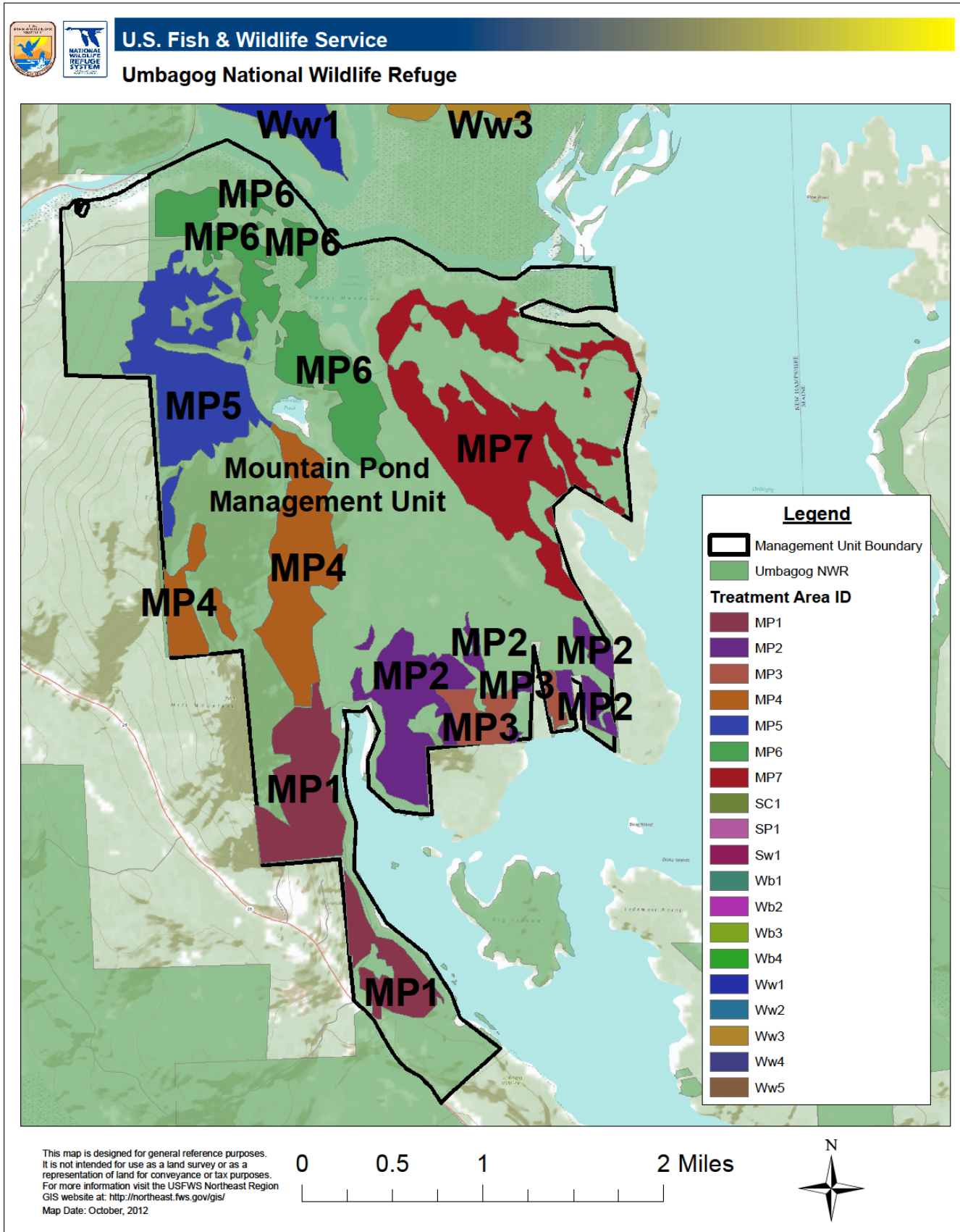
Approximately 4,968 acres of land in this management unit are fee-owned lands managed by the Refuge - 3,126 acres are within the special and general management zones, and 2,045 acres are uplands considered for forest management in the next 15 years (Map D-1). All of these lands are in the town of Errol in Coos County, New Hampshire. Access to this MU is from NH Route 26. North Mountain Road provides access to the northern areas of the MU, and Mountain Pond Rd provides access to the southern areas. Most of the uplands considered for forest management appear to have been managed for forest products at varying intensities.

**Map D-1: Mountain Pond; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**





**Map D-2: Mountain Pond (MP); Treatment Area**



### Management Considerations: Focal Species

- Black-throated green and Blackburnian warbler: Both of these species utilize mature forests with a conifer component. Blackburnian warbler favors conifer dominant forests. All of the treatment areas are within a tract of land that has approximately 4,500 acres of contiguous forest. Forest management that promotes the habitat needs of these species is a priority in treatment areas Mp1, Mp2, Mp6, and Mp7.
- Canada Warbler: Investigate opportunities to manage for Canada warbler in the Woodcock Focus Area. Consider managing areas primarily for Canada warbler as well as incorporating Canada warbler management into areas managed primarily for woodcock (woodcock treatment area plans). These techniques will need to be evaluated through research and monitoring.
- American Woodcock: Approximately 250 acres of land are within a **Woodcock Focus Area** (Umbagog CCP, sub-objective 3.1d) (Map D-1). A preliminary assessment indicates approximately 125 acres (1/2) of the woodcock focus area is best suited for woodcock management. Approximately 70 acres of land within the Woodcock Focus Area is included in the Potter Farm woodcock management area treatment plan (Appendix E).

### Management Considerations: Priority Habitats and Forest Characteristics

- Site Capability: Approximately 1/5 of the land capable of supporting mixedwood forest types are dominated by a hardwood forest type. The majority of softwood sites are within the restricted management zone but small patches are within hardwood and mixedwood types. These should be managed as softwood inclusions. Approximately 150 acres of land suited for softwood types are within general and special management areas 1/2 of which is dominated by mixedwood forest types.
- High Conifer Mixedwood Habitats: Restoring and managing for high conifer mixedwood habitats in MP1, MP2, MP4, MP5, MP6, and MP7 is a high priority
- Complex Forest Structure: Several softwood stands exhibit some of the traits of a complex forest structure, such as relatively large diameter trees (especially white pine, red spruce, or hemlock) and large diameter snags and down rotten logs. Islands of late-successional lowland spruce-fir communities are within the Mountain Pond wetland complex (Publicover, Bryce, et al; 1997). All of the treatment areas are within approximately 4,500 acres of contiguous forest owned by the Refuge. Forest management that promotes complex forest structure is a priority in treatment areas Mp1, Mp2, Mp4, Mp5, Mp6, and Mp7.
- Deer Wintering Area: A portion of this MU is identified as an important deer wintering area. The majority is centered on a large wetland complex associated with the drainage from Mountain Pond (Map D-1). Suitable shelter and available woody browse are critical components of a wintering area. Most of the deer wintering area is within the restricted management zone, although approximately 125 acres are within the upland area considered for forest management.
- Rare, Exemplary, and Unique plants and communities (REU): An imperiled Northern hardwood – black ash-conifer swamp (S2) plant community occurs just north and adjacent to Mountain Pond. Also associated with the same wetland complex is a Northern White Cedar Acidic Seepage Swamp (S3). Mountain Pond drains into and through a large wetland complex that is known to be utilized by osprey. An imperiled Northern white cedar-balsam fir swamp (S2) and vulnerable Lowland spruce-fir forest (s3) are located near where the Mountain Pond drainage enters the

wetland complex. These areas contain some of the oldest trees on the Refuge (Publicover, Bryce, et al; 1997). The imperiled species Dwarf Ragwort (S2) is located in another large wetland complex located in the northeast portion of the MU near “Eames Camp”. Osprey have been sighted in numerous locations associated with these two wetlands as well as along the banks of the Magalloway River and Lake Umbagog. This area is also known to contain Great Blue Heron nest sites.

### **Management Considerations: Other**

- The largest area of lowland spruce-fir on the refuge is found in the Mountain Pond area, and includes some patches of mature spruce-fir. This area of spruce-fir is in close proximity to the Mountain Pond wetland complex, which includes cedar swamps and black spruce bogs (Rapp, 2003). Three buildings owned and managed by the Refuge are in the southern portion of the MU. One of the buildings is the Refuge maintenance facility, another is “McClure house”, and the last is the “Potter Farm”, all of which are accessed from Mountain Pond Rd, and the later from continuing on to Potter Farm Rd. A number of buildings along the western shore of Lake Umbagog, in an area known as Thurston Cove, are privately owned buildings on land leased from the USFWS.
- One permitted campsite (R11) on land owned by the State of New Hampshire is located along the shore of Lake Umbagog in the southern portion of the MU, and in close proximity to the woodcock focus area. This campsite is more than 350 feet from the boundary of the woodcock focus area. Permitting and use of the campsites are managed by the NH Department of Resource and Economic Development, Division of Parks and Recreation.
- Two roads provide access to this area of the Refuge – North Mountain Road leading to Eames Road, and Mountain Pond Road leading to Potter Farm Road. These roads are gravel surfaced and in fair condition. Another gravel road known as Middle Mountain Pond Road connects these roads and was likely used for winter access prior to Refuge acquisition. This road provides access to the central region of the MU, is in poor condition, and is part of the network of connecting snowmobile trails.
- Snowmobile trails are along the Middle Mountain Pond Road , are allowed on the Mountain Pond Road and most of Potter Farm Road, and cross through the Woodcock Focus Area. An alternate snowmobile trail is proposed parallel to Mountain Pond Rd and Potter Farm Rd to provide access to the Potter Farm in the future. The snowmobile trail crosses through Mp1 and Mp5. The snowmobile trail provides access to the regional trail network. Arrangements will need to be made for alternate connectivity, or care to not impede snowmobile traffic during forest management operations.
- North Mountain Pond Rd, Middle Mountain Pond Rd, and Mountain Pond Rd are part of a multiple use trail network. A series of interpretive trails are proposed in the vicinity of the Potter Farm.
- Coordinate the forest management in the Potter Farm woodcock management treatment area (Mp3) with forest management in other treatment areas to make the harvests economically viable.
- Consult with the State of New Hampshire Department of Resource and Economic Development to explore opportunities to partner and coordinate management goals and implementation where Refuge-owned land and State-owned land are adjacent.

- Portions of Mp2 in the vicinity of the Potter Farm have site characteristics conducive to harvesting during the summer or fall growing season, when conditions warrant.
- The State of New Hampshire owns an easement on much of the land in this MU.

