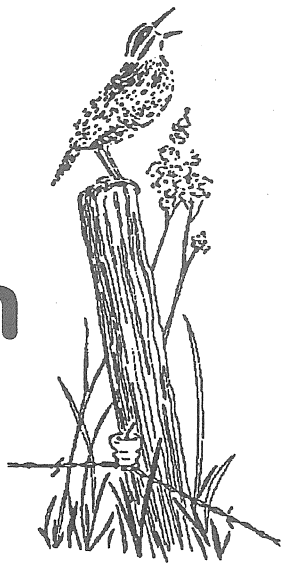
Live Oaks School Woodland and Wetland Outdoor Living Classroom



Milford, Connecticut

KING'S MARK ENVIRONMENTAL REVIEW TEAM REPORT

King's Mark Resource Conservation and Development Area, Inc.

Live Oaks School
Woodland and Wetland
Outdoor Living Classroom

Milford, Connecticut

Environmental Review Team Report

Prepared by the
King's Mark Environmental Review Team
of the King's Mark
Resource Conservation and Development Area, Inc.

for the
Inland Wetlands Agency
Milford, Connecticut

May 1998

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Acknowledgments

This report is an outgrowth of a request from the Milford Inland Wetlands Agency to the New Haven County Soil and Water Conservation District (SWCD). The SWCD referred this request to the King's Mark Resource Conservation and Development Area (RC&D) Executive Council for their consideration and approval. The request was approved and the measure reviewed by the King's Mark Environmental Review Team (ERT).

The King's Mark 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 Friday, February 20, 1998.

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I would also like to thank MaryRose Palumbo, City of Milford Inland Wetlands Agency, Donna Metty and Nicole Trione, City of Milford Youth and Family Services, Martin Malin, City of Milford Engineering Department, Nancy Gaumer and Eric St. John, New Haven County Soil and Water Conservation District, Robert Jontos, Land-Tech Consultants and Raymond Vitali, Principal, Live Oaks School, 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 maps and 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 City and the School. This report identifies the existing resource base and evaluates its significance to the proposed development, and also suggests considerations that should be of concern to the City and School. The results of this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The King's Mark RC&D Executive Council hopes you will find this report of value and assistance in planning, constructing and using this outdoor classroom.

If you require additional information please contact:

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Introduction

Introduction and Objectives

The Milford Inland Wetlands Agency (MIWA) has requested assistance from the Eastern Connecticut Environmental Review Team (ERT) in conducting an environmental review for a proposed woodland and wetland outdoor living classroom at the Live Oaks Elementary School. The New Haven County Soil and Water Conservation District along with Land-Tech Consultants have developed a design and plans for the project.

The Woodland and Wetland Outdoor Living Classroom will be adjacent to the Live Oaks School on a 1.3 acre parcel of land owned by the City of Milford. The site includes a man-made pond, freshwater stream and associated wetlands, and a salt marsh associated with the Oyster River.

The outdoor classroom would consist of a nature trail with learning stations that would utilize the various habitats found on site. Also planned is a small outdoor amphitheater for student gatherings and talks, and a platform and boardwalk out into the marsh. The ERT was requested to provide basic natural resource information about the area and provide information and discussion on planning, enhancing existing natural features, outdoor classroom/trail creation, protecting the natural resources through design and management guidelines, and ideas for a trail guide, activities and curriculum development.

The outdoor classroom project offers the opportunity to utilize the unique habitats adjacent to the school, to incorporate environmental education with the regular curriculum, and to develop a resource that can be used by the wider community to instill a sense of stewardship of the land.

The ERT Process

Through the efforts of the Milford Inland Wetlands Agency and the New Haven Soil and Water Conservation District this environmental review and report was prepared.

This report provides an information base and a series of recommendations and guidelines which cover the topics requested by the MIWA. 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 February 20, 1998, and various Team members also made separate and/or additional field 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.

Figure 1

General Location Map

Scale 1" = 2000'

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Approximate Site

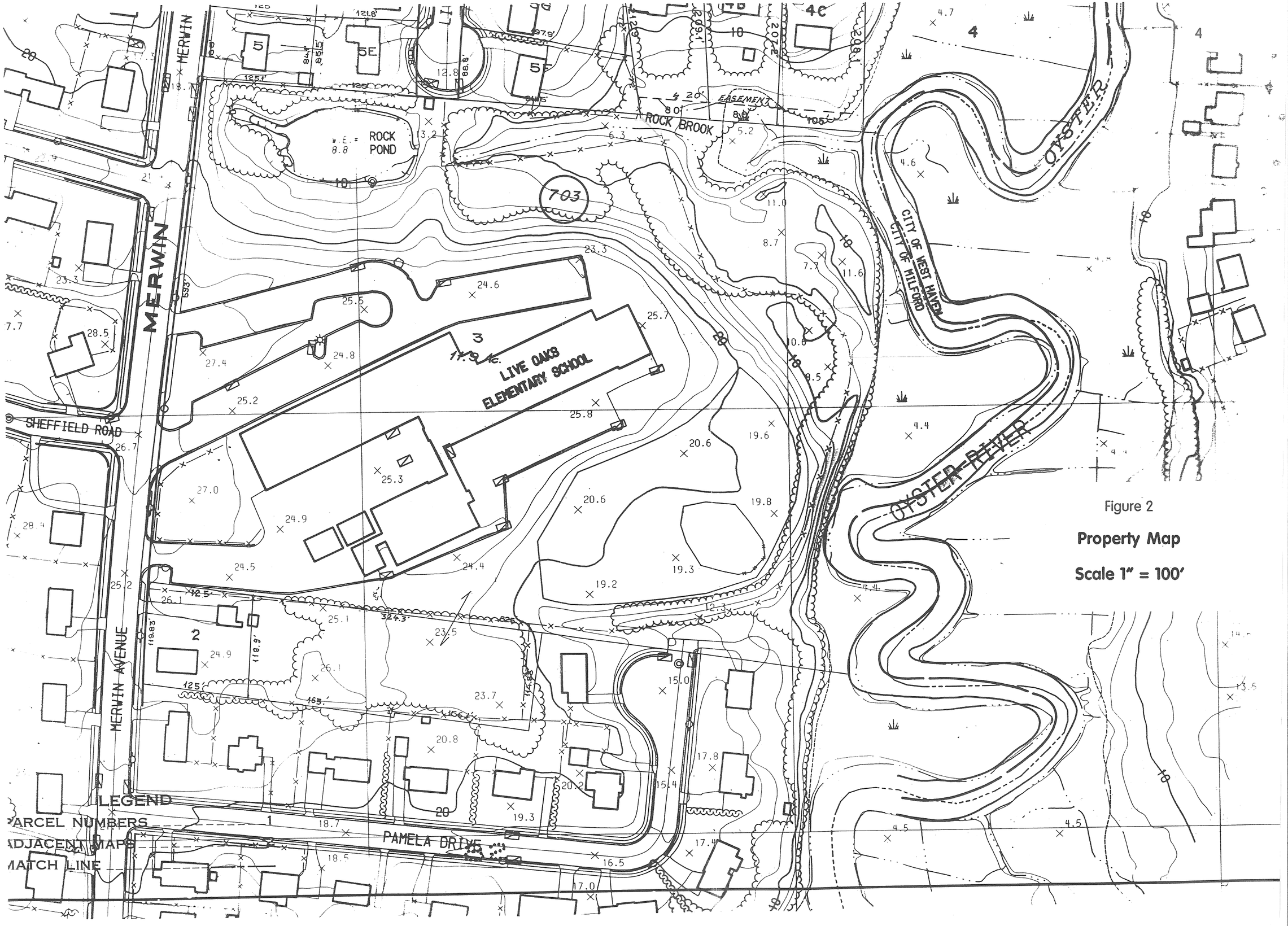


Figure 2

Property Map

Scale 1" = 100'

Environmental Education Opportunities

A review of the 1.3 acre parcel was undertaken from the perspective of educational opportunities. The parcel of land is immediately adjacent to the school allowing for easy access for the teachers and students. The site is comprised of the following characteristics: a small pond; a stream flowing out of the pond; a narrow strip of mixed hardwoods leading to a larger area of hardwoods; a wetland area along the stream and tidal wetlands that are part of the Oyster River.

First impressions of the area were one of high use and high impact. In the narrow hardwood section along the stream there is an existing path that appears to be in good condition, meaning that there was no immediate concern for erosion abatement or need for rebuilding any parts of the path. Further in, when the trail loops around a larger piece of the property, it is recommended that some trail work be undertaken primarily to define the trail and, in some areas, to fill in holes and depressions and to control some erosion problems. This area immediately adjacent to the salt marsh is also in need of some control measures to prevent bicycles and other kinds of higher impact use from occurring there. The area is literally crisscrossed by trails; it is recommended that a single looped trail be defined and wood chipped. Strategically placed plantings of native shrubs in some of the other trail areas or along the main trail would be ideal.

The educational significance of the area is high. There is a good mix of tree species on the property. The pond and freshwater stream can provide opportunities for studying aquatic life and freshwater ecosystems. This could include collecting live specimens and conducting basic water quality tests. The freshwater wetland system that grades into the saltwater marsh provides exceptional opportunities for plant identification, wetland values and bird identification and watching. In the larger area that is circled by the looped trail it is recommended that a small outdoor amphitheater be constructed with a view to the saltmarsh, this will provide an excellent area to gather students together for outdoor classroom work. In addition, this "loop

area" could have some specific study areas where, for example, soil tests could be conducted and permanent or seasonal study plots or transects could be established that would enable the children to study one defined area over a period of time.

Funding has been secured for an observation deck which is an excellent idea. It is recommended that an osprey nesting platform and wood duck boxes be erected so that students can observe them from the platform.There may not be any osprey activity in the area, but the presence of the platform is still a good teaching tool that could lead to some excellent discussions on the osprey in particular and about endangered species in a general sense.

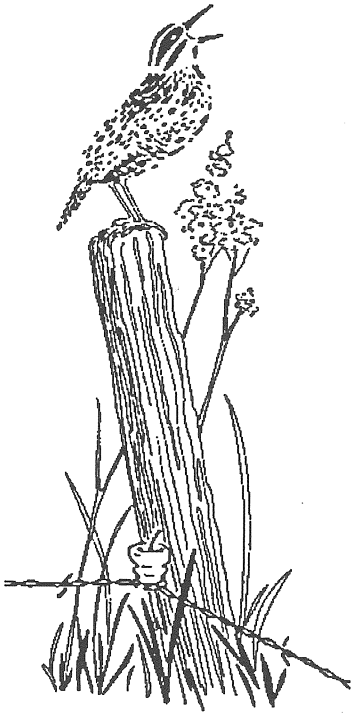
It is not recommended that signs be erected in the area unless there is better control of the access. Even then, the threat of vandalism to signs will be constant. It is strongly recommended that there is a "buy in" for the students and families that live in the area by having them become involved in the planning and actual work for the outdoor living classroom. In this way the students and residents in the area begin to take ownership of the classroom and keep an eye out for inappropriate activities.

There is an additional feature of the property that could be an interesting teaching tool, that is the storm drain pipe that discharges into the trail loop area. This might be a good location to do a number of things, such as rudimentary water quality tests of the runoff when it is discharging, to the creation of a small intermittent wetland area where the water discharges. A small bridge should be built for the trail as it passes this pipe and then a small area could be dug out where the water would drain and percolate through the soil. It would be interesting to study this area over a period of time recording vegetation type and any changes that occur through the seasons or over a period of several years with classes passing their data on to subsequent classes.

In summation, the area is heavily used at the present time, has a lot of impacts, but offers a good variety of vegetation and habitat types. It is easily accessible and will provide a very good outdoor classroom experience for children at Live Oaks Elementary School. It is strongly recommended that the teachers at the school partake in some staff development opportunities that exist such as Project Learning Tree, Project WILD and Project WET and that they become

familiar with the Schoolyard Habitat Project. Many activities and teaching techniques are available through these programs and are often specifically tailored to school grounds/outdoor classrooms. Information about all of these programs can be directed to Diane Joy who works with the DEP Division of Environmental Education. She can be reached at the Kellogg Environmental Center (203) 734-2513.

The Resources



Geology

The Live Oaks Elementary School was built atop a local terrace approximately 20 feet in elevation above the adjacent Oyster River, a tidal creek that is connected to nearby Long Island Sound. The terrace at the school site has been extensively graded such that the original topography is little in evidence today.

Rock Creek, a small perennial stream draining a watershed of 80-90 acres, crosses the northern portion of the school parcel. The flood way of Rock Creek is likewise extensively modified and a small pond has been constructed, originally for ice skating. The stream bed, at least in its lower reaches, is sandy. Peak velocities of the stream water are sufficient to transport sand forming numerous current-ripples on the streambed. The flood way merges with the tidal wetlands at the confluence of Rock Creek with Oyster River where an embayment of the tidal marsh has formed; there the stream bed is finer grained.

A small lower-level terrace, having an elevation approximately 4 feet above the tidal marsh, has formed south of Rock Creek at its confluence with the tidal marsh. This area, approximately 3/4 of an acre, is the intended site for development of an outdoor living classroom by the school and town. The terrace probably formed by deposition of sand by Rock Creek some time in the past (several thousand years ago) when it was graded to a slightly higher elevation. The lower terrace has an irregular topography showing the effects of man-made disturbance: depressions, mounds and artificial cuts are especially evident in the "amphitheater area."

The Oyster River occupies a narrow valley that is slightly wider than its current meander field and that valley is filled with peat and organic-rich sandy mud.

The higher terrace on which the school is built is underlain by a thin deposit (generally less than 20 feet thick) of unconsolidated sand and gravel, assigned (Flint,

1965) to the Oyster River valley train, that was deposited by glacial-meltwater streams. Flint described the sediments (p.22, based on exposures in a gravel pit north of the School, where it was only ten feet thick and covered an irregular bedrock surface) as consisting of poorly-stratified pebbly-sand lacking "ice-contact features." Flint, therefore, ascribed the deposit to the results of deposition by meltwater streams on an outwash plain to the south of the melting Ice Age Glaciers. The Oyster River, according to Flint's interpretation, occupies a valley that has been eroded into the outwash deposit. Indeed, he noted that the entire valley train had been extensively dissected. He also noted, on the map that accompanies the publication, that the area around the school grounds had been extensively disturbed, including the placement of artificial fill.

