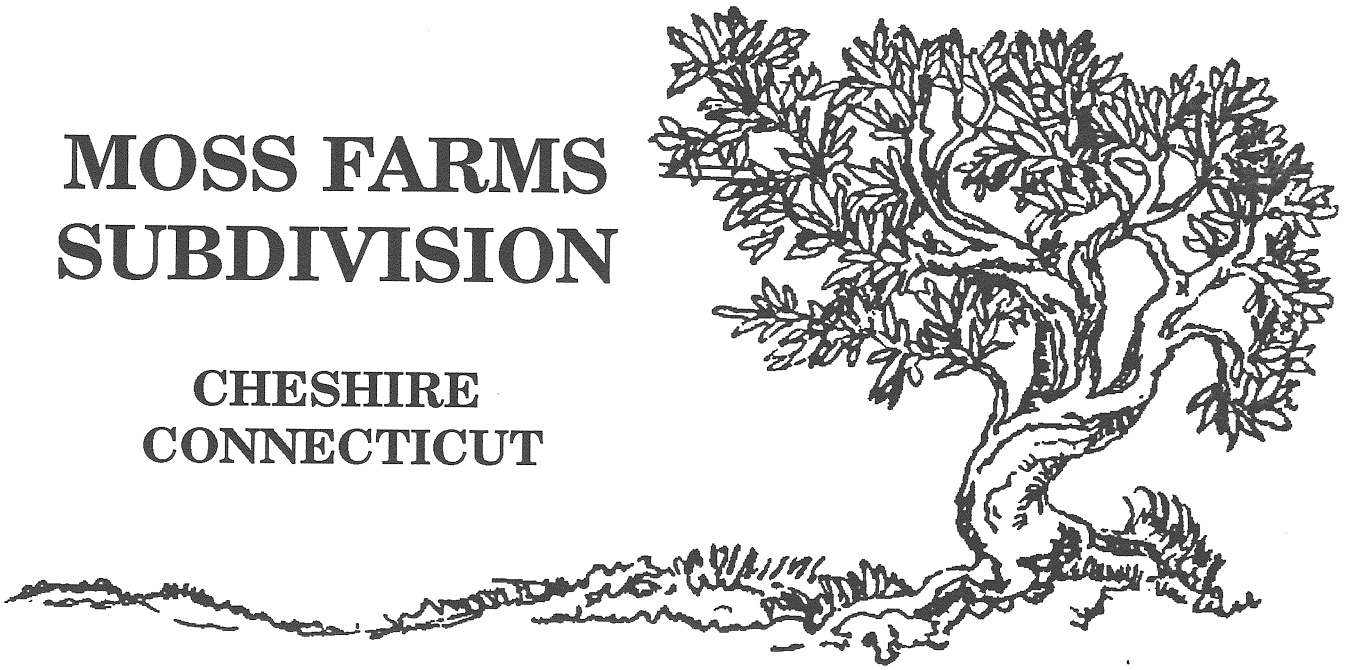
KING'S MARK ENVIRONMENTAL REVIEW TEAM

REPORT FOR

MOSS FARMS SUBDIVISION

CHESHIRE
CONNECTICUT



KING'S MARK
RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

MOSS FARMS SUBDIVISION

CHESHIRE, 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.

Haddam, Connecticut

for the

Town of Cheshire

This report is not meant to compete with private consultants by supplying site designs or detailed solutions to development problems. 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 Town. The results of the Team action are oriented toward the development of a better environmental quality and long-term economics of the land use. The opinions contained herein are those of the individual Team members and do not necessarily represent the views of any regulatory agency with which they may be employed.

October 1992

ACKNOWLEDGEMENTS

The King's Mark Environmental Review Team Coordinator, Elaine Sych, would like to thank and gratefully acknowlege the following Team members whose professionalism and expertise were invaluable to the completion of this study.

- Richard Kszystyniak, District Conservationist
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I would also like to thank James Sipperly of the Town of Cheshire for assisting in the completion of this report.

EXECUTIVE SUMMARY

Introduction

An environmental review was requested by the Town of Cheshire for the Moss Farms Subdivision, located at the intersection of Moss Farms Road and Jarvis Street. The 176 acre site has 99.8 acres of wetlands and an area of the Ten Mile River watershed is included.

A 98 lot single family subdivision is proposed. Lot sizes would be approximately 10,000 square feet, and the lots would be served by public sewer and water.

The purpose of this review is to inventory and assess the existing natural ,resources and to discuss the development proposal. This environmental information will be used to assist the Town in making their decisions regarding this project.

The ERT Process

The review process consisted of 4 phases: (1) inventory of the site's natural resources; (2) assessment of these resources; (3) identification of resource problem areas; and (4) presentation of planning, management and land use guidelines. Based on the review process, specific resources, areas of concern, management considerations and development opportunities were identified.

Geologic Resources

The central and northern parts of the parcel have a very gentle topography. An unnamed stream, the Ten Mile River and numerous drainage ditches cut through the property. Several shallow natural depressions that contain water may be pingoes, which are permanent ground frost phenomena.

There is an extensive sand deposit with some gravel along the southwest border of the property. It is suggested that this resource be used to its full potential within the limits of engineering, safety and aesthetics. These mined areas may need more than the minimum amount of topsoil to create lawns.

The presence of subsurface clay layers may pose a remote hazard from liquefaction and subsurface flowage. It is recommended that an engineer should test the soil prior to approval of the project.

Soil Resources

The soils in the southwest and central portion of the property are generally associated with glacial outwash plains and terraces. In the central portions silty glaciolacustrine deposits predominate. Soils in the northwest formed in recent silty alluvial deposits often found in the floodplains of major streams.

Land use limitations for soils are detailed in Table 1, hydric soils are found in Table 2, and soil erodibility factors are presented in Table 3.

Forestry and Vegetation Considerations

All of the forest types are typical of Connecticut in terms of species and age classes. Of special interest is an extremely large white oak and an 8" diameter American chestnut with no apparent symptoms of chestnut blight.

A conservation easement document should include a statement concerning the cutting of trees being permissible if done according to sound forestry principles. Cutting trees can improve wildlife habitat and forest productivity if done properly.

A qualified professional should look at the site plans and the trees on each lot to determine which trees should stay and to establish a protection plan for them.

When planting street trees, it is best to plant at least 10 different varieties. This makes it less likely that one disease or insect will kill off entire blocks of trees.

Fisheries Resources

The Ten Mile River is characteristic of a coldwater wetland stream. The DEP surface water classification is "Class Bc", which means uses are for recreation, fish and wildlife habitat, agricultural and industrial supply, and other legitimate uses including navigation. The subscript "c" identifies areas suitable for coldwater fisheries. DEP manages the Ten Mile River as a trout fishery.

Should mitigative measures not be implemented, site development and subsequent landuse changes associated with the subdivision have the potential to adversely impact aquatic habitats of the Ten Mile River and the Quinnipiac River.

Mitigative measures that should be considered include: (1) re-route the proposed sewer line to eliminate the Ten Mile River crossing; (2) maintain a minimum 100 foot buffer zone along perennial streamcourses and 50 foot buffer along intermittent drainages; (3) establish a comprehensive erosion and sediment control plan; (4) design and implement an effective stormwater management plan; (5) limit any regulated activities within or adjacent to watercourses to historic low stream flow periods of the year and (6) limit liming, fertilizing, and the introduction of chemicals to developed land susceptible to runoff into watercourses.

Ecological Assessment

The entire area provides a continuous and diverse breeding and feeding habitat for many mammals, songbirds, reptiles and amphibians. The "wetland pockets" in the northern part of the property may be important breeding grounds for numerous amphibians. The potential negative impacts on these areas could be high due to their proximity to development activities. These areas should be more intensively inventoried, especially in the spring, to determine the overall significance of this site.

The excavation of some basements should be reconsidered in homes planned in close proximity to the drained wetlands. There could be problems with moisture and water accumulation if the groundwater level is ever raised. The overall suitability of the site to support dry basements needs to be addressed so that house designs can be modified prior to construction.

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An environmental review was requested by the Town of Cheshire for the Moss Farm Subdivision. The 176 acre site is located directly across from the intersection of Moss Farms Road and Jarvis Street. Wetlands on the site encompass 99.8 acres, and an area of the Ten Mile River watershed is included.

The developer is proposing to develop 98 lots for single family homes on lots of approximately 10,000 square feet. All lots will be served by a public water supply and a connection to the town's sanitary sewer system is proposed.

The purpose of this review is to inventory and assess existing natural resources and discuss the development proposal. Specific objectives include:

1) Assessing the geological characteristics of the site, including geological development limitations and opportunities;

2) Determining the suitability of existing soils to support the planned development, including soil limitations and sediment and erosion concerns;

3) Assessing the impact of the development on vegetation and discussing management concerns;

4) Assessing the impact of development fish resources and river quality;

5) Assessing the impact of development on the wetlands, Ten Mile River and Quinnipiac River;

6) Assessing the impact of development on wildlife.

The Environmental Review Team Process

Through the efforts of the Town of Cheshire and the King's Mark ERT, this environmental review and report was prepared for the Town. This report primarily provides a description of on-site natural resources and presents planning, management and land use guidelines. The review process consisted of 4 phases:

1) Inventory of the site's natural resources (collection of data);

2) Assessment of these resources (analysis of data);

3) Identification of resource problem areas; and

4) Presentation of planning, management and land use guidelines.