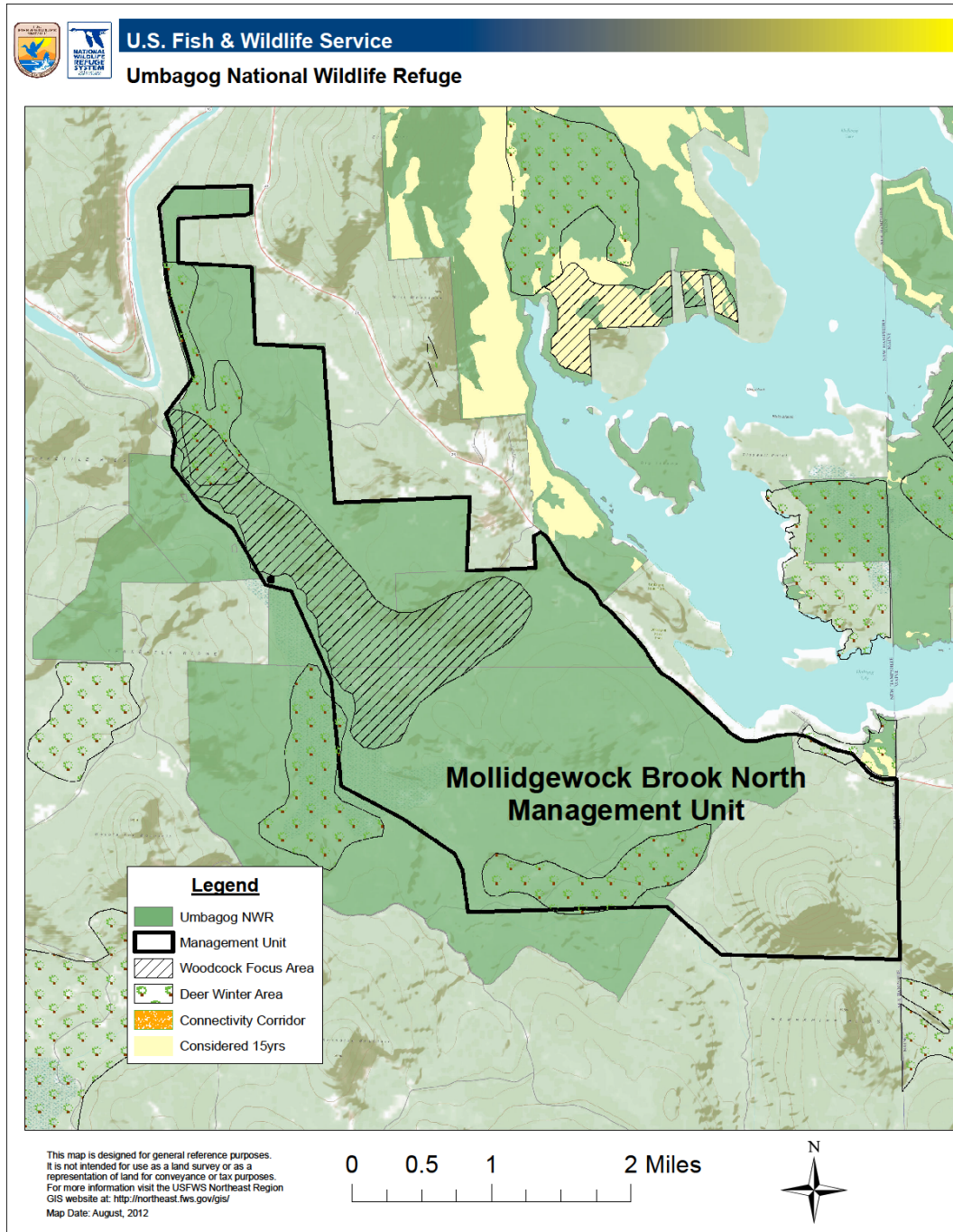
### **Forest Management**

- In treatment area MP1, MP2, MP4, MP5, MP6, and MP7 utilize uneven-aged forest management techniques, primarily single tree and group selection harvests following the hardwood, mixedwood, and softwood prescription guidelines. When warranted, introduce patch clearcuts approximately 1-2 acres in size in close proximity to deer winter shelter.
- In treatment area MP3 implement even-age forest management utilizing clearcutting in nesting and brood-rearing habitat according to the harvest schedule outlined in the Potter Farm woodcock management treatment area plan (Appendix E).
- In treatment area MP3 implement non-commercial habitat management in roosting and feeding habitat according to the Potter Farm woodcock management treatment area plan (Appendix E).

## E. Mollidgewock Brook North Management Unit

Approximately 5,347 acres of land in this management unit are fee-owned lands managed by the Refuge. These lands were acquired after the CCP was completed in 2009, and do not have inventory data for forest management planning. These lands will be evaluated when data is available. Reportedly, much of the commercial timber was removed prior to the recent acquisition by the USFWS.

**Map E-1: Mollidgewock Brook North; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



### **Management Considerations: Focal Species**

- Black-throated green and Blackburnian warbler: Both of these species utilize mature forests with a conifer component. Blackburnian warbler favors conifer dominant forests. Approximately 4,275 acres of contiguous forest are not within the Woodcock Focus Area. Forest management that promotes the habitat needs of these species is a priority for lands not included in the Woodcock Focus Area.
- Canada Warbler: Investigate opportunities to manage for Canada warbler in the Woodcock Focus Area. Consider managing areas primarily for Canada warbler as well as incorporating Canada warbler management into areas managed primarily for woodcock (woodcock treatment area plans). These techniques will need to be evaluated through research and monitoring.
- American Woodcock: Approximately 1,072 acres of land are within a **Woodcock Focus Area** (Umbagog CCP, sub-objective 3.1d) (Map D-1).

### **Management Considerations: Priority Habitats and Forest Characteristics**

- Complex Forest Structure: Recorded forests with complex forest structure are absent. Approximately 4,275 acres of contiguous forest are owned by the Refuge and not within the Woodcock Focus Area. Forest management that promotes complex forest structure is a priority for lands not included in the Woodcock Focus Area.
- High Conifer Mixedwood Habitats: Restoring and managing for high conifer mixedwood habitats is a high priority
- Deer Wintering Area: A portion of this MU is identified as an important deer wintering area. Suitable shelter and available woody browse are critical components of a wintering area. Some of the deer wintering area overlaps with the Woodcock Focus Area. The sloping topography with south and south west aspects within the DWA provide excellent conditions for wintering deer. This is one of the more valued DWA on the Refuge although reportedly much of the DWA was recently harvested. In harvested areas softwood regeneration is prevalent.

### **Management Considerations: Other**

- A recent study found a high density of successfully nesting and breeding Rusty Blackbirds. Continued research and providing suitable Rusty Blackbird habitat is a significant interest in this MU. Evaluate opportunities to incorporate Rusty Blackbird management in softwood dominant areas in WFA.
- Unconfirmed Lynx tracks have been reported in this area

### **Forest Management**

- Where best suited for woodcock management within the Woodcock Focus Area, include all height classes in area regulation and schedule 8-10 year harvest intervals to create and maintain 4 forest age classes with approximately 5 acre patch sizes and 40 year rotations. Where possible, focus initial harvests on areas with aspen that are mature and at risk of declining in population and/or vigor.

## **F. Mollidgewock Brook South Management Unit**

Approximately 2,489 acres of land in this management unit are fee-owned and managed by the Refuge. These lands were acquired after the CCP was completed in 2009, and do not have inventory data for forest management planning. These lands will be evaluated when data is available.

### **Management Considerations: Focal Species**

Insufficient information at this time

### **Management Considerations: Priority Habitats and Forest Characteristics**

Insufficient information at this time

### **Management Considerations: Other**

- Conditions favored by Rusty Blackbird are reportedly within this MU and further evaluation and research of Rusty Blackbirds is of significant interest in this MU.
- Unconfirmed Lynx tracks have been reported in this area

### **Forest Management**

Insufficient information at this time



## **G. Mollidgewock Pond Management Unit**

The USFWS does not own land or easements within this MU.