Bedrock in the area consists of Derby Hill Schist, a greenish-gray chloritic muscovite schist and phyllite (Fritts, 1965). The closest exposures of bedrock are along the shore at Oyster River Beach.

In the Team Geologist's opinion, no geologic features warrant preservation and no geologic conditions should hinder development as intended.

Activities

1. The sand in Rock Creek probably consists of material that has washed off the street and parking lots during winter rather than original material of the terrace. It may be able to confirm this by simple comparative observation if a sample of the terrace sand can be taken during construction or perhaps obtained from the old gravel pit located north of the site. Comparison could include size of sand particles, roundness of grains, and overall composition of particles. A small microscope or possibly a magnifying glass would facilitate observation.
2. Compare sand from Oyster River with that of Rock Creek. The sand in Oyster River may contain material derived from the beach. A sample of beach sand would aid the comparison.

3. Measure velocities of the two waterways by simply measuring the length of time it takes a cork (twig, ice cube, or any thing that will float) to traverse a given distance. Do the maximum measured velocities correlate with the size of materials in the beds of the creeks (normal velocities likely will be insufficient to move the coarsest material, i.e. sand on the bottom)?
4. Engineers will probably collect soil profiles. Those samples could be preserved by encasing them in epoxy resin. The resin impregnated samples from different locations on the site could likewise be compared. Marsh samples could be compared with flood way samples and those compared with material currently being transported by the two water ways.
5. Measure salinity of water samples taken from the Oyster River at several times during the tidal cycle. Electrical resistivity (or its reciprocal, conductivity), density, and refractive index of the water are three easily measured properties that change with changing salinity. Several artificial samples could be made up with common table salt to demonstrate that the instruments are operating properly. Old but workable surplus instruments might be obtained from the Coast Guard or State agencies.
6. One or several ground water monitoring wells could be installed at varying distances from the tidal wetland and the river wetland to observe the response of the water table to changing tides and river discharge. Salinity from the wells could likewise be monitored.

Included in Appendix A are copies of exercises devised for Jr. High School students that might be adapted to 4- 6th graders (McDonald and Stover, 1991).

References

Flint, R.F., 1965, The surficial geology of the New Haven and Woodmont Quadrangles, with map. State Geological and Natural Hist. Surv. Quad. Rpt. No. 18, 42p.

Fritts, C.E., 1965, Bedrock Geologic Map of the Milford Quadrangle, Fairfield and New Haven Counties, CT. U.S. Geol. Surv. Map GQ-427.

McDonald, R.H. and Stover, S.G., *eds.*, 1991, Hands-On Geology: K-12 Activities and Resources. SEPM (Soc. Sed. Geol), Tulsa, OK, 105p.

Soils

This soils report applies to the wooded riparian zone and the adjacent tidal areas along the northern and eastern boundaries of Live Oaks School in Milford, CT. The information in this report is based on the soil series description and mapping unit descriptions as presented in the 1979 USDA Soil Survey for New Haven County. Additional information on soil suitability and limitations can be obtained in the New Haven County Soil Survey.

Mapping Units

HcB - Haven silt loam, 3 to 8 percent slopes. This gently sloping, well drained soil is on outwash terraces in stream valleys. Slopes are smooth and most are less than 300 feet long. The areas dominantly are irregular in shape and 5 to 50 acres in size. In this mapping unit, the surface layer is very dark grayish brown silt loam 9 inches thick. The areas are dominantly strong brown and yellowish brown silt loam 22 inches thick. The substratum, to a depth of 60 inches, is yellow brown stratified sand and gravel.

In this mapping unit, small intermingled areas of less than 1 acre in size, of the well drained Agawam soils and the moderately well drained Ninigret soils which comprise approximately 5 to 15 percent of this map unit.

Permeability is moderate in the surface layer and subsoil and very rapid in the substratum, care must be taken not to pollute the ground water. Runoff is medium. The soil tends to dry out and warm up early in the spring. This soil has a high available water capacity. Unless the soil is limed, it is very strongly acid through medium acid.

This soil has good potential for community development. It is easy to excavate; however, the steep slopes of excavations are unstable. Waste disposal systems, such as septic tank absorption fields, will function satisfactorily with normal design and installation. Conservation measures are needed to prevent excessive runoff, erosion and siltation during periods of construction.

Soil is well suited to cultivated crops. Good tilth is easy to maintain. The hazard of erosion is moderate. Controlling runoff and erosion and maintaining fertility, good organic-matter content, and good tilth are major concerns if soil is used for farming. This soil is well suited for growing trees; however only a small acreage is in woodland. Productivity is moderately high. Trees to favor in existing woodlots are eastern white pine, sugar maple and northern red oak. Trees to plant in open areas are eastern white pine, European larch and Norway spruce.

We - Westbrook mucky peat. This nearly level, very poorly drained organic soil is in tidal marshes along the coast of Long Island Sound. The organic layers are 16 to 51 inches thick over loamy mineral material. This soil has slopes up to 1 percent. They are mostly 3 to 200 acres in size and are irregular in shape.

Typically, the organic layer is 48 inches thick; it is very dark brown, very dark grayish brown, and very dark gray mucky peat. The substratum, described to a depth of 99 inches, is dark gray silt loam.

Included with this soil mapping are small intermingled areas, generally less than 2 acres in size, of the very poorly drained Westbrook low-salt soils, Scarboro and Saco soils and the poorly drained Rumney and Walpole soils.

This soil has moderate to rapid permeability in the organic layers and moderate permeability in the substratum. The available water capacity is high. Runoff is very slow. This soil is subject to flooding twice daily. The total salt content is more than 10,000 parts per million. This soil is strongly acid to neutral.

This soil is mostly in its natural condition. A few small areas have been filled and are used for community development, mainly industrial parks. Generally, the soil has poor potential for community development. If filled and used for building sites, the organic layers should be removed to prevent them from settling after the construction is completed. If these areas are not filled extensively, they may be subject to flooding by storm tides.

This soil is not suited to crops or trees because of its wetness, daily flooding and high salt content.

This soil provides food or habitat for fish, shellfish and wildfowl. The most common grasses are salt meadowgrass, salt water grass and spike grass. Other vegetation on this soil is blackgrass, sea lavender, saltwort, seaside goldenrod, aster and purple garardi.

Soil Series

Haven Series: The Haven series consists of coarse-loamy over sandy or sandy skeletal, mixed, mesic Typic Dystrochrepts. These soils are well drained and have a B horizon of strong brown and yellowish brown silt loam over a class IIC horizon of yellowish brown stratified sand and gravel. They formed in a silt loam or very fine sandy loam mantle over outwash sand and gravel derived mainly from gneiss and schist. The Haven soils are on outwash terraces in stream valleys. Slopes range from 0 to 8 percent.

Haven soils are on the same landscape as Agawam soils which have a coarser textured solum; Ninigret soils, which are moderately well drained; and Walpole and Raypol soils which are poorly drained.

Typical pedon of Haven silt loam, 0 to 3 percent slopes, in the town of Orange, about 1,400 feet north of the Milford town line and 100 feet east of the railroad tracks near the Housatonic River:

Ap - 0 to 9 inches; Very dark grayish brown(10 YR 3/2) silt loam; weak medium grain structure; friable; common fine roots; 5 percent coarse fragments; strongly acid; abrupt smooth boundary.
B21 - 9 to 14 inches; strong brown (7.5YR 5/6) silt loam; weak medium subangular blocky structure; friable; few fine roots; 5 percent coarse fragments; strongly acid; gradual wavy boundary.
B22 - 14 to 27 inches; yellowish brown (10YR 5/6) silt loam: weak medium subangular blocky structure; friable; few fine roots; 5 percent coarse fragments; strongly acid; clear wavy boundary.
B3 - 27 to 31 inches; yellowish brown (10 YR 5/6) gravely loam: massive; friable; 25 percent coarse fragments; strongly acid; clear wavy boundary.
IIC - 31 to 60 inches; yellowish brown (10 YR 5/4) stratified sand and gravel; single grain; loose; 45 percent coarse fragments; strongly acid.

The solum is 18 to 36 inches thick. Rock fragments range from 2 to 15 percent in the A and B2 horizons and up to 35 percent in the B3 horizon. Rock fragments, including cobblestones, range from 10 to 65 percent in the IIC horizon. Reaction ranges from very strongly acid through medium acid.

Ap and Al horizons have a hue of 10YR, value of 2 through 47 and a chroma of 2 to 3.

The B horizon has a hue of 7.5YR or 10YR, value of 2 to 4 or 5, and chroma of 4 through 6. Texture of the B2 horizon is less than 5 inches thick and is loam, sandy loam, or their gravelly analogs. Structure is weak medium subangular blocky or the horizon is massive. Consistence is friable or very friable.

The IIC horizon has a hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 through 6. Texture is sand, gravelly sand, very gravelly sand or stratified sand and gravel.

Westbrook Series: The Westbrook series consists of euic, mesic Typic Sulfihemists. These soils are very poorly drained. They consist of mucky peat, which is high in salts, over dark gray silt loam. These soils are subject to tidal flooding twice daily. They formed in partially decomposed organic material from salt-tolerant herbaceous plants over loamy sediments that were derived mainly from gneiss and schist. Slope ranges from 0 to 2 percent and is dominantly less than 1 percent.

Westbrook soils are adjacent to the excessively drained Hinckley and Manchester soils, the well drained Agawam, Branford and Charlton soils and the somewhat excessively drained Hollis soils.

Oel - 0 to 8 inches; very dark brown (10YR 2/2) mucky peat; 75 percent fiber, 35 percent rubbed; dense mat of roots, stems and leaves; massive; slightly sticky; many

roots; sodium pyrophosphate extract color light gray (10YR 7/1); 62 percent organic matter, total salts, 26,000 ppm; slightly acid; clear wavy boundary.
Oe2 - 8 to 36 inches; very dark grayish brown (10 YR 3/2) mucky peat; 75 percent fiber, 30 percent rubbed; massive; slightly sticky; few roots; thin lenses of silt; sodium pyrophosphate extract color light gray (10YR 7/1); 48 percent organic matter, total salts, 27,300 ppm; neutral; gradual wavy boundary.
Oe3 - 36 to 48 inches; very dark gray (5y 3/1)mucky peat; 60 percent fiber, 30 percent rubbed; massive; slightly sticky; sodium pyrophosphate extract color light gray (10YR 7/1); 21 percent organic matter; total salts, 31,200 ppm; neutral; gradual wavy boundary.
IIC - 48 to 99 inches; dark gray (5Y 4/1) silt loam; massive; slightly sticky; 8 percent organic matter; total salts, 25,000 ppm; slightly acid.

The organic layers range from 16 to 51 inches in thickness. These soils range from strongly acid to neutral in their natural condition. Total salt content ranges from 1,000 to 35,000 ppm. Many pedons have thin layers of silt in the organic layers.

The surface tier ranges in hue from lOYR through 5Y and has value of 2 through 4 and chroma of 0 through 2. The organic matter content ranges from 20 to 70 percent.

The subsurface and bottom tiers range in hue from lOYR through 5Y and have value of 2 through 5 and chroma of 0 through 3. The organic matter content ranges from 20 to 70 percent, Layers of fibric or sapric materials up to 6 inches thick are common in places.

The IIC horizon ranges in hue from lOYR through 5Y and has value of 2 through 5 and chroma of 0 through 2. Texture is silt loam, silt or very fine sandy loam. Shell fragments and herbaceous fibers range from 0 to 5 percent.

Glossary

ABC soil. A soil having an A, a B and a C horizon.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Glacial outwash (geology). Gravel, sand and silt, commonly stratified, deposited by melt waters as it flows from glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas and outwash plains.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material The content of organic matter is more than 20 percent.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans or deltas.

Outwash plain. A land form of many sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth, where pitted, it is generally low in relief.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Series soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence and mineralogical and chemical composition.

Soil. A natural, three dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate

and living matter acting on earthy parent material, as conditioned by relief over periods of

Solum. The upper part of the soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Substratum. The part of the soil below the solum.

Texture, soil. The relative proportions of sand, silt and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, sandy loam, loarn, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse, " "fine, " or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated and difficult to till.

Figure 3

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Soils Map

Scale 1" = 1320'

HcA - Haven silt loam, 0 to 3 percent slopes. This nearly level, well drained soil is on outwash terraces in stream valleys.

HcB - Haven silt loam, 3 to 8 percent slopes. This is gently sloping, well drained soil is on outwash terraces in stream valleys.

We - Westbrook mucky peat. This nearly level, very poorly drained organic soil is in tidal marshes along the coast of Long Island Sound.

Aquatic Resources

Introduction

The Live Oaks School and adjacent town-owned properties provide an ideal opportunity for the outdoor classroom to showcase three distinct aquatic habitats. The site contains a small warmwater pond (Live Oaks School Pond), a small perennial freshwater stream (Rock Brook), and a tidal coastal stream (Oyster River) that is influenced by and directly connected to Long Island Sound, an estuarine habitat.

This section of the report will describe some of the attributes of these habitats that were observed during the field visit, and it will describe in general terms the types of aquatic organisms (emphasis on fish) that can reasonably be expected to live within them. No biological sampling was conducted during the site visit (February is a poor time of the year to collect fish). In addition, there are no known published reports which document the fisheries resources in these waters. Consequently, best professional judgment was used when predicting the types of species that live in these habitats.

Also provided are some ideas for incorporating fisheries resource information into the curricula that are to be developed for this outdoor classroom. Some suggestions are listed separately at the end, whereas other ideas can be gleaned from individual sections of the text.

