5.4 BIOLOGICAL DIVERSITY

Species diversity is an expression of community structure that includes both species richness (the number of species within a given area), and abundance (the number of individuals within each species) (Brower, *et. al.*, 1989). Local ecosystem diversity refers to the diversity of all living and non-living components in a given area, their interactions, and the biotic and abiotic factors that influence their interactions. Communities are specific assemblages of plant and animal species within a local ecosystem. Regional ecosystem diversity refers to the variety of ecosystems from larger scale perspectives (i.e. watershed or regional landscape) (CEQ, 1993).

Because of the interrelated complexities of ecosystems, impact to one component may affect other components of the system as well. This may result in both short-term and long-term effects that may have positive or negative impacts to the sustainability of the ecosystem. Physical alteration of the environment by man tends to be associated with disturbances that may have lasting impacts to the ecosystem. Examples of these disturbances include pollution, introduction of exotic species and the disruption of natural species. The construction of a new highway alignment could result in some or all of the above, which if unmitigated, may have detrimental effects on the local biodiversity. Even losses of a smaller scale ecosystem or microhabitat may result in a local extinction of certain species (Murphy, 1988). Anticipated or likely impacts to the major biological components of the project area's ecosystems are discussed below.

Biological field surveys conducted between September 2004 and September 2005 provided additional information for the assessment of impacts to vegetation, wildlife and wetland resources. Additional detailed information was collected on the distribution of flora and fauna, with a focus on wetland-dependent species, within the area potentially affected by preferred alternative $E_{(4)}$m-V3. Information collected during these surveys provided detailed data for the mitigation/ compensation planning phase of the project. The 2004-2005 biological surveys were described in Section 4.4, and the survey results have been incorporated into the impact analysis.

Correspondence from FWS dated March 30, 1998 and January 30, 2003 addressed federally endangered and threatened species and habitat issues concerning Bald Eagle, Peregrine Falcon, American Chaffseed, New England cottontail and Cerulean Warbler. Several meetings of the interagency Route 11 working group (see section 7.2.4) addressed these issues further, which led to developing protocols for the biological field surveys with the understanding that additional field surveys, focused on the final roadway alignment, would be conducted during the design phase of the project.

Potential mitigation measures for all of the alternatives are discussed for each biological resource type. A detailed, comprehensive mitigation and compensation plan will be developed for impacts of the preferred alternative during the design and permitting phase of the project. A preliminary plan, *Draft Statement of Wetland and Wildlife Habitat Blocks Impacts and Compensation Plan* was prepared in March 2003. Extensive coordination on this plan by the interagency working group (Section 7.2.4) resulted in the development of a *Mitigation and Compensation Framework* in 2006 to serve as a basis for the development of the comprehensive plan. The framework, provided in Appendix C, includes avoidance, minimization, and mitigation elements, as well as compensatory mitigation to address direct and indirect impacts to both wetland and upland habitats.

At the request of the ACOE, ConnDOT retained the University of Massachusetts (UMASS) in 2004 to utilize their Conservation Assessment and Prioritization System (CAPS) computer modeling program to quantify indirect impacts to biological diversity, and to identify potential compensation areas. CAPS is a complex quantitative system for assessing changes in habitat and biodiversity values and associated indirect impacts on habitat communities over a landscape by factoring in the effects of disturbance (e.g. development, roads, barriers to movement). The results were documented in the report, *CAPS Analysis for the Proposed Route 11 Extension*, *May 2004*, and were incorporated into the Mitigation and Compensation Framework.

5.4.1 Biological Impacts - Vegetation

Impacts to vegetation… May occur due to changes in topography, light regimes, Hydrology and substrate composition. The resulting effects range from minor alterations in microclimates that may change the dominance of a species in a given vegetational community to full scale replacement of existing, diverse, native vegetation by non-native, invasive or alien vegetation which tend to form prolific monocultures by out-competing native species.

Impacts to vegetation typically associated with highway construction projects include direct impacts resulting from land clearing for the roadway and secondary impacts associated with forest fragmentation, the introduction of non-native species, and sediment and toxicant impacts. Each of these potential impacts may affect the vegetational communities within the project corridor.

5.4.1.1 Land Clearing: Direct impacts to upland and wetland vegetation will occur during land clearing of forested areas for all build alternatives. The area of cleared vegetation for the roadway footprint would include all cut and fill areas (e.g., ramps and side slopes). The forested regions within the project area, especially along the new location alignments, tend to be composed of mature forests dominated by native vegetation. Impacts to existing vegetation in undisturbed forest blocks along each of the build alternatives will occur outside of the highway footprint, as an induced edge effect will result from clearing existing, established vegetation. Impacts to vegetation outside of, but adjacent to, the corridor may occur due to changes in topography, light regimes, hydrology and substrate composition.

The resulting effects range from minor alterations in microclimates that may change the dominance of a species in a given vegetational community to full scale replacement of existing, diverse, native vegetation by non-native, invasive or alien vegetation which tend to form prolific monocultures by out-competing native species. Vegetation changes extending from 10 m. to 30 m. (33 ft. to 100 ft.) into the forest block from the edge have been documented by Ranney (1977) and Wales (1972). Therefore, indirect impacts to the flora of the project area may be greater than the actual calculated losses from the highway footprints of the roadway including the cut and fill slopes.

5.4.1.2 *Elimination of Forest Blocks*: The Connecticut CEQ has reported a recent downward trend in privately-owned forest blocks of greater than 10 ha. (25 ac.) in the state resulting from development (*Environmental Quality in Connecticut*, 1996). The report noted that more acreage of forest lands is held by private land owners than by state forests. Large contiguous tracts of forests in Connecticut appear to be decreasing, with forest blocks greater than 100 ha. (250 ac.) becoming scarce. The report predicted that the number of forest blocks would be expected to decline sharply in the near future as many heirs to private land holdings are likely to subdivide it for sale to developers. Therefore, this downward trend in the number of privately owned forest blocks is expected to continue for the near future.

Prominent Connecticut biologists, Dr. William Niering, Biology Professor at Connecticut College and Dr. Richard Goodwin, Biology Professor Emeritus at Connecticut College (both now deceased) provided testimony of this trend within the project area. In their comment letter on the DEIS dated April 26, 1999 (See Comments and Responses section), they wrote:

> "As biologists who have lived in this area for a generation, we have watched this important wildlife corridor undergo significant degradation from forest fragmentation….development patterns are continually eroding the corridor which remains. Creeping suburban sprawl threatens to fragment all the remaining forest blocks, with zoning which favors residential subdivisions…"

5.4.1.3 *Introduction of Non-native Species*: Ecosystem disturbances may be exploited by non-native plant species. As an example, unconsolidated fill slopes and borrow piles along roadways tend to be colonized by such opportunistic species as the alien Japanese knotweed (*Polygonum cuspidatum*). This species tends to be an aggressive colonizer, and once established, prevents colonization by native plant species; further, it has little wildlife value and poor aesthetic value. This is a typical scenario with non- native species. The vegetated areas along the existing Route 85 illustrate the effects of this type of indirect impact. Many areas are dominated by aggressive non-native species, such as multiflora rose (*Rosa multiflora*) and oriental bittersweet (*Celastrus orbiculatus*).

5.4.1.4 *Sediment and Toxicant Effects*: Erosion within construction areas may transport sediment to off-site receptors such as emergent wetlands. Heavy sediment loads can replace the variable substrate in a natural freshwater emergent wetland system with a uniform, level substrate of homogenous composition. This sets the stage for potential monocultures to be formed by aggressive colonizers which decreases ecosystem diversity. Wetland vegetation impacts are discussed in more detail in Section 5.6.

Impacts to native established wetland vegetation outside of the highway footprint are also possible through nutrient or toxicant transport and loading.

Increased nutrient loading from highway construction typically occurs from stormwater runoff. Excess nutrients in freshwater wetlands encourage prolific growth of native but aggressive plants such as cattail (*Typha* spp.) and reed canary grass (*Phalaris arundinacea*). Bogs and other low-nutrient wetlands are especially susceptible to vegetation impacts from nutrient loading.

A marked decrease in lichen species in more urban and industrialized parts of Connecticut is thought to be a direct response to increased sulfur dioxide emissions and ambient concentrations in these areas (Metzler, 1980). In general, Metzler reported the most sensitive lichen form to be fruiticose, followed by foliose and then crustose; all three major growth forms of lichens were observed within the project corridor. Lichens were found to be common colonizers of bare rock substrates, tree bark and at one location (Route 11 terminus, south of Route 82) on a sandy soil substrate. Introduction of highway traffic on a new location (92PD, $E_{(4)}$, $E_{(2)}$, $F_{(4)}$, $F_{(2)}$, $G_{(4)}$, $G_{(2)}$, $H_{(4)}$ and $H_{(2)}$ alternatives), may affect the area ambient air quality, and may impact lichen species.

Salt spray, generated through the application of roadway deicing salts, is a common aerosol pollutant associated with roadways. Most major forest tree and understory species are sensitive to the effects of salt spray injury from sodium and calcium chloride road deicing salts. Sugar maples and white pines in New England have shown evidence of salt spray injury within 300 m. (985 ft.) downwind of heavily traveled highways (USDA, 1985). Impacts to the heavily forested vegetation along any of the proposed new expressway alignments caused by salt spray would be expected.

5.4.2 Comparison of Vegetation Impacts

The following describes the estimated area of impact to vegetation and forest blocks associated with each alternative (Table 5-24) and the relative impact between the alternatives. Forest block edges tend to have different flora and fauna composition than do forest interiors. Edge flora tends to be dominated by more non-native, opportunistic species, while the interior species tend to have a higher percentage of native species. Edges tend to have a higher density of predator and generalist species than forest interiors. Because of this, impacts to block edges generally have less effect upon forest specialists and interior species than do impacts to forest interiors.

TABLE 5-24
IMPACTS TO FOREST BLOCKS

	LARGER BLOCKS (> 200 ha. Forest Blocks)			SMALLER BLOCKS (50 - 200 ha. Forest Blocks)				
ALTERNATIVE	BLOCK #1 ha. (ac.)	BLOCK #2 ha. (ac.)	TOTAL (LARGER) ha. (ac.)	BLOCK #3 ha. (ac.)	BLOCK #4 ha. (ac.)	BLOCK #5 ha. (ac.)	BLOCK #6 ha. (ac.)	TOTAL (SMALLER) ha. (ac.)
No build	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
TSM	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
TDM/Transit	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
$W_{(4)}$	0.9 (2.2)	0.9 (2.2)	1.8 (4.4)	N/I	N/I	N/I	N/I	N/I
$W_{(4)}$m	0.7 (1.7)	0.7 (1.7)	1.4 (3.5)	N/I	N/I	N/I	N/I	N/I
$W_{(2)}$	0.6 (1.5)	0.6 (1.5)	1.2 (3.0)	N/I	N/I	N/I	N/I	N/I
92PD	12.5 (30.9)	34.2 (84.5)	46.7 (115.3)	8.0 (19.8)	N/I	4.5 (11.1)	N/I	12.5 (30.9)
$E_{(4)}$	12.5 (30.9)	34.2 (84.5)	46.7 (115.3)	8.0 (19.8)	3.4 (8.4)	5.7 (14.1)	N/I	17.1 (42.2)
$E_{(2)}$	9.5 (23.5)	25.7 (63.5)	35.2 (86.9)	6.0 (14.8)	2.0 (4.9)	4.3 (10.6)	N/I	12.3 (30.4)
$F_{(4)}$	12.5 (30.9)	27.3 (67.4)	39.8 (98.3)	7.4 (18.3)	4.0 (9.9)	9.1 (22.2)	8.0 (19.8)	28.5 (70.4)
$F_{(2)}$	9.5 (23.5)	20.6 (50.9)	30.1 (74.3)	5.6 (13.8)	3.0 (7.4)	6.9 (17.0)	6.0 (14.8)	21.5 (53.1)
$G_{(4)}$	12.5 (30.9)	27.3 (67.4)	39.8 (98.3)	7.4 (18.3)	5.7 (14.1)	6.3 (15.6)	9.1 (22.2)	28.5 (70.4)
$G_{(2)}$	9.5 (23.5)	20.6 (50.9)	30.1 (74.3)	5.6 (13.8)	4.3 (10.6)	4.7 (11.6)	6.9 (17.0)	21.5 (53.1)
$H_{(4)}$	12.5 (30.9)	2.3 (5.7)	14.8 (36.6)	7.4 (18.3)	10.2 (25.2)	5.7 (14.1)	N/I	23.3 (57.6)
$H_{(2)}$	9.5 (23.5)	1.7 (4.2)	11.2 (27.7)	5.6 (13.8)	7.7 (19.1)	4.3 (10.6)	N/I	17.6 (43.5)
$E_{(4)}$m-V3	9.5 (23.5)	33.7 (83.3)	43.2 (106.8)	7.0 (17.3)	2.6 (6.4)	4.1 (10.1)	N/I	13.7 (33.8)

N/I = No impact or negligible impact

5.4.2.1 *No Build Alternative*: Under the no build alternative, maintenance activities would include minor vegetation clearing to ensure adequate sight lines; measurable impacts due to these activities are unlikely. No substantive land clearing or construction associated with road building would occur. Of the alternatives, the no build would have the least amount of direct impact to the vegetation within the project corridor. However, if a decision to construct a highway on a new location is forgone, secondary impacts to the continuous forest blocks west of the existing Route 85 may occur should interest in residential development be renewed. Impacts to vegetation from air pollutants and salt spray would be expected to increase as traffic volumes increase into the future years.

5.4.2.2 *Route 82 and 85 Widening Alternatives*: A majority of the anticipated impact areas along the alignment for the widening alternatives would overlap areas previously impacted during the construction of Route 85 as it exists today. These previously impacted areas include the existing residential and commercial development along Route 85, areas where vegetational communities are dominated by alien or invasive species, and other areas where the native landscape has been altered through development or other land use (e.g., powerline easements; the shore of Lake Konomoc where stands of conifers were planted; and gravel quarries where topsoil has been removed, etc.). Although land clearing would be required for all the widening alternatives, this impact is not expected to adversely affect vegetative species, as many of the species along the existing road are either opportunistic native species, or non-native species.

The northeasterly limits of two forest blocks (Block Nos. 1 and 2) lie adjacent to and west of Route 85 and would likely be affected by the proposed $W_{(4)}$ and $W_{(4)}$m alternatives. The area of impact to Block No. 1 is west of Route 85 across from Fairy Lake; the area of impact to Block No. 2 is west of Lake Konomoc. Since both of these waterbodies are public water supply reservoirs, the proposed roadway configuration attempts to avoid them. Favoring the westerly side of Route 85 would help to avoid direct impact to the two waterbodies, but result in direct impact to the forest blocks. However, the direct impact to the forest blocks associated with widening extend in only one direction from the roadway into the eastern edges of the forest block.

The widening of Route 85 may impact the shore of Horse Pond by requiring direct filling. A state endangered herbaceous plant, *Xyris smalliana* has been reported in the area. Selection of the $W_{(4)}$ or $W_{(4)}$m alternative may result in the potential loss of habitat to this species (refer to Section 5.4.2).

Since this alternative would consist of improving an existing road, little impact resulting from introduction of non-native species is anticipated as many of those species already exist there today. Sediment/toxicant loading into wetland areas would also be greater than the TSM alternative, but much less than any of the new location alternatives. Impacts to vegetation resulting from air pollutants and salt would be expected to increase as traffic volumes increase in future years.

5.4.2.3 *TSM Alternative*: Under this alternative, only minimal intersection improvements and routine roadway maintenance activities would take place.

Intersection improvements would require the removal of small amounts of wooded area adjacent to the existing roadway. Maintenance activities would be similar to those discussed under the no build alternative. Compared to the build alternatives, this alternative would have very little direct impact to the vegetation within the project corridor.