The data collection phase involved both literature and field research. The ERT field review took place on September 14, 1992. Mapped data or technical reports were also perused, and specific information concerning the property was collected. Being on-site allowed Team members to check and confirm mapped information and identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. Results of this analysis enabled Team members to arrive at an informed assessment of the property's natural resource opportunities and limitations. Individual Team members then prepared and submitted their reports to the ERT Coordinator for compilation into the final ERT report.

LOCATION MAP

Scale 1" = 2000'

PHYSICAL CHARACTERISTICS

GEOLOGIC RESOURCES

Topography

Topography of the area, although locally modified by prior attempts to develop, is a function of either the bedrock or surficial geology. The lake sediments in the central and northern part of the parcel have very gentle topography. They have been dissected by a natural stream, by the Ten Mile River flood plain and by numerous drainage ditches that appear to be 15-20 years old (based on the size of tree trunks growing on piles of soil excavated from the ditches). Several natural shallow depressions normally contain standing water year round. The topographic map indicates that many of these depressions have slightly raised rims. This suggests they formed as "pingos", permanent ground frost phenomena, rather than as kettle holes (hoppers) as was suggested during the site visit.

Bedrock Geology

The bedrock geology of the area to be developed is everywhere concealed by surficial materials. Several outcrops are reported (LaSala, Jr., 1961), however, on steep slopes along the eastern portion of the parcel. Most of the area is underlain by coarse-grained sandstone, shale and perhaps conglomerate (Fritts, 1963) that are commonly referred to as "brownstone". These sedimentary rocks are cut by basalt (traprock) dike that, because of its resistance to mechanical erosion during the last ice age, forms a topographic ridge along the eastern border. Numerous outcrops of basalt may be found in the adjoining subdivision (east).

Surficial Geology

The surficial geology of the area is the result of deposition of material from meltwater when glacial ice of the last ice age melted. The central and northern part of the parcel contain appreciable silt (and clay?) at the surface. Bedrock is 20 or more feet below the surface of the fine-grained materials which were probably deposited in a lake. Glacial ice formed the dam that held back the lake. The ice, of course, melted long ago, draining the lake. The floodplain of the modern Ten Mile River is cut into the lake-bottom sediments. Poor drainage of the area is a function of the low permeability of the former lake-bottom sediments.

Along the southwestern border of the parcel is an extensive deposit of sand along with small amounts of gravel. The sediments are stratified which suggests they were deposited in

a large crack or crevice in the ice by melt-water streams. Most of the sand is fine-grained and suitable for backfill. Very little material suitable for aggregate or road construction is present.

Discussion

Subsurface clay layers are reported on the engineer's logs of nearby test borings. It is likely that clay underlies much of the area and accounts for the poor drainage. This suggests the possibility of wet basements if proper site preparation is neglected. The developer indicated that fill would be placed in this area to ensure that basement floor elevations would be higher than the 100 year flood elevation of the Ten Mile River.

The likely presence of clay below the surface suggests the possible (remote) hazard from liquefaction and subsurface flowage. Because a large number of homes will be built on potentially unstable soils, engineers should test the soil prior to approval of the project.

Sand and gravel deposits along the southwestern border of the parcel are a resource. Site plans indicate that some of this material will be mined and used on-site during construction. Any gravel remaining after development will be a resource that cannot be further developed. Although it seems unusual for a report of this nature, the Team Geologist recommends that the resource be used to its full potential, i.e. as much sand and gravel be mined as is practical, both from an engineering (safety) and an aesthetic point of view. The area is already extensively disturbed and once development begins the entire area will be impacted. The removal of extra gravel, therefore, will make little difference. After mining, both the slopes and flat areas will be extensively drained. As a former homeowner in such a situation, the Team Geologist believes that more than the minimum (usually 4 inches) of topsoil should be placed in the mined areas.

SOIL RESOURCES

Soils Descriptions and Limitations

Soils within this parcel, as described in the National Cooperative Soil Survey of New Haven County, have developed in a variety of parent materials. The Agawam and Branford (AfA, BoA, BoB) soils observed in the southwest and west central portions of the property have formed in coarse-textured materials on glacial outwash plains and terraces. Raynham (Ra) soils have developed in silty glaciolacustrine deposits which predominate in the central part of the parcel. Soils in the northwest portion of the proposed subdivision, classified in the Rumney Variant (Rv) and Saco (Sc) series, have formed in recent silty alluvial deposits and are often found in the flood plains of major streams. A small area of glacial till-derived Cheshire soils has been observed in the eastern part of the property.

The limitations of on-site soils for a variety of land uses are detailed in Table 1, in the Appendix. Please see page 72 of the Soil Survey of New Haven County (1975) for a more thorough discussion of land use limitations.

Table 2, in the Appendix, denotes hydric soils found within the parcel, as described in the Soil Survey of New Haven County. Hydric soils are soils that, in an undrained condition, are saturated, flooded or ponded sufficiently long during the growing season so that the growth and regeneration of hydrophytic vegetation is favored.

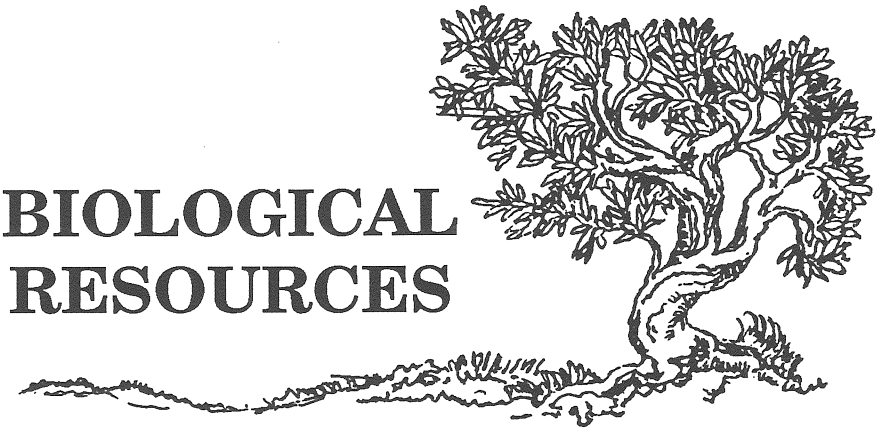
Soil Erosion and Sediment Control

Soil erodibility factors for soils within this parcel are presented in Table 3, in the Appendix. The soil erodibility factor (K) is a measure of the susceptibility of any given soil to erosion by water. In general, soils having the higher K factors are the more erodible, and soil erodibility also increases with increasing land slope.

SOILS MAP

Scale 1" = 1320'

BIOLOGICAL RESOURCES



FORESTRY AND VEGETATION CONSIDERATIONS

Vegetation Type Descriptions

All of the forest types are typical of Connecticut in terms of species and age classes. The upland oak forest is dominated by red and white oaks, roughly 80 years old, that regrew after being cleared for agriculture in the 1800's, as evidenced by the old barbed wire found on the site visit. Also noted were black birch, red maple, beech, tulip poplar, and mountain laurel. In the areas more recently disturbed by excavation and land-moving activities, aspen and birch have taken advantage of the full sunlight to establish themselves. Autumn olive, an aggressive, exotic shrub commonly found in meadows is growing profusely along many of the open trails. In the floodplain, red maple, pin oak, elm, and willow were found, and the wetlands primarily had red maple, with lesser amounts of pin oak and black tupelo.

Of special interest was an extremely large white oak along a trail that probably provided shade for livestock many years ago. Also noted along the trail near proposed Phase IV was an 8" diameter American chestnut without any apparent symptoms of chestnut blight.

Vegetation and Wildlife Habitat

With regard to the question of whether or not the removal of vegetation be adverse to wildlife habitat,certainly whenever large numbers of trees are cut down the wildlife habitat will change, and depending on the particular species of wildlife one is interested in, it may be for better or worse. Different species have different habitat requirements ranging from grasslands to old growth forests. Certain species will thrive in developed areas and others will not. There probably is a benefit to wildlife in keeping 128 acres of open space and developing the remaining 48 acres versus a more traditional subdivision spread over the entire site. However, this question would be more properly addressed by the Team wildlife biologist .

It was mentioned that a conservation easement may be employed to protect the open space. If so, it should include a statement to the effect that "cutting of trees is permissible if done according to sound forestry principles". When done properly, cutting trees can improve wildlife habitat and forest productivity, and to restrict this activity might deprive the future homeowners association from managing its land to produce many benefits such as wildlife, firewood, and timber on a sustainable basis.

Management Considerations

Regarding the issue of areas and species of special concern, there were two trees (the white oak and the chestnut) in particular that were unusual. There may be many more but time constraints prevent a more detailed study. It would be desirable to protect these trees during construction. This leads to a general discussion about whether trees should be removed from residential property before construction or should they be saved, and if so, how to properly protect them. Enclosed is a copy of a brochure developed by the Connecticut Division of Forestry called "Protecting Shade Trees During Home Construction" (See the Appendix). Basically, some trees on each lot will be worth protecting, and others will not. A qualified professional, such as an arborist, forester, or landscape architect, who understands the growing requirements of trees should look at the site plans and the trees on each lot and determine which should be removed and which should stay, and establish an effective protection plan for them.

Some factors to consider are species, location, size, age, and vigor. For example, aspens are short-lived and have relatively weak wood making them undesirable for street trees. Or a tree may be in the right location to provide afternoon shade, but because of extensive grading or drainage changes, the roots have been severely damaged, creating a hazard in the future. All too often, well intentioned builders leave trees in newly created yards, only for the trees to die a few years later because of fill placed over the roots or by cutting roots to install underground utilities.