Live Oaks School Pond

Habitat management: This roughly 0.25 acre pond was reclaimed (dredged) in the early 1990s. Since it is a flow through (or impoundment type) pond, it had been acting as a sediment retention basin for Rock Brook. The pond still suffers the effects of sediment deposition as evidenced by the sand delta extending outward from the inlet of Rock Brook at the pond's western end. Original pond restoration plans developed by Land-Tech Consultants, Inc. (Dated 6/11/93) called for the construction of a forebay area that would serve to trap sediments before they enter and adversely impact the pond. Had this forebay been created - and sediments

removed from it on an as needed basis - the existing sedimentation problem could have been avoided. Installing a forebay would still be a good idea, although doing so should be preceded by the partial dredging of the pond to remove recently accumulated sediments. Sediments are likely entering the pond from two sources. First, road sands (applied in the winter during storms) are being washed into the storm drainage system upstream of the pond. Second, a severe scour condition in the streambed of Rock Brook just downstream of Merwin Avenue (roughly 60 feet upstream of the pond) provides sediment during peak run off conditions.

The Team fisheries biologist noted that the 1993 pond restoration plans called for the future installation of a compacted stone dust path that would completely encircle the pond. Installing such a path around the entire pond will modify the existing terrestrial habitats along the pond's shoreline. Currently, the western and northern shoreline is densely vegetated with both low growing herbs and shrubs, and with larger trees. With the exception of a few planted trees and shrubs, the southern and eastern shorelines are dominated by grasses. Depending on the primary uses envisioned for this pond, it may be advisable to maintain the existing diversity of terrestrial pond bank habitats for both their ecological and educational value. The fisheries biologist was pleased to see that the school ground lawns are not maintained right up to the edge of the pond. Instead, an unmowed buffer ranging from 12 to 20 feet in width has been established. This buffer should be maintained (or enhanced) as it serves to minimize nutrient runoff from the adjacent lawn area, and it potentially provides more food to insectivorous (insect eating) pond fauna (fishes and amphibians) than would a manicured monoculture of lawn grass. The ability of this area to reduce nutrient loading to the pond could be further enhanced by planting ground covers and small shrubs since their roots penetrate deeper into the soil than do the roots of grasses. Many pond owners in Connecticut also maintain such buffers to minimize the likelihood that nonmigratory Canada geese will take up year round residence in their pond (Canada geese are fond of ponds surrounded by lawns). These birds can become a nuisance when large numbers take up residence on small ponds, and they "fertilize" the water with their droppings.

The 1993 pond restoration plans indicate that three species of emergent vegetation were planted in shallow shoreline areas of the pond. All three of these species (pickerel weed or *Pontederia cordata,* duck potato [a.k.a. arrowhead] or *Sagittaria latifolia* and burreed or

Sparganium eurycarpum) are highly recommended for enhancing habitat and providing food for wildlife. Because the site visit was conducted in the winter, however, it is unclear if these plants have become established. If such plantings were never made and if no other emergent species have colonized the pond, it would still be desirable to introduce these species. The winter inspection also precluded a determination of the submerged aquatic plants in the pond. Submerged aquatic vegetation provides ideal cover for pond fishes, providing them protection from piscivorous (fish eating) fishes and birds. In addition, submerged aquatic vegetation provides habitat for small invertebrates that pond fish will in turn feed on. Too much vegetation can result in stunted fish populations. This is caused when the excessive cover reduces predation to the point that too many prey (small fishes) remain in the pond and they compete with each other for limited food resources. The Fisheries Division generally recommends that aquatic vegetation should cover 30 to 40% of a pond's surface area.

Warmwater pond fishes: This pond is capable of supporting warmwater fishes *(note that "fishes" is the preferred plural form of "fish" when one is referring to more than one species).*

The following fish species *(the term "species" is both singular and plural; it is correctly used when describing "one species" or "several species")* are commonly found in small warmwater ponds in Connecticut; largemouth bass *(Micropterus salmoides),* bluegill (a.k.a. "bluegill sunfish," (*Lepomis macrochirus),* pumpkinseed *(Lepomis gibbosus),* brown bullhead *(Ameiurus nebulosus),* and golden shiner (*Notemigonus crysoleucas).*

Largemouth bass, bluegill, and pumpkinseed are all members of the sunfish family (Centrarchidae). Of these three species, only the pumpkinseed is native to our state. All sunfish create shallow saucer shaped nests in the pond bottom in shallow water into which they deposit their eggs. Spawning occurs in late spring. The male sunfish builds the nests, and after spawning is completed, guards the nests to keep them free of sediments which could suffocate the eggs, and also to ward away predators (other fish) who try to eat the eggs. *(Note - this represents an interesting example of the male parent being the primary care giver).* Largemouth bass are considered predators. Once they reach a certain size, they begin feeding on small fish and amphibians. When young, the diet of largemouth bass overlaps with that of bluegill and pumpkinseed, which feed primarily on zooplankton and aquatic insects.

Largemouth bass and bluegill are probably the most commonly stocked fishes in Connecticut ponds. Both survive and reproduce well in ponds, and they provide excellent angling opportunities for recreational anglers. Since bluegill and pumpkinseed are easy to catch, they provide an excellent opportunity for introducing youngsters and others to fishing.

Brown bullheads are members of the bullhead catfish family (Ictaluridae) and are native to Connecticut. They spawn in small natural depressions on the bottom of ponds and sometimes they create small depressions. Spawning occurs in the spring. The male is sometimes assisted by the female in preparing the nest site and both sexes care for the eggs and young (until a length of 2 inches is reached). These fish eat a variety of invertebrates, often muddying the water as they feed along the bottom. For this reason -- and because they can quickly overpopulate a pond -- pond owners are often advised not to deliberately introduce this fish. Those that do stock brown bullhead into their ponds often do so because they are good to eat.

Golden shiners are members of the minnow family (Cyprinidae), they are native to Connecticut, and occur in ponds and sluggish streams. They prefer areas with clear water and aquatic vegetation. Eggs are broadcast over aquatic vegetation and no parental care is provided. Golden shiners feed primarily on zooplankton from the water column although adults may also eat filamentous algae.

Rock Brook

General overview of aquatic habitat: This small stream may be capable of supporting limited populations of freshwater stream fishes, even though it has been adversely affected by various activities over the years.

The stream has a wooded riparian area (land adjacent to stream) that serves to **1)** provide shade which keeps stream temperatures cool, **2)** provide habitat for fish when trees fall in the stream or branches drop off (see below), and **3)** provide energy to the stream (leaves are broken down by microbes in the water, thereby providing nutrients to the stream).

Streams with diverse habitats contain a mixture of pools, riffles, and runs, and their stream bed substrates are usually a mixture of sand, gravel, cobbles, and boulders. Stream habitat diversity is low in Rock Brook since it is dominated by run type habitat containing sands and gravels. As a result, Rock Brook could benefit from stream habitat improvement efforts. Because of the overall low gradient of the land in this area, the stream does contain any riffle habitat. Riffles are shallow areas with increased stream velocity and larger substrate types (cobbles and boulders) that serve to aerate (put oxygen back into) the water. Because of the gradient here, however, it would be difficult to create riffles in this stream. Pools are deep areas that provide habitat for larger fishes and for all fish when water levels drop in the summer. Some pool habitat exists in this stream, primarily where the culvert outlet has scoured out the stream, and also behind some woody debris that is impounding water. Run habitat -- the predominant habitat in this stream -- is characterized by flowing water lacking surface turbulence but also lacking the depth provided by pools. Runs usually have a uniform stream channel that are flat. If there is enough water in this stream (see concerns below), its value to fishes could be improved by implementing habitat improvement measures that are aimed at enhancing habitat diversity. The manual by Seehorn (1992) is an excellent source of information.

Examples of environmental degradation: Although the historical length of this stream is unknown, it is clear that all of it located upstream of Merwin Avenue has been buried underground. As a result, that segment serves only to convey water; it lacks all of the other functions that would render it suitable to support aquatic life.

The viable section of Rock Brook is therefore limited to the Live Oaks School and town- owned property, a length of about 550 feet. This length was estimated by subtracting out the length of the pond (160'), the culvert pipe immediately downstream of it (40'), and the area near the mouth of the stream that is apparently tidally influenced by the Oyster River (rough estimate of 50').

The culvert pipe immediately downstream of the pond has adversely impacted the stream in several ways. First, the conversion of the natural streambed into concrete (the pipe) has destroyed the natural streambed. The lack of natural substrates (sands, gravels, cobbles)

within the pipe prevents this area from being colonized by most aquatic insects and other burrowing invertebrates, and it prevents it from being used by fish. Stones and other types of instream cover (undercut banks, fallen trees, etc.) provide fish with structural hiding places, and they also serve to break up or alter channel velocities. Stream fishes have various velocity preferences based on their overall morphology (shape), fin arrangement, and feeding capabilities and strategies. In addition, this particular culvert (as well as the one that is upstream of the Live Oaks School Pond) represents a physical barrier to the upstream migration of fish since its invert (culvert bottom) elevation is about 18" higher than the water surface elevation in the brook. Since small stream fishes are not capable of jumping this high, they are unable to swim upstream through the culvert.

There is also excessive stream bank erosion immediately downstream of each of these culverts. If these active erosion sites are stabilized, a significant source of sediment that is smothering the streambed can be minimized. Since the site is to be used as an outdoor classroom, it may be appropriate to incorporate more than one streambank stabilization technique into the project. Efforts should focus on using bioengineering rather than some of the traditional (yet less environmentally friendly) techniques such as riprap or gabions filled with riprap. As noted above, undercut banks, while they are often a problem if excessive erosion is occurring, also provide very valuable habitat for stream fishes. The cover provided by such overhangs conceals them from predators. As a result, consideration should be given to incorporating simulated undercut banks into any streambank stabilization project (or habitat improvement project) that is undertaken. The manual by Seehorn (1992) includes information on two structures (bank crib with log cover, and log and bank shelter) that can be used to effectively simulate undercut banks.

Large woody debris (trees and tree limbs that naturally fall into the water) also can provide valuable instream habitat for fishes. Unfortunately, too much of this material can interfere with fish migrations (by causing physical blockages), cause localized flooding, and accelerate or alter stream bank erosion patterns. It should be noted that an abutting landowner on the north side of Rock Brook has done extensive cutting along the stream. Trees were dropped in or adjacent to the stream, with apparently little or no effort made to remove them from the brook. Much of this debris has been transported downstream so it now litters an extensive segment of

the stream. The town would be well advised to investigate this situation and then remove a portion of this material. Some woody debris should be allowed to remain within the stream to provide cover for fish. Material to remain should be oriented parallel with the current, since it will then be less likely to cause flooding or bank erosion problem.

Although it does not directly affect aquatic habitat, the chain link fence that parallels Rock Brook restricts access to the brook. Consequently, the role of Rock Brook in the outdoor classroom is not likely to reach its full potential unless the fence is removed or gates are provided.

Probable fish community: If stream flow in the summer gets too low or if it dries up, Rock Brook may not support fish. Fish from Rock Brook are prevented from seeking refuge in the Live Oaks School Pond (due to the barrier culvert), and they may be unable to survive in the Oyster River if salinity levels are too high (higher salinity would be expected in the Oyster River during low flow periods). In addition, saline waters in the Oyster River may -- with the notable exception of high flow periods in the spring and fall -- prevent this stream from serving as a donor source of fishes for Rock Brook. Fishes that may live in this stream include American eel *(Anguilla rostrata),* blacknose dace *(Rhinichthys atratulus),* and tesselated darter *(Etheostoma olmstedi).* Even though brook trout *(Salvelinus fontinalis)* are very common in small streams in Connecticut, it is the Team fisheries biologist's opinion that water quality in Rock Brook may be unsuitable for this sensitive species. Water quality in Rock Brook can be expected to be adversely affected by stormwater runoff from its relatively densely developed watershed (aka drainage basin). Pollutants transported with the stormwater to Rock Brook would include but not be limited to lawn fertilizers and various contaminants resulting from automobiles.

The American eel (Family Anguillidae) is the fish *(Yes, eels are fish)* most likely to inhabit this stream. This catadromous species *(fishes that are hatched [fish are not born] in saltwater, migrate to and mature in freshwater, and then return to the sea to spawn)* is common in tidal creeks and freshwater streams in Connecticut, especially near the coast. Spawning takes place in the Atlantic Ocean in the area known as the Sargasso Sea. After hatching, these small eels known as leptocephali drift in the ocean currents for one or two years. When they reach a length of about 2 to 3 inches, they transform into transparent "glass eels" that resemble the

adult form. It is at this time that they enter estuarine waters. They become known as elvers when they develop pigment and start to migrate inland. Males tend to remain within estuarine or freshwater streams near the coast whereas females migrate farther inland, often residing in lakes or rivers several miles from the coast.

Blacknose dace are members of the minnow family (Cyprinidae) that are native to Connecticut and are commonly found in small streams. They feed on small aquatic insect larvae and algae.

Tesselated darter are native fishes that are members of the perch family (Percidae). This species can be found in both flowing and standing waters, but it prefers a sandy substrate. Spawning occurs in the spring. These fish deposit adhesive eggs on the undersides of rocks and other hard substrates. Small insects make up the majority of the diet.

Oyster River

This tidal portion of the Oyster River is considered an estuary (a place where freshwater mixes with saltwater). Estuaries are considered to be highly productive habitats. The fact that the Oyster River at this site meanders through a healthy tidal wetland (aka salt marsh) enhances the educational value of this site considerably.

The Oyster River probably supports year round residents that are commonly associated with salt marsh habitats such as mummichog *(Fundulus heteroclitus),* striped killifish *(Fundulus majalis),* sheepshead minnow *(Cyprinodon variegatus),* Atlantic silverside *(Menidia menidia),* and fourspine stickleback *(Apeltes quadracus).* These small species occur in large numbers, and provide an important link in estuarine food chains. Depending on the species, they feed on algae detritus (decaying plant matter), zooplankton, or other small invertebrates, and they in turn provide food for piscivorous fishes and birds. Species that live year round in estuarine waters must be able to tolerate wide fluctuations in salinity. Species that possess wide salinity tolerance are known as "euryhaline" species. "Stenohaline"species can only tolerate narrow fluctuations in salinity.