Indirect impacts to the continuous forest blocks west of the existing Route 85 could occur should interest in residential development be renewed following a decision to not pursue construction of a highway on a new location. Since this alternative would improve an existing road, little impact resulting from introduction of non-native species is anticipated since many of those species already exist there today. Sediment/toxicant loading into wetland areas would also be negligible given the nature of the minor improvements proposed for this alternative. Like the no build alternative, impacts to vegetation from air pollutants and salt spray would be expected to increase as traffic volumes increase into the future years.

5.4.2.4 *TDM/Transit Alternative*: Since this alternative does not involve any construction, there would be no impacts to vegetation if this alternative were implemented.

5.4.2.5 *New Location - Full Build Alternatives*: Because the areas of impact and effects upon forest blocks and specific communities vary between the full build alternatives, they are discussed individually, below.

92PD: The 92PD alignment traverses the center of the two larger forest blocks (Nos. 1 and 2) and two of the smaller forest blocks (Nos. 3 and 5). In addition to the direct impact of land clearing for this alignment, secondary impacts associated with vegetation changes will extend outward in both an easterly and westerly direction from the roadway alignment, further fragmenting these forest blocks.

Within Habitat Block No. 1, direct impacts associated with land clearing include the loss of 12.5 ha. (30.9 ac.) of forest interior. These forested areas are composed of mature oak forest and mixed hardwood forest, as well as areas of dense upland native shrub understory, diverse interspersed wetland plant communities, and numerous microhabitats and ecotones which exist within the block that are caused by the abrupt and frequent elevation changes of the region. The existing vegetation community located at the terminus of Route 11, which is dominated by non-native species, would likely colonize the impact corridor and extend deeper into Habitat Block No. 1. Approximately 34.2 ha. (84.5 ac.) of forest interior would be lost within Habitat Block No. 2 including areas of mature, mixed, hardwood forest; chestnut oak-dominated meso-xeric climax forest; and red maple-dominated palustrine forested wetland areas.

Approximately 8.0 ha. (19.8 ac.) of mixed hardwood forest would be directly impacted within Habitat Block No. 3, and approximately 4.5 ha. (11.1 ac.) of mixed hardwood forest would be directly impacted within Habitat Block No. 5. The mixed hardwood forests of Habitat Blocks Nos. 3 and 5 are similar to Block No. 1; however, Nos. 3 and 5 have more areas of black birch, black cherry, white ash, and sugar maples at the bottoms and toes of lower gradient slopes.

The total area of direct impact to forest blocks greater than 200 ha. (500 ac.) (the "larger" blocks) for the 92PD alignment is 46.7 ha (115.3 ac.). An additional 12.5 ha. (30.9 ac.) of forest blocks between 50-200 ha.(125-500 ac.) in size (the "smaller blocks") would also be directly impacted.

The 92PD alternative, as well as all other alternatives on new alignment, would introduce large amounts of non-native species into the ecosystem along their alignments. Since the areas along these alignments are primarily undisturbed, introduced species could have a serious effect on the species diversity and abundance in these areas.

Sediment/toxicant loadings from this alternative would be much greater than the previously discussed alternatives because the proposed roadway would be constructed through primarily undisturbed, vegetated land. Once the vegetation is removed, there would be a high potential for erosion and sedimentation, runoff and nutrient transport into sensitive areas. The volumes of material transported would likely be much greater as a result of the large area of disturbance. Lichens, which were observed along this alignment, would likely be affected by sulfer dioxide emissions. Additionally, salt spray could adversely affect vegetation communities along the alignment up to 300 m. (985 ft.) into the forest from either edge of the highway.

E Alternatives: Implementation of either the $E_{(4)}$ or $E_{(2)}$ alternatives would impact Habitat Blocks Nos. 1 and 2 and three of the smaller forest blocks (Habitat Blocks Nos. 3, 4 and 5). The forest communities and types of impacts would be similar to the 92PD alignment. The $E_{(4)}$ alternative would result in the loss of 12.5 ha. (30.9 ac.) of forest in Habitat Block No. 1 and 34.2 ha (84.5 ac.) of forest in Habitat Block No. 2, for a total loss of 46.7 ha (115.3 ac.) of forest interior from the larger blocks. An additional 17.1 ha. (42.2 ac.) would be lost from the smaller forest blocks. The $E_{(2)}$ alternative could reduce the hectares lost from the larger blocks to a total of 35.2 ha. (86.9 ac.) and could also reduce the hectares lost from the smaller blocks to 12.3 ha. (30.4 ac.).

This alternative would have very similar impacts to vegetation as the 92PD alternative. It follows the same alignment, except for a small section near its center, where it curves between Daisy Hill and Holmes Road, and impacts additional forest land.

F Alternatives: Forest Habitat Blocks Nos. 1 and 2, and all of the four smaller blocks (Habitat Blocks Nos. 3, 4, 5, and 6) would be directly impacted by this alternative. The $F_{(4)}$ alternative alignment would result in the loss of an approximate total of 39.8 ha. (98.3 ac.) of forest from the larger blocks; and 28.5 ha. (70.4 ac.) of forest from the smaller blocks. The two-lane version of the F alignment would result in the loss of an approximate total of 30.1 ha. (74.3 ac.) of forest from the larger blocks and 21.5 ha. (53.1 ac.) of forest from the smaller blocks. The communities which would be impacted by the $F_{(4)}$ or $F_{(2)}$ alternative are similar to those described for the 92PD, but also include a notable habitat outside of the forest blocks: a hemlock ravine located along Latimer Brook just south of Silver Falls in East Lyme.

This alternative would clear large areas of forest, including area within all six forest blocks, and would have some of the highest impacts to forest blocks as compared to the other alternatives. The F alternatives would introduce large amounts of non-native species into previously undisturbed forest areas, which would impact species diversity and abundance. As with the 92PD alternative, sediment/toxicant impacts could be quite pronounced.

G Alternatives: Habitat Blocks Nos. 1 and 2 and the four smaller forest blocks between 50-200 ha. (125-500 ac.) in size would be directly impacted by either of these alternative alignments. Alternative $G_{(4)}$ would result in the loss of approximately 39.8 ha. (98.3 ac.) of forest from the larger blocks and 28.5 ha. (70.4 ac.) of forest from the smaller blocks. The $G_{(2)}$ alignment would result in the loss of approximately 30.1 ha. (74.3 ac.) of forest from the larger blocks and 21.5 ha. (53.1 ac.) of forest from the smaller blocks.

The communities impacted by the G alternatives are similar to those impacted by the F Alternatives, as the two alignments are located in the western section of the corridor. Impact areas include the hemlock ravine located along Latimer Brook just south of Silver Falls in East Lyme.

5.4.2.6 *New Location - Partial Build Alternatives*: The two larger forest blocks (Nos. 1 and 2) and three of the smaller forest blocks (Nos. 3, 4, and 5) would be impacted directly by either the $H_{(4)}$ or $H_{(2)}$ alignment.

Alternative $H_{(4)}$ would result in the loss of approximately 14.8 ha. (36.6 ac.) of forest from the larger blocks and 23.3 ha. (57.6 ac.) of forest from the smaller blocks. The $H_{(2)}$ alternative alignment would result in the loss of approximately 11.2 ha. (27.7 ac.) of forest from the larger blocks and 17.6 ha. (43.5 ac.) of forest from the smaller blocks.

These alternatives are unique in that they combine a partial build on new alignment with a section of the widening alternative. Because of this, impacts along the alignment on new location are generally greater than those along the widening section of the alternative as this section would be built along an existing roadway. Impacted vegetation communities are similar to those described for the 92PD alignment above, except for Habitat Block No. 2 which, in the area of anticipated impact for this alignment, the forest is more characteristic of a mixed hardwood mesic woodland.

5.4.2.7 *Preferred Alternative*: Implementation of the $E_{(4)}$m-V3 alignment would impact Habitat Blocks Nos. 1 and 2 and three of the smaller forest blocks (Blocks Nos. 3, 4 and 5). The forest communities and types of impacts would be similar to the E alignments (Section 5.4.2.5). This alignment would result in the loss of 9.5 ha. (23.5 ac.) of forest in Habitat Block No. 1 and 33.7 ha (83.3 ac.) of forest in Habitat Block No. 2, for a total loss of 43.2 ha (106.8 ac.) of forest interior from the larger blocks. An additional 13.7 ha. (33.8 ac.) would be lost from the smaller forest blocks. This alignment would have very similar impacts to vegetation as the E alternatives. It follows the same alignment; however, it has been modified to minimize cuts and fills and to reduce the overall footprint of the roadway.

Although the acreage of forest block impact is similar to the 92PD and E alternatives, this alternative impacts much less of the interior forest of Habitat Block No. 2 since it was realigned along the western edge of the block. Many of the same vegetation community types would be impacted. Of the community types impacted, impacts to the chestnut oak ridgetop community would be reduced as compared with the other full build alternatives. Also, moving the alignment to the edge of the forest block would likely slow the advancement of invasive plant species into the forest block. The wildlife value of the fragmented portion of the block (i.e. the portion west of the alignment) has already been impacted in many areas due to its proximity to both existing subdivisions, logging, clear cutting, recreational uses (e.g. hunting, all terrain vehicles) and existing forest roads. The importance of this realignment to biological diversity is discussed further in Section 5.4.9.

5.4.3 Threatened and Endangered Vegetation Species

Three state-listed species of plants are reported in the project area (DEP, 1998, 2002). They include Small's yellow-eyed grass (*Xyris smalliana*), a state endangered species reported in the vicinity of Horse Pond in Salem; American chaffseed (*Schwalbea americana*), a federally endangered and state special concern (historic) species reported in the Silver Falls area; and the thread-leaved sundew (*Drosera filiformis*), a state-endangered species reported in the Latimer Brook area in East Lyme.

A determination of the current status of these species would require field sampling at the stations where these species were previously reported. The thread-leaved sundew (*D. filiformis*) has not been seen at the originally reported location for a number of years, and the station was believed to have been destroyed (Murray, NDDB, personal communication, 1998). The locations for *S. americana* and *X. smalliana* were still believed to be present, however, field verification of their presence would be required before accurate predictions of impact to these species could be made. The preferred alternative does not affect either of these areas; therefore, additional verification was not necessary.

Five listed species were identified during the 2004-2005 surveys: small whorled pogonia (federally threatened/state endangered), creeping bush-clover (state special concern), New England grape (state special concern), slender needlegrass (state special concern), and purple milkweed (state special concern). As currently proposed, the $E_{(4)}$m-V3 alignment, and all the new location alternatives (92PD, $E_{(2)}$, $E_{(4)}$, $F_{(2)}$, $F_{(4)}$, $G_{(2)}$, $G_{(4)}$, $H_{(2)}$, and $H_{(4)}$) would directly impact two areas documented as containing listed plant species, impacting a total of three listed species.

Both the New England grape and slender needlegrass are found within the footprint of the alignment within the electrical power line right-of-way in Montville. The populations of creeping bush-clover and slender needlegrass found along the rock cut on the unfinished portion of Route 11 in Salem would also be impacted by the $E_{(4)}$m-V3 alignment and all other new location alignments. Depending on the full extent of these populations, and the final design and maintenance schedule for the roadway, these populations could be negatively impacted. A survey in appropriate habitats for these species would be required to determine the full extent and condition of the populations in these areas. Based on coordination with the regulatory agencies during the 2004-2005 biological surveys, it was decided that detailed surveys for listed vegetation species would be deferred until the design and permitting phase of the project. Other similar habitat types within the proposed alignment right-of-way, not included in this survey, may also support this species.

Potential habitat for small whorled pogonia occurs throughout Connecticut, including within the proposed roadway corridor. The 2004-2005 vegetation classification survey documented small whorled pogonia on Transect 1 in the northern red oak/flowering dogwood association. None of the alternatives would cause direct or indirect impacts to the plants found at this location. Small whorled pogonia may also be present in the sugar maple/white ash/American basswood/New York fern community, the sugar maple/oak community, and stands of American beech (*Fagus grandifolia*). These vegetation communities comprise approximately 10% of the total combined length of the 16 transects (refer to Table 4-31). The survey transects were located to be representative of all habitat types within the proposed alignment and the entire survey area; however, they constitute a small portion of the total corridor.

The small whorled pogonia can be difficult to locate. The plant may be dormant underground for several years (see Section 4.4.7.1). Grazing and disturbance by animals may also hide the presence of the species.

The discovery of the small whorled pogonia was reported to the Route 11 interagency working group during meetings, as well as in interim field reports and the 2006 Biological Survey Report, which were circulated to members of the group (also see Section 7.2.4). Although no specific guidance has been received from the FWS concerning this plant species, the FHWA and ConnDOT have committed to conduct future field surveys during the design phase of the project to determine whether any populations of this plant exist within the impact areas of the project. FHWA will also ensure that appropriate reasonable and prudent conservation measures are implemented for any impact to the small whorled pogonia.

Future changes to listed resources under the ESA (as well as the DEP list) will be monitored during the design, permitting, and construction phases of the project. Any action(s), including possible Section 7 consultation under the ESA, that are determined to be necessary as a result of changes to these lists and/or the identification of listed species within the project limits, will be conducted as required by federal and/or state law or regulation.

5.4.4 Mitigation Measures - Vegetation Impacts

Because of the configuration and location of contiguous forest areas and forest blocks within the project corridor, avoidance of forest impacts is not possible, within the specified corridor area. Avoidance of rare and endangered species would require detailed field inventories of known sites in which the species were historically reported to document their current status, locations and specific habitat requirements.

Measures that could be employed to minimize impact to vegetation include narrowing the clear zone of the roadway to reduce the amount of land cleared, and establishing erosion and sedimentation controls to prevent sediment and its potentially harmful constituents from entering vegetated wetlands outside of the limits of disturbance. To minimize erosion, areas cleared of vegetation during construction activities should be revegetated as soon as possible following construction. Colonization or establishment of alien species could be discouraged by ensuring ground covers are seeded or applied to the proper application densities, and by obtaining well-established shrub or tree planting stock from local nurseries to avoid introduction of young or genetically inferior propagules that may be out-competed by aggressive or opportunistic alien colonizers. Additional measures that could be employed include reestablishing vegetation on land temporarily cleared for construction or incorporating plantings along the roadway.

According to the Connecticut Endangered Species Act, only species listed as endangered or threatened are regulated by the Act. Plants listed by the state as species of special concern are not regulated by the Act. Any mitigation proposed for impacts to the three potentially impacted state special concern plant populations would be voluntary. Avoidance and minimization measures would be undertaken where practicable. Slight modifications to the roadway design may also be utilized. Potential mitigation measures could include relocation of individual plants or establishment of new populations via seed propagation.

ConnDOT and FHWA will conduct additional surveys for listed species during the design and permitting phase of the project (refer to Section 4.4). If any small whorled pogonia populations are found in the area of direct or indirect effects of the project, FHWA will consult with the FWS prior to ConnDOT letting any construction contracts on the project that would use federal funds. FHWA will not authorize or fund any construction contracts or construction prior to completing the required ESA consultation for the project. FHWA will also seek to appropriately mitigate for any potential impact to the small whorled pogonia.

According to recent studies, the small whorled pogonia does not transplant well; therefore, mitigation methods other than relocation may be required (www.centerforplantconservation.org). Management techniques have been under study in recent years, and this species has been observed to respond favorably to opening of the tree canopy (Moorehead, personal communication 2007). In South Carolina, woods-road edges support this plant, and extra light might be an important factor (Natureserve, 2007). Management of an existing off-site population may be an alternative mitigation measure to relocation.

5.4.5 Biological Impacts - Fisheries and Aquatic Biota

Potential impacts to fisheries and aquatic resources are ultimately related to a reduction or impairment of water quality, quantity, flow rates, or through the construction of barriers to fish movement. The ecological impact of human-induced alterations can negatively affect the food sources, water quality, habitat structure, stream flow characteristics, and species interactions of aquatic communities (Karr, 1991).