### **Management Considerations: Focal Species**

Insufficient information at this time

### **Management Considerations: Priority Habitats and Forest Characteristics**

Insufficient information at this time

### **Management Considerations: Other**

Insufficient information at this time

### **Forest Management**

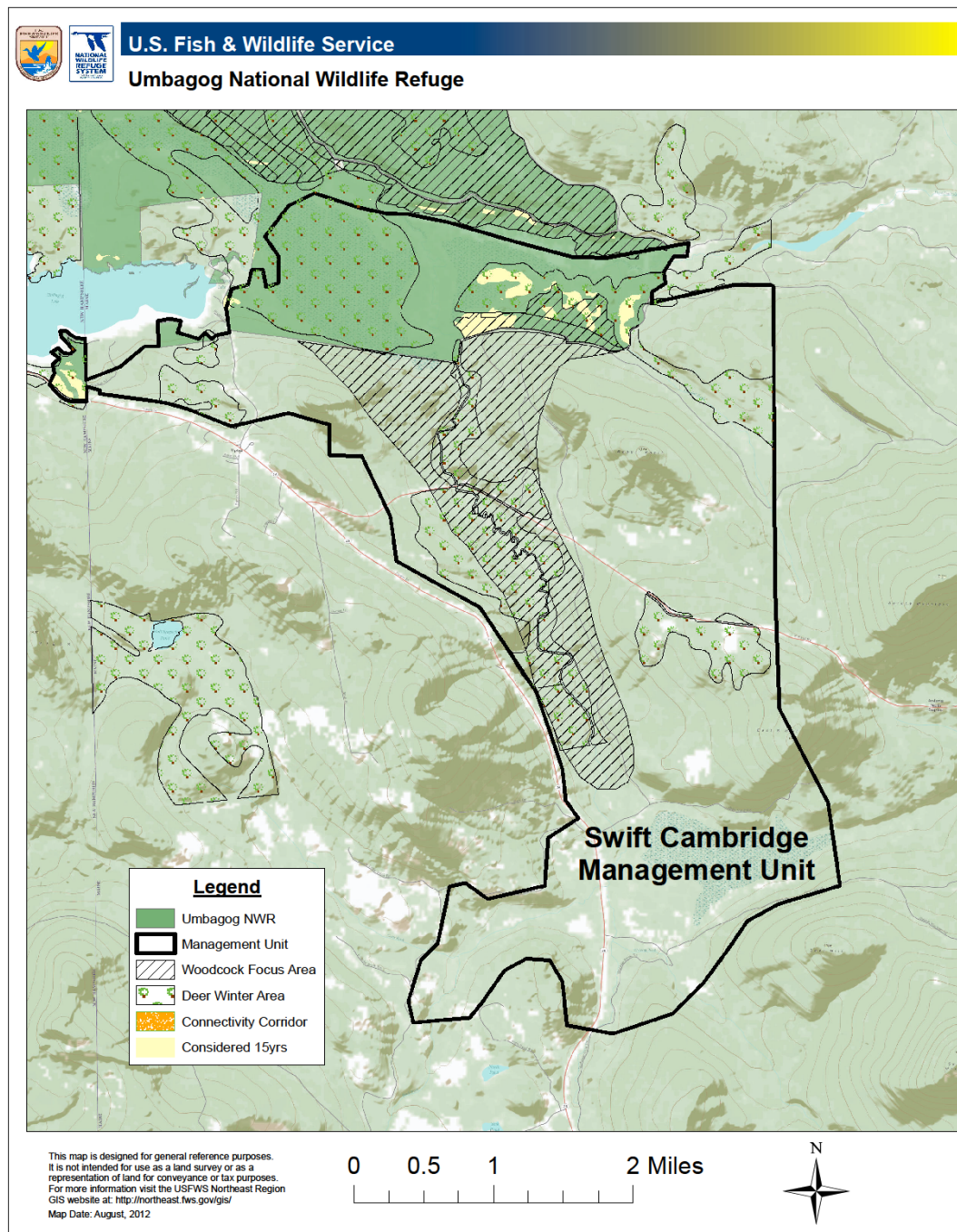
Insufficient information at this time

## H. Swift Cambridge Management Unit

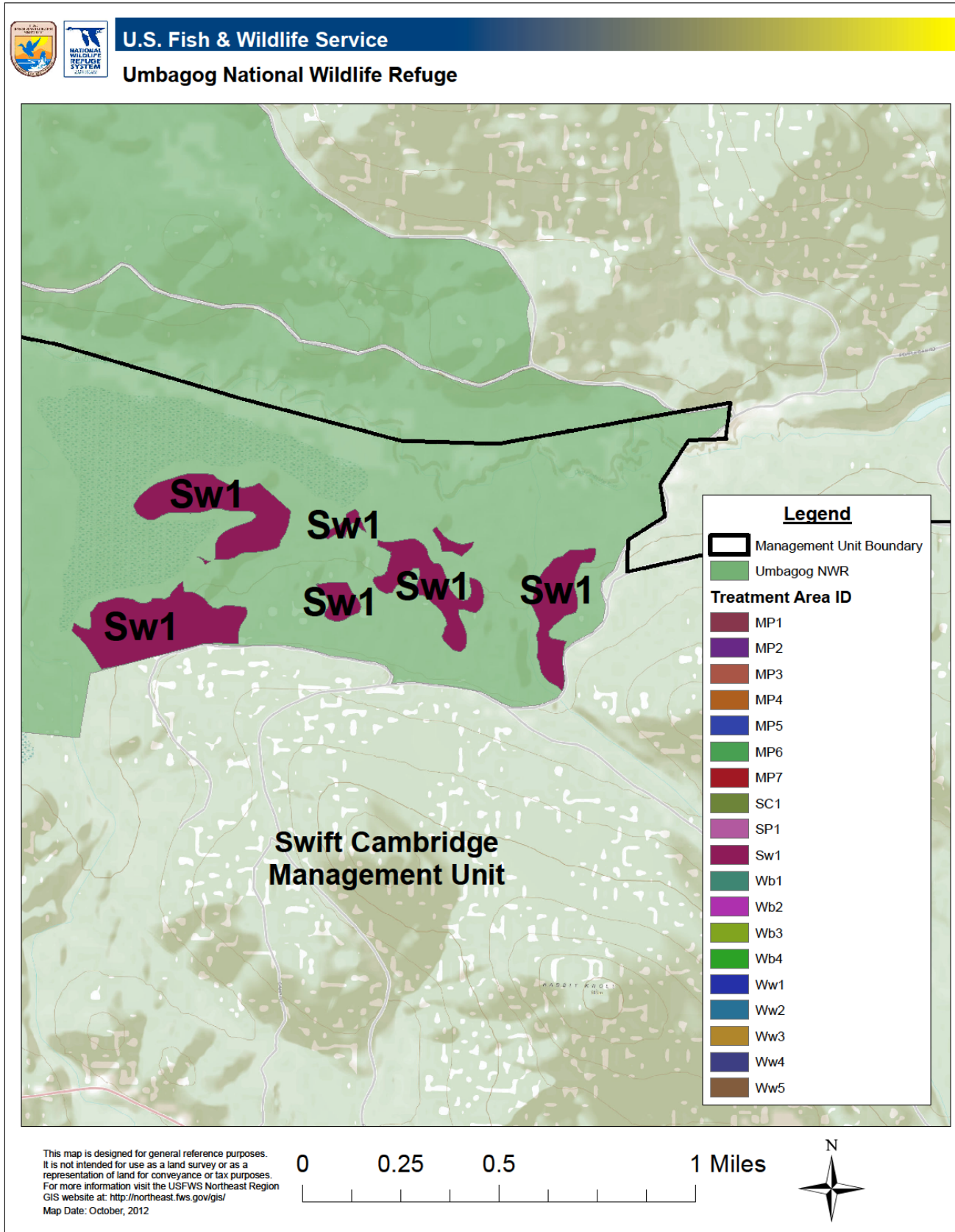
Approximately 1,582 acres of land in this management unit are fee-owned lands managed by the Refuge - 312 acres are within the special and general management zones, and 125 acres are uplands considered for forest management in the next 15 years (Map H-1). The majority of these lands are in the town of Upton in Oxford County, Maine, although some are within Cambridge in Coos County, New Hampshire.

Access to this MU is from ME Route 26. Mill Road provides access to the western areas the MU, and East B Hill Road to Lakeside Road provides access to eastern areas. Most of the uplands considered for forest management appear to have been managed for forest products at varying intensities.

**Map H-1: Swift Cambridge; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



## Map H-2: Swift Cambridge (Sw); Treatment Area



### Management Considerations: Focal Species

- Canada Warbler: Investigate opportunities to manage for Canada warbler in the Woodcock Focus Area. Consider managing areas primarily for Canada warbler as well as incorporating Canada warbler management into areas managed primarily for woodcock (woodcock treatment area plans). These techniques will need to be evaluated through research and monitoring.
- American Woodcock: Approximately 150 acres of land are within a **Woodcock Focus Area** (WFA) (Umbagog CCP, sub-objective 3.1d) (Map H-1). Much of this land is well suited for softwood species. A competing interest is managing for suitable shelter within the Deer Wintering Area (DWA). Further evaluate WFA for opportunities to manage for woodcock but do not compromise the integrity of the DWA.

### Management Considerations: Priority Habitats and Forest Characteristics

- Site Capability: Overall, no significant discrepancies are reported between the site capability and the dominant forest type, although in a few instances, adjacent forest types encroach on sites suited for a different forest type.
- Deer Wintering Area: A large portion of this MU is identified as an important deer wintering area (Map H-1). Suitable shelter and available woody browse are critical components of a wintering area. Most of the deer wintering area is within the restricted management zone, although approximately 130 acres of small scattered parcels are within the uplands considered for forest management. Some of the deer wintering area overlaps with the Woodcock Focus Area. Maine Department of Inland Fisheries and Wildlife deer wintering area records indicate DWA's in this vicinity of the refuge are highly valued for wintering deer (per communication with Charles Hulse MDIFW). Although separated by wetlands, connectivity of DWA's should be evaluated to determine management options.
- Rare, Exemplary, and Unique plants and communities (REU): The Satin Willow (*Salix pellita*) is a critically imperiled plant (S1) that was present at one time in the vicinity of the "Southeast Arm" of Lake Umbagog, but is believed absent of this writing.

### Management Considerations: Other

- Two roads provide access to this area of the Refuge. Mill Road is a town maintained paved road. Lakeside Road is private, not typically maintained in the winter, and is in fair condition. The USFWS has legal rights-of-way to utilize Lakeside Road to access to the Refuge.
- Snowmobile trails cross the Refuge for short distances at two locations in the western portion of the MU. A snowmobile trail follows an existing gravel road directly adjacent to the eastern perimeter of the MU.

### Forest Management

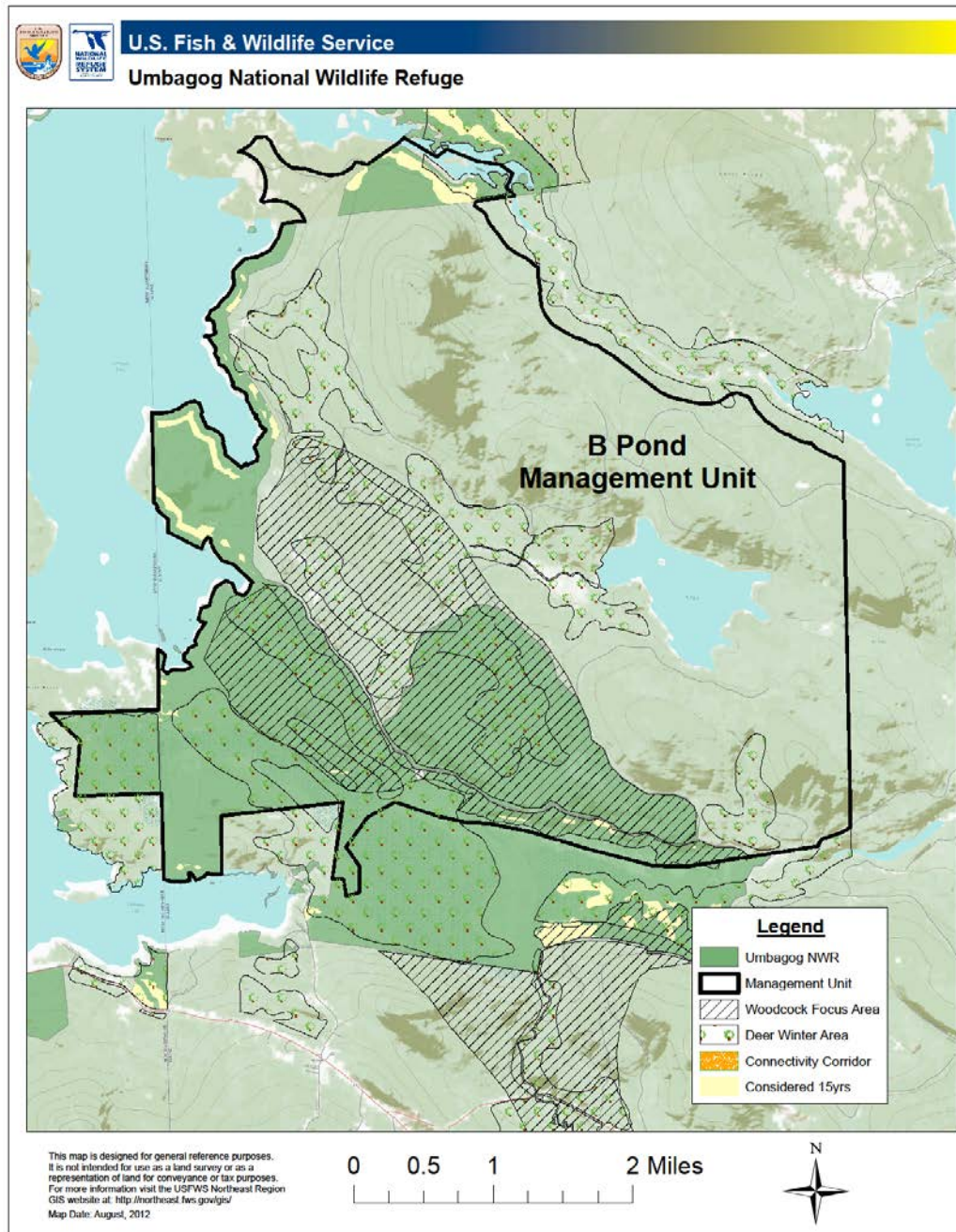
- In treatment area Sw1 utilize uneven-aged forest management techniques, primarily single tree and group selection harvests following the hardwood, mixedwood, and softwood prescription guidelines. When warranted, introduce patch clearcuts approximately 1-2 acres in size in close proximity to deer winter shelter.
- In areas not included in treatment area Sw1, delay forest management until additional lands in the vicinity are ready for harvest.



## **I. B Pond Management Unit**

Approximately 3,964 acres of land in this management unit are fee-owned and managed by the Refuge - 667 acres are within the special and general management zones, and 131 acres are uplands considered for forest management in the next 15 years (Map I-1) Inventory data is not available for 1,960 acres of recently acquired land. The majority of these lands are in the town of Upton in Oxford County, Maine. Portions to the north extend into the town of Magalloway Plantation also in Oxford County. Portions to the west extend into New Hampshire, in the town of Errol in Coos County. Access to this MU is from ME Route 26 and East B Hill Road to Lakeside Road to River Road. Most of the uplands considered for forest management appear to have been managed for forest products at varying intensities.

**Map I-1: B-Pond; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors**



### Management Considerations: Focal Species

- Canada Warbler: Investigate opportunities to manage for Canada warbler in the Woodcock Focus Area. Consider managing areas primarily for Canada warbler as well as incorporating Canada warbler management into areas managed primarily for woodcock (woodcock treatment area plans). These techniques will need to be evaluated through research and monitoring.
- American Woodcock: Approximately 900 acres of land are within a **Woodcock Focus Area** (WFA)(Umbagog CCP, sub-objective 3.1d) (Map I-1). The majority of this land does not have inventory data at the time of this writing. This WFA is a high priority for treatment planning and design largely because continued vigor and presence of existing aspen stands is a concern. Also this is a primary WFA considered for complimentary Rusty Blackbird habitat management on softwood dominant sites.