Even though it appears high and dry throughout much of the tidal cycle, the marsh itself is an important feeding ground for the mummichog and other killifishes (Family Cyprinodontidae; i.e. striped killifish and sheepshead minnow) during periods of high tide when the marsh is flooded. A few inches of water is all that is needed for these fish to enter the marsh. Many tidal marsh systems also contain shallow depressions (pannes) that retain water as the tide recedes. Although no pannes associated with the Oyster River salt marsh were noticed, it should be noted that these habitats also provide habitat for these fishes. The mummichog is probably the most abundant resident fish found in the tidal portion of the Oyster River.

Unlike in the freshwater aquatic habitats (the pond and Rock Brook), the species composition of fishes within the Oyster River can be expected to vary seasonally. Transient marine species that can be expected to use the Oyster River on a seasonal basis include bluefish *(Pomatomus saltatrix),* striped bass *(Morone saxatilis),* hickory shad *(Alosa mediocris),* Atlantic menhaden *(Brevoortia tyrannus),* bay anchovy *(Anchoa mitchilli),* grubby *(Myoxocephalus aenaeus)* and several others. These species generally visit estuarine waters because they are productive feeding areas. With the exception of striped bass and hickory shad, these transient marine species can be expected to visit the tidal portions of the Oyster River (and other estuarine waters in Connecticut) during the summer months. This influx of fishes greatly increases fish abundance and diversity. Striped bass and hickory shad are most likely to be present in the spring and fall.

Anadromous species *(those that are hatched in freshwater but that migrate to marine waters to mature before returning to fresh waters to spawn)* that the Fisheries Division has reason to believe occur in the Oyster River include alewife *(Alosa pseudoharengus),* blueback herring *(Alosa aestivalis),* and white perch *(Morone americana).* These anadromous fishes would spawn in freshwater sections of the Oyster River upstream of the Live Oaks School. The juveniles would be expected to use the estuarine portions of the Oyster River as a nursery area prior to migrating out to Long Island Sound and beyond. It should be noted that both striped bass and hickory shad are anadromous species, but they are listed as transient marine species here because neither species spawns in Connecticut waters. Therefore, in Connecticut, their ecological role is that of a marine visitor.

Because the anadromous (and catadromous) species migrate between saline and fresh waters, they also are euryhaline. It is interesting to note that on average, the internal salt concentration of fishes in marine waters (ocean waters where salinity is 35 ppt) is typically one third that of their external environment. As a result, these fishes are constantly losing water by diffusion, thus they must drink large volumes of water to replace the water lost. Since doing this takes in additional salts, marine fishes have highly specialized cells on their gill tissues that allow them to excrete this excess salt. Freshwater fishes -- such as those living in the Live Oaks School Pond and Rock Brook -- have the opposite problem. Since their internal environment is saltier than their external environment, they are continuously gaining water by diffusion. Excess water is excreted by the use of well developed kidneys. In fact, the large volume of dilute urine lost each day may be up to one third total fish body weight.

The catadromous American eel (see summary in Rock Brook section) is expected to be abundant in the Oyster River.

Specific Field Activities Associated with the Outdoor Classroom

- **Sampling for fish:** Small fish can be collected inexpensively within all three habitats using commercially available minnow traps. These traps generally cost less than $10 and they are readily available at tackle shops and from Mail Order Supply Businesses (those specializing in Hunting and Fishing equipment). These traps are ideal in that only small fish (< 5 inches) are collected. Small fish can be maintained for observation much easier than larger specimens. Fish enter the trap by swimming through a funnel at either end. The traps can be fished baited or unbaited.

  Multiple traps can be fished simultaneously within all three habitats, thereby providing hands on comparisons of the fish communities between the different habitats.

- **The aquatic food chain:** If the school has access to compound microscopes (unfortunately, most elementary schools probably do not), water samples from the pond

can be collected and observed. Each drop of water can be expected to contain an abundance of phytoplankton (base of the food chain) and zooplankton (the next level in the food chain; zooplankton feed on phytoplankton). Small fish in turn feed on the zooplankton. They in tern are preyed upon by larger fish and other piscivors (mammals, birds).

A similar example can be demonstrated in Rock Brook. Algae can be observed growing on the stream bottom. The aquatic insects of the stream (the next trophic level) can be collected by kick seining upstream of a small mesh net or screen or by visually examining overturned stones. Fish feed on the aquatic insects.

- **Other possibilities:** The possibilities for studying aquatic habitats are numerous. The best suggestions can probably be found in the various manuals that have been written by those specializing in aquatic education. One that the Team fisheries biologist is familiar with is called "Aquatic Project Wild - Aquatic Education Activity Guide" (1987). It is an interdisciplinary environmental and education guide that covers grades K through 12 (see Suggested References section).

- **Documenting anadromous fish runs in the Oyster River:** The Fisheries Division is interested in obtaining the assistance of cooperators who can assist in documenting anadromous fish runs in Connecticut's coastal streams. Information is needed on the species composition and timing of these runs. This effort would be best handled directly by adults (teaching staff), or by adults supervising older students (Middle School or High School level) who might become involved in the Outdoor classroom as mentors. Anadromous fish are generally sampled using a larger "customized" version of a minnow trap. The Fisheries Division constructs these traps using wire fence material and they are generally fished in riffles (fast flowing waters) upstream of the head of tide. Because the school site is tidally influenced, these traps may not fish efficiently at this location and other types of nets (that the Fisheries Division can supply) may be required. Anyone interested in assisting with this endeavor is encouraged to contact Steve Gephard (Supervisor of Anadromous Fisheries Programs) at 860-434-6043.

Suggested References

The following publications may be helpful to community and school officials in developing curricula, conducting aquatic resources inventories, managing aquatic habitats, or just learning more about aquatic natural resources. Some are available through the DEP Publications Office located on the store level at 79 Elm Street in Hartford.

Aquatic Project Wild - Aquatic Education Activity Guide. 1987. Project Wild, P.O. Box 18060, Boulder, Co. 240p.

Dreyer, G.D. and W.A. Niering (Eds.). 1995. *Tidal Marshes of Long Island Sound. Ecology, History and Restoration.* . The Connecticut College Arboretum, New London, CT. Bulletin No. 34. 72p.

Helfrich, L.A., D.I. Weigmann, R.J. Neves, and P.T. Bromley. 1986. *Landowner's Guide to Managing Streams in the Eastern United States.* Virginia Cooperative Extension Service. Publication 420-141. 32p.

Murphy, B. and D. Mysling. 1993. *Small Ponds in Connecticut - A Guide for Fish Management.* Ct. Department of Environmental Protection. Fisheries Division. DEP Bulletin 19. 81p.

Palstrom, N., G. Smith, D. Lowry and J. Simpson. 1995. *Ponds in Connecticut: A Guide to Planning, Design and Management.* Prepared for the Connecticut Department of Environmental Protection, Bureau of Water Management. DEP Bulletin No. 23. 51p. Plus Appendices.

Schmidt, B. 1991. *Sport Fishing and Aquatic Resources Handbook.* L. R. Jensen and S. Rushton, Eds. Kendall / Hunt Publishing Co., Dubique, Iowa. 102p.

Seehorn, M.E. 1992. *Stream Habitat Improvement Handbook.* United States Department of Agriculture. Technical Publication R8-TP 16. USDA Forest Service, Southern Region, 1720 Peachtree Rd, N.W., Atlanta, Ga. 29p.

Smith, C.L. 1985. *The Inland Fishes of New York State.* The New York State Department of Environmental Conservation. Albany, N.Y. 522p.

Teal, J.M. 1986. *The ecology of regularly flooded salt marshes of New England: a community profile.* U.S. Fish Wildl. Serv. Biol. Rep. 85 (7.4). 61p.

Thompson, K.S., W.H. Weed III, A.G. Taruski, and D.E. Simanek. 1978. *Saltwater Fishes of Connecticut.* State Geological and Natural History Survey of Connecticut. Department of Environmental Protection. Bulletin 105. 186p.

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Weiss, H.M. 1995. *Marine Animals of Southern New England and New York.* State Geological and Natural History Survey of Connecticut. Department of Environmental Protection. Bulletin 115.

Whitley, J.R., B. Bassett, J.G. Dillard and R.A. Haefner. 1990. *Water Plants for Missouri Ponds.* Bernadette C. Dryden, Ed. Published by the Missouri Department of Conservation, Jefferson City, Mo. 151p.

Whitworth, W.R. 1996. *Freshwater Fishes of Connecticut.* State Geological and Natural History Survey of Connecticut. Department of Environmental Protection. Bulletin 114. 243p.

Figure 4

Passive Capture Techniques

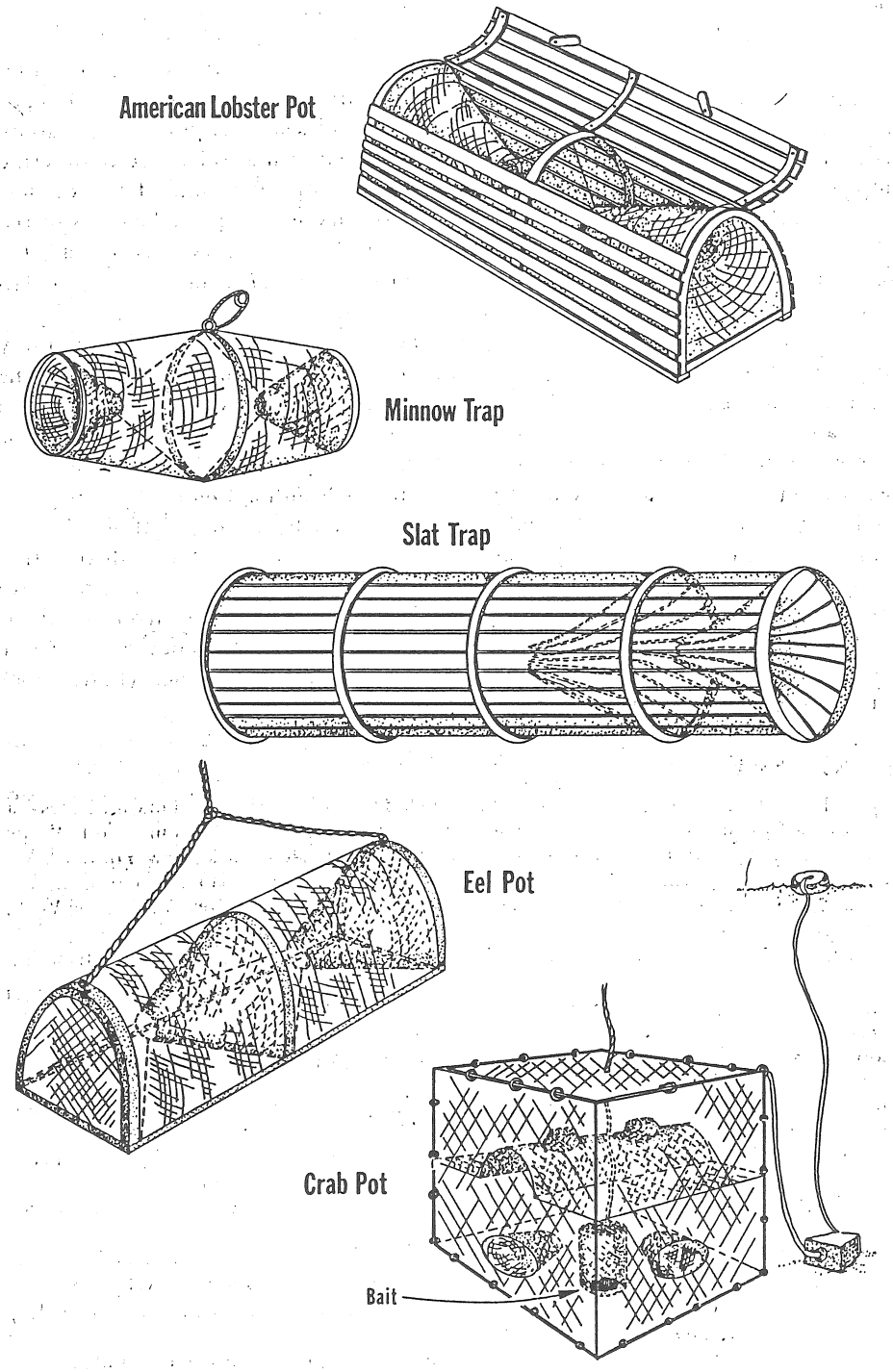
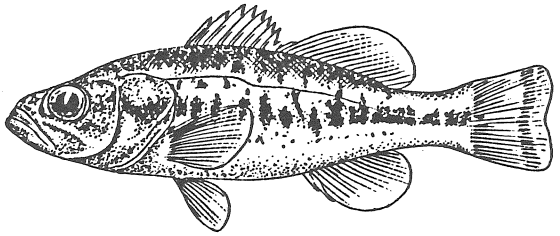


Figure 6.3 Pot gears. American lobster, crab pot, and slat trap from Sundstrom (1957).

