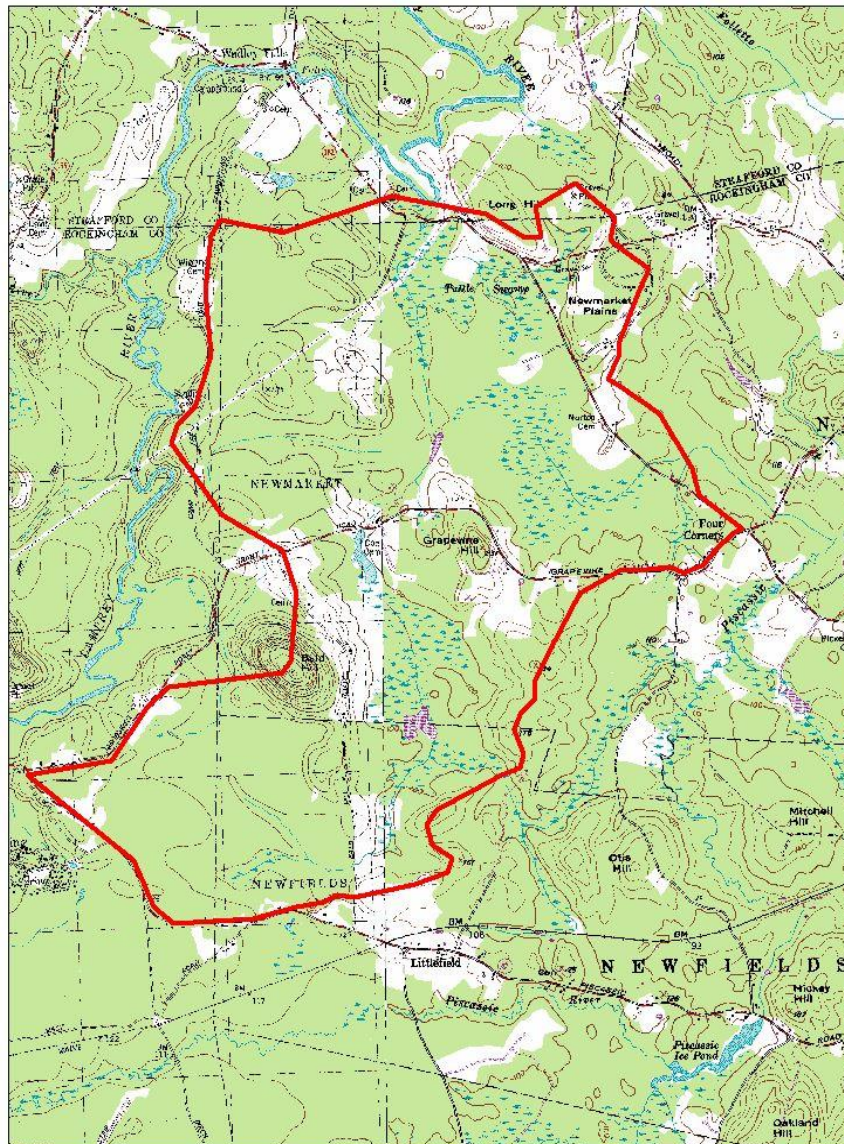

NATURAL RESOURCE MANAGEMENT PLAN FOR THE TUTTLE SWAMP WATERSHED

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on behalf of the Great Bay Resource Protection Partnership

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I. TUTTLE SWAMP WATERSHED SUMMARY

Name:	Tuttle Swamp Watershed
Total Acreage:	3,047
Total Protected Acres:	752
Location:	Newmarket, Rockingham County, New Hampshire
Directions:	From Concord: Rt 4 east to Durham NH. Rt 108 south to Newmarket. Rt 152 west from Newmarket center. Turn left onto Grant Road. Parking area for Tuttle Swamp is on right side of Grant Road at bottom of Grapevine Hill approximately 3.5 miles from Newmarket center.
Ecological Importance:	Tuttle Swamp is a large wetland complex that has been identified by the Great Bay Resource Protection Partnership as a protection priority due to the diversity of habitats and wildlife it supports as well as its integral role in protecting the regional water quality. The Tuttle Swamp watershed feeds both into the Lamprey and Piscassic Rivers which ultimately drain into the Great Bay Estuary.
Conservation Status:	Primarily in private ownership; 14% protected.
Goal Statement:	The primary goal of the Tuttle Swamp Watershed Management Plan is to provide management guidelines that will help protect the integrity of the constituent habitats and ecosystems in and around Tuttle Swamp. This plan is also intended to help coordination, cooperation, and communication between the individual landowners with respect to management actions and planning processes. The plan focuses on, prioritizes, and presents information on the natural resource features, while recognizing political and ownership boundaries.

II. INTRODUCTION

The Tuttle Swamp Watershed, including Ash Swamp, consists of a large wetland complex with associated forested uplands in the town of Newmarket, NH. The watershed has been recognized as a high priority conservation area due to its mosaic of wetland and upland habitat types including exemplary examples of acidic forested seepage swamps, floodplain forests, beaver flowages, and emergent marshes (Stevens & Anderson 1997). Tuttle and Ash Swamps combined represent one of the largest headwater swamps in the Great Bay drainage. The Tuttle Swamp Watershed straddles the larger Lamprey and Piscassic watersheds (Figure 1), with Tuttle Swamp draining into the Lamprey, and Ash Swamp draining into the Piscassic River. The protection of large headwater wetlands such as the Tuttle/Ash Swamp complex is important for ensuring the maintenance of downstream habitats and water quality, including the Great Bay estuary, a marine environment of enormous biological, commercial, and cultural value. The Tuttle/Ash Swamp wetland complex provides important wetland functions including nutrient uptake, sediment removal, flood control, and groundwater recharge. Associated upland forests and grasslands surrounding the wetland systems provide critical wetland buffer functions, support wildlife habitat, and provide connections with other habitats outside the area addressed in this report.

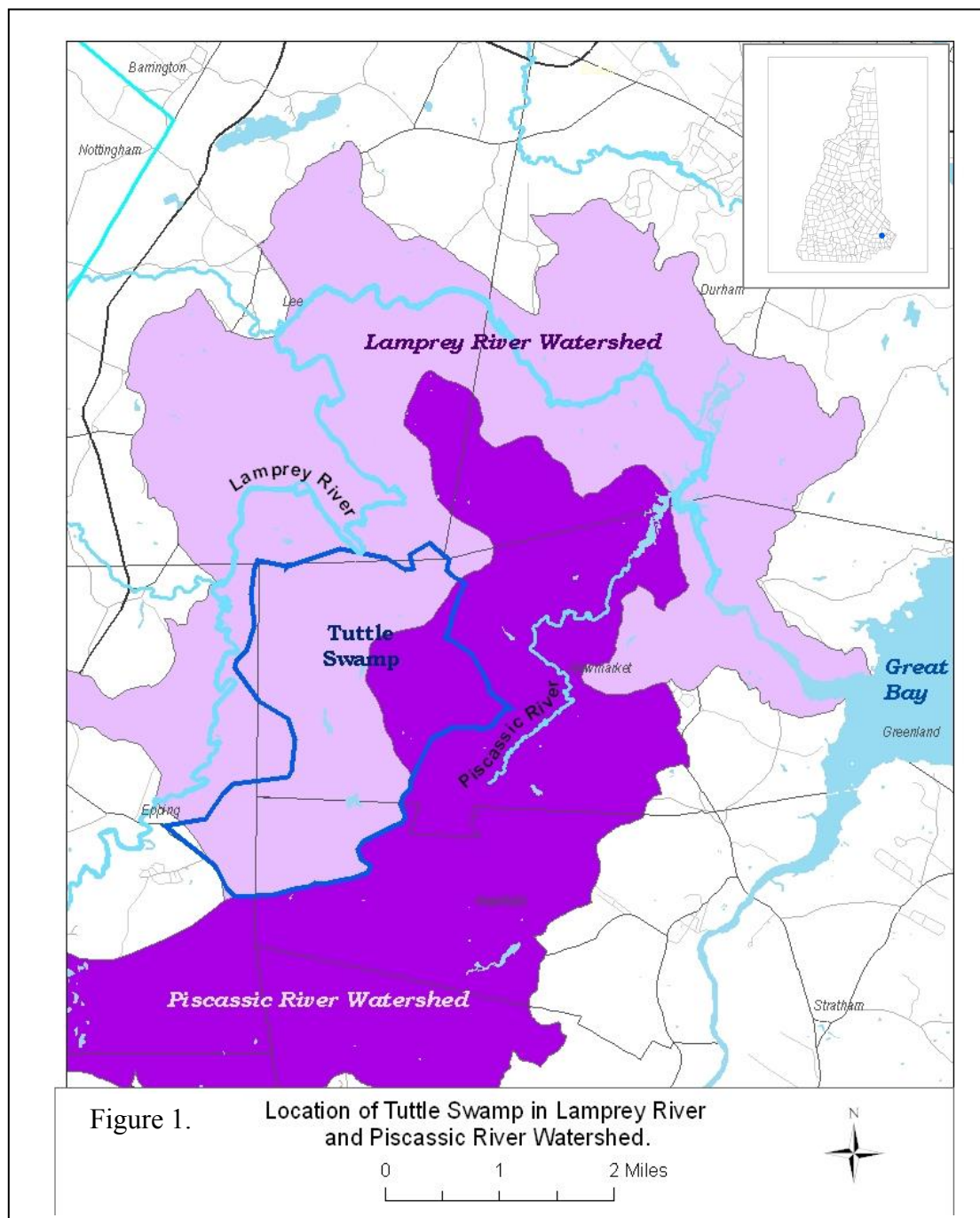
Tuttle Swamp supports several rare species and exemplary natural communities, including the largest example of a swamp white oak floodplain forest on the Lamprey River (Nichols & Sperduto 1997). The wetland natural communities that co-occur within the Tuttle Swamp Watershed can be broadly described as temperate minerotrophic swamp and emergent marsh – shrub swamp ecological systems (Sperduto 2004). Seventeen rare species are associated with these wetland ecological systems and the open field habitat within the watershed (Table 3).

Recently, lands in and around Tuttle and Ash Swamps have been protected through the efforts of the Town of Newmarket (Figure 2) and the Great Bay Resource Protection Partnership (Figure 3). As a result, multiple conservation landowners are now charged with managing this exemplary wetland system. The Tuttle Swamp Watershed Management Plan has resulted from a desire to compile management recommendations for the entire area to facilitate cooperative management between landowners and to promote landscape level management.

The management units described in this report were delineated based on similar natural features, such as natural communities, wetland edges, and wildlife habitats as opposed to parcel boundaries. Although this report focuses on the protected lands within the Tuttle Swamp Watershed, the habitat types that define the management units occur throughout the entire watershed. Therefore, the following management recommendations can be useful beyond the boundaries of the currently protected lands, and can apply to all lands within the watershed boundary.

This report focuses on the natural resources, land use, and threats to ecological integrity within the Tuttle Swamp Watershed. We delineated the Tuttle Swamp Watershed boundary to include all land draining into the Tuttle Swamp/Ash Swamp basin (Figure 2). Water quality and the natural hydrologic dynamics within the core of Tuttle Swamp are influenced by land use and land management within the watershed. Due to the underlying importance of the water quality within the watershed, we identified the primary considerations within the Tuttle Swamp watershed as:

- the protection of water quality and quantity
- the maintenance and enhancement of wildlife habitats within the watershed.



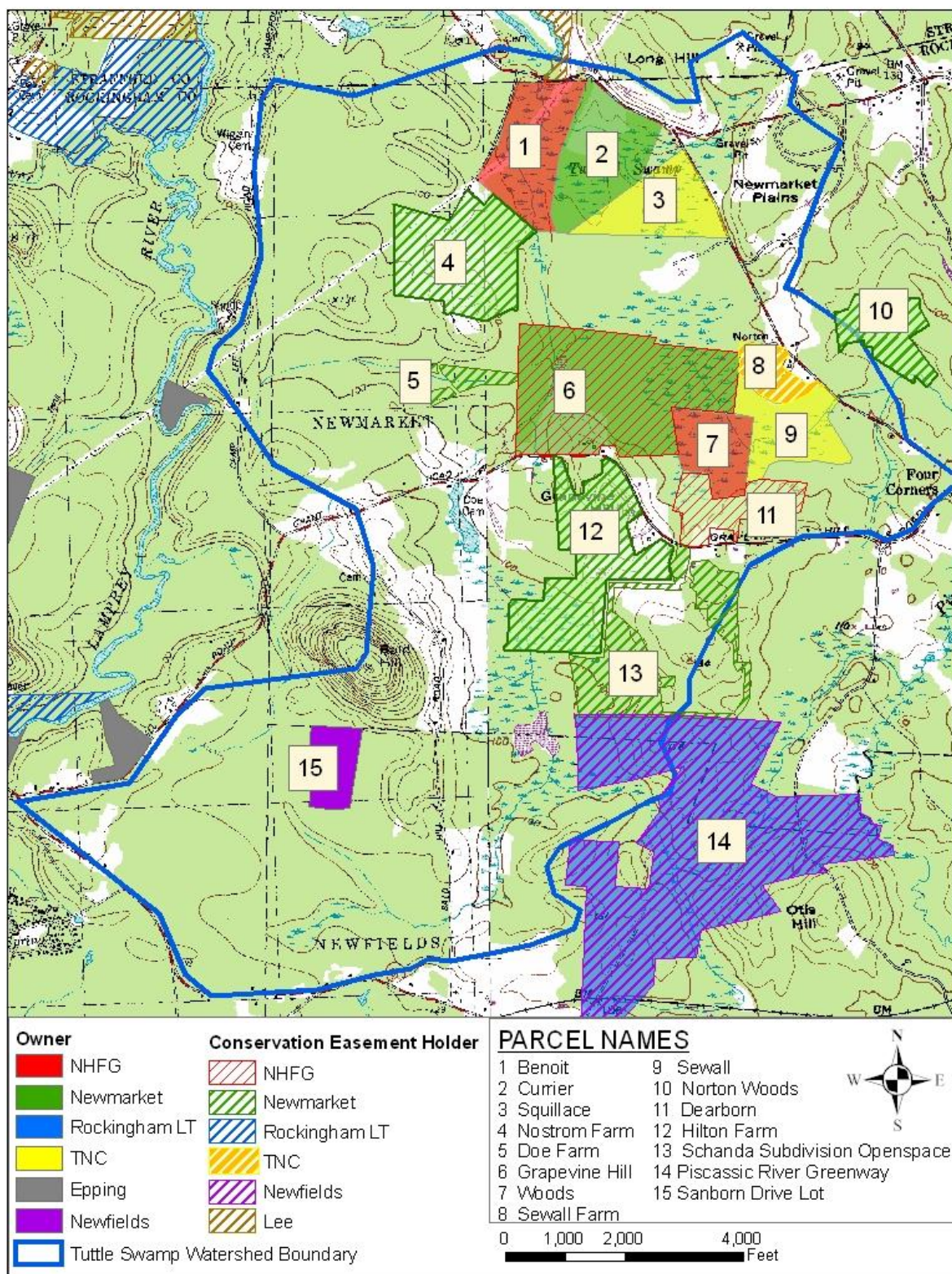


Figure 2. Conservation land within the Tuttle Swamp Watershed

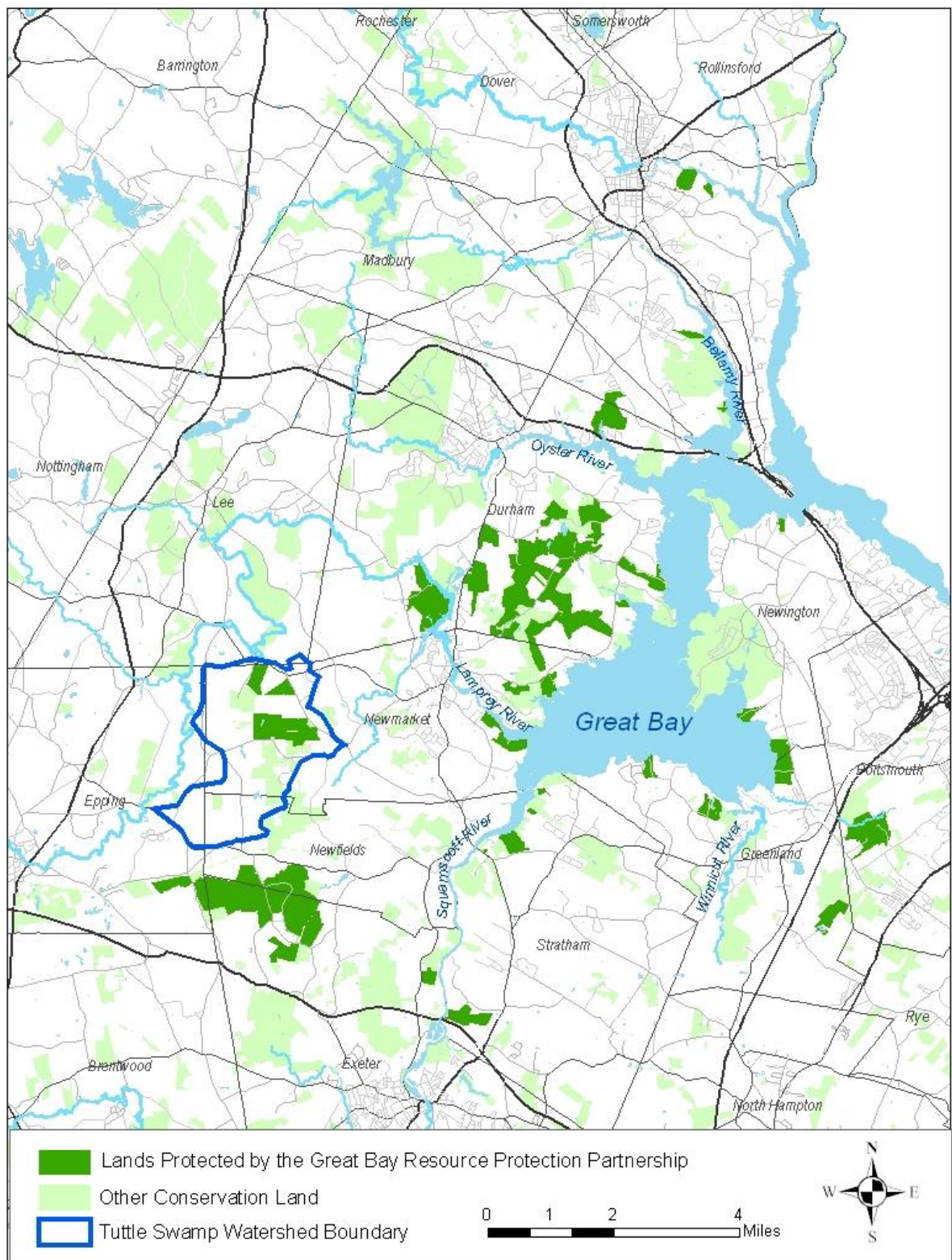


Figure 3. Surrounding Protected Land

IIa. SCOPE AND GOAL OF TUTTLE SWAMP WATERSHED MANAGEMENT PLAN

The Tuttle Swamp Watershed Management Plan is intended to help guide the management of the currently protected properties within the watershed boundary. Ecological processes related to hydrology have been identified as important factors influencing the functions and values of the swamp and consequently the health of its constituent species. As a result, this document describes representative land features within the watershed boundary, but focuses on publicly held and/or conserved lands. Additionally, management recommendations within this plan are based on field work performed on currently protected lands within the watershed, but should apply to all lands within the watershed, assuming similar habitats and hydrologic connections occur throughout the watershed.