### Management Considerations: Priority Habitats and Forest Characteristics

- Site Capability: Overall no significant discrepancies are reported between the site capability and the dominant forest type. In a few instances adjacent hardwood forest types encroach on sites suited for mixedwood forest types.
- Complex Forest Structure: Several softwood stands exhibit some of the traits of a complex forest structure, such as relatively large diameter trees (especially white pine, red spruce, or hemlock) and large diameter snags and down rotten logs. Islands of late-successional lowland spruce-fir communities are within the Tidswell Point wetland complex (Publicover, Bryce, et al, 1997; Rapp, 2003). This MU contains large tracts of contiguous forest. Forest management that promotes complex forest structure is a priority in areas not included in a woodcock management treatment plan.
- Deer Wintering Area: A large portion of this MU is identified as an important deer wintering area (Map I-1). Suitable shelter and available woody browse are critical components of a wintering area. Most of the deer wintering area is within the restricted management zone and on lands that do not have inventory data at the time of this writing. Some of the deer wintering area overlaps with the Woodcock Focus Area.
- Rare, Exemplary, and Unique plants and communities (REU): An imperiled shrubby cinquefoil – sedge circumneutral fen (S2) plant community occurs along the Maine/New Hampshire border in the south western area of the MU. Also associated with the same wetland complex is the Creeping Sedge (*Carex chordorrhiza*) (S1) and the Moor Rush (*Juncus stygius var americanus*) (S1). The Satin Willow (*Salix pellita*) is a critically imperiled plant (S1) that was present at one time in the vicinity of the “Southeast Arm” of Lake Umbagog, but is believed absent of this writing.

### Management Considerations: Other

- Three campsites (R21, R22, R23) are in the vicinity of Tyler Cove and along the shore of Lake Umbagog. Campsites are managed by the NH Department of Resource and Economic Development, Division of Parks and Recreation. These campsites are not within the lands considered for forest management and can be accessed by water.
- A gravel road connected to an array of additional gravel roads provides access to this area of the Refuge. All of these roads, including Lakeside Road are private, not typically maintained in the winter, and are in fair condition. The USFWS has legal rights-of-way to utilize these roads to access the Refuge.



- Many of the gravel roads are snowmobile trails in the winter.
- There are three known eagle nest locations. The nests on Tidswell Point and Pine Point are being utilized. The other has historic usage.
- Lynx tracks were confirmed but there are no indications of breeding or an established population. This area and perhaps portions of Sunday Cove MU are thought to have the most opportunity to manage for Lynx on the refuge. Privately owned land adjacent to this area appears to provide additional and more abundant habitat for Lynx.
- The Rapid River is popular for kayaking. There is a lot of activity and use by kayakers especially at launch and take-out sites and during times when water is released from the dam creating “white water”.
- An unknown amount of osprey nests are located along Rapid River and B Pond.
- This area is considered to be a premier location for Rusty Blackbird utilization and of particular interest for managing habitat for them. Evaluate opportunities to incorporate Rusty Blackbird management in softwood dominant areas in WFA.

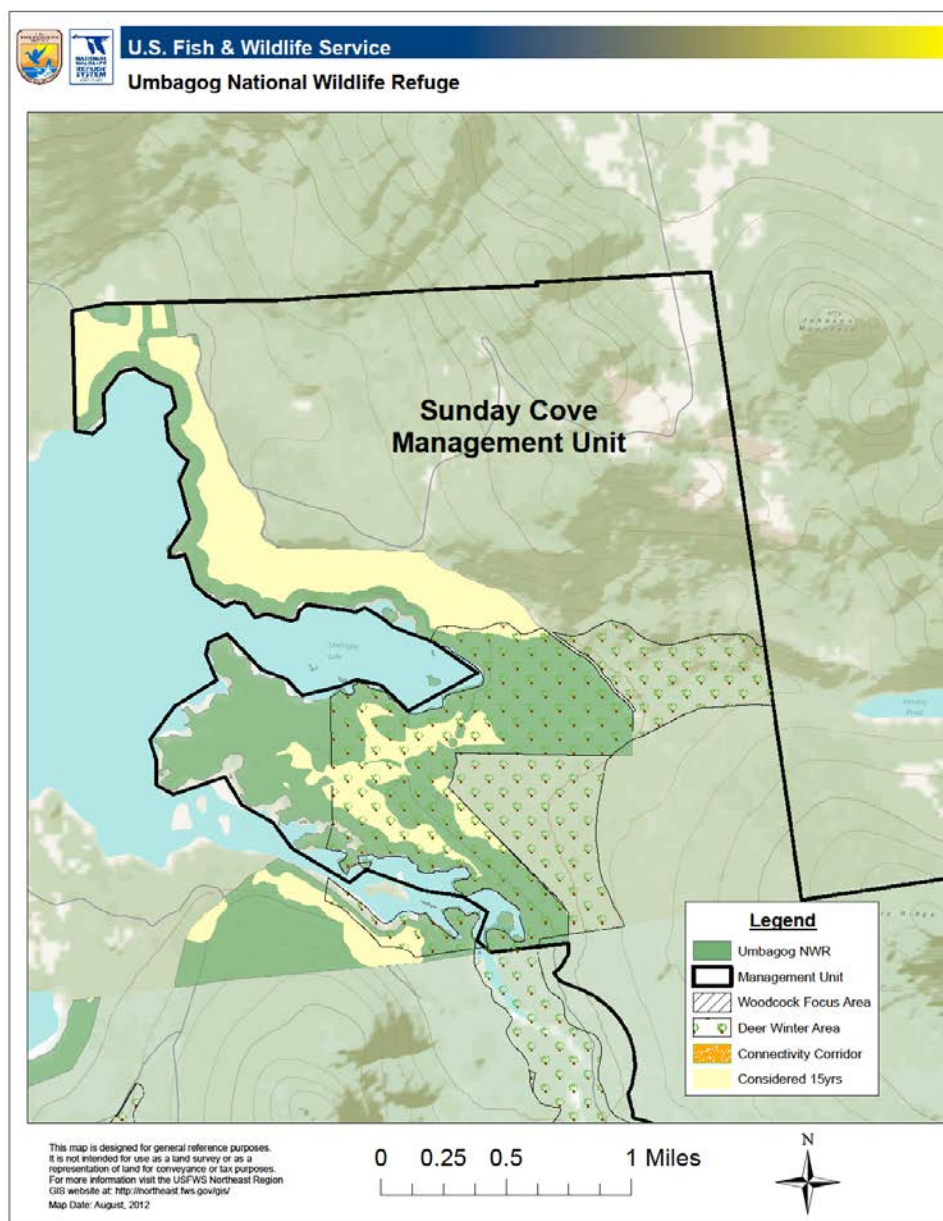
### **Forest Management**

- Where best suited for woodcock management within the Woodcock Focus Area, include all height classes in area regulation and schedule 8-10 year harvest intervals to create and maintain 4 forest age classes with approximately 5 acre patch sizes and 40 year rotations. Where possible, focus initial harvests on areas with aspen that are mature and at risk of declining in population and/or vigor.
- In areas not included in woodcock management, delay forest management until additional inventory data is available and all lands can be evaluated.

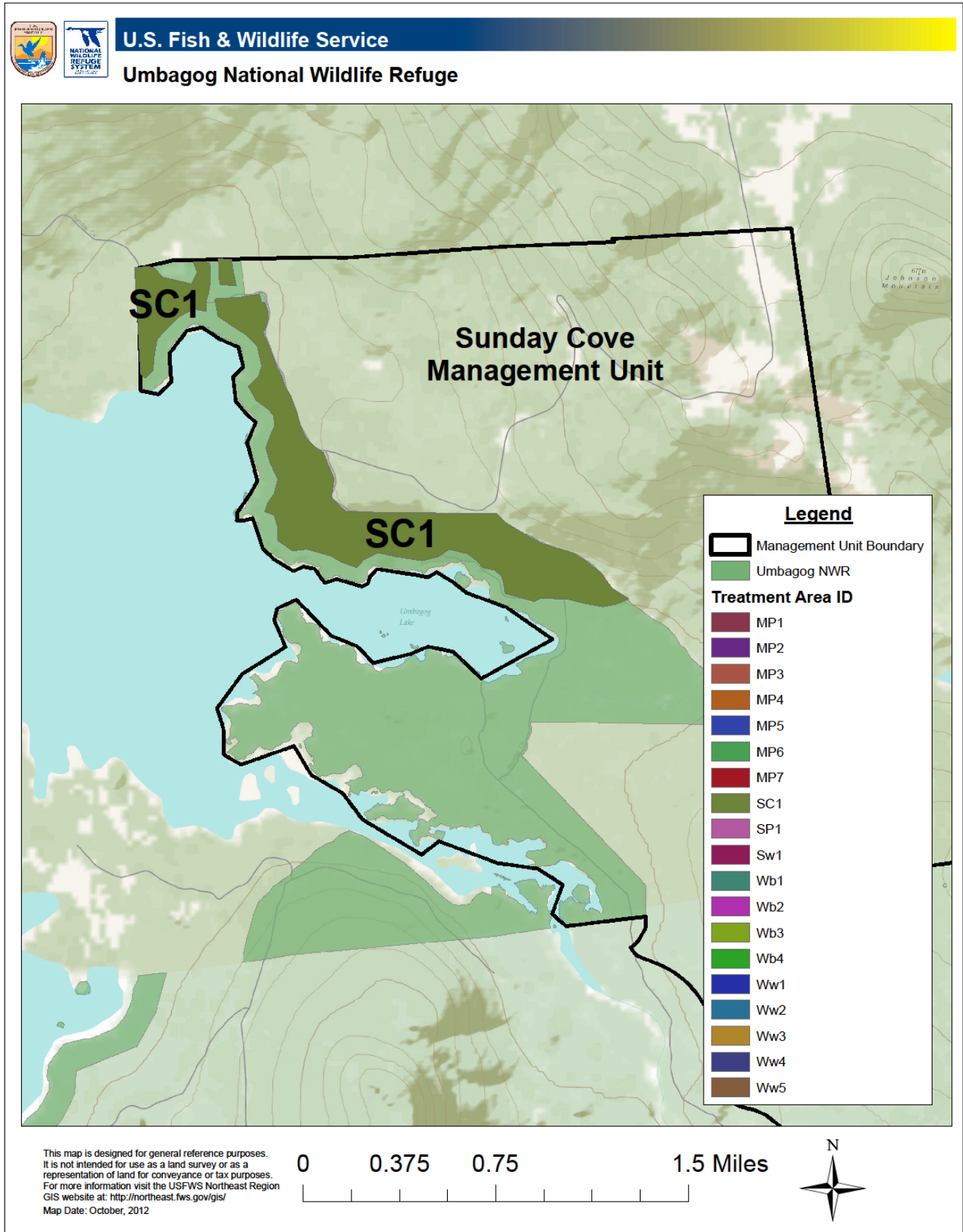
## **J. Sunday Cove Management Unit**

Approximately 1,038 acres of land in this management unit are fee-owned lands managed by the Refuge - 612 acres are within the special and general management zones, and 380 acres are uplands considered for forest management in the next 15 years (Map J-1). All of these lands are in the town of Magalloway Plantation in Oxford County, Maine. Access to this MU is from Pond Brook Rd in Magalloway Plantation, Maine, following onto a road referred to as the “Burke” road and continuing onto an unnamed gravel road. Alternative access is from a road commonly referred to as Switchback road that departs from Route 16 and through a series of gravel roads enters the Management Unit from the North. Most of the uplands considered for forest management appear to have been managed for forest products at varying intensities. During the winters of 2009-2010 and 2010-2011 approximately 250 acres (Appendix F) of treatment area SC1 were managed utilizing uneven-aged forest management for softwood forest types and mixedwood forest types (see VI. Prescription Guidelines).

**Map J-1: Sunday Cove; Uplands Considered in the next 15 years, Woodcock Focus Area, Deer Winter Area, and Connectivity Corridors.**



## Map J-2: Sunday Cove (SC); Treatment Area



### **Management Considerations: Focal Species**

- Black-throated green and Blackburnian warbler: Both of these species utilize mature forests with a conifer component. Blackburnian warbler favors conifer dominant forests. Treatment area SC1 is within a tract of land that is approximately 1,038 acres of contiguous forest. Forest management that promotes the habitat needs of these species is a priority in treatment areas SC1.

