Brook Crossing

Residential Development

East Granby, Connecticut

EASTERN CONNECTICUT ENVIRONMENTAL REVIEW TEAM REPORT

Eastern Connecticut Resource Conservation & Development Area, Inc.

Brook Crossing Residential Development

East Granby, Connecticut

Environmental Review Team Report

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

for the

Planning and Zoning Commission and the
Conservation/Inland Wetlands Commission
East Granby, Connecticut

July 1996

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Acknowledgments

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

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

The field review took place on Tuesday, June 11, 1996.

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I would also like to thank Rosalie McKenney, PZC staff person, Clifford Amirault, chairman, East Granby Conservation/Inland Wetlands Commission, Jean Manfredi, Conservation/Inland Wetlands Commission, Frank Kilby, East Granby Planning and Zoning Commission, David Kilban, First Selectman, Charles Francis, Town Engineer, Mark Levine the applicant and developer and Rob Sonnechsen, the applicant's environmental consultant for their cooperation and assistance during this environmental review.

Prior to the review day, each Team member received a summary of the proposed project, location and soils maps. During the field review the Team members were given plans and copies of the environmental, hydrologic and drainage reports. The Team met with and were accompanied by town officials, the applicant and his consultant. 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. 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 this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in making your decision this residential development.

If you require additional information please contact:

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Introduction

An environmental review was requested by the East Granby Planning and Zoning Commission and the Conservation/Inland Wetlands Commission for Environmental Review Team assistance in reviewing a proposed residential development.

The 41.17 acre site is located on South Main Street (Route 187), north of the middle/high school and south of the Higley Senior Complex, on the east side of the road. There are 19.55 acres of wetlands on the site. Sanford Brook flows through the western portion from south to north , and Sheldons Brook forms the eastern property boundary, it also flows from south to north.

An 88 unit multi-family residential development is proposed that will include a free standing clubhouse. The site will be served by public water and sewers. Proposed access to the site is from South Main Street across the Sanford Brook wetland area via an existing farm road that will be upgraded.

The ERT was asked to describe the natural resources present, address potential impacts and mitigation measures to the wetland systems on and off site, discuss stormwater management, erosion and sediment control, site design and traffic issues.

The Environmental Review Team Process

Through the efforts of the East Granby Planning and Zoning Commission and the Conservation/Inland Wetlands Commission and the Eastern Connecticut ERT, this environmental review and report was prepared for the town. This report primarily provides a description of certain on-site natural resources and presents planning, management, 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, land use guidelines.

The data collection phase involved both literature and field research. The ERT field review took place on June 11, 1996. Mapped data or technical reports were also perused, and specific information concerning the property was collected. Being on-site allowed some Team members to verify information and identify other resources.

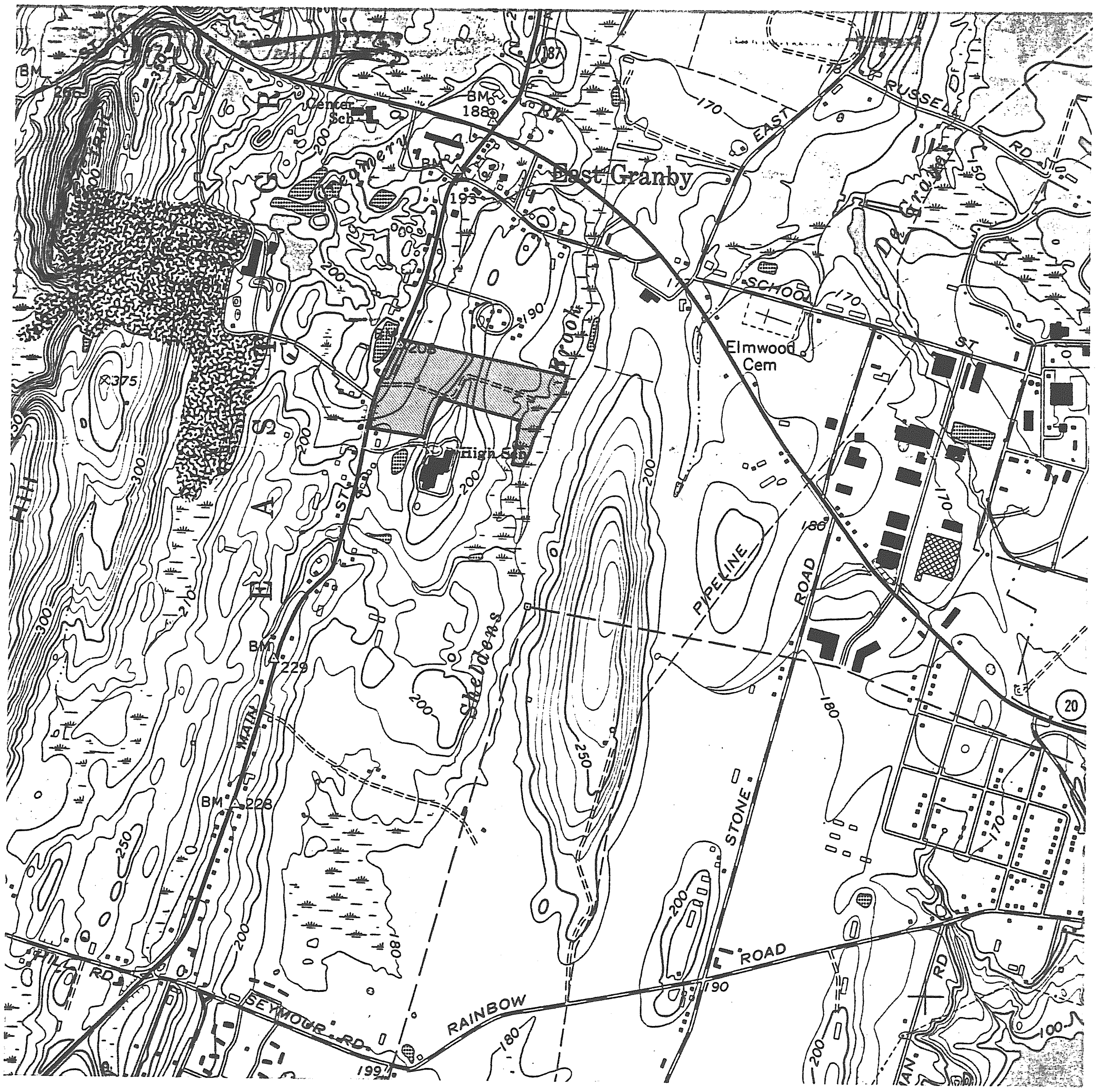
Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. Results of this analysis enabled Team members to arrive at an informed assessment of the property's natural resource opportunities and limitations. Individual Team members then prepared and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

Figure 1

Location and Topographic Map

Scale 1" = 2000'

N



Soil Resources

The landscape of the site is dominated by upland soils that are flat to steep. Slopes on this site range from 0 to 15 percent. The topography of the site ranges from 180 to 220 feet above sea level. The site is characterized by the soil association of Broadbrook-Wethersfield-Buxton. This association is dominated by the soil map units BrB2 and BrC2 (Broadbrook silt loam). Approximately half of the site is comprised of poorly to very poorly drained soils (Scarboro loam (SeA), Carlisle (PkA) and Walpole loam (WcA)). These soils are listed as hydric soils (see Hydric Soils List, Appendix A) and are therefore regulated wetland soils of the State of Connecticut.

The soil map (Figure 2) is taken from the Soil Survey of Hartford County (1962), atlas sheet number 15. The soil map legend provides a listing of those soil map units found on the atlas sheet and the current soil name used for soil interpretations for the map unit. The general suitability and limitations of these soil map units for the proposed uses will be discussed within the text and the referenced tables included with this section of the report. Soil limitations for this site range from slight to severe, depending upon potential development opportunities of the site.

The limitations are considered “slight” if soil properties or site features are favorable or site features are favorable for the intended use and limitations are minor or easily overcome. “Moderate” limitations occur if soil properties are not favorable for the intended use and specific planning, design or maintenance is needed to overcome or minimize limitations. “Severe” limitations occur when soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs and possible increased maintenance are required. A review of the soils map and the attached reports will indicate any areas of potential soil limitations.

The soils of the site are well drained to poorly drained, with approximately half of the site dominated by hydric soils. These soils range in texture from fine sandy loams to silt loams to peats and mucks. The soil map unit WcA is the most extensive hydric soil (wetland) soil on the site.

The dominant soil feature of this site is soil hydrology. Both soil map units of the Broadbrook series have perched water tables at 1.5 to 2.5 feet below the surface during the months of February, March and April. This perched water table is indicative of the compacted, glaciated till soils that comprise the soil association. Permeability of the compacted subsoil is slow for these soils.

The hydric soils (WcA, PkA and SeA) are shown to have an apparent water table that is at or near the surface for long periods of time during the growing season (see Water Features Table, Appendix A). The Water Management report (Appendix A) lists limitations for soils on the site. These limitations are useful in consideration of planning and designing water management measures (waterways, ponds or basins, etc.). Additionally, the Building Site Development report (see Appendix A) provides soil limitations for the site when considering specific site development.

The soil Survey is not a substitute for on-site soils investigations. It will be necessary to conduct an on-site investigation to accurately determine the suitability of any soil for any intended use.

The soil map units BrB2 and BrC2 are glacial till soils formed over bedrock controlled topography. Exposed bedrock was found throughout these soils on the site. The site plans submitted for review (Sheet SU-1) indicated that ground penetrating radar (GPR) was used along transects to determine the depth to bedrock. It appears that along the top of the ridge, bedrock is located within 2 to 7 feet of the surface. Site plans show proposed contours with final grades at cuts of 6 to 10 feet into the existing ground. To achieve the needed depths for foundations, utilities an such, it would appear that more extensive excavations will be needed. It is suggested that the applicant hire a professional soil mechanical engineer and hydrogeologist to determine the feasibility of the proposed cuts, the impacts to the site as a result of the excavations, especially on the site's ability for ground water recharging. This report should include an evaluation of the proposed infiltration trenches and other water conveyance structures on the impact to on and off-site water resources (including wetlands).