A reduction in water quality may occur through the alteration of physical or chemical parameters. Many times the alteration of one physical parameter may affect another. Furthermore, physical parameters are also tied to chemical and biological parameters. For example, temperature increases may promote an increase in bacterial growth, which in turn could increase oxygen demand. Temporary thermal pollution impacts may occur following removal of stream-side vegetation during highway construction. Chemical inputs from stormwater may cause direct impacts via acute toxicity (fish kills), through chronic toxicity (e.g. carcinogenic, teratogenic or mutagenic effects), or indirectly, such as through toxicity and the resulting reduction of available food supplies. Refer to Section 5.5 for more discussion on water quality impacts.

In addition to impacts to water quality (i.e. turbidity), erosion and resultant sedimentation may impact aquatic biota by reducing hunting success of fish, by disrupting production of food supplies and by silting over prime breeding substrates such as cobble areas in pools. Sediment deposits may also change channel flow characteristics by altering channel configuration. Areas requiring extensive cut and fill slopes have the highest risk of potential erosion and resultant sedimentation during highway construction. Also, direct discharges of paved drainage swales or leak-offs from the roadway may cause sedimentation impact.

Results of the 2004-2005 aquatic invertebrate sampling provided baseline information on the water quality of 10 perennial watercourses in the five subregional watershed basins within the study area. Results of the stream surveys revealed that all of the sampled streams support benthic invertebrate community assemblages indicative of minimally impaired streams with aquatic habitats favorable for supporting benthic communities that are sensitive to pollution and disturbance. Analysis of the benthic invertebrate community sampled from the reach of Latimer Brook downstream of Silver Falls suggests that this stream currently receives some degree of organic pollution, as evidenced by the presence of indicator organisms.

Potential impacts identified for aquatic invertebrates associated with the new location alternatives include the following:

- direct loss of habitat by filling, construction, excavation, or grading in association with bridge/culvert construction
- increased sediment load via stormwater runoff during and post construction, and during operation of the roadway
- chemical or thermal contamination by runoff, discharge of agricultural or urban effluent, or dispersion/interception of cooler groundwater seeps.

The Odonata (dragonflies and damselflies) survey identified three priority areas of conservation concern for Odonata. These areas and the reason for their conservation concern are as follows:

- Shingle Mill Brook in Salem, the site with the greatest Odonata diversity.
- Latimer Brook in Montville – reach north of Grassy Hill Road, this stream produced two records of species (not listed) previously unknown from New London County (*Ophiogomphus aspersus* and *O. mainensis*). The nymphs of *Gomphus abbreviatus*, a seldom encountered clubtail, were also encountered.
- An unnamed tributary to Latimer Brook at Silver Falls, a site where the state threatened tiger spiketail dragonfly (*Cordulegaster erronea*) was found to breed.

Since the Odonata are apex predators within the insect world, areas that exhibit high Odonata richness or productivity typically are important to other aquatic insect taxa as well.

The filling or draining of seasonal pools can lead to destruction of breeding habitat for some aquatic invertebrates. However, since most aquatic invertebrates that depend on seasonal pools tend to be good colonizers, impact to these species was not identified as a significant concern (i.e., would have little bearing on the local and regional status of seasonal pool-dependent invertebrate species). Vernal and other seasonal pools were found at several locations within the project corridor and throughout the adjacent landscape and are discussed further in Section 5.6.

5.4.6 COMPARISON OF FISHERIES/AQUATIC IMPACTS

Not only may culverts disrupt flow regimes but they may also act as barriers (dams) to fish movement if improperly designed or installed. High gradient streams that may require long expanses of culverts at road crossings may pose a barrier to fish if constructed improperly, or may cause injury to fish attempting to negotiate low flow or turbulent channels which may not be conducive to fish movement. Injury to fish may result in the fish being susceptible to predation, disease, or parasitism, or may reduce the fish's ability to compete.

Most of the potential impacts to fisheries and aquatic biota identified are related to water quality issues or disturbance to stream channels associated with culvert construction. A comparison of the impacts associated with each transportation alignment is provided below. A summary of the total intermittent and perennial stream crossings, as well as impacts to other waterbodies, is provided in Table 5-25.

5.4.6.1 *No Build Alternative*: The no build alternative would not involve additional stream crossings and therefore none of the associated impacts. However, increased traffic volumes along the existing Routes 82 and 85 could result in an increase in pollutant concentrations in stormwater runoff. Also, sediment would continue to enter wetland areas along roadways in the corridor.

Excessive sedimentation is an existing concern within the corridor, since many streams lie adjacent to or alongside of existing roadways. Many of these roadways have "leak-offs" which allow stormwater generated on the road surface to discharge directly to the receiving stream. Frequent sanding of the roadways during the winter months produces an annual supply of salt and sand which becomes a potential source of sedimentation during subsequent precipitation events. In contrast, the build alternatives would provide for stormwater management that would be incorporated into the highway design.

TABLE 5-25
DIRECTLY IMPACTED AQUATIC HABITATS BY TYPE

ALTERNATIVE	INTERMITTENT STREAM	PERENNIAL STREAM	WATERBODIES[1]	TOTAL
No build	N/I	N/I	N/I	N/I
TSM	2	2	N/I	4
TDM/Transit	N/I	N/I	N/I	N/I
$W_{(4)}$, $W_{(4)}$m, $W_{(2)}$	3	10	4	17
92PD	5	8	0	13
$E_{(4)}$	5	8	1	14
$E_{(2)}$	5	8	1	14
$F_{(4)}$	5	5	1	11
$F_{(2)}$	5	5	1	11
$G_{(4)}$	4	5	1	10
$G_{(2)}$	4	5	1	10
$H_{(4)}$	3	5	0	8
$H_{(2)}$	3	5	0	8
$E_{(4)}$m-V3	5	8	1	14

N/I = no impact or negligible impact
(1) = ponds or lakes

5.4.6.2 *Route 82 and 85 Widening Alternatives*: Both the two- and four-lane widening alternatives would require three intermittent and ten perennial stream crossings spanning three subregional drainage basins. These drainage basins include Latimer Brook, Oil Mill Brook, and Harris Brook. The alignment would also traverse or lie adjacent to four other waterbodies and numerous vegetated wetlands including those exhibiting fisheries habitat functions. The wider crossings would likely result in vegetation loss and alteration of the stream bed and banks. Construction associated with culvert replacement/extension would be a potential sediment source, and following construction, each stream crossing would continue, as today, to be a potential sediment and toxicant source from roadway storm runoff. Some of these effects can be reduced through prudent design of the stormwater management system. Although sedimentation impacts would occur as a result of this alternative, sedimentation impacts would be much greater with the alternatives on new location as the area of exposed soils would be much larger. Because the construction would be largely confined to work near the existing roadway, little stream-side vegetation would be lost, and therefore, stream temperatures would remain virtually unchanged.

Of the four waterbodies predicted to be impacted under this alternative, two waterbodies, Horse Pond and the un-named manmade pond at the intersection of Routes 85 and 161, would be directly impacted as a result of filling to allow room for the widening. The other two waterbodies, Fairy Lake and Lake Konomoc could potentially receive stormwater runoff from the highway.

Upon preliminary evaluation, there appear to be two basic alternate drainage schemes that could be used in the vicinity of the reservoir. One would collect, treat and discharge roadway runoff entirely within the drainage basin; as an alternative, stormwater could be diverted to the adjoining drainage basin to avoid discharging to water supply watershed lands. If a diversion were proposed, a careful analysis of the potential effects to the aquatic environment would be necessary. A water diversion could, potentially, lead to low flow conditions in some streams and tributaries in the watershed. However, in the absence of an interbasin diversion, potential impacts associated with reduced water flows would most likely be caused by deposition of sediment or the improper design or installation of culverts at stream crossings.

5.4.6.3 *TSM Alternative*: This alternative would involve work in two perennial and two intermittent stream crossings, resulting in the associated impacts. All crossings would take place within the Harris Brook sub-regional drainage basin and would occur along areas of the watercourses which were previously impacted by the initial construction of Routes 82 and 85. In the areas along Routes 82 and 85 which are not improved, increased traffic volumes along the existing Routes 82 and 85 could result in an increase in pollutant concentrations in stormwater runoff. Because the construction would be largely confined to edge-of-road work, little stream-side vegetation would be lost; therefore, stream temperatures would remain virtually unchanged.

5.4.6.4 *TDM/Transit Alternative*: Since this alternative would not involve any construction activities, there would be no disturbance to fisheries or other aquatic biota.

5.4.6.5 *New Location - Full Build Alternatives*: The 92PD, $E_{(4)}$, $E_{(2)}$, $F_{(4)}$, $F_{(2)}$, $G_{(4)}$ and $G_{(2)}$ alternatives would all require several intermittent and perennial stream crossings within the Harris Brook, Latimer Brook, Oil Mill Brook, and Niantic River subregional basins. Because the areas of impact and effects upon the aquatic environment would vary between the full build alternatives, they are discussed individually, below.

92PD Alternative: The 92PD alignment would include construction of a bridge spanning Shingle Mill Brook, and a second structure would be required at Latimer Brook in the vicinity of Grassy Hill Road. Construction of the Shingle Mill Brook structure would require land clearing of mature mixed hardwoods and placement of fill adjacent to the watercourse for the construction of the bridge abutments. Construction of a bridge over Latimer Brook would impact an existing agricultural field. Piers within the watercourse and wetland area would be required for the Shingle Mill Brook structure. Temporary diversions of the watercourse may be required for both structures during construction. The likely construction impacts at these stream crossings could include streamside vegetation clearing and increased sediment loading. Permanent impacts would include wetland fill and increased stormwater runoff from the highway.

In addition, culverts would be required at several intermittent and perennial tributaries to Harris Brook and Latimer Brook. Installation of the crossings would likely increase sediment deposition, and longer-term water quality impacts are likely from road runoff. Impacts related to this crossing would remain the same for any of the new expressway alignments, as they all share this section of alignment.

E Alternatives: The E alternatives would have the greatest number of stream crossings with 14. Of these, eight would be perennial and five would be intermittent. Culvert construction requirements and associated impacts would also be similar to those described for the 92PD alignment. The E alternatives would include construction of a bridge spanning Shingle Mill Brook, and Latimer Brook in the vicinity of Grassy Hill Road. The construction of these structures would require land clearing of mature mixed hardwoods or agricultural fields, and placement of fill adjacent to the watercourse for the construction of the bridge abutments. Temporary diversions of the watercourse might be required during construction, as would some streamside vegetation clearing. Permanent impacts might include wetland fill and increased stormwater runoff from the highway. Fisheries impacts would include elevated water temperatures near cleared areas, and stormwater pollutant inputs.

F Alternatives: The F alternatives would cross five perennial and five intermittent watercourses. Culvert construction requirements and associated impacts would also be similar to the 92PD alignment. The F alternatives would include construction of a bridge spanning Shingle Mill Brook, and Latimer Brook in the vicinity of Route 161. The construction of these structures would require land clearing of mature mixed hardwoods, placement of fill adjacent to the watercourse for the construction of the bridge abutments. Temporary diversions of the watercourse might be required during construction, as would some streamside vegetation clearing. Permanent impacts might include wetland fill and increased stormwater runoff from the highway. Fisheries impacts would include elevated water temperatures near cleared areas, and stormwater pollutant inputs. The streambed structure would likely be altered in and around construction areas.

G Alternatives: The G alternatives would cross five perennial and four intermittent watercourses. Culvert construction requirements and associated impacts would also be similar to the 92PD alignment. The G alternatives would also include construction of a bridge spanning Shingle Mill Brook, and Latimer Brook in the vicinity of Route 161. Land clearing of mature mixed hardwoods and placement of fill adjacent to the watercourse for the construction of the bridge abutments would be required for these alternatives. Temporary diversions of the watercourse might be required during construction, as would some streamside vegetation clearing. Permanent impacts might include wetland fill and increased stormwater runoff from the highway. Fisheries impacts would include elevated water temperatures near cleared areas, and stormwater pollutant inputs. The streambed structure would likely be altered in and around construction areas.

5.4.6.6 *New Location - Partial Build Alternatives*: Both $H_{(4)}$ and $H_{(2)}$ would require three intermittent and five perennial stream crossings spanning three subregional drainage basins (Harris, Latimer and Oil Mill Brooks). The spans at Shingle Mill and Latimer Brooks would also be required, therefore, impacts associated with these two stream crossings are the same as those described for the full build alternatives. The remaining stream crossings would require culvert construction and hence would incur the typical impacts associated with this activity. In addition to these intermittent and perennial stream crossings, the H alternatives would include impacts identical to the widening alternatives south of Route 161, including the potential impacts to water supply sources. Lake Konomoc could potentially receive stormwater runoff from this alternative. As with the widening alternatives, two basic alternate drainage schemes could be used in the vicinity of the reservoir. One would collect, treat and discharge roadway runoff entirely within the drainage basin; the other would divert stormwater to the adjoining drainage basin to avoid discharging to water supply watershed lands.

5.4.6.7 *Preferred Alternative:* Like the other E alternatives, implementation of the $E_{(4)}$m-V3 alignment would have 13 stream crossings. Of these, eight would be perennial and five would be intermittent. One pond would also be impacted. Culvert construction requirements and associated impacts would also be similar to those described for the 92PD alignment. Like the other E alternatives, this alternative would include construction of a bridge spanning Shingle Mill Brook in the vicinity of Old New London Road and Latimer Brook in the vicinity of Grassy Hill Road. Bridge construction would require land clearing adjacent to Shingle Mill and Latimer Brooks as described for the E alternatives. Placement of fill upgradient and proximal to the watercourse for the construction of the bridge abutments would also be required. Impact to adjacent fringing wetlands and the watercourse would be minimized because the conceptual plan for this alternative incorporates extended bridge spans, which would require less fill and would move the impact areas away from wetlands. Temporary diversions of both perennial and intermittent watercourses would likely be required during construction, as would some vegetation clearing. Permanent impacts might include temporary wetland fill (to provide construction access to the area of bridge pier in the upland buffer), permanent wetland fill (within bridge pier footprints), and increased stormwater runoff from the highway. Fisheries impacts would include elevated water temperatures near areas cleared of vegetation, and stormwater pollutant inputs.

At Shingle Mill Brook, the $E_{(4)}$m-V3 alignment would cross the brook and wetland via an extended span bridge. The wetland at Shingle Mill Brook (described in section 4.6.3.1) is valued for its wildlife habitat and uniqueness/ heritage. This is a large wetland with a high diversity of vegetation; interspersion and abundance of cover; a broad food base; and water. It is located at the edge of Habitat Block No.1. Direct wetland impacts (minimized by the addition of the extended spans) are estimated to be less than 0.01 ha (0.02 ac) resulting from the installation of the bridge piers. Temporary impacts to Odonata and other aquatic invertebrates at this location may result from construction activities. Potential impacts to watercourses that could adversely affect Odonata and other aquatic invertebrates include degradation of water quality (e.g. via turbidity, pollutants, etc.), alterations in water temperature, quantity, and/or flow rates, clearing of vegetation, erosion and sedimentation, and changes in other physical and chemical properties of the stream reach. Clearing of vegetation would reduce, but not eliminate, habitat for wetland-dependent vertebrates including the state special concern eastern ribbon snake detected within this system during the 2004-2005 biological surveys. One Great Blue Heron nesting site may also be impacted.

At the unnamed tributary to Latimer Brook the stream channel would be crossed by the $E_{(4)}$m-V3 alignment just upstream from Silver Falls off Silver Falls Road (wetland PD-11B). This surface spring is the most ecologically valuable area of all the Odonata survey sites. This unique community, though poor in overall species richness, is rich in spiketails; *Cordulegaster diastatops, C. erronea*, and *C. obliqua* were all present at the site, as well as the seldom encountered *Lanthus vernalis*. A culvert is proposed for this stream crossing and direct impact is estimated to be 0.5 ha (1.15 ac). The principal function of the wetland is wildlife habitat. Potential impacts to this stream that could adversely affect Odonata include degradation of water quality (e.g. turbidity, toxins, organic pollution, etc.), alterations in water temperature, quantity, and/or flow rates, clearing of vegetation, and changes in other physical and chemical properties of the stream reach.