### **Management Considerations: Priority Habitats and Forest Characteristics**

- Site Capability: Approximately 3/4 of the land capable of supporting mixedwood forest types are dominated by hardwood forest types. Approximately 1/2 of the land capable of supporting softwood forest types are dominated by mixedwood and in a few locations by hardwood forest types.
- High Conifer Mixedwood Habitats: Restoring and managing for high conifer mixedwood habitats in SC1 is a high priority
- Complex Forest Structure: Larger blocks of mature lowland spruce-fir occur in the Sunday Cove area (Rapp 2003). The complexity of forest structure of these blocks is unknown as of this write. Treatment area SC1 is within approximately 1,038 acres of contiguous forest owned by the Refuge. Forest management that promotes complex forest structure is a priority in treatment area SC1.
- Deer Wintering Area: A portion of this MU is identified as an important deer wintering area (DWA) (Map J-1). Suitable shelter and available woody browse are critical components of a wintering area. This DWA is reportedly one of the heaviest used and extensive browsing is evident. Approximately 115 acres of the deer wintering area are considered for forest management. Access to these stands for forest management is limited and will need to be further evaluated to determine if implementation is feasible.

### **Management Considerations: Other**

- Four private owned buildings on a lot leased from the USFWS, are along the shore of Lake Umbagog. Occupants are allowed access throughout the year.
- Six campsites (R13, R14, R15, R16, R18) are along the shore of Lake Umbagog. Campsites are managed by the NH Department of Resource and Economic Development, Division of Parks and Recreation, except for one campsite that is leased by the USFWS. These campsites are not within the lands considered for forest management and can be accessed by water.
- Two gravel roads, referred to as “Burke Road” and “Switchback Road”, provide access to this MU. Both of the roads are private owned, not typically maintained in the winter, and are in fair condition. The USFWS has legal right-of-way over both of these roads for access to Refuge lands. A potential third road entering from the east in the vicinity of the Rapid River may serve as additional access to areas in the southern portion of the MU, that are difficult, and potentially not accessible from the north.

## **Forest Management**

- In treatment area SC1, if regeneration of desired species is inadequate or compromised by competing vegetation on lands treated in 2009-2011 (Appendix F) consider supplemental planting and use of habitat improvement techniques (A.K.A. Timber Stand Improvement (TSI)) to establish or release softwood regeneration.
- In treatment area SC1, continue with uneven-aged forest management on all lands treated in 2009-2011 (Appendix F) following the hardwood, mixedwood, and softwood prescription guidelines. When warranted, introduce patch clearcuts approximately 1-2 acres in size in close proximity to deer winter shelter.
- In areas not included in treatment area SC1, delay forest management and reconsider in the next management cycle for SC1 or future harvests in the vicinity.

## V. Prescription Guidelines

The following guidelines are provided for developing prescriptions for each management action. Each forest type (stand) within a treatment area will have unique traits that will be evaluated at the time of implementation. Desired forest conditions and prescriptions will be developed for each stand after the evaluation is completed. The authors of this forest management plan recognize forest ecosystems are complex and dynamic systems, and expected wildlife and plant responses to management actions can vary. The values presented here represent an effort to describe the desired wildlife habitat and stand characteristics – and to translate these characteristics into traditional silvicultural ideas. As an example, we use the diminution quotient (q) common to forest management as a proxy for forest heterogeneity, an attribute important to a host of wildlife species.

### A. Uneven-aged Management (*Softwood Forest Types*)

**Silviculture:** Utilize single tree and group selection harvesting to transition even-aged forests to multi-aged and multi-structure forests with a minimum of 3 age classes and a diameter distribution approaching a slope of  $q = 1.7$  (Appendix H), which has an approximate basal area distribution of 41 ft<sup>2</sup>/acre in 6-10" diameters, 26 ft<sup>2</sup>/acre in 11-14" diameters, and 16 ft<sup>2</sup>/acre in 15"+ diameters. Use of the "q" is defined by Leak et al.:

*Diameter distributions are approximated by the reverse J-shaped curve, with a slope defined by "q" – the quotient between numbers of trees in successively smaller d.b.h. classes*

Distribute 1/10 to 1/20 acre group cuts throughout the stand. Do not exceed 10-15% of the stand with group cut openings. Use single tree selection between groups when appropriate, but not consistently throughout the stand so that patches of uncut forest approximately 2-4 acres in size remain. Retain approximately 7 ft<sup>2</sup>/acre (approximately 6 trees/acre) as reserve trees to contribute to snag, cavity, and coarse woody debris objectives. Reserve trees remain in the treatment area for the length of their natural lifecycle. Conduct harvests every 15 years with a residual basal area goal of approximately 100 ft<sup>2</sup>/acre.

**Preparation and layout:** Promote the long term goal of a predominately closed canopy stand (>70% canopy closure) with a variety of age classes. Release advanced softwood regeneration using group cuts. Retain/promote mature trees and supercanopy trees, especially large pines and red spruce. Do not remove trees simply because they are damaged during the harvest operation. Only remove those needed to meet prescription objectives. Retain a higher proportion of red spruce than balsam fir. Retain and promote trees with large horizontal branches, if the species is desirable (e.g. red spruce) consider use as seed tree for an adjacent group selection. Retain any uncommon or rare species. Do not harvest any Northern White Cedar unless necessary for access to critical harvest areas.



## B. Uneven-aged Management (Hardwood and Mixedwood Forest Types)

**Silviculture:** Utilize single tree and group selection harvesting to transition even-aged forests to multi-aged and multi-structure forests with a minimum of 3 age classes and a diameter distribution approaching the slope of  $q = 1.3$  (Appendix H), which has an approximate basal area distribution of 30 ft<sup>2</sup>/acre in 6-10" diameters, 28 ft<sup>2</sup>/acre in 12-14" diameters, and 42 ft<sup>2</sup>/acre in 16"+ diameters. Use of the "q" is defined by Leak et al.:

*Diameter distributions are approximated by the reverse J-shaped curve, with a slope defined by "q" – the quotient between numbers of trees in successively smaller d.b.h. classes*

Distribute 1/5 to 1/2 acre group cuts throughout the stand. When warranted, introduce patch clearcuts approximately 1-2 acres in size to meet habitat objectives. Space patch clearcuts widely apart (>1000 feet). Do not exceed 10-15% of the stand with group and patch openings. Use single tree selection between groups when appropriate. Retain approximately 7 ft<sup>2</sup>/acre (approximately 6 trees/acre) as reserve trees to contribute to snag, cavity, and coarse woody debris objectives. Reserve trees remain in the treatment area for the length of their natural lifecycle. Conduct harvests every 15 years with a residual basal area goals of approximately 100 ft<sup>2</sup>/acre for Mixedwood forest types, and approximately 70 ft<sup>2</sup>/acre for Hardwood forest types.

**Preparation and layout:** Promote the long term goal of a predominately closed canopy stand (>70% canopy closure) with a variety of age classes. Do not harvest softwoods trees, unless necessary for access to adjacent harvest trees or placement of skid road. Promote regeneration of softwoods, especially red spruce. Retain Beech trees especially those that exhibit potential resistance to beech bark disease. Release advanced softwood regeneration using group cuts. Retain/promote mature trees and supercanopy trees, especially large pines, Hemlock, and red spruce. Do not remove trees simply because they are damaged during the harvest operation. Only remove those needed to meet prescription objectives. Retain and promote trees with large horizontal branches, if the species is desirable (e.g. red spruce) consider use as seed tree for an adjacent group selection. Retain any uncommon or rare species.

## C. Even-aged Management (Woodcock Focus Area)

**Silviculture:** Where best suited for woodcock management within the Woodcock Focus Areas, include all height classes in area regulation and schedule 8-10 year harvest intervals to create and maintain 4 forest age classes with approximately 5 acre patch sizes and 40 year rotations. Where possible, focus initial harvests on areas with aspen that are mature and at risk of declining in population and/or vigor.

## D. Within Stand Features (All forest Types)

**Snag and cavity trees:** Retain approximately 6 trees per acre for snag and cavity trees including trees that exhibit signs of developing into one or the other - 3 should have diameters in excess of 12 inches and 1 in excess of 18 inches. Good snag recruitment trees are those that exhibit crown dieback, excavation by woodpeckers or other wildlife, and trees with significantly damaged boles or broken tops or limbs. Good cavity recruitment trees are large long lived species such as red spruce, hemlock, yellow birch, or sugar maple, which may include those that were left as legacy trees during previous harvests. In addition, other good candidate trees are those that are obviously older than the average stand age and have diameters in excess of 20 inches as well as trees with large branches broken off at the main stem of the tree or other defects that appear to have the potential to develop into a cavity. Retain a group of shade trees adjacent to snag and cavity trees to maintain a shade & thermal regime. It is particularly important for shade trees to be left on the southern aspect of the focal snag or cavity tree.

**Coarse Woody Debris (CWD):** Retain all CWD and root wads found resting on the forest floor. Leave topwood, branchwood, and other cull wood (especially hollow logs from harvested trees on the forest floor,).

**Vernal pools, seeps and streams:** Create 100 foot no cut or limited cut buffers around vernal pools and seeps, and along 1<sup>st</sup> and 2<sup>nd</sup> order streams. Avoid adding woody material to streams and keep vernal pools and seeps free of logging debris/slash and sediment. Retain >70% canopy closure over vernal pools, seeps, and streams and >70% canopy closure within 300 ft. of vernal pools. Do not interrupt groundwater flow above or below seeps.

## E. Roads and Landings (All forest types)

**Haul Roads, skid roads, and landings:** Where possible utilize existing haul roads, skid roads, and landings. If needed, place landings in strategic location that minimize the size and amount of alterations to the site. Do not place landings near 1<sup>st</sup> or 2<sup>nd</sup> order streams (should be at least 100 ft. distant). Keep skid road width to a minimum. Do not place skid roads/machinery in wet or dry vernal pool basins, headwater or other stream beds, intermittent stream beds or seeps. Keep skid roads at least 300 feet from vernal pools, if possible, and insure they don't alter water flow to or from vernal pools or create ruts near vernal pools. Avoid crossing streams if possible, and if stream crossings are necessary keep them to a minimum and use NH and ME best management practices guidelines to ensure crossings have a minimal impact to stream beds and water quality. Establish skid roads that follow contours instead of straight uphill, where possible. Use waterbars, etc. to reduce erosion, place slash in skid trails.

## VI. References and Literature Cited

- Calhoun, A.J.K., and P. deMaynadier. 2003. Forestry Habitat Management Guidelines for Vernal Pool Wildlife in Maine. U.S. Environmental Protection Agency, Boston, MA.
- Chace, Dr. Jameson; personal communication, 2011.
- Chase, V.P., Deming, L.S., and F. Latawiec. 1997. Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities. Audubon Society of New Hampshire, Concord, NH.
- Collins, S.L. 1983. Geographic variation in habitat structure for the wood warblers in Maine and Minnesota. *Oecologia*. 59: 246-252.
- Cullen, J.B. 2000. Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire. UNH Cooperative Extension Publications, Durham, NH.
- Darveau, M., DesGranges, J.L., and G. Gauthier. 1992. Habitat use by three breeding insectivorous birds in declining maple forests. *Condor*. 94: 72-82.
- DeGraaf, R.M., Yamasaki, M., Leak, W.B., and J.W. Lanier. 1992. New England wildlife: management of forested habitats. Gen. Tech. Rep. NE-144, Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experimental Station.
- DeGraaf, R.M. and M. Yamasaki. 2001. New England wildlife: habitat, natural history, and distribution. University Press of New England, Hanover, NH.
- Dettmers, R. 2004. Draft blueprint for the design and delivery of bird conservation in the Atlantic Northern Forest. U.S. Fish and Wildlife Service, Hadley, MA.
- Flatebo, G., Foss, C.R., Pelletier, S.K., and C.A. Elliott. 1999. Biodiversity in the Forests of Maine: Guidelines for Land Management. University of Maine Cooperative Extension Bulletin #7147.
- Foster, D. R. 2000. Conservation lessons and challenges from ecological history. *Forest History Today*, Fall, 2-11.
- Frank, R.M. and J.C. Bjorkbom. 1973. A Silvicultural Guide for Spruce-Fir in the Northeast. General Technical Report NE-6. Upper Darby, PA: U. S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.
- Hagan, J.M. and S.L. Grove. 1999. Bird abundance and distribution in managed and old-growth forest in Maine. Manomet Center for Conservation Sciences. Report No. MM-9901.
- Kelley, J. R., Jr. 2003. American woodcock population status. U.S. Fish and Wildlife Service, Laurel, MD.
- Latham, R.E. 2003. Shrubland longevity and rare plant species in the northeastern United States. *Forest Ecology and Management*, 185:151-168.