Once it has been decided which trees to save, they must be protected by not allowing construction equipment to damage them by compacting the soil or physically wounding the trunk, roots, or limbs. A tree's roots extend beyond the branches, so at a minimum, a barricade such as a snow fence should be erected around the drip line of each tree to be protected. Because some of the proposed lots are fairly small (10,000 sq. ft minimum), it may not be possible to save any trees in a given lot after all the construction is accounted for.

When planting street trees, it is best to plant at least 10 different species. By having a variety of trees, it is less likely that one disease or insect will kill entire blocks of trees such as what happened to Connecticut's towns when the American elm was ravaged by Dutch elm disease. A list of recommended trees as compiled by the University of Connecticut Cooperative Extension Service is included in the Appendix.

FISHERIES RESOURCES

Site Description

Flowing northerly, the Ten Mile River is located roughly along the western and northwestern boundaries of the proposed Moss Farms Planned Residential Subdivision. With a low gradient and meandering flows the Ten Mile River is characteristic of a coldwater wetland stream. Stream channel width is approximately 25 feet with average depths of 1 foot or less. Due to the low stream gradient, surface flows are predominated by moving pool interspersed by riffle. Stream substrate is of gravel, coarse sand, and sand/silt fines. In-stream cover is composed of undercut banks and fallen or overhanging vegetation. Riparian vegetation is comprised of dense growths of hardwoods and woody shrubs.

Commercial, industrial, and residential development within the Ten Mile River watershed has impacted water quality which, in 1987, received a surface water rating of "Class Bc" by the Department of Environmental Protection. Designated uses for water of this classification are recreational use, fish and wildlife habitat, agricultural and industrial supply, and other legitimate uses including navigation. The use of subscript c in the Class Bc rating is to identify areas suitable for coldwater fisheries, including spawning, growth, and passage.

Aquatic Resources

A formal fisheries resource inventory of the Ten Mile River had been conducted in 1990 by the DEP Fisheries Division. A 450 foot reach of stream within the vicinity of West Johnson Avenue, Cheshire, was surveyed. Survey results (see Appendix) indicated the presence of the following cold water stream fish species: brown trout, fallfish, tessellated darter, white sucker, and American eel. Redfin pickerel, a species common to wetland streams, were also present as were the following warm water pond species: bluegill sunfish, pumpkinseed sunfish, and redbreast sunfish. Although the survey site was located approximately 1 mile downstream, the reach of stream through the proposed subdivision site is anticipated to contain a similar fishery assemblage.

The DEP Fisheries Division manages the Ten Mile River as a trout fishery. Approximately 650 adult brown trout and rainbow trout are liberated annually in effort to meet angler demand.

Impacts

Should mitigative measures not be implemented, site development and subsequent land use changes associated with the proposed Moss Farms Planned Residential Subdivision have the potential to adversely impact aquatic habitats not only of the Ten Mile River but also those of the Quinnipiac River to which the stream is tributary. Anticipated impacts include:

■ Soil erosion, transport, and subsequent sediment deposition through increased runoff from unvegetated areas and sediment discharge from in-stream activities involved with the sewer line crossing of the Ten Mile River. Excessive erosion and sedimentation can degrade water quality and in-stream habitats in turn impacting the resident fishery population. Specifically, excessive siltation has the potential to:

- cause a depletion of oxygen within the water column - disrupt fish respiration and gill function

- reduce water depth resulting in a reduction of habitats used by fish for feeding, cover, and spawning

- reduce fish egg survival

- reduce aquatic insect production

- promote growths of aquatic plants

■ Influx of stormwater drainage may cause aquatic habitat degradation due to the release of "pollutants" from developed areas; such pollutants include gasoline, oil, heavy metals, road salt, fine silts, and coarse sediments.

■ Removal of riparian vegetation along stream courses can result in the following:

- remove the natural "filter" effect of vegetation which has the ability to prevent sediment, nutrients, fertilizers, and other non-point source pollutants from upland sources from entry into streams; such non-point pollutants can degrade water and habitat quality

- increase stream water temperature during the summer months (thermal loading)

while decreasing winter water temperatures to levels where there may be a complete cover of ice

- decrease streambank stability thereby increasing in-stream siltation and aquatic habitat degradation

- eliminate or drastically decrease the supply of large woody debris to the stream; such material provides critical instream habitat features for numerous species of aquatic organisms

- reduce a substantial proportion of food for aquatic insects which in turn constitutes a reduction in a significant proportion of food available for resident stream fish

- stimulate excessive aquatic plant growth

- decrease of the riparian corridor's ability to serve as a "reservoir" storing surplus runoff for gradual release back into streams during summer and early fall base or low flow periods

■ Nutrient enrichment from fertilizer runoff will stimulate aquatic plant growth. Herbicide runoff may result in fish kills and water quality degradation.

Recommendations

In an effort to mitigate impacts to the aquatic resources of both the Ten Mile River and Quinnipiac River the following should be considered:

■ Re-route the proposed sewer line to eliminate the Ten Mile River crossing.

■ Maintain, at a minimum, a 100 foot open space buffer zone along the developments closest encroachment to perennial surface watercourses and 50 feet along intermittent drainages; no construction or alteration of riparian habitat should take place within this zone; research has indicated that buffer zones of these widths prevent damage to aquatic ecosystems by absorbing surface runoff, and the pollutants they may carry, before discharge into surface waters; please refer to the DEP Fisheries Division Policy Statement and Position Statement for further information (in the Appendix).

■ Establish a comprehensive erosion and sediment control plan with mitigative measures (hay bales, silt fence, etc.) to be installed prior to and maintained through all development phases; land disturbance and clearing should be kept to a minimum with all disturbed areas being protected from storm events and restabilized in a timely manner.

■ Design and implement an effective stormwater management plan to contain storm water runoff on-site and not be allowed to discharge directly into surface water courses; stormwater detention facilities should not be constructed in watercourses.

■ Limit any regulated activities within or adjacent to watercourses to historic low stream flow periods of the year; reduced stream flows and rainfall during summer - early fall provide the least hazardous conditions to work near sensitive aquatic environments.

■ Limit liming, fertilizing, and the introduction of chemicals to developed land susceptible to runoff into watercourses.

ECOLOGICAL ASSESSMENT

The proposed Moss Farms subdivision is an intense use development with the retention of a large tract of land as open space. Much of the activity will occur on upland sites; however, a number of wetlands will be impacted by a variety of activities. Since the most sensitive habitat, the floodplain of the Ten-Mile River will be largely untouched, most of the comments below pertain to other parts of the property, especially the drained wetland area in the northeastern portion of the site.

(1). The report entitled "Environmental Assessment: Moss Farms Subdivision Cheshire, CT" by Soil Science and Environmental Services, Inc. is substantially correct in its description of the site and the associated vegetation. Much of the area has been impacted by clearing and ditching with the resultant vegetation reflecting the disturbed nature of the site. This area, however, provides a contiguous and diverse breeding and feeding habitat for numerous mammals, songbirds, reptiles and amphibians.

(2.) The "wetland pockets" in the northern part of the property may be important breeding sites for numerous amphibians; woodland frogs, toads, and salamanders. Since much activity will be in close proximity to these sites (10-15 feet of setback from fill or other activity) or directly impacted, the potential negative effect on this area for these species can be high. This area needs to be more intensively inventoried especially in the spring to determine the overall significance of this site.

(3.) The drainage ditches which were dug on-site should be carefully monitored to ensure that sedimentation, either from existing material or that discharged with storm drainage does not reach a point where the flow is restricted and the resultant groundwater level is raised. This may have a profound effect on moisture and water accumulation in the cellars of homes that are in close proximity to the drained wetlands. Since sediment in these ditches will probably accrete over time, the excavation of cellars for some homes should be reconsidered.

(4.) Similarly, since much of the site has formed on glaciolacustrine deposits of sand and silt, additional test bores should be conducted at the proposed house locations to determine overall suitability of the site to support dry cellars. Since most of the soils probably have a relatively impervious layer at various depths, these areas should be determined on-site to determine which house designs should be modified prior to construction.

APPENDICES

Appendix A - **Chart 1 - Soil Interpretation Chart**

Chart 2 -Hydric Map Unit Listing

Chart 3 - Soil Erodibility

TABLE 1

SOIL INTERPRETATION CHART

Survey Area - New Haven County, CT

Map Symbol Map Name	Shallow Excavations	Dwellings Without Basements	Dwellings With Basements	Local Streets and Roads	Lawns and Landscaping
Afa, Agawam	Severe, Cutbanks Cave	Slight	Slight	Slight	Slight
BoA, Branford	Severe, Cutbanks Cave	Slight	Slight	Slight	Slight
BoB, Branford	Severe, Cutbanks Cave	Slight	Slight	Slight	Slight
CtC, Cheshire	Moderate, Slope	Moderate, Slope	Moderate, Slope	Moderate, Slope	Moderate, Large Stones, Slope
HuD, Holyoke	Severe, Depth to Bedrock, Slope	Severe, Depth to Bedrock, Slope	Severe, Depth to Bedrock, Slope	Severe, Depth to Bedrock, Slope	Severe, Depth to Bedrock Slope
Cheshire	Severe, Slope	Severe, Slope	Severe, Slope	Severe, Slope	Severe, Slope
Ra, Raynham	Severe, Wetness	Severe, Wetness	Severe, Wetness	Severe, Wetness	Severe, Wetness
Rv, Rumney Variant	Severe, Cutbanks Cave, Wetness	Severe, Floods, Wetness	Severe, Floods, Wetness	Severe, Floods, Wetness	Severe, Floods, Wetness
Sc, Saco	Severe, Cutbanks Cave, Wetness	Severe, Cutbanks Cave, Wetness	Severe, Cutbanks Cave, Wetness	Severe, Wetness, Floods, Frost Action	Severe, Wetness, Floods

Slight - A slight limitation indicates that soil properties generally are favorable for the specified sue and that limitations are minor and easily overcome.
Moderate - A moderate limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design.
Severe - A severe limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils that are rated severe, costly measures may not be feasible.

