Gauthier Par - 3 Golf Course

Preston, Connecticut

FEBRUARY 1996

EASTERN CONNECTICUT ENVIRONMENTAL REVIEW TEAM REPORT

Eastern Connecticut Resource Conservation and Development Area, Inc.

Gauthier Par - 3 Golf Course
Preston, Connecticut

Environmental Review Team Report

Prepared by the
Eastern Connecticut Environmental Review Team
of the Eastern Connecticut Conservation & Development Area, Inc.
Haddam, Connecticut

for the

Preston Inland Wetlands and Watercourses Agency

February 1996

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

Acknowledgements

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

The ERT met and field checked the site on Thursday, February 1, 1996. Team members participating on this review include:

Nicholas Bellantoni	State Archaeologist UCONN - CT Museum of Natural History (860) 486-5248
Javier Cruz	Soil Conservationist USDA - Natural Resources Conservation Service (860) 887-4163
Mark Edmonds	District Conservationist USDA - Natural Resources Conservation Service (860) 887-4163
John Hirschfeld	Plant and Soil Ecologist DEP - Water Resources Division Permitting, Enforcement and Remediation (860) 424-3893
Chuck Lee	Lake Specialist DEP - Water Resources Division Lake Management Program
Laurence Marsicano	Academic Research Associate Connecticut College Department of Botany (860) 439-2155
Brian Murphy	Fisheries Biologist DEP - Inland Fisheries Division (860) 295-9523
Nancy Murray	Biologist/Environmental Analyst III DEP - Natural Resources Center (860) 424-3540
Dave Poirier	Archaeologist CT State Historical Commission (860) 566-3005

Milly Powell	Geologist UCONN Department of Geology and Geophysics (860) 486-1382
James Rabbit	Senior Planner, AICP Southeastern CT Council of Governments (860) 889-2324
Judy Singer	Groundwater Manager, RPG DEP - Waste Management Bureau Pesticide Management Division (860) 424-3326
Chris Vann	Wildlife Technician DEP - Wildlife Division (860) 424-3496

Prior to the review day, each Team member received a summary of the proposed project, and location and soils maps. During the field review the Team members received a plan, additional written materials and a video from the applicants. The Team met with and were accompanied by a member of the Inland Wetlands and Watercourses Commission and the applicant and his son. 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 designs or detailed solutions to development problems. The Team does not recommend what final action should be taken on a proposed project - all final decisions rest with the Town and landowner/applicant. 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 developer and the Town. The results of this Team action are oriented toward the development of better environmental quality and the long-ter economics of land use.

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in making your decision on this proposed golf course.

If you require additional information, please contact:

Elaine Sych, ERT Coordinator
Eastern Connecticut RC&D Area, Inc.
P.O. Box 70, 1066 Saybrook Road
Haddam, CT 06438
(860) 345-3977

Introduction

An environmental review was requested by the Preston Inland Wetland and Watercourses Agency for the proposed Gauthier Par-3 Golf Course.

The 10.75 acre site is located on Route 164 between North Shore Road, Amos Road and Amos Lake. The applicant proposes to construct a par-3 9 hole chip and putt golf course on the site. The site is presently a mown hay field/pasture with ±2 acre pond, which was excavated in 1986.

The ERT was asked to review the proposal due to its location adjacent to Amos Lake and the concerns of the town and lake association for potential negative impacts to the area. Specific concerns raised include the impact of fertilizers and pesticides on water quality of the site and lake, and the effects of the pond drawdown on neighboring wells and the lake. This report primarily provides a description of on-site natural resources and presents concerns, potential impacts, recommendations and planning, management and land use guidelines. Team members present information specifying the type and level of plans necessary for the town to have in order to make an informed decision on this project. It should also be a benefit to the applicant by pointing out omissions in his application and the need for further details.

LOCATION MAP

Scale 1" = 2000'

Approximate Site

Geology and Hydrology

Bedrock Geology

The rocks in the immediate vicinity of Amos Lake are part of the Quinebaug Formation, formed more than 440 million years ago. The rock types are garnet-hornblende gneiss mixed with granitic gneiss. They are not exposed at the surface in the study area, but may be seen east of Amos Lake or north of Route 165, on the south side of Prospect Hill (Dixon and Felmley, 1986). There is an old fault that is inferred to run through Amos Lake that passes less than 500 feet southeast of the study area. The fault trends NW-SE, and was active in Silurian times approximately 400 million years ago, or possibly later. There is no evidence to suggest that the fault is active at present. Rocks were thrust from the east over the Quinebaug formation along the fault. These rocks, called the Tatnic Hill Formation, are older than the Quinebaug rocks. Their composition is predominantly garnet-biotite gneiss and rusty-weathering gneiss.

The eastern part of the Jewett City Quadrangle, east of Pachaug Pond, has a major regional fault, known as the Lake Char Fault. This fault represents the boundary between the old North America plate and a land called "Avalonia" that was formerly off the coast of Africa. These plates welded together to form the supercontinent of Pangaea about 250 million years ago (Bell, 1985). At that time, a huge mountain range like the Alps formed, which has since been eroded away. The rocks we see at the surface now are the roots of that mountain range.

Surficial Geology

The study area is located near the northern margin of Amos Lake. During glacial times, about 10-15 thousand years ago, Amos Lake was a larger glacial lake. There are very thick deposits of sand on the north end of Amos Lake in the study area. These deposits are the result of sediment-laden glacial meltwater depositing its sediment as a delta into the lake. Bedrock in the study area is at an elevation of about 50 to 100 feet above sea level. Since the elevation of Amos Lake is about 129 feet above sea level, this indicates a very thick deposit. In support of this, well PS 33, drilled in

the study area, shows about 2 feet of gravel overlying 120 feet of fine sand. (Stone, 1978).

The small pond at the center of the study area is a kettle, a pond in a depression left by melted ice. A large chunk of ice sat in the glacial outwash plain and partially buried by sediment. After the ice melted, a depression was left, which became a pond and slowly filled up with peat. According to the present owners, at least 17 feet of peat was excavated from the pond in 1986.

Implications for the Hydrology

The study area is located at the site of a glacial delta consisting of 120 feet of fine-grained sand. This sand can be expected to be an excellent aquifer. The water table in the study area is quite high; 129 feet at Amos Lake, and higher at the pond. Given these facts, it is probable that the wells of the local homeowners may be shallow wells, which could easily be affected by a drawdown in the water table. It is not clear, however, that 6 feet of drawdown in the pond would be sufficient to make a neighbors' well go dry. However, measures could be taken to minimize this potential adverse impact. Measures could include monitoring groundwater levels in the neighbors wells during the drawdown period. Drawing the pond down 6 feet would not be expected to impact deep bedrock floored wells.The applicant claims that he has lowered the level in the pond by 6 feet several times in the past 10 years with no adverse impacts reported by any neighbors.

The nature of the topography is such that the pond drains a small area, which includes most of the proposed golf course. The present owner of the property has stated that there are strong springs which feed the pond below the water line. There are also several wetlands north of the study area which are at the pond elevation or above. From this information, it is reasonable to infer that the pond is primarily fed by groundwater, rather than a source for recharging groundwater. However, this could be confirmed by installing groundwater monitoring wells that would verify whether there is an up-gradient or down-gradient flow.

Any sediments or pollutants that enter the pond could be expected to either settle to the bottom of the pond or be discharged through the outlet to Amos Lake. From this reasoning, it seems that pollutants would not be likely to enter wells in the

area, but it would be more likely to enter Amos Lake by flow through the outlet. In any case, it is advisable to minimize the pollution potential because the circumstances can change depending on precipitation and discharge rates from local wells. Under any circumstances, there should be fairly rapid communication between ground water and surface water, because water flows relatively easily through sand deposits. Some baseline drinking water quality data from the neighbors drinking water wells (both shallow and deep wells) could be obtained for the purposes of measuring any water quality changes that may occur.