Two species of stream salamanders (*Hemidactylium scutatum* and *Eurycea bislineata*) were found to inhabit various unnamed tributary streams to Latimer Brook within the corridor. These species are sensitive to anthropogenic disturbances that may result in changes to hydrology. Impacts to herpetofauna are discussed further in section 5.4.9.

5.4.7 Threatened and Endangered Fisheries/Aquatic Species

No threatened or endangered fish species or other aquatic biota were reported by the DEP NDDB, the DEP Fisheries Division or FWS, therefore, impacts to threatened and endangered species were not anticipated as a result of implementation of any of the described transportation alternatives.

The 2004-2005 biological surveys were conducted in an effort to further verify this information. Extensive surveys of representative wetlands and watercourses from all five subregional drainage basins of the study corridor revealed the presence of two state-listed invertebrates dependent upon perennial watercourses. They are the state special concern Eastern pearlshell mussel (*Margaritifera margaritifera*), found within Harris Brook, and the state threatened tiger spiketail dragonfly (*Cordulegaster erronea*), found within an unnamed tributary to Latimer Brook. The pearlshell could potentially be impacted by the widening alternatives and the spiketail by the preferred alternative.

The widening alternatives would likely impact a population of Eastern pearlshell, which was found adjacent to Route 85 in Salem within Harris Brook. Roadway widening at Harris Brook may necessitate temporary diversion or relocation of the stream channel. Construction activity within or adjacent to the channel could result in changes or temporary impact to hydrology or water quality which could be detrimental to the pearlshell.

The preferred alternative incorporates a culvert for the stream crossing where the tiger spiketail was found.

Impacts associated with roadway construction that could potentially affect the pearlshell and tiger spiketail include degradation of water quality (e.g. via turbidity, pollutants, etc.), alterations in water temperature, quantity, and/or flow rates; clearing of vegetation;

erosion and sedimentation; and changes in other physical, chemical, or hydrologic properties of the stream reach.

5.4.8 Mitigation Measures - Fisheries/Aquatic Impacts

Stream crossings within the project corridor cannot be avoided based on the length of the corridor and the abundance of tributaries within the four subregional drainage basins traversed by the corridor alternatives. However, various impact minimization measures would be employed to prevent adverse effects to watercourses that would be detrimental to fish and aquatic biota.

The amount of cleared or disturbed land within the impact corridor would be reduced to limit potential sediment source area. This could be done by limiting the amount of disturbed land in advance of work activity, and by restoring cleared vegetation alongside the roadway immediately following construction activity.

Structures used at each stream crossing can be constructed to facilitate fish movement. An important consideration in fish movement through culverts and other structures is to maintain the natural flow rates and turbulence of the stream channel. Barriers to fish movement such as steep elevation drops (fall lines), increased flow rates, and structural features should be avoided. Channel bottoms should also maintain a minimum flow to allow fish to pass without injury and should contain a natural substrate. Customized culverts could be designed to obtain the desired configuration that would allow optimal flows at each channel crossing. Generally, the maintenance of fish movement in watercourses is a standard condition under most permit processes.

Habitat enhancement could help to mitigate potential impacts associated with the placement of a culvert structure within the channel. Stream enhancement measures include the addition of cover structures and the re-establishment of streamside vegetation where needed. Water quality impacts may be mitigated by preventing road runoff from directly discharging to watercourses. Detention basins, especially basins that incorporate constructed wetlands, may be used to attenuate sediments and toxicants before water is discharged into watercourses.

Indirect impacts to the breeding areas of Odonata and other aquatic invertebrates typically result from alteration of hydrology, loss of habitat, or introduction of pollutants toxicants. The use of best management practices (BMPs) for highway construction and erosion/sedimentation control, would minimize the potential for temporary impacts associated with highway construction from extending outside the immediate impact area of the roadway and affecting the Shingle Mill Brook and Latimer Brook stream systems. The specific anthropogenic threats to larval and adult Odonata identified by Nikula et al., (2003) and the associated impact avoidance, minimization, or mitigation techniques incorporated into the conceptual plan for the preferred alternative are provided in Table 5-26.

TABLE 5-26
IMPACTS TO ODONATA AND MITIGATION MEASURES – PREFERRED ALTERNATIVE

ANTHROPOGENIC THREATS TO ODONATA [1]	AVOIDANCE, MINIMIZATION, MITIGATION MEASURES AND BMPS FOR THE CONSERVATION OF ODONATA
THREATS TO LARVAL ODONATA	
ALTERATION OF LARVAL AQUATIC HABITAT	
Direct loss of habitat by in-filling, construction, removal of substrate, trampling, and off road vehicle use	Alignment shifts to minimize overall wetland fill; minimization of fill in wetland via reduced roadway footprint and use of expanded bridge spans
Increase in sediment load by destruction of vegetation cover in catchment area and subsequent erosion	Minimization of vegetation disturbance ahead of construction; seeding and reestablishment of vegetation upon completion of work areas; use and enforcement of erosion and sedimentation BMPs during construction and until area is vegetatively or otherwise stabilized
Destruction of heterogeneity of wetland margins and rate of flow by channelization	Alignment shift to minimize overall wetland fill; minimization of fill via reduced roadway footprint and use of expanded bridge spans; preventing or limiting work within wetland areas wherever possible; expedient restoration of wetland areas temporarily impacted during bridge construction or culvert installation; incorporation of expanded bridges and over-sized culverts to prevent channelization and concentration of flows
Intermittent exposure of littoral zone (shoreline) by dam release, draining, drawdown from wells, or water diversion	Maintenance of existing stream flows via suitably sized bridge spans and culverts; avoidance of water diversions and drawdowns either directly (consumptive use) or indirectly (cuts below groundwater level or deposition of surplus fill)
Eutrophication and subsequent changes in dissolved oxygen	Prevention of excessive nutrient runoff via use of stormwater BMPs (e.g., detention basins, grassed swales, deep sump catch basins, etc.); limiting the amount of vegetation removed from the stream channel
Chemical or thermal contamination by runoff or discharge of agricultural, industrial, or urban effluent	Prevention of excessive nutrient runoff via use of stormwater BMPs (e.g., detention basins, grassed swales, deep sump catch basins, etc.); retention of riparian vegetation
Major pollution event upstream	Management of stormwater; signage at sensitive watersheds, safe road construction
Degradation by invasive exotic plants and animals	Use of native, non-invasive plantings; erosion and sedimentation BMPs
THREATS TO ADULT ODONATA	
HABITAT DESTRUCTION AND DEGRADATION	
Destruction of uplands, forests, and meadows where adults hunt and roost	Minimization of highway footprint cuts and fills; compensation for lost upland habitat
OTHER	
Road mortality	None. The occasional loss of individuals due to vehicle strikes is possible and anticipated.

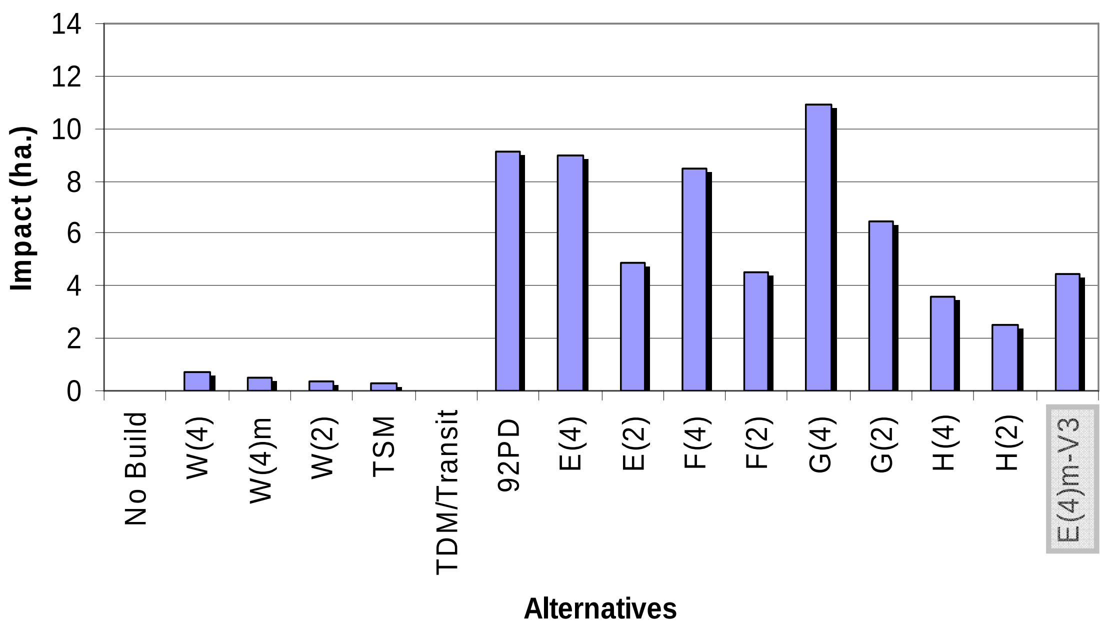
[1] from Nikula et al., 2003

The same avoidance, minimization, or mitigation techniques identified in Table 5-26, above, will benefit other aquatic organisms as well including other aquatic insects, crustaceans, mollusks, fish, stream salamanders, etc.

5.4.9 BIOLOGICAL IMPACTS - TERRESTRIAL BIOTA

Direct impacts to wildlife occur as a result of habitat loss, fragmentation or considerable degradation. Habitat loss can be caused by development of the existing land area, or large scale changes in community composition. Construction of a new highway alignment associated with the build alternatives will cause direct loss and degradation of both upland and wetland habitat, impacting various wildlife groups. Figure 5-14 depicts the area of impacted wetlands, by alternative, in which wildlife habitat was identified as a principal function.

Figure 5-14
Impact to Wetlands With Wildlife Habitat as Principal Function



Note: 1 hectare = approximately 2.47 ac.

Indirect impacts on wildlife may occur because of edge effects (i.e., reduced habitat quality, noise, light, invasive species, predation, erosion and sedimentation) caused by the construction of a roadway within a forest block.

Wildlife impacts associated with the build alternatives will very among taxa and depend on habitat conditions. The value of forest as habitat for wildlife is a direct function of the suitability of cover, feeding, nesting or breeding areas. The quality and quantity of these areas will affect the survivorship, fecundity and other aspects of wildlife ecology which influence the sustainability of the population within a given area.

Invertebrate fauna: The state threatened butterfly, frosted elfin, was encountered in early successional habitat along the existing Route 11 right-of-way during the Odonata survey. Direct impacts would occur in one area that provides habitat for the frosted elfin. Habitat for this species includes early successional shrubland containing the host plant wild indigo (*Baptisia tinctoria*), a perennial herb of dry, open woods and fields. During construction of preferred alternative $E_{(4)}$m-V3 or any of the new location alternatives, shrubland areas containing this host plant would be impacted by vegetation clearing. Loss of this host plant may impact the frosted elfin population in that area.

Herpetofauna: Direct impacts to herpetofauna that may potentially occur include the destruction or alteration of foraging and breeding habitat, water quality degradation, or the creation of barriers to movement.

The filling or draining of seasonal pools can lead to destruction of breeding habitat. Seasonal pools were found at select locations within the project corridor, and as expected, were frequently observed occupied by amphibians and their egg masses. Highway retaining walls or steep slopes may act as barriers to movement of herpetofauna, and the highway surface itself may deter certain species from crossing, or substantively reduce their chance of survival. Impacts to upland habitat areas surrounding seasonal pools would also cause negative impacts to herpetofauna. Impacts to obligate and facultative seasonal pool herpetofauna are discussed further in Section 5.6.

Forest dwelling species of herpetofauna that require two or more habitat types or a range of microhabitats are thought to be especially susceptible to fragmentation (Wilcove *et. al.*,1986). Examples of this requirement include certain salamanders and tree frogs that require ponds for breeding and forested areas for shelter, or snakes that require certain areas that are suitable for hibernation and other areas suitable for foraging and breeding. Construction of a highway through previously unfragmented forest blocks may pose a barrier to movement of certain herpetofauna.

The 2004-2005 biological surveys served to identify the herpetofauna in the project area that require two or more habitat types, forested habitats, or that disperse long distances and are therefore susceptible to new highway construction. Illustrative examples of herpetofauna that require two or more habitat types (e.g., breeding seasonal pools and upland hibernacula) and that were frequently encountered in the study area include spotted and marbled salamanders (*Ambystoma maculatum* and *A. opacum*) and wood frog (*Rana sylvatica*). An illustrative example of a herpetofaunal species that requires forested habitat and avoids dispersal across open canopy areas, that were also frequently encountered in the study area, is the red-spotted newt (*Notophthalmus v. viridescens*). *carolina*).

The surveys also identified the herpetofauna dependent upon perennial stream habitats that may be adversely impacted by direct stream impacts or stormwater runoff unless appropriate management practices are incorporated. Two species of stream salamanders, the two-lined salamander (*Eurycea bislineata*) and the northern dusky salamander (*Desmognathus fuscus*), were detected within the various tributaries to Latimer Brook and eastern ribbon snake was found along Shingle Mill Brook.

These salamander species are susceptible to habitat alteration that may destroy spring or seep areas, remove streamside vegetation, scour stream channels, or add stormwater runoff to the stream. Seep areas adjacent to the stream are essential microhabitat features for dusky salamanders in that they add cooler, more oxygenated groundwater to typically warmer surface water flows. Increased stream flows due to channel alteration or an increased stormwater discharge may flush accumulated organic matter from within the channel. The accumulated organic matter is a microhabitat feature essential for the survival of stream salamanders in that it provides both cover and food for the organisms that the salamanders prey upon. *D. fuscus* is apparently intolerant of sediment and other pollutants that are introduced to stream systems by stormwater runoff, and as a result is becoming increasingly rare in urbanized watersheds.

Avifauna: As would be expected, species which require specific types of habitat or occupy narrow niches (specialists) are more susceptible to environmental disturbance than those which are more adaptable to changes in their environment (generalists). Both groups were noted among the avifauna of the project corridor. Avifauna specialists noted within the project corridor generally included wetland dependent species, forest interior specialists, and top carnivores. Wetland-dependent species noted, such as the Black Duck and Swamp Sparrow, are susceptible to changes in wetland hydrology, vegetational composition, and other disturbances associated with wetland impact (refer to Section 5.6).

The loss of mature forest trees as a result of land clearing for the expressway alignments (including the H alternatives but to a lesser extent) will result in secondary impacts to the avifauna preferring the taller trees of climax and later successional upland forests such as the Pileated Woodpecker.

Forest fragmentation resulting from the construction of any of the expressway alternatives may adversely affect certain bird species within the project area.

Neotropical migrants are most susceptible to forest fragmentation, which may be one factor that has contributed to their well-documented nationwide decline (Wilcove, 1990; Askins 1995). A number of forest interior bird species, that are also neotropical migrants, are documented breeders within the study area (Bevier, ed. 1995). Examples include the Wood Thrush, Scarlet Tanager, Hooded Warbler, and Worm-eating Warbler. Studies in mid-Atlantic states have shown that the latter two species have disappeared from historic breeding areas reduced by forest fragmentation.

A number of forest interior species, composed of year-round residents, breeding resident neotropical migrants, and transitory neotropical migrant species were noted within the study area during the 2004-2005 biological surveys. Breeding resident neotropical migrants observed within the project corridor that prefer the interior of large tracts of unfragmented woodland for breeding are listed in Table 5-27.