Because of the surficial and geological modifications being proposed to the site, the applicant may wish to revisit the hydrological calculations for surface runoff since the resulting landscape will not be consistent with a "natural" land form (i.e. soils will be dramatically altered due to the cuts and fills being proposed). An evaluation should also include the suitability of excavated materials as fill material on the site.

The report Physical Properties of Soils (see Appendix A) shows that soil erodibility factor (k) for soil map units located on the parcel range from 0.17 to 0.32, where the higher the number, the more susceptible the soil is to erosion by water. The soil map units BrB2 and BrC2 range in slope from 3 to 15 percent. With an erodibilty factor of 0.32, these soils become highly erodible on steep slopes. It is on these slopes that a majority of the site will be developed.

Due to the proximity of the steep, erodible soils to regulated wetlands, intensive efforts will need to be employed to keep sediments out of wetlands. Attempts to protect all existing buffer areas will help to ensure that existing wetlands can be protected. This could include, but not be limited to: maintaining as much separating distances between construction activities and wetlands, especially on steep areas; establishing all erosion and sediment control devices outside of the buffer areas and not use buffer areas as sediment filters; maintaining and protecting existing native vegetation within buffer areas to help protect wetlands and provide for wildlife habitat and a natural screen to wetland areas.

Because of the high hazard of erosion, this site needs a more extensive soil erosion and sediment control plan than what is presented in the plans offered for review. Detailed phasing and sequencing of the construction activity is needed for this site. Control measures need detailed drawings and calculations and additional information should be provided to ensure that off-site impacts are not realized due to stormwater flows from outlets.

Additional Recommendations for Consideration

1. Reducing the footprint of the proposed crossing of Sanford Brook (and the resulting impact to wetlands) by constructing a raised or span bridge. This should be possible since runoff calculations show that there is not a need for stormwater detention in this watershed.

2. Combine storm drain outlets into fewer structures to reduce multiple outlets and the need for multiple outlet treatment measures. By combining outlets it will allow for fewer water quality treatment measures and reduce long term operation and maintenance costs.

3. Provide for a more appropriate design for water quality renovation of stormwater runoff than the proposed plan to use existing buffers. In some cases the outlet for storm drainage is directly outletting into a wetland with no treatment.

4. Install "hooded outlets" on the grit separators to indicate need for cleaning of structures, or allow for sediments to be transported to a permanent sediment basin that will be cleaned on a scheduled basis.

5. Research a more appropriate design for the infiltration trenches. The ones presented on drawings do not appear to be much more than shallow level lip spreaders. Provide designs and calculations for infiltration trenches that will "recharge" ground waters to help replicate current conditions and maintain wetland water budgets.

6. Establish a "wildlife corridor" between the interior wetland (wetland "C") and the riparian area (to wetland "B" - Sheldons Brook). This corridor should allow for a connection of the two systems for those types of wildlife currently using the area.

7. Consider the improvement of the farm road across Sheldons Brook to maintain current water elevations for the upstream area, replacing the failing pipe structure that is present, as a potential mitigation measure.

Figure 2

Soils Map and Legend

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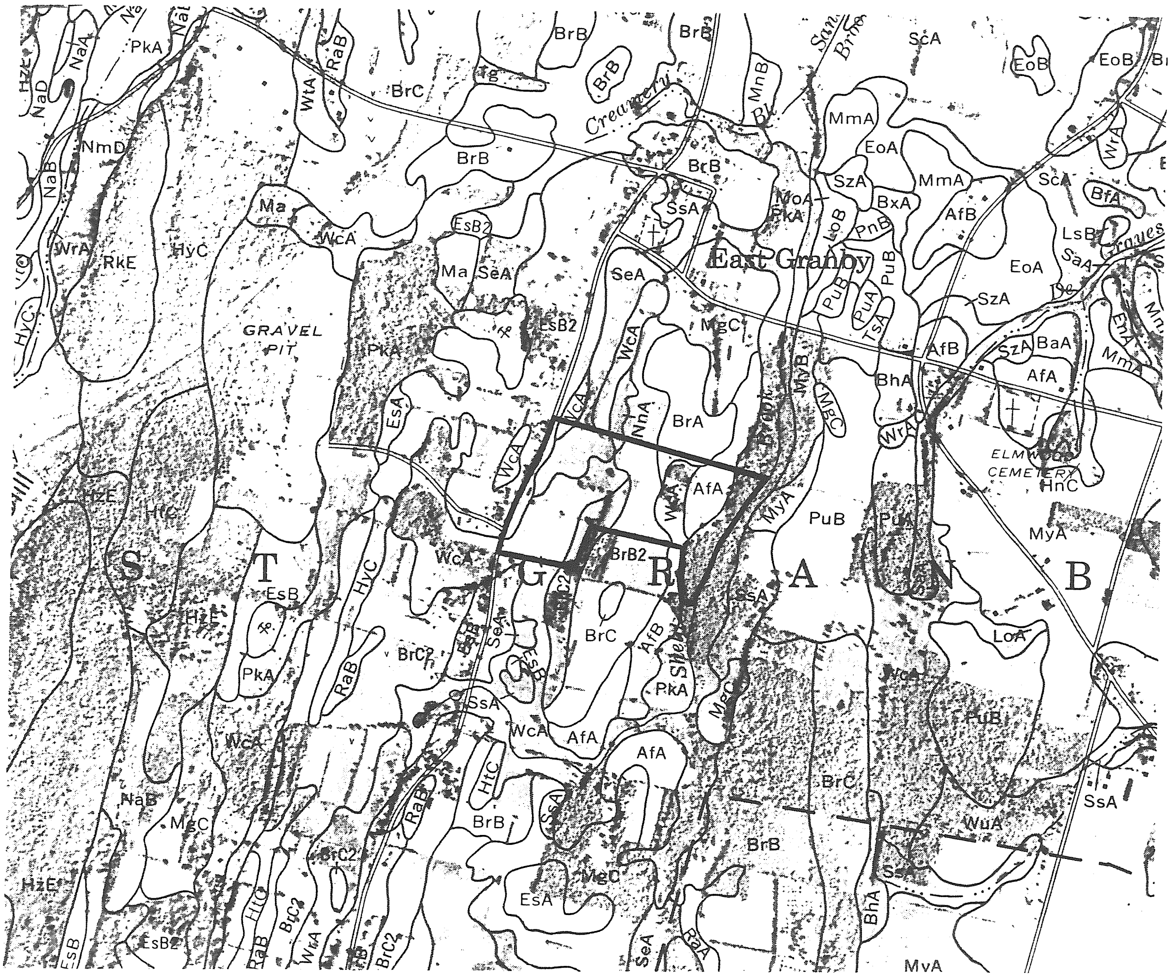
Scale 1" = 1667'



SOIL MAP LEGEND
Brooks Crossing

Map symbol	Soil name
AfA	Agawam fine sandy loam, 0 to 3 percent slopes
BrB2	Broadbrook silt loam, 3 to 8 percent slopes, eroded
BrC2	broadbrook silt loam, 8 to 15 percent slopes, eroded
EsB2	enfield silt loam, 3 to 8 percent slopes, eroded
SeA	scarboro loam, 0 to 3 percent slopes
PkA	peats and mucks
NnA	ninigret fine sandy loam, 0 to 3 percent slopes
WcA	walpole loam, 0 to 3 percent slopes

Wetland Review

Introduction

As indicated by the design of the currently proposed plan, it is evident that the applicant has taken positive steps to avoid impact not only to the wetland areas themselves but also the adjacent upland buffer area. Direct wetland impacts remain in the form of an access road and sanitary sewer crossings. Possible indirect impacts are also proposed including the introduction of pollutants via the stormwater management system as well as the introduction of excess sediment and nutrients as a result of soil erosion during the construction period. It is the responsibility of the applicant to prove to the East Granby Conservation/Inland Wetlands Commission (EGC/IWC) that all feasible and prudent alternatives to the proposed development have been considered and substantiate that the currently proposed design is the least environmentally damaging alternative.

Existing Conditions

The Delta Environmental Impact Assessment (EAI) is correct to emphasize the exceptional quality of wetlands "A" and "B". Their riparian nature automatically endows them with high value on the areas of flood control, nutrient retention and wildlife characteristics. The EAI affords a lower "moderate" value to wetland "C" however. From what the Team wetland specialist observed during the field inspection, he could not confirm this area as a "vernal pool" type wetland due to the lack of a clearly defined circular depression as well as the presence of a fairly distinct inlet and outlet to the wetland system. In a general sense, a description of "moderate" seems to be appropriate here. However, its lower value relative to wetlands "A" and "B" should not diminish the need to take "feasible and prudent" steps to avoid impacts to it.

Direct Impacts to Wetlands

Question 6 on the municipal inland wetlands and watercourses application indicates that the "Area of wetlands to be disturbed" is "N/A" or not not applicable. It is not clear why the applicant feels that the area of disturbed wetlands is not applicable on a wetlands application, however question #31 does list 20,200 square feet under "Area of material deposited." While the application does not indicate where this impact will occur, it is stated on page 19 of the Delta Environmental Impact Assessment (EIA) that "[T]he regulated activities proposed within the wetlands on the site are limited to the placement of fill along the existing wetlands roadway crossing." This does not appear to an accurate statement according to the set of site plans presented to the ERT. There is a second area of direct impact indicated on sheet SU-6 of the plan where the installation of a sanitary sewer line is proposed to traverse a portion of wetland "C" parallel to the existing water main.

Using an electronic planimeter, the Team wetland specialist arrived at a total figure of 40,155 square feet (0.92 acres) for these two separate, direct impact areas. This includes 37,559 square feet of impact for the road crossing and 2,596 square feet for the sanitary sewer crossing. Some of the discrepancy in the Team member impact area for the road and that listed on the application (a difference of 17,359 s.f.) may be the fact that he included all the area inside of the erosion control barrier, assuming that the narrow area between the grading limits and erosion control barriers would also likely be impacted as a result of erosion control barrier installation, grading activities and sediment accumulation (using the grading limits and stormwater outlets as a limit of impact he arrived at a figure pf 28,017 s.f.).