The lands and waters within the Tuttle Swamp Watershed are owned and managed by a number of different conservation organizations and private land owners (Figure 2). The principal landowners of conservation land within the Tuttle Swamp watershed are the Town of Newmarket, The Nature Conservancy (TNC), and the New Hampshire Department of Fish and Game (NHFG); however each entity has their own mission, management goals, and capacity. In addition, a diverse array of funding sources was used to acquire many of the protected lands within Tuttle Swamp often leading to many levels of interest in individual parcels. Consequently, the Great Bay Resource Protection Partnership (GBRPP) identified Tuttle Swamp as an area in need of an ecologically based management plan. This plan will help guide the individual owners to manage the swamp from a landscape perspective rather than on a parcel by parcel basis. Guidelines presented here are intended to meet the goals of all landowners and major funders (Table 1).

The primary goal of the Tuttle Swamp Watershed Management Plan is to provide management guidelines that will help protect the integrity of the constituent habitats and ecosystems in and around Tuttle Swamp. The plan focuses on, prioritizes, and presents information on the natural resource features, while recognizing political and ownership boundaries. This plan is also intended to help coordination, cooperation, and communication between the individual landowners with respect to management actions and planning processes.

Table 1: Management Goals of the funding partners and agencies with interest in the protected lands at Tuttle Swamp. Acronyms: Land and Community Heritage Investment Program (LCHIP), North American Waterfowl Conservation Act (NAWCA), Department of Environmental Services (DES), Lamprey River Advisory Committee (LRAC).

Management Goals	Newmarket Openspace Bond	LCHIP	NH DES	LRAC	GBRPP	NHFG
Protect scenic views	X	X			X	
Protect drinking water & surface water quality	X	X	X	X	X	
Protect & manage diversity of wildlife populations & habitat/travel corridors	X				X	X
Protect rural character of town & cultural resources	X	X				
Protect & manage diversity of wetland habitats, migratory waterfowl populations, & other constituent species					X	X
Provide public recreation opportunities compatible with wildlife resources & management	X	X		X	X	X
Provide educational opportunities compatible with wildlife resources & management		X			X	X
To protect, enhance, restore, & manage exemplary natural & characteristic coastal natural communities & habitats for rare, threatened, & endangered species of animal, plants, & other wildlife.		X			X	X
Manage project areas from a landscape perspective to protect integrity of ecosystem					X	X
Maintain working forests & agriculture, & protect farm soils from development		X				

IIb. ACQUISITION HISTORY

The majority of land within the Tuttle Swamp Watershed is privately owned. Land protection efforts at Tuttle Swamp have been focused in the northeastern portion of the watershed around the large basin swamps of Tuttle and Ash Swamps. Currently 25% of the watershed is protected (752 acres; see Table 2). The Town of Newmarket and The Great Bay Resource Protection Partnership have focused their efforts on protecting the most sensitive resources in the core of Tuttle and Ash Swamps.

The Nature Conservancy acts as the primary land acquisition agent for the Great Bay Resource Protection Partnership. The fee and management responsibilities for all the properties protected by the GBRPP in Tuttle Swamp will eventually be transferred from TNC to the NHFG.

Timeline of land protection at Tuttle Swamp (Figure 4):

Currier, 1996	The first parcel to be protected at Tuttle Swamp was the Currier parcel on Route 152 which was purchased by the town of Newmarket in 1996.
TNC, 1997	The Nature Conservancy identified Tuttle Swamp as a land protection priority in its Conservation Area Plan completed in 1997.
Dearborn, 2000	A 36-acre conservation easement was donated to the New Hampshire Fish and Game (NHFG) on the Dearborn parcel off Grant Rd.
Squillace, 2001	The GBRPP's first acquisition at Tuttle Swamp was the Squillace parcel in 2001, located near the corner of Ash Swamp road and Route 152.
Benoit, 2002	In 2002, the GBRPP bought the Benoit parcel in fee on the corner of Jan Lane and Route 152.
Woods, 2002	The GBRPP bought the Woods parcel, a landlocked parcel of forested wetlands in the center of Ash Swamp.
Sewall, 2002	The Sewall family agreed to put a conservation easement on 55 acres of their family farm in 2002. The easement was held by The Nature Conservancy.
Grapevine Hill, 2003	The town of Newmarket partnered with the NH Department of Environmental Services (DES), The State of New Hampshire Land and Community Heritage Investment Program (LCHIP), the Lamprey River Advisory Committee (LRAC), and the Great Bay Resource Protection Partnership to protect the 160-acre Grapevine Hill parcel. Interest in the Grapevine Hill parcel is shared between the many funding partners. The town of Newmarket holds the fee, NHFG holds a conservation easement on the parcel, LCHIP holds executory interest and public access, and DES has retained the right to use the property for a public drinking water supply.
Hilton, 2004	The town of Newmarket used Open Space Bond money to acquire a conservation easement on the Hilton farm. The 96-acre Hilton farm abuts the Grapevine Hill property to the south across Grant Rd. The Rockingham Land Trust has been contracted to do the easement stewardship on the Hilton parcel for the town.
Sewall, 2005	A subdivision clause in the Sewall deed expired allowing the parcel to be split into two. Forty-three acres of the original easement was sold in fee and will be transferred to

NHFG. Their 14-acre field was retained under easement and will be transferred to NHFG.

Nostrom, 2006 The town of Newmarket, the Great Bay Resource Protection Partnership, and the US Department of Agricultural combined resources to protect the 81-acre Nostrom Farm in Tuttle Swamp with a conservation easement that will continue to allow agricultural activities such as grazing and organic farming.

Table 2: Owners of protected land within the Tuttle Swamp watershed (See also Fig. 4):

<i>Tuttle Swamp Core</i>	<i>Acres</i>	<i>Fee Owner</i>	<i>CE holder</i>	<i>Year Protected</i>
Benoit	58	TNC – to be transferred to NHFG		2002
Currier	61	Town of Newmarket		1996
Dearborn	36	Private	NHFG	2000
Grapevine Hill	144	Town of Newmarket	NHFG	2003
Nostrom Farm	81	Private	Town of Newmarket	2006
Sewall Farm	15	Private	TNC to be transferred to NHFG	2002
Sewall	43	TNC – to be transferred to NHFG		2002
Squillace	42	NHFG		2001
Woods	33	NHFG		2002
Total Tuttle Swamp Core	513			
<i>Other protected parcels within TUTTLE SWAMP WATERSHED</i>	<i>Acres</i>	<i>Fee Owner</i>	<i>CE holder</i>	
Brady	2	Lee	SPNHF	
Doe Farm	11	Town of Newmarket		
Hilton	96	Hilton	Town of Newmarket	
Norton Farm	3		Town of Newmarket	
Piscassic Greenway	40	Rockingham Land Trust	Town of Newfields	
Sanborn Drive Lot	24	Town of Newfields		
Schanda Farm Open Space	63	Town of Newmarket		
Other lands Total	239			
Total Conserved Acres in Tuttle Swamp Watershed	752			

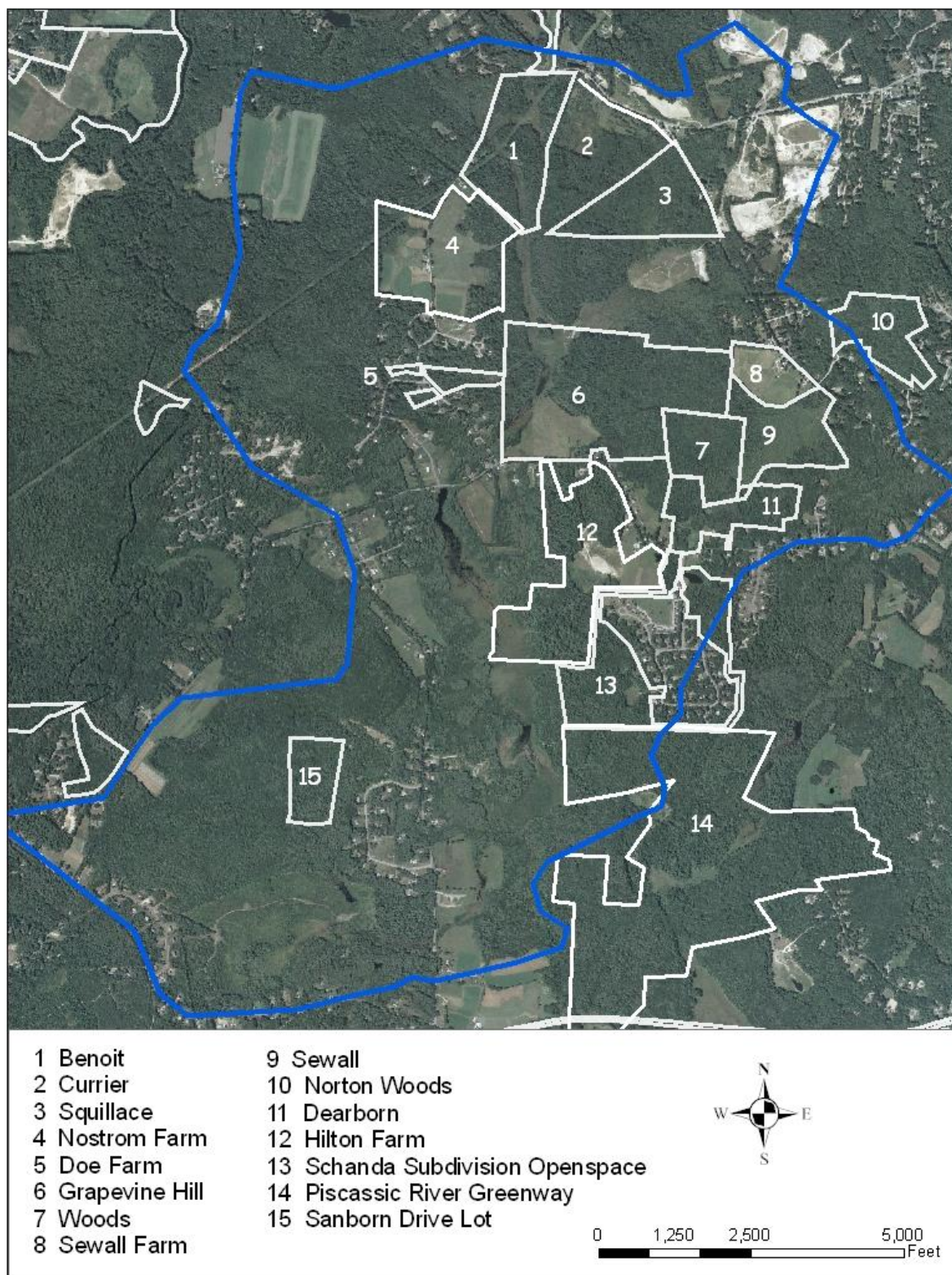


Figure 4. 2004 True-colour aerial photograph of the Tuttle Swamp Watershed with conservation lands identified.

IIc. FIELD METHODS AND MANAGEMENT UNIT APPROACH

Data Collection: As a first step, we compiled existing natural resource data from within the Tuttle Swamp Watershed. Rare species and exemplary natural community information was provided by the NH Natural Heritage Bureau. Various inventories and reports on the natural communities, rare species, and birds of the Tuttle Swamp Watershed have been conducted by The Nature Conservancy, the NH Natural Heritage Bureau, the Lamprey River Advisory Committee, and the University of New Hampshire. Results from the following reports are incorporated into this plan.

- A vegetation assessment of the Lamprey River corridor in Epping, Lee, Durham, and Newmarket, New Hampshire. Sperduto & Crow 1994.
- Conservation Plan for the Great Bay Region. Stevens & Anderson 1997.
- Ecological Assessment of Selected Towns in the Great Bay Area. New Hampshire Natural Heritage Program 1997.
- An Assessment of Natural Communities and Significant Wildlife Habitat in Selected Focus Areas in the Piscassic River Watershed. The Nature Conservancy, NH Chapter. June 2002.
- Wildlife habitat GIS modeling study. Society for the Protection of New Hampshire Forests 2002.
- Developing a Conservation Strategy to protect land habitat functions for New Hampshire's reptiles and amphibians using the Blanding's Turtle as a flagship species. Jenkins & Babbitt 2003.
- Natural Resource Management Plan: Grapevine Hill – Tuttle Swamp Conservation Area. Tarr 2005.

Field Work: To complement the existing data, an assessment of the natural communities within the Tuttle Swamp protected lands was completed in the field season of 2004. Natural community and rare species field data was collected following standard Natural Heritage methodology. The natural communities at Tuttle Swamp were determined using the Natural Communities of New Hampshire (Sperduto & Nichols 2004).

GIS: Many GIS layers available through NH GRANIT provide valuable information about the landscape, land use, and environmental conditions of a site. The following GIS layers were used to help delineate the management units and natural community boundaries, and to estimate land cover types as well as land use change within the watershed.

- Aerial photos (1974, 1992, 1998, 2003)
- Soil Types
- Land Cover Types
- Bedrock Geology
- USGS Topographic maps
- National Wetlands Inventory

III. NATURAL RESOURCE DESCRIPTIONS

IIIa. Landscape Features

Land Cover The NH GRANIT GIS Land Cover (2001) data layer estimates the percentage of the different land cover types in the Tuttle Swamp watershed as:

Forest	59%
Agriculture	5%
Disturbed/Open	18%
Developed	5%
Open Water	2%

Land Use History Similar to most of New Hampshire, the land within the Tuttle Swamp watershed was once open farm land. Stonewalls and barbed wire fences are evident in the core of Tuttle Swamp and were probably used to contain cows, sheep and other grazing farm animals. Some local farmers can recall losing cows to the mucky soils and deep peat in Tuttle Swamp (D. Sewall, *personal communications*). The conditions at Tuttle Swamp were not ideal for farming, except where the landscape is slightly higher in elevation where mostly hay production is more feasible. There are currently three separate grasslands on the Tuttle Swamp protected lands, all of which are a high priority to maintain for the unique habitat that they provide within this watershed.

A town-owned landfill was located near the center of Tuttle Swamp and was a significant threat to the water quality of Tuttle Swamp. The landfill was closed and capped with a geomembrane and clay liner in 1995 and has dramatically reduced the concentration of contaminants released from this area. Water from groundwater monitoring wells surrounding the landfill is monitored twice per year for contaminants including arsenic and volatile organic compounds. Since capping, the contaminant load in the groundwater has been slowly decreasing. As groundwater flows through Tuttle Swamp contaminated groundwater is directed generally towards the north, but the concentration of contaminants is reduced quickly as it moves away from the mound (CMA Engineers 2000). Over time, materials within the landfill are expected to decompose, degrade and become less and less of a threat to the water quality.

Wetlands Tuttle and Ash Swamps have been designated as Prime Wetlands by the town of Newmarket. The Prime Wetland encompasses all the forested and non-forested wetlands within the core of Ash and Tuttle Swamps. The entire Prime Wetland is 520 acres (Figure 5). The National Wetland Inventory has identified over 25% of the entire Tuttle Swamp watershed as wetlands (750 acres). The dominant wetland type within the watershed is red maple swamp, but many other wetland types do occur in less abundance including cattail marshes, scrub-shrub swamps, seepage fens, and mixed graminoid marshes.