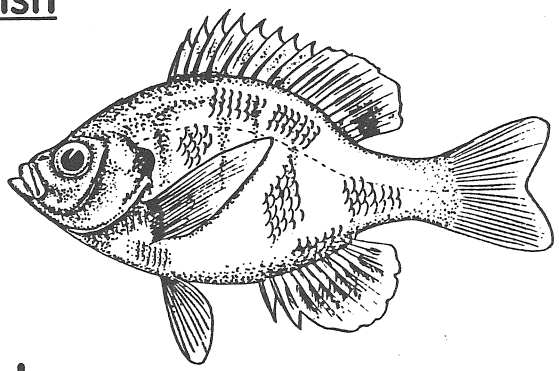
Figure 5

Warmwater Pond Fishes

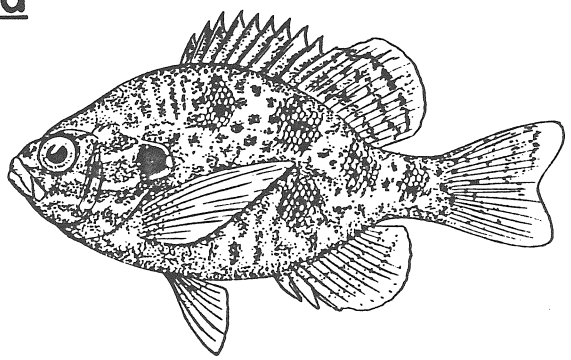
Largemouth Bass



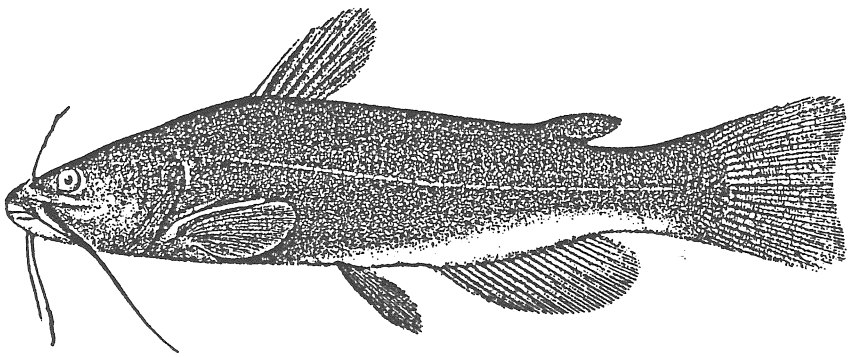
Bluegill Sunfish



Pumpkinseed



Brown Bullhead



Golden Shiner

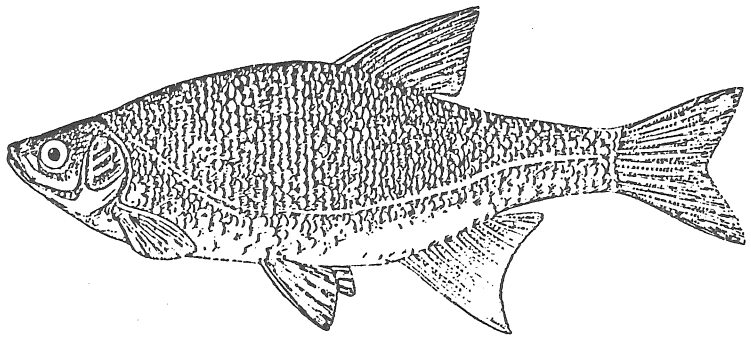
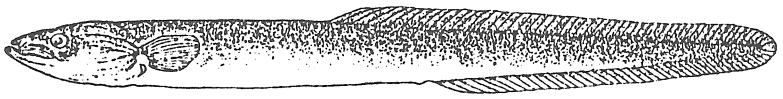
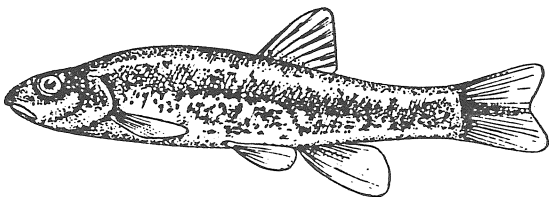


Figure 6
Rock Brook Fishes

American Eel



Blacknose Dace



Tesselated Darter

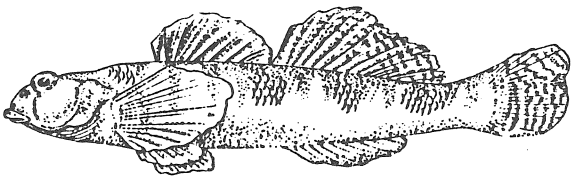
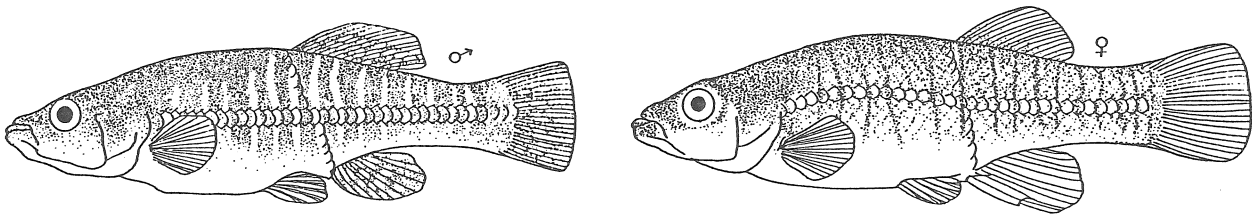
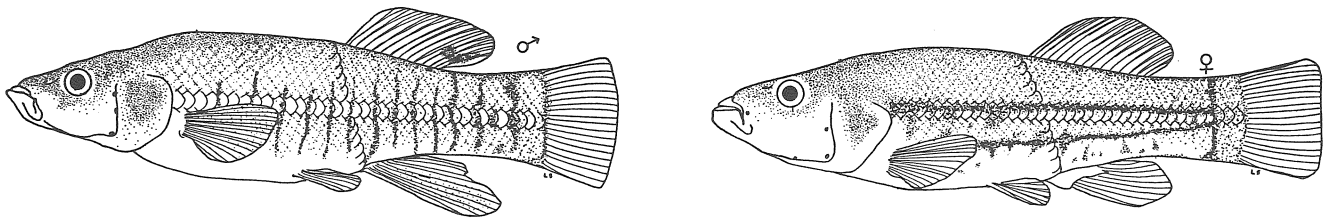


Figure 7
Oyster River Fishes

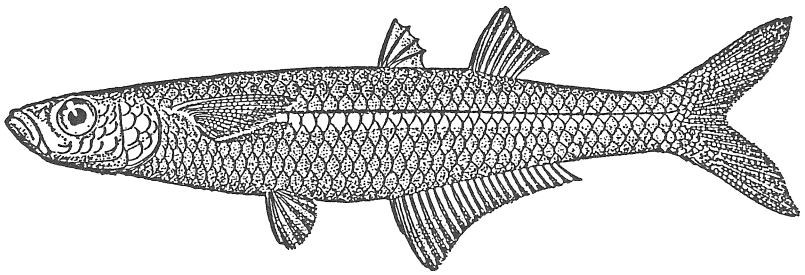
Mummichog



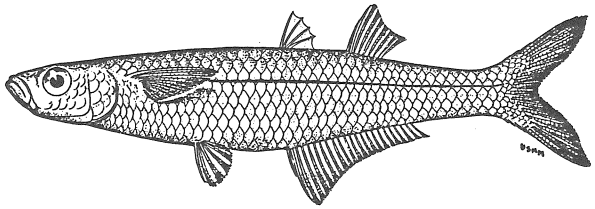
Striped Killifish



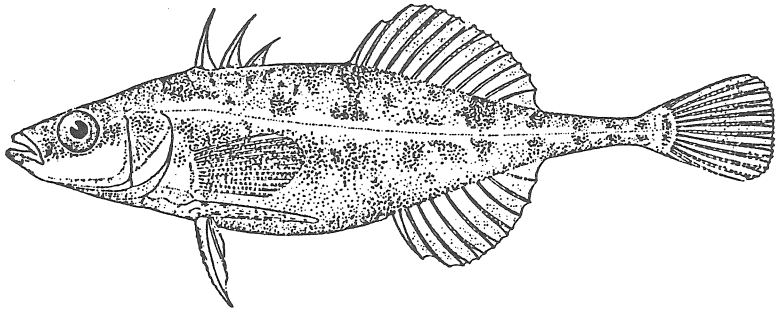
Sheepshead Minnow



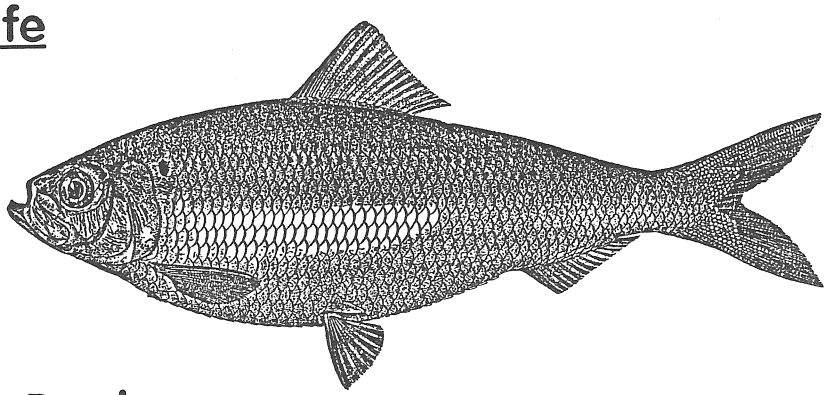
Atlantic Silverside



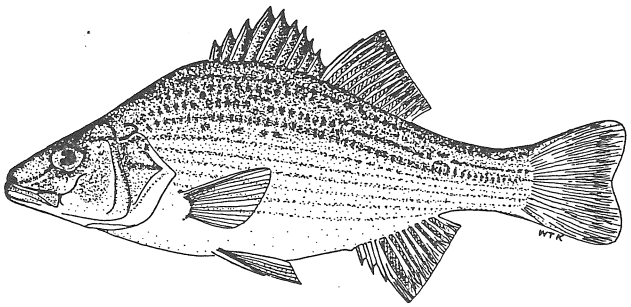
Fourspine Stickleback



Alewife



White Perch



Inland Wetlands

According to the ERT request, the single concern regarding Inland Wetlands was that of "...the importance and value of these wetlands and the role they have in maintaining the health of our environment....".

Included in this section are two listings of wetland functions and values, one from the federal government and one from the state of Connecticut. Inland wetlands and watercourses on this site are comprised of a small pond and outlet stream. Neither of these wetland assessment methodologies are very effective when applied to a wetland system as limited as the one present on this site. However, it is acceptable to consider these functions and values and the individual qualifiers associated with each from a nonstatistical point of view while utilizing the reviewer's best professional judgment.

The inland wetlands on this property have been significantly effected by the urban land uses that surround them. As a result of land filling, stream culverting, channel straightening, vegetation removal and the reduction of surrounding upland habitat, the functional value of this freshwater wetland has been reduced.

The functional values which most apply to the inland (freshwater) wetlands referred to above are:

1. Nutrient Retention and Sediment Trapping - The pond serves, albeit with some concern, as a place where excessive sediment loads being transported by the incoming watercourse can be deposited due to the slowing of the water's velocity as it enters the pond. In cases such as this, where a waterbody is located directly "instream" inclusion of a small, maintainable plunge-pool just upstream of the pond is critical. This pool could capture the larger sediment particles before the water flows downstream into the larger pond.

2. Educational Potential - This is the wetlands highest value due to the presence of a nearby school, safe parking, the presence of the pond and a perennial stream (flows all year round) and the proximity to populated areas and potential users. One item which could improve this rating is to increase the ease of access to the perennial stream leading from the pond to the tidal marsh.
3. Water-based Recreation - The presence of a waterbody, good access to the pond and a fair level of esthetic quality give this rating an "honorable mention."
4. Noteworthiness/Uniqueness - The fact that this wetland system exists within an urban setting and that it is a freshwater extension of a tidal system may qualify it under this type of rating. In addition future use of this system as an educational resource and/or a site for scientific research could increase this function.

It should be added that even though the other functional values included on the accompanying lists would most likely receive low ratings, it is not to say that these functions are absent or could not be enhanced. For instance, the wildlife rating could be enhanced if a "no-mow" area was created around the south edge of the pond. This shoreline vegetation is critical to allow for certain food and cover needs of aquatic wildlife. In addition it would discourage the Canada geese from accessing the pond. It has been shown that large numbers of Canada geese can significantly decrease the water quality of the receiving waterbody through deposition of their fecal matter.

The ERT request mentioned that the site contained a vernal pool. No vernal pool was observed on the property, however, there was a small, moist depression located within the forested area adjacent to the tidal marsh. This depression most likely receives overland runoff from a stormwater discharge pipe located nearby and retains some of this water due to a silty layer "lining" the bottom of the depression. Besides being fed by a water source that is most likely tainted with non-point source pollutants, this pool does not appear to have the characteristics necessary to qualify it as a vernal pool.

During the site walk, the issue of managing and treating the stormwater discharging from the above-mentioned pipe was discussed. With limited space available to construct surface treatment for this stormwater, such as a plunge-pool/bio-filter, it may be worthwhile to

investigate the possibility of infiltrating some or all of the stormwater. The success of an infiltration system depends on primarily two factors, the infiltration capacity of the receiving soil and the depth to the groundwater table. According to the county soil survey, soils here were mapped as "Haven silt loam" which is described as well-drained with a permeability of greater than 20 inches per hour at depths exceeding 31 inches. This is well in excess of the 0.5 in/hour required. With ground elevations out in the marsh at 4.4 feet and elevations near the pipe at approximately 8.7 feet, a rough guess of 4 feet to groundwater can be made, disregarding normal groundwater fluctuations. This may not be enough room to retain the recommended two feet of separation once any infiltrating galleys are sunk into the ground. More accurate data on groundwater conditions will be needed before this option can be fully evaluated.

Stormwater infiltration systems are not as conventional as other types of stormwater treatment systems, and do have drawbacks such as more onerous maintenance requirements and higher cost, however, this may be a good opportunity to test this alternative method. Funding may be available through the DEP's Section 319 Non-point Source grant program.

One final note. During the ERT field walk the Team wetland specialist noticed that a several trees had been clear-cut adjacent to the outlet stream of the pond. No reason for this activity was readily apparent. Preserving "riparian" or stream-side habitat is essential to maintaining the health of that watercourse. Further cutting of this nature is not recommended.

Figure 8

What wetland functions and values are considered by the Corps in its Section 404 permit process?

The 13 functions and values that are considered by the Regulatory Division for any Section 404 wetland permit are listed below. The list includes eight functions and five values. Values are grouped together at the end of the list.

These are not necessarily the only wetland functions and values possible. Nor are they so precisely defined as to be unalterable. However, they do represent the best working "palette" of descriptors which can be used to paint an objective representation of the wetland resources associated with a proposed project.

GROUND WATER RECHARGE/DISCHARGE— This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area. Recharge should relate to the potential for the wetland to contribute water to an aquifer. Discharge should relate to the potential for the wetland to serve as an area where ground water can be discharged to the surface.

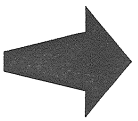
FLOODFLOW ALTERATION (Storage & Desynchronization) — This function considers the effectiveness of the wetland in reducing flood damage by attenuation of floodwaters for prolonged periods following precipitation events.