It is recommended that these revised total direct impact figures be listed on page one and four of the application as well as in the Delta EIA.

Indirect Impacts to Wetlands

The Delta EIA did a good job in describing the impacts that urban stormwater runoff may have on the water quality of the wetland systems, as well as the possibilities of wetland sedimentation as a result of erosion during the construction period. There are twelve (12) individual stormwater outlets proposed, each with either a "plunge pool" / "level spreader" devise, "diffusion trench" or "infiltration trench". Gross particle separators are also routinely used upstream of each outlet. The trenches are located well outside of the wetlands, however the plunge pool/level spreaders re located in or just outside of the wetland boundary.

The Delta EIA focused on the possible impacts to the Sanford Brook system as a result of the proposed development including a detailed discussion of the culverted crossing. Its conclusions indicate that with the currently proposed dual culvert crossing there was no overtopping of the road crossing "... during all of the storms that were modeled." These modeled storm events appear to be the 100-year and 25-year, 24-hour rainfall event.

According to the report, the proposed design would attenuate downstream increases in flood flows as well as "... allow for utilizing the stormwater storage capacity of the wetlands upstream of the crossing to control the downstream discharges. The selected design will assure that no increased flooding upstream of the culvert crossing will result." No summary table of net change to peak stormwater discharges for either the Sanford Brook or Sheldons Brook was found in this report.

The possibility of sedimentation of wetland areas on this property and watercourses flowing through and off of this property is significant given the upland soil types documented on the "Soil and Wetlands Boundary Map" contained in the Delta EIA (see Figure 3). All three of the primary upland soils on this parcel are listed on the USDA-NRCS publication *Highly Erodible Soil Map Units of Connecticut* (1986). The texture of these soils range from "fine sandy loam" to an even finer "silt loam." The fine particle size along with the natural slopes, (which were not designated on the Soils and Wetland Boundary Map) calculated off of the site plan to be as high as 18% in some places, indicate that proper erosion and sedimentation control is essential on this site.

Recommendations for Mitigation of Direct Impacts

When evaluating project impacts to wetlands and watercourses, section 22a-41(b) of the Connecticut General Statutes states that, in the case of an application which receives a public hearing, the inland wetlands agency must find that a feasible and prudent alternative with less impact to the proposed wetland alteration does not exist prior to issuing a wetlands permit. If the final design contains unavoidable wetland impacts, wetland restoration and/or creation that would act to replace the functional values lost by impacted, on-site wetlands should be discussed by the applicant and become a condition of the permit if the application is approved.

Due to the high value of the Sanford Brook riparian area, all alternatives which would avoid or minimize the impact associated with an improved crossing should be explored and the results placed on the record of the public hearing. Although basic alternatives to the proposed road crossing were summarily discussed during the ERT meeting, there does not seem to be any discussion in the supporting documents accompanying the application. The necessity for a 45 foot wide "boulevard" at the crossing should be documented by the applicant. If emergency access is an issue of concern, an evaluation could be made by the applicant, on the record, as to the possibility of providing a discreet emergency access from the north end of the property through the Higley Senior Complex. Narrowing the road to a standard width, or narrower if possible, would significantly reduce direct impacts to this valuable wetland area.

Another alternative which could be explored by the applicant would be to provide the main access from the south end via the middle/high school drive, (see Figure 4). This option may not be possible due to private land ownership along this southern boundary, however the common border between land owned by Brown and land owned by the Town of East Granby was not placed on the site plan.

Avoiding the direct impact associated with the proposed sanitary sewer crossing of wetland "C" could be accomplished by aligning the sewer line with the 8" water line that follows the proposed road west of wetland "C" or simply taking a shorter detour around the wetland area (see Figure 5).

Mitigation of Stormwater Quantity Impacts

Some of the conclusions stated within the Delta Hydrologic Analysis appear to be in conflict with one another. As mentioned earlier in this section, the report concludes that the proposed design would attenuate downstream increases in flood flows as well as " ... allow for utilizing the stormwater capacity of the wetlands upstream of the crossing to control downstream discharges. The selected design will assure that no increased flooding upstream of the culvert crossing will result." (Pg. 14). On the other hand it states that the wetland upstream of the crossing is detaining stormwater, but on the other it says that there will be no increased flooding upstream. Admittedly, the applicant's choice of dual 30 inch and 24 inch culverts was to detain stormwater in upstream wetlands. Page 11 of the Delta Hydrologic Report rejects the utilization of larger box culverts because it would increase peak discharges downstream presumably by passing through increased flood flows resulting from the development of this parcel.

A common recommendation made by this office is that existing wetlands should not be used as a detention system for stormwater runoff generated by development in adjacent upland areas. If stormwater detention is deemed necessary to guard against downstream erosion and flooding, upland areas adjacent to the wetlands should be used for purpose. Once proper detention is provided, the use of larger box culverts could once again be considered in order to minimize impacts on fisheries resources (refer to Fisheries Resources section of this report).

The majority of the proposed stormwater discharges appear to be in the Sheldons Brook watershed which is not addressed in the narrative of the Delta Hydrologic Report. During the ERT meeting, it was mentioned that a pre-existing detention system built for the industrial park would provide adequate detention of increased flood flows in the Sheldons Brook watershed as a result of this proposal. This condition should be substantiated within the applicant's supporting documents.

Finally, a clear, concise summary table of pre- and post- development peak flood flow discharges should be included in the documentation for both watershed areas.

Concerning the possible impacts of changes in the contributing watershed to wetland "C", the report states that approximately one half of the existing watershed will be re-routed as a result of the proposed stormwater management system. Although the applicant has made an attempt to mitigate for this impact, it still remains a significant alteration to the hydrology of this wetland area.

Mitigation of Stormwater Quality Impacts

Permanent mitigative measures used by the applicant to address stormwater quality issues are limited to gross-particle separators. The use of oil/water separators, vegetative swales, filter strips and landscape management practices are not apparent. although the 100 foot upland buffer to wetland "C" is utilized for the three stormwater outlets leading to it. The use of this measure alone is not a recommended Best Management Practice (BMP). According to *A Current Assessment of Urban Best Management Practices* (Metropolitan Washington Council of Governments,

1992) these structures have "limited pollutant removal capacity" when used alone due to its failure to trap finer grained particles, trace metals and organic matter." Page 16 of the Delta EIA lists pollutant removal percentages for grassed swales yet there were no such measures found proposed on the site plan. In addition, to be effective this BMP usually needs 100 to 200 feet linear dimensions to reach the removal efficiencies listed in the Delta EIA. Most of the proposed stormwater outlets are located just outside of the wetland boundary with insufficient flow length to wetlands to allow for a properly designed wetland swale. Finally, both of the above BMP's rely heavily on routine maintenance to be effective. No such maintenance schedule was found on the site plan or in the narrative.

A gross-particle separator design utilizing a baffled third chamber and/or inverted outlet pipe to retain oil and other floatables is recommended. An "anti-vortex" design may also be useful to reduce re-suspension of soil particles during storm events.

The most effective stormwater treatment system, according to several BMP manuals including the above reference and *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (EPA, 1993), is the wetland detention system. These structures are able to detain the proper amounts of stormwater for sufficient periods in order to remove a majority of pollutants.

Mitigation of Temporary Erosion and Sedimentation Impacts

The erosion and sedimentation (E&S) control plan relies heavily on a single row of silt fence and hay bales placed at the proposed construction limits. Silt fence should not be used as a primary "defense" as it is in this situation. Given the fine-grain nature of the soils here, it is recommended that additional E&S control measures be specifically located or mentioned in the E&S notes, included but not limited to small, temporary sedimentation basins, stormwater diversion structures and project phasing.

Much of the silt fence/hay bale proposed for this site is situated perpendicular to the slope. This arrangement tends to create more erosion than it controls due to the channelization of stormwater runoff as it slows downhill along the barrier. Silt fence is most effective when it is placed parallel to the slope.

Other items which should be added to the site plan to enhance E&S control efforts include:

1. A schedule of major construction activities (including erosion and sedimentation control measures), preferably in the form of a “Gant” type bar chart listing each activity in proper sequence and assigning to them start and stop dates,

2. Signatures and seals of the consulting engineer/land surveyor along with certification statement attesting to the accuracy of the information contained on the plans,

3. Non-wetland soil types as designated on USDA-NRCS Soil Survey or by a soil scientist including boundaries and map unit symbols (although included in the Delta report, it should be on the site pan which is to be referenced in the field),

4. Temporary erosion protection when time of year or weather prohibit establishment of permanent vegetative cover,

5. Planned temporary vegetation if disturbed areas are to remain for thirty (30) day or more,

6. Provisions for a pre-construction meeting to allow for coordination between the applicant, his primary contractors and municipal staff,

7. A statement which would allow for the inspection of the marked construction limits in the field prior to the construction start by a municipal staff.

Other Regulatory Programs

Maps on file in this office indicate the existence of a FEMA 100-year floodplain boundary bordering Sheldons Brook. The boundary should be transposed onto the site plan.

This project appears to fall under Category II of the new U.S. Army Corps of Engineers (ACOE) Programmatic General Permit (PGP) requiring screening by the Corps under their section 404 jurisdiction and screening by the DT DEP under our

Section 401 jurisdiction. For questions regarding these regulatory programs contact Ruth Ladd of the ACOE at 617-647-8338/800-343-4789 or Sally Synder of the CT DEP at 860-424-3019.

Construction activities covering five acres or more may require the applicant to apply to the CT DEP for a general permit for the discharge of stormwater under the National Pollutant Discharge Elimination System (NPDES) program. For further information on this permit program contact Christopher Stone of the DEP {Permitting Enforcement and Remediation Division at 860-424-3850).