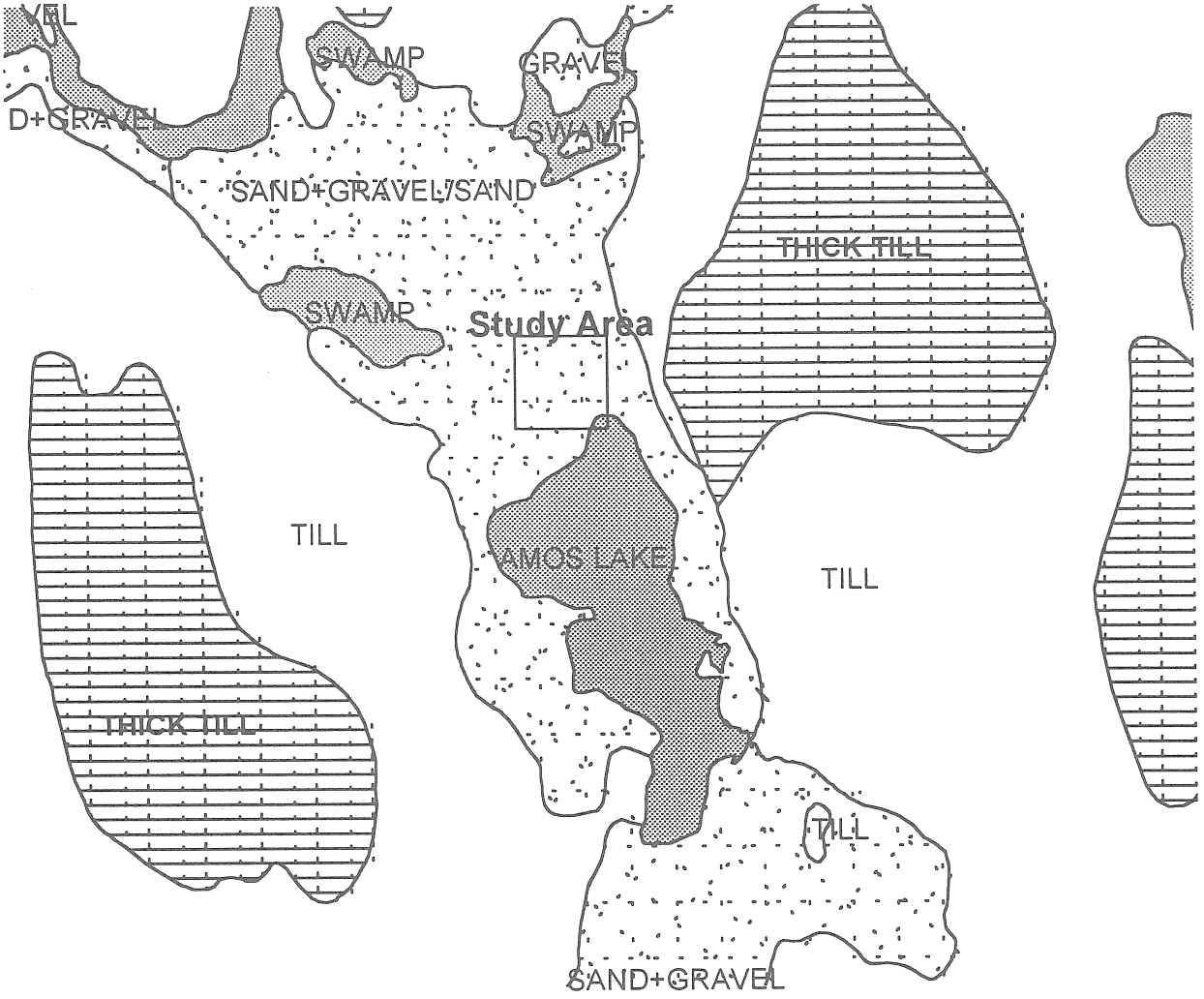
References

Bell, Michael, 1985. The Face of Connecticut: People, Geology, and the Land, Bulletin #110, State Geological and Natural History Survey of Connecticut, 196 pp.

Dixon, H. Roberta and J. Karen Felmley, 1986. Bedrock Geologic Map of the Jewett City Quadrangle, New London County, Connecticut, Geologic Quadrangle Map GQ-1575, U.S. Geological Survey.

Stone, Byron D., 1978. Surficial Geologic Map of the Jewett City Quadrangle, New London County, Connecticut, Geologic Quadrangle Map GQ-1434, U.S. Geological Survey.

Surficial Geology



Scale: 1 inch = 2000 feet

Data obtained from
CT Department of Environmental Protection via
University of Connecticut Map Library
World Wide Web site
Jan. 30, 1996

Soil Resources and Turfgrass Management

Preface

Intense management of turfgrass areas raises concerns about the potential for nutrient and pesticide transport through ground water and surface runoff. Golf course management requires the use of fertilizers (mainly nitrogen and phosphorus) and pesticides to maintain greens and fairways in acceptable conditions for golfers.

Before considering the potential effects fertilizer in runoff and ground water discharges could have on Amos Lake, the eutrophication process should be discussed.

Eutrophication is the increased productivity of a lake at a rate faster than under natural conditions. The most important nutrients causing lakes to shift to a more productive system are phosphorus and nitrogen.

Phosphorus has a unique biochemical role that is not duplicated by other nutrients; it is less available in the environment than other nutrients (carbon, nitrogen, etc.), and it does not have a gaseous phase, so it cannot leave the lake as a gas. As phosphorus loading increases the productivity of the lake, nitrogen often becomes the nutrient limiting plant growth.

Nitrogen only becomes a significant factor in the eutrophication process when the levels of biological productivity in the lake are already high from phosphorus loading. A lake without significant inputs of phosphorus would not maintain sufficient biological productivity for nitrogen to have a significant role in the eutrophication process.

The Connecticut Agricultural Experiment Station Bulletin 817, Chemical and Physical Properties of Connecticut Lakes (1984), classifies Amos Lake as mesotrophic. Reoccurring summer algae blooms have increased concerns about the advanced trophic status of the lake. (Please also refer to the Lake Management Review and the Amos Lake Water Quality sections for further discussion of lake conditions.)

A study conducted by Connecticut College indicates that Amos Lake started shifting to a higher trophic level in the 1960's and 70's. This was around the time when a lot of land use changes took place in the watershed. Some of the changes that probably induced the lake's trophic change include the filling of wetlands, the clearing of forest lands, and the increase of impervious areas.

The Connecticut College study found a large amount of phosphorus trapped in the sediments at the bottom of the lake. The lake also exhibits highly anoxic conditions below 7 meters. These conditions result in high releases of phosphorus from the sediments during stratification. Water quality data currently being collected by the University of Connecticut indicates that the release of phosphorus from the bottom sediments seems to be sufficient to cause Fall algae blooms.

All information available to USDA-NRCS office seems to indicate that Amos Lake is in an advanced trophic state. Although current Spring phosphorus data is not available, it is suspected that the lake is close to being eutrophic. As discussed above, additional nitrogen inputs into a productive lake would have the potential of increasing its level of productivity, further accelerating the eutrophication process. This would be the case for Amos Lake.

Frequent fertilization and irrigation of a golf course so close to the lake could result in additional contributions of nutrients into the lake. This could increase the productivity of the lake, depending on the quantity and frequency of nutrient flow toward the lake.

A golf course so close to the lake should incorporate the use of best management practices (BMP's) towards the reduction of fertilizer use, reduction of irrigation, and the reduction of nutrient losses in surface runoff and ground water. Proper management could significantly reduce the potential impacts the golf course could have on the lake.

Potential for Transport of Nutrients in Ground Water and Surface Runoff

Fertilizer applied on a golf course could be taken up by plants, volatilize (in the case of nitrogen), carried by surface water, adsorb to soil particles, degrade through biological processes, or leach through the soil profile into ground water. Once in the

ground water, nutrients move with the ground water until they reach a well or a discharge point, in this case Amos Lake.