- Leak, W.B., Solomon, D.S., and P.S. DeBald. 1987. Silvicultural guide for northern hardwood types in the Northeast (revised). Research Paper NE-603. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.
- Litvaitis, J.A. 2003. Are pre-Columbian conditions relevant baselines for managed forests in the northeastern United States? *Forest Ecology and Management*, 185:113-126.
- Lorimer, C.G. 1977. The pre-settlement forest and natural disturbance cycle of northeastern Maine. *Ecology*. 58: 139-148.
- Lorimer, and A.S. White. 2003. Scale and frequency of natural disturbances in the northeastern US: implications for early successional forest habitats and regional age distributions. *Forest Ecology and Management*, 185:41-64.
- Marchand, P.J. 1987. North woods: an inside look at the nature of forests in the Northeast. Appalachian Mountain Club, Boston, MA.
- New Hampshire Division of Forests and Lands. 1995. New Hampshire forest resources plan: assessment report. New Hampshire Department of Resources and Economic Development, Concord, NH.
- New Hampshire Forest Sustainability Standards Work Team. 1997. Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire. The Society for the Protection of New Hampshire Forests, Concord, NH.
- Publicover, D., Et al. July, 1997, Ecological Survey and Management Plan for Crown Vantage Lands Within the Lake Umbagog National Wildlife Refuge. Appalachian Mountain Club, Gorham, NH.
- Rapp, J. 2003. Ecological communities of the Lake Umbagog National Wildlife Refuge: classification and mapping with the national vegetation classification system. University of Vermont, Burlington, Vermont.
- Reay, R.S., Blodgett, D.W., Burns, B.S., Weber, S.J., and T. Frey. 1990. Management guide for deer wintering areas in Vermont. Vermont Department of Fish and Wildlife, Waterbury, VT.
- Rich, T.D., Beardmore, C.J., Berlanga, H., Blancher, P.J., Bradstreet, M.S.W., Bulter, G.S., Demarest, D.W., Dunn, E.H., Hunger, W.C., Inigo-Elias, E.E., Kennedy, J.A., Martell, A.M., Panjabi, A.O., Pashley, D.N., Rosenberg, K.V., Rustay, C.M., Wendt, J.S., and T.C. Will. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.
- Rosenberg, K.V. and T.P. Hodgman. 2000. Partners in Flight land conservation plan: physiographic area 28: eastern spruce-hardwood forest. Cornell Lab of Ornithology, Ithaca, NY.
- Sauer, J.R., Casey, J., Laskowski, H., Taylor, J.D., and J. Fallon. 2004. Use of survey data to define regional and local priorities for management on National Wildlife Refuges. Gen.Tech.Rep. PSW-GTR-191, U.S. Department of Agriculture, Forest Service.
- Seymour, A. S. White, and P. G. deMaynadier. 2002. Natural disturbance regimes in northeastern North America—evaluating silvicultural systems using natural scales and frequencies. *Forest Ecology and Management* 155:357-367.

Thompson, R.R., 3<sup>rd</sup> and D.E. Capen. 1988. Avian assemblages in seral stages of a Vermont forest. *Journal of Wildlife Management*. 52: 771-777.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2003. National Soil Survey Handbook, title 430-VI.

U.S. Fish and Wildlife Service. 1991. Final environmental assessment: proposal to protect wildlife habitat, Lake Umbagog, Coos County, New Hampshire, U.S. Fish and Wildlife Service, Newton Corner, MA.

U.S. Fish and Wildlife Service. 1996. American woodcock management plan: Eastern region. U.S. Fish and Wildlife Service, Hadley, MA.

U.S. Fish and Wildlife Service. 2009. Umbagog National Wildlife Refuge Comprehensive Conservation Plan, Umbagog National Wildlife Refuge, Coos County, New Hampshire, U.S. Fish and Wildlife Service, Hadley, MA.

White Mountain National Forest. 2004. Draft Environmental Impact Statement for Forest Plan Revision. U.S. Department of Agriculture, Forest Service, Laconia, NH

## VII: Appendices

### Appendix A: Explanation of Global and Subnational Rank Codes.

These rank codes describe the degree of vulnerability of an element of biodiversity (species, natural community, or natural community system) to extirpation, either throughout its range (global or “G” rank) or within a subnational unit such as a state (subnational or “S” rank). For species, the vulnerability of a subspecies or variety is indicated with a taxon (“T”) rank. For example, a G5T1 rank for a sub-species indicates that the sub-species is critically imperiled (T1) while the species is secure (G5).

#### **Code Examples Description**

**S1** Critically imperiled because of extreme rarity (e.g., one to five occurrences), very restricted range, very steep recent declines, or other factors making it extremely vulnerable to extirpation.

**S2** Imperiled due to very few occurrences (e.g., six to 20), restricted range, steep recent declines, or other factors making it very vulnerable to extirpation.

**S3** Vulnerable due to relatively few occurrences (e.g., 21 to 80), relatively restricted range, recent declines, or other factors making it vulnerable to extirpation.

**S4** Apparently secure due to having more than a few occurrences (e.g., >80) and/or an extensive range, but possible cause for long-term concern due to local recent declines or other factors.

**S5** Secure; widespread and abundant.

**SU** Status uncertain. More information needed.

**SH** Known only from historical records (e.g., a species not reported as present within the last 20 years or a community or system that has not been reported within 40 years).

**X GX SX** Believed to be extinct. May be rediscovered, but habitat alteration or other factors indicate rediscovery is unlikely.

[http://www.nhdfi.org/library/pdf/Natural%20Heritage/Natural%20Community%20Manual\\_2nd%20Ed.pdf](http://www.nhdfi.org/library/pdf/Natural%20Heritage/Natural%20Community%20Manual_2nd%20Ed.pdf)



## **Appendix B: Umbagog CCP, Resources Sensitivity Zones**

**Low Resource Sensitivity Zone:** Stands within this zone allow for the greatest flexibility in managing over the long term to diversify forest age class and structure to benefit our focal species. A variety of commercial and noncommercial timber harvesting may occur as described below under each habitat type. All harvesting will follow best forestry and wildlife management practices (BMPs), as recommended by the states of New Hampshire and Maine. Where this zone surrounds or abuts moderate and high sensitivity and industry inoperable zones, stand prescriptions will reflect the need to protect or enhance the resource values on those adjacent, more sensitive areas.

**Moderate Resource Sensitivity Zone:** Stands within this zone are subject to more restricted silvicultural prescriptions or timing of harvest than in the Low Resource Sensitivity Zone. Restrictions may include (but are not limited to) seasonal operational closures, maintenance of closed canopy conditions, retention of coarse woody debris or snags, etc.

**High Resource Sensitivity Zone:** Stands within this zone are subject to very few manipulations. We may fell, girdle, or otherwise treat individual trees, or small groups of trees, to benefit wildlife or for safety reasons. Highly restrictive areas may include excessively steep slopes, hydric soils, and/or close proximity to resources of concern, such as streams and wetlands. Most of these areas are also considered “inoperable” by the forest products industry (see below); however, the refuge’s high resource sensitivity zone is more extensive than what industry would consider “inoperable”.

**Forest Industry Inoperable Zone:** This zone represents local forest industry standards for inoperability. These areas were mapped by the former timber company landowner. This zone includes stands that are non-forested wetlands, or are too steep or wet to be economically harvested (Johnson 2003). We may fell, girdle, or otherwise treat individual trees, or small groups of trees, to benefit wildlife or for safety reasons; otherwise, tree harvest will be quite limited.

## **Appendix C: Umbagog CCP and HMP Goal 3, Objective 3.1, sub-objectives, and strategies pertaining to forested uplands**

**Goal 3:** *Manage upland forest habitats, consistent with site capability, to benefit Federal trust species and other species of conservation concern*

### **Objective 3.1 (Mixed Spruce-Fir/Northern Hardwood Forest)**

Conserve up to 59,611 acres of mixed spruce-fir/northern hardwood forest on Service-owned lands, including those planned for acquisition from willing sellers within the approved refuge boundary, to sustain well-distributed, high quality breeding and foraging habitat for species of conservation concern, including blackburnian, black-throated green, and Canada warblers, and American woodcock. Also, where consistent with management for those refuge focal species, protect critical deer wintering areas and provide connectivity of habitat types for wide-ranging mammals

#### **Sub-objectives: Spruce-Fir Habitat Type (3.1a)**

- Sustain singing, nesting and feeding habitat for blackburnian and black-throated green warblers (refuge focal species) by perpetuating a high (>70%) crown closure, favoring spruce during stand improvement, and maintaining super- canopy trees
- Maintain at least 50% of deer wintering areas (see Map 4-3) as quality shelter at any given time, consistent with management of our focal species
- Provide connectivity of forested habitat types for wide-ranging mammals, consistent with management for our focal species.
- Provide other structural characteristics to improve stand diversity for other native wildlife species dependent on this habitat type. This will include retention of approximately six live cavity trees or snags (standing dead trees/ acre), with at least 1 of these exceeding 18 inches/dbh, and three others exceeding 12 inches dbh, and retaining coarse woody debris and super dominant or super- canopy trees.
- Additional attributes of this habitat type important to focal species, such as blackburnian warbler, black throated-green warbler, deer, and associated communities include:
  - Mature interior forest (>60 yrs)
  - Tall (>50 ft) conifers (especially spruce and/or hemlock)
  - Large horizontal upper branches for nesting sites
  - Medium-high tree densities
  - Large (>100 ha) patches of unfragmented forested habitat
  - Multi-layered stand structure with tree-fall gaps

#### **Strategies: Spruce-Fir Habitat Type (3.1a)**

- Improve habitat structural diversity for refuge focal species through light pre-commercial and commercial thinning and/or other stand improvement operations, as appropriate. We will favor spruce during all stand improvements.
- Regenerate this habitat type through accepted silvicultural practices. Methods include, but are not limited to: 1) Utilize primarily single tree or group selection uneven-aged management techniques, and to a lesser extent, clearcutting, or shelterwood even-aged techniques, 2) treatments should be timed to optimize the ability of the site to regenerate spruce and other conifer, 3) target age class goals under management will range from 100-130 years; and, 4) the size of each treatment action and cutting interval will be determined by management unit size, silvicultural prescription, and rotation age.
- In critical deer wintering areas maintain updated maps of critical areas and manage these stands, to the extent compatible with management of Federal trust resources, to ensure long-term

continuation of this habitat. The overall target would be to maintain a minimum of 50% of a deer wintering area as quality shelter at any point in time. Quality shelter includes softwood cover over 35 feet tall and 70% or higher crown closure (Reay et al. 1990).