Figure 3

Soils and Wetland Boundary Map

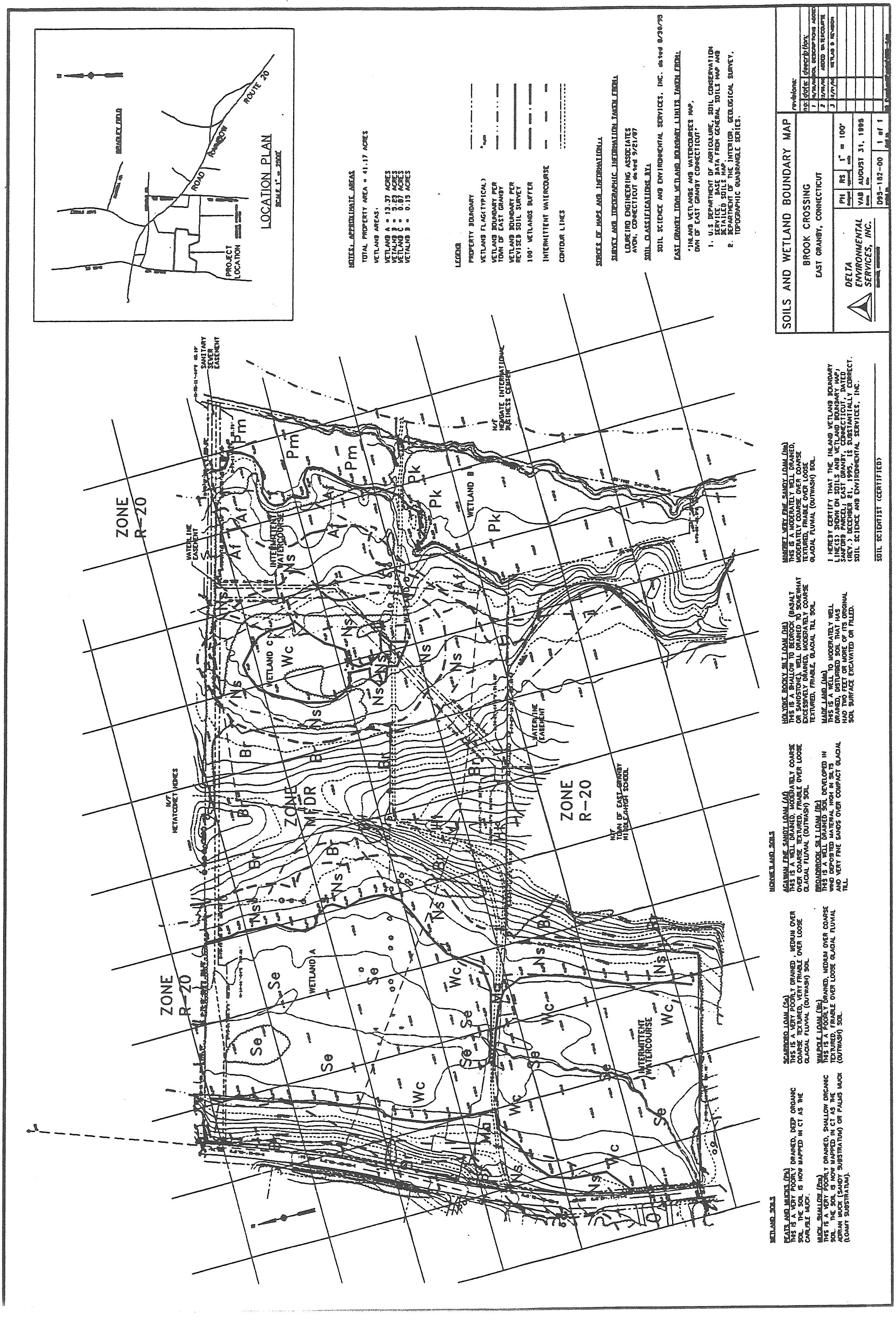


Figure 4

Alternate Access

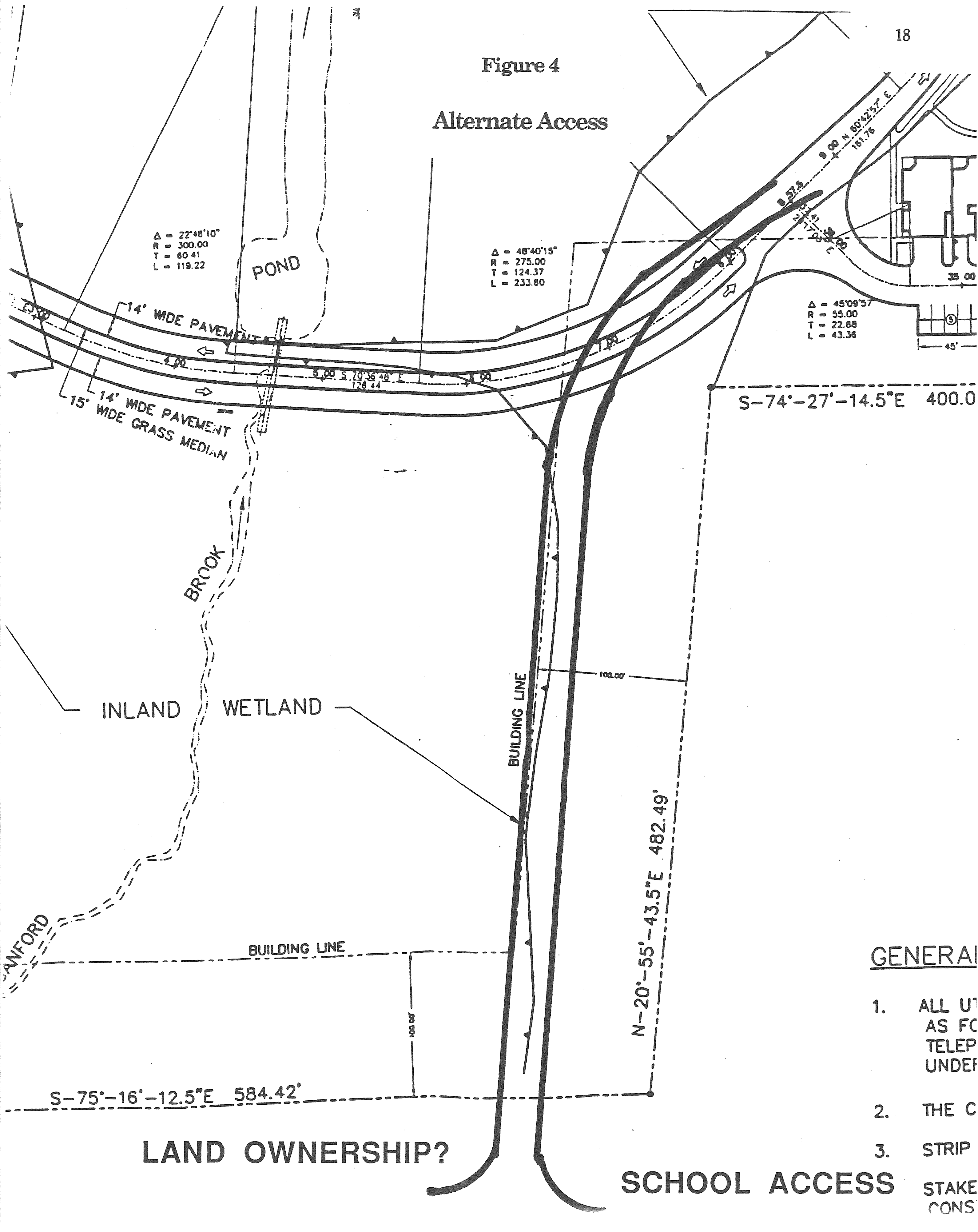
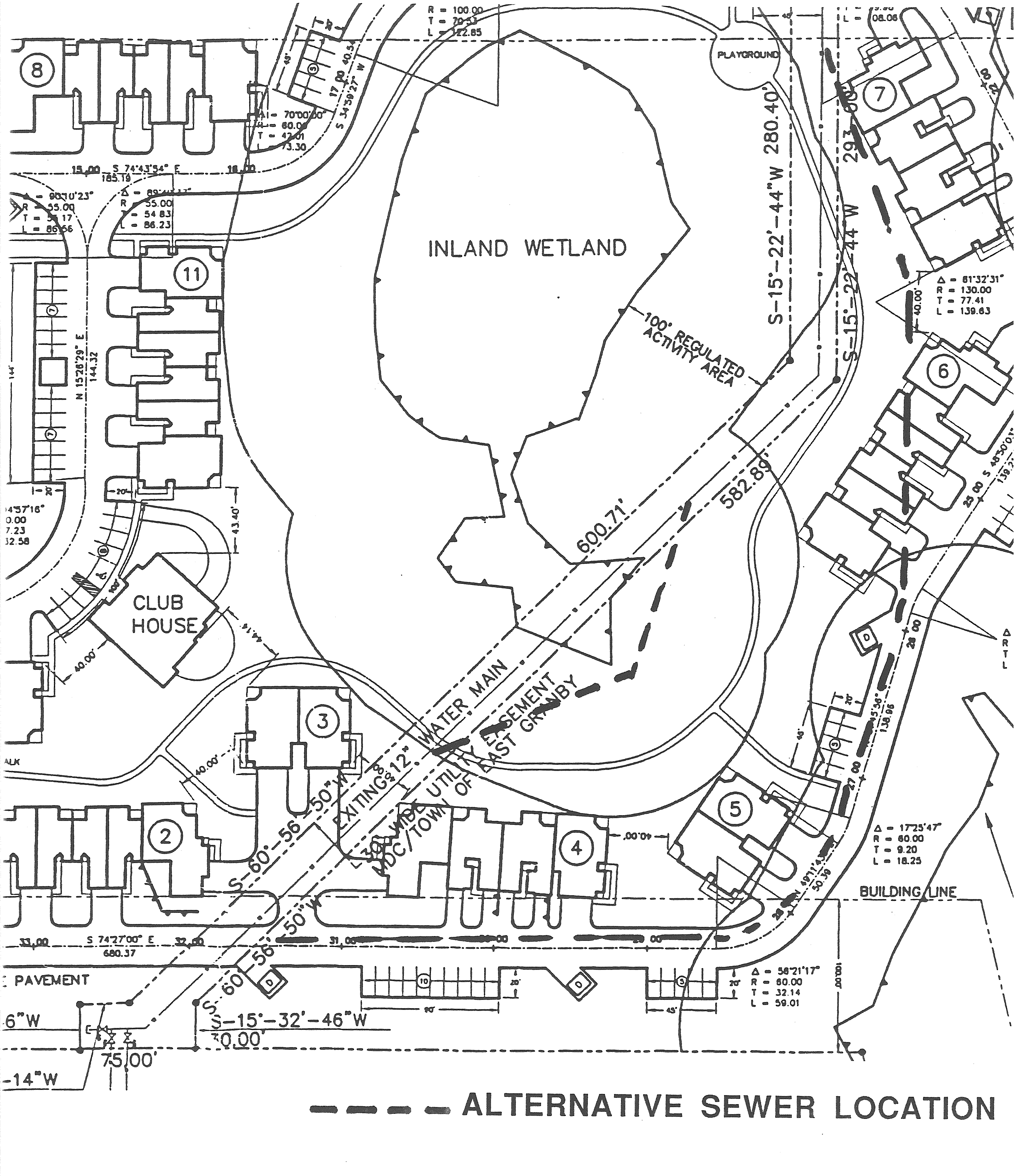


