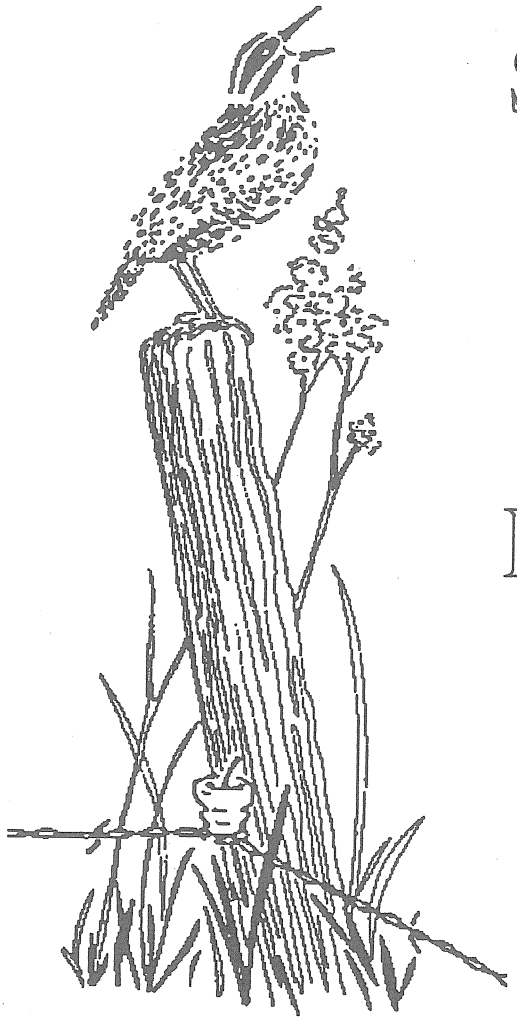


SOUTHEAST REGION NATURAL RESOURCE INVENTORY

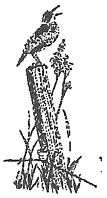
WATERFORD, CONNECTICUT

Eastern Connecticut Environmental Review Team Report

Eastern Connecticut
Resource Conservation and Development Area, Inc.

SOUTHEAST REGION NATURAL RESOURCE INVENTORY

Waterford, Connecticut



Environmental Review Team Report

Prepared by the
Eastern Connecticut Environmental Review Team
of the
Eastern Connecticut
Resource Conservation and Development Area, Inc.

for the
Conservation Commission
Waterford, Connecticut

December 1998

CT Environmental Review Teams
1066 Saybrook Road, P.O. Box 70
Haddam, CT 06438
(860) 345-3977

Acknowledgments

This report is an outgrowth of a request from the Waterford Conservation Commission to the New London County Soil and Water Conservation District (SWCD). The SWCD referred this request to the Eastern Connecticut Resource Conservation and Development Area (RC&D) Executive Council for their consideration and approval. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The Eastern Connecticut Environmental Review Team Coordinator, Elaine Sych, would like to thank and gratefully acknowledge the following Team members whose professionalism and expertise were invaluable to the completion of this report.

The field review took place on Tuesday, July 14, 1998.

Nicholas Bellantoni	State Archaeologist CT Museum of Natural History - UCONN (860) 486-5248
Laurel Christofferson	Wildlife Biologist (seasonal) DEP - Sessions Woods WMA (860) 675-8130
Joan Hoelzel	Senior Coastal Planner DEP - Office of Long Island Sound Programs (860) 424-3034
Douglas Hoskins	Wetland Specialist/Environmental Analyst III DEP - Inland Water Resources (860) 424-3903
Robert Hust	Senior Environmental Analyst DEP - Planning and Standards (860) 424-3718

Seth Lerman	Environmental Technician New London County Soil & Water Conservation District (860) 887-3604
Brian Murphy	Fisheries Biologist DEP - Eastern District (860) 295-9523
David Poirier	Staff Archaeologist Connecticut Historical Commission (860) 566-3005
Sherwood R. Raymond	Forester DEP - Goodwin Conservation Center (860)455-0699
Judy Wilson	Wildlife Biologist DEP-Sessions Woods WMA (860) 675-8130

I would also like to thank Maureen Fitzgerald, environmental planner, Morgan Miner III, chairman, conservation commission, Henry Curtis, conservation commission member, and many of the landowners in the project area for their cooperation and assistance during this environmental review.

Prior to the review day, each Team member received a summary of the proposed project with location and soils maps. During the field review Team members were given additional information. Following the review, reports from each Team member were submitted to the ERT coordinator for compilation and editing into this final report.

This report represents the Team's findings. It is not meant to compete with private consultants by providing site plans or detailed solutions to development problems. The Team does not recommend what final action should be taken on a proposed project - all final decisions rest with the town and landowners. This report identifies the existing resource base and evaluates its significance to potential development, and also suggests

considerations that should be of concern to the town. The results of this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in reviewing this area of southeastern Waterford.

If you require additional information please contact:

Elaine Sych, ERT Coordinator
CT ERT Program
P. O. Box 70
Haddam, CT 06438
(860) 345-3977

Table of Contents

List of Figures

Introduction

Introduction

The Waterford Conservation Commission has requested assistance from the Eastern Connecticut Environmental Review Team in conducting a natural resource inventory and a discussion of possible development limitations and opportunities for portion of southeastern Waterford.

The area studied is bounded by Great Neck Road, Dimmock Road and Braman Road, with a small portion north of Braman Road. The total acreage is approximately 800 acres. The area consists of residential development (an ERT was conducted in 1985 for the Nursery Acres Subdivision), a large abandoned nursery (the Verkades property), farmland and undeveloped forest and wetlands. The area is drained by two major streams which drain to Goshen Cove and ultimately to Long Island Sound. Seaside Regional Center, Harkness Memorial State Park and other state land is to the south of this area across Great Neck Road on Long Island Sound.

Objectives of the ERT Study

The Commission will use this ERT report as a reference document to assist in the evaluation of potential cumulative impacts of recent and future development on the natural resource base of the area. Future development could include residential, commercial and golf course uses, but there were no plan proposals at the time of the ERT field review. The ERT as asked to provide information on the diversity and quality of the natural resources, make recommendations and supply guidelines to protect those resources.

The ERT Process

Through the efforts of the conservation commission this environmental review and report was prepared for the Town of Waterford.

This report provides an information base and a series of recommendations and guidelines which cover the topics requested by the commission. Team members were able to review maps, plans and supporting documentation provided by the applicant.

The review process consisted of four phases:

1. Inventory of the site's natural resources;
2. Assessment of these resources;
3. Identification of resource areas and review of plans; and
4. Presentation of education, management and land use guidelines.

The data collection phase involved both literature and field research. The field review was conducted on Tuesday, July 14, 1998 and some Team members made additional site visits. The emphasis of the field review was on the exchange of ideas, concerns and recommendations. Being on site allowed Team members to verify information and to identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. Individual Team members then prepared and submitted their reports to the ERT coordinator for compilation into this final ERT report. Please be aware that within the many sections of the report different acreage and percentage amounts are indicated for the various land uses and natural resource areas. This is a reflection of the individual Team member's area of expertise and interpretation of mapping and aerial photographs (for example: wetland area designated by hydric soil type or from mapping and aerial photo interpretation or wetland vegetation/tree species or the statutorily defined coastal boundary).

Figure 1.

N

Location and Topographic Map

Scale 1" = 2000'

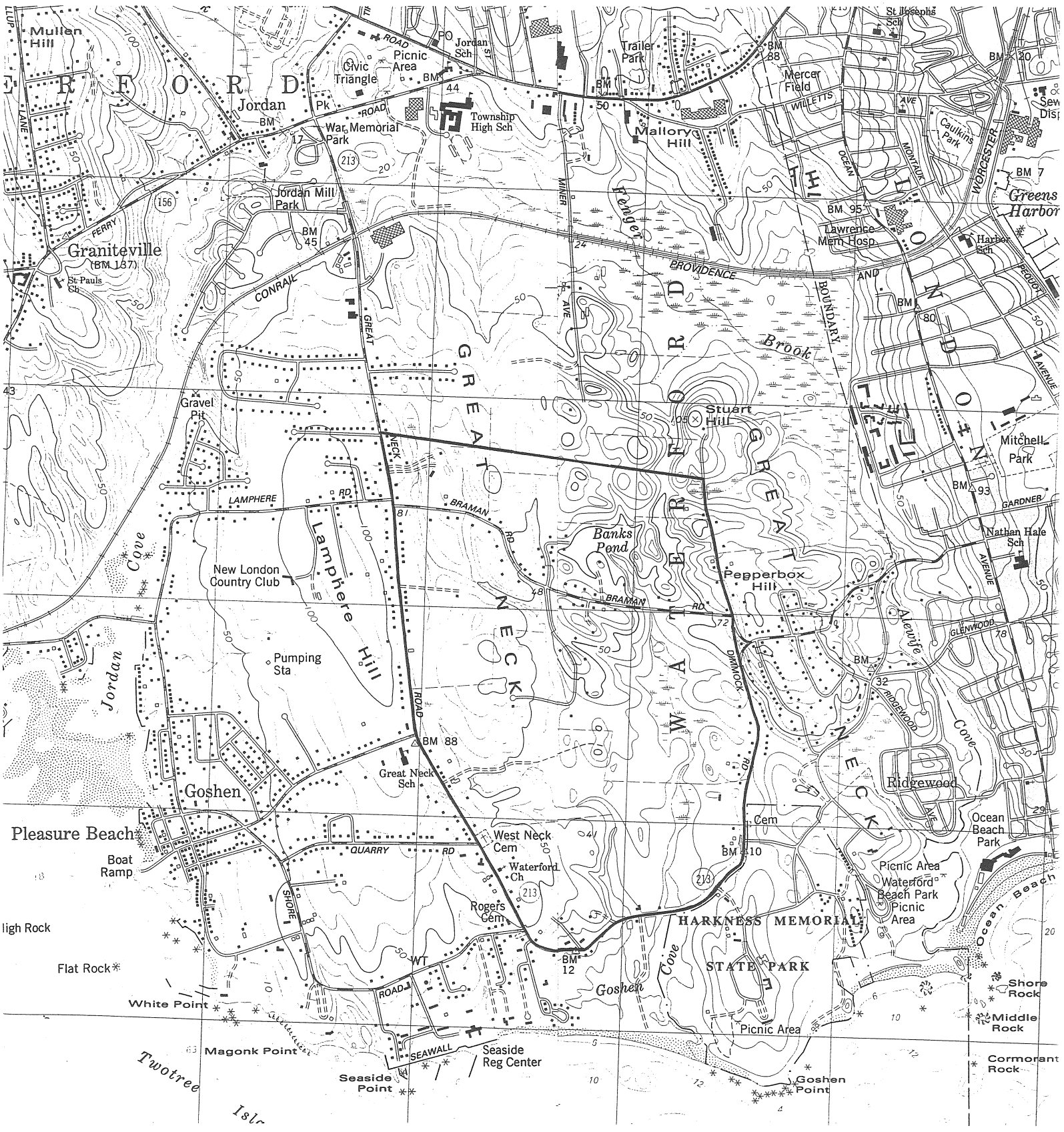


Figure 2.