FISH AND SHELLFISH HABITAT — This function considers the effectiveness of seasonal or permanent waterbodies associated with the wetland in question for fish and shellfish habitat.

SEDIMENT/TOXICANT/PATHOGEN RETENTION — This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants or pathogens.

NUTRIENT REMOVAL/RETENTION/TRANSFORMATION — This function relates to the effectiveness of the wetland to prevent adverse effects of excess nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers or estuaries.

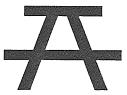
PRODUCTION EXPORT (Nutrient) — This function relates to the effectiveness of the wetland to produce food or usable products for human, or other living organisms.



SEDIMENT/SHORELINE STABILIZATION — This function relates to the effectiveness of a wetland to stabilize stream banks and shorelines against erosion.

WILDLIFE HABITAT — This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered. Species lists of observed and potential animals should be included in the wetland assessment report.

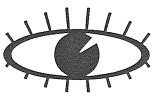
RECREATION (Consumptive and Non-Consumptive) — This value considers the effectiveness of the wetland and associated watercourses to provide recreational opportunities such as canoeing, boating, fishing, hunting and other active or passive recreational activities. Consumptive opportunities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland, whereas non-consumptive opportunities do not.



EDUCATIONAL/SCIENTIFIC VALUE — This value considers the effectiveness of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.

UNIQUENESS/HERITAGE — This value relates to the effectiveness of the wetland or its associated waterbodies to produce certain special values. Special values may include such things as archeological sites, unusual aesthetic quality, historical events, or unique plants, animals, or geologic features, etc.

VISUAL QUALITY/AESTHETICS — This value relates to the visual and aesthetic qualities of the wetland.



THREATENED or ENDANGERED SPECIES HABITAT — This value relates to the effectiveness of the wetland or associated waterbodies to support threatened or endangered species.

ES

Figure 9

OVERVIEW OF EVALUATION METHOD

The evaluation method uses simple mathematical and word models to determine the Wetland Value Units (WVU) for each of the following functional values of wetlands:

1. Flood Control - Evaluates the effectiveness of the wetland in reducing flood damages.

2. Ecological Integrity - Evaluates the overall health and function of the wetland ecosystem.

3. Wildlife Habitat - Evaluates the suitability of the wetland as habitat for those animals typically associated with wetlands and wetland edge. No single species or group of species is emphasized.

4. Finfish Habitat - Evaluates the suitability of watercourses associated with the wetland for either warm water or cold water fish. No single species or group of species is emphasized.

5. Nutrient Retention and Sediment Trapping - Evaluates the effectiveness of the wetland as a trap for sediment and nutrients in runoff water from surrounding upland.

6. Educational Potential - Evaluates the suitability of the wetland as a site for an "outdoor classroom".

7. Visual/Esthetic Quality - Evaluates the visual and esthetic quality of the wetland.

8. Agricultural Potential - Evaluates the potential for conversion of the wetland to agricultural use. Present SCS policy prohibits, with a few limited exceptions, technical assistance by SCS personnel for the conversion of wetlands to agricultural use. This functional value was included only to make the method as complete as possible.

9. Forestry Potential - Evaluates the potential of the wetland for the production of forest products.

10. Water Based Recreation - Evaluates the suitability of the wetland and associated watercourses for non-powered boating, fishing, and other similar recreational activities.

11. Groundwater Use Potential - Evaluates the potential use of the underlying aquifer as a drinking water supply.

12. Shoreline Anchoring and Dissipation of Erosive Forces - Evaluates the effectiveness of the wetland in preventing shoreline erosion.

13. Noteworthiness - Evaluates the wetland for certain special values such as archaeological sites, critical habitat for endangered species, etc.

Wildlife

Current Conditions

The Live Oaks Elementary School property is located in an urbanized area of Connecticut. Wildlife that inhabit or utilize an urbanized area are typically generalists which are highly adaptable to human-induced changes of the landscape. The Live Oaks school property is uniquely positioned along the shoreline that a wider variety of wildlife species can be observed in comparison to schools further inland. The salt marsh, the Oyster River, pond and the upland area combine to make the property rich in possibilities for use as an outdoor living classroom and habitat improvement projects.

Field Observations and Notes

The following wildlife were observed during the field visits either directly or indirectly by identifying calls, tracks, scat or other sign: black ducks, mallards, Canada goose, greater yellowlegs, grackle, northern cardinal, red-winged blackbird, bluejay, fish crow, herring gull, mourning dove, and gray squirrel.

Habitat Conditions

The school property has a variety of habitats which include the forested area, the estuary, the river, a brook, and the pond.

- **Lowland forested area**: This small fragmented forest patch provides habitat for local adaptable wildlife. There is a general lack of vertical diversity in this small patch of woods. The understory is virtually absent and the middle canopy is also

sparse. There appears to have been a lot of soil compaction and other disturbances which preclude good understory development.

- **Riverine Tidal Wetland Area**: this area is a very important habitat component of the school's property. It provides valuable habitat for a wide variety of coastal wildlife species.

- **Oyster River**: This river, with its tidal influence, adds to the diversity of habitats and the types of wildlife that can be seen at this school site. A wide variety of riverine wildlife and fish species can be expected in this river.

- **Rock Pond and Rock Brook**: Rock Pond and Rock Brook add to the habitat diversity of this school site. Wildlife that will utilize these areas include great blue heron, green heron, mink, river otter, muskrat and a variety of ducks.

- **School Lawn Areas**: The mowed lawn areas on the school grounds provides a limited habitat for some wildlife. Overall, lawn areas are low in plant structure and diversity and incur low use by wildlife.

Overall the variety of habitats on this school property offers a great opportunity to view a wide variety of wildlife. These are also many opportunities to make habitat improvements to attract more wildlife.

Enhancement and Planning Considerations

Plantings for improving seasonal food sources and cover can be accomplished along the trail and lawn areas (see Figure 10). The school's nature area can be planted with variety of fruiting shrubs and wildflowers. Further technical assistance is available from the Team wildlife biologist. All plantings should not be invasive non-natives. The following plants should not be planted:

Trees

- Norway Maple (*Acer platanoides*)
- Tree of Heaven (*Ailanthus altissima*)
- Catalpa (*Catalpa spp.*)

Shrubs

- Autumn Olive (*Elaeagnus umbellata*)
- Russian Olive (*Elaeagnus angustifolia*)
- Winged Euonymus (*Euonymus alatus*)
- Burning Bush (*Euonymus atropurpureus*)
- Privet (*Lignustrum spp.*)
- Common Buckthorn *(Rhamnus cathartica*)
- Glossy Buckthorn (*Rhamnus frangula*)
- Multiflora rose (*Rosa multiflora*)

Vines

- Asiatic bittersweet (*Celastrus orbiculatus*)
- Japanese honeysuckle (*Lonicera japonica*)
- Tartarian honeysuckle (*Lonicera tatarica*)

Plantings that strive to be complimentary to the existing habitat and species which occur in the particular habitat area should be utilized. Careful observation of plant communities and plant succession of a particular area will help formulate species lists for enhancement or restoration.

Plant materials should be of native sources as much as possible. Plant species which restore and enhance natural habitat should be utilized. Plantings of native trees, shrubs and wildflowers can enhance conditions for wildlife in the area. Planting should strive to diversify the seasonal availability of food sources such as planting spring, summer, fall, or winter persistent food sources. Enhancement of seasonal

food sources benefits resident wildlife as well as migratory species which may come through in Spring and Fall periods.

The following is a list of native plants recommended to enhance the property:

Native trees

- Flowering Dogwood (*Cornus florida*)
- Black Cherry (*Prunus serotina*)
- Pin Cherry (*Prunus pensylvanica*)
- White Pine (*Pinus strobus*)
- Eastern Red Cedar (*Juniperus virginiana*)
- American Holly (*Ilex opaca*)
- White Oak (*Quercus alba*)
- Pin Oak (*Quercus palustris*)
- Hackberry (*Celtis occidentalis*)

Native Shrubs

- Gray Dogwood (*Cornus reacemosa*)
- Silky Dogwood (*Cornus amomum*)
- Arrowwood Viburnum (*Viburnum recognitum*)
- Nannyberry Viburnum (*Viburnum lentago*)
- Common Elderberry (*Sambucus canadensis*)
- Winterberry (*Ilex verticillata*)
- Bayberry (*Myrica Pennsylvania*)
- American Cranberry Bush (*Viburnum trilobum*)
- Sweet Pepperbush (*Clethra alnifolia*)

Meadow Environment Plantings

Encourage native wildflowers through planting and/or selective mowing. Allow the growth of a wildflower environment by not mowing unused lawn areas. For example, the lawn area near the pond can be allowed to grow into a meadow environment. It can be managed as a meadow by mowing it only once a year in the late winter to prevent woody plant invasion.

Native Plant Sources

New England Wildflower Society, Inc.
Garden in the Woods
Hemenway Road
Framingham, Ma 01701-2699
Tel. 617-237-4924 or 877-7630

DEP Forestry Division
Seedling Program
Pachaug State Nursery
Box 23A, 190 Sheldon Road
Voluntown, CT 06384
Tel. 860-376-2513

Connecticut Native Trees Availability List, 16 pp.
Connecticut Native Shrubs Availability List, 12pp.
Peter M. Picone
DEP Wildlife Division
P.O. Box 1550
Burlington, CT 06013
Tel. 860-675-8130

The nature trail and adjacent property needs to have a long term habitat management plan that has objectives for increasing and maintaining biodiversity through planting and removal of invasive non-native plants. The schoolyard area

currently has a diversity of native trees and shrubs, however, some invasive non-natives are also present. Of note, Autumn Olive (*Elaeagnus umbellata*) is growing along edges of the forested areas. It should be removed to curtail its further spread. Autumn olive is particularly aggressive and displaces more valuable native plants. Also noted is a patch of invasive Japanese Knotweed along the Rock Pond border.

Controlling invasive non-native plants will require a diligent application of mechanical removal by hand, pick and shovel, and/or tractor (backhoe). Also, application of herbicides may be necessary for some invasives to prevent resprouting of cut stumps (if herbicide use is major concern - least environmentally sensitive compounds can be used). The need for controlling invasive non-natives outweighs the risks of utilizing herbicides. Managing invasive non-natives on the schoolyard area should be planned and strategies should be implemented to reduce the impacts to the natural habitats. Limited herbicide use should not be ruled out as an option to control some of the particularly aggressive invasive plants. It is advised to consult with the Connecticut Agricultural Experiment Station (Todd Mervosh) at 860-683-4984 for advice on herbicides.

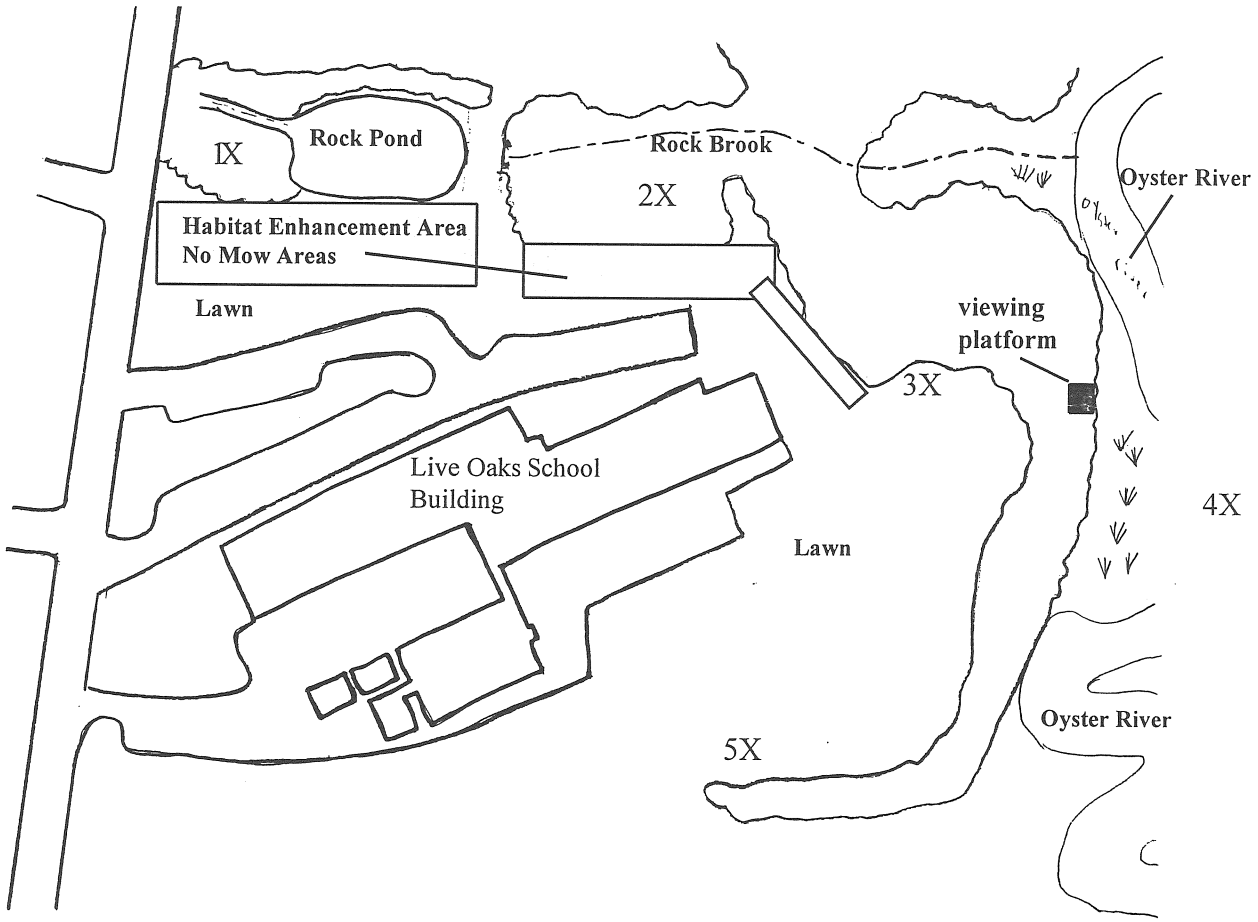
Schoolyard Habitat Size

Increasing the size of the natural schoolyard area can be accomplished using a simple strategy of eliminating some of the unused lawn area adjoining Rock Pond (see Figure 10). By adding these no mow areas, an increase in overall habitat is achieved. The no mow areas can be interplanted with wildflowers, shrubs and/or trees. Students can also learn about the value of leaving some areas unmowed and can also document the natural succession of plants.