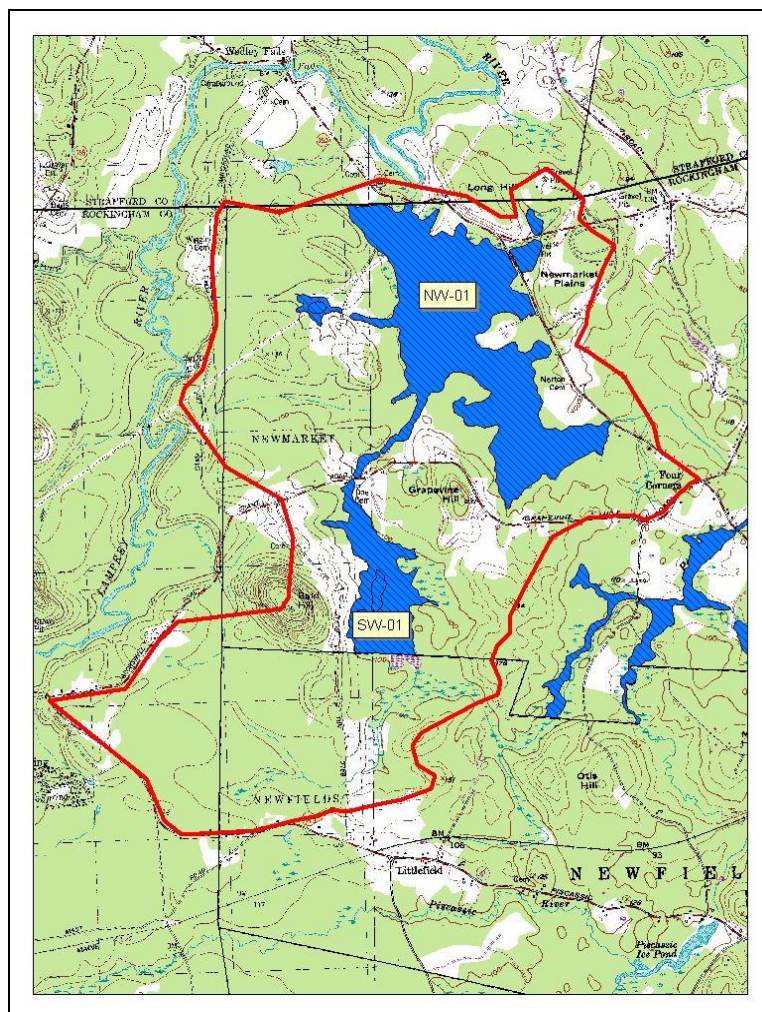


Figure 5. Prime Wetlands within the Tuttle Swamp Watershed

Soils

The dominant soils within the Tuttle Swamp Watershed are fine sandy loams, mucky peats, and silt loams. Forty percent of the soils in the Tuttle Swamp watershed are considered to be wetland Hydric A or B soils. A few small family farms are located in the watershed. The open fields associated with the farms are on soils consisting of fine sandy loams, and provide important nesting habitat for turtles associated with the larger wetlands.

10%	Silt Loams (Maybid, Boxford & Scitico)
9%	Mucky Peats (Greenwood & Chocorua)
81%	Fine Sandy Loams (Eldridge, Deerfield, Squamscott & Canton)

Bedrock

Bedrock underlying the Tuttle Swamp watershed is the Eliot Formation, a dolomitic phyllite, slate and schist complex which lends a calcareous to circumneutral character to the soils and vegetation (Simmons 1996). Groundwater seepage brings a constant supply of nutrients to the surface and tends to support a plant community rich in species diversity.

IIIb. Conservation Features

Rare Species Inventories for rare plant and animal species in and around Great Bay by ecologists from NH Natural Heritage Bureau, The Nature Conservancy, and others have resulted in the documentation of hundreds of records of plants and animals unique to the coastal area. Several of these rare plant species occur in the Tuttle Swamp watershed (Figure 6, Table 3). Although none of the species are globally imperiled, they characterize the distinct natural heritage of this region and require specific monitoring to ensure they persist over time.

Table 3: Rare species, associated habitat types, and exemplary natural communities in the Tuttle Swamp Watershed.

Rare Species	State Rank	Forested Wetland	Forested Upland	Emergent Marsh	Sedge Fen	Open water	Hay fields	Early successional habitat
Blanding's Turtle	T	x		x		x	x	x
Spotted Turtles	SC			x		x	x	x
Wood Turtle	SC			x		x		
Climbing Hempweed	T	x						
Tufted Loosestrife	T			x				
Large Bur-reed	T			x				
Black Maple	T		x					
Fen Ant	E	x			x			
Eastern Meadowlark	SC						x	
Bobolink	SC						x	
Blue-winged Warbler	SC						x	
American Woodcock	SC				x		x	x
New England Cottontail	SC				x			x
Red Shouldered Hawk	SC	x						
Whip-poor-will	SC							x
Sedge Wren	SC						x	
Least Bittern	SC			x				
Swamp White Oak Floodplain Forest	S2	x						
Red maple – black ash – swamp saxifrage swamp	S2	x						
Low gradient sandy-silty riverbank system	SNR			x				

E, Endangered; T, Threatened; SC, Species of Special Concern; SNR, State Not Ranked



Bobolink - photo by Art Morris



Blanding's turtle basking on log in pond on the landfill property



Abandoned fen ant mound on Squillace parcel in red maple-black ash-swamp saxifrage swamp

Natural Communities An inventory of the exemplary natural communities in the Tuttle Swamp and Piscassic River area was performed by ecologists from NH Natural Heritage Bureau in 1997 and 2002. One season of ecological field work was performed by The Nature Conservancy using NH Bureau methodology to supplement the 1997 information and document the entire suite of natural communities present on the protected lands within the Tuttle Swamp Watershed for this report (Figure 7). All natural community names presented here follow Natural Communities of New Hampshire (Sperduto & Nichols 2004).

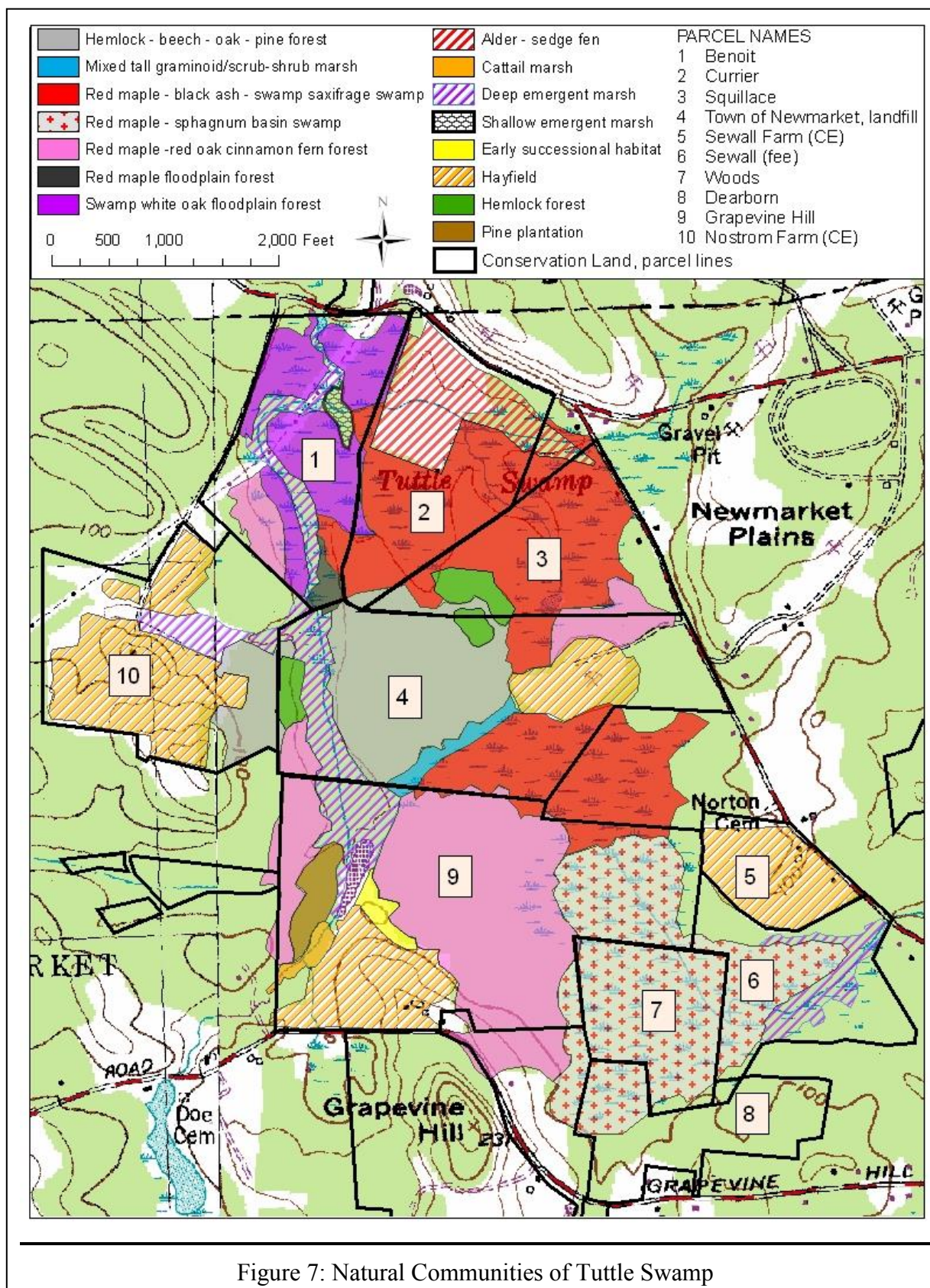


Figure 7: Natural Communities of Tuttle Swamp

Forested wetlands

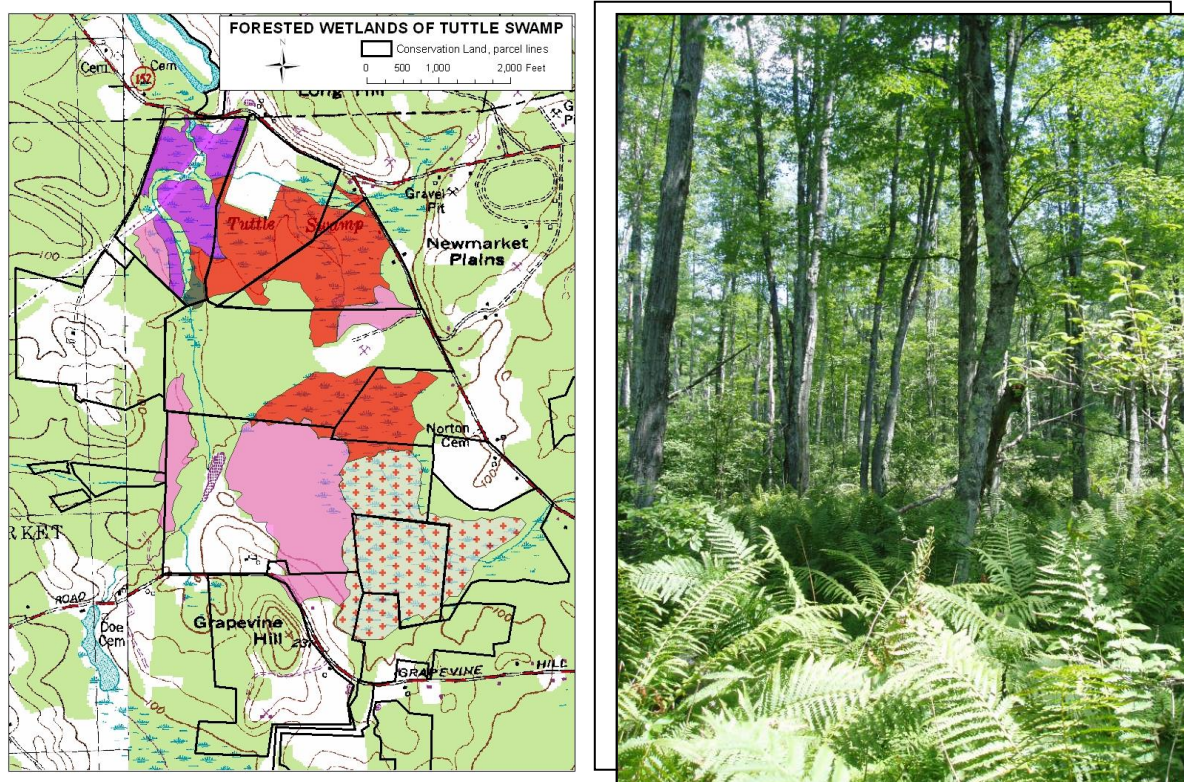







Figure 8: Forested Wetlands in Tuttle Swamp

Map Color	Forested Wetlands - Natural Community types	State Rank	Size, acres	NHB Rank	Parcels
	Red maple-black ash – swamp saxifrage swamp	S2	118	B	Benoit, Currier, Squillace, landfill, Grapevine hill
	Red maple – sphagnum basin swamp	S4	85		Woods, Sewall (fee), Grapevine Hill
	Red maple floodplain forest	S2S3	3		Benoit
	Swamp white oak floodplain forest	S1	35	B	Benoit
	Red maple-red oak-cinnamon fern forest	S3S4	99		Benoit, Squillace, Grapevine Hill, landfill

Forested wetlands are the dominant habitat type within Tuttle Swamp. The forested wetlands occur on over 66% of the protected lands within the core of the Tuttle Swamp Watershed, and are a mosaic of different types of red maple dominated swamps. Combined these forested wetland community types make up a large temperate minerotrophic swamp system (Sperduto 2004). This large wetland system is described by the NH Natural Heritage Bureau as occurring in headwaters on mineral soils around open wetlands, and is relatively common in southern New Hampshire.



Red maple – sphagnum basin swamp

The core of Tuttle Swamp is a red maple – black ash – swamp saxifrage swamp (S2). This is the classic type of forested seepage swamp with plants indicative of nutrient-enriched groundwater seepage commonly occurring throughout. This forested swamp type is often a part of a larger mosaic of swamp communities occurring in flat or slightly sloping wetlands on poorly drained soils where groundwater and/or subsurface upland runoff influences the root zone of the swamp (Sperduto & Nichols 2004). At Tuttle Swamp this forest type is quite similar to the community description in Sperduto & Nichols 2004 with a thin canopy dominated by red maple (*Acer rubrum*) and occasional American elm (*Ulmus americana*), white pine (*Pinus strobus*), and black ash (*Fraxinus nigra*). Both yellow birch (*Betula alleghaniensis*) and young red maple were common in the understory. Shrubs occur in dense patches throughout including male berry (*Lyonia ligustrina*), northern spicebush (*Lindera benzoin*), winterberry (*Ilex verticillata*), speckled alder (*Alnus incana*), poison sumac (*Rhus vernix*), sweet pepperbush (*Clethra alnifolia*), common elderberry (*Sambucus canadensis*), and black chokeberry (*Aronia melanocarpa*). The swamp supports a diverse assemblage of herbaceous species and very little sphagnum moss. Herbaceous species present include swamp candles (*Lysimachia terrestris*), goldthread (*Coptis trifolia* var. *groenlandica*), swamp saxifrage (*Saxifraga pennsylvanica*), and sensitive fern (*Onoclea sensibilis*), with patches of narrow-leaved cattail (*Typha latifolia*), yellow sedge (*Carex flava*), bur-reed (*Sparganium americanum*), common three-square (*Dulichium arundinaceum*), rattlesnake manna-grass (*Glyceria canadensis*), and arrowhead (*Sagittaria* sp.) occurring in the more open areas.

A large red maple - sphagnum basin swamp (S4) is the dominant forest type in Ash Swamp. This forested swamp occurs on Greenwood mucky-peat and has well developed hummock-hollow topography. The canopy is composed of sparse to dense red maple with occasional yellow birch, white pine, and American elm. The shrub layer has a patchy distribution composed of winterberry, mountain holly (*Nemopanthus mucronata*), male berry, high bush blueberry (*Vaccinium corymbosum*), and nanny berry (*Viburnum nudum*). Cinnamon fern (*Osmunda cinnamomea*) dominates the herbaceous layer and is occasionally growing with few individuals of bladder sedge (*Carex intumescens*), marsh fern (*Thelypteris palustris*), royal fern (*Osmunda regalis*), and common water horehound (*Lycopus uniflorus*). Wild sarsaparilla (*Aralia nudicaulis*), goldthread, and Canada mayflower (*Maianthemum canadense*) grow on

the hummocks of drier soils within the swamp. Blow-downs are common throughout the swamp resulting in abundant downed and decaying wood.

The swamp white oak floodplain forest (S1) in Tuttle Swamp is the largest example of its kind in the Lamprey River Watershed (NHB 1997). Swamp white oak floodplain forests are rare in New Hampshire, only occurring in floodplains with silty soils of marine origin within 50km of the coast (Sperduto & Nichols 2004). The swamp white oak floodplain forest at Tuttle Swamp is found on the east and west sides of Tuttle Brook on the south side of Route 152. The canopy is composed of mature swamp white oak (*Quercus bicolor*), musclewood (*Carpinus caroliniana* var. *virginiana*), red maple, and white pine. Large carpets of New York fern (*Thelypteris noveboracensis*) create a glade-like appearance in some areas. The shrub layer is patchy and species diverse including high bush blueberry, eastern meadow-sweet (*Spiraea alba* var. *latifolia*), winterberry, American hazelnut as well as saplings of musclewood and swamp white oak. Other herbaceous species occurring in this floodplain forest include sessile-leaved bellwort (*Uvularia sessilifolia*), lake sedge (*Carex lacustris*), sensitive fern (*Onoclea sensibilis*), and common woodreed (*Cinna arundinacea*).

Good examples of the red maple-red oak-cinnamon fern forest (S3S4) community type occur on the Grapevine Hill and Benoit properties. This forest type is typically found on somewhat poorly drained mineral soils in the transitional zone between upland and wetland communities (Sperduto & Nichols 2004). The red oak – red maple cinnamon fern forest at Tuttle Swamp is composed of a mixture of wetland (cinnamon fern, red maple, American elm) and upland species (Appalachian oaks and hickories) and occurs on poorly drained silty loams. The canopy is dominated by red maple, with scattered red oak (*Quercus rubra*), white pine, and hemlock. The shrub layer is sparse and composed of wetland species including highbush blueberry and winterberry. Cinnamon fern carpets the understory with other ferns including royal fern (*Osmunda regalis* var. *spectabilis*) and New York fern.