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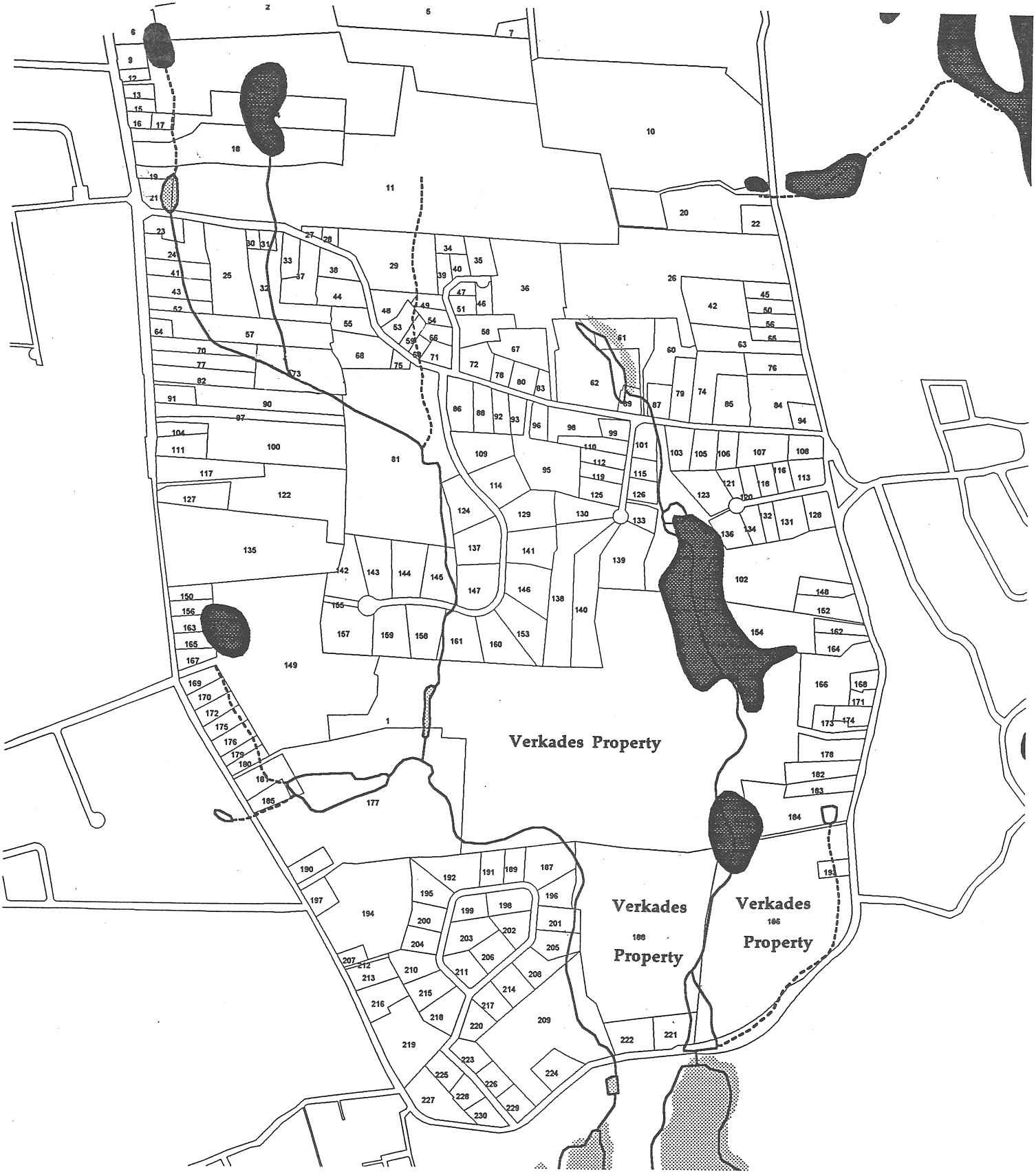
Parcel Map



SOILS

An understanding of soil properties makes it possible to effectively develop a site while minimizing the impact, both short and long term, to the area. This section presents information and comments about the limitation of the soils on the project site regarding their suitability for residential and recreational development, their ability to accommodate waste treatment systems, and their potential to function as or offer wildlife habitat. Particular attention will be given to the southeast corner of the 800 acre study site (referred to as the Verkades property), where it is anticipated development for the area will be proposed within the next one to two years. The comments in this section are based on the information contained in *the Soil Survey of New London County, Connecticut* (referred to in this report as the *Survey).* Due to the small scale of the *Survey* it should be understood the information in it serves as a guide to be used for general planning purposes and is not a substitute for onsite field investigations.

General Soil Characteristics

Twenty four (24) different soil map units were identified on the site according to the *Survey*. Four (4) soil map units are classified as hydric, or State regulated wetlands. Approximately 152 acres of the roughly 800 acre site were identified as hydric soils. The remaining twenty (20) soil map units are considered upland soils. The individual soil maps for the site are found on sheets 80 and 88 of the *Survey*.

The broad categories of upland soil map units contained on the site include Canton, Charlton, Haven, Hollis, Narragansett, Ninigret, Pawcatuck, Paxton/Montauk, Sutton, Tisbury, Udorthents, and Woodbridge. (Please refer to the Appendix A for a list and detailed description of each individual soil map unit). Typically, the majority of upland soil map units contained on the site have a depth of greater than six feet to the water table. Soils with a depth to the water table less than six feet include the Paxton, Sutton, Tisbury, and Woodbridge map units. The depth to the water table for these soils ranges from 1 to 2.5 feet. Similarly, most of the soils have a depth to bedrock greater than sixty (60) inches. Exceptions to this include the Charlton-Hollis map units which have bedrock at a depth of fourteen (14) inches in spots, the Hollis-Charlton complex which commonly has bedrock between twenty to sixty (20-60) inches below the surface, and the Narragansett map unit in which depth to bedrock ranges from six (6) feet in the Narragansett soils to ten to twenty (10-20) inches for the Hollis soils.

Permeability for the upland soils is generally moderate to moderately rapid in the surface layer. Some variation exists for subsurface permeability and ranges from rapid to slow. Surface runoff in most cases is considered to be medium.

The hydric soils contained on the property include Aa - Adrian and Palms muck, Pa - Pawcatuck mucky peat, Rn - Ridgebury, Leicester, and Whitman extremely stony fine

sandy loams, and Wd Walpole fine sandy loam. Like the majority of upland soils, all of the hydric soils have a depth to bedrock typically greater than sixty (60) inches. For the Aa and Pa soil map units the water table remains at or near the surface for most of the year. The Rn soil map unit experiences a high water table at or near the surface from fall through spring, while the water table for Wd map unit has a seasonal depth of about ten (10) inches between fall and spring. Permeability in the surface layer of the Rn, Wd, and Aa soils is considered moderate or moderately rapid. The organic layers of the Pa soil have a moderate or rapid permeability and the mineral layers have a rapid or very rapid permeability. Subsurface permeability for the Rn map ranges from slow to very slow for the Ridgebury and Whitman soils and moderately rapid in the Leicester soils. While the Wd map unit has a rapid to very rapid permeability in the substratum, the Aa map unit ranges from rapid to moderately slow. Surface runoff is slow to very slow for all four hydric soils contained on the property.

For more information on general characteristics please refer to the Nontechnical Soils Description Report, Hydric Soils List report, Physical Properties of Soils report, and Water Features report contained in the Appendix A.

Site Development Limitations

Soil conditions will be evaluated for development of buildings with basements, small commercial buildings, and local roads and streets. The hydric soils have severe limitations which would require extensive design and planning work to overcome in order to make the soils suitable for any type of building development. Flooding, ponding, wetness, and low strength of organic materials are cited as the principal deterrents for the hydric soils.

In contrast, the upland soils are well suited to community development. Specific details on the information which follows can be found in the Building Site Development report in Appendix A.

Buildings

For residential dwellings with basements the Canton-Charlton, Haven, and Agawam series are rated with slight limitations. The slight rating means the limitations are minor and can be easily overcome. Both moderate and severe limitations are listed for the remaining upland soils. Moderate limitations can be overcome with special design, planning, or maintenance while severe limitations would require extensive planning and work to overcome. Slope and depth to bedrock are the most frequent barriers for the majority of the soils. Wetness is identified as the primary hurdle for development on the Sutton, Tisbury, and Woodbridge soil map units.

For small commercial developments only the HcA soil unit is rated with slight limitations. The AfB, CcB, CbB, HcB, Nn, PbB, SwB, and the three Woodbridge (WxB,

WyB, WzC) soil units have moderate limitations because of slope and wetness. The remaining upland soil map units are severely limited by slope and depth to bedrock.

The concerns with these limitations are that slope and depth to bedrock can affect excavation and construction activities, and wetness may possibly cause movement of building footings.

Roads and Streets

Obstacles to road and street construction over the 800 acre site include slope, depth to bedrock, frost action, and wetness. Only slight limitations exist for the AfB, CbB, and CcB soils. Soil types where moderate limitations are present include the CcC, CrC, HcA, HcB, NlC, PbB, and PdC map units. The remaining soils have severe limitations. The Sutton, Tisbury, and Woodbridge soil units are severely limited by frost action.

Slope and depth to bedrock, as with building construction, can be problematic for excavation and construction activities The degree of wetness and severity of frost action can affect the high traffic capacity of the roads.

Sanitary Facilities

Given that the subject property is primarily zoned for residential use, this report will focus on the potential of the various soils for use as septic tank absorption fields. Additional information can be obtained in the Sanitary Facilities report contained in the Appendix A. The obstacles to using the Canton-Charlton, Hollis-Charlton, and Narragansett soils for septic field development include slope, large stones, and functioning poorly as a filter. These limitations are rated in the *Survey* as moderate. The remaining upland soils are characterized with severe limitations ranging from poor filtration, to slope, to depth to bedrock, to wetness and slow percolation. While slope and depth to bedrock present potential problems with excavation and installation, they also, along with the other limitations mentioned above, present potential problems with absorption of effluent, seepage, and possible groundwater contamination in places.

Despite the moderate and severe ratings for the soil map units, several soil types are identified by the *Survey* as being better suited for use as septic fields. The CbB, CcC, and CcB map units are considered to provide the best combination of soil characteristics for development as a septic field. Other soils commonly used for residential septic system construction are the Ts and HrC map units.

Wildlife Habitat

Typically the upland soils throughout the 800 acre site provide good habitat for wild herbaceous plants, hardwood trees, and coniferous trees. Potential habitat for open land wildlife is rated as good on the AfB, CbB, HcA, HcB, PbB, and Ts soils, fair for the Nn

soil, and is considered poor the other soils contained on the property. Virtually all of the upland soils are identified as offering good potential for woodland wildlife habitat.

All four wetland soils, according to the *Survey,* offer good potential habitat for wetland plants and shallow water areas, as well as good potential habitat for wetland wildlife. In addition to providing potential wetland habitat, the Rn soil type is considered to present fair habitat potential for woodland wildlife and the Wd unit is rated fair habitat potential for both woodland and open land wildlife. Please see the Wildlife Resources section for more information.

Recreational Development

According to information from Waterford municipal officials, golf course development (particularly within the Verkades property) is a possibility. The soil map units AfB, CbB, and PbB have only slight limitations for golf course fairway development while the remaining upland soils contained on the 800 acre site are restricted by moderate to severe limitations such as large stones, slope, wetness, and depth to bedrock.

It is important to realize golf course maintenance typically involves the use of fertilizers and pesticides. Also, products such as oils, gasoline, and solvents used for the maintenance and operation of equipment such as mowers or tractors may be contained on site. A more detailed analysis should be conducted in order to determine the potential impact of these products on water quality. Moreover, changes to the landscape resulting from the clearing of land should be assessed. The permeability, rate of surface runoff, and erodability are among some of the factors to be considered when reviewing a proposal for a golf course. Additional details can be obtained from the Recreational Development report in the Appendix A.

It should be recognized that the limitations noted for the different categories addressed in this report may, but will not necessarily be encountered. On-site investigation should be used to determine site specific conditions and to assess what problems, if any, the soil type may pose for development.

Verkades Property

According to information from the Waterford municipal office, the Verkades property is approximately 156 acres. The upland soil map units contained on the Verkades property include Canton-Charlton (CrC, CcC), Charlton-Hollis (CrD, CrC), Haven (HcB, HcA), Ninigret (Nn), Narragansett (NlC), Tisbury (Ts), and Hollis-Charlton (HrC) and comprise roughly 116 acres. All four hydric soils identified above are also present on the Verkades property, according to the *Survey,* and comprise approximately 40 acres, or 25 percent, of the property.

Generally the soils are well suited to community development. More than one half of the upland soils contained on the property are comprised of the Ts and HcA map units. The Haven series has slight limitations for most types of development and the primary

concern for residential development on the Tisbury complex is wetness. Other potential problems for building site development associated with the remaining soil units include slope, depth to bedrock, and wetness. The limitations range from slight to severe.

About 48 acres (41 percent of the upland soils) are comprised of the Ts, HrC, or CcC map units. As describe above, the CcC map unit is considered the best combination for septic fields and the Ts and HrC soils are commonly used for septic systems.

The soils potential to provide wildlife habitat is the same for the Verkades property as for the remainder of the 800 acre site. The wetlands on the site offer the same potential as do the wetlands throughout the entire site (please refer to the Wildlife Resources portion of the report for details). Good habitat potential exists for wild herbaceous plants, hardwood trees, and coniferous trees. The soil map units HcA, Ts, HcB, Nn, and CbB contained on the Verkades site constitute around 83 acres (72 percent of upland soils) and are all rated as providing good potential for open land wildlife habitat with the exception of the Nn unit which is rated as fair.

Figure 3.

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N

Soils Map

Scale 1″ = 1320′

WETLAND REVIEW

Existing Conditions

Figure 4 represents wetland soils within the watershed/study area overlaid onto a digitally produced "orthophotograph". The study area exists wholly within a local watershed known as the Goshen Cove Watershed which is part of the Southeast Coast Major Basin. This local watershed consists of two primary watercourses, each with their own "sub-local" drainage basin. The first is Ledges Brook on the west side of the watershed and an unnamed tributary on the east side of the watershed. Both watercourses run south to Goshen Cove. The sub-local drainage divide between these two watercourses was approximated and added by hand to Figure 4. Figure 4 also contains hand-delineated wetlands and watercourses not included within the digital database, but detected on stereographic aerial photo pairs. Refer to Figure 5 for a representation of the study area's hydrography.

There are approximately 186 acres of wetland within the study area, 21 acres of tidal wetlands and 40 acres of open waterbody. This represents approximately 17% of the total watershed area of 1420 acres. Coincidentally, this is the percentage of wetlands present on state-wide basis.

Almost all of the Ledges Brook sub-local watershed is classified as "Ridgebury, Leicester, and Whitman extremely stony fine sandy loams" (Rn). These soils typically exist, as they do in this case, in narrow drainageways and depressions on glacial till upland areas. The eastern watercourse, while containing some "Rn" soil units, also contains a significant amount of "Adrian and Palms mucks" (Aa).