The fate of applied fertilizer is a function of the following factors:

- Soil characteristics; permeability, cation exchange capacity, organic matter content, moisture, temperature, etc.
- Climatic conditions and slope of the site.
- Physiochemical characteristics of the fertilizer.
- Managements practices; objectives of fertilization plan, fertilizer application times and rates, irrigation practices, etc.
- Species of grass used; density of growth, root depth and density, thatch development, nutrient needs, etc.

The area is mapped in the New London County Soil Survey as Hinckley gravelly sandy loams 3 to 15% slopes. These are excessively drained soils with rapid to very rapid permeabilities, which is a concern because of their high leaching potential. The texture of these soils also makes them droughty, thus the potential demand for irrigation is higher. The organic matter content below 7 inches tends to be extremely low. These physical characteristics of the site make it a high risk for leaching problems, but a low risk for runoff problems. (See the enclosed Soils Report)

Nitrogen fertilizer is more mobile than phosphorus. It is also applied in larger quantities than phosphorus, and is found occurring naturally in larger amounts in the environment (air, water, and soils). Any management technique used to prevent the transport of nitrogen to the lake would also result in a reduction of phosphorus transport.

The type of fertilizer used must be considered in the management strategy. Slow release fertilizer (ie.- sulfur coated urea, isobutyldine diurea, urea formaldehyde, and plastic coated urea) tend to leach less than water soluble fertilizers (ie.- ammonium nitrate, potassium nitrate, urea, and calcium nitrate). This does not necessarily mean that water soluble fertilizers should not be used, but that applications should be carefully planned. The applicants are proposing to use

isobutyldine diurea fertilizer, which tends to have a low leaching potential.

The type of grass used for greens and fairways can have an effect on the amount of nutrients leaching into the ground and the amount of surface runoff leaving the site. Grasses with deep and thick rooting systems, high tillard density (usually associated with stolon growth), and that produce a thick thatch should be considered. Also, tolerance to drought and low soil fertility are desired attributes. The goal is to use grasses that would uptake nutrients efficiently, increase infiltration, reduce and retard surface runoff, and would require minimal fertilization.

The existing plan proposes the use of Penncross bent grass for the greens and Kentucky blue grass for the fairways. Knowing how tolerant these grasses are to low fertilization and dry conditions would help develop a better suited management plan. Information about tolerances and growth patterns of these grass varieties is usually available from the distributing companies.

The amount of fertilizer infiltrating the soil also depends on the application rate, the moisture content in the soil, and the amount of rainfall or irrigation following the application of fertilizer.

Ideally, fertilizer should be applied when the soil moisture content is below field capacity, and heavy rain events are not expected. Light irrigation immediately after fertilizer applications helps transport the nutrients slightly below the soil surface, where they are more likely to be utilized by the plants or adsorbed to the soil.

If irrigation or heavy rains follow an application of fertilizer on soils with a high moisture content, leaching of nutrients could be expected.

Soil moisture can be measured with tensiometers. Variations of this instrument are available through landscaping, irrigation, or gardening equipment distributors. A Gypsum block sensor system is also an efficient way of determining irrigation needs by measuring soil moisture. Gypsum blocks are also more practical in areas where mowing is frequent.

In a high risk site like this one, a fertilization management plan should be

developed to prevent water quality problems. Although information about the fertilizer to be used and planned irrigation of the greens was provided, a comprehensive fertilization plan that incorporates the use of Best Management Practices has not been developed. This plan should include:

1. A clear goal of minimizing the potential for nutrient transport to the lake.
2. Identification of areas that would be fertilized.
3. Use of grasses with tolerance to low fertility and dry conditions.
4. Use of soil tests and/or plant tissue tests to determine the need for fertilizer applications.
5. Consideration of climate conditions to determine timing of fertilizer applications and type of fertilizer to be used.
6. Use of soil moisture measuring instruments to determine need for irrigation.
7. A water quality monitoring plan to detect nutrient leaching or runoff problems. (See section on Potential Water Quality Impacts).

The course manager should be responsible for implementing the plan, and should maintain records that would be available to the town for review. Record keeping should include rates and timing of fertilizer applications, soil and plant tissue tests results, and water quality test results. Any changes in the plan should be reviewed by the town.

Potential Water Quality Impacts From Fertilization

Increases in nutrient transport from the proposed site into Amos Lake is going to be a function of the fertilization management practices used. Therefore, a detailed management plan is necessary to properly assess the potential impact the golf course could have on the lake.

The area of the proposed site is approximately 11 acres. According to the applicants, frequent fertilizer use will only occur in the greens, although this is not detailed in the proposal. This is a relatively small area when compared to the approximately 537.6 acres draining into the lake. If a nutrient management plan for

the golf course clearly reflects low nutrient losses from the site, it could be assumed that impacts to the lake would be negligible.

If the nutrient management plan does not satisfy the concerns about potential impacts to the lake from nutrient loading, water quality monitoring could be incorporated into the plan. The applicant's well is the only well down gradient from the proposed site for the golf course, and it is a shallow well. Water samples could be collected from this well to try to detect leaching of nutrients from the golf course and take corrective actions. Reference samples should be collected prior to the development of the golf course.

From the information provided to the ERT, it seems that precautions are being taken to reduce the potential of impacting the lake from fertilization of the golf course. It would be of benefit to have a detailed management plan so that town officials and concerned agencies can follow up with the management of the site.

Potential for Transport of Pesticides

Pesticides should not be a concern in this site because the applicants are not planning to use them. The decision to eliminate pesticides from the management of the golf course might result in pest problems on the greens. If pest problems arise, some type of remediation would follow. The applicants have stated that they would consider replacing the greens before considering use of pesticides.

Replacement of the greens would involve some land disturbance. The applicants are proposing to use mature sod; therefore, soil exposure to erosion should be brief and should not be a concern. The procedure for the replacement of the greens, the disposal of the old greens, and erosion and sediment control measures (if needed) should be described in the management plan.

If at some point pesticides are to be used, the following information should help assess the potential impacts.

The same factors affecting the transport of nutrients affect the transport of pesticides. The difference between assessing nutrient and pesticide transport is the chemical characteristics of the components or active ingredients in the pesticides.

Each of these chemicals has a measurable adsorption coefficient, which is an indicator of the chemical's mobility in the soil. Pesticides also have halflife, which is the approximate time it would take for half of the mass of the chemical to naturally decay.

Soil adsorption is expressed as the soil adsorption coefficient (Koc). A Koc of less than 100 indicates that the chemical is very mobile in the soil, a Koc between 100 and 1,000 indicates that the chemical is moderately mobile in the soil, and a Koc greater than 1,000 indicates that the chemical is not mobile.

If a chemical has a half-life of less than 30 days it is considered non-persistent, if it has a half life of 30 to 120 days it is considered moderately persistent, and if it has a half life of over 120 days it is considered persistent.

These characteristics and some hydrogeological information (permeability, bulk density, porosity, hydraulic gradient) can be used to estimate transport of these chemicals. But not enough information is available to conduct such an assessment.

Summary

The proposed site is at high risk for loss of nutrients and pesticide, especially in the ground water. However, proper management can significantly reduce these potential problems, and considering the small size of the site, reduce impacts to the lake to a negligible level.

A fertilization and pest management plan should be developed that takes into account all factors influencing the transport of these chemicals. A clear objective of reducing losses of these chemicals from the site should be established. The information provided to the ERT reflects the intent to minimize the application of fertilizer, use slow release fertilizer, and exclude the use of pesticides. A comprehensive plan that provides more details about the proposed management methods should be developed.

Other Potential Water Quality impacts

Pesticide and fertilizer mixing and storage facilities are also a water quality concern and a safety concern. The proposed plan shows one storage shed to be used for equipment, fertilizer, and pesticides. Spills and accidents can be prevented by providing proper storage facilities and through sound management.

This storage facility should be a secure, fire safe building, with impervious flooring designed for containment of spills, and protected from freezing (freezing might induce bursting of liquid storage containers). Some type of communication system and clean water for eye and skin wash should be available.