Figure 10

Live Oaks Elementary School Grounds

(Please note the recommended shaded habitat enhancement/no mow areas.)



Recommended Nesting Structures (see Figure 10)

- 1X : Squirrel Nest box in tree (15-25 feet up)
- 2X : Screech Owl nest box in tree or on a post (15 to 20 feet high)
- 3X : Bluebird box on a post
- 4X : Osprey Platform in a tidal marsh
- 5X : Bluebird box on a post

Plans for these nesting boxes are included in the Appendix B. Although Ospreys are not noted to nest at this time in this area, it may at some time in the future. Also, it may serve as a roosting or resting post for Osprey or other hawks that are hunting in the marsh area. The Team biologist is available for further consultation.

Wildlife Viewing Platform (see Figure 10)

A wildlife viewing platform can be added to allow students to view with binoculars or spotting scopes the variety of wildlife that use the marsh throughout the school year.

Forested Area Enhancement

The forested area of the schoolyard has a lack of vertical structural diversity. The soils underneath have been severely impacted and compacted over the years. A forester should be contacted for recommendations of which trees to cull to improve and increase understory plants and vertical structure. Improving vertical structure of the forest will benefit wildlife. Snag trees should be retained whenever possible or even created to maintain a minimum of 2-5 snags per acre. Notable understory shrubs that are existing are high bush blueberry (*Vaccicium corybosum*) and sweet pepperbush (*Clethra alnifolia*). Adding additional plants of highbush blueberry and sweet pepperbush is recommended especially in the vicinity that they are currently found.

Discussion

The Live Oaks School outdoor living classroom can be a place for children, teachers and parents to learn more about our natural environment and the other organisms that share the environment with us. Habitat enhancement recommendations are outlined in this report. If they are undertaken, real improvement to wildlife habitat will occur. Incrementally, as each habitat enhancement is made wildlife will benefit. Student participation will ensure a real sense of accomplishment. Also, however, they will learn the difficulties in implementing habitat enhancement projects. Further consultation may be needed during the implementation phase of the project. Please feel free to contact the Team wildlife biologist for further technical assistance.

The Natural Diversity Data Base

The Natural Diversity Data Base maps and files regarding the project area have been reviewed and according to our information, there are no known extant populations of Federal or State Endangered, Threatened or Special Concern Species that occur at the site in question.

Natural Diversity Data Base information includes all information regarding critical biologic resources available to us at the time of the request. This information is a compilation of data collected over the years by the Natural Resources Center's Geological and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substituted for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available.

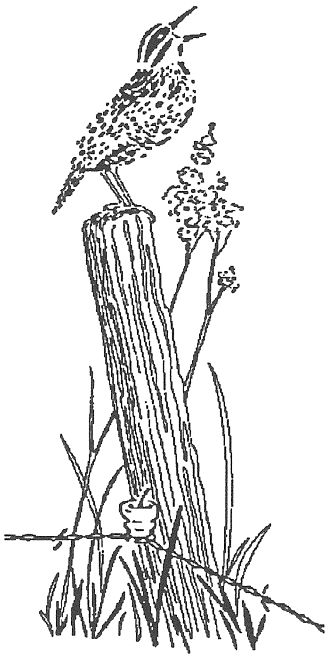
It is now possible for you to conduct an initial endangered species review using the "State and Federal Listed Species and Significant Natural Communities" maps available for viewing through each town's Town Hall. The Town Planner should have a copy of the map and instructions on how to use the maps. This map shows the generalized locations for listed species and communities as gray-shaded areas on a 1:24,000 scale map of the town.

Archaeological Sensitivity

A review of the State of Connecticut archaeological site files and maps shows no known archaeological sites on the school property. However, its proximity to the Oyster River suggests a high sensitivity for undiscovered archaeological sites which may lie adjacent to the drainage. A review of the project suggests no land use disturbances which may impact an archaeological resource, however, teachers working with the outdoor living classroom may wish to incorporate a cultural resources component including instruction on Native American adaptations along coastal environments like these in Milford.

The Office of State Archeology has curricula that they can share with the teachers as well as site information in the Milford and West Haven areas centered around coastal adaptations. The educational process could include not only the natural resources of the coast but also how humans have adapted to those natural resources over the last 10,000 years. The Office of State Archaeology is prepared to offer Live Oaks Elementary School assistance with archaeological or cultural resource information in the development of their outdoor living classroom. (Please contact Nicholas Bellantoni, State Archaeologist at (860) 486-5248.)

Coastal Resource Issues and Land Use Planning Considerations



Coastal Resource Issues

The Live Oaks Elementary School proposes to develop an "outdoor living classroom" on property owned by the City of Milford adjacent to the school grounds off Merwin Avenue to supplement existing school facilities and curricula. As discussed at the field review , the "classroom" envisions no new instructional buildings, but rather is principally a curriculum development project with a few limited potential support structures to facilitate on-site environmental education programs. The site contains a non-tidal freshwater pond and freshwater wetlands and watercourses with associated floodplain, salt marsh, tidal creek (Oyster River), intertidal flats, coastal flood hazard area, wooded uplands and adjacent school ground lawns and buildings. As a follow-up to the ERT site meeting for this proposed project, the Office of Long Island Sound Programs identified the following issues which were discussed on-site and in additional detail below to assist the school and project cooperators: **1)** avoid or minimize potential adverse impacts to on-site coastal resources; **2)** enhance on-site coastal resource education opportunities; and **3)** identify potential state coastal permit application issues and necessary permit information.

Minimizing Potential Coastal Resource Impacts

Structures

The Connecticut Coastal Management Act (CCMA) (C.G.S. 22a-90 to 22a-112) (see Master Copy of ERT Report) requires that coastal area projects be designed to avoid and minimize potential coastal resource impacts and assigns highest priority and preference to water-dependent uses of waterfront sites. Water-dependent uses may include facilities required to support uses which, by their nature, are dependent on proximity to water. Although no buildings are contemplated as part of the classroom, some limited facilities to support student instruction and activities were discussed as potential project components. Specifically, potential on-site structures discussed at the site include: **1)** gazebo for student shelter and instruction, **2)** access pier to the Oyster River for student water sampling, fish traps setting, etc. and **3)** walkway over the Oyster River salt marsh for salt marsh study. Consistent with the coastal

resource impact avoidance and minimization standards of the CCMA, the following recommendations and guidance are offered when evaluating alternative siting and design for these facilities to minimize encroachments into the state regulated area and potential adverse impacts to on-site coastal resources.

Instructional Gazebo/Shelter: This proposed facility is non-water dependent since it can reasonably function without direct access to coastal waters and therefore should be sited upland of tidal wetlands and the high tide line (see high tide line delineation discussion below under Coastal Permit Application Issues) outside the state's coastal permitting jurisdictions. The facility should also be sited on the upland out of the FEMA base flood hazard area (elevation 11 feet NGVD) or, if necessary, be constructed to pass the water of the 100 year frequency flood or anchored to minimize potential flood damage the facility. Since the gazebo would not contain walls it would not be considered an "insured structure" subject to FEMA standards but nevertheless would be subject to storm damage which could be prevented through flood proofing or siting upland of the base flood elevation. Additional information regarding appropriate siting and flood proofing any proposed structure can be obtained through the Department's Inland Water Resources Division, Flood Management Unit at 860-424-3706.

Access pier: Any proposed access pier must be designed to "minimize potential adverse impacts to coastal resources." This should be accomplished by siting the access pier to minimize encroachment into the salt marsh and Oyster River and selecting a design which minimizes shading of tidal wetland vegetation, changes to existing water circulation patterns and subtidal area disturbances. Two sites should be further investigated to meet these objectives, each is located immediately adjacent to where the river channel meanders toward the site where the upland floodplain forest steeply slopes to the river (see Figure 11 map sites A and B for approximate locations). Further, the access pier decking should be sized to the minimum area necessary to meet its intended purpose.

Salt marsh walkway: The extent to which you can demonstrate that providing safe access to the Oyster River salt marsh via a walkway for educational purposes is a water-dependent use, as defined in CGS 22a-93 (16), the greater the justification will be to permit such a structure according to the standards of the CCMA. You should be aware that the statutory definition of a

water-dependent use does not specifically mention such uses but does list general public access to marine or tidal waters as a water dependent use. Nevertheless, the potentially competing objective of protecting this relatively healthy salt marsh from pedestrian trampling and potential adverse impacts of a walkway structure over the marsh must be also be considered. In order to assist you to identify methods for providing safe, dry access across the marsh with minimal adverse impacts, literature describing various methods for providing pedestrian access to the marsh is in included in this section. Regardless of which type of marsh access facilities are used, all must be appropriately sited and installed to minimize adverse impacts to acceptable levels. Three types of tidal wetland access facilities/products discussed in Appendix C include: **1)** elevated walkways; **2)** geotextile mats; or **3)** retractable or mobile marsh surface plank systems. Examples of these systems are provided, each at widely varying cost and efficacy, without endorsement of specific manufacturers or products.

Coastal Resource Education Opportunities

The site provides a variety of coastal resource education opportunities. A list of potential coastal/estuarine environmental educational topics is provided below. Other topics, including more specific curriculum development ideas and existing coastal resource education program literature, may be available through the Department's Office of Education. You are encouraged to contact Dave Parsons at 860-424-3542 for further assistance.

Potential Coastal Resource Education Topics

- Salt marsh vegetation zonation
- Intertidal mud flat invertebrate sampling, identification and classification
- Oyster River salinity measurement variation by tidal cycle and upland stream dilution effects Surface water tidal elevation measurement variation by lunar cycle (Use plexiglass tube inserted into marsh surface with holes drilled above grade with inside of tube coated with chalk dust to mark height of rising tide.)
- Water clarity/secchi disk measurements
- Invasive plant species identification, growth and implications (discussion)
- Salt marsh organism carcass "scavenger hunt" and identification

- Stormwater discharge effects on salt marsh (discussion)
- Finfish trapping and identification
- Peat core samples to observe deposition of salt marsh sediments and time required for marsh development
- Bird observation/inventorying and calling (marsh/shore bird whistles available)

Coastal Permit Application Issues

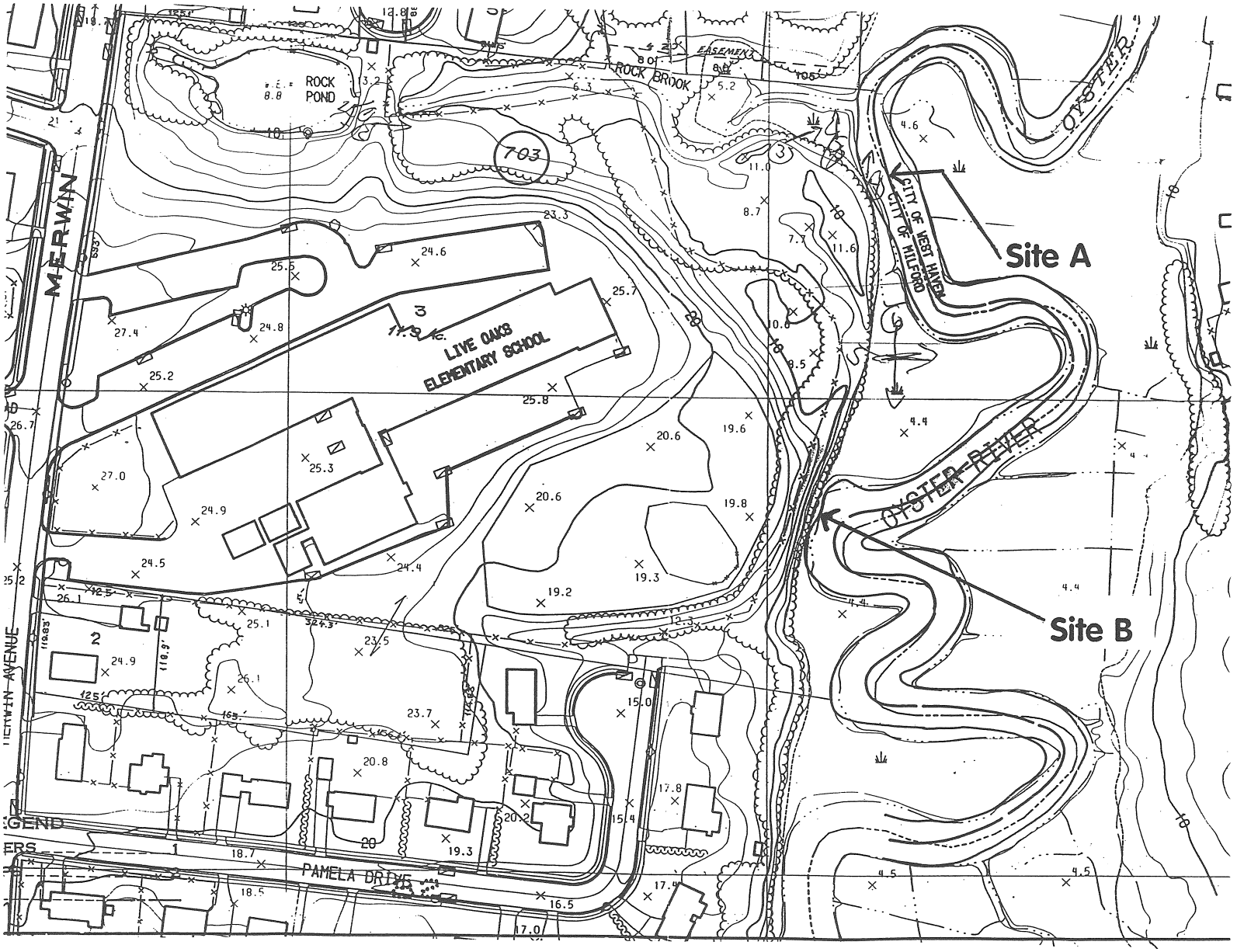
Potential structures at the site discussed above under *Minimizing Potential Coastal Resource Impacts-Structures* may, depending on their construction and location, be subject to state coastal permitting requirements and municipal coastal site plan review requirements of the CCMA. As discussed above under *Minimizing Potential Coastal Resource Impacts,* the CCMA requires that proposed coastal area projects avoid potential coastal resource impacts. Unavoidable impacts must be minimized to acceptable levels and in some cases unmitigated impacts must be compensated through coastal resource restoration or creation. In order to identify areas of the site subject to the Department's coastal permitting programs, identify coastal resource boundaries and assist in evaluating potential coastal resource impacts, the high tide line, mean high water, mean low water and tidal wetlands boundaries should be delineated on the project plans. The high tide line serves as the inland boundary of the state's Structures, Dredging and Fill Act (see Master Copy ERT Report) jurisdiction and is customarily delineated as the one-year frequency tidal flood elevation as published in the U.S. Army Corps of Engineers "Tidal Flood Profile" (1988), which for the subject site is 5.7 feet (NGVD). The tidal wetland boundary, used to identify the extent of the permitting jurisdiction pursuant to the Connecticut Tidal Wetlands Act (see Master Copy ERT Report) for this site can be easily delineated using the site's existing salt marsh vegetation as a guide. Because there is an abrupt elevation and vegetation distinction between the site's floodplain forest and salt marsh, this delineation should be fairly easily accomplished using the site's high tide line elevation delineation and salt marsh vegetation as guides to identifying the regulated tidal wetlands jurisdiction boundary described in the statutory definition of tidal wetlands in CGS Sec. 22a-29 (2). An order form for a recent CT DEP/Connecticut College publication entitled *Tidal Marshes of Long Island Sound* may be found in Appendix C. Copies of the state Structures, Dredging and