This soil type consists of thick deposits of organic mucks and are found in irregularly shaped topographic pockets and depressions. Another abundant wetland soil type within the watershed, and associated solely with the eastern watercourse, is "Walpole fine sandy loam" (Wd) found on sandy stream terraces and outwash plains.

Assessment

The quality of these wetlands as a whole is difficult to assess in any detail within the scope of this ERT, however a few general comments concerning this topic can be made. A majority of these wetlands exist close or adjacent to residential and agricultural (albeit abandoned) land-uses. This juxtaposition can act to isolate the wetland from its surrounding uplands, reducing its overall ecological integrity. However, there is a state endangered species (American Bittern / *Botauras lentiginosus)* that was documented as part of the DEP-Natural Resource Center's Natural Diversity Database outside of the study site in the coastal area to the south, that could make use of the subject inland

wetlands to the north (refer to Wildlife Resources section for more details). Finally, the linear, relatively uninterrupted configuration of the wetlands located in the Ledges Brook sub-local watershed and to a lesser extent the eastern sub-local watershed, suggests that it may serve as a highly functional wildlife travel/migration corridor.

Potential Vernal Pool

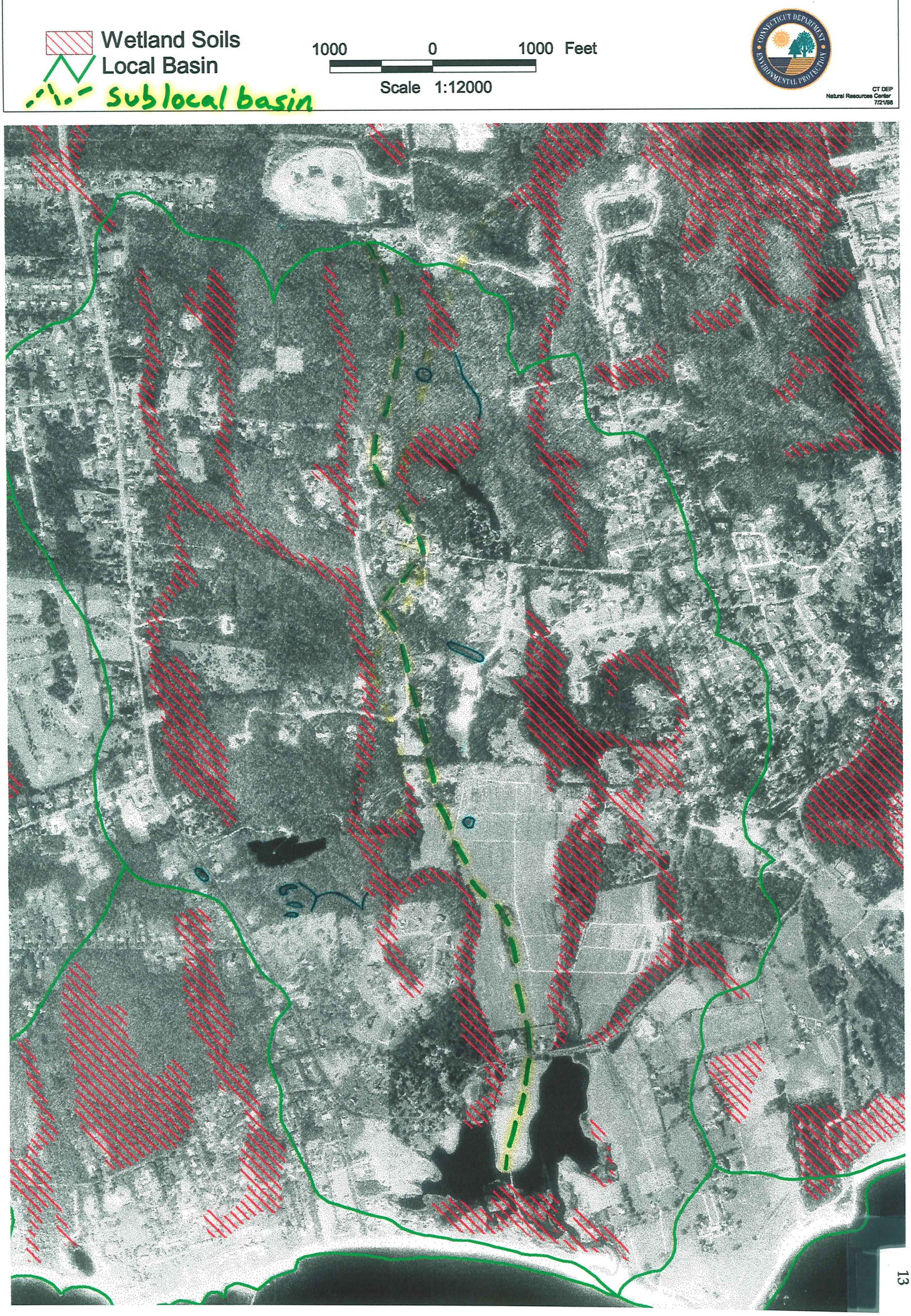
There is one particular inland wetland that deserves special mention. A Potential Vernal Pool (PVP) was observed the day of the ERT site visit. Vernal pools are small, shallow, circular depressions in the landscape which fill with water during periods of high spring melt-water and storm-water run-off, becoming drier during the warm summer months. True vernal pools also support a large, diverse assemblage of wildlife. Much of this wildlife is **solely** dependent on these areas for one or more periods of their life cycle. Because of the absence of permanent water, fish do not live in these ephemeral pools, making these areas very attractive to certain animals which would normally fall prey to these carnivorous fish. Rare and endangered wildlife are commonly found in these pools. Activities in the vicinity of vernal pools should be heavily scrutinized in order to avoid impacts to these highly valuable yet fragile areas. Most likely an excavated watering hole located in the northwestern portion of the Verkades parcel, this PVP has enough indicators to label it as such for now, however, to be sure, a biological survey should be completed, preferably in the spring, which could confirm the presence of certain obligatory wildlife species.

Buffer Area

In light of the above discussion on the functional value of these wetlands, the preservation of a suitable development "setback" for the purpose of buffering the effects of future development is highly recommended. The question of "How far is far enough?" has resulted in several studies on the topic. In general, it depends on what function you are trying to preserve. The focus in this case should be erosion control, nutrient retention/sediment trapping, and wildlife utilization. Buffers suited for these purposes typically range from 50 to 200 feet (the greatest distance needed for the wildlife buffer). It has been found that in typical development scenarios, at least a 100 foot buffer is needed to adequately perform the functions listed above. However, where providing and/or preserving wildlife corridors is recommended, such as perhaps within the Ledges Brook watershed as discussed above, it is suggested that this buffer be extended out to the 200 foot range.

Figure 4.

S.E. Waterford Natural Resources Inventory wetland soils on digital orthophoto



AREA OF DETAIL

TOWN QUADRANGLE

102

WATERFORD NEW LONDON

500

FEET

0 1000 2000

1:24000 Scale or 1" = 2000'

PLOTTED: 07/16/98 10.19.24 GIS

DEP-GIS

LEGEND

Hydrography

S.E. Waterford Natural Res. Inv.

- Stream / Ditch / Shore
- Intermittent Stream
- Intermittent Shore
- Submerged Stream / Shore
- Aqueduct
- Channel Boundary
- Dam / Canal / Spillway
- Lake / Pond / Stream / Open water
- Intermittent Lake / Stream
- Submerged Lake
- Marsh (appears on USGS Quadrangle)
- Inundated / Submerged Marsh
- Inundation Area
- Tidal / Sand Flats
- Dam / Rock in water
- Covered Reservoir

Figure 5.

Natural Resources Center, Connecticut DEP

VEGETATION

Vegetation Types

A land use type (residential) and five (5) vegetation cover types were identified within the seven hundred forty-six (746) acre study area of the Southeastern Waterford Natural Resource Inventory. The vegetation cover types found are Old Field, Woodland, Wetlands, Open or Field, and Water. The approximate locations of these land use/ cover types are delineated on the Land Use/Vegetation Map.

Residential

The Residential areas occupy approximately 304 acres (41%) of the study area. This land use/cover type consists of low to moderate density housing with associated maintained yard space. Also included with this type in mapping were portions of other cover types whose size and/or location were not significant to map separately and/or precluded management for other uses. These included cover types are primarily woodland, wetlands and open.

Old Field/Nursery Site

The former nursery occupied approximately 86 acres (11%) of the study area (the entire Verkades parcel is approximately 156 acres). Now abandoned, it has begun the early stages of succession from cultivated fields to forest. This site would be classified as Old Field in the vegetation cover typing system. The ground cover varies from clover, goldenrod, vetch and cultivated grasses such as timothy and orchard grass to shrubs such as bayberry, blackberry, viburnums and willow. In addition to sapling-sized horticultural specimens/cultivars of white pine, spruce and juniper left on the site, the pioneer tree species such as aspen and gray birch have begun to appear as seedlings and saplings. Multiflora rose, Tartarian honeysuckle and bittersweet are exotic invasives which have become established throughout the site. Moist and poorly drained areas are stocked with alder, cattails, phragmites and sedges. A narrow, moderately dense border of pole to sawtimber-sized trees surrounds the southern and western edges of the site. Species present include white ash, cherry, red maple, magnolia, red and black oak, white pine, blue and Norway spruce.

Woodland

The Woodland cover type is found on 266 acres (36%) of the study area. It is primarily Mixed Hardwood Forest which is composed of 60% or more of hardwoods and not over 40% of softwoods. The hardwoods are the so-called transition hardwoods; red oak, ash, maple, basswood, birch and tulip and/or the Connecticut hardwoods; white, red, black, scarlet and chestnut oaks, hickory and/or a small percentage of other species such as beech, birch and maple. The softwoods will be white pine and/or hemlock. Minor

component tree species noted during the fieldwork include American elm, chestnut, American hornbeam, black gum, sassafras and serviceberry. Blueberry, huckleberry, barberry, bittersweet, multiflora rose, greenbrier, bull brier, ferns, spicebush and viburnums form the ground cover and shrub layer. Some of the study area considered wetland by soil type falls into this vegetation cover type as the individual wetlands are not wide enough to be free of the influence of the surrounding cover type.

Wetlands

The Wetland type occupies 58 acres (8%) of the study area. This type is composed of broad riparian zones and swamps with tree growth or open swamps not yet producing tree growth. Trees found in these riparian zones and swamps are primarily red maple with elm, black ash and black gum. The shrub layer on these sites is comprised of spicebush, sweet pepperbush, swamp azalea, highbush blueberry, witch hazel and viburnums.

Field or Open

The Field or Open type occupies 26 acres (3%) of the study area. This type is not covered by tree growth and may be active agricultural lands such as cultivated fields, mowings or pastures, or open areas such as large maintained yard space in very low density residential areas. Some wetland areas may be included in this type as well as old fields which are abandoned farmland that is reverting to forest. Scattered small trees, largely gray birch and red cedar, and brush species such as juniper, hardtack and grey dogwood are found in the old fields.

Water

The Water type occurs as small ponds, totaling approximately 6 acres (1%) of the study area, including the flooded quarry. Any area of water too deep to support the growth of tree or brush species is included in this type.

Concerns

The impact of development of the study area would be to remove additional land from open space or forest land from the potential production of forest products. Development of the remaining wooded parcels into large homesites will preclude long term forest management. It is doubtful any system of forest management would be viable long term economic use for these properties given the local land values. In addition to supplying wood fiber, the other amenities of trees and forests must be considered. Trees and forests have value in reducing climatic extremes, controlling runoff, filtering pollutants from the air and water, reducing noise, providing aesthetic enjoyment, creating wildlife habitat, recharging aquifers and functioning as a carbon sink. Therefore a good relationship between development and the retention of forested open space is essential if future generations are to enjoy a high quality of life.

Wooded buffers should be retained along the streams and wetlands in the parcels not yet developed. This buffer would serve as a visual buffer and noise barrier between the different housing developments, control and filter runoff, and maintain some wildlife habitat. If the buffer was a continuous greenway along the stream and wetlands on the west side of the study area, wildlife could travel the corridor from Goshen Cove to the north boundary.

Figure 6.