Erosion and Sediment Control

The following should be considered and addressed in a more comprehensive plan.

1. The final plans should show existing topography and proposed grades. Location of all neighboring wells should also be shown in the plan.

2. Even though the parking lot will be gravel instead of pavement, runoff from this area should be considered. The lot should be graded such that water leaves by sheet flow not concentrated flow down the hill. Final grades should be showed in the plan.

The bump that is proposed down slope from the parking lot might concentrate the runoff from the parking lot and create erosion problems. If the parking lot is properly graded, runoff should safely flow through the existing sod cover.

3. The pond grading diagrams do not indicate the finished grade of the pond side slopes. They should not exceed 2:1 for stability, with 3:1 preferred. Three to one slopes are also preferable from a safety standpoint in the event that someone goes into the pond.

4. The extent of grading around the proposed building is not indicated. If much grading is required appropriate sediment controls should be installed.

5. The seventh note on the plan sheet references a maintenance shed. Is this the same as the storage shed labeled on the plans, or is the construction of another building anticipated? Again, will much earth work be required for construction?

6. The plans show one area for gravel removal (parking area). Plans and/or a narrative should address the quantity of material to be removed, where topsoil will be stored during removal, the finished slopes after gravel is removed, and revegetation measures (seed mix, seeding dates, and mulch application).

7. For what period of time is it anticipated that the level of the pond will be lowered and how long is the estimated dredging period? The minimum detention time for a typical sediment basin on a construction site is 10 hours. Hopefully the settling time

in the pond would be much longer than this, allowing the majority of the sediment to settle out before outflow to Amos Lake occurs.

8. If the dredged material is to be piled and dried prior to grading, the stockpile locations and sediment controls should be noted on the plans.

9. Sediment barriers should be installed down slope from disturbed or unprotected areas. Location, installation procedure, and detail drawings of erosion and sediment control measures should be included in the plan.

10. A sequence of events would be helpful, including beginning and ending dates, and installation of erosion and sediment control measures.

Hydrogeology and Potential Pesticide and Fertilizer Impact

This golf course proposal has been reviewed with particular emphasis on the hydrogeology and potential impact of pesticides and fertilizers. A limited literature search, a review of background materials and a proposal presentation by the applicants combined with an on-site field inspection were conducted.

Evaluating any land use change should assess the potential for impact to the existing natural resource condition. In this case, the Gauthier property is a relatively undisturbed parcel with an outstanding scenic view toward Amos Lake. The gently rolling hills are readily recognized as characteristic glacio-fluvial topography. Surface topography is a good predictor of the composition and structure of subsurface materials. In fact, the surface kame and kettle features are mapped as the Shewville Brook Deposits, a very coarse-grained pebble-cobble gravel and sand overlying deltic sand. The pebble-cobble gravel and sand are about 100 feet thick at the site (Stone, 1978). Hydraulic conductivity for these materials is extremely high and can range from 50 to 2000 feet per day (CT Water Resources Bulletin #28). Hydraulic conductivity is the measure of a porous medium's (gravel and sand) ability to transmit a fluid (groundwater).

The refilling of the pond has been described by the owner as spring-fed. Apparently groundwater discharging conditions account for the pond refilling with little dependence on surface runoff conditions or direct precipitation. These groundwater discharging conditions are also inferred to prevail from the site's subsurface materials into Amos Lake. The direction of groundwater flow is likely south-southeasterly directly to the lake as well as along deeper flow lines beneath the lake. The deeper aquifer system may extend farther south beyond Amos Lake.

Due to the high rate of groundwater flow through the aquifer, the site can be described as a hydrogeologically sensitive area. Degradation of the groundwater resource by an unwanted contaminant can occur very quickly in this type of surficial geology while restoration (remediation) of groundwater quality can be a lengthy, expensive and incomplete process.

Elevation contours for both the existing and proposed site conditions are absent

in the site plan for the golf course. Therefore, surface flow conditions for the existing conditions were inferred from the visual site inspection. Although most precipitation would readily percolate into the pebble-cobble gravel, surface runoff during saturated groundwater conditions is likely directed to the lake. Water discharge to Amos Lake is also regulated by piping and an outlet from the pond on site. It is important to know the configuration of the proposed regrading contours designed for the golf course in order to evaluate alterations to surface and groundwater flow systems.

Although the owners stated that no pesticides will be used, several attachments to the proposal package discuss the issue. It should be noted that pest control at golf courses often involves the use of fungicides, insecticides, and herbicides. Also, it is important to mention that many fertilizers used on turf grass contain certain percentages of pesticides. For example, pendimethalin is often an ingredient in fertilizer mixtures. If future consideration is made for pesticide usage, a full risk assessment for groundwater and surface water contamination should be made. Guidelines and best management practices (BMP's) should be developed concerning the safe handling and use of pesticides. Similarly, nitrogen and phosphorous fertilization loading rates should be performed to ascertain surface runoff concentration and the leaching value to groundwater. A properly designed monitoring well network should be installed to monitor groundwater quality for pesticides and nutrients. Background details on the subject of fertilizer and pesticide usage on turf grass are contained in the Soil Resources and Turfgrass Management section of this report. This section also points out the importance of providing mixing and storage areas for fertilizers and pesticides. Both mixing practices for pesticides as well as the normal usage of pesticides have been known to cause groundwater contamination.

Another condition that contributes to the hydrogeologic sensitivity of the area is the shallow depth to groundwater. Depth to the water table is thought to be less than 30 feet from the ground surface, although the water table (the top surface of groundwater) will fluctuate seasonally in this unconfined aquifer setting. Therefore, it is very easy for any available contaminant to percolate readily and rapidly from the ground surface through the pebble-cobble gravel down to the water table. Another negative factor is the Hinkley gravelly sandy soil at the site which has poor properties for pesticide dissipation through the adsorption process.

Reportedly, the owner's well is 12 feet deep. If neighbors' wells are also of shallow construction, they too, are potentially vulnerable to impact by the activities associates with the proposed golf course. Recently, proposed private well regulations have gone to public hearing (January 18, 1996). According to these proposed regulations, private water supplies used for domestic purposes will be subject to sampling, testing and certain standards.

An alternative land use consideration may be to explore the eligibility for open space acquisition through the town of Preston and Land Acquisition and Management Division of the CT Department of Environmental Protection.

References

Connecticut Water Resources Bulletin #28, page 42.

Stone, Byron D., 1978. Surficial Geologic Map of the Jewett City Quadrangle, New London County, Connecticut.

Plant and Soil Ecologist Review

In short, the Team ecologist's concerns over the proposed golf course are clearly presented in the Soil Resources and Turfgrass Management and Erosion and Sediment Control sections of this report. The following is a reiteration of the salient points of those comments and expansion upon them.

The potentials for leaching of agrichemicals from the golf course and impacting ground water and Amos Lake are great. The soils beneath the site are excessively well drained and offer little buffer to prevent leaching of fertilizers and pesticides. Further, the applicant indicates there is below ground systems of springs at the site. This below ground water system provides a direct route to both the lake and ground water aquifer. Although proper turf management could reduce some of the potential environmental impacts to receptors, the solum and groundwater system on this particular site makes the management task even more demanding.

The applicant (Matt Gauathier) indicated to the ERT at the field review meeting that he has no expertise in turf management. He further indicated that they will not be using pesticides on the turf, but rather, will replace the turf as necessary. The applicant provided the ERT with several technical articles; all emphasisized the need for intensive management to alleviate agrichemical runoff. Further, the articles and general consensus of the experts is that pesticides use is necessary to maintain turf.

The applicant has not offered a technical plan for management of the turf on this proposed golf course. He mentioned that he would hire a grounds keeper, but has not indicated who that would be, nor the level of training this grounds keeper would have. Considering the soil type, below ground water system, and the proximity to Amos Lake, management of the turf would require a highly trained manager, with sufficient resources to scientifically apply the chemicals, and adequately monitor plant tissue and soil chemistry. Monitoring wells would also be justified to assess any impacts to the ground water. Both baseline and systematic sampling would be needed to evaluate any impacts from the golf course activities. The applicant lives on-site and his private drinking water well is a highly susceptible target for contamination. Other nearby wells are also potential targets. It is

important to note that this a GA ground water classification area, and public water is not available.