Red maple – black ash – swamp saxifrage swamp on the landfill property

Rare Species of the Forested Wetlands

There are several rare wildlife species associated with the forested wetlands at Tuttle Swamp. A population of **Blanding's turtles** (S3) has been tracked moving throughout the forested wetlands, nearby upland, and open wetland habitats in Tuttle Swamp by the University of New Hampshire. Tuttle Swamp was the only site included in their study where researchers found juvenile Blanding's Turtles (Kim Babbitt, personal communication). Two Blanding's turtles were observed while mapping the natural communities on the Tuttle Swamp conservation lands for this report in the summer of 2004. One adult was seen basking on a log in a fire pond on the landfill property, and one young was seen crossing the dirt lane on the Nostrom tract. Blanding's turtles are capable of traveling great distances between wetland and nesting habitats, consequently the protection of large unfragmented landscape at Tuttle Swamp is very important for their survival (Jenkins & Babbitt 2003).

A population of the fen ant (S1) was documented at Tuttle Swamp in 1996--only the second reported populations in New Hampshire. Fen ants are indicative of minerotrophic groundwater seepage, and are an important part of fen structure and function. Fen ants make large mounds up to several feet tall of dark rich soil around the bases of shrubs. The shrub roots then grow into the mounds of rich soil. The ants tend a garden of fungi on the roots and feed on the honeydew of another insect that feeds on the fungus. Even abandoned mounds provide excellent nesting habitat for turtles (Tim Simmons, personal communication). A search for the fen ant population was carried out in the summer of 2004 and only abandoned mounds were found in the Red maple – black ash – swamp saxifrage swamp. Open wetlands are required to maintain a fen ant population, and it appears this population may have been shaded out as the forest has matured into a less open, more forested swamp at this site.

A population of climbing hempweed (S2) was documented from the swamp white oak floodplain forest in 1997 by the Natural Heritage Bureau. Climbing hempweed is a twining vine in the Aster family that occurs in wetlands primarily along the eastern coast. Populations of climbing hempweed in NH are on the northern edge of their range which extends west to Missouri and south to Texas and Florida. It is listed as threatened in NH and believed to be extirpated from ME (NatureServe, 2005). Thirteen plants were found in 1997 growing along the north-south stream channel south of the powerline in a relatively small patch. The plants were searched for as a part of the field work for this report in 2004, but were not found. Additional searches are recommended to update the status of this small population.

Large, mature, forested wetlands associated with open wetlands provide excellent habitat for red shouldered hawks. This species is in decline throughout its range as a result of habitat fragmentation and loss (NHFG, 2006). Large forested wetlands as well as development pressures are most common in southern NH. Forest fragmentation favors great horned owls and red tailed hawks over red shoulder hawks (NHFG, 2006). Although not specifically documented from this area, the Society for the Protection of New Hampshire Forests identified Tuttle Swamp as excellent potential habitat for Red Shouldered Hawks as part of a GIS analysis of the Lamprey River watershed (SPNHF 2002).

Forested uplands

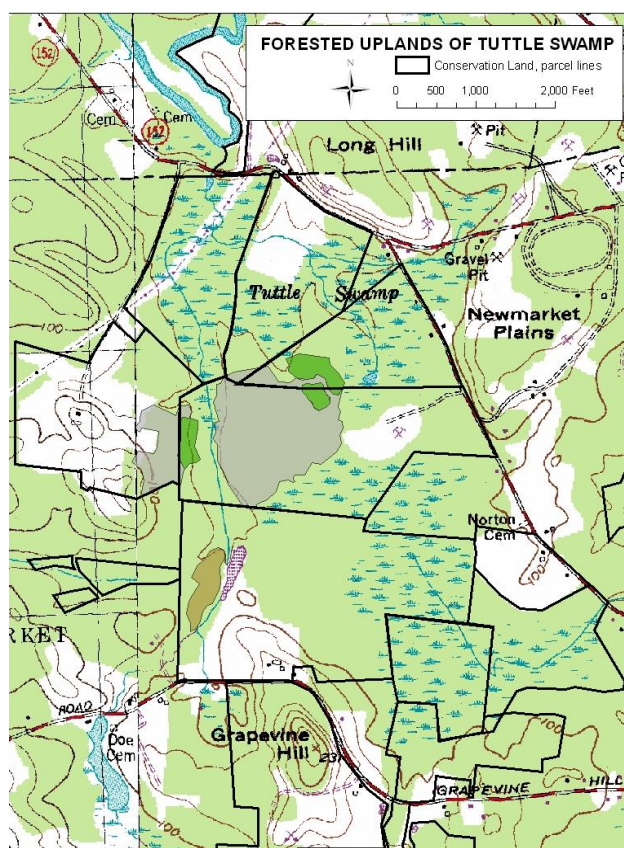





Figure 9. Forested uplands in Tuttle Swamp

Map Color	Forested Upland	State Rank	Size	Parcels
	Hemlock-beech-oak-pine forest	S5	55 acres	Landfill, Squillace, Nostrom
	Hemlock forest	S5	Small patches	Squillace, Landfill
	Pine plantations	N/A	6 acres	Grapevine Hill

Hemlock-beech-oak-pine forest is the common forest type found on the upland within the Tuttle Swamp Watershed. The largest example is found on the town of Newmarket property, west of the old land fill. As with most examples of this community type in the state, this forest is in an early to mid-successional stage due to a history of agriculture and frequent timber cutting. Many white pine cut stumps are evident throughout this forest. White pine dominates the canopy and is abundantly regenerating in the understory. Big-toothed aspen (*Populus grandidentata*) has also densely colonized the canopy gaps created by timber activities. Beech (*Fagus grandifolia*), red oak, sugar maple (*Acer saccharum*), and red maple are frequent canopy and subcanopy trees. Very few shrubs and herbaceous species are present although in some area large patches of hay-scented fern (*Dennstaedtia punctilobula*) carpet the forest floor. Small patches of hemlock forest no more than an acre in size (i.e. inclusions) occur within the red maple swamp, and provide excellent cover for wildlife, especially deer, in the winter months. As with most hemlock forests, there is dense shade and little understory vegetation in the hemlock dominated islands within Tuttle Swamp.

Open emergent wetlands and open water

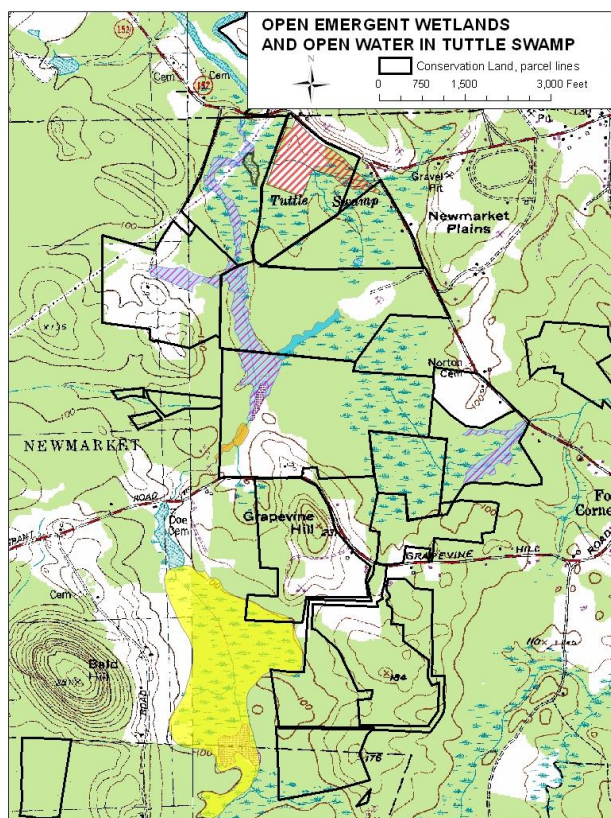







Figure 10. Open emergent wetlands in Tuttle Swamp

Map Color	Open Water & Emergent Wetlands	State Rank	Size	NHB Rank	Parcels
	Low gradient sandy-silty riverbank system	S3	120 acres	B+	South of Grant Road
	Open pond		1 acre		Grapevine Hill
	Cattail marsh	S4	2 acres		Grapevine Hill
	Mixed tall graminoid/scrub-shrub marsh	S4S5	4 acres		Benoit
	Tall graminoid emergent marsh (deep emergent marsh)	S4	44 acres		Grapevine Hill, Nostrom, landfill, Benoit, Sewall

An exemplary low gradient sandy-silty riverbank system has been reported by the Natural Heritage Bureau within the headwaters of the Piscassic River south of Grant Road (TNC 2002). This system is found in sandy or silty river channels and riverbanks along low gradient, low to moderate energy, meandering stream, and minor rivers (Sperduto 2005). This complex of wetland types includes alluvial shrub thickets, tall graminoid emergent marshes, and graminoid meadows. This area was inventoried in 2001 by the Natural Heritage Bureau and the NH Audubon Society biologists for The Nature Conservancy. The habitat was described as a very large wetland complex with extensive wetland shrub cover interwoven with open water pockets. As part of the survey, a high diversity of bird species

was found within the wetlands including a pair of Virginia rails. The wetlands were also identified as potential breeding habitat for numerous wetland bird species including the endangered pied-billed grebe (TNC, 2002).

Beaver activity, including chewed stumps and sticks, is evident along Tuttle Brook. A dam, of potentially man-made origin, blocks the slow north flowing drainage and has create a small open pond adjacent to the hayfield and the tall graminoid emergent marsh on the Grapevine Hill property. Floating aquatic vegetation covers much of the open water in the pond. Based on aerial photographs, it looks as if the open pond on the Grapevine Hill property may have been excavated and dammed prior to 1974. NRCS has no record of this activity, although it could have been performed prior to the need for federal or state permits. Downstream from the pond the wide and slow moving channel supports a sizeable cattail marsh.

Tuttle Brook is a long linear drainage flowing slowly north into the Lamprey River. Along its length, its wide banks support a tall graminoid emergent marsh, and in slower back water areas, more dense vegetation of mixed tall graminoid/scrub shrub marsh. Dominant species include tussock sedge (*Carex stricta*), cattail, water horehound (*Lycopus uniflorus*), blue-joint grass (*Calamagrostis canadensis*), speckled alder (*Alnus incana*), male berry (*Lyonia ligustrina*), sweet pepperbush (*Clethra alnifolia*), and meadowsweet (*Spiraea alba*). Narrow braided channels of open water flowing through the marsh are also largely vegetated with arrowhead (*Sagittaria* sp.), pickerel-weed (*Pontedaria cordata*), and bur-reed (*Sparganium* sp.).

Rare Species of the Open Water and Emergent Marshes

Many rare plants and rare turtles are associated with the open emergent marshes and open water of Tuttle Swamp. As noted before, **Blanding's** turtles have been radio-tracked by UNH throughout the wetland habitats of Tuttle Swamp. Wood turtles have been reported from Tuttle Brook. They are known to follow slow moving streams with sand or gravel substrate, to stay within the riparian corridor, and not to travel more than a few hundred meters from the stream edge (MNHESP Fact Sheet 1999, NHFG 2006). As the most terrestrial turtle in North America, they make extensive use of uplands in the summer and seem to prefer areas that have diverse habitat types including some disturbances that may open up potential nesting sites (NHFG 2006). Spotted turtles have been seen basking in the scrub-shrub wetlands and open ponds of Tuttle Swamp and are known to nest in the open grassy pasture on the Sewall conservation easement (K. Sewall, personal communication). Spotted turtles are found in areas with diverse wetland types including marshes, ponds, forested swamps, shrubs swamps, and slow moving stream. All three rare turtle species occurring at Tuttle Swamp are declining throughout their range as a result of habitat fragmentation and loss, increased roads and traffic, collection, and an increase in generalist predation associated with residential development (raccoons, dogs, cats, skunks, etc.) (NHFG 2006).

A population of the state threatened tufted loosestrife (*Lysimachia thyrsiflora*) was found growing in the wide emergent marsh in the riparian border of Ash Brook. Tufted loosestrife is a 1-2ft tall herbaceous wetland plant in the Primrose family with paired globe-shaped yellow flowers emerging from the leaf axils. It is primarily a northern wetland species and is considered rare in many states on the eastern and southern edges of its range. A small population of 50 flowering and fruiting plants was found growing in the shallow water near the upland edge of the open marsh near Ash Swamp Road.

The cattail marsh in Tuttle Swamp provides habitat for the least bittern, a Species of Special Concern in NH. The least bittern is a secretive marsh bird that is extremely rare in NH occurring in only a few suitable cattail marshes in southeastern NH (NHFG, 2006). A least bittern was heard at Tuttle Swamp by a reputable local birder, but no formal documentation of this sighting was made (Gavutis, personal communication). Along with pollution, development, and habitat fragmentation, invasive plant species are a major threat to least bitterns. Purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*) can outcompete with native cattails and degrade cattail marsh habitat quality.

Sedge fen

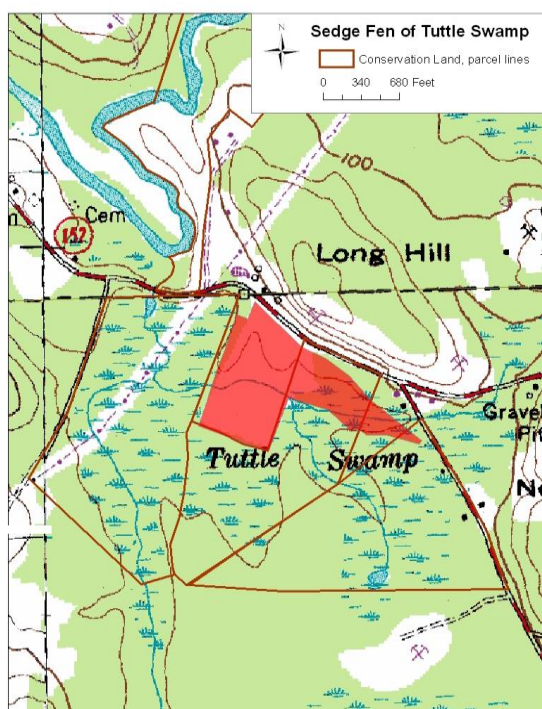



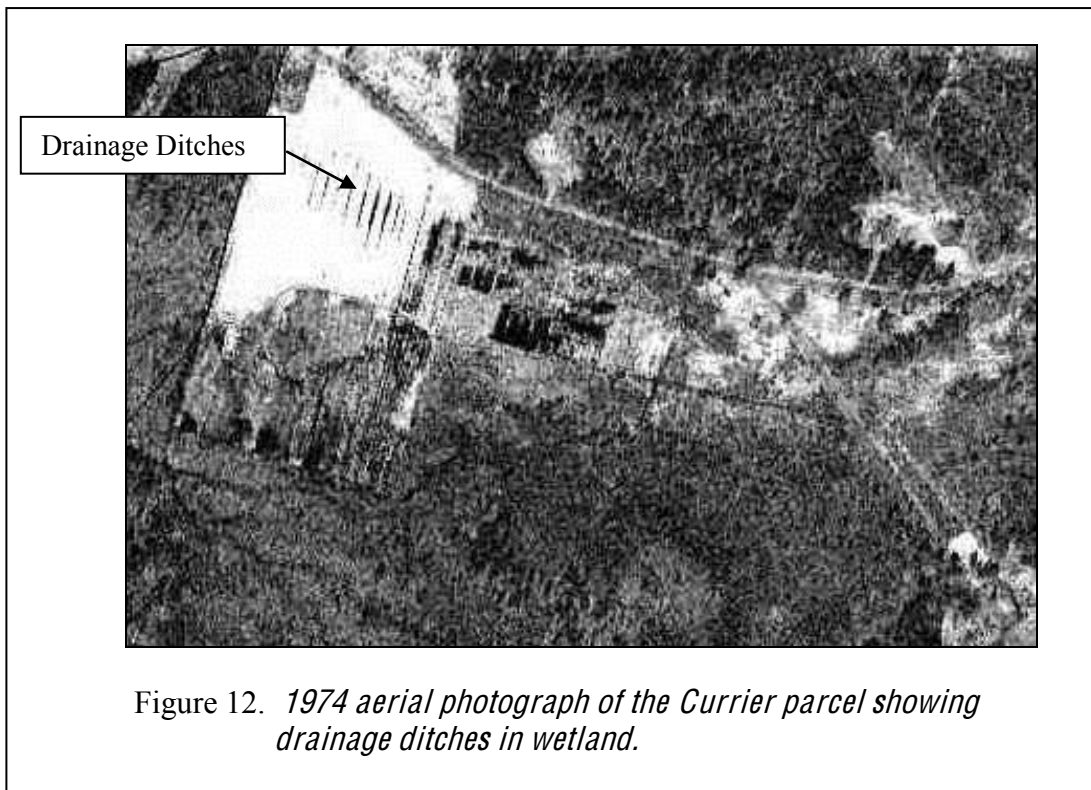
Figure 11. Sedge fen in Tuttle Swamp

Map Color	Sedge Fen	State Rank	Size	Parcels
	Speckled alder – lake sedge intermediate fen	S2S3	25 acres	Currier, Squillace

Remnant parallel scars running north-south through the Currier parcel indicate that the area which is now an open fen has been highly disturbed in the past. The parallel scars are typical of wet field situations where farmers dug ditches in an effort to direct water off pasture or crop land into nearby streams. The east-west stream that runs through the center of the sedge fen to Tuttle Brook was also straightened. The parallel ditches and channelized stream are noticeable in the field and were obvious on the earliest aerial photograph found for this area (Figure 12).

Although the ditches suggest a history of farming at this site, the area was actually disturbed by mining. The underlying soils are fine sandy loams which are currently classified as udorthents (soils that have been modified by human activity). The owner of the gravel pit on the north side of Route 152 (Currier) was the previous owner of this parcel and he incorporated it into his resource extraction business. The top soil was scraped off this entire area leaving behind a wide open area that is in close contact with the water table and is often flooded as a result. Perhaps the ditches were cut in an effort to dry out more removable top soil. A few top soil piles remain on the south side of the parcel.

The open area is now recovering from these various land uses and is currently vegetated with numerous sedges, grasses, and speckled alder (*Alnus incana* var. *americana*). As a result of these disturbances, the plant community is in a transitional stage and supports many non-native wetland species including abundant purple loosestrife (*Lythrum salicaria*). If left to mature naturally, red maples would probably re-colonize the area and it would revert to a red maple – black ash – swamp saxifrage swamp (S2). Currently, it best fits the description of a speckled alder – lake sedge intermediate fen and it provides an interesting open wetland habitat that is unique to the Tuttle Swamp Watershed.