TABLE 5-27.
FOREST INTERIOR BIRD SPECIES
RESIDENT WITHIN THE SURVEY AREAS
SENSITIVE TO HABITAT LOSS AND FOREST FRAGMENTATION

Broad-winged Hawk	*Buteo platypterus*
Barred Owl	*Strix varia*
Hairy Woodpecker	*Picoides villosus*
Pileated Woodpecker	*Dryocopus pileatus*
Acadian Flycatcher	*Empidonax virescens*
White-breasted Nuthatch	*Sitta carolinensis*
Brown Creeper	*Certhia americana*
Veery	*Catharus fuscescens*
Hermit Thrush	*Catharus guttatus*
Black-throated Green Warbler	*Dendroica virens*
Cerulean Warbler	*Dendroica cerulea*
Black-and-white Warbler	*Mniotilta varia*
Worm-eating Warbler	*Helmitheros vermivorus*
Ovenbird	*Seiurus aurocapillus*
Louisiana Waterthrush	*Seiurus motacilla*
Hooded Warbler	*Wilsonia citrina*
Canada Warbler	*Wilsonia canadensis*
American Redstart	*Setophaga ruticilla*
Scarlet Tanager	*Piranga olivacea*

Some of these species, such as the Hooded Warbler and Worm-eating Warbler, have specific habitat requirements within these large forest blocks. Others such as the Acadian Flycatcher and Kentucky Warbler are characteristic species of more southern woodlands and reach the northern limits of their range in the vicinity of Connecticut and bordering states. Studies in mid-Atlantic states have shown that some specialist passerines such as the Hooded Warbler and Acadian Flycatcher have disappeared from historic breeding areas fragmented or reduced by increased urbanization (Wilcove 1988; Askins 1995).

Among the list of forest interior species noted during the biological surveys two species, the Barred Owl and the Broad-winged Hawk are considered area sensitive. These species not only prefer forest interiors, but also require large acreage within their home ranges inside the forest interior. Therefore, when considering impact to forest interior birds due to habitat fragmentation, two thresholds apply: one for forest interior species and one for area-sensitive interior species.

Generally, an area of 40± ha (100± ac.) or greater is considered important habitat for forest interior species (Askins, personal communication). Moreover, the surrounding landscape may have an impact on the suitability of the small forest fragments to nesting birds (Wilcove 1988; Askins 1995). Forest fragments that are surrounded by intensely agricultural areas or dense urban areas may have less value to the reproductive success of forest interior species than forested fragments surrounded by other land uses (e.g., rural residential, wetlands, or an interspersion of various rural land types). This is due largely to the fact that many of the neotropical migrant forest interior bird species are sensitive to nest predation which occurs more heavily along edge habitat than within deeper forest interiors. In addition, rates of brood parasitism from the Brown-headed Cowbird are typically higher at or near forest edges (Wilcove 1988). The effect of heavy predation and increased rates of brood parasitism may extend into the habitat block for as far as 300 m. to 600 m. (985 ft. to 1,970 ft.) (Wilcove et al. 1986). During the survey, Brown-headed Cowbirds were typically observed within the approximate 600 m. (1,970 ft.) edge effect zones that extended into the forest interior from man-induced edges, even within the center of the largest forested habitat block (Habitat Block No. 2).

A threshold value of approximately 100 ha. (247 ac.) is typically used in determining potential impact to area-sensitive forest interior birds species such as certain raptor species. As top predators, these raptors require larger home ranges within their preferred habitat type in order to acquire enough food to sustain a viable population. For instance, the required home range for the Barred Owl (reported by DeGraaf and Yamasaki, 2001, citing others) is, on average, 229 ha. (565 ac.), but ranged from 86 ha. (213 ac.) to 369 ha. (912 ac.) for nine owls studied. Other raptors noted or expected to occur within the corridor are unlikely to be impacted by the forest fragmentation since they have large home ranges that typically include natural gaps and other habitat inclusions, and sufficient forest occurs in the adjacent surrounding landscape (e.g. Red-tailed Hawk, Great Horned Owl, Cooper’s Hawk).

Area-sensitive forest interior passerines (songbirds) do not fare as well since they have small home ranges within the same contiguous habitat types. They may be excluded from forest patches smaller than an average range of 354 - 1,086 ha. (874 - 2,682 ac.) depending upon the species. Examples of area-sensitive forest interior passerines that could be impacted by the highway construction within forested habitat blocks within the project area include the Hermit Thrush, Brown Creeper, Blue-gray gnatcatcher, Yellow-throated Vireo, Black-throated Green Warbler, Cerulean Warbler, and Worm-eating Warbler.

Therefore, some avifauna species (forest interior dwelling, neotropical migrants, and other habitat specialists) will be adversely affected by fragmentation of the forest caused by highway construction. Others (habitat generalists) will be resilient to habitat disturbances (e.g. the catbird and Song Sparrow) and may actually benefit from disturbances. Still other species may benefit from forest fragmentation, usually to the detriment of habitat specialists. Disturbance may cause initial, short-term increases in species richness; however, as generalists begin to out-compete (or parasitize) specialists, overall species diversity may decrease concurrently with the elimination of specialists.

Beyond habitat loss and fragmentation, additional impacts (direct and indirect) to forest bird communities typically associated with adjacent road systems may also include noise aversion, visual impacts, pollution, and direct mortality. The effects of roadways on resident forest birds will vary with each species and their individual breeding ecology. An effects distance range of 60-300 m. (197-985 ft.) from the road edge has been reported for a variety of forest birds adjacent to a moderately busy (10,000 vehicles/day) roadway due to traffic disturbance (Forman et al., 2003). Reijnen et al., (1995) demonstrated that noise load is most likely the most important cause of impact (reduced breeding density) to woodland birds, with visibility of cars, pollution, and direct mortality argued as unimportant to breeding populations. Birds that delineate their nesting territories via vocalizations (e.g., a majority of the passerines) may avoid roadway edges to avoid competing with the noise of roadways during singing. Therefore, among the avifauna, the effects of noise generated by the roadway would have the greatest impact to passerines inhabiting the areas adjacent to the roadway.

Small Mammals: Approximately 17 species of small mammals are known or expected to occur in the project corridor (Section 4.4.4). Representative species of the families Didelphidae (New World opossums), Soricidae (shrews) Talpidae (moles) Leporidae (hares and rabbits) Sciuridae (tree squirrels and marmots), Castoridae (beavers) Muridae (mice, rats, voles), Vespertilionidae (bats), and Dipodidae (jumping mice) were noted during the 2004-2005 biological surveys.

According to Forman (1995), many species show limitations as to the width of road which they will cross during movement. For instance, road crossing by some small mammals were shown to be inhibited by roads greater than 15 m. (49 ft.) wide. The probability of mammal movements across roads was found to be less than 10% of the movements recorded within adjacent habitat. Studies observed that small forest mammals (chipmunk, meadow vole, red squirrel, and white-footed mouse) would rarely cross roads wider than 15-30 m. (49-98 ft.), but readily crossed roads less than 15 m. (49 ft.) wide. Forman also states that mid-sized mammals, such as woodchuck, raccoon, grey squirrel, and stripped skunk, crossed road corridors up to 30 m. (98 ft.) wide. None of the small or mid-sized mammals were noted crossing highway corridors of 118 m. (387 ft.) and 137 m. (450 ft.) wide. Three important aspects governing the crossing of roads by mammals seemed to be 1) width of the inhospitable section of the road, 2) traffic volume, and 3) mobility and behavior of the species.

Moles are an example of a small mammal group with mobility limitations that exclude them from crossing large paved roadways. These animals are fossorial, spending most of their time in the subsurface environment where their bone structure is better suited for digging than running or climbing. As such they avoid crossing large open expanses where they are susceptible to predation. The 2004-2005 biological surveys identified the eastern mole within the project corridor.

An example of an animal with behavioral limitation that typically excludes it from crossing open roadways is the New England cottontail. The New England cottontail, a FWS ESA candidate species, prefers shrubland with a high woody stem density. Unlike the closely related eastern cottontail, the New England cottontail rarely strays far from dense cover, a behavior that would preclude it from crossing the relatively large, open space of the proposed highway.

The 2004-2005 biological surveys identified the New England cottontail at two sites along the project corridor. One of the sites occupied by New England cottontail is associated with a disturbed area within the previously cleared section of the Route 11 extension. Similar habitat would likely result along the immediate footprint after construction of the proposed roadway, comparable to portions of I-95 in southern Maine (Litvaitis et al. 2003). However, because most of the land adjacent to the new location alignments is mid-successional forest, existing and potentially generated habitats (i.e., land cleared prior to construction activity that reverts to shrubland post-construction) will support few New England cottontail. The second site where New England cottontail was found is a power line right-of-way that crosses the proposed highway corridor and is considered to be marginal habitat for New England cottontail. Therefore, beyond the effects of landscape fragmentation that further isolates remnant populations of New England cottontail, it was determined that the extension of Route 11 on new location would have limited influence on the status of New England cottontail in this portion of their current range.

The future status of New England cottontail on the FWS ESA list and the DEP list will be monitored during the design, permitting, and construction phases of the project. Any action(s), including possible Section 7 consultation under the ESA, that are determined to be necessary as a result of changes to the status of species present within the project limits, will be pursued as required by federal and/or state law or regulation.

Habitat fragmentation and clearing of trees for a new roadway may eliminate or reduce the availability of roosting sites for a variety of tree-roosting bat species (Kunz and Lumsden, 2003). Impacts to wetlands and watercourses may affect several species of bats that forage for insect prey over open water.

Larger Mammals: Larger mammals inhabiting the forested land within the project area include white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*) and coyote (*Canis latrans*). Evidence of bobcat (*Felix rufus*) noted during initial field reconnaissance suggests that this species may still occupy the forests of the project area. Loss in forest area may result in a decrease in the carrying capacity of the forest for sustaining larger mammalian species, especially predators. Top carnivores such as the bobcat are most susceptible to a loss in habitat area due to their large home ranges. Forman (1995) found that larger mammals tended to cross most roads, but at a lower rate than adjacent habitat. Therefore, construction of the roadway may impact the daily movements of larger mammals in the project corridor. Impact to individuals of numerous wildlife species would occur as the build alignments would invariably pass through the home ranges of many individuals of these species. As a result, individuals of some species will be forced to leave the corridor and search for new territory where they may face severe competition from established individuals determined to defend their territory. In such cases the previously established individual typically has the advantage over the immigrant; however competition may decrease the survivorship of both interacting individuals.

The relationship of all vertebrate wildlife to stand size is generally assumed to be reasonably indicated by bird species richness (Thomas et al. 1979). Among all the habitats and sites (e.g., large forest block, small forest block, grassland, agricultural, shrubland, wetland) surveyed during the 2004-2005 biological surveys, bird species richness was found to be greatest in the two largest forest habitat blocks (Habitat Blocks Nos. 1 and 2). This finding is likely a function of habitat size, composition (floristic complexity and structure), and the overall greater community diversity and microhabitat variability within the larger habitat blocks, which sustains a broader, or more productive food base. Therefore, the greatest mammal diversity is expected to be within the largest forest habitat blocks, with the smaller forest blocks providing a supporting role in population ecology (e.g., dispersal corridors, geneflow through metapopulations, etc.). Furthermore, large mammal species requiring large expanses of forest interior in their home ranges that were noted during the surveys were typically found within Habitat Blocks Nos. 1 and 2. Examples include bobcat (found only along survey routes that traversed Habitat Blocks Nos. 1 and 2), gray fox (found only in Habitat Block No. 2), and fisher (found only in Habitat Blocks Nos. 1 and 2). These species would be most sensitive to forest fragmentation.

5.4.10 Comparison of Terrestrial Impacts

The ability of certain species to thrive even though their habitat may be disrupted by construction activities or by the presence of a new road or more paved surface area is dependent on a number of overall habitat factors. Some of these habitat attributes are noted and compared in Table 5-28 with respect to each alternative.

5.4.10.1 _No Build Alternative_: The no build alternative would most likely have minimal direct impact to the current wildlife population trends in southeastern Connecticut. Wildlife dispersal would continue across Routes 82 and 85; however, as traffic increased along this roadway, the frequency of traffic-related animal deaths may also increase, and wildlife dispersal frequency or effectiveness would be expected to decrease.

TABLE 5-28
WILDLIFE HABITAT ATTRIBUTES POTENTIALLY IMPACTED BY ALTERNATIVE

ALTERNATIVE	NUMBER OF DIRECT SEASONAL POOL IMPACTS(1)	NUMBER OF FOREST BLOCKS > 200 ha.	NUMBER OF FOREST BLOCKS 50-200 ha.	LANDSCAPE LEVEL WILDLIFE CORRIDORS	LISTED SPECIES SITES(2)
No build	N/I	N/I	N/I	N/I	N/I
TSM	N/I	N/I	N/I	N/I	N/I
TDM/Transit	N/I	N/I	N/I	N/I	N/I
$W_{(4)}$	1	2	0	0	1
$W_{(4)}$m	1	2	0	0	1
$W_{(2)}$	1	2	0	0	1
92PD	3	2	2	3	9
$E_{(4)}$	2	2	3	3	9
$E_{(2)}$	2	2	3	3	9
$F_{(4)}$	5	2	4	0	8
$F_{(2)}$	5	2	4	0	8
$G_{(4)}$	5	2	4	1	8
$G_{(2)}$	5	2	4	1	8
$H_{(4)}$	3	2	3	1	8
$H_{(2)}$	3	2	3	1	8
$E_{(4)}$m-V3	4	2	4	3	9

N/I = No impact or negligible impact
(1) Seasonal pool surveys were not conducted for portions of the W, 92PD, $E_{(2)}$, $E_{(4)}$, F, G, and H Alternatives.
(2) Number of locations along alignments where listed species (i.e., species designated as state or federal special concern, threatened, or endangered (both candidate and current) were found. Pertains to plants and breeding animals. Note: Listed species surveys were not conducted for portions of the W, 92PD, $E_{(2)}$, $E_{(4)}$, F, G, and H Alternatives.

5.4.10.2 *Route 82 and 85 Widening Alternative*: Of the build alternatives, this alternative would likely have the least impact to wildlife populations since the majority of the impact area will occur along the existing roadway which includes developed areas and areas of low wildlife value characterized by noise and other man-made sources of impact. Since, however, the widening alternative would involve improvements to the entire length of road, more individuals of herpetofauna and small mammals would likely be impacted and/or displaced. Two forest blocks greater than 200 ha. (500 ac.) would be impacted by this alternative. However the impact would occur along a very small portion of the forest block and would be incurred along an existing induced edge. Construction of the widening alternatives would not have as great an impact to the forest blocks as if the road traversed the forest interior.

The widening alternative would have the greatest impact to edge species. Edge species are flora and fauna that have adapted to the greater light availability, and other habitat attributes lacking deep within the forest interior. Natural forest edges tend to have a zone of shrubs and small trees (called a "mantel") that protects the forest interior from outside impacts (such as weather). The mantel is typically flanked by the forest on one side and a perennial herbaceous zone on the side with the open area (Payne and Bryant, 1994).

Although the edge habitats along Routes 82 and 85 were induced by the construction of these roadways, they have existed for many years and in undeveloped areas have developed into edge habitat that is floristically and structurally similar to a natural edge. The abundance of food and cover in the edge attracts a multitude of fauna to the forest edge. Forest edges tend to have a high diversity of Lepidoptera (butterflies) exploiting the nectar sources which tend to be abundant there, while songbirds find berry-producing shrubs (an important food source) plus an abundance of insects and weed seeds.

An increased road width may also deter some small mammal species with mobility or behavior limitations (discussed earlier) from dispersing across the road surface.