The proposal to replace the turf rather than manage it is problematic. The risk of soil erosion and sedimentation into the lake and bordering wetlands is a concern. Without proper management of the turf to ensure a healthy establishment, replacement may be frequent. Frequent disturbance could hasten erosion. The loam and gravel used to build up the greens would also be susceptible to erosion from frequent disturbance. The New London County Soil Survey rates these soils as unsuitable for establishment of golf fairways and lawns. Even though sod will be placed on the greens (rather than seeding), intensive management will be necessary to establish a rooting system capable of sustaining healthy turf and stabilizing the physical structure of the greens.

The site plan indicates a silt bowl (silt collection basin) near the lake. What level of sedimentation is expected? The plan does not show topography, nor the location of the wetlands in this area. Is this silt bowl in the wetlands? How close does the golf course come to the wetlands and the lake? A more detailed site plan illustration would be helpful in evaluating the proximity of the proposed facility to sensitive environments.

In summary, the applicant has provided limited technical information on his plans for realistic use of agrichemicals to establish the turf. The site and surrounding environment are highly susceptible to impacts and will require a high degree of expertise and resources to prevent environmental degradation. The Team ecologist believes that the applicant has only the best intentions, but has not adequately presented a best management plan addressing the circumstances and potentials for environmental degradation.

Lake Management Review

The Connecticut Department of Environmental Protection (DEP) has identified Amos Lake as a lake with declining water quality. In August 1980 water clarity was 12 feet. In August of 1986 DEP measured the water clarity at 5 feet and in August 1988 the water clarity was 2.5 feet. These data indicate that Amos Lake is becoming more biologically productive as nitrogen and phosphorous increase and the lake becomes more prone to algae growth. DEP has attributed this increase in nutrient loading to changes in the watershed from wooded to residential land use. Due to this water quality impairment, DEP's Bureau of Water Management, Lakes Management Program initiated a survey of the Amos Lake watershed (see appendix). This report "Amos Lake Watershed Management Approach for Long Term Protection" identified septic systems and Canada geese as two major sources for nutrients entering Amos Lake.

The primary concern of phosphorous is fertilization of blue green algae blooms. Often an increase in duration and intensity of blue green blooms during the summer occurs with an increase of phosphorous. Nitrogen is usually the limiting nutrient for growth of rooted aquatic plants. The process of a lake becoming enriched with nutrients and more biologically productive is called eutrophication. If human sources generate nutrients, the term is cultural eutrophication. Connecticut DEP recommends reducing all sources of nutrients when addressing eutrophication problems.

The proposed golf course brings forth several concerns that may add to the Amos Lake nutrient loading problem. Among these concerns are increased waterfowl, fertilizers, and management of the pond and subsequent impacts to Amos Lake. These impacts should be addressed before land use commissions grant final approval.

Canada Geese

Construction of the proposed golf course will change the ±10 acre site from a field used for cattle to a more manicured grass area. Although the field in its current condition is conducive to feeding by Canada geese, the proposed change will encourage more use by these birds. Canada geese have become a problem at golf

courses throughout Connecticut by destroying greens and leaving droppings. Canada geese frequent golf courses during the day and roost on a nearby waterbody at night.

While roosting on the lake, Canada geese can impact water quality by increasing bacteria levels, adding to the oxidizable organics, and increasing nutrient loading. These pollutants generated from Canada geese have contributed to the degradation of recreational lakes in Connecticut, including Amos Lake, and are considered a major source of nonpoint pollution by DEP's Lakes Management Program.

The golf course management plan should include a program to discourage geese from using the site. Due to the proximity to the lake, this should be an intensive program with daily harassment of the birds. Additionally, it is recommended that a barrier to prevent birds on the lake from walking onto the golf course be constructed. The barrier could be natural vegetation that the applicant allows to grow or a fence along the shore of the lake. Natural vegetation has the added benefit of trapping nutrients and sediments before entering the lake.

Fertilizers

The plans provided to the ERT had little information regarding how they will apply fertilizers to this site or if any water testing and soil testing would be done to determine fertilization rates. In any event, one can assume that more fertilizers will be used closer to the lake than with the current land use. It should be noted that some fertilizers are labeled "environmentally safe." These are slow release or low phosphorous fertilizers. However, both types can affect a lake. Slow release fertilizers still have the potential to leave the site through surface runoff if a waterbody is close. Low or non-phosphorous fertilizers contain nitrogen, the nutrient usually most needed by rooted aquatic plants.

Golf Course Pond

Reportedly, the pond on the property is 16 feet deep. The information provided by the applicants proposed placing a fountain in the center of the pond. The reason stated for the fountain is to add oxygen to the water. Fountains do not directly aerate water in a pond. During the growing season, the surface of a lake or pond will have a

high concentration of oxygen from photosynthesis and atmospheric diffusion. However, fountains can prevent algae from clumping together and forming mats by keeping water moving. The system being proposed is advertised as having the capability of "breaking up thermal stratification." If the fountain eliminates thermal stratification, oxygen may reach deeper areas of the pond and the bottom water can move to the surface.

The destratification of a pond may bring bottom water rich in reduced metals, ammonia and phosphorous to the surface where it can become available for algae growth. With a direct discharge to Amos Lake, further investigations will be needed to assess potential water quality impacts. It is possible that the DEP Permits, Engineering and Enforcement Division of the Bureau of Water Management will require a permit for this discharge if they determine that destratification of the pond will impact Amos Lake.

Amos Lake Water Quality

The proposed development is located on the northern shore of Amos Lake, a rather deep waterbody with a relatively small surface area and small watershed area surface area ratio (WA-SA) (See Table 1 for morphometric characteristics). Amos Lake has recently been the subject of intensive limnological investigations (Marsicano et al, 1996). In these investigations water quality monitoring was used in conjunction with a paleolimnological study and an historical analyses of the watershed using aerial photographs and GIS (Geographic Information Systems) technologies. The following pages summarize much of the that study.

Table 1. Morphological Characteristics of Amos Lake Preston, CT

Surface Area	42 hectares
Watershed area surface area ratio	5
Mean Depth	5.8 meters
Maximum Depth	14.5 meters
Volume	$2.436 \times 10^6 m^3$
Retention Time	657 days

Amos Lake has been characterized as mesotrophic to eutrophic from 1980 to 1993. Results from monitoring efforts in 1995 revealed a mesotrophic lake with a mean summer Secchi disk transparency of 3.45 meters, mean summer chlorophyll *a* concentration of 3.7 $\mu g\ L^{-1}$, mean total phosphorous concentration of 22 $\mu g\ L^{-1}$, and mean total nitrogen concentration of 348 $\mu g\ L^{-1}$. The trophic condition of Amos Lake in 1995 was most likely effected by the unusually low levels of precipitation received in Connecticut during the winter, spring and summer of 1995. Reduced precipitation can result in less non-point source nutrients entering a waterbody.

Based on the fossil record, Amos Lake was mesotrophic from at least *ca* 1890 up through the late 1960's. The fossil record also indicated that between *ca* 1968 and the late 1980's, the trophic state of Amos Lake rapidly increased to late mesotrophic levels. The trophic increase corresponded with residential development and wetland loss within the drainage basin of the lake. Based upon the timing of the trophic increase and the developments within the watershed between *ca* 1968 and the late

1980's, it was concluded that Amos Lake had undergone culturally induced eutrophication.

Other data supported a continued influence from watershed developments. Specific conductivity levels and sodium (Na^+) and chloride (Cl^-) concentrations have steadily increased in recent years. The parallel increases in sodium and chloride concentrations suggested influences from deicing agents on roads and other impervious surfaces. The fossil record indicated recent increases in dissolved salt levels in the lake.