Rare Species of the Sedge Fen

No rare species are documented from the open sedge fen in Tuttle Swamp. However, the alder thickets within the fen provide excellent habitat for some of NH's declining species that rely on early successional shrubland habitat including many songbirds, whip-poor-will, American woodcock, and New England cottontail.

Grasslands

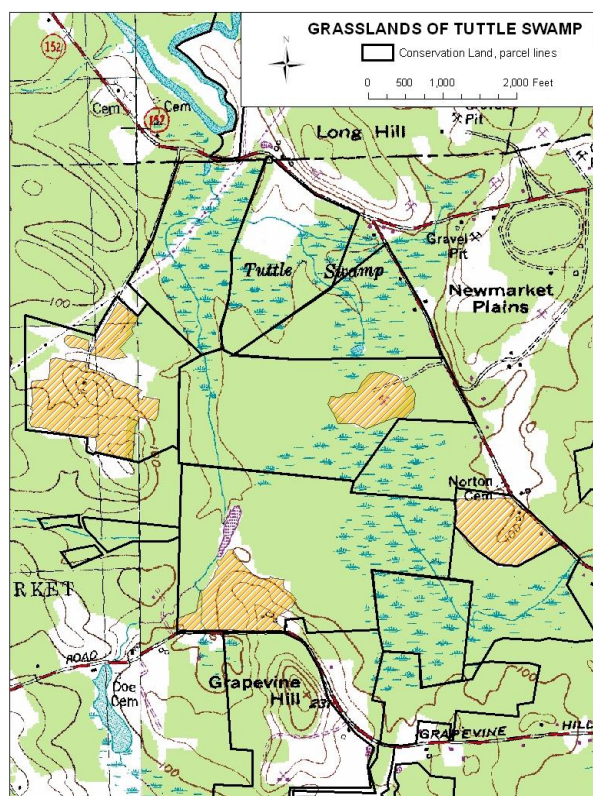


Figure 13. Grasslands in Tuttle Swamp

Map Color	Grasslands	State Rank	Size	Parcels
	Hay field	N/A	26 acres	Grapevine Hill
	Hayfield and Pasture	N/A	39 acres	Nostrom Farm
	Pasture	N/A	14 acres	Sewall Farm(CE)
	Capped landfill	N/A	13 acres	Landfill

Hay fields of cool season grasses and herbaceous species such as goldenrods, clover, and asters are found on the Grapevine Hill property, Nostrom Farm, Sewall Farm, and on the capped landfill. The grasslands in the Tuttle Swamp Watershed add to the diversity of wildlife habitats within the Watershed. Also, the fields on the Grapevine Hill property provide one of the few dry wildlife viewing and recreational opportunities at Tuttle Swamp.

Rare Wildlife Species of the Grasslands

In the Grapevine Hill Management Plan (Tarr 2004) the portion of the Fisk hayfield underlain by fine sandy-loams was identified as excellent potential turtle nesting habitat for all four state-listed turtle species found in Tuttle Swamp. Spotted turtles are also known to use the pasture on the Sewall easement to nest.

Open grasslands are declining throughout New Hampshire as our pastures are reverting to forests due to the decline in agriculture. As a result, species that are dependant on grasslands are also declining across the state. The state has designated many of these grassland species “Species of Conservation Concern.” The fields at Tuttle Swamp have been identified as excellent potential habitat for three Species of Conservation Concern: Eastern meadowlark, blue-winged warbler, and American woodcock (SPNHF 2002). Bobolinks, also a Species of Conservation Concern, are known to nest in the Grapevine Hill fields, and can be seen conducting elaborate courtship displays in the spring time (Tarr 2004).

Early successional shrubland habitat

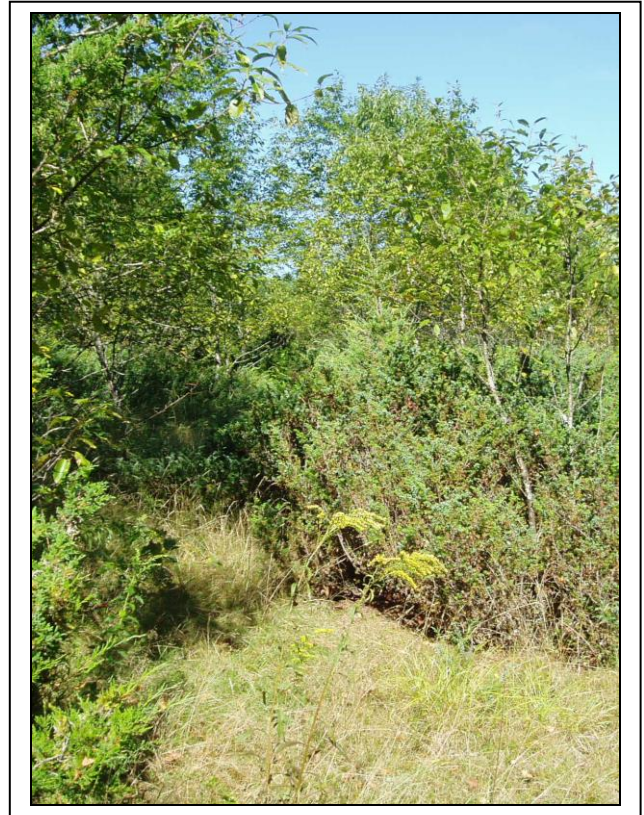
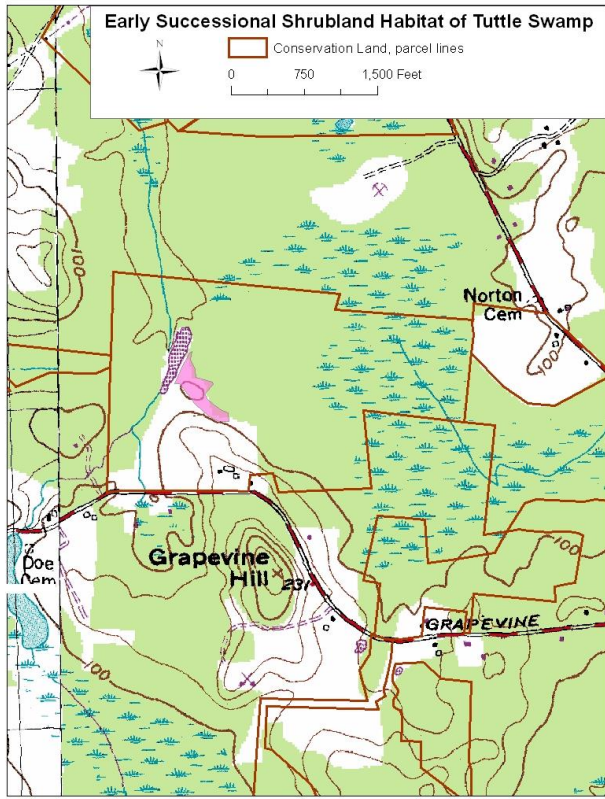



Figure 14. Early successional habitat in Tuttle Swamp

Map Color		State Rank	Size	Parcels
	Early successional shrubland habitat	N/A	3 acres	Fisk

Northeast of the hayfield on the Grapevine Hill property is a small patch of early successional shrubland. This is potential habitat for declining shrubland species such as the New England cottontail. The shrubland is composed of trees and shrub species typical of recently abandoned old fields including black cherry (*Prunus serotina*), grey birch (*Betula populifolia*), ground juniper (*Juniperus communis* var. *depressa*), white pine, and steplebush. Many species of goldenrods, asters, and grasses are also abundant in the early successional shrubland.

Wildlife Species of the Early Successional Habitat

The shrubby early successional habitats on the Grapevine Hill property have been identified as excellent feeding and nesting habitat for American woodcock with good potential for enhancement. The early successional habitat is also identified as potential habitat for whip-poor-wills and New England cottontails, two Species of Conservation Concern in New Hampshire.

IV. WATERSHED MANAGEMENT

Water quality and the natural hydrologic dynamics within the core of Tuttle Swamp are influenced by land use and land management within the watershed. Ecological processes related to hydrology have been identified as important factors influencing the functions and values of the swamp and consequently the health of its constituent species. Due to the underlying importance of the water quality within the watershed, we identified the primary considerations within the Tuttle Swamp watershed as:

- the protection of water quality and quantity
- the maintenance and enhancement (if necessary) of wildlife habitats within the watershed.

In this section, several land use issues and land management options that are common to conservation land ownership and management are discussed as they relate to both water quality and wildlife habitat. Included in each of the following land use and land management discussions are options to consider and suggested recommendations. The following discussion applies to management actions appropriate for the watershed in general, whereas recommendations unique to a specific habitat type are presented in the following sections.

IVa. Public land use

Allowable uses The allowable recreational uses on the conservation land should correspond to the management goals, and thus have minimal impact on water quality, wildlife habitat, rare species, and natural communities.

Ultimately it is up to each landowner to determine appropriate recreational uses on their properties. Some land uses are specifically required or prohibited in the deed restrictions, conservation easements, etc associated with individual parcels. Table 4 summarizes the current allowed (Y) and not allowed (N) recreational uses of the protected parcels, based on conservation agreements; such as conservation easements or deed restrictions; project funding; and/or ownership goals. All allowable uses should be regularly monitored to ensure they remain consistent with the management goals.

Public land use management options and recommendations

Motorized Recreation:

Motorized vehicles (except snowmobiles on the established state trail system) are not currently allowed, and should not be allowed on any conservation land within the Tuttle Swamp watershed, except for management purposes.

ATVs All Terrain Vehicles (ATVs) pose a serious threat to the wildlife habitat and water quality within the Tuttle Swamp watershed, and should be prohibited to protect sensitive wetlands, soils, native vegetation, and wildlife. All access points to the preserve should be posted to clearly indicate that ATVs are not permitted, and trails should be monitored for ATV use. A gate should be installed where the snowmobile trail enters the Tuttle Swamp protected lands off Grant Road to control wheeled vehicles onto the field. Currently, there is moderate ATV use on a portion of the snowmobile trail on the northwest side of Tuttle Swamp (Figure 15).

Potential damage from ATVs include:

- soil erosion and resulting degradation of the water quality and interruption of ecological process that impact the wetland habitats

- noise disturbance to nesting birds, including disturbance-sensitive neotropical migrants, waterfowl, and wading birds
- impacted wildlife foraging and movement patterns – many animals will avoid traveling across vehicular roads and trails, changing their natural migration corridors and fragmenting habitat
- animal mortality (i.e., roadkill), especially for snakes, salamanders, and frogs
- invasive species introduction.

Snowmobiles The snowmobile trail bisecting Tuttle Swamp is currently part of a state maintained trail network and should be maintained as a connector trail to a large trail system north of Tuttle Swamp (Figure 15). This snowmobile trail has been maintained by the Great Bay Sno-Rollers for over 30 years, and was one of the first established trails in the area. Snowmobiling off of this formal trail should not be permitted. Snowmobile use of the trail should be limited to when there is sufficient snow cover (approximately 4-6 inches) to prevent damage to the soils and vegetation below. As stated in the Natural Resource Management Plan of Grapevine Hill, the current trail does not appear to interfere with the natural features of the watershed, and may remain provided the private landowners that share the through-trail also grant the necessary permission (Tarr 2005).

	Pets (under control)	Horseback riding	Mountain biking	Hiking	X-country skiing/ snow-shoeing	ATVs	Snowmobiling	Nature study	Picnicking	Fishing	Hunting	Trapping	Wheeled Vehicles	Camping	Sledding	Swimming	Night time use
Benoit	Y			Y	Y	N	Y	Y		Y	Y	Y	*	N			
Currier	Y			Y	Y	N	Y	Y		Y	Y		*	N			
Squillace	Y			Y	Y	N	N	Y		Y	Y	Y	*	N			
Landfill																	
Sewall (fee)	Y			Y	Y	N	N	Y		Y	Y	Y	*	N			
Sewall (ce)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Woods				Y	Y	N	N	Y		Y	Y	Y	*	N			
Grapevine Hill	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y		*	N	Y	N	N

Table 4: Allowed (y) and not allowed (n) recreational uses of the protected lands in Tuttle Swamp. Asterisks (*) reflect management purposes only.

Passive Recreation:

Hiking No formal hiking trail currently exists within Tuttle Swamp; consequently pedestrian use is limited and usually confined to the field on Grapevine Hill and the dry areas of the snowmobile trail. The wetland crossings on the snowmobile trail are flooded and impassable on foot throughout the spring and summer. Development of formal hiking trails on the Grapevine

Hill property is underway and recreational use of the hay field on this property is expected to increase.

As more land is protected at Tuttle Swamp, there will likely be requests to develop more hiking trails. Communication between landowners is strongly recommended when planning any new trail system within the swamp. All trail construction should follow the Best Management Practices for Erosion Control during Trail Construction and Maintenance (DRED 1996). Considering collection is a major threat to the rare turtle species of Tuttle Swamp, trail construction should consider trying to reduce the interaction between hikers and turtles (as recommended in NHFG's Wildlife Action Plan 2006). Care should be taken to divert trails from areas where turtles have been observed in the past as well as vernal pools and open sandy areas that could be potential nesting sites.

Dog Walking Visitors to the protected lands within the watershed are currently allowed to bring dogs. There is a leash law in the town of Newmarket; despite this, many visitors may want to exercise their dogs in the open fields. Dogs pose a threat to ground nesting grassland birds during their nesting season (May-August). Dogs can destroy eggs and young hatchlings, and can cause considerable distress to the parents causing them to abandon nests. Consequently, allowing dogs to run free on the fields may offset the conservation benefits of delayed mowing (see below). All landowners with grasslands on their properties should consider the benefits and costs of allowing dogs on the land and clearly post the rules at all access points.

Horseback Riding Horses are allowed on all NHFG properties. However, the NHFG properties within Tuttle Swamp are dominated by wetlands, and consequently, none of them have an appropriate trail system. If other upland landowners are considering whether or not to allow horseback riding on their trails, there is good documentation showing that horses can be vectors for non-native species along trails and into forest interiors. Landowners should carefully consider whether or not to allow horses on their property, and clearly post the rules at all access points.

Hunting The protected lands in the Tuttle Swamp Watershed are one of the largest unfragmented natural area in Newmarket, and consequently offers excellent opportunities for hunting. Currently, all the protected lands within the core of the Tuttle Swamp Watershed allow hunting, fishing, and trapping, and are subject to NHFG rules. The principle hunting opportunities include mostly small game such as woodcock, rabbits, snowshoe hare, ruffed grouse, and wild turkey, as well as large mammals, primarily deer.

NHFG Hunting and Public Use Rules Standard NHFG rules and laws concerning hunting, fishing, and public use apply to the protected lands under NHFG ownership, lands to be transferred to NHFG in the future, and all lands with easements held by the NHFG within Tuttle Swamp. According to these rules the following activities require permits through the NHFG:

- archaeology, dog training, trapping
- hunting and fishing (require license and only allowed in appropriate season)
- tree stands and blinds – requires permission from landowner and removal at end of season

Horseback riding and mountain biking are allowed on NHFG lands only on an individual basis, but no organized event relating to these or other sport groups are allowed.

A complete list of the rules pertaining to NHFG lands can be viewed online at the NHFG web site: <http://www.gencourt.state.nh.us/rsa/html/indexes/XVIII.html>.

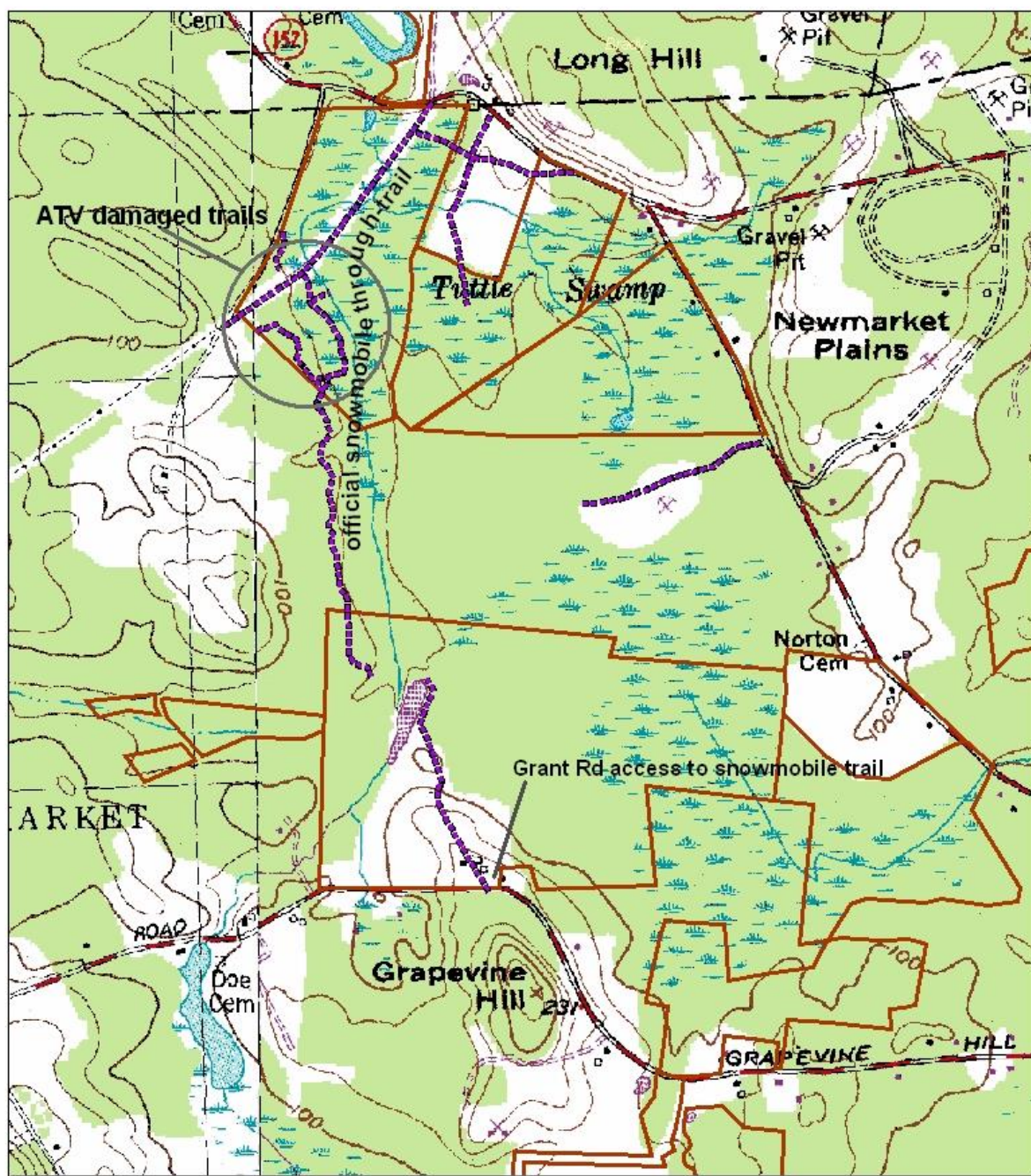


Figure 15. Trail system on Tuttle Swamp conservation lands



IVb. Forestry and silviculture

Forest management planning within Tuttle Swamp should prioritize goals that maintain and enhance wildlife habitat and that do not have an adverse impact on water quality. Active land management may be required to maintain the diversity of habitats at Tuttle Swamp. For example, grasslands and shrubland habitats are the result of past and present land management activities that should continue in order to allow grassland and shrubland species to persist.