TABLE 2

HYDRIC MAP UNIT LISTING

Survey Area - New Haven County, Connecticut

MAP SYMBOL	SOIL MAP UNIT NAME	SOIL ACRES	SOIL PERCENT	HYDRIC RATING
AfA	Agawam Fine Sandy Loam 0-3 % slopes	2750	100	N
BoA	Branford Silt Loam 0-3 % slopes	3770	100	N
BoB	Branford Silt Loam 3-8 % slopes	4870	100	N
CtC	Cheshire Very Stony Fine Sandy Loam 8-15 % slopes	490	100	N
HuD	Holyoke-Cheshire Complex 15-35 % slopes Holyoke Cheshire	3630 3219	40 35	N N
Ra	Raynham Silt Loam	1390	100	Y
Rv	Rumney Variant Silt Loam	1800	100	Y
Sc	Saco Silt Loam	1420	100	Y

TABLE 3

SOIL ERODIBILITY

SOIL MAP UNIT SYMBOL	SOIL ERODIBILITY FACTOR (K)
AfA	.28
BoA	.24
BoB	.24
CtC	.17
Ra	.49
Rv	.43
Sc	Not Estimated

Appendix B - Protecting Shade Trees During Home Construction

Trees for Urban Sites

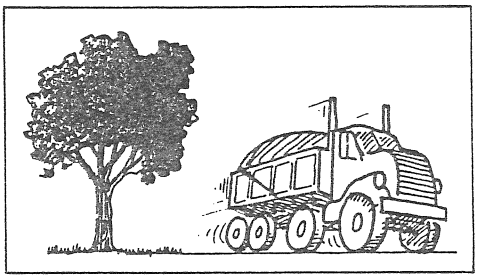
Appendix B - Protecting Shade Trees During Home Construction

Trees for Urban Sites

PROTECTING SHADE TREES DURING HOME CONSTRUCTION

Should trees be removed from residential property before home construction or should they be saved?

Shade trees can add thousands of dollars to the value of residential property -- yet developers and home building contractors often remove them before starting construction. It's a known fact that saving trees can increase a developer's profit margin. Site preparation, landscaping and maintenance costs can be lower, and by saving existing trees one will increase the value -- and selling price -- of the property. Sound environmental planning is good for a developer's public image as well.



Many trees can be saved with little effort or expense; many are valuable enough to justify considerable effort and expense in protecting them. Besides, saving trees can mean savings on . . .

- **Tree removal costs:** escalating costs of fuel, labor and machinery make site preparation economy a necessity; leaving solid areas of native vegetation, with only minimal clearing, is especially economical.
- **Landscaping costs:** leaving trees can reduce expensive grading, planting, and follow up watering and maintenance.
- **Maintenance of unsold areas:** remember, landscaping and lawns require constant care.
- **Installation costs of drainage systems:** utilizing natural drainage patterns, leaving natural vegetation in place along streams, ponds and swampy areas can eliminate expensive site work to handle runoff and retention requirements. Where allowable and feasible, sheet drainage -- using wide right-of-way in a natural state to absorb runoff from streets, etc. -- is cheaper, more attractive, and requires less maintenance than curb and gutter installation.

Saving established, healthy, well developed trees on construction sites will also increase consumer demand for the property, lower energy consumption for heating and cooling costs, create quieter and more private living conditions, and improve the environmental quality of the area following construction.

IS THE TREE WORTH SAVING?

Some trees may be worth less than realized by the average homeowner and may not warrant the time, effort, and expense of attempting to protect them. One must evaluate each tree carefully by considering its location, type of tree or species, age, and condition. One must also consider what type of protection will be necessary to save the tree, how much work it will involve and how much it will cost.

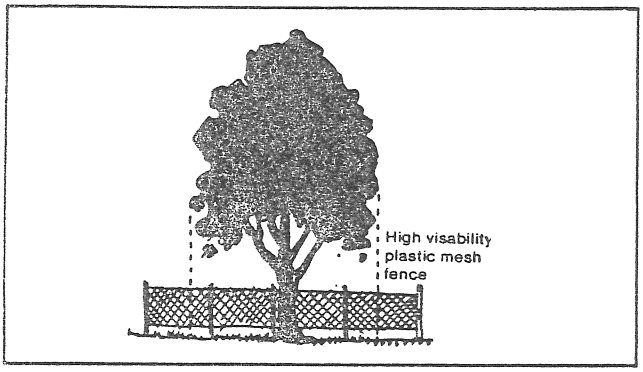
Whatever the size and scope of the development, to make the most of what you have it pays to bring in a professional, qualified arborist, urban forester, environmental planner, or landscape architect who knows and understands trees. This professional should be able to determine:

- which trees are desirable, healthy, which need pruning or removal.
- which will survive anticipated changes in grade, drainage, etc. and how to accomplish these changes.
- which trees should be removed from near buildings, weak root systems make trees prone to wind throw, invasive roots cause problems with sewer lines, shallow roots may upheave driveways, sidewalks, etc.
- which trees are relatively pest and disease resistant, and those that cause major problems in this respect.
- which areas of the site, from the standpoint of economy, ecology and beauty, would best be left natural or minimally cleared.
- how to protect single trees, groups of trees, or natural areas of vegetation before, during and after construction.
- where and what trees should be planted, or transplanted, and how to do it.
- whether you can market trees that must be removed for timber, firewood, etc.

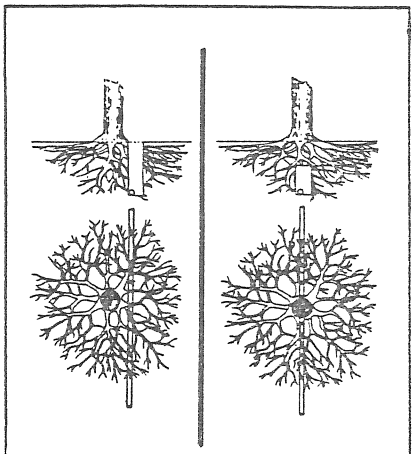
WHY IS PROTECTION NECESSARY?

Once the decision has been made to save certain trees on the construction site they must be protected from one or more of the following:

* Construction equipment and machinery: impact injuries from heavy equipment like trucks, bulldozers, etc; cutting of roots, soil compaction over roots, wounds to trunk, roots, and low-hanging branches.
  - all are hazards that can be avoided. Areas of vegetation, single trees, or groups of trees should be fenced with barricades. These should be:
  - large enough to include everything inside the spread of the branches or dripline of the tree.
  - constructed of sturdy scrap wood (4 X 4 or 2 X 4 stock is ideal).

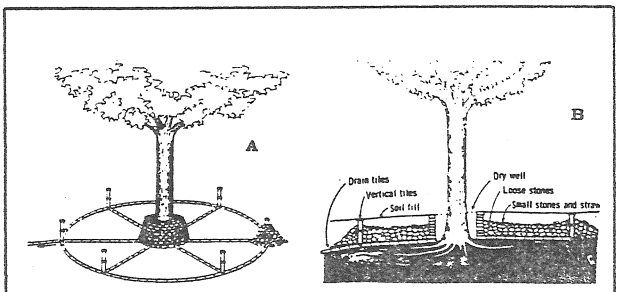


* Chemical poisoning: run off from washing down equipment, petroleum products, lime and mortar, misuse (including overuse) of fertilizers, insecticides, herbicides or soil sterilands; residue of chemicals like calcium chloride used to keep down dust on dirt roads -- all can harm or kill trees. Such dangers can be avoided by keeping the area within the dripline of trees free of building materials and run off; by seeing that chemicals are used only by trained personnel and strictly according to directions, and by having closely controlled disposal of excess chemical materials. Preferably off the site.
* Excavations: trenching for utility lines, etc., can remove vital tree roots, change drainage patterns. Where possible, trenches should be routed away from trees and outside the dripline. If this is impossible, the next best approach is tunneling under roots, using a power driven soil auger. Tunneling should be offset to one side of the truck to protect major roots. Excavations should be filled immediately, leaving no air pockets.

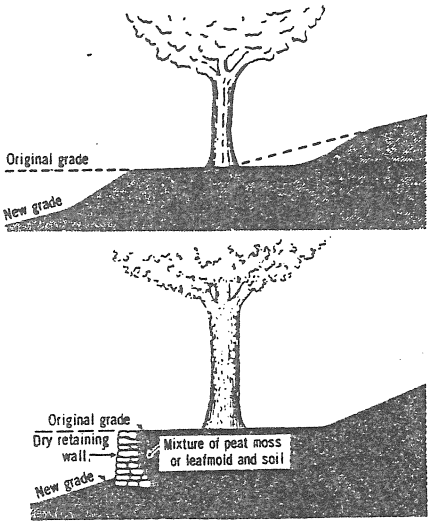


Tunnel beneath root systems. Drawings at left show trenching that would probably kill the tree. Drawings at right show how tunneling under the tree will preserve many of the important, feeder roots.