Land use changes in the Amos Lake drainage basin also suggest cultural influences over the last 60 years. The percentage of residential/urban area in the watershed increased from approximately 2% to 4% to 11% from 1934 to 1979 to 1990, respectively. Much of that development occurred along the eastern border of the lake. The percentage of residential/urban land use nearly tripled between 1970 and 1990 which corresponded with the timing of trophic increases inferred from the fossil record.

There is much agreement in the scientific community on the general effects of various land use types on water quality. Agricultural land use has been associated with increased nutrient loading, particularly nitrogen. Urban land has also been correlated to increased nutrient loading and increased dissolved salt concentration. Forest and wetland types either export small quantities of nutrients, or may even act as sinks for nutrients (Field et al, in press, and references therein).

The proposed par-3 golf course can pose a threat to water quality in Amos Lake. Mismanagement of the facility, especially with regards to pesticides and fertilizers can result in unwanted nutrients and other chemicals in the lake. Proponents of the development have ruled out the use of pesticides and have chosen to use slow releasing ammonium based fertilizers. However, much of the concern lies in the hydrology of the area.

Based on the analyses of aerial photographs of the watershed in 1934, 1970, and 1990, it would appear that as farmlands were abandoned and returned back to woodlands, some of the areas, especially north of the lake, reverted back to wetlands. This suggests that much of that area may have been wetlands prior to colonial

farming and that soils are poorly drained. This idea was supported by discussion pertaining to the pond on the applicant's property, where a substantial amount of peat was uncovered when the pond was dredged. The use of fertilizers on lands which may be poorly drained and adjacent to a lake warrants additional hydrological investigations.

Buffer zones and appropriate vegetation management have been shown to reduce nutrient loading from nonpoint sources. Selectively using indigenous plant species in landscaping shoreline property can lower irrigating, fertilizing and maintenance costs while reducing nutrient and sediment loading into the lake. It is recommended that the applicants investigate these management practices and incorporate them into the plan.

The foresightedness of the Amos Lake community has resulted in indepth baseline data set on the present and past water quality in Amos Lake. Any significant shifts in future quality would be detected based upon that information. Shifts may then be correlated to developments along the shoreline or within the watershed.

Literature Cited

Field, C.K., P. A. Siver, A.M. Lott. *In press*. Estimating the effects of changing land use patterns on Connecticut Lakes. Journal of Environmental Quality.

Marsicano, L.J., P.A. Siver, A. M. Lott, E. Cash, K. King and J. Moss. 1996. Historical analysis of the water quality of Amos Lake, Preston, CT. A completion report to the Amos Lake Association. 64 pp.

The Natural Diversity Data Base

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

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.

Please contact the Data Base if you have further questions (424-3589). Also be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for this proposed site.

Wildlife Resources

Existing Habitats and Land Use

The existing ±10 acre lakefront site consists of a pasture/hay field surrounding a ±1.25 acre pond. Little vegetation other than mowed grass occurs on the site. Some recent small plots and roadside hedgerow plantings of small spruce sp., arborvitae and burning bush have been established. A few mature hardwoods remain in the pasture including white ash, oak and black mulberry. A stone wall runs along the property's east boundary across which a stand of mature mixed hardwood forest of western ash, eastern red cedar and sugar maple exists.

Presently, the most valuable area for wildlife on the site, other than the coniferous trees surrounding the landowners home, is the small wetland (±.25 acres) and drainage swale which exists along the lake front edge. The wetland vegetation here includes phragmites, cattail sp., tussock sedge, fern sp., blackberry, alder sp. and willow sp. which provides a variety of food and cover, wildlife requirements not found elsewhere on the property. The pond, although ice and snow covered at this time, appears to have little value to wetland mammals or waterbirds due to its complete lack of vegetation and isolated location surrounded by pasture/hay fields.

Existing Wildlife Use

The lack of vegetation diversity on this site plus the high level of development in the area in the form of lake front homes, driveways and heavily traveled road (Route 164) makes the existing site unsuitable to many species of wildlife. The species that may be commonly associated with these sites include meadow voles, woodchucks, grey squirrels, European starlings, cowbirds, American robins, and American crows. The wetland with its greater plant diversity may be used by a variety of species including frogs, snakes, muskrats, sparrows, redwinged blackbirds and waterfowl. However, due to its extremely small size, use may be limited especially by larger species of waterfowl, and the more sensitive herons. The ponds isolated location, piped outlet and absence of shoreline vegetation also make it far less valuable to wildlife.

Impacts to Wildlife and Habitats - Recommendations for Their Protection and Enhancement

The existing proposal will involve few changes to existing wildlife habitats. Excavation work around the pond edges for materials to build-up tees and greens and in the outlet brook for installation of a sediment basin has the potential for causing sedimentation damage to the wetland and drainage swale. Properly designed soil and erosion control measures must be utilized to prevent this and also be employed wherever soil disturbance is to occur until vegetation is firmly reestablished.

The piped underground brook will remain an impediment to many species of wildlife and fish.

Plans do not indicate planting or encouraging any vegetative cover around the pond following excavation. Golf course compatible pond boundary plantings could include sedges, button-bush, silky dogwood, viburnum and highbush blueberry. These shrubs not only would provide food and cover for many species of songbirds, but also add to the attractiveness of the pond while at the same time discouraging its use by Canada geese by creating a natural physical barrier to easy movement on and off the pond. It's further suggested that the pond's edges be gently sloped (i.e. 3:1) to discourage possible muskrat burrowing erosion damages and promote emergent growth.

Through planting or encouraging wetland vegetation around the drainage swale and small wetland adjacent to the lakeshore, the site's value to wildlife would also be greatly enhanced. The existing phragmites stand already provides some degree of a natural barrier to goose access onto the site from the lake.

Additional improvements to the wildlife value on the upland sections of the site may be realized by planting dense small clumps of native upland shrubs around tees or "out of bounds" areas along fairway slopes. Field juniper, wax myrtle, sweet pepperbush, gray dogwood and huckleberry should be considered for their food and cover attributes.

The mature hardwood trees remaining on the property should be maintained for their value in providing food and nest sites to both birds and mammals. Existing

birdhouses attached to some of these trees may attract bluebirds but may more likely be used by black-capped chickadees, tufted titmouse and mice. Bluebirds and tree swallows will find nesting boxes placed on poles away from wooded edges along fairways more attractive.

Canada Goose - Potential Impact and Control

Current use of the open pasture/hay field and small pond by geese is reportedly minimal according to Matthew Gauthier (per communication, 1996). He further states no nesting activity has been or is known to occur on the property and geese were not known to walk onto the property from Amos Lake. Those few geese which he has observed in the past have flown in.

DEP Canada goose survey data indicate Canada goose use of Amos Lake has declined significantly over the past 5-8 years. Data from the mid to late 80's showed large populations of fall migrant geese numbering up to 1,000 utilizing the lake until ice-over forced them elsewhere. (P. Merola 1996 per comm. and *Amos Lake: A Watershed Management Approach for Long Term Protection, 1994*).

Presently, ongoing surveys reveal few Canada geese utilizing Amos Lake (P. Merola, 1996, per comm.). A significant decline in the Canada goose migratory population along the Atlantic Flyway is recognized to be the cause of this dramatic decline.

P. Merola further adds that resident Canada geese are utilizing nearby habitats around Amos Lake. Although making any comparisons with other golf courses in the area may be scientifically invalid due to significant differences in available on-site or surrounding habitats, Gene Williams (1996, per comm.) owner of Lisbon Golf Course reports both Spring breeding and summer post-breeding activity on his course. He reports up to five pairs with young and approximately 100 geese occupying course ponds at various times throughout the year. These geese cause damage to the course from their fecal deposits left on greens, tees and fairways following feeding forays onto these attractive sites. In addition to the fecal damages, Canada geese also cause damage to golf courses from their interference with play, feather loss during molt, turf damage as a result of feeding and increased nutrient loading of course ponds from fecal contamination.