Figure 5


INLAND WETLAND
100' REGULATED ACTIVITY AREA
PLAYGROUND
CLUB HOUSE
EXITING 12" WATER MAIN
30' WIDE UTILITY EASEMENT ADC/TOWN OF EAST GRANBY
S-15°-22'-44"W 280.40'
S-60°-56'-50"W
600.71'
582.89'
BUILDING LINE
PAVEMENT
S-15°-32'-46"W
75.00'
S 74°27'00" E
680.37
S 74°43'54" E
185.19
N 15°26'29" E
144.32
ALTERNATIVE SEWER LOCATION

The Natural Diversity Data Base

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

Natural Diversity Data Base information includes all information regarding critical biological 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 substitutes 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.

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 the proposed site.

Fisheries Resources

Aquatic Habitats

Significant lengths of Sanford Brook and Sheldens Brook are located on the proposed project site. Both streams are low gradient with a meandering channel pattern and surface flow predominated by moving pool. Such physical characteristics can classify each as a coolwater, wetland stream resource. Development within the watershed has impacted surface water quality of both streams which, according to 1987 standards of the Department of Environmental Protection, are classified as "Class B/A" surface waters.

Through the proposed Brook Crossing site, Sanford Brook has a channel approximately 5 feet in width having bank full flow depths of 6 to 8 inches. Sheldens Brook is approximately 15 feet in width and water depths of 1.5 feet at bank full flow. Substrate of both streams is composed of gravel, coarse sand, and sand-silt fines. Dense growths of hardwoods and woody shrubs predominate as riparian vegetation. Physical in-stream habitat is provided by undercut banks and fallen woody debris.

As the site had formerly been used for agriculture, sections of both streams have been previously impacted by road crossings and a section of Sanford Brook excavated as a flow-through pond. Beaver activity has created a shallow flow-through pond in Sheldens Brook upstream of the former road crossing.

The DEP Fisheries Division has never conducted investigations into the aquatic resources of either Sanford Brook or Sheldens Brook. However, based upon Division investigations of similar streams in the immediate vicinity, both Sanford Brook and Sheldens Brook are anticipated to support a finfish population composed of grass pickerel, fallfish, tessellated darter, white sucker, and American eel. These species are commonly associated with cool water or wetland stream systems. The streams may also contain bluegill sunfish, pumpkinseed sunfish, redbreast sunfish, black crappie, largemouth bass, and golden shiner.

Impacts

Access to the proposed residential development is to be via a two lane boulevard from South Main Street (Route 187) which will require crossing Sanford Brook and associated wetlands. The proposed crossing structure is to be twin culvert pipes, one 24 inches in diameter and the other 30 inches. The roadway and crossing structure are designed to create a backwater or temporary retention of flood flows. Of concern is the crossing structure which will eliminate the existing open stream channel. The structure may also create a barrier to fish passage.

Stormwater runoff from the 88 unit residential development will be directed to permeable areas by way of sheet flow or collected in a stormwater drainage system discharging to underground chambers or surface detention/retention basins. While the development itself is not anticipated to require wetland fill, some stormwater drainage system structures will be within 100 feet of wetlands. Alteration of wetlands may indirectly impact the quality of water supplied to the surface watercourses.

Recommendations

The following should be considered in effort to mitigate impacts potentially affecting the aquatic resources of Sanford Brook and Sheldens Brook:

1. Relocate the proposed boulevard access road. It appears that it may be feasible that access to the site can be gained via the middle/high school roadway. This would eliminate crossing Sanford Brook and wetlands and could allow for a meaningful restoration of previously degraded stream and wetland habitat.

2. Maintain, at a minimum, a 100 foot open space buffer zone along the developments closest encroachment to all wetlands. This is to include areas destined for components of the stormwater drainage system. Research has indicated that buffer zones of this width prevent damage to aquatic ecosystems that are supportive of diverse species assemblages; these buffers absorb surface runoff, and the pollutants they may carry, before they enter wetlands and aquatic habitats. Please refer to Appendix B for documentation which presents Fisheries Division policy and position regarding riparian buffers.

3. 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. All disturbed areas should be revegetated in a timely manner upon site development completion.

4. Limit any permitted activities adjacent to riparian buffers to historic low precipitation periods of the year; reduced precipitation periods of summer - early fall provide the least hazardous conditions to work near sensitive aquatic environments.

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

Wildlife Review

Current Conditions

The 41.17 acres of field, shrubland, forest and wetland areas currently provide a variety of wildlife with their habitat requirements. Typical wildlife that may be found in the various habitat types on the property are listed below.

Upland Open Fields/Shrubland/Hedgerow Areas - Although the open field habitats are human-induced through mowing or other agricultural practices, they are valuable for wildlife ranging from meadow voles to white-tailed deer. With the abandonment of mowing or grazing, these habitat areas gradually become forested. Wildlife observed directly or indirectly utilizing the open field/shrubland/hedgerow areas were: white-tailed deer (*Odocoilius virginiana)*, coyote (*Canis latrans*), woodchuck (*Marmota monax*), cottontail rabbit (*Sylvilagus floridanus*), meadow vole (*Microtus pennsylvannicus)*, meadowlark (*Sturnella magna*), gray catbird (*Dumetella carolinensis)*, yellow warbler (*Dendroica petechia*), song sparrow (*Melospiza melodia*), northern flicker (*Colaptes auratus*), American robin (*Turdas migratorius*), northern cardinal (*Cardinalis cardinalis*), American goldfinch (*Carduelis tristis)* and red-winged blackbird (*Agelaius phoeniceus*).

Red Maple Wetland Area - This area referred to as wetland "C" in the Delta Environmental Impact Assessment (EIA), is a small but significant wetland. This wooded area has a predominant overstory of red maple (*Acer rubrum*). Although this area doesn't meet all the criteria for a vernal pool, there are numerous temporary small pools of water throughout the area. The wet seepy areas along with the accompanying lower canopy vegetation, dead wood, and rocks provide habitat for wildlife such as the Northern two-lined salamander (*Eurycea bislineata*), American toad (*Bufo a. americanus*), wood frog (*Rana sylvatica*) and Northern water snake (*Nerodia s. sipedon*). This wooded wetland and habitat conditions also may be frequented seasonally by hens with their young of turkeys (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), and American woodcock (*Scolopax minor*) searching for the variety insects associates with the moist habitat conditions. A variety of other songbirds will also utilize this habitat seasonally.

Beaver-Influenced Wetland Area - This area referred to as wetland "B" in the Delta

EIA, has had past beaver activity. Evidence of chewed vegetation was found in the vicinity of this wetland area. This area has experienced a rising water table which has caused the die-off of the standing trees and appears to be beaver-induced, in addition to the Delta report stating that the water pipeline caused some of it. Many of the standing dead trees in this area have excavated nesting cavities from primary excavators such as downy woodpecker (*Picoides pubescens*), which benefit secondary cavity-nesting wildlife such as great crested flycatcher (*Myiarchus crinitus)*, eastern bluebird (*Sialis sialis)*, and tree swallow (*Tachycineta bicolor*). The ponded water conditions are valuable to amphibians such as green frog (*Rana clamitans melanota*), bull frog (*Rana catesbeiana*), Northern spring peeper (*Pseudacris c. crucifer*), and reptiles such as painted turtle (*Chrysemys picta*) and common snapping turtle (*Chelydra s. serpentina*). Other wildlife that benefit from the swamp conditions is the wood duck (*Aix sponsa)*, green heron (*Butorius virescens)*, and great blue heron (*Ardea herodias*).

Open Water/Stream Riparian Area - The emergent and submergent vegetation of these areas provide habitat for many aquatic-based organisms such as fish, frogs, salamanders, toads, ducks, herons, muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor)*, deer and mink (*Mustela vison*). Vegetative diversity along the edges of Sheldon Brook provide valuable cover and shelter for wildlife as well as diverse food sources by way of berry production and lush vegetation for foraging.

Hedgerows and Field Row Edges - The edges of the property's fields and hedgerows contain a variety of early successional shrub and medium-sized trees which are valuable berry producers for some of the resident wildlife as well as migrating songbirds. Notably, there is gray dogwood (*Cornus racemosa*), silky dogwood (*Cornus amomum*), elderberry (*Sambucus canadensis*) arrowwood viburnum (*Viburnum recognitum*), choke cherry (*Prunus virginiana*) and black cherry (*Prunas serotina*). Interspersed with the native vegetation are some invasive non-native species such as multi-flora rose (*Rosa multiflora*) and oriental bittersweet (*Celastrus orbiculatus*).

Potential Impacts and Recommendations for Reducing Impacts

Impacts #1 - The Sanford Brook crossing, filling and alterations associated with the boulevard access road. Currently, wetland "A" is somewhat impacted by the old farm road, but overall it is contiguous. Wildlife can currently travel through the wetland with little interruption of habitat along the stream. The ability for wildlife to travel across and through the wetland and stream corridor increases its value. The proposed boulevard requires filling and crossing the brook with pipe culverts. The proposed alterations may affect the travel of some wildlife along the stream corridor.

Recommendations for Reducing Impact #1

A - Utilize a span bridge for the brook crossing, thereby allowing for the free flow of wildlife along the brook without having to traverse over a boulevard or go through narrow culverts.