* Grade Changes: there are two types of grade changes that can be detrimental to tree health. One is raising the grade; the other is lowering it. Tree roots need air, water, and minerals to survive. When the grade level is changed by removing soil from the top of roots or by adding soil or filling over the top of roots, the tree has difficulty obtaining its normal amount of air, water, or minerals. Cutting away or smothering of tree roots affects their water and oxygen supply, often with fatal results. A light fill up to 4 inches of porous gravelly material or good topsoil high in organic matter and loamy in texture usually does little harm to healthy trees.

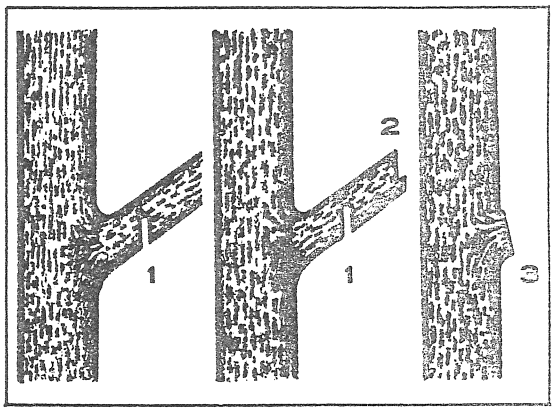


A tile system protects a tree from a raised grade. *A*, The tile is laid out on the original grade, leading from a dry well around the tree trunk. *B*, The tile system is covered with small stones to allow air to circulate over the root area.



A retaining wall protects a tree from a lowered grade.

Proper tree maintenance including watering, soil aeration, pruning or thinning of the crown to compensate for root injury, wound treatment and fertilization will help trees survive grade changes.



To prevent splitting wood and stripping bark on large limbs, make the first cut part way through from below (1.) Cut off the limb from above (2.) Remove stub with a smooth cut (3.)

More severe grade changes will require you to supply air to the roots of the tree. This is usually done by installing drainage tiles and constructing a drywell under the spread of the tree before gravel and porous fill is added. The tiles are laid on the original grade; they form a wagon wheel shape with the spokes of the wheel opening into a dry well built around the tree trunk. The dry well acts as the hub of the tile system and holds fill away from the tree trunk.

It may also be necessary to place a series of bell tiles vertically over the roots and connected to the wagon wheel system to allow for additional air and water circulation.

For shallow fills, the fill material may be gently sloped down to the level of tree roots, leaving the tree in a depression larger than the spread of its crown.

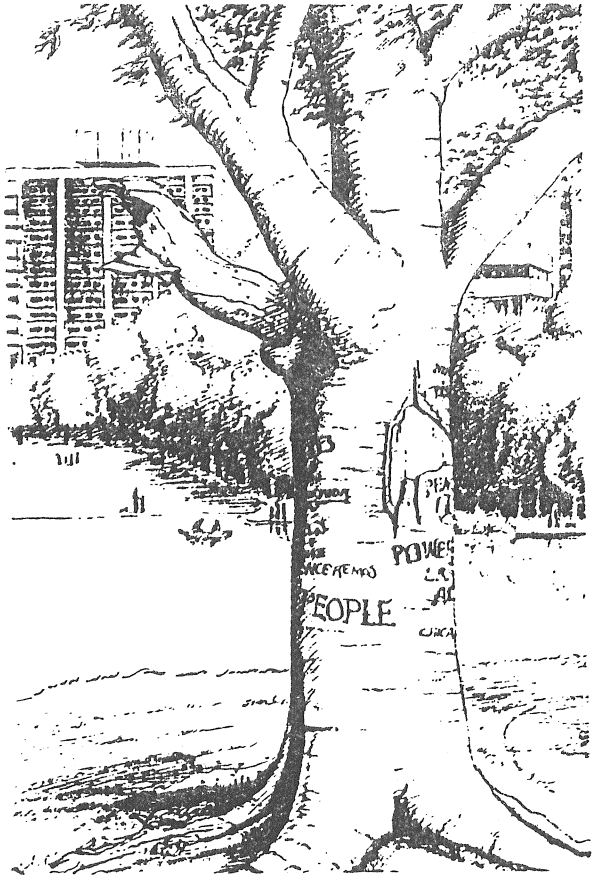
Deep grade lowering around a tree or group of trees means building a retaining wall at a sufficient distance from the trunk to save most of the roots -- out at the dripline should be adequate.

For shallow grade lowering, the soil may be sloped gently away from the tree roots down to the level desired, leaving the tree on a sort of island a bit larger than the dripline.

* **Transplanting existing plant materials:** with modern tree moving equipment, it may be possible to move especially desirable native trees and shrubs from construction sites to other locations in the landscape. when selecting native trees for transplanting, choose those that are healthy, young, vigorous specimens of species that move successfully. It is important to get professional advice on all aspects of tree protection during construction!

* **Adding new trees to the construction site:** after all site changes have been completed the final stage of the construction plan may be to add new trees and shrubs to the landscape. Proper plant selection for particular sites is of utmost importance. Select plant materials that will be assets as they mature instead of liabilities. Carefully consider the growing conditions, diversity of plant materials in the area, insect and disease resistance of plant materials and maintenance requirements. Be sure new trees and shrubs are properly planted and watered when necessary.

WHAT'S WRONG WITH THIS PICTURE?



Yankee Forest
COOPERATIVE PROJECT

P.O. Box 760 Chepachet, RI 02814

A Cooperative Natural Resource Management Agreement

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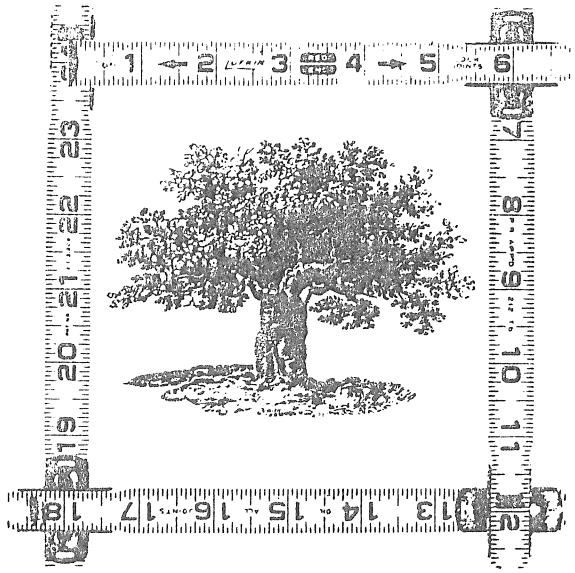
USDA Forest Service,
Northeastern Area
State & Private Forestry

PROTECTING SHADE TREES DURING HOME CONSTRUCTION



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THE UNIVERSITY OF CONNECTICUT ■ COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
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91-27

URBAN AND COMMUNITY FOREST FILE
FACT SHEET #3 May 1991

Trees for Urban Sites

Trees are of value in the urban setting because they provide shade, cooling, add humidity to the air, provide wildlife habitats and improve the aesthetics of our surroundings, just to name a few. Unfortunately, the urban environment is one of the toughest places for trees to survive and grow. Many trees living in an urban site will be exposed to many, if not all of the following stresses:

1. Minimal amounts of water
2. Road deicing salts
3. Restricted root zones
4. Soil compaction
5. High soil alkalinity due to leaching from cement
6. Low soil fertility
7. Poor soil structure
8. Pollution and toxins
9. Vandalism
10. High winds created by clusters of tall buildings
11. Radiated heat and light
12. "People pressure"

There are basically two approaches that can be taken to help ensure the survival of trees planted in urban settings. One approach is to alter current planting and after-care practices by providing trees with larger and improved root zones, by supplying additional water to a tree until it is firmly established in its site and by affording trees greater protection from "people pressure". Tree survival in urban sites can also be enhanced by selecting only tree species or cultivars which are tolerant of stressful conditions and are appropriate for their location. An abbreviated list of trees that are suitable for planting in Connecticut's cities and towns is provided below.