5.4.10.3 *TSM Alternative:* This alternative, as the no build, would most likely have minimal direct impact to the current wildlife population trends in the corridor and southeastern Connecticut. Wildlife dispersal would continue across Routes 82 and 85; however, as traffic increased along this roadway, the frequency of traffic-related animal deaths may also increase. Herpetofauna and small mammals would likely be impacted the most by this alternative since avifauna and large mammals would not be affected by small improvements due to their better mobility and larger home ranges. Small mammals and herpetofauna would move slower across roads, and since they generally have smaller home ranges, the roadway itself could make up a substantial portion of their territory. Since the impacts would occur along the edge of an existing roadway, impacts would largely be to individuals, rather than populations of organisms.

5.4.10.4 *TDM/Transit Alternative*: This alternative would not have any impacts on terrestrial biota because it does not involve any construction activities.

5.4.10.5 *New Location - Full Build Alternative*: Impacts to terrestrial habitat features vary among the full build alternatives are discussed individually, below.

92PD Alternative: Construction of the 92PD Alternative may form a barrier to small mammals and herpetofauna moving between the natural areas of Nehantic State Forest to the west and the Shingle Mill Park/Horse Pond natural areas to the east within Habitat Block No. 1. It may also result in forest fragmentation impacts to wildlife of Habitat Block No. 2 and to two of the smaller (50-200 ha.) forest blocks. Three landscape level wildlife corridors would also be impacted by this alternative. Alternative 92PD would have direct impacts to a tract of grasslands located south of Grassy Hill Road.

The populations of area-sensitive wildlife such as the bobcat would be most affected by the fragmentation impacts to these forest blocks. Herpetofauna would be impacted by both upland and wetland disturbances, as would many species of small mammals. Forest interior species of avifauna would suffer impacts since a number of forest blocks would be bisected by the new location alternative. Large mammals such as deer would be displaced, and incidents of roadkill would likely be high initially, until large mammals redefined their territories or adjusted their behavior to avoid traffic.

This alternative would also have direct impact to a tract of grasslands located south of Grassy Hill Road. Because this tract represents a large portion of this habitat type within the project corridor, and because grasslands are an uncommon habitat type in the project area, this impact would be notable. Two state listed species of special concern, the eastern ribbon snake and the Bobolink were noted within this area. Direct impact (loss of suitable habitat due to fragmentation) would be likely for the Bobolink. Impact to the habitat of the eastern ribbon snake could be reduced by the use of extended bridge spans and retention of scrub-shrub vegetation along the wetland and watercourse borders.

In addition, numerous wetlands in which wildlife value was determined to be a primary function would be directly impacted as a result of the construction of these alternatives. Areas of high wildlife value within these forest blocks include wetlands such as vernal pools within Habitat Block No. 2. Three seasonal pools would be directly impacted by this alternative.

E Alternatives: Construction of the $E_{(4)}$ or $E_{(2)}$ alternatives, like the 92PD Alternative, may form a barrier to small mammals and herpetofauna moving between the natural areas of Nehantic State Forest to the west and the Shingle Mill Park/Horse Pond natural areas to the east within forest Habitat Block No.

1. It may also result in forest fragmentation impacts to wildlife of forest block No. 2 and to two of the smaller (50-200 ha.) forest blocks. In addition, the E Alignment would traverse an additional smaller forest block (Habitat Block No. 4).

Impacts to wildlife would be slightly greater than those of the 92PD, since this alternative utilizes almost the entire alignment of the 92PD, but passes through an additional forest block in its middle section. The $E_{(4)}$ or $E_{(2)}$ alternatives would also have direct impacts to a tract of grassland located south of Grassy Hill Road (habitat for state special concern Bobolink), as well as three landscape level wildlife corridors. Herpetofauna (including the state special concern eastern ribbon snake) would be impacted by both upland and wetland disturbances, as would many species of small mammals. Alternative $E_{(4)}$ or $E_{(2)}$ would directly impact two seasonal pool areas.

<u>F Alternatives</u>: The $F_{(4)}$ or $F_{(2)}$ alternatives would impact the wildlife habitat of all four forest blocks of 50-200 ha. in area. They would also have similar impacts to the two forest blocks of 200 hectares or greater described for the 92PD alignment. Impacts to herpetofauna and small and large mammals would be very similar to the 92PD alignment. However, the F alignment bisects Habitat Block No. 2 almost in half, while the 92PD is aligned towards the east side of the block, leaving a larger block intact. Because of this, the F alternatives would have a greater impact on this block. Additionally, this alternative passes directly through an area of large mixed hardwood habitat where a Cerulean Warbler was observed during field investigations. This species is an uncommon forest interior bird of conservation concern. FWS recently reviewed a petition to list Cerulean Warbler as threatened, but in December 2006 announced their finding that listing is not warranted (refer to Sections 4.4.7.1 and 5.4.11). The F alignment would also impact a tract of grasslands located south of Grassy Hill Road.

In addition, the construction of these alternatives would impact the notable wildlife habitats of the hemlock ravine associated with Latimer Brook south of Silver Falls, and the vernal pool wetlands within Habitat Block No. 2 west of lower Pember Road.

<u>G Alternatives</u>: Alternatives $G_{(4)}$ or $G_{(2)}$, like the F Alternatives, would impact the wildlife habitat of all four forest blocks of 50-200 ha. in area. They would also have similar impacts to the two forest blocks of 200 ha. or greater described for the 92PD alignment. Impacts to herpetofauna and small and large mammals would be very similar to the 92PD alignment, however, like the F alternatives, the G alignment would bisect Habitat Block No. 2 almost in half, while the 92PD is aligned closer to one side of the block, leaving a larger block intact. Because of this, the G alternatives have a greater impact on this block. This alternative also passes directly through an area where a Cerulean

Warbler was observed during field investigations. The G alignment would also impact a smaller tract of grasslands located south of Grassy Hill Road.

In addition, the construction of these alternatives would impact the notable wildlife habitats of the hemlock ravine associated with Latimer Brook south of Silver Falls, and the seasonal pool wetlands within Habitat Block No. 2 west of lower Pember Road.

5.4.10.6 *New Location - Partial Build Alternatives*: Construction of either the $H_{(4)}$ or $H_{(2)}$ alternative would result in the impact to three smaller forest blocks and impact to the two forest blocks greater than 200 ha. in area. Impacts to Habitat Block No. 1 would be similar to those described under the 92PD alignment. Impacts to Habitat Block No. 2 would affect a small area of the extreme northern tip of the block, since this portion of either $H_{(4)}$ or $H_{(2)}$ is along Route 85. The impacts to Habitat Block No. 2 are minimal since the alignment would impact an area that represents a small fraction of the block's total area. Impacts to wildlife would be similar to the 92PD alternative along the northern portion of this alternative; impacts would be similar to the widening alternatives along the southern portion of the alternative.

As with the 92PD and the E Alignments, Alternative H would also have direct impact to a tract of grasslands located south of Grassy Hill Road. Because this tract is a large portion of this uncommon habitat type within the project corridor, and because these grasslands appear to support two state listed species of special concern, the eastern ribbon snake and the Bobolink, this impact would be notable. Direct impact (loss of suitable habitat due to fragmentation) would be likely for the Bobolink. Impact to the habitat of the eastern ribbon snake could be reduced by the use of an extended bridge span and retainage of scrub-shrub vegetation along the wetland and watercourse borders.

For each of the new expressway alignments, the four-lane version would have greater impact to wildlife dispersal across the roadway than the two-lane, based on the wider road width. This would result in a greater loss of habitat area. For the portion of the H alignment that proceeds along Route 85, the impacts of the two-and four-lane versions would be similar based on configuration of the travel lanes in relation to existing and proposed shoulders.

5.4.10.7 *Preferred Alternative:* Like all of the other new location alternatives, preferred alternative $E_{(4)}$m-V3 may form a barrier to small mammals and herpetofauna moving between the natural areas of Nehantic State Forest to the west and the Shingle Mill Park/Horse Pond natural areas to the east within forest Habitat Block No. 1.

It may also result in forest fragmentation impacts to wildlife of the forest blocks. Of particular concern are the neotropical migrant passerine birds, many of which require forest interior habitat. To quantify these impacts, the area of contiguous forest block remaining as suitable habitat for interior forest bird species was determined. Following Forman and Deblinger (1998) an indirect effects zone of 300 m. (985 ft.) from the edge of disturbance was added to the direct impact of the roadway area (pavement plus associated cut and fill) as a practical threshold for measuring impacts to forest interior (Table 5-29). Habitat Blocks Nos. 1, 2, and 5 would still be sufficiently large enough to support forest interior bird species, and most forest dwelling raptors. Habitat Block No. 3 would be reduced from the threshold value of 94 ha (233 ac) by approximately half. Without the contribution of the surrounding supporting landscape, this impact would otherwise render the forest blocks less suitable or unsuitable habitat for forest interior woodland raptors such as the Barred owl and Sharp-shinned Hawk. Habitat Block No. 4 would become more fragmented but would still have value to some neotropical migrant birds and comparatively less value to woodland raptors. No fragmentation would occur to forest Habitat Block No. 6.

TABLE 5-29
AREA OF HABITAT BLOCKS REMAINING OUTSIDE OF ROADWAY EFFECTS ZONE[1] FOR FOREST INTERIOR BIRDS

HABITAT BLOCK NO.	ORIGINAL SIZE ha. (ac.)	DIRECT IMPACT FROM ROADWAY ha. (ac.)	AREA OF HABITAT BLOCK REMAINING OUTSIDE OF ROADWAY EFFECTS ZONE[2] ha. (ac.)
1	271 (671)	9.5 (23.5)	147 (364)
2	835 (2,065)	33.7 (83.3)	496 (1,227)
3	94 (233)	7.0 (17.3)	48 (119)
4	52 (130)	2.6 (6.4)	32 (79)
5	167 (413)	4.1 (10.1)	129 (320)
6	77 (190)	0	77 (190)

(1) Excluding recent development areas within the survey area unrelated to the preferred alternative.
(2) Outside of the preferred alternative road footprint (including cut and fill) and adjacent 300 m. (985 ft.) effects zone

The $E_{(4)}$m-V3 alternative would also have direct impacts to a tract of grassland located south of Grassy Hill Road (habitat for state special concern Bobolink), as well as three landscape level wildlife corridors. Herpetofauna (including the state special concern eastern ribbon snake) would be impacted by both upland and wetland disturbances, as would many species of small mammals. Alternative $E_{(4)}$m-V3 would directly impact four seasonal pool areas.

The concept for the preferred alternative alignment minimized impact to mammal diversity, top predators requiring large expanses of forest interior, and wide ranging mammals such as black bear and bobcat by avoiding further fragmentation of large habitat blocks where possible, and by maintaining connectivity between forested areas via conservation measures that provide permeability of the roadway to various wildlife species (both predators and their prey).

5.4.11 THREATENED AND ENDANGERED TERRESTRIAL SPECIES

No threatened or endangered wildlife species were reported from impact areas of the project corridor by the DEP NDDB or FWS, therefore impacts to endangered or threatened wildlife species were expected to be negligible. The 2004-2005 biological surveys identified six listed terrestrial species including one state threatened, four state special concern and one federal candidate species that could potentially be impacted by the alternatives. The total number of listed species that may be impacted by each alternative was provided in Table 5-28. The terrestrial species are discussed below.

The state threatened butterfly, frosted elfin, would likely be impacted by loss of habitat where vegetation clearing adversely affects its host plant, wild indigo. During construction of preferred alternative $E_{(4)}$m-V3 or any of the new location alternatives, shrubland areas containing this host plant may need to be cleared and this may impact the frosted elfin population in that area.

The state special concern eastern ribbon snake may be adversely impacted by the preferred alternative, and all of the new location alternatives, by the clearing of vegetation and potential water quality impacts at Shingle Mill Brook. The state special concern Eastern box turtle was observed in a location that may be impacted by the 92PD, E, F, and G alternatives, but would not be affected by the preferred alternative.

Twelve bird species listed as state special concern, threatened, or endangered by the DEP, including the Bald Eagle, were noted along the project corridor during the 2004-2005 biological surveys (refer to Section 4.4). The Bald Eagle was removed from the federal list, but remains as endangered on the state list (refer to Section 4.4.7.1). Most of the listed bird species were determined to be migrants within the project corridor, and therefore construction of the proposed highway would not result in the loss of breeding habitat.

Transient Bald Eagles reported to occur within the project area most likely use the Lake Konomoc Reservoir area for hunting. Reports from area residents and PSGNLU support this claim. Little impact to transient, migrant or potential wintering Bald Eagles is expected since the reservoir is a protected, aquatic resource and would remain so, regardless of the selected transportation alternative. Although the Bald Eagle is now federally delisted, it is still protected under the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA). The MBTA applies to almost all birds in the U.S., with the exception of non-native species, such as starlings, English sparrows, quails and pheasants. The MBTA prohibits the taking of a protected bird or destruction of its nest or eggs without a permit. MBTA also applies to raptors (e.g. eagles, hawks, falcons); however, the BGEPA takes precedence for Bald and Golden Eagles. FWS conservation guidelines for protection of the Bald Eagle must be followed, and future consultations with the FWS may require surveys for migratory birds prior to construction to ensure that unauthorized takings of migratory birds do not occur.

The Peregrine Falcon is another state endangered species (now federally delisted) reported to potentially occur within the project corridor as a transient. The frequency of occupancy of this species within the project corridor, even as a transient, is expected to be very low, since resident breeding pairs in the state are known only from urban areas. In addition, the primary migratory routes for this species through Connecticut tend to be along the coast, along the major rivers, or along the north-south trending traprock ridges of the central valley, landforms that lie outside of the project corridor.

Of the listed avian species observed during the biological surveys to occur within the study area, two species, the Brown Thrasher and Bobolink were observed within suitable breeding habitat during their breeding seasons, and therefore are considered possible breeders. Brown Thrasher occurred in shrubby edge habitat created by previous clearing for Route 11 that would be impacted by the preferred alternative and all of the new location alternatives. A second location where this bird was found lies outside of the area of impact for any of the alternatives.

The sole location where Bobolink was observed within the survey area would be directly impacted by construction of the preferred alternative and the 92PD, E, and H alternatives. However, the reproductive success of the birds at this location is suspect as they may already be impacted by harvesting of the forage hay that is cultivated within the cool season grassland in which it was observed. In addition, this grassland parcel remains in private ownership and, like many grassland parcels within or adjacent to the project area, may ultimately be vulnerable to residential development in the absence of preservation.

Suburban sprawl is a significant threat to listed species and other species of conservation concern. The late Drs. Niering and Goodwin contended (DEIS comment letter 1998) that it is the greatest risk to biodiversity as a whole in the region. Again, they provided the following as evidence specific to the project corridor regarding the loss of listed species and other species of conservation concern due to subdivision development:

> "Many native grassland birds were displaced by the Beckwith Hills Subdivision (prime nesting habitat for declining species such as Eastern Meadowlark, Bobolink, Whip-poor-will, Blue-winged and Nashville Warbler, Field and Savannah Sparrow). Amphibian species are being wiped out by current subdivision design."

The Cerulean Warbler was not considered further in the analysis of threatened and endangered species impacts because of the FWS finding that listing of this species is not warranted (refer to Section 4.4.7.1).

The New England cottontail, a federal candidate for listing, may be impacted in two locations along the alignments of the preferred alternative and all of the new location alternatives. However, beyond the effects of landscape fragmentation that further isolates remnant populations of this species, these alternatives would have limited influence on the status of New England cottontail in this portion of their current range (refer to Section 5.4.9).

5.4.12 MITIGATION MEASURES - TERRESTRIAL IMPACTS

Many of the mitigative measures (e.g. avoidance, minimization, mitigation through restoration or enhancement, etc.) described for vegetation impacts would also benefit wildlife. Avoidance strategies that could benefit wildlife include avoiding known breeding areas (i.e. vernal pools), hibernacula (i.e. rocky ledges or historic roosting or den sites) or feeding areas (i.e. large stands of berry-producing shrubs).