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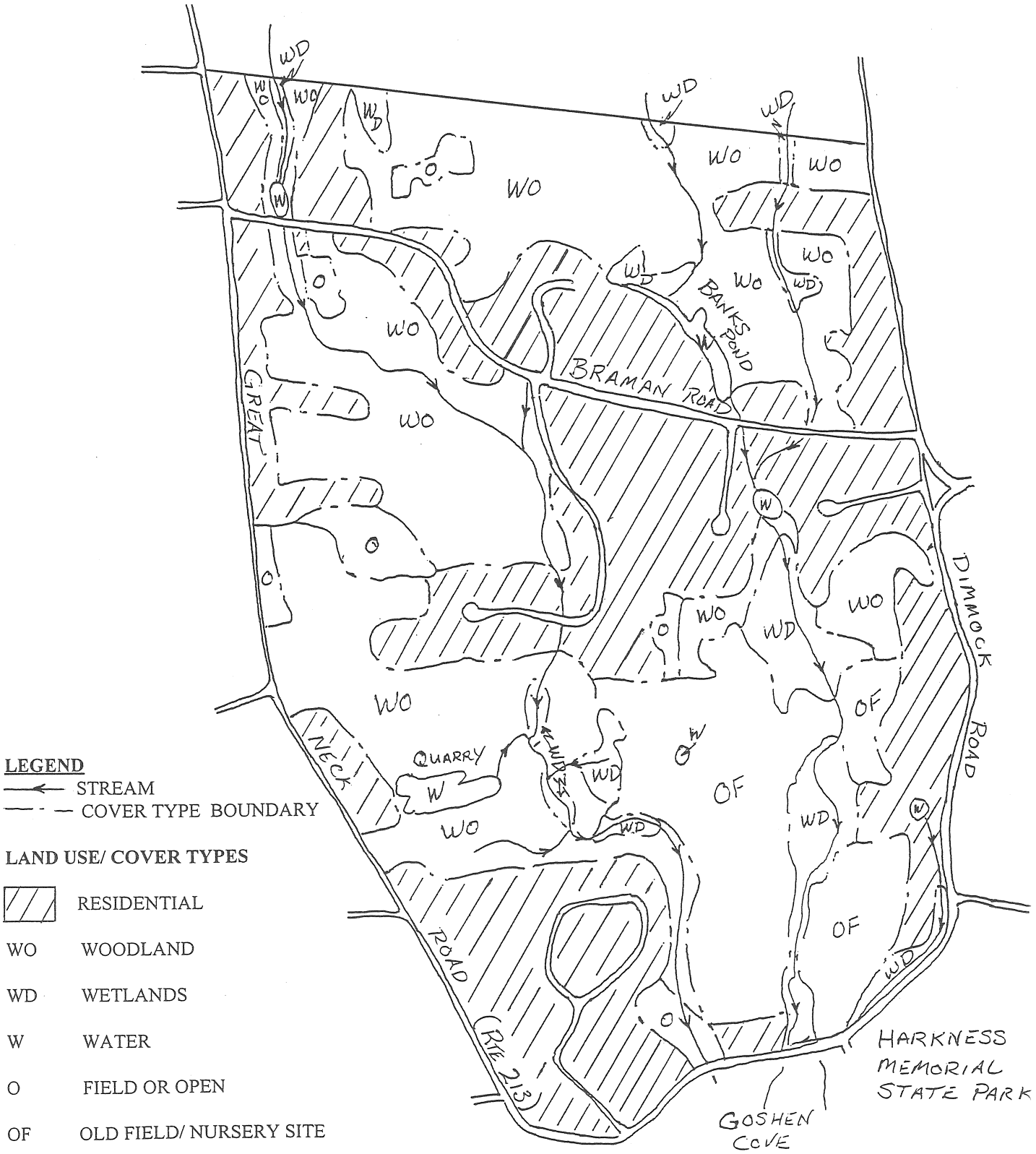
N

Land Use/Vegetation Type Map

Scale 1" = 1000'



LEGEND

STREAM

COVER TYPE BOUNDARY

LAND USE/ COVER TYPES

	RESIDENTIAL
WO	WOODLAND
WD	WETLANDS
W	WATER
O	FIELD OR OPEN
OF	OLD FIELD/ NURSERY SITE

WILDLIFE RESOURCES

Introduction

This evaluation is based upon a cursory field review, aerial photos, the forestry and water sections of this ERT and other existing resource information concerning the area. Species seen or heard during the site visit are noted with an asterisk (*).

Site Description/Wildlife Habitat

The approximate 800 acre parcel has elevations ranging from about sea level in the south to 100 - 110 feet on a couple scattered hills in the northern area. The site is relatively flat with a few rock outcroppings and slight rises along the western stream. The area is composed of six different habitat types according to the Vegetation section of this report: Residential, Old Field/Nursery Site, Woodland, Wetlands, Water and Field/Open. For this discussion of the wildlife aspects, Old Field/Nursery Site has been combined with Field/Open and the Wetlands combined with Water.

Wildlife habitat is said to be the complex of vegetative and physical characteristics that provide for all the requirements of wildlife, that is food, shelter, resting, nesting and escape cover, water and space. The study site has a diversity of habitat types that can provide for the needs of a wide variety of wildlife. Generally, the greater the habitat diversity and degree of interspersion of various habitat types, the greater the variety of wildlife there will be using an area (Note: the quality and types of habitat will influence the overall abundance and diversity of species present.) On the other hand, though there may be fewer wildlife species, large unbroken expanses of one habitat type provide important habitat for many species of wildlife including species that avoid edges. For instance, some species of migratory birds for which population declines have been noted will only nest in forest interiors at a certain distance from the edge, while other species need large expanses of grasslands or shrublands. There are many factors to consider when determining habitat use and quality of an area for different species, including habitat types, size of habitat types and their quality, overall size of the area, location, degree of isolation, diversity, and juxtaposition with other neighboring habitat types, etc.

Although the habitat type interspersion is high, the area provides overall, only fair wildlife habitat because of all the residential development and degradation of existing habitats. The two most notable and valuable wildlife habitat features of the area are the relatively large contiguous expanse of early successional stage habitat, in this case hay fields and old field areas containing grasses and shrubs, on the Verkades property (old nursery) and the corridor provided by the almost continually forested riparian areas. The early successional stage habitat provided by the Verkades property provides fair to good habitat for species utilizing this open and old field type habitat. Although narrow

in a few locations, the relatively wide buffer or corridor of trees, shrubs and herbaceous plants existing along the wetland corridor provides habitat for a variety of edge species and is probably also important in providing a travel and dispersal corridor. When these specific areas are considered in conjunction with the neighboring habitat provided by Harkness State Park and the Enders property (state land), the area's potential to provide valuable wildlife habitat is markedly increased.

The study site provides habitat for a wide variety of wildlife species, especially those species associated with wetland areas and hay fields and old fields containing shrubs. An array of birds, mammals, reptiles and amphibians could be expected to utilize this area to serve all their needs while many more would find it a place to meet some requirements. Species likely to occur in the area include: coyote, eastern chipmunk*, gray squirrel*, flying squirrel, white-footed mouse, woodland vole, woodland jumping mouse, gray fox, red fox, raccoon, opossum, striped skunk, white-tailed deer*, goshawk, broad-winged hawk, ruffed grouse, wild turkey, great-horned owl, white-breasted nuthatch, red-bellied woodpecker, hairy woodpecker*, downy woodpecker, pileated woodpecker, tufted titmouse, black-capped chickadee*, spotted salamander, garter snake, etc. along with many, many others.

Residential/Suburban Habitat Type

The study area is composed primarily of residential areas (41% according to the Vegetation section of this ERT) with much of this area divided up into smaller house lots. On the 1983/84 topographic maps of the area, the majority of houses were located along Dimmock, Great Neck and Braman Roads with three roads coming off of these, and two of these roads were less than a quarter of a mile long. Since then, two new roads have been constructed into the interior of the area, one of the original three has been extended, and new houses have been built along all roads. There are only about a dozen larger plots (and none very large except for the Verkades property) scattered throughout the area in various states of use.

While residential areas do provide habitat for some species, they do not provide quality habitat for most species, due to the patchy distribution of small areas of vegetation interspersed with major areas of disturbance and development. Adaptable wildlife species that can use small areas of habitat with lots of edge, tend to utilize these types of areas. Some wildlife species such as deer*, squirrels, chipmunks, raccoons, American robins, blue jays, finches, tufted titmouse, hairy and downy woodpeckers, black-capped chickadees* and other generalist species and introduced species such as house finches and European starlings may use lawn areas. Many of these species may become what are considered damaging and/or nuisance species of wildlife. This is particularly true of species like the white-tailed deer and raccoon.

Woodland Type Habitat

The mixed hardwood forest of transition hardwoods along with white pines or hemlocks covers about 36% or 266 acres of the study site (see Vegetation section for plant species present). The forest cover does not have much structural diversity, that is it lacks much of an understory and ground layer of plants and trees. It contains an understory that varies from only moderately thick to sparse. In general, the greater the vertical structural diversity of a forest, or the more layering of plant communities there are composing it, the greater the diversity *of* bird species there will be using the forested area. Because of the very limited vertical structural diversity and the fact that most of the forest land exists as smaller patches crisscrossed by roads and interspersed with development, it's value to wildlife is reduced.

The majority of the forest cover is found north of Braman Road and on the western side of the site with two plots on the eastern side south of Braman Road. There is some forest cover within the area designated residential, but it is scattered and highly influenced by human development and activity. Much of the forested areas within the residential area are along the watercourses, although the watercourses are not totally forested along their entire length. Streams, brooks and rivers can be extremely important travel corridors for wildlife, and are much more useful if they are buffered by a continuous area of useable habitat on both shores. Continuous cover along watercourses is even more advantageous because wetland areas are very productive and species traveling or migrating along the streams may find more food, water and cover than in drier forested areas. Functional travel corridors along streams, can be valuable to wildlife for dispersal, range expansion, travel within and between territories, and migration because they can provide cover, food, and resting places. Furthermore, when wildlife is living in areas with lots of development and disturbance, such as is found at this site, they may spend much of the their time in these corridors moving away from or towards the coast, traveling from one area of their territory to another, or dispersing out of the area to better quality habitat.

Forested areas provide valuable wildlife habitat. Forests provide many things to wildlife including cover, food, nesting places denning sites and roosting places. Trees provide a variety of food in the form of nuts, berries, catkins, buds and browse. Trees, both living and dead also serve as a home to a variety of insects which in turn are eaten by many species of birds like woodpeckers, warblers and nuthatches. A few den trees (i.e. trees with cavities in them) were noted, but were fairly scarce as were large snags (dead and dying trees) although a few short snags (<10 feet) were noticed along the western stream corridor. Den trees and snags can serve as nesting and denning places for animals such as squirrels, owls, and raccoons.

In addition to serving as habitat for a wide variety of birds and mammals upland forest also serves as habitat for salamanders and reptiles. For example, the relatively abundant redback salamander uses forested areas extensively. It breeds and deposits eggs under rotten logs and rocks and spends its adulthood under leaf litter. Many other species of salamanders utilize temporary pools for breeding then spend the rest of their time in

nearby forested uplands. In addition to high profile species of mammals and birds, forested areas provide habitat for a variety of other lesser known species.

While the value of the forested areas on this site for wildlife are limited, they would still provide numerous benefits. There usefulness is limited due to the amount of development dispersed throughout them and their low structural diversity.

Open Water and Wetland and Open Water Habitat

The study site contains riparian wetland habitat associated with two perennial watercourses and smaller tributaries, Ledges Brook on the west half and an unnamed tributary on the east side of the area that runs north to south and empties into Goshen Cove. A few ponds are scattered throughout the site as are some deciduous red maple swamps, a saltwater marsh, and at least one potential vernal pool. Brooks, intermittent streams, marshes, vernal pools and their associated wetland zones can provide important habitat for a number of species including various types of reptiles, amphibians and birds. Many species of wildlife would utilize some or all of these wetland/stream complexes.

The tidal wetland at the southern end of the property has low vegetative diversity, and contains some phragmites (*Phragmites australis*), which although native is an invasive species that tends to spread and take over a wetland area, especially in sites that have been degraded through siltation, construction, ditching, changes in salinity, etc. Unfortunately, it provides only minimal cover for some species of wildlife and no food value. Wetlands containing proportionally high concentrations of phragmites have proportionally lower wildlife habitat values. While this lowers the quality of the wetlands and wildlife habitat, the wetland still provides important wildlife habitat.

Because wetlands increase the habitat diversity of an area and offer a variety of food and cover to wildlife they are important areas to consider for protection. Acre for acre some types of wetlands and their associated riparian zones exceed all other land types in wildlife productivity. In addition to their value as wildlife habitat, wetlands serve other valuable functions including, water recharge, sediment filtering, flood storage, etc. Because of their value as wildlife habitat and the other important functions they serve, the development of, filling in and/or crossing of watercourses and wetlands should be avoided or limited whenever possible.

Streams and brooks also serve as important corridors for a variety of wildlife. They provide travel corridors for many species of wildlife, to travel within the site and to and from the site. Ledges Brook and the other unnamed stream provide a vegetated corridor connected to the northern end of the area. Streams are often easier to travel along especially in winter. Streams and even intermittent streams also offer a variety of food items like insects, various invertebrates and facultative wetland vegetation.

Wetlands and riparian areas also offer potential breeding sites for many species of insects, salamanders, amphibians, and birds. Various species such as the spotted salamander, red-spotted newt, American toad, Fowler's toad, gray tree frog, wood frog, painted turtle, snapping turtle and water snake could potentially be found in the wetland habitats on the site. Northern two-lined salamanders, northern spring peepers, green frogs, pickerel frog and the bull frog have a higher potential of being present on the site because they have been recorded in adjacent towns and the site does provide suitable breeding sites for these species. The high level of human disturbance in the area does however reduce the value of the site even for these species. Many of the reptile and amphibian species are even more susceptible to the negative impacts associated with habitat loss, because they are not very mobile and are not able to simply move if their habitat is impacted or destroyed altogether.