SCIENTIFIC NAME	COMMON NAME
Acer campestre	Hedge Maple
Acer ginnala	Amur Maple
Acer platanoides 'Cleveland'	Cleveland Norway Maple
Acer platanoides 'Deborah'	Deborah Norway Maple
Acer platanoides 'Emerald Queen'	Emerald Queen Norway Maple
Acer platanoides 'Globosum'	Globe Norway Maple
Acer platanoides 'Erectum'	Upright Norway Maple
Acer platanoides 'Columnare'	Columnar Norway Maple
Acer platanoides 'Olmsted'	Olmsted Norway Maple
Amelanchier spp.	Serviceberry, Shadbush
Betula nigra	River Birch
Carpinus betulus	European Hornbeam
Carpinus betulus 'Columnaris'	Columnar European Hornbeam
Carpinus betulus 'Fastigiata'	Fastigiate European Hornbeam
Carpinus betulus 'Globosa'	Globe European Hornbeam
Corylus avellana 'Contorta'	Contorted Weeping Filbert
Corylus colurna	Turkish Filbert
Crataegus crusgalli	Cockspur Hawthorn
Crataegus x lavallei	Lavalle Hawthorn
Crataegus phaenopyrum	Washington Hawthorn
Crataegus viridis 'Winter King'	Winter King Green Hawthorn
Fraxinus pennsylvanica 'Marshall Seedless'	Marshall Seedless Green Ash
Fraxinus pennsylvanica 'Patmore'	Patmore Green Ash
Fraxinus pennsylvanica 'Summit'	Summit Green Ash
Fraxinus pennsylvanica 'Urbanite'	Urbanite Green Ash
Ginkgo biloba 'Princeton Sentry'	Princeton Sentry Ginkgo
Gleditsia triacanthos inermis 'Moraine'	Moraine Thornless Honeylocust
Gleditsia triacanthos inermis 'Shademaster'	Shademaster Thornless Honeylocust
Gymnocladus dioicus	Kentucky Coffeetree

Koelreuteria paniculata	Goldenraintree
Liquidambar styraciflua 'Moraine' Sweetgum	Moraine American
Liquidambar styraciflua 'Variegata'	Variegated American Sweetgum
Malus floribunda	Japanese Crabapple
Malus hupehensis	Tea Crabapple
Malus sargentii	Sargent Crabapple
Malus 'Adams'	Adams Crabapple
Malus 'Centurion'	Centurion Crabapple
Malus 'Coralburst'	Coralburst Crabapple
Malus 'Donald Wyman'	Donald Wyman Crabapple
Malus 'Harvest Gold'	Harvest Gold Crabapple
Malus 'Molten Lava'	Molten Lava Crabapple
Malus 'Professor Sprenger'	Professor Sprenger Crabapple
Malus 'Robinson'	Robinson Crabapple
Malus 'Snowdrift'	Snowdrift Crabapple
Malus 'Sugar Tyme'	Sugar Tyme Crabapple
Ostrya virginiana	American Hophornbeam
Platanus x acerifolia 'Bloodgood'	Bloodgood London Planetree
Platanus x acerifolia 'Columbia'	Columbia London Planetree
Platanus x acerifolia 'Liberty'	Liberty London Planetree
Pyrus calleryana 'Aristocrat'	Aristocrat Callery Pear
Pyrus calleryana 'Autumn Blaze'	Autumn Blaze Callery Pear
Pyrus calleryana 'Chanticleer'	Chanticleer Callery Pear
Pyrus calleryana 'Redspire'	Redspire Callery Pear
Quercus imbricaria	Shingle Oak
Quercus rubra	Northern Red Oak
Syring reticulata	Japanese Tree Lilac
Taxodium disticum	Baldcypress
Tilia americana 'Redmond'	Redmond America Linden
Tilia cordata (numerous cultivars)	Littleleaf Linden
Tilia x euchlora	Crimean Linden
Tilia tomentosa	Silver Linden
Ulmus 'Camperdownii'	Camperdown Weeping Elm
Ulmus parvifolia	Lacebark Elm

Avoid the following:

Malus 'Almey'	Almey Crabapple
Malus 'American Beauty'	American Beauty Crabapple
Malus 'Bechtel'	Bechtel Crabapple
Malus 'Flame'	Flame Crabapple
Malus 'Hopa'	Hopa Crabapple
Malus 'Royalty'	Royalty Crabapple
Malus 'Spring Snow'	Spring Snow Crabapple
Malus 'Van Eseltine'	Van Eseltine Crabapple
Pyrus calleryana 'Bradford'	Bradford Callery Pear

Dr. Mark H. Brand
Cooperative Extension Specialist, Nursery Crops
Department of Plant Science
University of Connecticut

Appendix C - Stream Survey Dta of the Ten Mile River

DEP Fisheries Division Policy State ment: Riparian Corridir Protection

Position Statement: Utilization of 100 Foot Buffer Zones to Protect Riparian Areas in CT

STREAM NAME : TATETUCK BROOK SITE #: 2174
SITE DESCRIPTION: BELOW EVERETT RD, EASTON, BHC PROP. DIRECTLY BELOW SITE 2121
SAMPLE LENGTH : SAMPLE DATE: 08/21/1990

PHYSICAL			CHEMICAL	MEAN	STD
AIR TEMP. . . .	:20.0	(C)	DISSOLVED OXYGEN (mg/l). . :		
WATER TEMP. . .	:16.0	(C)	pH . . . . . :		
VELOCITY. . . .	:	(m/s)	COND . . . . . (uS/cm3). . :		
DISCHARGE . . .	:	(m3/s)	ALKALINITY .(mg CaCO3 eq/l):		

	MEAN	STD	
WIDTH.	:		(m)
DEPTH.	:		(cm)

DOMINANT SUBSTRATE TYPE. . :			POOL/RIFFLE RATIO . .:	
TYPE THREE SUBSTRATE . . . :		(%)	AIR/WATER TEMP. RATIO:	1.25
EMBEDDEDNESS OF TYPE THREE :		(%)		
OVERHEAD CANOPY. . . . . :		(%)		
INSTREAM SHELTER . . . . . :		(m2)		

BIOLOGICAL

SPECIES	POPULATION (Present)
Lepomis macrochirus	
Salvelinus fontinalis	
Rhinichthys atratulus	
Unknown Centrarchid	
Lepomis gibbosus	
Etheostoma olmstedi	
Catastomus commersoni	
Ictalurus nebulosus	

STREAM NAME : TEN MILE RIVER SITE #: 2015
SITE DESCRIPTION: UPSTREAM OF WEST JOHNSON RD, MILLDALE. STOCKED, MEANDERING MEADOW, DEEP HOLES
SAMPLE LENGTH : 150. SAMPLE DATE: 07/19/1990

PHYSICAL			CHEMICAL	MEAN	STD
AIR TEMP. . . .	:31.0	(C)	DISSOLVED OXYGEN (mg/l). . :	7.6	0.32
WATER TEMP. . .	:26.0	(C)	pH . . . . . :	7.0	0.06
VELOCITY. . . .	: 0.225	(m/s)	COND . . . . . (uS/cm3). . :	216.0	1.73
DISCHARGE . . .	: 0.437	(m3/s)	ALKALINITY .(mg CaCO3 eq/l):	60.3	0.64

	MEAN	STD	
WIDTH.	: 7.2	1.4	(m)
DEPTH.	: 64.4	43.86	(cm)

DOMINANT SUBSTRATE TYPE. . :	1		POOL/RIFFLE RATIO . .:	2000.00
TYPE THREE SUBSTRATE . . . :	0.00	(%)	AIR/WATER TEMP. RATIO:	1.19
EMBEDDEDNESS OF TYPE THREE :	31.67	(%)		
OVERHEAD CANOPY. . . . . :	53.00	(%)		
INSTREAM SHELTER . . . . . :	838.04	(m2)		

BIOLOGICAL

SPECIES	POPULATION SIZE (Number/ha)	STANDARD ERROR (Number/ha)
Etheostoma olmstedi	250	2.04
Anguilla rostrata	18	4.63
Semotilus corporalis	9	3.09
Esox americanus	64	4.63
Lepomis gibbosus	18	4.63
Lepomis auritus	111	5.85
Lepomis macrochirus	37	5.29
Catastomus commersoni	287	6.38
Salmo trutta	9	9.27

DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND FISHERIES DIVISION

POLICY STATEMENT
RIPARIAN CORRIDOR PROTECTION

I. INTRODUCTION, GOALS, AND OBJECTIVE

Alteration and exploitation of riparian corridors in Connecticut is a common event that significantly degrades stream water quality and quantity. Inasmuch as riparian ecosystems play a critical role in maintaining aquatic resource productivity and diversity, the Inland Fisheries Division (Division) recognizes that rigorous efforts are required to preserve, protect, and restore these valuable resources. Consequently, a riparian corridor protection policy has been developed to achieve the following goals and objective:

Goals

Maintain Biologically Diverse Stream and Riparian Ecosystems, and

Maintain and Improve Stream Water Quality and Water Quantity.

Objective

Establish Uniform Riparian Corridor Buffer Zone Guidelines.

II. DEFINITIONS

For the purpose of implementing a statewide riparian corridor protection policy, the following definitions are established:

Riparian Corridor: A land area contiguous with and parallel to an intermittent or perennial stream.

Buffer Zone: An undisturbed, naturally vegetated area adjacent to or contained within a riparian corridor that serves to attenuate the effects of development.

Perennial Stream: A stream that maintains a constant perceptible flow of water within its channel throughout the year.

Intermittent Stream: A stream that flows only in direct response to precipitation or which is seasonally dry.

III. RIPARIAN FUNCTION

Naturally vegetated riparian ecosystems perform a variety of unique functions essential to a healthy instream aquatic environment. The delineation and importance of riparian functions are herein described. Vegetated riparian ecosystems:

* Naturally filter sediments, nutrients, fertilizers, and other nonpoint source pollutants from overland runoff.

* Maintain stream water temperatures suitable for spawning, egg and fry incubation, and rearing of resident finfish.

* Stabilize stream banks and stream channels thereby reducing instream erosion and aquatic habitat degradation.

* Supply large woody debris to streams providing critical instream habitat features for aquatic organisms.

* Provide a substantial food source for aquatic insects which represent a significant proportion of food for resident finfish.

* Serve as a reservoir, storing surplus runoff for gradual release into streams during summer and early fall base flow periods.

IV. RIPARIAN CORRIDOR BUFFER ZONE GUIDELINES

Recognizing the critical roles of riparian corridors, the Division provides buffer zone guidelines that are designed to bring uniformity and consistency to environmental review. The guidelines are simple, effective, and easy to administer. The following standard setting procedure should be used to calculate buffer zone widths.