Fill and Tidal Wetlands permit application materials to assist you in completing state coastal permit applications which will likely be required for the project have been included with the Master Copy of the this ERT report that has been given to the Milford Inland Wetlands Agency.

It is hoped that these comments are helpful to the City of Milford and the New Haven County Soil and Water Conservation District in developing site and curriculum plans as well as any required coastal permit applications. The Office of Long Island Sound Programs believe the site provides tremendous potential for instructing children in coastal and estuarine ecology. Any questions regarding information in this section may be directed to David Kozak at 860-424-3034.

Figure 11

Possible Access Pier Locations



Land Use Planning Considerations

Site Location

The Live Oaks Elementary School and adjacent 1.3 acre parcel lies in the eastern section of the City of Milford bordering the City of West Haven. The project site is located south of the Connecticut Turnpike, next to the Oyster River, which flows into Long Island Sound at the Oyster River Beach. The school is also located within the Coastal Zone Boundary. All buildings, uses, and structures fully of partially within the coastal boundary are subject to Coastal Site Plan Review requirements and procedures. The surrounding zoning district is classified as residential (R-12.5. and R-10). The minimum lot requirements for these districts are 12,500 square feet and 10,000 square feet respectively (see Figure 12 and 13).

Site Characteristics

The site includes many significant and noteworthy natural features, including a pond, freshwater stream and associated wetlands, wooded area, a salt marsh, and the Oyster River with its' tidal influences.

Land Use Considerations

The parcel provides an excellent opportunity to enrich and bolster the science curriculum of the adjacent Live Oaks elementary school, as well as, other curriculum at schools within and outside of the City of Milford. The proximity to the Oyster River and other natural on-site features offers an excellent opportunity to develop a "hands-on" outdoor living classroom for students of all ages and the neighborhood community.

Selected Demographic Data

The United States Census Bureau has created census tracts with boundaries delineated with the intention of being maintained over a long period of time so that statistical comparisons can

be made from census to census in various tabulations and reports. The City of Milford is made up of 12 such census tracts, originally designed to be somewhat homogeneous with respect to population characteristics, economic status, and living conditions. The Live Oaks school and proposed outdoor classroom lies within census tract number 1512. The census tract numbered 1512 is bounded by the Connecticut turnpike to the north, the Oyster River to the east, and Brewster Road and New Haven Avenue to the south (see Figure 14). Some selected general demographic

information from the most recent **1990 Census** is listed below for consideration:

- Total Population - 1,106 persons
- Population over 3 years old enrolled in school (pre-school through high school) - 567
- Total Housing Structures -1,106 housing units
- Majority of housing units built between 1950 and 1969 - 676 units or 61 %
- Majority of the housing units served by public sewer - 79 %
- Housing Units served by public water systems - 100%

The census tract encompasses approximately all population and housing units within one mile radius of the Live Oaks School in the City of Milford. The census data is not current and may not be accurate in terms of sewer service, but rather represents information gathered from residents in 1989 for the 1990 Census. The characteristics of the surrounding neighborhoods may have changed slightly, however the basic population and housing characteristics have probably not changed significantly. The proposed outdoor classroom site should be able to document local environmental information and provide a forum to discuss other local issues such as polluted drainage runoff, and failed septic systems and their impact on the health and habitat of the Oyster River and Long Island Sound. It should be noted that the census tracts do not correspond with the local elementary school districts. The City of Milford public school system is currently comprised of nine elementary schools, three middle schools, and two high schools.

Organizational Framework

The outdoor classroom would be a great opportunity to improve the local school curriculum by establishing a "hands-on" outdoor environmental education program which incorporates

information concerning the natural systems that the children experience in their own local surroundings.
The project manager should develop a working relationship with local and statewide organizations who can provide resources and ideas to establish short-term objectives and long term goals. The Soil and Water Conservation Districts in cooperation with the Department of Environmental Protection have been very successful in assisting communities in establishing various outdoor education classrooms encompassing local habitats and natural settings. The University of Connecticut Cooperative Extension Program is a valuable technical resource for many land use officials and local educators. The National Wildlife Federation has also developed a comprehensive program to assist communities in developing schoolyard habitats.

The key to successful programs lies with effective local project leadership to initiate the volunteer efforts and garner public support for the project. The project manager and/or project task force must take charge to see the project through the various stages of development. Outside funding opportunities for the project may be available through the various community foundations, other non-profit environmental education organizations, charitable trusts, and government agencies. The use of the Internet and other electronic search mechanisms has made project "grantsmanship" a much easier task in recent years.

One example of a successful local "grass roots" wildlife habitat project is occurring in the Town of Branford. The idea for a schoolyard habitat was "hatched" at a local day care center, which is housed at a former elementary school, owned by the town in a residential section of the Town of Branford. One of the teachers (Leslie Hurlburt) at the Branford Day Care Center came up with the idea after hearing about a program sponsored by the National Wildlife Federation for the development of schoolyard habitats. The day care center site included 13 undeveloped acres, which had become overgrown with invasive vegetation. The site was unique in that it contained a primitive trail network, pond and wetland area along with a vernal pool. With the assistance of both the National Wildlife Federation and Connecticut Department of Environmental Protection in terms of technical assistance and advice, Leslie set in motion a chain of events and activities which has brought recognition and support of the project by the community officials, growing local volunteer participation, and donations and in-kind contributions from the business community. In a period of eight months the site has been cleared of invasive

vegetation, and a trail network with landscaped seasonal garden plots developed to illustrate the seasonal changes and native vegetation. Through hard work, dedication and local publicity a "buy-in" from the community was established which has transformed an overgrown, natural resource into a schoolyard wildlife habitat, which the entire community has adopted. An example of the "community adoption" of the project is illustrated by the school contest in which participant's came up with an official name for the project site - *Nature's Garden.*

Summary

The City of Milford should be commended for the vision and support, in seeking to provide the community with a valuable resource to provide hands on environmental and science opportunities for the children and residents of the area. The site not only provides a unique resource for the elementary school children at Live Oaks school, but also would help to establish another "outdoor classroom" for children outside of the local school district. Various unique habitat sites would enable students from different environments and backgrounds to interact and view first hand the unique natural systems found throughout the State of Connecticut. As more of the unique schoolyard habitat sites are developed in the towns and cities of Connecticut interaction through on site field trips and interactive web sites can create a strong network for learning and exploration. The City of Milford has one of the longest coastlines in the state with an abundance of cultural, recreational, and educational resources including the National Marine Fisheries Service, Connecticut Department of Agriculture - aquaculture laboratory, Connecticut Audubon Coastal Center and the soon to be developed Silver Sands State Park. The relatively small outdoor classroom site would help young students to better understand their own unique landscape in which they live.

Figure 12

Zoning Requirements

3.1.4.1

SCHEDULE OF LOT AND BUILDING REQUIREMENTS FOR ONE FAMILY RESIDENTIAL DISTRICT

CATEGORIES	R-AA	R-A	R-30	R-18	R-12.5	R-10	R-7.5	R-5
MINIMUM REQUIREMENTS:								
Lot Area (sq. ft.)	87,120	43,560	30,000	18,000	12,500	10,000	7,500	5,000
Lot Width (feet)	180	150	125	100	80	70	60	50
Lot Depth (feet)	200	150	135	125	100	100	85	70
Principal Uses:								
Front Yard (feet)	50	50	50	40	30	25	20	*
Each Side Yard (feet)	25	25	20	15	10	10	**	**
Rear Yard (feet)	50	50	40	30	25	25	25	20
Accessory Buildings:								
Side Yard (feet)	15	15	15	10	4	4	4	4
Rear Yard (feet)	10	10	10	10	5	5	5	5
MAXIMUM PERMITTED:								
Building Height Stories (excluding basement)	3	3	3	3	3	3	3	3
Feet (in height)	35	35	35	35	35	35	35	35
Building Area as % of Lot	10%	15%	20%	25%	30%	35%	40%	45%
Lot Coverage	20%	25%	30%	40%	45%	50%	60%	65%

*Ten feet or the actual front yard setback, whichever is greater; except that the minimum required front yard shall not be required to exceed 20 feet.

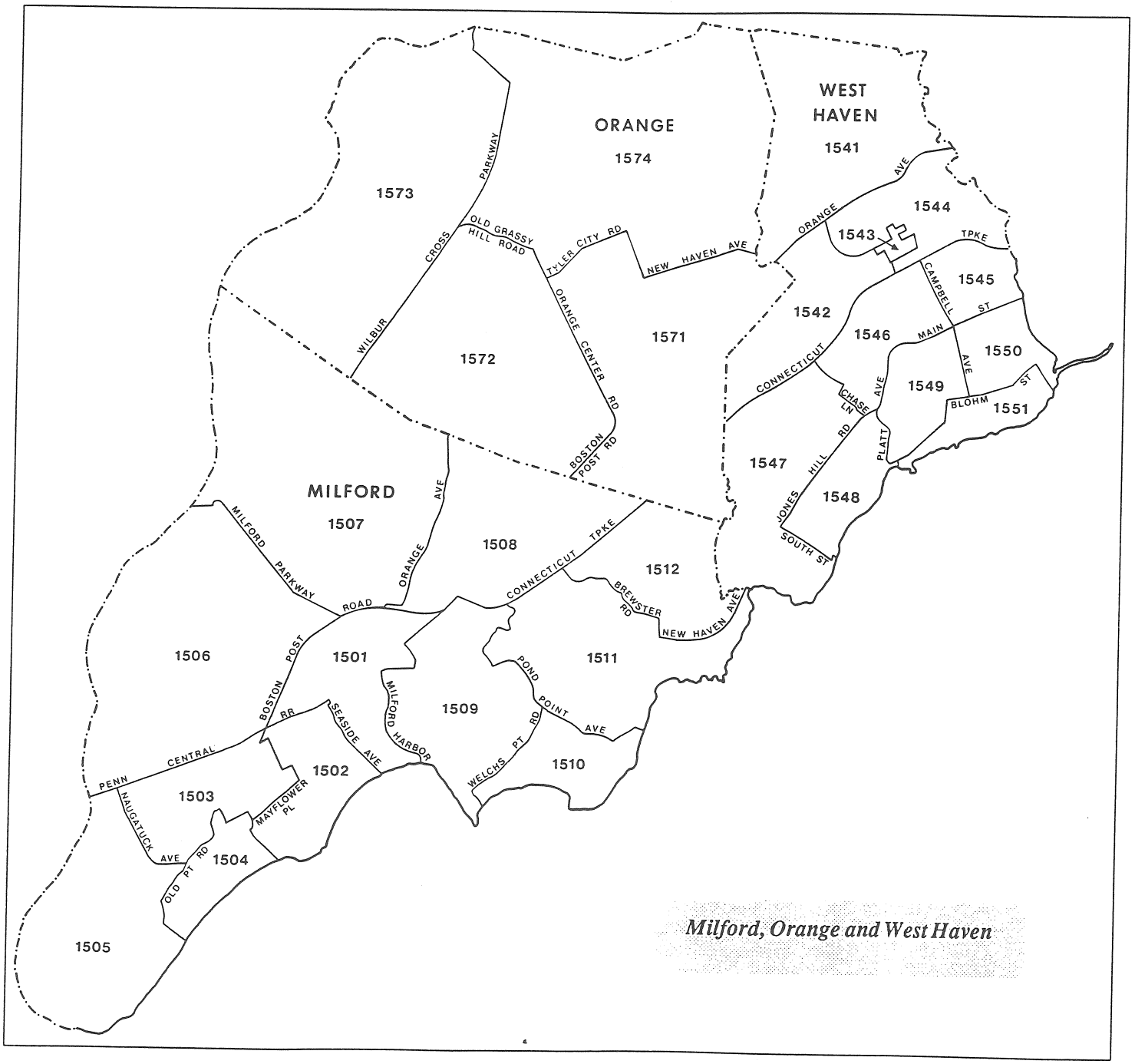
**One side ten (10) feet; other side five (5) feet. (Clarified effective 11/7/92.)

Figure 13

Zoning Map

Figure 14
Census Tracts

1990 Census Tracts
South Central Connecticut



Appendix A

For Appendix Information Please contact the
ERT Office at 860-345-3977