B - Select an alternative access road to avoid crossing Sanford Brook. For example: Can access be gained by improving the middle/high school access road to the south of the crossing?

Impact #2 - Wetland "C" is being encircled by roads and buildings with no connection by means of a vegetated corridor to adjoining wetlands or other habitat areas.

Recommendations for Reducing Impact #2

Maintaining a strip of natural woody vegetation that connect wetland "C" to wetland "B", preferably in the area located northeast of the proposed buildings labeled number 5. The width of the strip should be maximized to whatever is practically feasible.

Impact #3 - Post development will have reduced the size of the watershed flowing to wetland "C". Will this affect the water table and cause drying up of this wetland? If the water table is lowered then this will reduce the quality of the wetland to wildlife.

Recommendation for Reducing Impact #3

Artificially enhance the water table to maintain existing water table averages.

Other Recommendations

Maintain natural vegetation along hedgerows, borders of roads or other developed areas within the project area. Although most of the upland area is being developed, hedgerows and edges can provide fall foods for migratory songbirds, as well as resident birds. To prevent further introduction of escaped non-native exotics into the surrounding landscape, use of any non-native invasive planting stock for landscaping of the buildings and grounds is not recommended. In buffer areas where vegetation is to be established, native plant sources should be used as much as possible which are complimentary to existing vegetative types. A list of invasive non-native plant species to avoid can be provided upon request.

Summary and Discussion

This report was limited by time and further investigations may have revealed other recommendations to the overall project proposal. The wildlife concerns were delineated in this report by stating potential impacts and recommendations to reduce the impacts.

An alternative brook crossing design utilizing a bridge to span Sanford Brook is recommended to allow the uninterrupted travel of wildlife along the brook and the riparian corridor. Another recommendation is to look at the feasibility of an alternative access road, in particular, modifying the existing middle/high school access road.

The non-wetland areas are going to be densely developed which will alter the existing open field and shrubland conditions to the detriment of meadowlarks and other wildlife that occupy that habitat type. Some of the generalist wildlife species with broad habitat requirements such as deer, coyote, will continue to utilize the undeveloped wetlands and buffer areas, but much of the foraging habitat will be reduced.

Some schools in Connecticut are utilizing open spaces for learning about local natural resources. The brooks and associated wetland resources on this property can be valuable in this regard to local schools. The Team wildlife biologist is available for further consultation on this subject.

Archaeological Review

The project area location along a drumlin-like feature by Sanford and Sheldons Brooks and associated wetlands suggests a moderate to high sensitivity for Native American archaeological resources. The Office of State Archaeology and the State Historic Preservation Office's (SHPO) statewide inventory notes a reported prehistoric archaeological site (#40-1) located in close proximity to the project area. A reconnaissance survey by a professional archaeologist is recommended to identify and evaluate archaeological resources which may be located within project limits.

If the proposed development will be subject to Army Corps of Engineers (ACOE) Section 404 or Programmatic General Permit requirements, then the applicant will need to resolve (on behalf of the ACOE) the archaeological sensitivity of the project area in accordance with the National Historic Preservation Act of 1966. All archaeological studies should be carried out in accordance with SHPO's *Environmental Review Primer for Connecticut's Archaeological Resources.*

The proposed development will be located adjacent to the East Granby Historic District, which is listed on the National Register of Historic Places. The proposed access road will require demolition of an agricultural barn, historically associated with 58 South Main Street. The barn is a contributing property (#159) with the East Granby National Register Historic District.

At the request of the developer, the SHPO (in its role as Connecticut Historical Commission) previously assessed the proposed demolition of this historic barn pursuant to the Connecticut Environmental Protection Act. The SHPO concurs with the developer that no feasible or prudent alternative exists which would effectively accomplish preservation and/or adaptive use of the extant barn, while minimizing wetland impacts and traffic-related sightlines. As such, SHPO has decided that no further action is required under the provisions of the Connecticut Environment Protection Act.

However, if ACOE regulatory review is required, then the proposed demolition of this historic structure would be subject to coordination vis-a-vis the National Historic Preservation Act of 1966. In accordance with 36 CFR 800 (federal regulations which implement the historic preservation provisions of the National Historic Preservation Act of 1966), the proposed demolition would represent an adverse effect upon the rural agricultural character of this historic district. However, based upon its prior review of the access road alternatives, the SHPO, ACOE (on behalf of the permit applicant), and the Advisory Council on Historic Preservation would require further coordination regarding the identification of pertinent mitigation measures.

The proposed housing clusters may also represent a visual intrusion upon the small-scale residential character of the East Granby National Register Historic District. SHPO strongly recommends the maximum retention of mature tree species which front the development along South Main Street. The existing trees will serve as a visual buffer between the proposed new construction and historic houses along Main Street. In addition, SHPO encourages the developer and the East Granby Planning and Zoning Commission to focus upon the overall architectural design and site layout as viewed from South Main Street. It is important to note that in the proposed site plan the side and rear elevations of several housing clusters will be oriented towards South Main Street. As such, design review should emphasize the character and detail of these elevations (which normally are not a focus of architectural concern) vis-a-vis potential visual compatibility with existing South Main Street properties.

The Office of State Archaeology and State Historical Preservation Office are prepared to offer any technical assistance in conducting the recommended archaeological survey and National register concerns.

DOT Comments

It appears as though the proposed residential development will not impact the existing roadway system. It is recommended however, that optimum sight line distances be attained. Also, any changes in the design plans should accompany a revised traffic analysis. Adequate sedimentation control devices should be in place when construction commences.

Planning Comments

1. The residential use appears to be compatible with surrounding uses - elderly housing and the middle/high school. The agricultural zone to the east may eventually be rezoned and converted to another use, perhaps industrial. Therefore, existing landscaping should be preserved in as much as is feasible and additional plantings should be added to ensure that mature buffering exists for some time in the future.

2. The development in general will benefit from preserving as much native mature landscaping as possible.

3. A pedestrian friendly approach should be taken. Some effort to connect this development with the abutting senor housing could be made via walking trails, exercise paths or even unpaved cleared paths of sufficient width. This link will allow residents of both complexes to feel they are a part of a community rather than one isolated development.

4. To avoid disturbance to the wetlands on Route 187, an alternative entrance should be thoroughly explored. Some opportunities may exist off-site with an ability to tie into buildable non-wetland areas of the site.

5. Site distances along Route 187 appear to be adequate for the proposed curb cut.

6. Implementation and maintenance of sediment and erosion control measures will be essential. The developer should designate one individual to be responsible for maintenance of sediment and erosion control measures and report to the town wetland enforcement officer if problems occur.

7. A "phasing" plan should be adopted whereby only part of the site is disturbed at any given time until it can be stabilized.

8. A conservation easement should be drafted to preserve the wetland areas on site.

9. Once approval is granted for the development, a detailed time frame for installation and maintenance of sediment and erosion control measures should be

drafted, submitted, and updated for use by the wetlands enforcement official monitoring the site.

10. The use of the club house should be restricted to residents of the development. Otherwise, parking problems may occur which may impede access by emergency vehicles.

11. Interior drives should be reviewed by the fire marshal to ensure that access by emergency vehicles will not be compromised.

Appendix A

Soils Information

1. Non-Technical Soils Description Report
2. Hydric Soils List
3. Water Features Table
4. Water Management Report
5. Building Site Development Report
6. Physical Properties of Soils

NONTECHNICAL SOILS DESCRIPTION REPORT
Brooks Crossing

Map Symbol	Soil name and description
AfA	Agawam fine sandy loam, 0 to 3 percent slopes This nearly level, well drained soil formed in sandy water deposited materials. It is on outwash plains and stream terraces. Depth to bedrock is commonly more than 60 inches below the surface. The water table is commonly below a depth of 6 feet. Permeability is moderately rapid in the surface layer and upper part of the subsoil, moderately rapid or rapid in the lower part of the subsoil, and rapid in the substratum. Surface runoff is slow and the available water capacity is moderate.
BrB2	Broadbrook silt loam, 3 to 8 percent slopes, eroded This gently sloping, well drained loamy soil formed in silty mantled compact glacial till on uplands. It is on till plains, low ridges, and drumlins. Depth to bedrock is commonly greater than 60 inches below the surface. This soil has a seasonal high water table that is perched at a depth of about 2 feet for a short period in early spring. Permeability is moderate in the surface layer and subsoil, and slow or very slow in the dense substratum. Surface runoff is medium to rapid and the available water capacity is moderate.
BrC2	broadbrook silt loam, 8 to 15 percent slopes, eroded This sloping, well drained soil formed in loamy glacial till. It is on the sides of drumlins and hills on glacial till uplands. Depth to bedrock is commonly more than 60 inches from the surface. The water table is commonly below a depth of 6 feet. Permeability is moderate in the surface layer and subsoil and slow or very slow in the substratum. Surface runoff is rapid and the available water capacity is high.
EsB2	enfield silt loam, 3 to 8 percent slopes, eroded

Map Symbol	Soil name and description
	This gently sloping, well drained loamy soil formed in silty mantled glacial outwash. It is on outwash plains and terraces. Depth to bedrock is commonly greater than 60 inches below the surface. The water table is commonly below a depth of 6 feet. Permeability is moderate in the surface layer and subsoil, and very rapid in the substratum. Surface runoff is slow to medium and the available water capacity is moderate.
SeA	scarboro loam, 0 to 3 percent slopes
	This nearly level, very poorly drained soil is formed in sandy glaciofluvial deposits. It is in low depressions of outwash plains and terraces. Depth to bedrock is commonly more than 60 inches below the surface. The soil has a seasonal high water table at or near the surface from fall until late spring. Permeability is rapid in the surface layer and very rapid in the substratum. Surface runoff is slow to very slow and water is on the surface of some areas. This soil has low available water capacity.
PkA	peats and mucks
	This nearly level, very poorly drained soil formed in deep organic materials. It is in low depressions on outwash terraces and glacial till plains. Bedrock is commonly more than 60 inches below the surface. The soil has a water table at or near the surface during most of the year, and water is ponded on some areas in the fall through spring and after heavy rains. Permeability is slow to moderately rapid. Surface runoff is very slow and the available water capacity is high.
NnA	ninigret fine sandy loam, 0 to 3 percent slopes

NONTECHNICAL SOILS DESCRIPTION REPORT
Brooks Crossing

Map Symbol	Soil name and description
	This level to nearly level, moderately well drained soil formed in loamy over sandy and gravelly glacial outwash. It is on outwash terraces in slight depressions and broad drainageways. Depth to bedrock is commonly greater than 60 inches below the surface. The soil has a seasonal high water table at a depth of about 20 inches from fall to spring. Permeability is moderate or moderately rapid in the surface layer and subsoil, and rapid or very rapid in the substratum. Surface runoff is slow to medium and the available water capacity is moderate.
WcA	walpole loam, 0 to 3 percent slopes
	This nearly level, poorly drained soil formed in loamy over sandy and gravelly glacial outwash. It is in shallow drainage ways and low-lying positions on terraces and outwash plains. Depth to bedrock is commonly more than 60 inches below the surface. The soil has a seasonal high water table at or near the surface much of the year. Permeability is moderate in the surface layer and subsoil and rapid or very rapid in the substratum. Surface run off is slow and the available water capacity is high.