Perennial Stream: A buffer zone 100 feet in width should be maintained along each side.

Intermittent Stream: A buffer zone 50 feet in width should be maintained along each side.

Buffer zone boundaries should be measured from either, (1) edge of riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or (2) in the absence of a riparian wetland, the edge of the stream bank based on bank–full flow conditions.

The riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition. All activities that pose a significant pollution threat to the stream ecosystem should be prohibited.

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths and allowable development uses within these areas, local authorities should be encouraged to adopt the more restrictive regulations and policies.

12/13/91
Date

James C. Moulton
Acting Director

POSITION STATEMENT
UTILIZATION OF 100 FOOT BUFFER ZONES TO PROTECT RIPARIAN AREAS IN CONNECTICUT

BY
BRIAN D. MURPHY
TECHNICAL ASSISTANCE BIOLOGIST
INLAND FISHERIES DIVISION

I. INTRODUCTION

One tenet of the Inland Fisheries Division Policy on Riparian Corridor Protection is the utilization of a 100 foot buffer zone as a minimum setback along perennial streams. The adoption of such a policy is sure to be controversial. Laymen, developers and natural resource professionals alike will ask questions such as: Why was a standard setting method adopted? What's magical about 100 feet? Will 100 feet be sufficiently protective, or will it be overly protective? In response, this paper outlines the ramifications of adopting a riparian corridor policy including the use of a 100 foot buffer zone.

II. STANDARD SETTING VERSUS SITE SPECIFIC BUFFER ZONES

There are two approaches for determining buffer zone width; standard setting and site specific. Standard setting methods define an area extending from the streambank edge or highwater mark to some landward fixed point boundary. Site specific methods utilize formulas that incorporate and consider special site specific land characteristics, hence, the calculation of a variable width buffer zone. In both case, buffers are employed to define an area in which development is prohibited or limited.

A major advantage of standard setting methods is that they are easy to delineate and administer, thereby improving the consistency and quality of environmental assessments. Furthermore, valuable staff time would not be required to determine site specific buffer zones along each and every watercourse of concern.

The exact width of a buffer zone required for riparian corridor protection is widely disputed (Bottom et al. 1985 and Brinson et al. 1981). Buffer width recommendations found in the literature vary from as little as 25 feet to as great as 300 feet (Palfrey et al. 1982). The 100 foot buffer is widely accepted in Connecticut having been adopted by numerous inland wetland and conservation commissions as an appropriate minimum setback regulation for streambelts. In addition, Division staff have been recommending the utilization of the 100 foot buffer zone to protect streambelts since the early 1980's. Scientific research has not been generated to dispute the adequacy of utilizing 100 foot buffer zones to protect Connecticut's riparian corridors. In fact, to ensure that riparian functions are not significantly altered, recent scientific information points towards maintaining buffer zones that would be at a minimum, 100 feet in width (see section III).

Site specific methods define buffer widths according to the character and sensitivity of adjacent streamside lands. These buffer widths, also referred to as "floating buffers," consider physical site characteristics such as slope, soil type, and vegetative cover. The advantage of site specific methods is that buffer widths are designed using site characteristics and not an arbitrary predetermined width. Unfortunately, there is no "one" universally accepted formula or model and none have been developed for use in Connecticut. Most formulas are based on the degree to which sediment can be removed or filtered by natural vegetation, thus, the primary useage is sediment control. Other weaknesses of site specific techniques are (1) all areas must be evaluated on a case-by case basis and, (2) the subjectivity of different techniques (i.e. if the evaluation technique is inadequate, the buffer width will also be inadequate).

Additionally, these formulas only concentrate on one specific riparian function at a time and do not take into account multiple riparian functions, especially those of inland fisheries values as discussed in Section III. Consequently, site specific formulas approach riparian function on a single dimension rather than taking a more realistic, holistic approach.

In the absence of a scientific model to determine buffer widths suitable to protect Connecticut's riparian corridors, the utilization of a standard setting method is environmentally and politically prudent.

III. RIPARIAN FUNCTION

To assess the efficacy of a 100 foot buffer zone, the literature was searched to identify studies which have applied a quantitative approach to buffer width determination. Literature was searched for studies which both support and dispute the 100 foot zone. The following is a summary "by riparian function" of quantitative studies which assess buffer widths.

Sediment Control

Width, slope and vegetation have been cited as important factors in determining effectiveness of buffer zones as sediment filters (Karr and Schlosser 1977). Wong and McCuen (1981), who developed and applied a mathematical model to a 47 acre watershed, found that a 150 foot zone along a 3% slope reduced sediment transport to streams by 90%. Mannering and Johnson (1974) passed sediment laden water through a 49.2 foot strip of bluegrass and found that 54% of sediment was removed from the water. Trimble and Sartz (1957) developed recommendations as to width of buffer areas between logging roads and streams to reduce sediment load. They determined a minimum strip of 50 feet was required on level land with the width increasing 4 feet for each 1% slope increase. Buffer widths as determined by Trimble and Sartz (1957) have been characterized as evaluated guesses rather than empirically defined widths (Karr and Schlosser 1977). Rodgers et al. (1976) state that slopes greater than 10% are too steep to allow any significant detention of runoff and sediment regardless of buffer width. After a critical review of the literature, Karr and Schlosser (1977) determined that the size and type of vegetative buffer strip needed to remove a given fraction of the overland sediment load cannot be universally quantified. Existing literature does suggest that 100 foot riparian buffers will assist with sediment entrapment, although efficacy will vary according to site conditions.

Temperature Control

Brown and Brazier (1973) evaluated the efficacy of buffer widths required to ameliorate stream water temperature change. They concluded that angular canopy density (ACD), a measure of the ability of vegetation to provide shading, is the only buffer area parameter correlated with temperature control. Results show that maximum angular canopy density or maximum shading ability is reached within a width of 80 feet. Study sites were 9 small mountain streams in Oregon that contained a conifer riparian vegetative complex. Whether or not maximum angular canopy density is reached within 80 feet in a typical Connecticut deciduous forest riparian zone is doubtful. Tree height in Connecticut riparian zones is smaller than in Oregon (Scarpino, personal communication), therefore buffers greater than 80 feet in width would be required for temperature maintenance in Connecticut.

Nutrient Removal

Nutrient enrichment is caused by phosphorous and nitrogen transport from, among other things, fertilized lands and underground septic systems. Most research on nutrient enrichment has focused on overland surface flow. Karr and Schlosser (1977) report that 88% of all nitrogen and 96% of all phosphorous reaching watercourses in "agricultural watersheds" were found to be attached to sediment particles; thus, successful nutrient removal can be accomplished through successful sediment removal. There are conflicting reports on the ability of buffer widths to remove nutrients with most research being tested on grass plots. Butler et al. (1974) as cited by Karr and Schlosser (1977) found that a 150 foot buffer width of reed canary grass with a 6% slope caused reductions in phosphate and nitrate concentrations of between 0–20%. Wilson and Lehman (1966) as cited by Karr and Schlosser (1977) in a

study of effluent applied to 300 m grass plots found that nitrogen and phosphorous concentrations were reduced 4 and 6%, respectively. Studies on subsurface runoff as cited in Clark (1977) found high concentrations of nitrates at 100 feet from septic systems with unacceptable levels at 150 feet. Clark (1977) recommended that a 300 foot setback be used whenever possible, with a 150 setback considered adequate to avoid nitrate pollution. Environmental Perspective Newsletter (1991) states that experts who commonly work with the 100 foot buffer zone set by the Massachusetts Wetlands Protection Act are increasingly finding that it is insufficient since many pollutants routinely travel distances far greater than 100 feet with nitrate-nitrogen derived from septic systems moving distances of greater than 1000 feet. Research indicates that the adoption of 100 foot buffer widths for Connecticut riparian zones will assist with the nutrient assimilation; albeit, complete removal of all nutrients may not be achieved.

Large Woody Debris

The input of large woody debris (LWD) to streams from riparian zones, defined as fallen trees greater than 3 m in length and 10 cm in diameter has been recently heralded as extremely critical to stream habitat diversity as well as stream channel maintenance. Research on large woody debris input has mainly been accomplished in the Pacific Northwest in relation to timber harvests. Murphy and Koski (1989) in a study of seven Alaskan watersheds determined that almost all (99%) identified sources of LWD were within 100 feet of the streambank. Bottom et al. 1983 as cited by Budd et al. (1987) confirm that in Oregon most woody structure in streams is derived from within 100 feet of the bank. Based on research done within old-growth forests, the Alaska region of the National Marine Fisheries Service, recognizing the importance of LWD to salmonid habitat, issued a policy statement in 1988 advocating the protection of riparian habitat through the retention of buffer strips not less than 100 feet in width (Murphy and Koski 1989). All research findings support the use of a 100 foot buffer zone in Connecticut for large woody debris input.

Food Supply

Erman et al. (1977) conducted an evaluation of logging impacts and subsequent sediment input to 62 streams in California. Benthic invertebrate populations (the primary food source of stream fishes) in streams with no riparian buffer strips were compared to populations in streams with buffer widths of up to 100 feet. Results showed that buffer strips less than 100 feet in width were ineffective as protective measures for invertebrate populations since sediment input reduced overall diversity of benthic invertebrates. Buffer strips greater than 100 feet in width afforded protection equivalent to conditions observed in unlogged streams. The ultimate significance of these findings is that fish growth and survival may be directly impacted along streams with inadequate sized riparian buffer zones. All research supports the feasibility of implementing a 100 foot buffer zone in Connecticut to maintain aquatic food supplies.