A small, isolated wetland located on the Verkades property was noted in the Wetland Review section as a potential vernal pool. Vernal pools share the following characteristics 1) contain water for at least two months during the growing season, 2) they occur within a confined depression or basin and lack a permanent outlet stream, 3) they lack fish and 4) they dry out in most years. Some species such as the spotted salamander, marbled salamander and wood frog are thought to depend primarily on vernal pools for breeding and early development, and along with fairy shrimp (a macro invertebrate) their presence can be used to designate a wetland as a vernal pool if it meets the above criteria. A site visit during the spring breeding season should be completed to determine if this site is actually a functional vernal pool and provides breeding sites for amphibians, reptiles and fairy shrimp. Various amphibians, reptiles and invertebrates eat fairy shrimp. Seasonally standing water may also be important breeding habitat for other reptiles and amphibians, provide water for many upland species, and attract bats and many songbirds species because of concentrations of insects and seed and fruit-bearing shrubs that may be present. Some species like the eastern American toad, northern spring peeper and gray tree frog could use this area as breeding habitat.

As indicated in the wetlands and wildlife sections of this report, the American Bittern (*Botaurus lentiginosus*) which is a state endangered species has a historical occurrence record in the coastal area to the south of the study site. The American Bittern is a secretive bird of marshes and bays and is now a rare and local migratory breeder at interior marshes in Connecticut (Bevier, 1994). Reportedly the bird is most often seen during the fall migration at coastal marshes, but a few may spend the winter feeding there. Although the wetlands on the study site have been somewhat degraded in functional value due to their invasion by phragmites, the American bittern, along with other bird species could potentially make some use of the wetland habitat on site.

Protecting and conserving the wetland habitat on site for any and all wildlife use it might receive is important. It is also important to maintain it's biological integrity because it is the drainage area to Goshen Cove. Goshen Cove serves as a nesting and foraging area for piping plovers (*Charadrius vociferous*) (state and federally threatened) and least terns (*Stema antillarum*) (state threatened). All necessary steps should be

taken to maintain and/or improve the biological integrity of the wetlands and maintain or improve the water quality discharged from them into Goshen Cove, so that any negative impacts to this important coastal area are minimized.

Nursery/Old Field and Field/Open Habitat Types

The Verkades property which has about 86 acres of old field/shrubland was protected from development for agricultural purposes and is probably the most valuable section with regard to wildlife within the area. There are a few other hay fields or open areas totaling about 26 acres that are scattered throughout the study site, but none are individually very large. Large contiguous areas of habitat, with minimal development or none at all (i.e. no homes, lawns, road crossings, parking lots, etc.) are becoming harder and harder to find in Connecticut as development increases. Large areas of contiguous early successional stage habitat provides for a myriad of wildlife, but are particularly useful to birds, insects, and mammals specialized for such vegetative structure.

The now abandoned nursery site has begun the process of succession, where one plant community is replaced by another in a predictable fashion. The fields contain mixed grasses, herbaceous plants, mixed with left over nursery specimens, shrubs and young trees. This old field type habitat provides a high degree of plant diversity and structural diversity and provides abundant food sources, nesting sites, perching sites and cover. These early successional stage habitats can provide important habitat for a variety of species including small mammals like the meadow vole and white footed mouse, birds like the bluebird, bobolink and field sparrow and hawks like the red-tailed and owls like the great horned. Many other species such as deer, turkey, woodcock, tree swallow and bat use field habitat such as that found here in conjunction with the other types of habitat found on site and on adjacent sites.

Large areas of early successional habitat types such as grasslands, old fields and shrublands are fast disappearing in Connecticut and across New England because these sites are usually the easiest to develop or revert to woodland without maintenance. There are different groups of birds dependent on early successional habitats. A group of birds, collectively known as grassland specialists depend on open grassland and/or hayland, while another group known as shrubland specialists are dependent on old fields with some woody growth and shrublands.

Grassland birds, like the bobolink and savannah sparrow have shown drastic declines in their populations in recent years. While many people are concerned with the decline of forest breeding neotropical migrants, the documented declines for populations of shrubland, grassland and shorebirds in Connecticut and throughout the northeast have been even greater. Many grassland birds require large fields of hay or grasses to nest and feed in. They generally begin nesting in May, but may not be done nesting and fledging young until mid July. Traditionally farming, which calls for cutting hay two or three

times during the summer beginning in late May or early June, often causes the demise of a population using a particular field. In many cases, modification of the haying dates and/or leaving a refuge area within a field uncut or an entire field uncut can provide at least some habitat for these birds to try and nest and fledge young in. So while haying practices have impacted the viability of these bird populations, outright habitat loss is the greatest threat.

Grassland specialists like the bobolink would be expected to utilize these sites for foraging and nesting along with other field associated species like the kingbird and bluebird. While some of the grassland specialists reported for the site may not have been able to successfully nest and fledge young each year due to the past haying schedule, the hayfields still provide important foraging habitat for birds that may actually be nesting nearby. Birds moving through on migration could also be expected to utilize these areas for stop over habitat. These field sites could offer potential nest sites for some of the grassland specialists, if adequate time for the nesting period was ensured.

Shrubland species have a similar breeding pattern to grassland birds, but the major reason for their decline is the loss of habitat through either development or succession from shrubland to woodland. Shrubland can be maintained through burning or mowing every couple years. The approximately 86 acres of shrubland habitat is important because it is a fairly large area of habitat, located in one general area. At the Verkades property it would desirable to remove many of the non-native invasive species currently growing there, to increase the quality of the habitat even more.

A wide variety of species specialize in using shrubland habitat while many others use it in conjunction with other habitat types. A wide variety of wildlife could be expected to use this important area of shrubland habitat including things like, the chestnut-sided warbler, prairie warbler, indigo bunting, song sparrow, ruffed grouse, meadow vole, white footed mouse, garter snake, red fox, coyote, white-tailed deer, along with many others.

Potential Wildlife Impacts

This area has already seen much development, and there is a good chance that more of the area will continue to be developed over time. When deciding what the future will be for this area it is important to consider the needs of the town and availability of open, protected space within the town of Waterford and surrounding areas.

If the Verkades property and other sites within and surrounding study area are developed the following impacts discussed below could be expected. In general, as with any development, wildlife and wildlife habitats are negatively affected. Development of the site reduces the available habitat and impacts wildlife not only in the area being developed but also within abutting areas.

Reduction In Available Habitat

The decrease in available habitat could cause some wildlife species' densities to decrease and some other species to disappear completely. Habitat quality is species specific and is going to be dependent on the different factors present that provide for food and water, shelter, breeding and space; so each wildlife species' response to the development will be different. Territory sizes, which also vary by species, will also influence the number of animals of a species that are present at the site. As mentioned previously, some species, especially the grassland neotropical migrants are area sensitive so the loss of habitat to development may actually cause a species to vacate the area or die.

Increased Disturbance

An often overlooked impact of development is the general increased disturbance to wildlife. Some species are sensitive to development and move away from the vicinity of developed areas, vacate the area entirely or perish causing them to decrease in numbers within the study area. The clearing of land, construction of homes and new roads that disrupt the contiguous nature of the area, free roaming dogs and cats, more people, more cars on the road and the many other factors associated with any development can disturb less tolerant species and cause them to move out of the area or decrease in number. Additionally, any development will also negatively affect wildlife in surrounding areas where there has been no physical change. Conversely, development in areas that border the site or occur within other areas will negatively impact the species present. The value of the study area for wildlife habitat would correspondingly decrease as the amount of development in the area increased.

Nuisance Species

Development changes the type of habitat available to wildlife. Species sensitive to man's presence or the changes he will make at the site will either move out or perish. Species that will choose the site tend to be species that can survive in a variety of habitat types and/or are adaptable to man's activities. Such species include house sparrows, European starlings (both introduced species), pigeons, raccoons, squirrels, brown-headed cowbirds, etc. Such species can become what is usually considered "nuisance wildlife" and quite a few of these species not only cause problems for humans, but they reduce bird populations through competition for nest sites and predation and parasitism of nests.

Wetland Degradation

Increased development within the study area could negatively impact streams, tributaries and the other wetlands on the site and off the site. Alteration or degradation of the wetlands will negatively affect wildlife within the study area and have potential effects downstream. The extent of the effects on the wetlands and on wildlife will be dependent on many factors including the practices used and the location and size of the development. A minimum buffer of 100 feet between the edge of a wetland and any development is usually suggested and if it is determined that the independent wetlands are vernal pools a larger buffer is suggested.

During clearing and construction, and before vegetation stabilizes cleared areas, erosion will occur in areas with any type of slope, with increased erosion on steeper slopes. The eroded earth can wash into wetland areas. The actual effect on wetland areas will vary due to vicinity and soil types. Any practices that may be used to reduce erosion and siltation of wetlands such as hay bales, vegetation between cleared area and wetland areas, etc., should be used. Siltation of a wetland negatively affects the wildlife that uses it and can change or destroy a wetland's entire structure, such as the filling in of a vernal pool or the muddying of a stream's water. After construction is completed, increased runoff from the development containing oils and various chemicals from roads and driveways, along with fertilizers and pesticides applied to fields could negatively impact the water quality which in turn could degrade the wildlife habitat that now exists.

The clearing of vegetation along and around wetlands also directly impacts wildlife. For some species that live in forested areas, but breed in wetland areas the forested area and the wetland must be contiguous. Even when a species will cross cleared areas to disperse or to return to the water to breed the loss of cover can increase the chance of predation. The clearing of trees along the streams could increase erosion and disrupt the continuity of the vegetated corridor.

As stated above, wetland impacts on site can impact areas off site, especially in regards to water quality. The shoreline habitat in and around Goshen Cove is used as a feeding area by piping plovers and least terns, both species listed as "threatened" in Connecticut (See Connecticut's Endangered, Threatened and Special Concern Species List 1998). It is imperative that the water draining from the already highly impacted/degraded wetlands on the site is not further degraded, in order to reduce any negative impacts to this important coastal feeding area.

Recommendations

Ideally, all the remaining major portions of the undeveloped areas on the study site should be set aside as open space if the goal is to optimize wildlife habitat values. Short of this, the two most important areas for habitat preservation and management are

protection of the existing open and shrubland habitat and protection and enhancement of the existing habitat buffer along all the stream/wetland corridors.

Protection and improvement of the riparian and wetland areas by the maintenance of a vegetative buffer is very important for wildlife and the protection of water quality, erosion control and other factors associated with waterways and wetlands. Maintaining the existing buffer along the stream course, widening it where possible and ensuring that linkages with other existing habitats are maintained is crucial to maintaining the value of this wetland corridor for wildlife. The wetland buffer should be no less than 100 feet in width, and should be wider if possible. Because of the occurrence of several threatened and endangered species (see the subsection of this section entitled open water and wetlands) in the Goshen Cove area, it is important to maintain the existing wetland habitat on the site so that it would be available for potential use and to ensure that the tidal wetlands in the Cove area are not degraded due to erosion, sedimentation and/or water quality problems arising on the study site.

Protection and proper management of both the open hay field and shrubland habitat is also extremely important. This would ensure the conservation of this important habitat type that is quickly declining here in Connecticut. It may be beneficial to manage some of the existing shrubland type habitat near Rte. 213 as grassland habitat, due to the proximity of the other adjacent grassland habitat at Harkness State Park. This would need to be determined after more extensive study of bird and general wildlife use. etc.

Protection and conservation of the habitat on the Verkades property could probably be best accomplished by outright purchase, while protection of the wetland/stream corridor could be accomplished through and easement and/or purchase combination. In general protecting small isolated patches of habitat is the least desirable. Protection of larger areas of quality habitat that are linked together either by direct connection of the same habitat type or another habitat type or at least by riparian and/or wetland corridors is highly desirable.

Conclusion

Even though the area has been somewhat degraded due to the extensive development and the degradation of the wetlands, it still provides habitat for various wildlife species. The most valuable attributes of this study site are the mosaic of hay fields and the fairly intact forested corridor of vegetation along the wetlands. If preserving the greatest wildlife habitat value is desired, than at the very least, all of the field habitat contained in the Verkades property should be designated as open space and any measures necessary should be taken to insure preservation of the existing corridor of vegetation along the wetland area.

Maintaining the biological integrity of the wetlands on site is not only important to wildlife on site but is also important because they drain into Goshen Cove, which is

used by several threatened and endangered species, along with many, many other species of wildlife.

The areas most valuable feature is the old field habitat provided by the Verkades property along with the wooded/vegetated corridor found along the streams. Increased development on the site would have irreversible impacts on wildlife, while maintaining this area as open space would retain the greatest wildlife habitat value.

General Recommendations If The Area Is Further Developed

If sites within the project area are purchased for any type of development there are some steps that should be considered in planning and constructing any type of development in order to help minimize adverse impacts on wildlife. It should be noted that despite these measures, wildlife habitat will increasingly be adversely impacted as the amount of development increases on a site (i.e. the less area cleared, the better).