Minimization strategies could also be employed as a mitigative measure. These strategies include reducing the amount of cleared land by utilizing a two-lane roadway and reducing the footprint by minimizing clear zones and cut and fill slopes. By spanning wildlife corridors with bridges or large archways, barriers to wildlife movement could also be minimized. Notable areas that would achieve wildlife benefits through spanning would be the Shingle Mill Brook drainage valley at the northern terminus of the 92PD, E, F, G, and H alternatives and the Latimer Brook Hemlock Ravine valley south of Silver Falls (F and G alternatives). During construction, disturbance could be minimized by controlling noise, fugitive dust, or by limiting the extent of construction.

Impact avoidance and minimization for the $E_{(4)}$m-V3 preferred alternative alignment includes 13 bridges across watercourses and wetlands. In addition to reducing wetland impact when compared to culverts, the proposed bridges will serve to maintain connectivity between forest blocks and allow passage along the high value riparian corridors minimizing impacts to wildlife habitat and wildlife corridors. Some of these bridges are proposed in areas where culverts were originally proposed in previous alignment variations in recognition of the fact that riparian systems are utilized by many species of terrestrial wildlife as movement corridors and habitat linkages (Forman, 1995). This represents an improvement to wildlife habitat value over other alternatives. Extended spans minimize the need for wetland fill and provide higher permeability to wildlife movement via the bridge underpass. Typically, the wider the whole underpass and the wider the passageway itself, the better the passageway functions as a wildlife movement corridor (Veenbaas and Brandjes, 1999).

The incorporation of 13 bridges (Table 5-30) within the 13.7 km (8.5 mi) of new alignment north of the I-95 interchange represents a wildlife crossing at an average interval of 1.0 km (0.65 mi), providing a higher degree of permeability than other recent highway construction projects that have incorporated wildlife underpasses along their respective alignments. Brown and Sommers (1999) reported a wildlife crossing every 4.0

km (2.5 mi) for State Route 260 in Arizona. For three different highway projects in New Brunswick, Canada, Phillips (1999) reported that for every highway mile within important habitat blocks, a range of one structure every 1.4 km (0.9 mi) to 2.6 km (1.6 mi) was provided.

Bridges and culverts will be designed to provide habitat connectivity and wildlife passage for a multitude of fauna among various taxa. For bridges, this will include providing sufficient height between the existing ground and low chord of the proposed structure for larger wildlife, maintaining upland buffers adjacent to wetlands and watercourse for upland species, retaining vegetation for prey species, and maintaining natural flows for aquatic species. A minimum clearance of 16 ft. 3 in. will be provided wherever possible with a desired height of approximately 20 ft., allowing passage of all vertebrates identified along the corridor that are known to use underpasses. The design of

TABLE 5-30
BRIDGES ALONG PREFERRED ALTERNATIVE $E_{(4)}$M-V3

BRIDGE NO.	ROADWAY	APPROXIMATE CENTERLINE STATION	WETLAND AREA SPANNED[1]	BRIDGE LENGTH FT	BRIDGE WIDTH FT	BRIDGE AREA ACRES
1	$E_{(4)}$M-V3	22+580	PD-1	167	77	0.30
2	$E_{(4)}$M-V3	21+900	PD-2B Shingle Mill Brook	400	77	0.71
3	$E_{(4)}$M-V3	20+920	PD-3A	292	77	0.52
4	$E_{(4)}$M-V3	19+530	PD-4A	509	77	0.90
5	$E_{(4)}$M-V3	18+060	PD-E4	344	77	0.61
6	$E_{(4)}$M-V3	17+180	PD-8A	354	77	0.63
7	$E_{(4)}$M-V3	16+730	PD-9B	138	77	0.24
8	$E_{(4)}$M-V3	16+470	PD-9A	331	115	0.87
9	$E_{(4)}$M-V3	14+080	PD-12B	197	77	0.35
10	$E_{(4)}$M-V3	12+960	PD-13A	466	77	0.83
11	I-95 N.B.	22+620	PD-17B Oil Mill Brook	52	59	0.07
12	I-95 S.B.	22+660	PD-17B Oil Mill Brook	52	59	0.07
13	$E_{(4)}$M-V3 N.B	10+710	PD-17B Oil Mill Brook	72	26	0.04

[1] wetland identification no.

bridges will also include provisions to extend the span beyond the boundary of adjacent wetlands and watercourses to provide sufficient shelf and upland area for wildlife species expected to use the crossing. The face of abutments will extend approximately 20 ft. to 25 ft. beyond the boundaries of the adjacent wetlands and watercourses wherever possible.

In addition to the bridges, culverts are planned for conveying surface flows at numerous other locations. These culverts will be designed to maintain stream flows, site hydrology, and convey an appropriate design storm in accordance with the structure's classification. Culverts in critical areas will also be designed to provide habitat passage for the wildlife species anticipated to use culvert crossings (e.g., smaller mammals, metafauna, and lower vertebrate taxa). The selection of appropriate culvert types (e.g. arch with footings, natural bottom, etc.) increasing the width or height of the culvert, over sizing the culvert depth-wise to provide natural substrate bottoms and maintain natural flow velocities.

Where wildlife passage cannot practicably be provided by bridges or culverts, an open median will be incorporated as mitigation for unavoidable effects on wildlife movement. This will involve modifications of the typical roadway cross section in three locations along the preferred alternative alignment. The open medians will be located north of the I-95 / I-395 interchange and south of Route 161 in Habitat Block No. 2, and south of the existing terminus of Route 11 in Habitat Block No. 1. They are optimally located within the largest habitat blocks in the corridor, and are situated between areas with bridges, further increasing the permeability of the roadway for wildlife. The open medians will be designed to incorporate a 100 ft. wide vegetated area to provide a safe refuge for wildlife crossings. The pre-cast concrete barrier that separates northbound and southbound lanes along the alignment will be discontinued at the open median areas to reduce obstacles to movement. Existing vegetation will be retained where feasible, or replaced with native, non-invasive plantings. The vegetated medians will also provide connectivity with nearby habitats and wetlands.

As suggested by Clevenger (1998), a mixture of widely spaced structures with more frequent smaller structures at key connectivity points is believed be a more cost effective and more ecologically functional than a series of large multi-species structures at fewer intervals. Together with other general recommendations incorporated into the concept for the preferred alternative, the roadway is expected to remain permeable to most of the fauna found to exist within the study area.

Various other mitigation measures such as habitat restoration or enhancement could also be incorporated into the highway design to mitigate wildlife impact. Highway planting schemes could incorporate wildlife usage factors with aesthetics. For instance berry producing shrubs or shrubs providing dense coverage could benefit birds and small mammals. Larger animals such as deer should be discouraged from the highway edge to avoid an increase in collisions with automobiles.

The effectiveness of conservation easements adjacent to the highway corridor as a mitigation strategy is advocated by many, including the late Drs. Niering and Goodwin. In their comment letter on the DEIS, they wrote:

> "…construction of a limited-access highway the length of the corridor, linked with a greenway protecting the remaining forest blocks and watersheds will protect all of the species mentioned in the DEIS from being extirpated within the corridor…"

They provide evidence of the success that this approach has had on wildlife conservation along the built portions of Route 11, citing one parcel in particular, protected as conservation land, as an illustrative example:

> “The Bingham property along the completed portion of Route 11, for instance, has a bird list of over 180 species. This property also supports marbled and spotted salamanders, bobcat, woodland warblers, and several grassland species such as Savannah Sparrow and Bobolink”.

The Mitigation and Compensation Framework, 2006 was created by the interagency Route 11 working group as an outline for the development of appropriate measures to mitigate or compensate for impacts associated with construction of the preferred alternative. The framework, provided in Appendix C, includes avoidance, minimization, and mitigation elements, as well as compensatory mitigation to address direct and indirect impacts to both wetland and upland habitats.

Avoidance, minimization and mitigation measures in the framework for mitigating terrestrial impacts include but are not limited to the following (many of which were discussed earlier):

- Habitat fragmentation avoidance through roadway design and alignment modifications.
- Added/extended bridges to minimize wetland impacts and preserve wildlife movement corridors.
- Reduce vegetation clearing or require prompt replacement with native, non-invasive plantings.
- Light reduction techniques.
- Over-sized culverts that allow wildlife passage.
- Open median to mitigate wildlife mortality caused by collisions with vehicles during roadway crossings in areas without bridges or other passages.

In addition to the abovementioned avoidance, minimization and mitigation measures, compensatory measures will also be undertaken to offset remaining impacts. Compensatory mitigation for unavoidable indirect impacts to wildlife habitat will be achieved through the preservation and potential enhancement of undeveloped, ecologically valuable lands within or proximate to the Route 11 corridor.

The results of the CAPS analysis showed that 485 biodiversity value units may be directly and indirectly impacted by construction of the roadway. A biodiversity unit is a computer model output that measures the habitat and biodiversity values of an area. These units include 381 biodiversity units that may be indirectly impacted, of which 64 are within wetland and aquatic communities. The CAPS model calculated that compensation for 485 biodiversity units would require preservation of 686 ac. of high-value habitat. Preservation for indirect impacts only would require 539 ac. Mapping generated using GIS with CAPS also identified areas of high-value habitat within and near the Route 82/85/11 corridor that offer good potential for preservation (UMASS 2004).

Separate sites outside of the highway alignment could be acquired and protected from future development as an off-site mitigation measure. Acquisition of the forested areas around Shingle Mill Pond would increase the protected area within forest Habitat Block No. 1 and establish a protected wildlife corridor between Shingle Mill Park and Horse Pond, effectively increasing the wildlife value of the forest block. Other lands adjacent to Nehantic State Forest to the west of the project corridor could be acquired to increase the size of this natural area. As an alternative to fee acquisition, conservation easements might also be encouraged; this option may prove more attractive to both private property owners and the municipalities.

Priorities for the preservation strategy will include the acquisition and/or protection of land exhibiting one or more of the following characteristics:

- Contiguous with existing preserved areas,
- Adjacent to areas with low potential for development,
- Probability for sustained ecological and biodiversity value for foreseeable future (e.g. low probability for future degradation from development of surrounding land),
- Connects two or more preserved areas,
- Identified by CAPS as having a high biodiversity value,
- Habitat blocks under imminent threat from development,
- Contains important wetlands: riparian areas, vernal pools, high-value wetlands (e.g. significant in maintaining water quality, stream flow and aquatic habitat in a contiguous or downstream watercourse),
- Contains habitat, or has the potential for creation of habitat, for any endangered species determined to be impacted by the project based on the biological surveys, and
- Combination of the above to promote the creation of an ecological preserve

5.5 Topography, Geology and Surface/Groundwater Resources

5.5.1 Impacts to Topography

The existing topography along and adjacent to the proposed alternatives will be affected by the excavation and fill required for construction of any of the alternatives. Alterations of topographical features could result in hydrologic and aesthetic impacts. Although standard engineering practice seeks to maintain existing drainage patterns to the maximum extent possible, hydrologic impacts could be incurred through cuts at hilltop groundwater recharge areas, fills within low-lying discharge areas, and diversions of surface water drainage patterns.

Deep cuts may alter groundwater flow regimes and potentially have an adverse effect on the quantity of groundwater available to nearby private residences that utilize groundwater supply wells. Aesthetic impacts could occur via a disruption in otherwise undeveloped, continuous ridgelines, and the removal of vegetation associated with land clearing for cut and fill slopes. Positive consequences associated with the alteration of topographical features include the removal of traffic hazards such as restricted lines of sight or narrow shoulders along existing roadways. Areas of potential topographic impacts associated with each alternative alignment are described below and summarized in Tables 5-31 and 5-32.

5.5.1.1 *No Build Alternative*: This alternative, being non-intrusive in nature, is not anticipated to impact corridor topography.

5.1.1.2 *Routes 82 and 85 Widening Alternatives*: Widening of the existing Routes 82 and 85 would require varying amounts of cut and fill along the lengths of the roads with more intensive topographic alterations required in the vicinity of more prominent topographic features. Areas potentially requiring substantial cuts along the existing roadway are described in Table 5-32. Alternative $W_{(4)}$, the four-lane widening alternative, would result in the most grading with $W_{(4)}m$ and $W_{(2)}$ following in relative degree of impact. Of all of the build alternatives considered, the two-lane widening alternative ($W_{(2)}$) would disturb the least amount of land via cutting and filling.

5.5.1.3 *TSM Alternative*: TSM improvements would occur generally within the existing roadway alignment; however, any construction activity that would extend beyond the existing pavement area would have a limited effect upon topography on a localized basis. This degree of topographic impact that would result from TSM-type improvements is considered inconsequential.

5.5.1.4 *TDM/Transit Alternative*: This is a non-intrusive alternative and therefore is not expected to impact corridor topography.

TABLE 5-31
NOTABLE TOPOGRAPHIC MODIFICATIONS BY ALTERNATIVE

LOCATION	DEPTH	ALTERNATIVE
South of Route 82, approx. 250 m. (820 ft.) east of Route 11	12 m. (39 ft.) cut	Widening
West of Route 85, opposite Fairy Lake	6 m. (20 ft.) cut	Widening
West side of Route 85, 50 m. (165 ft.) north of Horse Pond Road	5 to 7 m. (16 to 23 ft.) cut	Widening
East side of Route 85, toe of Maynard Hill located opposite Horse Pond	24 m. (80 ft.)	Widening
West side of Route 85, across from Emerald Glen Road	5 to 7 m. (16 to 23 ft.) cut	Widening
East side of Route 85, north of Beckwith Hill Drive	2 to 4 m. (6 to 13 ft.) cuts	Widening
East side of Route 85, north of Fox Hollow Drive	6 m. (20 ft.) cut	Widening
East side of Route 85, power line crossings in Montville	2 to 4 m. (6 to 13 ft.) cut	Widening
West of Route 85, south of Route 161	15 m. (50 ft.) cut	Widening
East side of Route 85, south of Montville/Waterford town line	3.5 m. (11 ft.) fill	Widening, H
West of Route 85, toe of Morgan Hill in Waterford	2 to 3 m. (5 to 10 ft.) cut	Widening, H
Northwest of Shingle Mill Pond	25 m. (81 ft.) cut	92PD, E, F, G, H
Shingle Mill Brook	fill/structure	92PD, E, F, G, H
South of Shingle Mill Pond	21 m. (70 ft.) cut	92PD, E
Vicinity of Fawn Run	21 m. (70 ft.) cut	F, G, H
Old New London Road	3 m. (10 ft.) cut	F, G, H
North of Beckwith Hill	4 m. (13 ft.) fill	92PD, E
Beckwith Hill	11 m. (36 ft.) cut	92PD, E
Salem Turnpike overpass	11 m. (36 ft.) fill	92PD, E
Holmes Road	13 m. (43 ft.) cut	F, G
Holmes Road	6 m. (20 ft.) cut	H
Eastern slope of Walnut Hill	14 m. (47 ft.) cut	E
Walnut Hill, north summit	8 m. (25 ft.) cut	F
Walnut Hill, north summit	10 m. (34 ft.) cut	G