HYDRIC SOILS LIST
MAPUNITS WITH HYDRIC COMPONENTS
Brooks Crossing

The "Hydric Soils Criteria" columns indicate the conditions that caused the mapunit component to be classified as "Hydric" or "Non-Hydric". These criteria are defined in "Hydric Soils of the United States" (USDA Miscellaneous Publications No. 1491, June, 1991. The "FSA Criteria" columns contain information needed for the Food Security Act determinations required by Section 512.11(h)(4) of the National Food Security Manual (August, 1991). See the "Criteria for Hydric Soils" endnote to to determine the meaning of these columns. Spot symbols are footnoted at the end of the report.

Map Symbol Mapunit Name	Component(C)/ Inclusion(I)	Hydric	Local Landform	Hydric Soils Criteria				FSA Criteria and Information	
				Hydric Criteria Code	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria	Natural Condition of Soil	Needs On-Site
SeA:									
scarboro loam, 0 to 3									
percent slopes--------	SCARBORO (C)-	YES	Outwash Plain	2B2,3	YES	NO	YES	Wooded	
	PALMS (I)----	YES	Swamp	1,3	NO	NO	YES		
	RAYPOL (I)---	YES	Outwash Plain	2B3	YES	NO	NO		
	SACO (I)-----	YES	Flood Plain	2B3	YES	NO	NO		
	WALPOLE (I)--	YES	Outwash Plain	2B3	YES	NO	NO		
PkA:									
peats and mucks-------	CARLISLE (C)-	YES	Swamp	1,3	NO	NO	YES	Wooded	
	MENLO (I)----	YES	Depression	2B3,3	YES	NO	YES		
	PALMS (I)----	YES	Swamp	1,3	NO	NO	YES		
	SACO (I)-----	YES	Flood Plain	2B3,4	YES	YES	NO		
	SCARBORO (I)-	YES	Swamp	2B2,3	YES	NO	YES		
	WHITMAN (I)--	YES	Depression	2B3,3	YES	NO	YES		
WcA:									
walpole loam, 0 to 3									
percent slopes--------	RAYPOL (C)---	YES	Outwash Terrace	2B3	YES	NO	NO	Wooded	
	NINIGRET (I)-	NO							
	RAYNHAM (I)--	YES	Outwash Plain	2B3	YES	NO	NO		
	SCARBORO (I)-	YES	Outwash Plain	2B2,3	YES	NO	YES		
	TISBURY (I)--	NO							
	WALPOLE (I)--	YES	Outwash Plain	2B3	YES	NO	NO		

HYDRIC SOILS LIST
MAPUNITS WITH HYDRIC INCLUSIONS
Brooks Crossing

The "Hydric Soils Criteria" columns indicate the conditions that caused the mapunit component to be classified as "Hydric" or "Non-Hydric". These criteria are defined in "Hydric Soils of the United States" (USDA Miscellaneous Publications No. 1491, June, 1991. The "FSA Criteria" columns contain information needed for the Food Security Act determinations required by Section 512.11(h)(4) of the National Food Security Manual (August, 1991). See the "Criteria for Hydric Soils" endnote to to determine the meaning of these columns. Spot symbols are footnoted at the end of the report.

Map Symbol Mapunit Name	Component(C)/ Inclusion(I)	Hydric	Local Landform	Hydric Soils Criteria				FSA Criteria and Information	
				Hydric Criteria Code	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria	Natural Condition of Soil	Needs On-Site
BrB2: Broadbrook silt loam, 3 to 8 percent slopes, eroded	Broadbrook (C)	NO							
	CHESHIRE (I)	NO							
	NARRAGANSETT (I)	NO							
	RAINBOW (I)	NO	Depression	2B3	YES	NO	NO		
	RIDGEBURY (I)	YES							
	WETHERSFIELD (I)	NO	Depression	2B3	YES	NO	NO		
	WILBRAHAM (I)	YES							
NnA: ninigret fine sandy loam, 0 to 3 percent slopes	NINIGRET (C)	NO							
	AGAWAM (I)	NO							
	ELMRIDGE (I)	NO							
	ENFIELD (I)	NO							
	HAVEN (I)	NO							
	SUDBURY (I)	NO	Outwash Plain	2B3	YES	NO	NO		
	WALPOLE (I)	YES							

HYDRIC SOILS LIST
NON-HYDRIC MAPUNITS
Brooks Crossing

The "Hydric Soils Criteria" columns indicate the conditions that caused the mapunit component to be classified as "Hydric" or "Non-Hydric". These criteria are defined in "Hydric Soils of the United States" (USDA Miscellaneous Publications No. 1491, June, 1991. The "FSA Criteria" columns contain information needed for the Food Security Act determinations required by Section 512.11(h)(4) of the National Food Security Manual (August, 1991). See the "Criteria for Hydric Soils" endnote to to determine the meaning of these columns. Spot symbols are footnoted at the end of the report.

Map Symbol Mapunit Name	Component(C)/ Inclusion(I)	Hydric	Local Landform	Hydric Soils Criteria				FSA Criteria and Information	
				Hydric Criteria Code	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria	Natural Condition of Soil	Needs On-Site
AfA: Agawam fine sandy loam, 0 to 3 percent slopes	Agawam (C)	NO							
	HAVEN (I)	NO							
	MERRIMAC (I)	NO							
	NINIGRET (I)	NO							
BrC2: broadbrook silt loam, 8 to 15 percent slopes, eroded	Broadbrook (C)	NO							
	CHESHIRE (I)	NO							
	NARRAGANSETT (I)	NO							
	RAINBOW (I)	NO							
	WETHERSFIELD (I)	NO							
EsB2: enfield silt loam, 3 to 8 percent slopes, eroded	Haven (C)	NO							
	AGAWAM (I)	NO							
	ELLINGTON (I)	NO							
	NINIGRET (I)	NO							
	TISBURY (I)	NO							

HYDRIC SOILS CRITERIA CODES AND DEFINITIONS

Endnote -- HYDRIC SOILS LIST

The column 'Natural Condition of the Soil' indicates the following information: 'Wooded' indicates the soil supports woody vegetation under natural condition; 'Farmable' indicates the soil can be farmed under natural conditions without removing woody vegetation or other manipulation; and 'Neither' indicates neither of the above conditions are met.

1. All Histosols, except Folists, or

2. Soils Aquic suborder, Aquic subgroup, Albolls suborder, Salorthids great group, Pell great group of Vertisols, Pachic subgroup, or Cumulic subgroups that are:

   a. somewhat poorly drained and have a frequently occuring water table less than 0.5 feet from the surface for a significan period (usually 14 consecutive days or more) during the growing season, or
   b. poorly drained or very poorly drained and have either:

      (1) a frequently occuring water table less than 0.5 feet from the surface for a significant period (usually 14 consecut days or more) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inc or for other soils,

      (2) a frequently occuring water table less than 1.0 feet from the surface for a significant period (usually 14 consecut days or more) during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within inches, or

      (3) a frequently occuring water table less than 1.5 feet from the surface for a significant period (usually 14 consecut days or more) during the growing season if permeability is less than 6.0 in/hr in any layers within 20 inches, or

3. Soils that are frequently ponded for long or very long duration during the growing season, or

4. Soils that are frequently flooded for long or very long duration during growing season.

WATER FEATURES
Brooks Crossing

Map symbol and soil name	Hydro-logic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
AfA:									
Agawam----------	B	None	---	---	>6.0	---	---	---	---
BrB2:									
Broadbrook------	C	None	---	---	1.5-2.5	Perched	Feb-Apr	---	---
BrC2:									
Broadbrook------	C	None	---	---	1.5-2.5	Perched	Feb-Apr	---	---
EsB2:									
Haven-----------	B	None	---	---	>6.0	---	---	---	---
SeA:									
SCARBORO--------	D	None	---	---	---	Apparent	Jan-Dec	Long	1.0
PkA:									
CARLISLE--------	A/D	None	---	---	---	Apparent	Sep-Jun	---	0.5
NnA:									
NINIGRET--------	B	None	---	---	1.5-2.5	Apparent	Nov-Apr	---	---
WcA:									
RAYPOL----------	C	None	---	---	0.0-1.0	Apparent	Nov-May	---	---

WATER FEATURES

Endnote -- WATER FEATURES

This report gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms. The four hydrologic soil groups are:

Group " A". Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group "B". Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group "C". Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group "D". Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in this report, the first letter is for drained areas and the second is for undrained areas. Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes. This report gives the frequency and duration of flooding and the time of year when flooding is most likely. Frequency, duration, and probable dates of occurrence are estimated.

Frequency is expressed as "None", "Rare", "Occasional", and "Frequent". "None" means that flooding is not probable; "Rare" that it is unlikely but possible under unusual weather conditions; "Occasional" that it occurs, on the average, once or less in 2 years; and "Frequent" that it occurs, on the average, more than once in 2 years.

Duration is expressed as "Very brief" if less than 2 days, "Brief" if 2 to 7 days, "Long" if 7 to 30 days, and "Very long" if more than 30 days. The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding. Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods.