Factors effecting the future use of Amos Lake by migrant Canada geese include the size of the migratory population, use patterns, continued availability of nearby agricultural feeding areas and availability of open water. The potential for migrant geese or the existing resident geese population causing damage to the proposed golf course is even further dependent on more site specific factors such as the course proximity to the lake and the attractiveness of open well maintained grass fields and pond so well liked by these birds. On the other hand, the small size of the pond, little past evidence of high use of existing pasture and pond, plus the presence of some existing vegetative barriers in the wetland bounding the lake may discourage use by geese. Based on these considerations, it is uncertain if Canada geese will become a problem at this site.

There is no question that Canada geese may pose a serious threat to any golf course having ponds or being located adjacent to nearby water bodies. Controlling these damages is difficult and may require such measures as fencing water access points, frightening noisemakers, application of registered animal taste repellents, employment of highly trained and expensive border collies to patrol the course or even direct population reduction through egg addling and shooting of resident adults under special permit issued by the U.S. Fish and Wildlife Service. As stated earlier, whether or not any of these controls may be necessary is uncertain, however, they are worth discussing as part of this proposal.

References

1994. CME Associates Inc., Woodstock, CT. Amos Lake: A Watershed Management Approach for Long Term Protection, 18 pp.

1996. Gauthier, Matthew., Applicant's son, per communication.

1996. Merola, Paul., per communication, DEP Waterfowl Biologist, CT Wildlife Division, 391 Route 32, North Franklin, CT 06254.

1996. Williams, Gene., Owner of Lisbon Golf Course, Lisbon, CT., per communication.

Fish Resources

This section will address the impacts to fisheries resources due to the proposed creation of a par-3 golf course and delineate appropriate measures to mitigate impacts.

Fish Resources

Property Pond

No information is available relative to the fish population structure in this pond. Fish population density and diversity may have been impacted by past drawdowns. Based on the pond's morphological characteristics, it appears that it provides suitable habitat for supporting warmwater fish species such as largemouth bass, sunfish, and bullheads.

Amos Lake

Amos Lake is a very popular waterbody for regional anglers. It is designated by the CT DEP Fisheries Division as a trophy trout lake. The goals of trophy trout lakes are to enhance recreational fishing and provide a variety of opportunities for Connecticut's trout anglers. It is stocked with over 9,200 adult (9-12") brown and rainbow trout each year. In addition to stocked trout, the pond supports a wide variety of warmwater fish species. DEP Fisheries Division lake and pond surveys indicate that largemouth bass and chain pickerel are the major gamefish that inhabit the lake. Large panfish present include yellow perch and brown bullhead. Sunfish are very common and include bluegill and pumpkinseed. Other non-game species include: golden shiner, banded killifish, American eel, creek chubsucker, and landlocked alewife. Alewife serve as the main forage species for large adult trout.

Amos Lake is considered to be in a "mesotrophic" state of eutrophication or lake aging albeit, more recent aquatic surveys suggest that the lake is approaching an eutrophic state. During the process of eutrophication, a lake typically passes through three major states of succession; oligotrophy, mesotrophy, and eutrophy. The transition from one state to the next may take thousands of years; however,

eutrophication can be rapidly accelerated by man-made inputs of nutrients such as excessive soil erosion, fertilizer runoff, stormwater runoff, and septic tank leachate. A "mesotrophic" state of eutrophication essentially means that moderate levels of nutrient enrichment have occurred. Mesotrophic lakes are susceptible to the development of periodic "algal blooms" that will discolor the water and they support average amounts of aquatic weeds.

Impacts

The health of lake fisheries resources is predicted upon maintaining favorable water quality conditions. The project site should be considered a high risk site due to the close proximity to Amos Lake. Without careful land management planning, proposed activities may likely impact lake water quality; however often times, these impacts are difficult to measure since they can be secondary, cumulative, and latent in nature. The following impacts may occur if proper mitigation measures are not implemented:

1. Increase in nutrient transport to the lake due to fertilization. Fertilizer placed on the golf course could enter Amos Lake either through groundwater or surface runoff. Introduction of fertilizer to Amos Lake may degrade water quality by further accelerating the eutrophication process. One potential side effect of increased fertilization is the increased tendency for the lake to exhibit algal blooms. Algal blooms not only impact water clarity but can lead to decreases in dissolved oxygen levels.

2. Transport of pesticides to the lake. Many pesticides are toxic to aquatic organisms, therefore without careful planning, the application of pesticides may pose a risk to aquatic organisms of Amos Lake.

3. Site soil erosion and sedimentation of the lake due to construction activities. Without proper safeguards, land disturbances associated with golf course construction may create runoff and introduce suspended sediments downgradient into Amos Lake. This is one potential impact, which if observed, would have a more immediate effect on lake fisheries resources. Excessive sediment deposition could damage the aquatic ecosystem of Amos Lake in some of the following ways:

(1) Sediment reduces the amount of usable habitat required for spawning purposes. Resident fish may be forced to disperse to other areas not impacted by siltation.

(2) Sediment reduces the survival of resident fish eggs and hinders the emergence of newly hatched fry. Water, free of excess sediment particles is required for fish egg respiration and successful hatching.

(3) Sediment reduces the survival of aquatic macroinvertebrates. Since aquatic insects are important food items in fish diets, reduced insect population levels in turn may adversely affect fish growth and survival.

(4) Turbid waters impair gill functions of fish and normal feeding activities of fish. High concentrations of sediment can cause mortality in adult fish by clogging the opercular cavity and gill filaments.

(5) Sediment can encourage the growth of algae and nuisance proportions of aquatic macrophytes. Eroded soils contain plant nutrients such as phosphorous and nitrogen. Once introduced into aquatic habitats, these nutrients function as fertilizers resulting in accelerated plant growth.

Recommendations

The existing proposal lacks information and many details necessary to make an objective decision relative to the feasibility of this project. The following recommendations are provided to assure protection of aquatic resources.

1. A detailed fertilization management plan should be devised detailing best management practices relative to the application of fertilizer. After this plan is devised, a more thorough evaluation can be made of the possibility of nutrient transport and loading to Amos Lake.

2. A detailed pest management plan should be devised detailing best management practices relative to the application of pesticides. After the plan is devised, a more thorough evaluation can be made of the potential impacts to Amos Lake due to pesticide application.

3. Based upon the results and evaluation of the aforementioned plans, a determination can then be made regarding the need for water quality monitoring. Water quality monitoring should be utilized as a diagnostic tool only if nutrient loading impacts are expected to be significant.

4. Develop an aggressive and effective erosion and sediment control plan for project construction. Proper installation and maintenance of erosion/sediment controls is critical to environmental well being. This includes such mitigative measures as filter fabric barrier fences, staked hay bales, and sediment basins. All disturbed areas should be protected from storm events. It is unlikely that pond drawdown and subsequent refilling activities will have a significant impact relative to introducing silt and sediments directly into Amos Lake. However, as a safeguard, a gravel check dam could be placed within the outlet stream channel to act a a filter and provide extra erosion and sediment protection. The check dam should be removed upon project construction.

Planning Review

The following comments and recommendations are based on the information supplied by the applicants and the field review. In addition to the information supplied by the applicant the Team planner also reviewed the following material: Soil Survey of New London County (June 1983); 1962 and 1990 Aerial Photos, CT DEP; USGS Topography, Jewett City Quadrangle, 1984; Geological Quadrangle Map, Surficial Geology, Jewett City Quadrangle, 1978; and Groundwater Availability Map, CT DEP, 1978.

The owner/developer needs to develop accurate information concerning their site. The information that the ERT reviewed concerning the physical layout was not accurate and did not show a level of detail necessary to complete a proper evaluation of the site. The site plan showed the pond in the wrong location. This error affects the layout of three of the proposed nine holes. They should establish horizontal and vertical control to depict existing natural features (i.e. stone walls, water bodies, mature trees), property lines and topography. At a minimum a Class-A2 survey and T2/T3 survey should be completed. In addition a certified soil scientist should map the soils. In some areas it is unclear where wetland soils begin and end on the site.