Forestry and silviculture management options and recommendations:

Landowners within the Tuttle Swamp Watershed should consider several alternatives for forest management, such as:

- A. No Cut – The no cut option would result in allowing natural processes, such as succession, to occur on the lands within Tuttle Swamp. Areas at greatest risk of reverting to forest are the early successional habitats on the Grapevine Hill property, and the alder thickets on the Currier property. Other than these two small areas, the no-cut option will allow forest maturation, increase coarse woody debris, provide undisturbed wildlife habitat, prevent soil loss to wetlands, and protect water quality. Due to the abundance of hydric soils and inaccessible upland, allowing forest maturation within Tuttle Swamp is an excellent management option to ensure the integrity of the wetland and water quality.
- B. Forest management for wildlife – Careful forest management to benefit wildlife species might include maintaining early successional habitats on the Grapevine Hill property and the open alder –sedge fen on the Currier parcel. Management of these habitats could include regular selective cutting regimes to maintain a grassland and alder-dominated shrubland vegetation structure. UNH Cooperative extension should be consulted to accomplish this type of management, and the NH Fish and Game department's Small Habitats Grant is an excellent program to help fund this management practice.
- C. Timber harvest – Timber harvest could be a means for generating revenue for the town. However, because of the extensive area within Tuttle Swamp that is designated as a Prime Wetland and its 100ft regulatory buffer, there is likely limited area where such a timber harvest is feasible without some level of disturbance to the wetland or water quality. We recommend the following should timber harvest occur:
 - 1. Contact the Rockingham county UNH Cooperative Extension for a list of licensed foresters
 - 2. Require a forest management plan written by a licensed forester that identifies soil types, wetlands, wildlife habitat, forest roads, and recreational features, and that follows Best Management Practices for erosion control during timber harvests in New Hampshire (NHDES 2001), and practices recommended in the "Good Forestry in the Granite State" guidebook (DRED & SPNHF 1997).
 - 3. Require the licensed forester supervise harvest activities and work with a certified professional logger.

IVc. Invasive species

As with most large unfragmented natural areas, invasive species are present primarily along the periphery of forests and wetlands. The forested areas in the interior of Tuttle Swamp are currently nearly free of invasive species. Road and field edges support small populations of invasive shrub species, but little evidence of their expansion into the forest interior was noted during the 2004 field season. The most common invasive species within the forested areas of Tuttle Swamp was glossy buckthorn (*Rhamnus frangula*).

The emergent and scrub-shrub marshes within Tuttle Swamp are currently invasive species free. Due to its history of soil disturbances, it isn't surprising that the alder-sedge fen on the Currier property has the largest and most diverse invasive species populations within Tuttle Swamp. Purple loosestrife (*Lythrum salicaria*) is currently abundant throughout the fen and is vigorously regenerating. Two small patches of common reed (*Phragmites australis*) are also growing within this fen near the road edge. Bittersweet (*Celastrus orbiculatus*), a non-native invasive vine that can smother native vegetation and pull down canopy trees, is present on the Grapevine Hill property along the stonewall on the northern edge of the hayfield. Japanese barberry shrubs (*Berberis japonica*) are also present in few numbers within the Grapevine Hill field.

We recommend aggressive monitoring and control actions to eradicate populations of non-native invasive species while the populations are still small and manageable. Mobilizing a volunteer invasive species monitoring and control team is recommended to evaluate current populations and hand pull small infestations on all these properties. Additional explanation on control mechanisms is included in the appropriate management unit descriptions.

IVd. Water quality protection

All land uses within the Tuttle Swamp watershed will influence water quality within Tuttle Swamp, and the quality of the water flowing out of the swamp into the Lamprey River and the Piscassic River. Land protection within the watershed should continue to focus on protecting an adequate upland buffer around the swamp. A nutrient management plan should be developed for all grasslands and agricultural lands within the watershed that are fertilized. If invasive species are to be controlled chemically, care should be taken to avoid use of chemicals in wetlands, and appropriate permits should be obtained to ensure proper application of herbicides.

The landfill property situated in the center of Tuttle Swamp is owned by the town of Newmarket, but is not designated as conservation land. The town should strongly consider putting the back portion of this property into conservation. The subwatershed divide between Ash Swamp and Tuttle Swamp runs through the landfill property, and the protection of this property would protect a natural habitat and hydrologic connection between these two basins. Furthermore, disturbances on the west portion of the landfill property could adversely affect the water quality of both Ash and Tuttle Swamps. Lastly, protection of the landfill property would reduce the fragmentation of the town of Newmarket's conservation lands by providing a connection between the Grapevine Hill property on Grant Road and the Currier parcel on Rt 152. The town of Newmarket could then manage and steward the three properties as one large conservation area.

IVe. Threats, Opportunities, and Accomplishments Summary

Tuttle Swamp has long been recognized as an important and unique natural feature not only by the Town of Newmarket, but also from a state-wide perspective. It has attracted the attention of conservation groups, town entities, and state agencies for its high quality habitat values, its unique blend of constituent rare and common species, and ecological services it provides, such as the protection of water quality. Substantial efforts to protect these resources will provide for long-term benefits in the community, and for the region. However, there continue to be land uses within the Tuttle Swamp watershed that may negatively impact water or habitat quality within the basin swamp. Identifying threats that may cause impairment or degradation resulting

in reduced viability and function of natural features allows land managers to make more informed decisions. The most serious types of potential degradation that affect conservation targets and management goals are discussed below.

Perhaps the best way of abating the threat of water quality degradation is through additional land protection; however the town of Newmarket has been successful in accomplishing many other projects that have had a positive impact on this high priority conservation area.

Current Accomplishments:

- land protection (Figure 2)
- prime wetland designation (Figure 5)
- surface water withdrawal prohibition & signs installed by the town at stream crossings and open water
- Grapevine Hill management plan (Tarr 2005)
- landfill closure and long term monitoring plan

Potential Threats	Opportunities/Strategies
<i>Water quality degradation</i>	<ul style="list-style-type: none"> • 75% of the watershed is unprotected • Seek opportunities for protection of adequate buffer of upland around wetlands to protect from pollutant run-off, sediments, and anthropogenic disturbances associated with development • Encourage farmers within watershed to work with UNH Cooperative Extension and NRCS to develop nutrient management plans and establish naturally vegetated wetland buffers
<i>Fragmentation</i>	<ul style="list-style-type: none"> • Protection of the old landfill property will reduce fragmentation of protected lands of Tuttle and Ash Swamp • Encourage additional land protection that would expand upon the core of protected lands within Tuttle Swamp
<i>Incompatible recreation (ATVs)</i>	<ul style="list-style-type: none"> • Maintain communications with the Great Bay Snow-rollers • Post snowmobile trail with “no ATV” signs • Report any ATV sightings on Tuttle Swamp protected lands to a NHFG conservation officer • Gate the entrance to the snowmobile trail off Grant Road • Coordinate recreational plans with abutting land owners

Potential Threats	Opportunities/Strategies
<i>Invasive Species</i>	<ul style="list-style-type: none"> • Organize an invasive species volunteer team to monitor for new infestations and expansion rates of existing populations. • Organize volunteer work days to control invasive species populations by pulling, cutting, girdling, etc.
<i>Loss of habitat diversity & other impacts to rare species</i>	<ul style="list-style-type: none"> • Practice delayed mowing to manage open fields • Maintain early successional habitats within the watershed • Plan trail routes to avoid interactions between visitors and rare species • Encourage field owners/managers to adjust mower blade height to 6" to avoid accidental mortality of turtles and other wildlife • Assess culvert condition to insure they are passable for wildlife and provide adequate wetland habitat and hydrologic connectivity • Discourage granite curbing along roadways and soft shoulders that may attract nesting turtles to roadways • Maintain natural vegetation along wetland edges • Install sign in kiosks with NH animal collection laws • Allow natural process of beaver dam creation, maintenance, and abandonment to occur within the watershed • Prohibit removal of beaver dams • Reduce impacts to forested land within the watershed to manage for species in decline due to fragmentation and loss of large forested blocks in southeastern NH

V. Management Unit Descriptions and Recommendations

Tuttle Swamp Management Units (MUs) were defined based on combining similar natural features that shared management needs. Therefore, MU boundaries cross parcel lines and follow specific habitats or groups of habitat types. Management Units are also defined to be easily identifiable on the ground to facilitate land management activities. In all cases, the description of each MU includes a list of landowners. Overall, this section is intended to increase communication and coordination between landowners managing for similar ecological resources and with similar goals.

1. Forested wetlands: Management Unit # 1

Proposed Management Goal:

- Allow natural processes to occur (i.e. beaver activity, forest growth and maturation), minimize human impacts to the system, and maintain water quality.

Acres : 327

Target Species/Natural Communities: see pages 20-23 for complete description

- Red maple – black ash – swamp saxifrage swamp
- Red maple-red oak-cinnamon fern forest
- Red maple – sphagnum basin swamp
- Swamp white oak floodplain forest
- Red maple floodplain forest
- Climbing hempweed
- Blanding's turtle
- Fen ant
- Wood ducks
- Red-shouldered hawk

Ownership:

Parcel Name	Landowner	Approx Acres
Benoit	Town of Newmarket	39
Currier	Town of Newmarket	34
Grapevine Hill	Town of Newmarket	101
Landfill	Town of Newmarket	35
Woods	NHFG	28
Sewall	TNC to be transferred to NHFG	16
Squillace	TNC to be transferred to NHFG	36

Access:

- Snowmobile trail can be accessed from Jan Lane and off Rt 152
- Spring-fall access to forested wetlands along snowmobile trail is periodically flooded
- No formal trail to forested wetlands from the south

Recreation:

- Limited public use due to inaccessibility, unstable footing on hummocks and water-logged soil, and deep pockets of standing water
- Expected recreational uses include: hunting, cross-country skiing, snowshoeing, snowmobiling (through trail), bird watching, and occasional bush-whackers in the spring-fall
- Majority of recreational use in the interior of Tuttle Swamp occurs in the winter time when ground is frozen and swamp is more accessible

Recommended Management Actions:

ATVs

- Post "No Wheeled Vehicles" signs on snowmobile trails, especially off Jan Lane on Benoit parcel
- Monitor use of snowmobile trail by ATVs

Timber & Wildlife Management

- No cut timber management for most of this area due to inaccessibility and wetland soils
- Red maple thinning along the northern boundary of the red maple- black ash – swamp saxifage swamp could be considered to re-open the area to sedge fen and alder thicket and improve wildlife habitat (See also Management Unit #4)

Non-native species

- Monitor to insure early detection and implementation of control measures if non-native species become established.

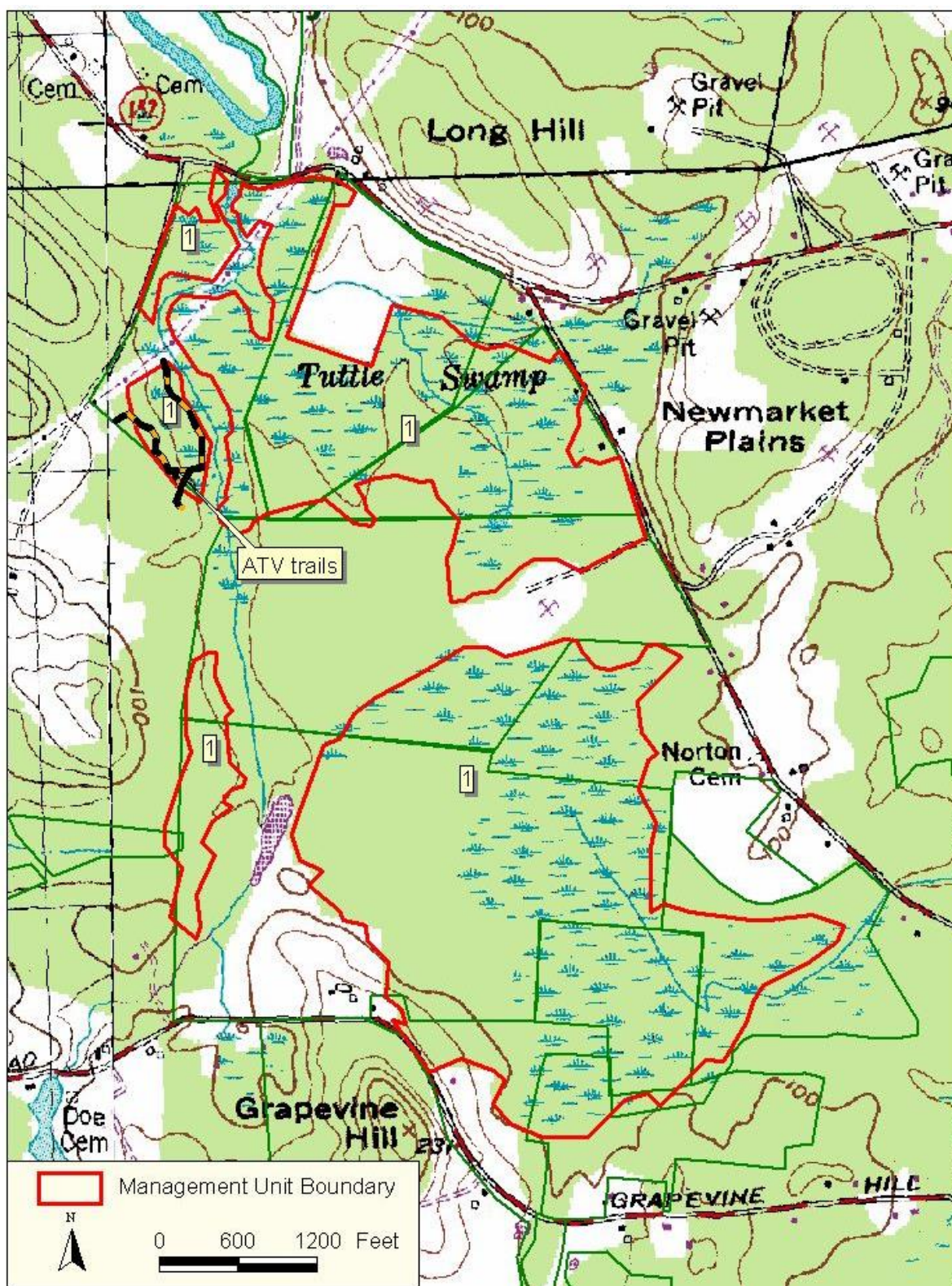


Figure 16: Management Unit 1: Forested Wetlands of Tuttle Swamp.

2. Forested uplands: Management Unit # 2

Proposed Management Goal:

- Practice sound forest management for wildlife habitat and forest regeneration.

Acres: 59

Target Species/Natural Communities: see page 24 for complete description

- Hemlock-beech-oak-pine forest
- Hemlock forest
- Pine plantations

Ownership:

Parcel Name	Landowner	Approx Acres
Currier	Town of Newmarket	0.5
Grapevine Hill	Town of Newmarket	6
Landfill	Town of Newmarket	46
Squillace	TNC to be transferred to NHFG	5

Access:

- No formal trail leads to upland forest patches in Tuttle Swamp
- Most patches are inaccessible from spring-fall without wading across deep emergent marsh and crossing streams

Recreation:

- Limited public use due to inaccessibility
- Expected recreational uses include: hunting, cross-country skiing, snowshoeing, snowmobiling (through trail), bird watching, and occasional bush-whackers in the spring-fall
- Majority of recreational use in the interior of Tuttle Swamp occurs in the winter time when ground is frozen and swamp is more accessible

Recommended Management Actions:

Timber & Wildlife Management

- Consider no-cut forest management to allow forest growth and maturation and allow natural processes to occur.
- Harvest of the pine plantations on the Grapevine Hill property may improve wildlife habitat and generate revenue to support Grapevine Hill stewardship.
- Timber management should follow the practices described in Good Forestry in the Granite State, (SPNHF & DRED 1997). and the Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire Erosion (DRED & UNH Coop Ext. 2001), and be performed by a licensed forester.
- All timber management should require a forest management plan (to be written by a licensed forester) and forest management plans should be shared among the Tuttle Swamp land owners to help cooperate and coordinate forest management decisions.

Non-native species

- Monitor to insure early detection and implementation of control measures if non-native species become established.