Streamflow Maintenance

The importance of riparian ecosystems in terms of streamflow maintenance has been widely recognized (Bottom et al. 1985). In Connecticut, riparian zones comprised of wetlands are of major importance in the hydrologic regime. Riparian wetlands store surplus flood waters thus dampening stream discharge fluctuations. Peak flood flows are then gradually released reducing the severity of downstream flooding. Some riparian wetlands also act as important groundwater discharge or recharge areas. Groundwater discharge to streams during drier seasonal conditions is termed low flow augmentation. The survival of fish communities, especially coldwater salmonid populations is highly dependent upon low flow augmentation (Bottom et al. 1985). Research, although documenting the importance of riparian zones as areas critical to streamflow maintenance, has not investigated specific riparian buffer widths required to provide the most effective storage and release of stream flows.

IV. OTHER POLICY CONSIDERATIONS

Measurement Determination

The proposed policy states that buffer zone boundaries should be measured from either the edge of the riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or in the absence of a riparian wetland, the edge of the streambank based on bank-full flow conditions. This boundary demarcation is absolutely necessary to ensure that all riparian wetlands are protected. For example, if all measurements were to start from the perennial stream edge and extend landward for a distance of 100 feet, many riparian zones that contain expansive wetlands greater than 100 feet in width would be left unprotected.

Also, since boundary demarcation includes wetland delineation, the ultimate width of the buffer will vary according to site specific features. Consequently, buffer width determination as stated by Division policy is a "hybridization" of both standard setting and site specific methods. This hybridization of methods is advantageous since it acknowledges the sensitivity of streamside wetlands.

Home Rule

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths, local authorities would be encouraged to adopt the more restrictive regulations and policies. This feature incorporates flexibility to acknowledge the importance of local "home rule" regulations or policies already in accepted practice. Conversely, towns and cities without accepted policies and regulations could choose to enact the Division policy.

Allowable Uses in Buffer Zones

The Division policy states that "the riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition and that all activities that pose a significant pollution threat to the stream ecosystem should be prohibited." In essence, the buffer zone becomes an area where no development should be allowed. For this policy to be effective, there should be no exceptions, a blanket restriction of all uses would be recommended. Further clarification and more precise definitions of allowable uses will, however, be required in the future if the policy evolves into a departmental regulation.

Recently, the Connecticut Supreme Court has ruled that local agencies can prohibit specific development within buffer zones. The *Lizotte v. Conservation Commission of the Town of Somers, 216 Conn.320 (1990)* decision ruled that the construction or maintenance of any septic system, tank, leach field, dry well, chemical waste disposal system, manure storage area or other pollution source within 150 feet of the nearest edge of a watercourse or inland wetland's seasonal high water level can be prohibited (Wetlands Watch 1990). If this decision is a precursor of the future, Connecticut courts will continue to the support the use of buffers, especially those which restrict or prohibit detrimental activities.

V. CONCLUSIONS

The following actions are required to preserve, protect, and restore Connecticut's riparian corridors:

1. The Inland Fisheries Division needs to adopt and implement the proposed policy so that staff can use it as a guideline to assist cities, towns, developers and private landowners with making sound land use decisions. This policy will act to solidify a collective position concerning riparian corridor protection.

2. While the proposed policy in its "current form," represents a recommendation from the CTDEP Inland Fisheries Division, the ultimate goal of the Division should be to progressively implement this policy as either a CTDEP regulation or State of Connecticut statute.

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NOTES

ABOUT THE TEAM

The King's Mark Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a variety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, foresters, soil specialists, engineers and planners. The ERT operates with state funding under the supervision of the King's Mark Resource Conservation and Development (RC&D) Area — an 83 town region.

As a public service activity, the Team is available to serve towns and/ or developers within the King's Mark RC&D Area - free of charge.

PURPOSE OF THE TEAM

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

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

REQUESTING A REVIEW

Environmental reviews may be requested by the chief elected official of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Environmental Review Request Forms are available at your local Soil and Water Conservation District and through the King's Mark ERT Coordinator. This request form must include a summary of the proposed project, a location map of the project site, written permission from the land owner/developer allowing the Team to enter the property for purposes of review and a statement identifying the specific areas of concern the Team should investigate. When this request is approved by the local Soil and Water Conservation District and the King's Mark RC&D Executive Committee, the Team will undertake the review. At present, the ERT can undertake approximately two (2) reviews per month.

For additional information and request forms regarding the Environmental Review Team please your local Soil and Water Conservation District or the ERT Coordinator: 203-345-3977, King's Mark ERT, P.O. Box 70, Haddam, Connecticut 06438.

Judy Wilson, Wildlife Biologist
DEP - Western District Headquarters
485-0226
(Late report, distributed at close of public hearing)

WILDLIFE RESOURCES

Habitat Types and Species

The 176 acre parcel contains 99 acres of wetlands along with a variety of other wildlife habitats types, including forest, and reverting old field. Because of the diversity and quality of habitat types, including the varied and productive wetland habitats on the site, the area currently provides good to excellent wildlife habitat.

Based on the habitat types, a wide variety of wildlife could be expected to utilize this area to serve all their needs, while many more would find it a place to meet some requirements. Species which could utilize an area such as this for some or all of their requirements include, deer, ruffed grouse, weasel, raccoon, otter, fox, coyote, various types of birds including warblers, woodpeckers, sparrows and many, many others. (An extensive list was provided by Richard W. Carroll, this information was given to Team members by the Town) A variety of reptiles and amphibians could be expected to use the site also, including red spotted newt, spotted salamander, redback salamander and some of the less common mole salamanders, such as the marbled salamander. (Hank Gruner of the Hartford Science Museum gave additional information on potentially resident species of reptiles and amphibians) This list is based on the habitat types observed. It is merely a brief list indicating the range of species that would typically occupy these habitat types.

Impacts on Wildlife

The variety of wetland types, Ten Mile River floodplain, forested wetland, temporary and permanent pools, offer important wildlife habitat to a variety of species. Although much of the wetlands will be set aside as open space, the development of the uplands will still have an impact on wetland habitats for the following reasons:

■ First, many species that use wetlands also require upland habitat. This would include not only reptile and amphibian species, but also many birds and mammals.

■ Secondly, storm water runoff will be increased and the potential contaminants it contains (oils, lawn fertilizers, etc.) will find their way into wetlands via the storm water drainage. (To conserve wetland wildlife habitat, it is preferable to have all detention basins located out of the wetland areas).

■ Third, may of the temporary and permanent small ponds are either in the developed areas or very close. This will greatly diminish their use by wildlife especially for species like marbled salamander and the wood frog who use temporary pools on a seasonal basis for breeding and then migrate into upland forested areas.

In addition, much of the development (including areas cleared for lawns, etc.) is within 50 feet of the wetland boundary. Ideally, a buffer of undisturbed vegetation left between any wetland and any development or disturbance including lawns is recommended. This buffer of vegetation provides some habitat, helps to filter sediment and reduces disturbance to the wetlands. It helps conserve some small measure of usefulness of the river/wetlands for wildlife.

The fairly extensive expanse of mature forest, with its thick and well developed understory in most areas, does provide habitat for a variety of birds. According to a report furnished by Richard W. Carroll, over forty species were recorded during a spring survey he conducted. Some of those reportedly seen include species from a group of birds (commonly referred to as neo-tropical migrants) which require larger expanses of unbroken forest to nest in. Certainly, the loss of the majority of the upland forest with only the wetland forest remaining will have a negative effect on these birds.

It is well established that providing wildlife corridors or linear pathways helps to preserve habitat and provides areas for wildlife to travel through. It is important that the habitat along the Ten Mile River be left undeveloped in order to help provide a corridor along the river.

Although much of the wetland will be set aside as open space, most of it cannot be developed for residential development anyway. It is always preferable to set aside a combination of habitat types, including forest, field, etc. Open space areas should be connected and ideally should be connected with open space areas outside of the development area. The open space area is more valuable to wildlife if not traversed by roads, which may impede the movements of wildlife at times. Setting aside a combination of habitat types in conjunction with wetlands is desirable.

As with any development of an undeveloped area, the impact on wildlife habitat will be negative. The impact at this site will probably be extensive because of the density of the development, addition of roads, driveways, and numerous wetland crossings. Large portions of the area would be broken up and lost in the construction of homes, parking areas, and walkways. Additionally, there would be the loss and change in habitat where cover is cleared for lawns and landscaping. A third impact is the increased human presence, vehicular traffic, and numbers of free roaming dogs and cats. This could drive less tolerant species from the immediate area of development and even from areas where there has been no physical change. In general, the value of the area for wildlife habitat would correspondingly decrease as the amount of development in the area increased.

Certain species which are adaptable to man's activities and the habitat changes may increase and associated nuisances may occur. Species sensitive to man's presence or the changes that he makes at the site will either move out or perish.

Additional Considerations

In order to reduce the impact to wildlife habitat the following options should be considered:

- Reduce the density of the development and increase the lot size.

- Use cluster development so that more upland habitat could be conserved along with the wetlands.

- Develop only the western portion of the property, the area off Jarvis Street and use the remainder for open space.

In a small but heavily developed and populated state like Connecticut, where available habitat continues to decline on a daily basis, it is critical to maintain and enhance where possible existing wildlife habitat.