- Maintain a 100 foot (minimum) wide buffer zone of natural vegetation around all wetland/riparian areas to filter and trap silt and sediments and to provide some habitat for wildlife.

- Utilize natural landscaping techniques (avoiding lawns and chemical runoff) to lessen acreage of habitat lost and possible wetland contamination.

- During land clearing, care should be taken to maintain certain forest wildlife
- requirements:

    - Encourage mast producing trees (i.e. oak, hickory, beech). A minimum of five oaks/acre, 14 inches dbh or greater should remain where present.

    - Leave 5 to 7 snag/den trees per acre as they are used by birds and mammals for nesting, roosting and feeding.

    - Exceptionally tall trees, used by raptors as perching and nesting sites, should be encouraged.

    - Trees with vines (i.e. fruit producers) should be encouraged.

    - Brush debris from tree clearing should be piled to provide cover for small mammals, birds and amphibians and reptiles.

- Shrubs and trees which produce fruit should be encouraged (or can be planted as part of the landscaping in conjunction with the buildings) especially those that produce fruit that persists through the winter (example, winterberry). Call the DEP Wildlife Division for a list of native plants.

- A buffer of undisturbed vegetation of at least 100 feet should be maintained around any wetland. If a wetland site is determined to be a vernal pool, the vegetation, downed logs and sticks should not be removed

Most importantly, any development on the site should attempt to avoid any wetland crossings. If a wetland crossing is necessary for vehicles or pedestrians, bridge crossings are almost always more preferable than culverts. Less fill is usually required and the stream bottom is left in a natural state, which is much more desirable for wildlife. Furthermore, wildlife corridor use is less likely to be hindered by a bridge, especially if a minimum of vegetation is removed.

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Fisheries Resources

Aquatic Resources

Watercourses

Two perennial streams flow into Goshen Cove (Ledges Brook and an unnamed stream). 'These two watercourses are best characterized as low gradient meandering systems with forested riparian zones. Instream habitat is dominated by shallow water pool and run habitat. Although some stretches of these streams contain coarse substrates, most instream bed materials are comprised of sands and silts. Excessive amounts of roadway sands were particularly evident in watercourses below the Braman Road Crossing.

No freshwater fisheries survey information are available for the two watercourses that drain into Goshen Cove. Based on a field review of physical instream and riparian resources on the site and the presence of impoundments on this system such as Banks Pond, these streams are expected to seasonally support warmwater fish populations. More likely, the streams would contain "blowdowns" or fish that live in the ponds that move downstream during high flow periods. Thus, any fish species that resides in pond habitats can be found in these watercourses. The following freshwater finfish could be found: brown bullhead, largemouth bass, chain pickerel, yellow perch, sunfish species and golden shiner. American eel, a species which exhibits catadromous migratory behavior may also inhabit these systems.

Goshen Cove

Goshen Cove is a coastal embayment located adjacent to Harkness Memorial State Park. In addition to Harkness Park, much of the property surrounding the cove was recently willed to the State of Connecticut. Freshwater enters into the cove through the two perennial streams that flow beneath Great Neck Road. A narrow strait provides access to Long Island Sound. This inlet/outlet which is across the barrier beach at Harkness Memorial State Park has a history of filling in with sediment during coastal storms. The frequency of blockages depends on the frequency and severity of coastal storms. This accumulation of sand inhibits tidal flushing of the cove. In order to maintain adequate flushing of the cove and to prevent backflooding of neighboring property, the CT DEP periodically removes sand from the channel to restore the cove's connection with Long Island Sound.

Much of the cove is surrounded by tidal wetlands and intertidal flats. Small forage fish, striped killifish and mummichogs (*Fundulus* spp.), are probably the most abundant finfish that inhabit the cove. Shallow water and intertidal areas are typically dominated by forage species which spend the majority of their life cycle inshore. Although not of direct commercial or recreational importance, forage fish are extremely valuable

components of the marine food web. *Fundulus* spp. and silversides *(Mendia mendia)* are by far the most common forage species captured by the Inshore Seine Survey of the Fisheries Division (Howell and Molnar 1998). The cove is not thought to provide important spawning and/or nursery habitat for winter flounder. Shallow conditions at the entrance to the cove, as well as periodic closures of the inlet probably restrict the movements of marine species into and out of the cove.

Potential Impacts

Future development in the watershed could possibly lead to a host of wide ranging potential impacts to aquatic resources. Present and past land uses such as the large nursery operation have more than likely contributed to nutrient enrichment of adjacent streams and Goshen Cove. Some potential problems are outlined below.

- **Percolation of septic effluent into watercourses.** A failure of individual septic systems to operate properly is potentially dangerous to aquatic habitats. Nutrients and assorted chemicals that may be placed in septic systems could enter surface waters in the event of a failure or possible infiltrate groundwater, especially when water tables are seasonally close to the surface. The introduction of septic effluent could result in a major threat to fish, public health, and overall water quality conditions.

- **Transport of lawn fertilizers and chemicals to watercourses.** Runoff and leaching of nutrients from fertilizers placed on lawns can stimulate nuisance aquatic weed growth and help precipitate algal blooms. The introduction of nutrients will accelerate the eutrophication process. Introduction of lawn chemicals may result in fish kills and water quality degradation.

- **Aquatic habitat degradation in streams due to the influx of stormwater drainage.** Stormwaters that outlet to watercourses can contain a wide variety of pollutants that are detrimental to aquatic organisms. Pollutants commonly found in stormwaters are: hydrocarbons (gasoline and oil), herbicides, heavy metals, road salt, fine silts, and coarse sediment. Nutrients in stormwater runoff can fertilize stream waters causing water quality degradation.

- **Impacts to downstream environments.** Any water quality problems and habitat degradation that directly occurs within these streams may be observed in downstream areas such as Goshen Cove. Goshen Cove has been known to suffer from a eutrophication problem due to the periodic closure of the tidal inlet.

Recommended Mitigation Measures

- **Properly design and locate individual septic systems.** It is crucial that new septic systems are placed in areas that will effectively renovate septic effluent. All septic systems should be maintained on a regular basis. It is also important to prevent the disposal of harmful chemicals into septic systems which may negatively affect operation and possibly result in system failure.

- **Limit liming, fertilization, and the introduction of chemicals to residential lawns.** 'This will help abate the amount of additional nutrients to aquatic resources. Non-phosphorus lawn fertilizers are available from various lawn care distribution centers.

- **New developments need to implement effective stormwater management strategies.** The effective management of stormwaters and roadway runoff can be accomplished through proper design, location, and maintenance of catch basins and detention basins. Particular attention should be made to stormwater discharges that outlet to watercourses to ensure that instream erosion is not accelerated. Maintenance is very critical. Catch/detention basins should be regularly maintained to minimize eventual adverse impacts to aquatic resources. The use of sodium chloride road salt to deice paved surfaces should be minimized. Calcium chloride should be primarily utilized since it is less environmentally harmful.

- **Maintain at the minimum, a 100 foot buffer zone along the edge of the two perennial watercourses that flow into Goshen Cove.** No construction or alteration of natural vegetative habitat should be allowed in this zone. Research has shown that 100 foot buffer zones help prevent damage to aquatic ecosystems that support fish and aquatic insect life. These buffers help absorb surface runoff and other pollutants before they can enter wetlands and aquatic habitats.

- **Open Space.** Local land planning commissions should maximize their authority when extracting open space from developments. Open space efforts should be made to secure environmentally sensitive areas. Appropriate locations for open space acquired for the purpose of environmental protection should include areas adjacent to streams and wetlands.

References

Howell, Penelope T. and David R. Molnar. 1998. A Study of Marine Recreational Fisheries in Connecticut. Job 3: A Study of Nearshore Habitat.

ARCHAEOLOGICAL REVIEW

A review of the state of Connecticut Archaeological Site Files and Maps shows no known archaeological site in the project area. Harkness Memorial Park and the Seaside Regional Center are located south of the natural resource study area - both properties are listed on the National Register of Historic Places. Because of existing residential and road patterns, any new development within the study area would not effect the historic and architectural importance of Seaside. In contrast, any proposed future development of the Verkades parcel (southeastern extreme of the study area) should explicitly consider the effects of possible visual landscape alterations opposite from the entrance to Harkness Memorial State Park.

Undeveloped lands within the study area possess a moderate to high sensitivity for prehistoric and historic archaeological resources. The Office of State Archaeology and the State Historic Preservation Office recommends that the Town of Waterford consider inclusion of a reconnaissance archaeological surveys an integral part of future decision-making for all proposed development alternatives within the Great Neck study area. This survey data will assist planning and zoning and conservation commission members and the town planning department in their landuse decision-making capacity. All archaeological studies should be undertaken in accordance with the Connecticut Historical Commission's ***Environmental Review Primer for Connecticut's Archaeological Resources.***

The Office of State Archaeology and the Connecticut Historical Commission are prepared to offer the Town of Waterford any technical assistance in conducting an archeological survey of the study area and to review proposed development plans for cultural resource management plans for cultural resource management purposes.

COASTAL MANAGEMENT CONSIDERATIONS

Connecticut Coastal Management Act

In 1972, Congress passed the federal Coastal Zone Management Act (CZMA) to give coastal states and territories the opportunity to establish comprehensive management programs for their shores. Connecticut began developing its program in 1975 and completed its plan for regulating coastal activities and protecting coastal resources four years later. In 1979, the State legislature passed the Connecticut Coastal Management Act [CCMA - Connecticut General Statutes (C.G.S.) Sections 22a-90 through 22a-112, inclusive] which is the enabling legislation for implementing the State's program. The CCMA, which became effective January 1, 1980, includes goals and policies for the use, development and protection of Connecticut's coastal resources. The subject of this ERT study is an approximately 800 acre study area including approximately 84 acres which are within the statutorily defined coastal boundary [C.G.S. Section 22a-94(b)]. Therefore, any significant development proposal within the coastal portion of this 800 acre parcel would have to be consistent with all applicable policies and standards of the CCMA.

Coastal Resources Present In and Around the Study Area

The study area includes an approximately 84 acre section just north of Great Neck Road which supports the following coastal resources: shorelands, coastal flood hazard area, tidal wetlands, freshwater wetlands, and an estuarine embayment. Each of these resources is statutorily defined in the CCMA.

Shorelands

> "Shorelands" means those land areas within the coastal boundary exclusive of coastal hazard areas, which are not subject to dynamic coastal processes and which are comprised of typical upland features such as bedrock hills, till hills and drumlins. [C.G.S. Section 22a-93(7)(M)]

Within the coastal portion of the study area, those upland areas at elevations above the 100-year flood elevation are designated shorelands. Approximately 47 acres of the study area located within the coastal boundary are designated shorelands.

Coastal Hazard Area

> "Coastal Hazard Areas" means those land areas inundated during coastal storm events or subject to erosion induced by such events, including flood hazard areas as defined and determined by the National Flood Insurance Act, as amended (U.S.C. 42 Section 4101, P.L.

> 93-234) and all erosion hazard areas as determined by the Commissioner. [C.G.S. Section 22a-93(7)(H)]

The coastal hazard area, also known as the coastal flood hazard area, follows the two brooks which terminate at the southern portion of the site and also borders the northern side of Great Neck Road (see coastal resources and FEMA maps in Appendix B). Coastal flood hazard areas are subject to flooding during 100 year storm events as shown on flood insurance rate maps prepared by the Federal Emergency Management Agency (FEMA). The 100 year flood level at this location is 10 feet National Geodetic Vertical Datum.

Tidal Wetlands

> "Tidal Wetlands" means "wetland" as defined by C.G.S. Section 22a-29. [C.G.S. Section 22a-93(7)(E)]
>
> "Wetland" means those areas which border on or lie beneath tidal waters, such as, but not limited to banks, bogs, salt marsh, swamps, meadows, flats, or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters, and whose surface is at or below an elevation of one foot above local extreme high water; and upon which may grow or be capable of growing some but not necessarily all of the following: (wetland vegetation - see C.G.S. Section 22a-29(2) for complete list of species).

The southern portion of the site just north of Great Neck Road supports a tidal marsh area in which salt-meadow cord-grass *(Spartina patens)* and common reed *(Phragmites australis)* are evident. In particular, this area is located where a brook from Banks Pond meets the saline waters from Goshen Cove through a culvert under Great Neck Road. Salt-meadow cord-grass is present in the area north of the culvert which is inundated by the waters of Goshen Cove. Common reed is present around the edges of the salt-meadow cord-grass area. This is consistent with salt-meadow cord-grass growing in more saline waters than common reed which thrives in fresh water areas or areas of very low salinity, in this case, where freshwater inputs from the brook are observed.

As detailed in Waterford's 1982 Municipal Coastal Program, tidal wetlands perform the following important functions:

- Marine food production - tidal wetlands are one of the most productive ecosystems in the world; they have a very high concentration of nutrients. Two thirds of all commercially harvested fish and shellfish depend on the marsh-estuarine system at some time in their life cycle.