- Retain wildlife forage and mast producing trees (such as beech, aspen, striped maple, black cherry)
- Retain coarse woody debris
- Protect vernal pools, headwater streams, and seeps with appropriate buffers and management

**Sub-objectives: *Conifer-Hardwood “Mixed Woods” Habitat Type (3.1b)***

- Sustain singing, nesting and feeding habitat for blackburnian and black-throated green warblers (refuge focal species) by perpetuating a high (>70%) crown closure, favoring spruce during stand improvement, and maintaining super canopy trees. Enhance foraging habitat for the black-throated green warbler and other native species dependent on this habitat type by developing small gaps to promote a diverse, layered understory. We will favor conifers wherever possible based on site capability.
- Provide connectivity of forested habitat types for wide-ranging mammals, consistent with management for our refuge focal species.
- Provide other structural characteristics to improve stand diversity for other native wildlife species dependent on this habitat type. This will include retention of approximately 6 live cavity trees or snags (standing dead trees)/ acre, with at least 1 of these exceeding 18 inches/dbh, and 3 others exceeding 12 inches dbh, and retaining coarse woody debris and super dominant trees.
- Acquire up to 13,406 acres of this cover type from willing sellers within the approved refuge boundary, and manage fee title lands similar to current refuge lands under objective 3.1b.
- Additional attributes of this habitat type important to focal species, such as blackburnian warbler, black throated-green warbler, and associated communities include:
  - Mature interior forest (>60 yrs) with a high conifer component
  - Tall (>50 ft) conifers (especially spruce and/or hemlock)
  - Large horizontal upper branches for nesting sites
  - Medium-high tree densities
  - Large (>100 ha) patches of unfragmented forested habitat
  - Multi-layered stand structure with tree-fall gaps

**Strategies: *Conifer-Hardwood “Mixed Woods” Habitat Type (3.1b)***

- Improve habitat structure for refuge focal species through light pre-commercial and commercial thinning and/or other stand improvement operations. We will favor spruce during all stand improvements.
- Retain wildlife forage and mast producing trees (such as beech, aspen, striped maple, black cherry)
- Retain coarse woody debris
- Protect vernal pools, headwater streams, and seeps with appropriate buffers and management
- Regenerate this habitat type through accepted silvicultural practices. Favor conifer on appropriate sites. Methods include, but are not limited to:

**On conifer- dominated sites**

- utilize primarily single tree or group selection uneven-aged management techniques, and to a lesser extent, clearcutting, or shelterwood even-aged techniques;
- treatments should be timed to optimize the ability of the site to regenerate spruce and other conifer;

- target age class goals under management will range from 100-130 years;
- the size of each treatment action and cutting interval will be determined by management unit size, silvicultural prescription, and rotation age;
- in areas of advanced, healthy conifer regeneration, we will implement silvicultural techniques to protect it.

#### On hardwood- dominated sites

- utilize small group selection with up to 1/5 to 1/2 acre group sizes;
- target age class goals under management are 100-200 years; and,
- cutting cycles will be 15 to 20 years in order to maintain understory development.

#### **Sub-objectives: *Northern Hardwood Habitat Type (3.1c)***

- Provide foraging habitat for blackburnian and black-throated green warblers (refuge focal species) by developing multi-aged stands and a mid- to high canopy closure
- Sustain breeding, nesting and foraging habitat for Canada warblers, a refuge focal species, by developing openings, a diverse, layered understory, and promoting the aspen and birch community. This management would also benefit American woodcock (see discussion below)
- Provide other structural characteristics to improve stand diversity for other native wildlife species dependent on this habitat type. This will include retention of approximately six live cavity trees or snags (standing dead trees)/ acre, with at least one of these exceeding 18 inches/dbh, and three others exceeding 12 inches dbh, and retaining coarse woody debris, and super dominant trees. Where possible, we will maintain and encourage the development of mast producing trees (e.g. black cherry, mountain ash, beech).
- Additional attributes important to focal species such as Canada warbler and associated communities include:
  - Uneven-aged, multi-story structure with good species diversity and relatively low (<17 m) canopies
  - Canopy gaps
  - Structurally complex, well-developed understory of herbaceous plants (especially ferns and mosses) and shrubs/ saplings, 2-6 m. tall, <8 cm dbh (total ground cover > 70%)
  - Presence of exposed, emergent perch trees (relatively isolated trees that emerge > 3m above surrounding canopy)
  - Limited herbivore/ ungulate browse
  - Abundant coarse woody debris, including large decaying logs and stumps and rootwads
  - Uncompacted, uneven forest floor with hummocks

#### **Strategies: *Northern Hardwood Habitat Type (3.1c)***

- Improve habitat structure for refuge focal species through light pre-commercial and commercial thinning and/or other stand improvement operations no earlier than mid-successional stage (> 6 m high).
- Leave woody debris on site
- Regenerate these habitat types through accepted silvicultural practices. Methods include, but are not limited to:
  - Utilize single tree or small group selection of up to 1/2 acre group sizes,
  - target age class under management are 100-200 years; and,
  - cutting cycles of 15 to 20 years in order to maintain understory development.

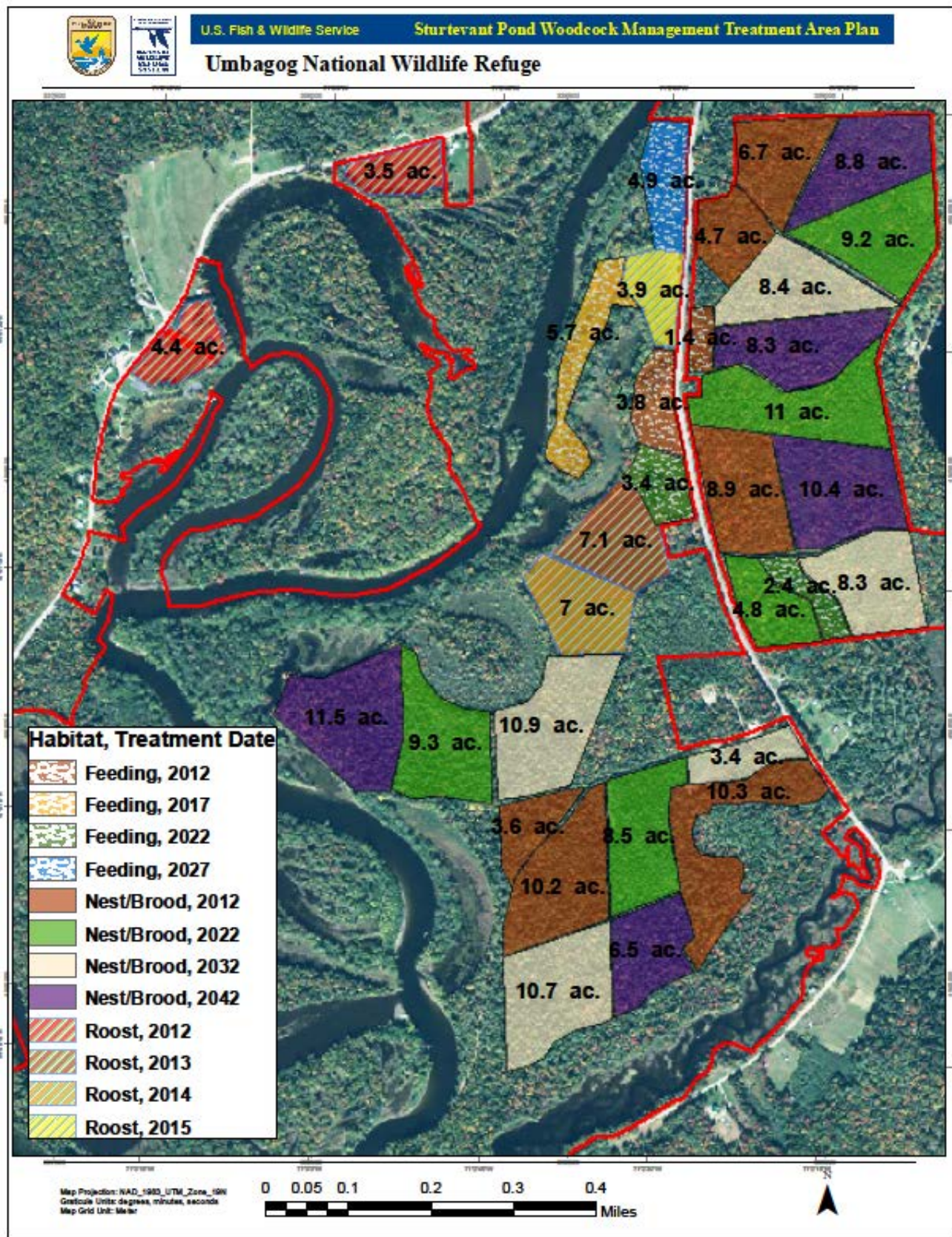
- Retain wildlife forage and mast producing trees (such as beech, aspen, striped maple, black cherry)
- Protect vernal pools, headwater streams, and seeps with appropriate buffers and management

**Sub-objectives: *Woodcock Focus Areas (3.1d)***

- Use accepted silvicultural practices in woodcock focus areas to create openings, promote understory development, and sustain early successional habitat for American woodcock and Canada warbler. Generally, use group selection, clearcuts or patch cuts of up to 5 acres in size. Some larger roosting fields may also be maintained. Cutting cycles will be approximately 8-10 years on a 40 year rotation. Some 3-5 acre openings may be permanently maintained primarily by mowing and brush clearing using mechanized equipment.
- Perpetuate aspen-birch communities where they exist, and strive to achieve an appropriate distribution of regenerating, young, mid and mature age classes