WATER FEATURES

Endnote -- WATER FEATURES--Continued

Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in this report are the depth to the seasonal high water table; the kind of water table, that is, "Apparent", "Artesian", or "Perched"; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in this report.

An "Apparent" water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

An "Artesian" water table exists under a hydrostatic beneath an impermeable layer. When the impermeable layer has been penetrated by a cased borehole, the water rises. The final level of the water in the cased borehole is characterized as an artesian water table.

A "Perched" water table is water standing above an unsaturated zone. In places an upper, or "Perched", water table is separated from a lower one by a dry zone. Only saturated zones within a depth of about 6 feet are indicated.

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, evaporation, or a combination of these processes.

This report gives the depth and duration of ponding and the time of year when ponding is most likely. Depth, duration, and probable dates of occurrence are estimated.

Depth is expressed as the depth of ponded water in feet above the soil surface. Duration is expressed as "Very brief" if less than 2 days, "Brief" if 2 to 7 days, "Long" if 7 to 30 days, and "Very long" if more than 30 days. The information is based on the relation of each soil on the landscape to historic ponding and on local information about the extent and levels of ponding.

WATER MANAGEMENT
Brooks Crossing

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigatio

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterway
AfA: Agawam----------	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Favorable	Too sandy	Favorable
BrB2: Broadbrook------	Moderate: slope	Severe: piping	Severe: no water	Deep to water	Slope, percs slowly, rooting depth	Erodes easily, percs slowly	Erodes easi rooting de percs slow
BrC2: Broadbrook------	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope, percs slowly, rooting depth	Slope, erodes easily, percs slowly	Slope, erodes eas rooting de
EsB2: Haven-----------	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Slope, erodes easily	Erodes easily, too sandy	Erodes easi
SeA: SCARBORO--------	Severe: seepage	Severe: seepage, piping, ponding	Severe: cutbanks cave	Ponding, frost action, cutbanks cave	Ponding, droughty, fast intake	Ponding, too sandy	Wetness, droughty
PkA: CARLISLE--------	Severe: seepage	Severe: excess humus, ponding	Severe: slow refill	Ponding, subsides, frost action	Ponding, soil blowing	Ponding, soil blowing	Wetness
NnA: NINIGRET--------	Severe: seepage	Severe: seepage, wetness	Severe: cutbanks cave	Frost action, cutbanks cave	Wetness	Erodes easily, wetness	Erodes easi
WcA: RAYPOL----------	Severe: seepage	Severe: seepage, wetness	Severe: cutbanks cave	Frost action, cutbanks cave	Wetness, erodes easily	Erodes easily, wetness, too sandy	Wetness, erodes eas

WATER MANAGEMENT

Endnote -- WATER MANAGEMENT

This report gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes and levees; and aquifer-fed excavated ponds. The limitations are considered "Slight" if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; "Moderate" if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and "Severe" of soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.
This report also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways

POND RESERVOIR AREAS hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

EMBANKMENTS, DIKES, AND LEVEES are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this report, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction. The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties. Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

AQUIFER-FED excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

DRAINAGE is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium , or sulfur. Availability of drainage outlets is not considered in the ratings.

WATER MANAGEMENT

Endnote -- WATER MANAGEMENT--Continued

IRRIGATION is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

TERRACES AND DIVERSIONS are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

GRASSED WATERWAYS are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

BUILDING SITE DEVELOPMENT
Brooks Crossing

(The information in this report indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AfA:						
Agawam----------	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Slight
BrB2:						
Broadbrook------	Moderate: dense layer, wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness, slope	Moderate: wetness, frost action	Slight
BrC2:						
Broadbrook------	Moderate: dense layer, wetness, slope	Moderate: wetness, slope	Moderate: wetness, slope	Severe: slope	Moderate: wetness, slope, frost action	Moderate: slope
EsB2:						
Haven-----------	Severe: cutbanks cave	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
SeA:						
SCARBORO--------	Severe: cutbanks cave, excess humus, ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding, frost action	Severe: ponding
PkA:						
CARLISLE--------	Severe: excess humus, ponding	Severe: subsides, ponding, low strength	Severe: subsides, ponding, low strength	Severe: subsides, ponding, low strength	Severe: subsides, ponding, frost action	Severe: ponding, excess humus
NnA:						
NINIGRET--------	Severe: cutbanks cave, wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness

BUILDING SITE DEVELOPMENT--Continued
Brooks Crossing

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WcA:						
RAYPOL----------	Severe: cutbanks cave, wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action	Severe: wetness

BUILDING SITE DEVELOPMENT

Endnote -- BUILDING SITE DEVELOPMENT

This report shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are "Slight", "Moderate", or "Severe". The limitations are considered "Slight" if soil properties and site features are generally favorable for the indicated use and limitaions are minor and easily overcome; "Moderate" if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and "Severe" if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

SHALLOW EXCAVATIONS are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or bands to sloughing or caving is affected by soil texture and the depth to the water table.

DWELLINGS AND SMALL COMMERCIAL BUILDINGS are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

LOCAL ROADS AND STREETS have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

LAWNS AND LANDSCAPING require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

PHYSICAL PROPERTIES OF SOILS
Brooks Crossing

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodability index" apply only to the surface layer)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in		Pct					
AfA:												
Agawam----------	0-8	4-10	1.10-1.20	2.00-6.00	0.15-0.21	Low	1.0-5.0	0.28	---	3	---	---
	8-26	1-10	1.20-1.40	2.00-6.00	0.11-0.21	Low	---	0.37	---			
	26-36	1-6	1.30-1.40	2.00-6.00	0.11-0.18	Low	---	0.28	---			
	36-60	1-2	1.30-1.40	6.00-20.00	0.02-0.12	Low	---	0.17	---			
BrB2:												
Broadbrook------	0-8	4-10	1.10-1.35	0.60-2.00	0.14-0.24	Low	2.0-5.0	0.32	---	3	---	---
	8-26	4-10	1.35-1.60	0.60-2.00	0.12-0.22	Low	---	0.43	---			
	26-65	2-10	1.70-2.00	0.00-0.20	0.05-0.12	Low	---	0.24	---			
BrC2:												
Broadbrook------	0-8	4-10	1.10-1.35	0.60-2.00	0.14-0.24	Low	2.0-5.0	0.32	---	3	---	---
	8-26	4-10	1.35-1.60	0.60-2.00	0.12-0.22	Low	---	0.43	---			
	26-65	2-10	1.70-2.00	0.00-0.20	0.05-0.12	Low	---	0.24	---			
EsB2:												
Haven-----------	0-8	5-18	1.10-1.40	0.60-2.00	0.15-0.25	Low	2.0-6.0	0.32	---	3	---	---
	8-26	2-18	1.25-1.55	0.60-2.00	0.08-0.12	Low	---	0.24	---			
	26-60	0-3	1.45-1.65	>20.00	0.01-0.03	Low	---	0.17	---			
SeA:												
SCARBORO--------	0-8	1-7	0.70-1.00	6.00-20.00	0.10-0.23	Low	---	0.17	---	5	---	---
	8-22	1-5	1.15-1.35	6.00-20.00	0.04-0.13	Low	---	0.17	---			
	22-36	0-2	1.35-1.55	6.00-20.00	0.02-0.13	Low	---	0.10	---			
	36-60	0-2	1.35-1.55	6.00-20.00	0.01-0.13	Low	---	0.10	---			
PkA:												
CARLISLE--------	0-66	---	0.13-0.23	0.20-6.00	0.35-0.45		70-99	---	---	5	2	---
NnA:												
NINIGRET--------	0-8	3-12	1.00-1.25	0.60-6.00	0.15-0.24	Low	2.0-5.0	0.32	---	3	---	---
	8-30	3-12	1.35-1.60	0.60-6.00	0.14-0.22	Low	---	0.37	---			
	30-60	0-2	1.45-1.70	6.00-20.00	0.01-0.10	Low	---	0.15	---			

PHYSICAL PROPERTIES OF SOILS--Continued
Brooks Crossing

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
WcA:												
RAYPOL----------	0-8	3-12	1.00-1.25	0.60-2.00	0.16-0.28	Low	2.0-8.0	0.49	---	3	---	---
	8-22	3-12	1.35-1.55	0.60-2.00	0.15-0.26	Low	---	0.49	---			
	22-48	0-2	1.40-1.65	6.00-20.00	0.01-0.10	Low	---	0.10	---			
	48-65	0-2	1.40-1.65	6.00-20.00	0.01-0.10	Low	---	0.10	---			

PHYSICAL PROPERTIES OF SOILS

Endnote -- PHYSICAL PROPERTIES OF SOILS

This report shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

CLAY as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this report, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

MOIST BULK DENSITY is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this report, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

PERMEABILITY refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

AVAILABLE WATER CAPACITY refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

SHRINK-SWELL POTENTIAL is the potential for volume change in a soil with a loss or gain of moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils. If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed. Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are "Low," a change of less than 3 percent; "Moderate," 3 to 6 percent; and "High," more than 6 percent. "Very high," greater than 9 percent, is sometimes used.

PHYSICAL PROPERTIES OF SOILS

Endnote -- PHYSICAL PROPERTIES OF SOILS--Continued

ORGANIC MATTER is the plant and animal residue in the soil at various stages of decomposition. In report J, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

EROSION FACTOR K indicates the susceptibility of the whole soil (including rocks and rock fragments) to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

EROSION FACTOR Kf is like EROSION FACTOR K but it is for the fine-earth fraction of the soil. Rocks and rock fragments are not considered.

EROSION FACTOR T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

WIND ERODIBILITY GROUPS are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

PHYSICAL PROPERTIES OF SOILS

Endnote -- PHYSICAL PROPERTIES OF SOILS--Continued

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

The WIND ERODIBILITY INDEX is used in the wind erosion equation (WEQ). The index number indicates the amount of soil lost in tons per acre per year. The range of wind erodibility index numbers is 0 to 300.

Appendix B

Fisheries Policy and Position Statements

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.

2/13/91
Date

James C. Moulton
Acting Director

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

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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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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.