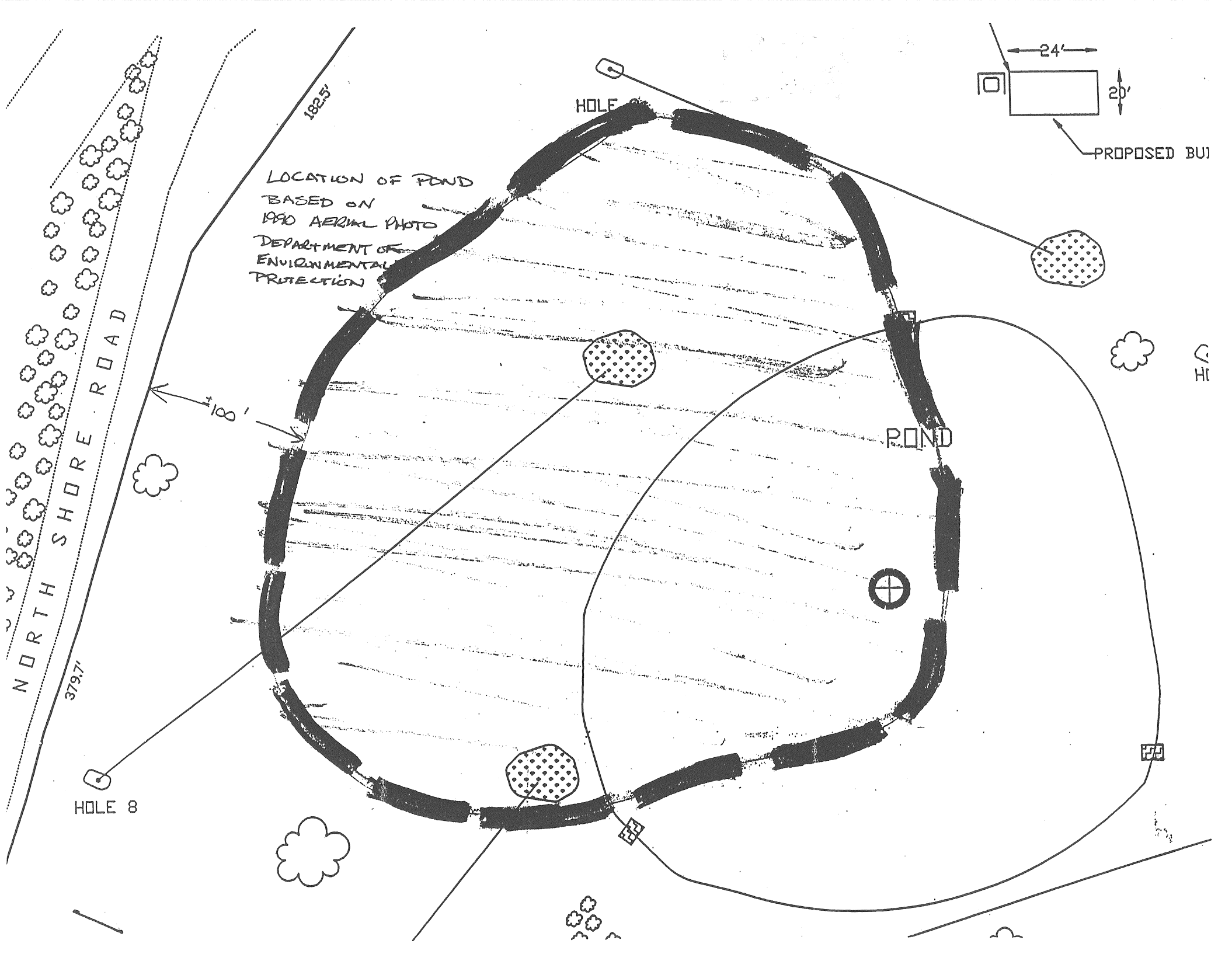
The Soil Survey of New London County Connecticut classified the soil on this site as Hinckley gravelly sandy loam (HkC). The soil at he site fits the classical definition of HkC. The site gently slopes in the three to fifteen percent ranges, excessively drained sandy soil that a very rapid permeability in the substratum. HkC soils are extremely susceptible to frost. The footings for the foundation should be constructed below the frost line to prevent frost heaves which can cause the concrete floor to crack. For added protection installing a non-permeable geo-textile membrane may be advisable.

In addition to the HkC soils, it is apparent that there are some wetland areas associated with and next to Amos Lake on the eastern portion of the property. The soils in the proposed fairway for hole #3 were extremely wet. This area is close to Amos Lake and associated wetlands. This wet area could cause problems during wet periods of the year.

The site also contains a ±2 acre pond. This pond is located on the northwest portion of the property. The site plan prepared by Matt Gauthier does not represent the actual location of the pond based on 1990 aerial photography (please refer to following map). The western edge of the pond is located ±100 feet from North Shore Road and the northwestern edge is ±100 feet from Amos Road. Consequently, the layout of holes #7, #8 and #9 would have to be changed. The physical shape and size of the pond has changed very little since 1962 (refer to 1962 air photo). However, the depth of the pond has changed as a result of dredging and peat removal in 1986. The owner/developer should determine the volume (storage capacity) of the pond and the volume of water necessary to irrigate greens and fairways. Water necessary for irrigation should be compared to the volume of water available, recharge rates and pumping rates. If you are going to pump 10,000 gallons per day/week and the recharge rate is less, there may be a problem. The installation of an irrigation system that uses subsurface water (drilled well/stand pipe) may have less of an impact on the pond versus the proposal to use surface water.

The site plan does not accurately represent the amount of cuts and fills necessary to build the proposed parking area and building. There is a significant change in elevation in this area. Proposed cuts should be limited to 3:1 slopes, to mitigate any potential erosion problems. Without accurate topography it is difficult to determine whether or not the proposed bump (shown on side view of parking lot) will be adequate. The existing drainage patterns along Amos Road need to be maintained. The construction of the proposed entrance could interrupt this pattern. The applicants should minimize the amount of off site runoff. The parking area should incorporate a turnaround area.

The impact of the proposed use if designed and engineered properly will have minimal impacts on the environment. It is the Team planner's opinion that the information submitted to date does not constitute proper design and engineering. The applicants should retain the proper licensed professionals to help them incorporate their best management practices into the physical design and layout of the proposed use. A combination of poor design (physical layout) and/or management practices could have a detrimental effect on the environment.


24'
20'
PROPOSED BUI
HOLE
182.5'
LOCATION OF POND
BASED ON
1990 AERIAL PHOTO
DEPARTMENT OF
ENVIRONMENTAL
PROTECTION
100'
POND
NORTH SHORE ROAD
379.7'
HOLE 8

Archaeological and Historical Review

A review of the State of Connecticut archaeological site files and maps indicate that the proposed project area is located in close proximity to the Preston City Historic District, which is on the National Register of Historic Places. The nomination inventory form which provides a description of the area's historic and architectural character may be found in the appendix.

In an evaluation of the significance of this important area, the proposed development project should be designed so as to not alter the historic, small village ambience of the Preston City Historic District. In particular, mature tree species should be retained wherever feasible, in order to provide a natural buffer of the project area. Likewise, any proposed signage for the golf course should be located outside of the boundaries of the Historic District. The signs should be designed and located in such a manner as to harmonize with Preston's rural character.

Several prehistoric sites are located around Amos Lake. Unless the project already possesses significant subsurface ground disturbance the development parcel would appear to be of moderate to high archaeological sensitivity.

The Connecticut Office of State Archaeology and the Connecticut Historical Commission recommend a reconnaissance survey, in accordance with the State Historic Preservation Office's *Environmental Review Primer for Connecticut's Archaeological Resources*. The Office of State Archaeology is prepared to offer any technical assistance to the developer and/or the Town of Preston to see that an archaeological survey is conducted.

Appendix

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

ABOUT THE TEAM

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

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

PURPOSE OF THE TEAM

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

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

REQUESTING A REVIEW

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

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