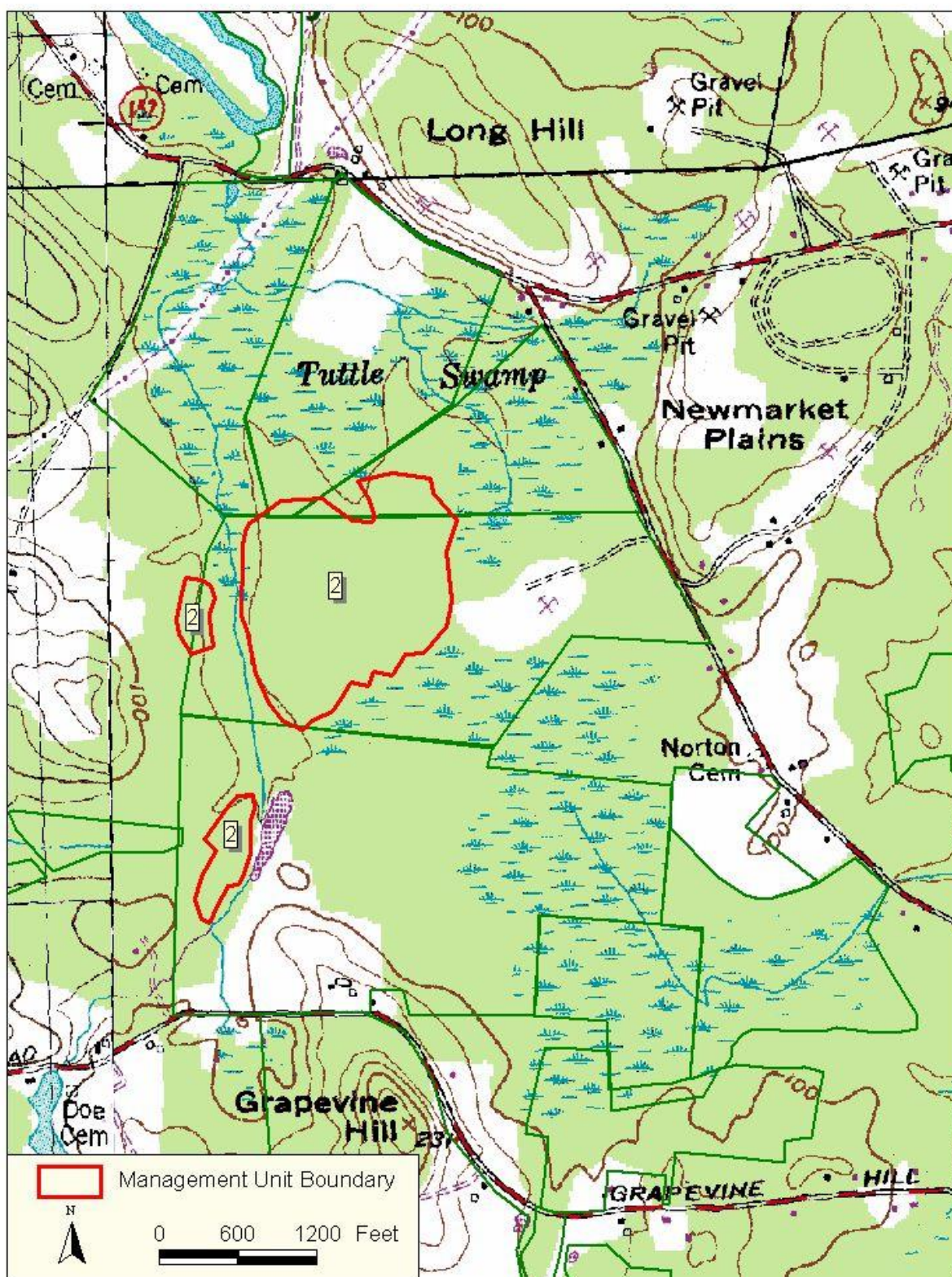


Figure 17: Management Unit 2: Forested Uplands.

3. Open emergent wetlands and open water: Management Unit # 3

Proposed Management Goal:

- Allow natural processes to occur (i.e. beaver activity) and minimize human impacts to the system that would degrade wetland habitat and water quality.

Acres: 27

Target Species/Natural Communities: see page 25 for complete description

- | | |
|------------------------------------------|----------------------|
| • Lower perennial riparian system | • Least bittern |
| • Open pond | • Blanding's turtle |
| • Cattail marsh | • Spotted turtle |
| • Mixed tall graminoid/scrub-shrub marsh | • Wood turtle |
| • Tall graminoid emergent marsh | • Tufted loosestrife |
| • Waterfowl (American black duck) | |

Ownership:

Parcel Name	Landowner	Approx Acres
Grapevine Hill	Town of Newmarket	12
Landfill	Town of Newmarket	9
Sewall	TNC to be transferred to NHFG	8
Benoit	TNC to be transferred to NHFG	12

Access:

- Tuttle Brook flows north under Rt 152 on the Benoit parcel, and can be accessed from the road.
- Ash Brook flows east under Ash Swamp Rd on the Sewall parcel and can be accessed from the road.
- Snowmobile trail on the Grapevine Hill parcel leads to the cattail marsh and south side of the largest emergent wetland in the Tuttle Swamp core.
- Scrub-shrub emergent wetlands can be accessed from the west edge of the landfill.
- Although visible from these locations, these emergent wetlands are very deep and not passable without chest waders from spring-fall.

Recreation:

- Limited current public use within wetlands, but people often walk up to the edges to watch waterfowl and other birds using the wetlands.
- Majority of recreational use in the interior of Tuttle Swamp occurs in the winter time when ground is frozen and swamp is more accessible.
- Snowmobile trail crosses the emergent wetland on the northern edge of the Grapevine Hill property.

Recommended Management Actions:

Timber & Wildlife Management

- Minimize impacts to wetland habitat and water quality– including restricting dogs from swimming in the open pond on the Grapevine Hill parcel.
- Allow natural processes to occur (eg. beaver activity, flooding).
- Expand buffer of unmowed vegetation between hayfield and open pond for water quality and wildlife habitat (see Tarr 2005).

Non-native species

- Control purple loosestrife populations in wetlands through hand-pulling efforts by volunteer stewardship crew, and investigate possibility biological control option (i.e. *Galerucella* beetles).

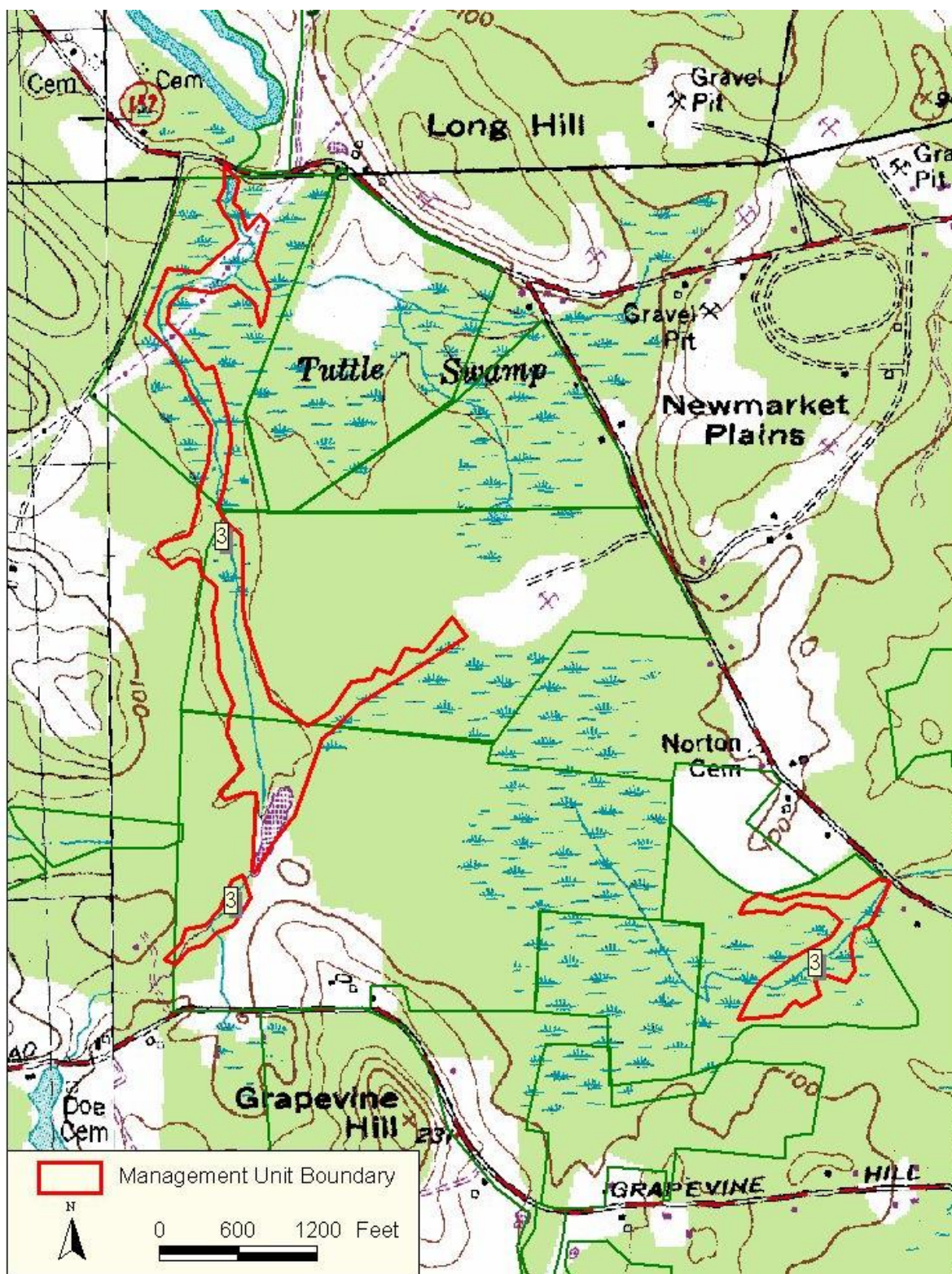


Figure 18: Management Unit 3: Open Emergent Wetlands

4. Sedge fen : Management Unit # 4

Proposed Management Goal:

- Maintain open sedge fen and alder thickets for wildlife habitat.

Acres: 26

Target Species/Natural Communities: see page 27 for complete description

- Speckled alder – lake sedge intermediate fen
- American woodcock
- New England cottontail

Ownership:

Parcel Name	Landowner	Approx Acres
Currier	Town of Newmarket	25
Squillace	TNC to be transferred to NHFG	1

Access:

- A small parking area exists off Route 152; however, the sight lines are poor and pulling in and out of this small pull-off is dangerous due to high speed road traffic.
- An old woods road (flooded from spring-fall) can be followed from the parking area south into the interior of Tuttle Swamp.
- The snowmobile trail travels east-west across the fen from Route 152 to the powerline and can also be used as a dry access point.

Recreation

- The current old woods road and snowmobile corridor could be maintained in the summer as a hiking trail by periodic mowing; however, this would only be an option during dry years as the heavy rains during the summer of 2004 resulted in a very high water table and considerable ponding on the poorly drained soils in this area that resulted in over two feet of standing water on the old woods road.
- Expected recreational uses include: hunting, cross-country skiing, snowshoeing, snowmobiling (through trail), bird watching, and occasional bush-whackers in the spring-fall.
- Majority of recreational use in the interior of Tuttle Swamp occurs in the winter time when ground is frozen and the fen is more accessible.

Recommended Management Actions

Wildlife management

- The alder thicket should be cut within the next few years, and re-cut on a 5-10 year rotation to maintain early successional wildlife habitat.
- Red maples on the southern edge of the sedge fen could also be cut to maintain the southern half of the alder-sedge fen that appears to be transitioning to red maple swamp.
- The shallow drainage ditches throughout the Currier parcel are filling in naturally and no alternation of the hydrology or soils is recommended.

Invasive species

- The town should consider working with state agencies to control the current purple loosestrife infestation, and to apply herbicides to cut stems of the *Phragmites* within this wetland. This could include obtaining herbicide application permits and hiring a professional herbicide applicator.
- Control purple loosestrife populations in the sedge fen through hand-pulling efforts by volunteer stewardship crew, and investigate possibility biological control option (i.e. *Galerucella* beetles).
- All populations of non-native species should be monitored to determine if they are expanding into the swamp and at what rate.

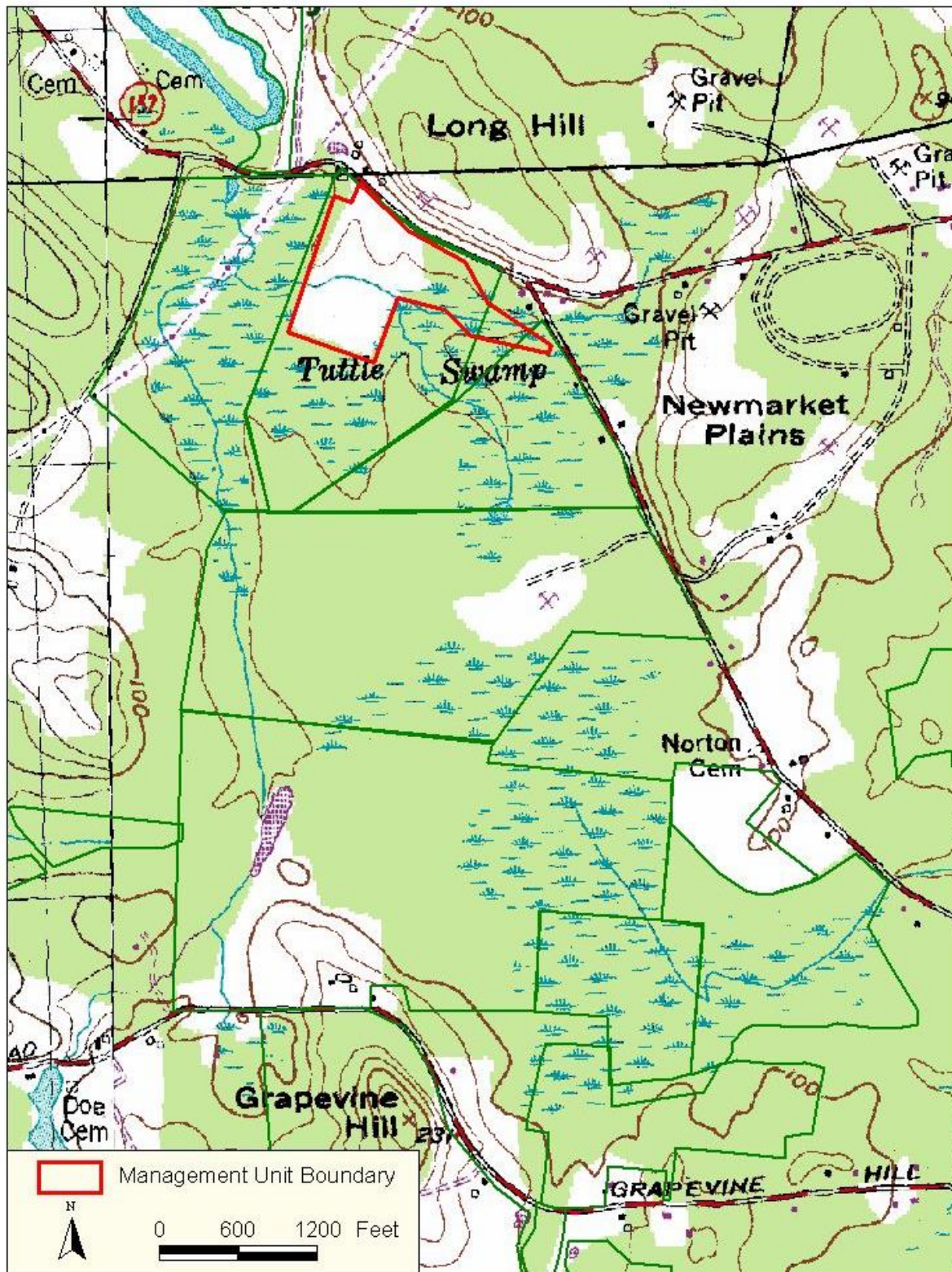


Figure 19: Management Unit 4: Sedge Fen.

5. Grasslands: Management Unit # 5

Proposed Management Goal:

- Maintain open habitat for declining species of grassland birds and other wildlife, and promote field management to enhance the wildlife habitat value of the open lands while also providing for public recreation or agricultural purposes.

Acres: 53

Target Species/Natural Communities: see page 29 for complete description

- | | |
|-----------------------|---------------------|
| • Bobolink | • Spotted turtle |
| • Eastern meadowlark | • Blanding's turtle |
| • Woodcock | • Wood turtle |
| • Blue-winged warbler | |

Ownership:

Parcel Name	Landowner	Approx Acres
Grapevine Hill	Town of Newmarket	23
Sewall	TNC to be transferred to NHFG	15
Landfill	Town of Newmarket	14
Nostrom	Town of Newmarket	39

Access:

- There is no public access allowed on the Sewall or Nostrom pastures.
- Grapevine Hill fields can be accessed from the parking area on Grant Road and a field perimeter trail will be maintained by the town from this location.
- The capped landfill can be accessed from the transfer station on Ash Swamp Rd.

Recreation:

- This Management Unit is easily accessible and the fields on Grapevine Hill are well used throughout the year.
- Expected recreational uses include hiking, cross-country skiing, shoe-shoeing, snowmobiling (on established trail only), hunting, fishing, and bird watching.