- Wildlife habitat - tidal wetlands are important breeding, nesting and feeding grounds.

- Flood and storm protection - tidal wetlands serve as a natural buffer, protecting upland and developed areas from storm tides and absorbing wave damage.

- Recreation - tidal wetlands provide many opportunities for hunting, fishing, birdwatching, etc.

- Pollution control - tidal wetlands serve as an important basin in which organic pollutants are chemically and biologically converted into useful nutrients.

- Sedimentation - tidal wetlands absorb silt and organic matter which otherwise would obstruct channels and harbors.

Freshwater Wetlands and Watercourses

> "Freshwater Wetlands and Watercourses" means "wetlands" and "watercourses" as defined by C.G.S. Section 22a-38 and C.G.S. Section 22a-93(7)(F).
>
> "Watercourses" means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water, natural or artificial, public or private, which are contained within, flow through or border upon this state or any portion thereof, not regulated pursuant to Sections 22a-28 to 22a-35, inclusive. [C.G.S. Section 22a-38(16)]

Freshwater wetlands within the coastal boundary are found in conjunction with the two brooks which flow towards Great Neck Road. Please see the separate section on Wetland Review for a discussion of this resource.

Estuarine Embayment

> "Estuarine Embayments" means a protected coastal body of water with an open connection to the sea in which saline sea water is measurably diluted by fresh water including tidal rivers, bays, lagoons and coves. [C.G.S. Section 22a-93(7)(G)]

Immediately south of Great Neck Road is Goshen Cove, an estuarine embayment which is connected to Long Island Sound by a narrow channel. This channel has historically narrowed or closed up as a result of shifting beach sands at the mouth of the cove. However, a permit issued to the Department of Environmental Protection in 1989

allowed dredging of the southernmost portion of this channel, and also allows for maintenance dredging as needed. The need for this dredging was explained, in part, in the permit application materials as follows:

> Goshen Cove inlet has a long history of in-filling with sediment during coastal storms, the number of blockages depending on the frequency and severity of coastal storms. During the past eight to ten years, the DEP has restored the channel on an annual basis in order to maintain a tidal connection between Long Island Sound and Goshen Cove. Maintaining a tidal connection between the two water bodies is vitally important to avoid the following potential problems:
>
> 1) Stagnation of shallow waters, particularly during the summer months, can contribute to:
>   a) low dissolved oxygen with resultant fish kills;
>   b) exacerbation of water qulaity problems due to nutrient inputs, especially from a nearby nursery;
>   c) excessive algae bloom;
>   d) increased production of hydrogen sulfide gas.
> 2) Back flooding of stormwater runoff of neighboring private property surrounding Goshen Cove.
>
> Sand carried into the inlet channel has raised the bed of the channel approximately one foot above local mean low water, preventing the cove from thoroughly flushing out during the ebb phase of the tidal cycle.
>
> Accumulation of sediment in the inlet has periodically resulted in offsetting the inlet mouth progressively to the west, out of the confines of the existing training walls. This progressive offset not only causes a decrease in flushing due to a lower hydraulic efficiency, but also results in the offset channel eroding into a dune line on the part of the barrier beach known as the Strand.
>
> In order to maintain adequate tidal flushing of Goshen Cove so as to avoid creating the aforementioned environmental problems, dredging of the sediments which have accumulated between and upstream of the existing training walls is necessary.

Therefore, activities in the Goshen Cove watershed directly impact Goshen Cove and the land area immediately adjacent to it.

Applicable Coastal Resource and Activity Policies

In general terms, any development in the 800 acre study area must be sensitive to impacts on the coastal resources present in the southern portion of the site. The CCMA provides policies and standards applicable to each of the coastal resources present on the site and identified above. A listing of all these resource policies is provided in Appendix B. Any proposed development would have to be consistent with all applicable policies.

Of all the coastal resources present in the study area, tidal wetlands are considered among the most sensitive to development impacts. This is reflected in the overriding tidal wetlands policy from the CCMA which is to preserve tidal wetlands and to prevent their despoliation and destruction in order to maintain their vital natural functions [C.G.S. Section 22a-92(b)(2)(E)].

Consistent with this policy, any activities proposed in tidal wetlands would be regulated in accordance with C.G.S. Section 22a-28 through 22a-35, inclusive. However, activities outside of the tidal wetlands but within the Goshen Cove watershed can have significant detrimental impacts on these wetlands. In particular, increased stormwater flows as a result of increases in impervious surfaces from uses such as buildings, roads, driveways and parking lots in the watershed can result in detrimental impacts on the wetlands in the form of increases in silt and pollutant-laden runoff. Therefore, any development within the subject parcel should be designed to minimize increases of stormwater runoff.

Other areas of concern from a coastal management perspective are areas of coastal flood hazard. The CCMA requires the management of coastal hazard areas so as to insure that development proceeds in such a manner that hazards to life and property are minimized [C.G.S. Section 22a-92(b)(2)(F)]. Therefore, any development in areas of coastal flood hazard in this parcel should take into consideration potential flooding hazards and all FEMA and zoning regulations regarding development in these areas.

The least sensitive resource present on the site are areas designated as shorelands. The CCMA requires that shoreland use and development be regulated in such a manner that adverse impacts on adjacent coastal systems and resources are minimized [C.G.S. Section 22a-92(b)(2)(I)]. Therefore, while this would be the most appropriate area for any proposed development, consideration must be made for impacts to adjacent coastal resources, in this case, coastal flood hazard areas, wetland areas and the water quality of Goshen Cove.

With regard to CCMA policies and standards applicable to proposed activities, we can discuss one relevant policy in the absence of a development plan. C.G.S. Section 22a-92(a)(3) requires that highest priority and preference be given to uses and facilities which are dependent upon proximity to the water or the shorelands immediately adjacent to marine and tidal waters. Water-dependent uses are defined by the CCMA to be those uses which:

> require direct access to, or location in, marine or tidal waters and which therefore, cannot be located inland, including but not limited to: marinas, recreational and commercial fishing and boating facilities, finfish and shellfish processing plants, waterfront dock and port facilities, shipyards and boat building facilities, water-based recreational uses, navigation aides, basins and channels, industrial uses dependent upon water-borne transportation or requiring large volumes of cooling or process water which cannot reasonably be located or operated at an inland site and uses which provide general public access to marine or tidal waters [C.G.S. Section 22a 93(16)]

While the tidal wetland area which constitutes tidal waters is clearly not appropriate for active water-dependent uses, it may be appropriate for some sort of public access. Therefore, if any subdivision of or development of the area including the tidal wetland area is proposed, an evaluation of the appropriateness of public access must be made.

Municipal Coastal Program

As part of a comprehensive system for the management of Connecticut' s coastal area, Section 22a-101 of the CCMA affords each municipality the voluntary opportunity to prepare a Municipal Coastal Program (MCP). The Town of Waterford took advantage of this opportunity to create a program and adopted its Municipal Coastal Program in 1982. This document includes a detailed analysis of the coastal area and a plan to guide future decision-making within the coastal boundary. The Town is currently in the process of updating its Plan of Preservation, Conservation and Development and incorporating relevant portions of its 1982 MCP.

The 1982 program described Goshen Cove as part of the Goshen Cove watershed which is generally characterized by good water quality and is of value as a wildlife area. However, the water quality is identified as being not of sufficient quality to allow the harvesting of shellfish which inhabit the area. The Cove is considered an important environmental feature, and "improving the water quality and maintaining this tidal wetland will add to the overall quality of the coastal zone of Waterford." (Town of Waterford Municipal Coastal Program, 1982, page VI 6) The 1982 program also recommended that the sparsely developed areas surrounding the sensitive cove be designated rural density residential in order to encourage the existing rural quality of the area and protect the tidal wetlands from increased pollution. The 1998 draft of Waterford's Plan of Preservation, Conservation and Development does not specifically mention Goshen Cove and the subject study area but does include the following general recommendations:

- continue to preserve, protect, and enhance our coastal areas as one of the unique and defining characteristics of Waterford;

- protect the Town's coastal water bodies, wetlands, fragile shoreline environment, and other important coastal resources;
- development in coastal areas, floodplains, or low-lying areas is not prudent;
- consider the cumulative impacts of development activities;
- control the percentage of impervious surfaces to reduce the water quality impacts from development; and
- while significant improvements have been made to protect Waterford's coves, they are still affected by runoff and/or sedimentation.

This updated Plan also includes maps of various land uses including open space and residential uses. In terms of the portion of the 800 acres within the coastal boundary, these maps show the area around the tidal wetlands on-site and roughly west of the brook from Banks Pond as either open space or low density residential. Further, the majority of the other undeveloped portions of this coastal area are shown as low density residential. An open space designation in conjunction with a low density residential designation for the rest of the coastal area would help to protect this area, in particular, the tidal wetlands and the water quality of Goshen Cove.

Possible Development Scenarios and Associated Considerations

As stated previously, the CCMA includes policies and standards for proposed activities or types of development. Since there is currently no definitive development proposal for this parcel, the DEP-LIS cannot provide specific guidance at this time. However, based upon the possible development scenarios presented during the ERT review, in particular, a golf course, assisted living and/or residential development, some general guidance and the identifying of some factors which should be considered in any development of this parcel can be provided. In addition, based upon these possible development scenarios, the DEP-LIS have provided some relevant development policies in Appendix B.

Assisted Living Facility

The concept of assisted living facilities does not raise specific coastal management concerns unless such facilities are planned in areas of coastal flood hazard. The development of such facilities within these areas including A-zones raises significant concerns regarding increased hazards to life and property, in particular, the potential need to evacuate handicapped and elderly individuals who require help with daily living activities including ambulation. Therefore, it is recommended that assisted living facilities and potential evacuation routes not be located in any areas of coastal flood hazard.

Golf Course

The construction of improperly planned or maintained golf courses can result in adverse impacts on wetlands, floodplains, riparian zones and forests, all of which contribute to stream quality and, in this case, coastal water quality. Following development, the use of fertilizers, pesticides, fungicides and other chemicals has the potential to deliver pollutants to ground and surface waters. As stated above, Goshen Cove has a history of water quality problems exacerbated by nutrient inputs and subsequent excessive algae blooms leading to low dissolved oxygen levels with resultant fish kills. In the past, much of the nutrient input was from a nursery formerly operated on the subject site. However, a golf course can once again introduce some of the same problems to the watershed. Therefore, a detailed evaluation of impacts to all resources including streams, wetlands, floodplains, slopes and forest stands from both development activities and golf course maintenance and operation activities should be conducted in conjunction with site plan review. (Please see additional information on the impacts of golf courses included in Appendix B.)

Stormwater Concerns

The development of an assisted living facility or residential units would result in increases in impervious surfaces such as roads, driveways, sidewalks, parking areas and buildings. The replacement of undeveloped vegetative areas with impervious surfaces in the form of these structures would cause changes in runoff quantity, quality and rate. This results in decreased infiltration (and decreases in the filtering of pollutants) and an increase in the volume and rate of water running off the site into adjacent water bodies and ultimately Goshen Cove and Long Island Sound. Therefore, any development proposal which includes significant impervious surfaces should be designed to ensure that stormwater flows are properly treated to remove sediment and pollutants. One of the key factors in stormwater treatment is the collection and treatment of the "first flush" or first inch of stormwater which has been shown to have the highest concentration of pollutants. Therefore, proper treatment of this first flush in the form of on-site retention should be ensured.

The DEP would require a stormwater general permit and stormwater management plan for construction activities which disturb five acres or more of land. Due to the potential detrimental impacts to tidal wetlands of significant increases in silt and pollution-laden runoff, the stormwater general permit that permit requires that post-construction stormwater discharges located less than 500 feet from a tidal wetland be discharged through a system designed to retain the volume of stormwater runoff generated by one inch of rainfall on the site. Staff of the DEP's Water Bureau can provide additional information on their permit requirements. They can be reached at 1-860-424-3850.

Sewage Treatment and Disposal

As discussed above, Goshen Cove which is located at the base of this watershed has a history of water quality problems exacerbated by nutrient inputs and subsequent excessive algae blooms leading to low dissolved oxygen levels with resultant fish kills. The possible installation of on-site sewage treatment systems raises a concern with regard to the potential discharge of nitrogen, phosphorous, viruses and bacterial pathogens to ground waters and surface waters which ultimately lead to Goshen Cove. However, sewers exist along Great Neck Road and their installation was, in part, funded by the DEP. As a stipulation of providing this funding, individuals may hook up to this sewer as long as there is a demonstration of the suitability of the subject site for an on-site septic system (Please refer to the Water Quality section for surhter discussion). It is recommended by DEP-LIS that any development of this parcel include connection to the sewer system where possible, thereby minimizing potential adverse impacts to the water quality of Goshen Cove and ultimately Long island Sound.

Coastal Site Plan Review Requirements

Sections 22a-105 through 22a-109 of the Connecticut Coastal Management Act require municipal coastal site plan review for all significant development proposals within the coastal boundary, in this case, an area of roughly 84 acres. Coastal site plan review includes an evaluation of development proposals and their potential impacts on coastal resources based upon specific standards and criteria of the CCMA. Proper consideration of coastal policies and standards can effectively balance the need for reasonable development while protecting sensitive coastal resources.