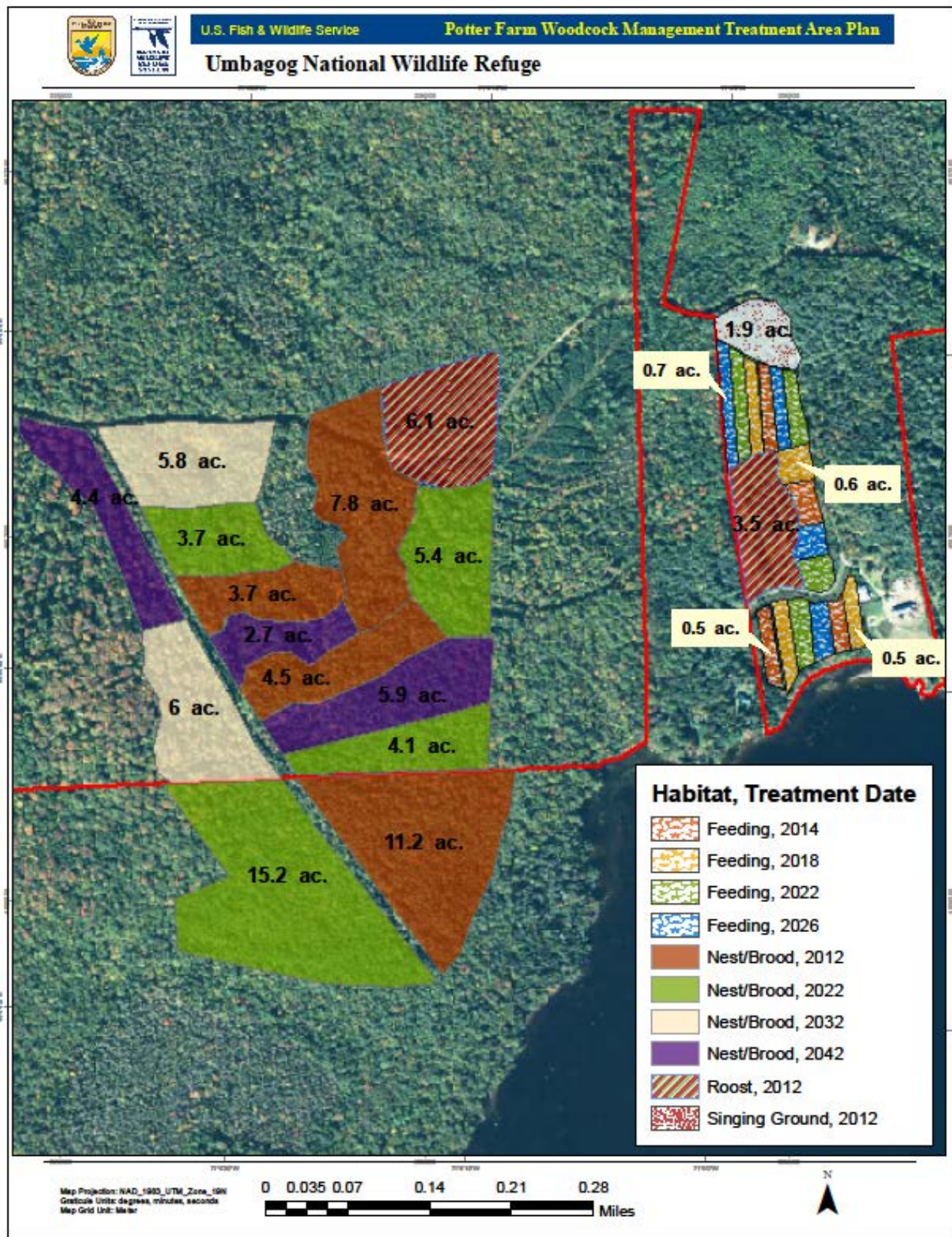


## Appendix D: Sturtevant Pond woodcock management treatment area plan, harvest schedule



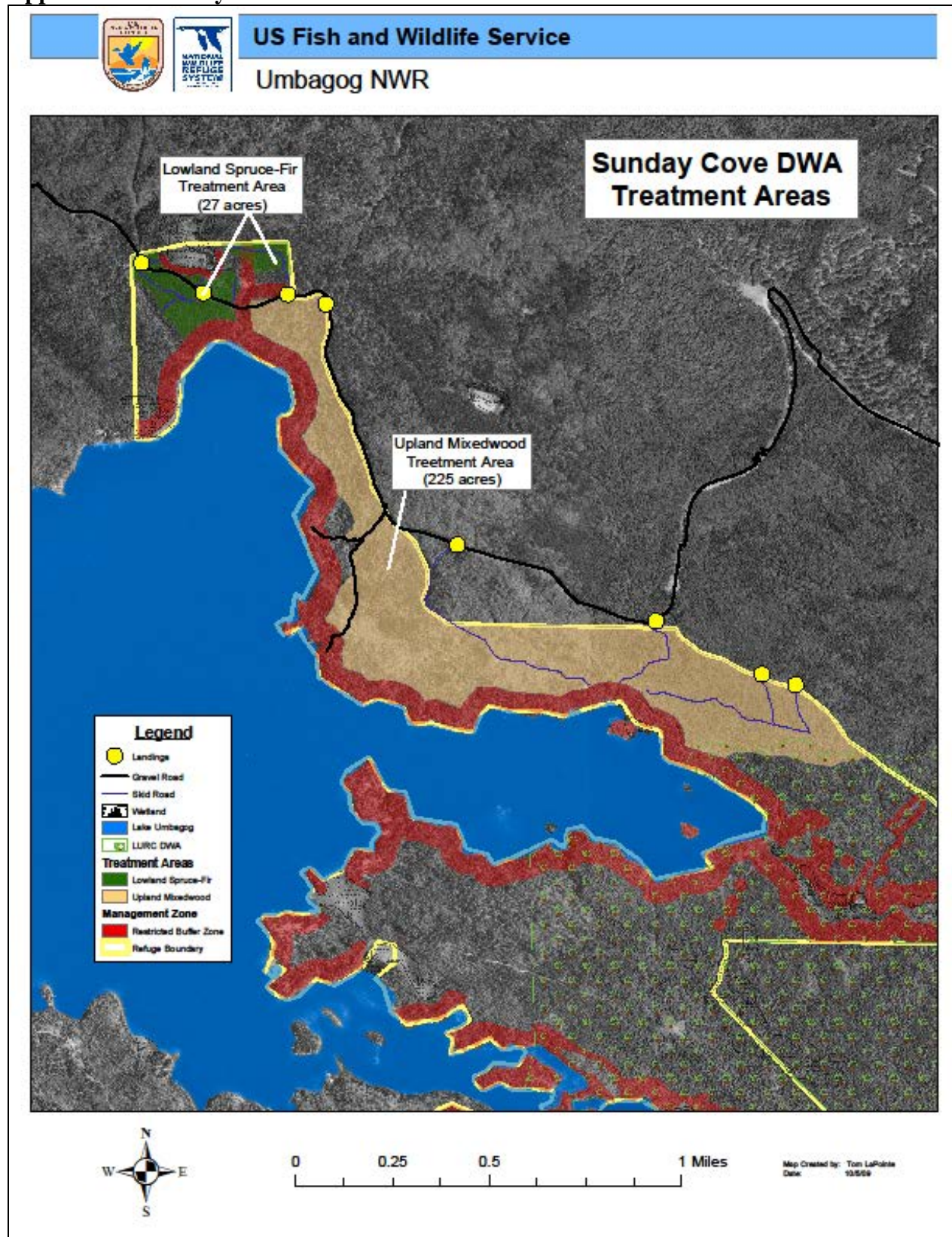


## Appendix E: Potter Farm woodcock management treatment area plan, harvest schedule





# Appendix F: Sunday Cove treatment areas harvested winter 2009/2010 and 2010/2011



## Appendix G: Definitions of Silvicultural Terms

### *Group Selection*

This technique involves the removal of small groups of trees throughout a stand, to initiate and/or maintain an uneven-aged forest. A group selection opening is considered to be less than, or equal to, twice the height of the adjacent mature trees. This method will encourage regeneration of intermediately tolerant and tolerant species, but some intolerant species can appear towards the center of the harvest areas when the groups are at the maximum size. The likelihood of the harvest areas regenerating combined with the ability to schedule continual harvest entries, results in this technique being a method of choice to convert even-aged stands to uneven-aged stands when desired.

Group selection results in moderately- closed to closed-canopy conditions. Regeneration and shrubby vegetation can be expected to develop with reasonable assurance. This technique can be used in combination with singletree selection to ensure canopy closure requirements meet desired conditions. Focal species such as the blackburnian and black-throated green warbler will benefit from the application of this technique in a conifer-dominated habitat area. The predominantly closed canopy condition resulting from this technique will also benefit deer winter cover areas. The technique can be applied in all habitat types. Its application in the refuge's spruce-fir forest most closely resembles the natural disturbance that would be expected to take place if the area were allowed to develop without manipulation.

### *Single Tree Selection*

This technique involves the removal of individual trees throughout a stand. Use of this technique, on a continual harvesting cycle, is considered uneven-aged management. It can also be used during even-aged management, and when done so, is commonly referred to as an intermediate thinning. In uneven-aged management, it is used to introduce small openings in the canopy by focusing the harvest on dominant, older aged trees. In even- aged management, it is used to promote the quality and growth of the remaining trees by focusing the harvest on poor quality, low vigor trees. The technique will likely result in varying quantities of regeneration of mostly shade tolerant species.

Single tree selection results in a relatively closed canopy condition. Understory development is usually minimal. The opportunity for regeneration is created but when trees are selected singularly, the opening produced in the canopy will typically be utilized quickly by the crowns of adjacent older trees. This technique is often used in combination with group selection to ensure regeneration is established and separate age classes are created to perpetuate the overall desired condition. In using single tree selection, with even-aged objectives in the form of a thinning, it will likely result in less opportunity for regeneration and understory development. Often times the suppressed and co-dominant trees are selected for removal resulting in very little change in canopy closure after a treatment. This technique can be applied in all habitat types.

### *Pre-commercial Stand Treatments to Improve Habitat Conditions*

These treatments include entering an even- or uneven-aged stand at any stage of development with the intent of tending to habitat needs through thinning, weeding, cleaning, liberation, sanitation, or other improvement methods. This technique can be used to control species composition and reduce an overabundance of stems per acre to a more desired stocking level. This can be applied through thinning young stands (pre-commercially) to control species composition, conducting intermediate thinnings in middle aged stands to maintain accelerated growth and remove unwanted vegetation, and prescribed fire. This technique may also be used to control stocking levels of habitat features such as snag trees, cavity trees, den trees, downed wood and other features through girdling, felling, boring, hinging, or other techniques.

This habitat improvement technique is varied in its application, but overall should be applied to alter or enhance young stands and encourage desirable forest stand characteristics to achieve goals and objectives. This can be applied in all habitat types and may be extended to areas that are not capable of supporting equipment for larger scale manipulation efforts.

### *Shelterwood System*

This technique involves a series of harvests carried out with the intent of regenerating a stand utilizing mature trees that are removed at the end of the scheduled rotation. Essentially, the overstory is removed and the well-developed underlying regeneration then becomes the stand. This technique is typically used to regenerate intermediately tolerant (mid-successional) and tolerant (late successional) species, but in certain instances can be used for intolerant (early successional) species. Use of this technique is considered even-aged management, although variations more often found in the irregular shelterwood system can result in a multi-aged stand. In order for a shelterwood system to be considered, a stand should be reasonably well stocked with a moderate to high component of the species desired for regeneration.

A number of shelterwood system applications exist. The more commonly used is the open shelterwood system. Although less commonly used, the dense shelterwood, deferred shelterwood, irregular shelterwood, natural shelterwood, and nurse tree shelterwood systems are also useful in accomplishing specific regenerative needs as well as other resource management objectives.

The shelterwood variations allow a variety of habitat conditions to be created while fulfilling the regenerative objectives of the technique. It can be used to create a denser crown closure when connectivity of an older age forest needs to be maintained. The amount of time needed to establish regeneration and conduct the overstory removal can provide enough time for other areas to develop into an older age condition, and ensure refuge goals are being met continually. Overstory removal can be delayed through a deferred shelterwood if further development of other areas is necessary. It can also be used to create a more open crown closure when development of a shrub component in the understory is desired or residual tree are needed to meet specific habitat requirements. Once regenerative needs have been reached and the —shelter (seed) trees have been removed, the new stand can then be managed for structural objectives as it develops. Overstory removal can result in a regenerative condition which does offer some early successional benefits as described in the clearcut technique.

This technique can be used in all habitat types. Its application on habitats comprised of predominately shallow root species (e.g. red spruce/balsam fir) or wet soil conditions, does introduce a greater susceptibility of the residual trees to windthrow from wind events.

### *Clearcutting*

This technique involves the removal of an entire stand of trees in one cutting to obtain natural reproduction. Two common methods of clearcutting are patch or block clearcuts, and strip clearcuts. This regeneration technique is considered to be even-aged management, although somewhat coarse multi-aged stands can be developed through progressive patch or progressive strip clearcut systems. Clearcut size does have an effect on regeneration. As clearcuts increase in size, they tend to favor shade intolerant regeneration. As they become smaller they gravitate towards encouraging intermediately tolerant and tolerant species.

Clearcuts are often used to create an early successional habitat condition. Early successional habitat is when an area is in a young, shrubby, regenerating condition that covers an area large enough to be recognized and perhaps utilized by wildlife or plants associated with such an open or no-canopy condition.

This technique should be utilized when an early successional habitat condition is desired and found to be lacking or not available within the landscape. As mentioned previously in this description, clearcut size does have an impact on tree species composition, and therefore should also be utilized when current species composition is not desired or diverse enough to reach goals and objectives. This technique can be used in all habitat types, and although somewhat limiting in terms of emulating natural processes or conditions, can be used in a continual, progressive system that sustains multiple age classes.

## Appendix H: Approximated Reverse J-shaped Curve for Uneven-aged Management