Management Recommendations

- Mow on an annual or bi-annual basis to retain the grassland habitat
- Mowing should occur after August 1st to reduce impacts to grassland nesting birds
- Mower blade height should be adjusted to 6" to avoid accidental mortality of turtles and other wildlife in the fields
- Mulch hay should be left on the field to recycle nutrients; however, if hay is removed the fields should be limed to replenish nutrients and maintain grassland habitat
- A nutrient management plan should be written before field is fertilized (Tarr 2005)
- All wet areas in fields should be excluded from mowing regime
- All dogs should be leashed and a sign stating this rule should be posted at the Grapevine Hill parking area
- All unleashed dogs during hunting season should be under the owners control at all times
- A buffer of early successional vegetation should be maintained between the field and wetland to improve wildlife habitat by creating a softer edge.
- Wetland buffer should be cut on a 3-yr rotation following guidelines described in Grapevine Hill Management Plan (Tarr 2005).
- Install gate at the snowmobile trail entrance onto Grapevine Hill parcel off Grant Rd
- Access onto fields from the gated entrance should be for management purposes only.
- Bittersweet population on field edge should be controlled with a cut-stem application of herbicides

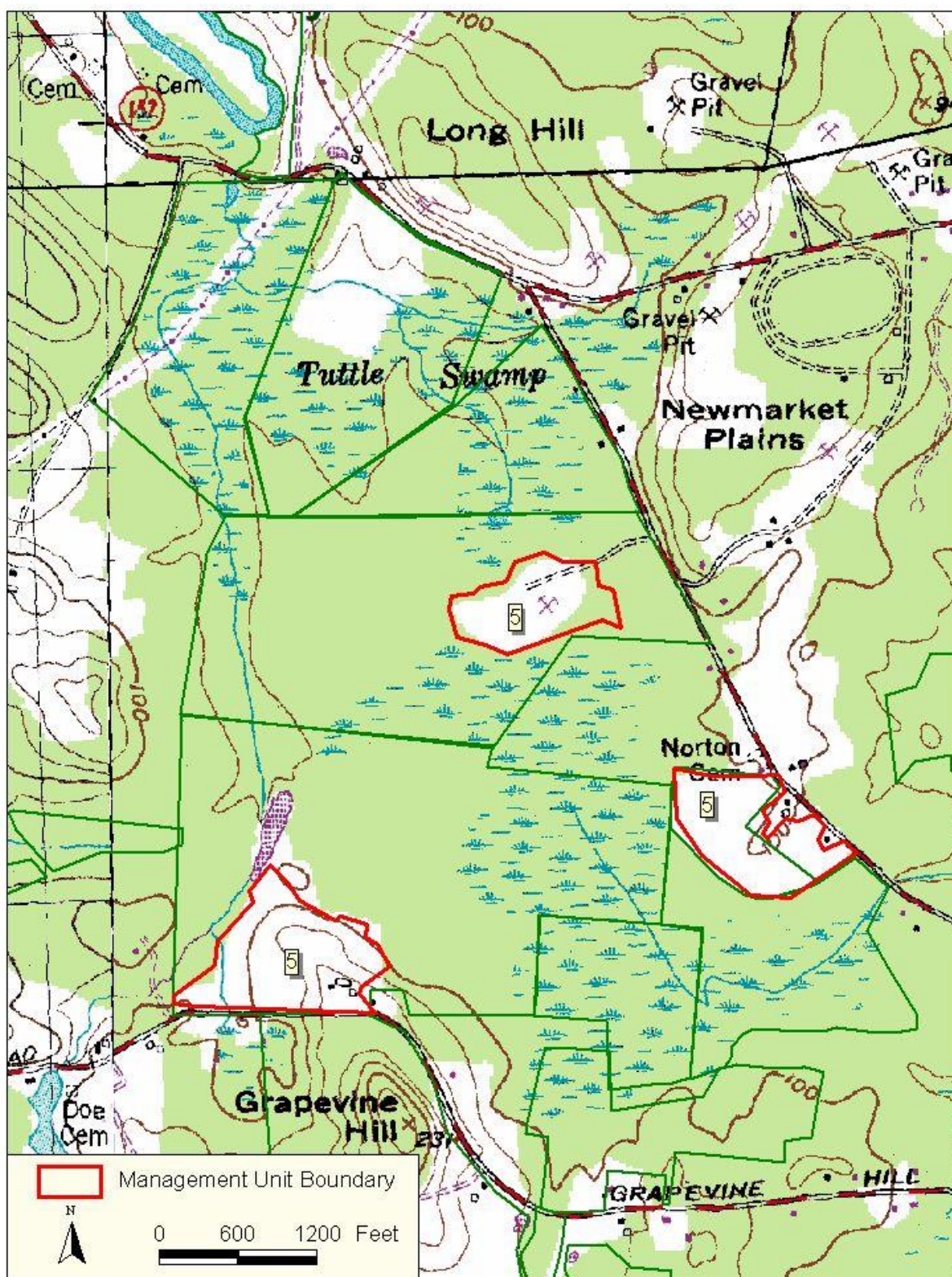


Figure 21: Management Unit 5: Grasslands

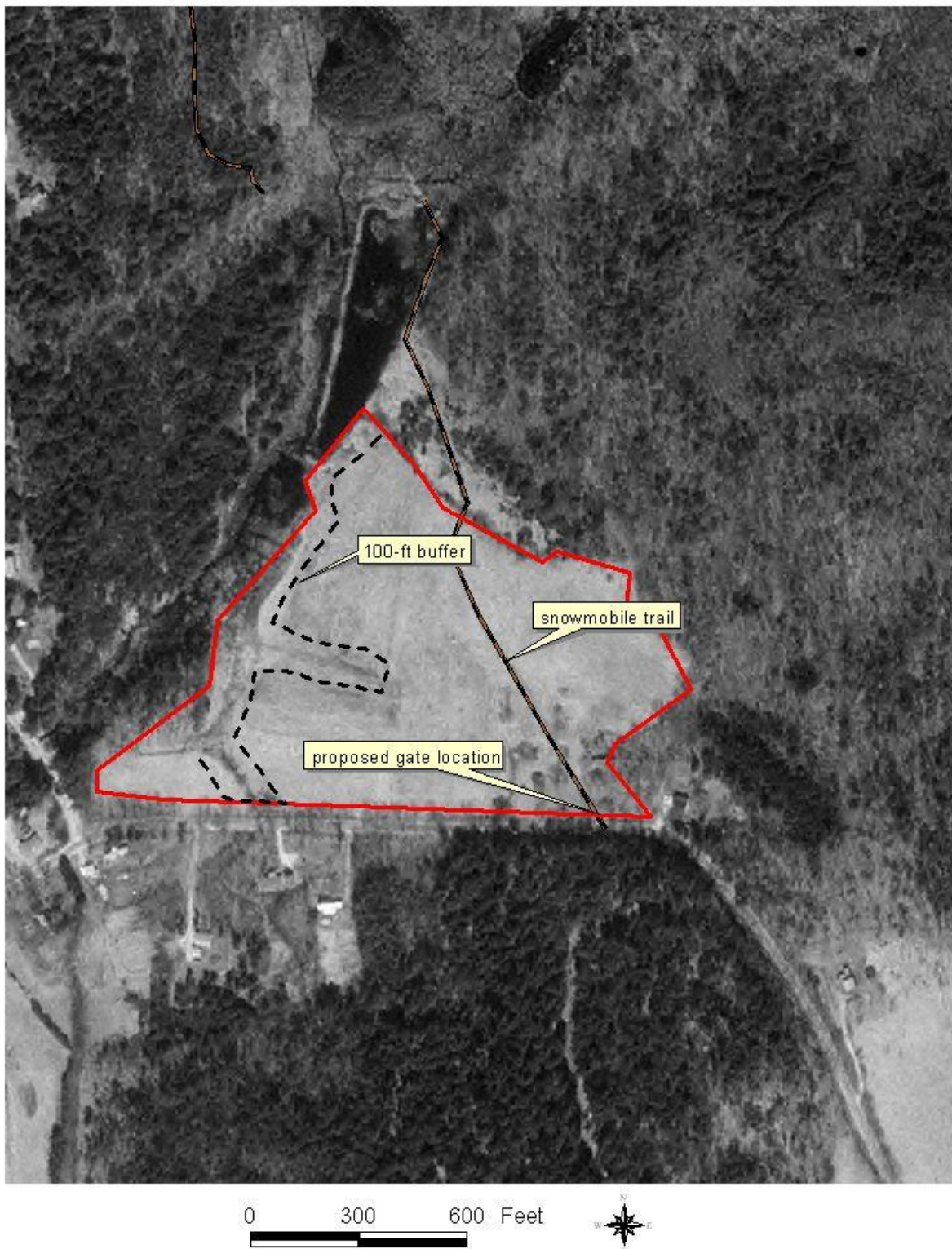


Figure 22: Management Unit 5, Grapevine Hill field and proposed wetland buffer

6. Early successional shrubland habitat: Management Unit # 6

Proposed Management Goal:

- Maintain some areas in Tuttle Swamp as early successional habitat for declining species of shrubland birds and other wildlife and improve field edge habitat where possible by eliminating hard edge around fields and near wetlands.

Acres: 3+

Target Species/Natural Communities: see page 30 for complete description

- American woodcock
- Whip-poor-will
- New England cottontail

Ownership:

Parcel Name	Landowner	Approx Acres
Grapevine Hill	Town of Newmarket	3+

Access

- Early successional habitat can be accessed on the Grapevine Hill property from the trail to be provided from the parking area on Grant Road

Recreation

- Unlike the rest of Tuttle Swamp, the dry shrublands on the Grapevine Hill property are easily accessible and well used throughout the year
- Expected recreational uses include hiking, cross-country skiing, shoe-shoeing, snowmobiling (on through trail only), hunting, fishing, and bird watching

Management Recommendations

- Selectively cut early successional habitat every 5-10 yrs according to guidelines described in the Grapevine Hill Natural Resource Management Plan (Tarr 2005).
- This habitat is especially vulnerable to the establishment of non-native species and should be included in any non-native species monitoring in the watershed
- There are several options for creating more of this habitat type on the Grapevine Hill property. These areas provide the greatest habitat value when they are adjacent to wetlands or fields and include:

6a

- Wetland buffer between Grapevine Hill field and Tuttle Brook – recommended in Grapevine Hill management plan (Tarr 2005) as 100ft wide buffer of variable aged native vegetation to create soft-edge and improve wildlife habitat and water quality.

6b

- Red Pine plantation on Grapevine Hill property on north side of Tuttle Brook could be harvested and then maintained as shrubland habitat

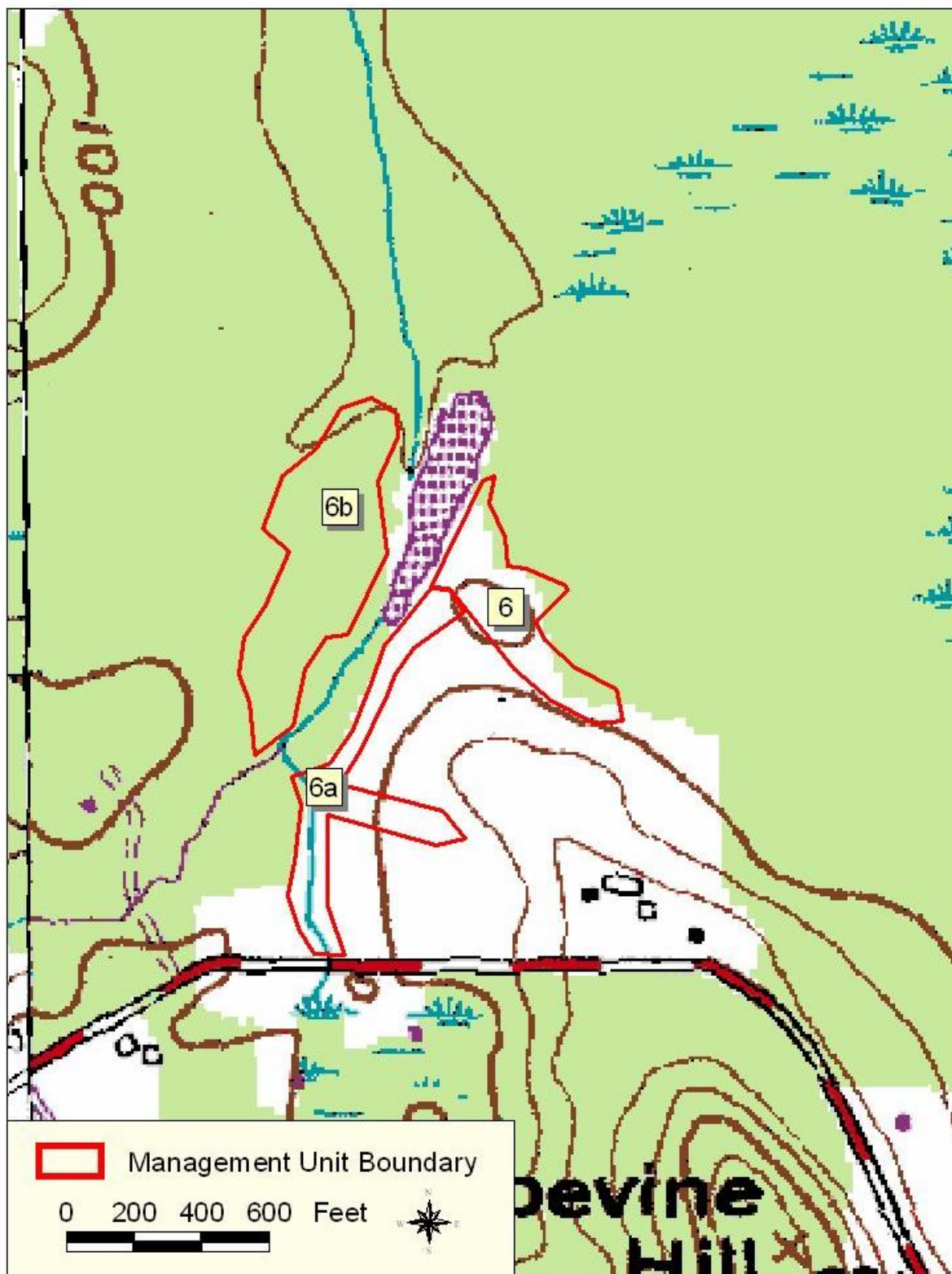


Figure 23: Management Unit 6: Early Successional Habitat

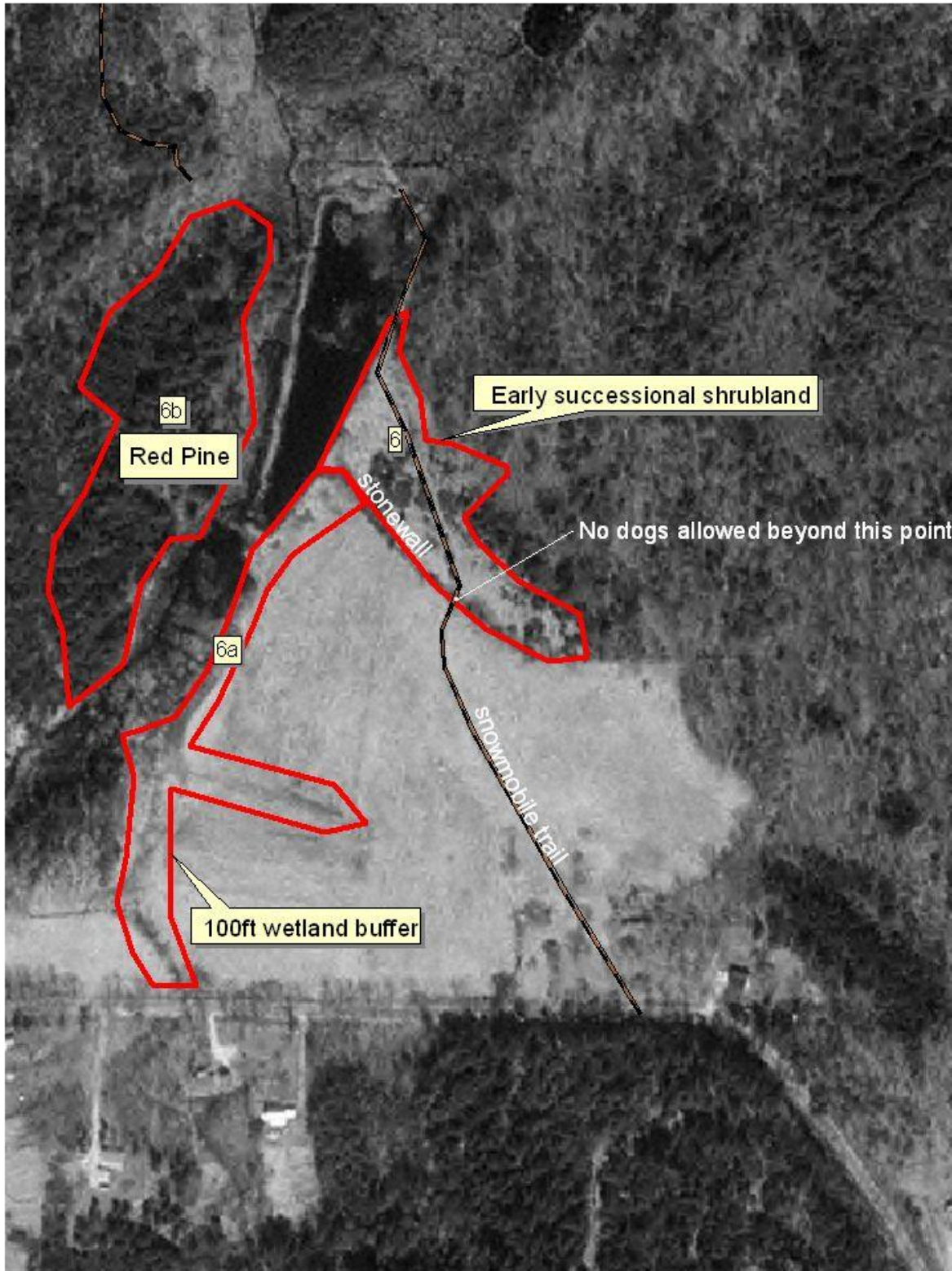


Figure 24: Aerial photographs of Management Unit 6.

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