Waterford's Planning and Zoning Commission and Zoning Board of Appeals conduct coastal site plan reviews for all development proposed within the coastal boundary except for those minor activities which are exempt under Waterford's zoning regulations. These town boards review coastal site plans to determine consistency with the coastal policies contained in C.G.S. Section 22a-92 and to identify potential adverse impacts on coastal resources and future water-dependent uses. Although coastal site plan reviews are the legal responsibility of the Planning and Zoning Commission and the Zoning Board of Appeals, the DEP's Office of Long Island Sound Programs frequently provides Waterford with technical planning assistance in evaluation coastal site plan applications in accordance with C.G.S. Section 22a-110.

If significant development of the southern portion of this site is proposed, a coastal site plan review would be required.

Recommendations

Based upon the above information, the DEP-LIS would recommend that the coastal portion of this 800 acre parcel bounded by Great Neck, Dimmock and Braman Roads be designated a combination of open space and low density residential with the undeveloped portions closest to the tidal wetland area being designated open space. As discussed above, such a designation would serve to protect the tidal wetland area and, in turn, Goshen Cove, by essentially maintaining a buffer from any development of the rest of the study area.

Further, any specific projects ultimately proposed must include proper development within a coastal flood hazard area, proper treatment of any generated stormwater including retention on-site of the first inch of runoff, and the minimization of any potential adverse impacts to tidal wetlands and the water quality of Goshen Cove.

Water Quality

Water Quality Conditions

Figure 7 shows the State Water Quality Classifications for surface and ground waters at and adjacent to the project site. All the site's streams and water bodies are classified "A" water quality. Class "A" waters have overall excellent water quality and are designated as recreational use and fish and wildlife habitat (fishable/swimmable), agricultural and industrial water supply, and potential drinking water supply. Groundwaters on the site are classified "GA". Class "GA" groundwaters are designated as existing private and potential public or private water supplies suitable for drinking without treatment, and as baseflow to adjacent surface water bodies. Goshen Cove is classified "SC/SB" quality. This designation indicates that the cove may not currently meet the class "SB" goal of fishable and swimmable due to certain point or nonpoint source of pollution. The primary impairment is closure to recreational shellfishing, and suspected causes are waterfowl, restricted flushing, and stormwater runoff. Sources of stormwater are more due to near coastal waters flowing into the cove as opposed to inland stream flow.

During the site visit there were concerns expressed by the town that there may be potential areas of the Verkades site that were used for disposal of sewage sludge. Review of available state Leachate and Wastewater Discharge Sources Inventory mapping that supports the water quality classifications doesn't indicate areas of disposal. Further discussion with the DEP Water Bureau Permit and Remediation Section indicates that disposal activity was not approved but that storage for application to nursery areas was done at the site. The field review did not find any disposal areas. It is recommended during development of individual site development plans that test pits verify soil conditions and if buried sludge material is encountered then, or during actual construction, that the extent of material be verified, and the material be removed and properly disposed of off site.

Groundwater/Aquifer Resources

Aquifer information is summarized statewide on the map "Groundwater Availability in Conn.", D. Meade, 1978. The site consists primarily of bedrock/till and shallow stratified drift deposits which are generally capable of yielding relatively small amounts of water to wells. This yield would be sufficient for small individual domestic water supply wells and small commercial uses. A pocket of saturated coarse grained stratified drift exists along the east tributary from Goshen Cove to about 1000 feet north of Great Neck Road. This area has some potential for higher yield (> 100 gallons per minute), however, several factors suggest that yield would be limited (including the small size of the area, hydraulic association with a very small stream, and potential salt water intrusion). According to the town the Verkades site would be served by public water from existing outside sources, so no further recommendations are suggested.

Sewage Disposal

The Verkades site is currently unsewered and is not planned for sewers according the DEP Water Management Bureau and the Town of Waterford. However, sewers do extend to adjacent areas to the west and east of the site. These sewers were constructed with state funds to correct sewage problems associated with Pleasure Beach and the Seaside Regional Center, areas to the west and also extend to adjacent areas of Ridgewood Park to the east. The state sewer grants used for these sewer systems include standard language regarding control of induced development in environmentally sensitive areas due to sewer extensions. The attached guidance fact sheet "Controlling Induced Development on DEP's Clean Water Fund Projects" further explains this condition (see Appendix C). Any proposed use of this site would be restricted by this condition, essentially limiting development to no more than the carrying capacity without sewers or avoiding the use of sewers altogether.

A general review of the Verkades parcel and soils conditions indicate that unfavorable conditions exist on several areas of the site due to slope, shallow water table, or shallow bedrock. The northeast corner in particular has numerous limitations for on-site sewage disposal and for development in general. The central portion of the site has the fewest limitations, here the soils are generally well drained and permeable but a limitation may be too rapid a permeability. The soils section provides a more detailed discussion of these limitations. Based on the soils mapping, sewage disposal for much of the site is likely to be an area of special concern and require engineering design. Septic systems should be placed outside of all wetlands and their buffers, and flood plain or flood prone areas. Three potential options exist for sewage disposal:

- connection to the sewer line (probably to the west). This would require an analysis of the existing system (primarily the pump station capacity) because the system was not designed to include this site. The site development would also be limited to no more than the carrying capacity without sewers. Sewers could provide great flexibility for cluster types of development.

- on site septic systems. Most systems probably would require engineering design. For sites such as this which are served by public water, it is generally recommended that a minimum buildable (excluding wetlands, floodplain ,etc.) lot size of 3/4 acre is necessary for single family residential use.

- community septic system. Although probably not the preferred option, this could be an alternative to individual septic systems (if sewers are not possible) which would allow clustering of lots or buildings and sharing one system. This could require a fairly large area (several acres) of suitable land for the system and would require a wastewater discharge permit from the State DEP.

Stormwater Management

Stormwater from urbanization is a significant "non-point" source of pollution. Management of both the quantity and quality of runoff should be considered to protect receiving waters. While control of stormwater on an individual site needs to be examined, the site's relationship to the overall watershed also needs to be considered regarding overall affect to receiving waters.

Certain stormwater discharges which may have potential significant impacts are regulated by the State DEP Water Management Bureau through a state general permit. These include:

- Construction activities which disturb 5 acres or more; and
- Certain industrial and commercial activities with high runoff pollution potential.

The state program centers on "stormwater pollution prevention plans for these uses, however monitoring and "end of pipe" treatment may also be required. Local land use control, however, will continue to be an important way stormwater is managed.

Because a specific site development plan is not proposed, a detailed stormwater review can not be done for this report. However, given the known nature of the site and potential development types being considered, there are certain guidelines that are recommended. Studies have generally shown that water quality impacts to surface waters begin to show up when watershed impervious coverages approach 15%, between 30-60% impacts can become significant, and >60% can become severe. A number of stormwater documents and guides are available which discuss impact assessment, management options, and design criteria to implement them. Below are some basic stormwater management guidelines. Where possible specific potential issues relating to this site are indicated.

Site Layout and Protection of Sensitive Water Resource Areas

Site layout and design is important to minimizing impacts and maintaining natural protection of receiving waters. The subdivision of the land, road layout, and individual site plan layout should maintain the natural streambelt system and buffers discussed previously in the wetlands section, and direct development to the "buildable land" areas. This helps maintain the natural drainage patterns and recharge of runoff, and takes advantage of the passive treatment and flood control capacities while minimizing the use and maintenance of structures. With a good site layout many sites may require little more than source controls and passive stormwater controls.

Source Controls

Pollution prevention measures should be a major practice for commercial/industrial uses. Typical residential use will have minimal and more dispersed pollution sources, such as household waste and lawn maintenance, which are best handled through education. The following practices should be part of a stormwater pollution prevention plan:

- Insure all wastewater discharges are properly connected and disposed of. On site septic systems should be located outside wetland/watercourse buffers and properly separated from subsurface drainage structures.

- Prevent stormwater contact with all waste and material storage areas, and divert clean storm water from these areas. Hazardous materials should be stored inside a structure with secondary containment.

- Minimize the use of impervious surfaces where possible. Attached is a list of ways to reduce imperviousness and resulting runoff contaminants (see Appendix C). Where reduction is difficult, large areas can be broken up into smaller segments with landscaped areas in between to help maintain natural recharge. Because the study site has good contiguous buildable areas in the central section, the use of cluster or flexible zoning techniques could be considered to concentrate development, reduce road and parking requirements, and maintain open space.

- Minimize the application of sodium chloride chemicals as a deicing agent for snow and ice control, and maximize the use of abrasives.

- Only apply chemical fertilizers after a soil test indicates the need. Minimize the use of chemical pesticides, use a licensed applicator in highly landscaped areas, and use non-chemical alternatives where available. The most common problems caused by chemical fertilizers and pesticides is improper handling and application.

Runoff Treatment and Renovation

Regardless of the extent of source controls, stormwater may pickup and transport pollutants from incidental sources such as litter, vehicle use, lawns, and atmospheric deposition. Contaminants from paved surfaces include suspended solids, hydrocarbons, metals, nutrients, bacteria, road salt, and thermal pollution. Roughly 90% of these contaminants are contained in the first 1/2 -1 inch of runoff. This "first flush" may need treatment depending on the type and intensity of land uses and discharge point. It has been shown that basic separation treatment to remove gross particles and floatables followed by a land surface type of treatment such as vegetated swales, filter strips, or

detention basins are effective and protect both surface and ground water quality. Direct infiltration structures such as dry wells or leaching fields can be effective, but care must be taken in groundwater drinking supply areas (not recommended in private or public drinking water supply well areas).

For potential types of development, the following general treatment guidelines can be used.

Small Sites: <1 acre contiguous pavement and <30% impervious coverage.

- Minimize the use of drainage structures, maintain natural drainage ways.
- Encourage sheet flow to natural drainage areas.
- Recharge roof water.

Large Sites: >1 acre contiguous pavement, > 30% impervious coverage, high vehicle use, or high materials handling sites.

- Treatment by diverting first flush to a particle/oil separator which removes heavy sediment and floatables as well as provides emergency spill contaminant. Lower intensity sites could use hooded (baffled) catch basins instead. Swirl, or concentration type, separators are the most effective.

- Discharge of first flush to a vegetated swale, filter strip, or detention basin to promote settling, filtration, and biological uptake. Wet basins and manmade wetlands are the most effective because of better detention and biological activity. Because you are only handling the first 1/2 inch of runoff, land areas needed are relatively small.

Design criteria should generally be for detention times or treatment methods which will remove 80% of suspended material. The attached fact sheet describes stormwater BMPs, their benefits and efficiencies (see Appendix C).

Peak Flow Controls

Runoff flow controls may be necessary to protect downstream flooding or streambank erosion.

The overall watershed, the sites location within the watershed, and selected downstream design points (stream culverts, structures, or water bodies) should all be considered when determining the potential affect of individual site runoff on peak flows of the receiving waters. When considering the use of detention measures, the following general guidelines can be used:

- In the lower 1/3 of the watershed: little or no detention.
- In the middle 1/3: limited detention.
- In the upper 1/3: longer detention.

Pre and post development runoff volumes and peak flows should be calculated for each individual site development. This information should then be used to assess its affect on peak flow of the receiving stream and overall watershed. In the case of this study site, the local watershed boundaries and study site are almost the same. The local watershed is about 1400 acres and the site was further broken down into two smaller subwatersheds for the east and west tributaries (see Figure 7 - Hydrography). The need for significant structural detention measures should be minimal because a number of site factors including: a small watershed area, predominately gentle topography, mostly permeable soils, and natural wetland areas with good flood control characteristics. Also, no known flooding conditions currently exist. Structural controls or improvements may needed in the upper northeast study area where runoff factors are higher and road cross culverts appear marginal.

The use of combination structures for treatment and runoff control, and the use of shared stormwater facilities for more than one site, should be encouraged to reduce land area disturbance and structure maintenance.

Appendix A

Soils Information

For Appendix Information A-C please contact the ERT Office at 860-345-3977

ABOUT THE TEAM

The Eastern Connecticut Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a varety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, foresters, soil specialists, engineers and planners. The ERT operates with state funding under the supervision of the Eastern Connecticut Resource Conservation and Development (RC&D) Area — an 86 town region.

The services of the Team are available as a public service at no cost to Connecticut towns.

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in reviewing a wide range of projects including subdivisions, landfills, commercial and industrial developments, sand and gravel excavations, elderly housing, recreation/open space projects, watershed studies and resource inventories.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

REQUESTING A REVIEW

Environmental reviews may be requested by the chief elected official of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the chairman of your local Soil and Water Conservation District and the ERT Coordinator. A request form should be completely filled out and should include the required materials. When this request is approved by the local Soil and Water Conservation District and the Eastern Connecticut RC&D Executive Council, the Team will undertake the review on a priority basis.

For additional information and request forms regarding the Environmental Review Team please contact the ERT Coordinator: 860-345-3977, Eastern Connecticut RC&D Area, P.O. Box 70, Haddam, Connecticut 06438.