TABLE 5-31
NOTABLE TOPOGRAPHIC MODIFICATIONS BY ALTERNATIVE

LOCATION	DEPTH	ALTERNATIVE
South of Walnut Hill, north summit	5 m. (17 ft.) fill	G
Walnut Hill, south of power line	16 m. (53 ft.) cut	G
Tributary to Latimer Brook, north of Grassy Hill Road	18 m. (60 ft.) fill/structure	G
Daisy Hill	12 m. (39 ft.) cut	92PD
East Lyme/Montville town line	6 m. (21 ft.) cut	H
Montville, south of power line	17 m. (48 ft.) cut	H
Grassy Hill Road overpass	7 m. (25 ft.) fill	92PD, E
Grassy Hill Road overpass	15 m. (48 ft.) fill	F
Grassy Hill Road overpass	17 m. (55 ft.) fill	G
Grassy Hill Road overpass	5 m. (17 ft.) fill	H
Pigeon Hill, west ridge, north end	22 m. (74 ft.) cut	F
Pigeon Hill, west ridge, south end	23 m. (76 ft.) cut	F
Pigeon Hill, east ridge, south end	39 m. (127 ft.) cut	G
Route 161 overpass near Silver Falls Road	8 m. (27 ft.) fill	92PD, E
Route 161 overpass near Walnut Hill Road	7 m. (23 ft.) fill	F, G
East of Butlertown Road	8 m. (25 ft.) cut	H
Latimer Brook south of Route 161	fill/structure	92PD, E, F, G
East Lyme, East of Latimer Brook	49 m. (160 ft.) cut	F, G
East Lyme/Waterford town line, north	6 m. (20 ft.) cut	F, G
Waterford, south of Montville/Waterford town line	11 m. (37 ft.) cut	92PD, E
Waterford	21 m. (68 ft.) cut	92PD, E
Waterford, Pember Road	16 m. (52 ft.) cut	92PD, E, F, G
East Lyme/Waterford town line, south	12 m. (39 ft.) cut	92PD, E, F, G
I-95/I-395 Interchange	12 m. (39 ft.) fill/structure	92PD, E, F, G
I-95/I-395 Interchange	25 m. (81 ft.) cut	$E_{(4)}$m-V3

TABLE 5-32 COMPARISON OF TOPOGRAPHY IMPACTS					
ALTERNATIVE	TOTAL VOLUME OF EARTH CUT	TOTAL VOLUME OF FILL	NUMBER OF CUTS > 5 M. (15 FT.)	DEEPEST CUT	HIGHEST FILL
$W_{(4)}$	225,000 m^3 (294,300 yd^3)	107,500 m^3 (140,600 yd^3)	7	24± m. (80± ft.)	3.5± m. (11± ft.)
$W_{(4)}$m	160,500 m^3 (209,900 yd^3)	115,500 m^3 (151,100 yd^3)	7	24± m. (80± ft.)	3.5 m. (11± ft.)
$W_{(2)}$	151,100 m^3 (197,600 yd^3)	99,900 m^3 (130,700 yd^3)	7	24± m. (80± ft.)	3.5± m. (11± ft.)
92PD	4,495,000 m^3 (5,878,900 yd^3)	1,990,600 m^3 (2,603,400 yd^3)	8	25± m. (81± ft.)	11± m. (36± ft.)
$E_{(4)}$	4,560,300 m^3 (5,964,300 yd^3)	2,889,100 m^3 (3,778,600 yd^3)	8	25± m. (81± ft.)	11± m. (36± ft.)
$E_{(2)}$	2,711,300 m^3 (3,546,100 yd^3)	1,023,700 m^3 (1,338,800 yd^3)	8	25± m. (81± ft.)	11± m. (36± ft.)
$F_{(4)}$	9,490,400 m^3 (12,412,200 yd^3)	1,374,300 m^3 (1,797,300 yd^3)	12	49± m. (160± ft.)	15± m. (48± ft.)
$F_{(2)}$	6,914,600 m^3 (9,043,400 yd^3)	757,400 m^3 (990,600 yd^3)	12	49± m. (160± ft.)	15± m. (48± ft.)
$G_{(4)}$	10,328,800 m^3 (13,508,800 yd^3)	1,783,900 m^3 (2,333,000 yd^3)	11	49± m. (160± ft.)	17± m. (55± ft.)
$G_{(2)}$	7,396,000 m^3 (9,673,000 yd^3)	1,054,200 m^3 (1,378,700 yd^3)	11	49± m. (160± ft.)	17± m. (55± ft.)
$H_{(4)}$	2,754,900 m^3 (3,603,000 yd^3)	403,100 m^3 (527,200 yd^3)	7	25± m. (81± ft.)	5± m. (17±ft.)
$H_{(2)}$	2,029,200 m^3 (2,653,900 yd^3)	275,800 m^3 (360,700 yd^3)	7	25± m. (81± ft.)	5± m. (17±ft.)
$E_{(4)}$m-V3	4,241,300 m^3 (5,547,100 yd^3)	2,677,000 m^3 (3,501,200 yd^3)	10	25± m. (81± ft.)	15± m. (49±ft.)

5.5.1.5 *New Location - Full Build Alternatives*: The 92PD, E, F, and G alternatives would require frequent cuts and fills within the varied terrain of the region. The alignments would share similar impacts at the extreme northern and southern ends of the corridor where the alternatives follow the same route in parts of Salem and Waterford. In Salem, the alternatives would traverse the rugged Shingle Mill Brook area where substantial cuts would be necessary as well as a structure to span the brook. In Waterford, the alternatives run along a ridge parallel to the East Lyme/Waterford town line where further cuts and fills would be necessary. The ridge top in this area has surficial geology characterized by a shallow depth to bedrock, and cut areas would likely extend into bedrock. Additional cuts would be required for Alternative 92PD and E at Beckwith Hill, Daisy Hill and Walnut Hill. Alternatives F and G would require substantial cuts along Walnut and Pigeon Hills and at the western wall of the East Lyme/Waterford ridge where a 49 m. (160 ft.) deep cut into the ridge would be required.

Large areas of fill would also be necessary at highway overpasses at Salem Turnpike, Grassy Hill Road, and Route 161 in order to raise the existing grade to meet the height of the proposed structures. Other fill areas and structures would be used to cross the various streams and wetlands in the corridor.

In general, the two-lane expressway options would require less modification to the landscape than the four-lane alternatives. Of the full build expressway alternatives, the F and G alignments would necessitate the greatest amount of cutting and filling during construction based on the numerous hills and valleys these routes traverse. Alternative $G_{(4)}$ would require the greatest volumes of cut and fill necessary to construct a new expressway.

5.5.1.6 *New Location - Partial Build Alternatives*: The H alignments ($H_{(4)}$ and $H_{(2)}$) would have topographic impacts similar to Alternatives F and G at the northern end of the corridor from the current Route 11 terminus south to Holmes Road in East Lyme. South of Holmes Road, the H alignment would bear southeast toward Route 85. The expressway portion of the H alignment would have substantial cuts in the Shingle Mill Brook area, at the north end of Walnut Hill, and east of Butlertown Road and would also have a large fill area located at the Grassy Hill Road overpass. After the expressway portion of Alternatives $H_{(2)}$ and $H_{(4)}$ connects to Route 85, impacts to topography would be similar to the impacts for the two- and four-lane widening alternatives, respectively. Impacts to topography resulting from the H alternatives would be intermediate to those caused by the widening and full build expressway alternatives.

5.5.1.7 *Preferred Alternative*: Impact minimization techniques employed during creation of the $E_{(4)}$m arterial roadway allowed for a reduction in the volume of cuts and fills along the alignment as compared with the DEIS full build expressway alternatives. The preferred alternative, $E_{(4)}$m-V3, also incorporates these lower-impact design standards.

Almost half of required earth cuts would occur at the interchange of I-95/I-395. The deepest cut would be approximately 19 m. (62 ft.) and would occur south of the proposed Route 161 interchange, east of Chapman Drive. Approximately one third of total fill would occur at the I-95/I-395 interchange. The highest fill would be approximately 15 m. (49 ft.) and would occur south of the Route 161 interchange, east of Quailcrest Road.

5.5.1.8 *Mitigation Measures – Topography*: During preliminary engineering design for the preferred alternative, efforts will be made to minimize the amount of cut and fill required to construct the new roadway, and to achieve a balance between cut and fill volumes. Modifications to the horizontal and vertical geometry may be possible in some areas to minimize the required excavation or fill. Minimum clearances over and under state and local roads may also be used to further minimize areas of cut and fill. Structures over watercourses and wetlands have been proposed for each alternative in an attempt to minimize fill in these sensitive areas. Existing drainage patterns and flows would be maintained for any of the alternatives. Any surplus material from excavations would be disposed of by the construction contractor in accordance with ConnDOT Standards for Road, Bridges, and Incidental Construction.

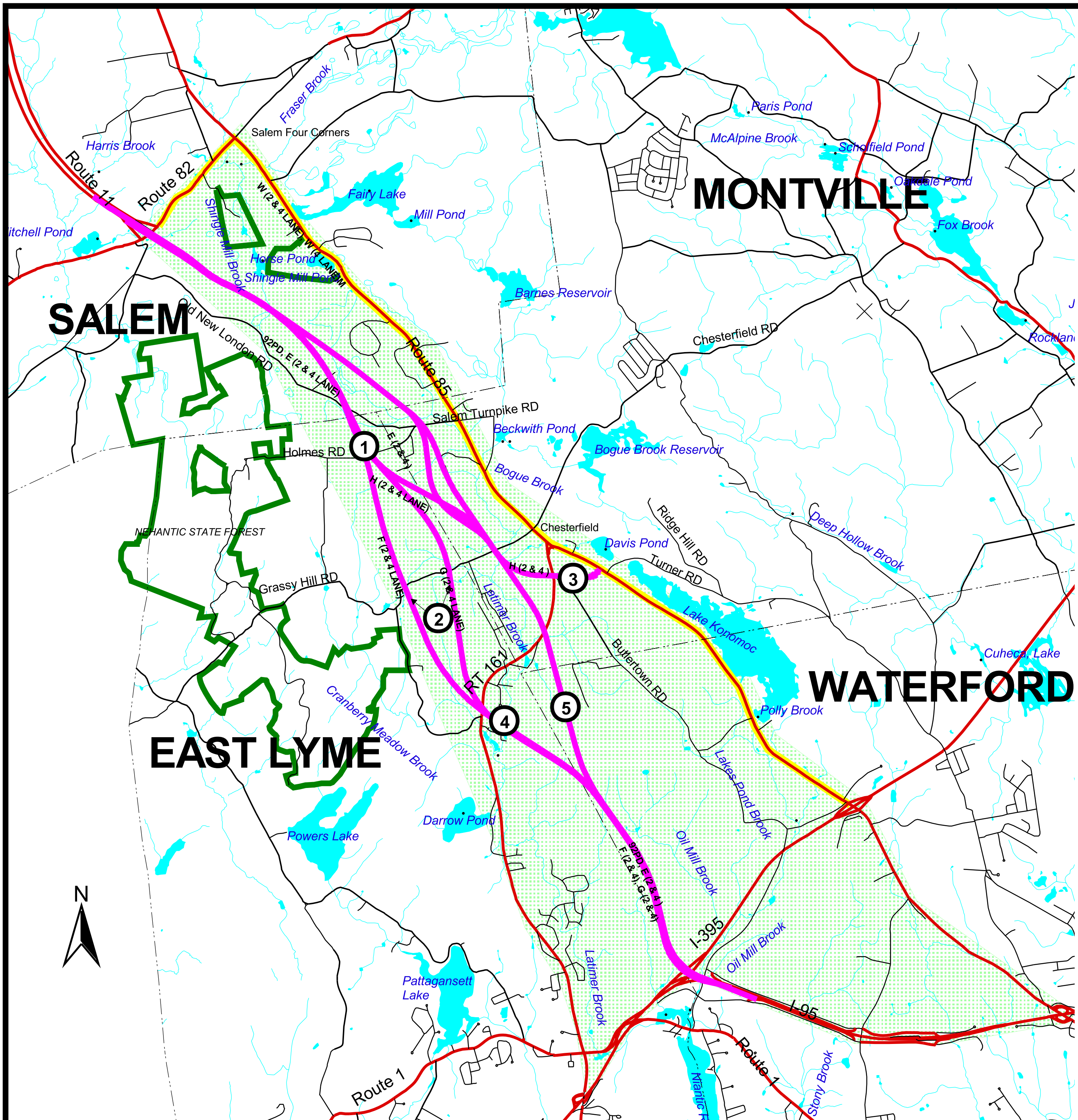
5.5.2 Geologic Features

The hill and valley topography that is characteristic of the corridor will necessitate frequent cuts through areas of high relief in order to maintain desired roadway grades for the new expressway alignments and safety improvements on the existing roadway.

Major rock cuts may occur in both bedrock and glacial till, where roadway cuts may involve the underlying bedrock. Additionally, a multitude of bedrock outcrops exist in the corridor through which roadway cuts will be necessary.

The most notable rock cuts, as generally determined from preliminary concept plans, were located for the purpose of analyzing impact on geologic features. This review is of a general nature using available mapping of surficial materials and bedrock geology as published by the USGS. Detailed analysis of rock cuts will be required during the actual design of the LEDPA. Aesthetic impacts of terrestrial cuts and fills are discussed in Section 5-13.

The greatest amount of impact to geologic units occurs with the $F_{(4)}$, $F_{(2)}$, $G_{(4)}$ and $G_{(2)}$ alternatives. These alignments require the deepest rock cuts. The widening alternatives involve less volume of cuts into geologic units than the expressway alternatives, but the frequency of areas of contact with bedrock is similar. Notable rock cut areas are shown on Figure 5-15 and described in Table 5-33.



LEGEND

1 Notable Geologic Impact Areas

RT 82/85 Widening Alternatives

Expressway Alternatives

Route 82/85/11 Corridor Study Area

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82/85/11
ENVIRONMENTAL IMPACT STATEMENT (EIS)

NOTABLE AREAS OF GEOLOGIC IMPACT

Notes:

Sources:
Geology: U.S.G.S. Bedrock Geologic Map
Hydrology: CTDEP Natural Resources Center GIS Database 1994
Alternatives: CTDOT and Maguire Group, Inc.

2500 0 2500 5000 Feet
500 0 500 1000 Meters

August 1998

Figure 5-15

TABLE 5-33
LOCATION AND GEOLOGIC DESCRIPTION OF NOTABLE ROCK CUT AREAS BY ALTERNATIVE

AREA ID#	DESCRIPTION	ALTERNATIVE														
		$E_{(4)}$m-V3	TSM	TDM/ Transit	$W_{(4)}$	$W_{(4)}$m	$W_{(2)}$	92PD	$E_{(4)}$	$E_{(2)}$	$F_{(4)}$	$F_{(2)}$	$G_{(4)}$	$G_{(2)}$	$H_{(4)}$	$H_{(2)}$
1	**Walnut Hill, north summit, and Holmes Road:** Underlain by the Brimfield Formation of the Hunts Brook Syncline. No outcrops indicated, but cuts over 6 m. (25 ft.) may contact bedrock. This unit contains rusty weathering, sulfide-bearing schists.										×	×	×	×	×	×
2	**Pigeon Hill, west and east ridge, south of Grassy Hill Road:** Cuts may involve the underlying Plainfield schist and gneiss (this unit is locally "pyritic" in central Montville but is not identified as such in this location).										×	×	×	×		
3	**East of Butlertown Road and south of the junction of Routes 161 and 85:** Area of cut is covered by thick glacial till and underlain by the Plainfield schist, gneiss and quartzite (this unit is locally "pyritic" in central Montville but is not identified as such in this location).														×	×
4	**East Lyme, East of Route 161 and Latimer Brook**: Numerous outcrops of Plainfield schist and gneiss (this unit is locally "pyritic" in central Montville but is not identified as such in this location) and nodular granite outcrops.										×	×	×	×		
5	**Waterford, south of Montville/Waterford town line**: Numerous outcrops of Plainfield schist and gneiss (this unit is locally "pyritic" in central Montville but is not identified as such in this location) and nodular granite outcrops.	×						×	×	×						

× = impacted areas

5.5.2.1 *No Build Alternative*: This alternative does not require disturbance of the land and therefore does not result in impacts to geologic units.

5.5.2.2 *Route 82 and 85 Widening Alternatives*: The widening alternatives, $W_{(4)}$, $W_{(4)}m$ and $W_{(2)}$, involve less volume of cuts into geologic units than the expressway alternatives, but frequency of areas of contact with bedrock is similar. The widening alternatives do not involve rock cuts into known problematic geologic units.

5.5.2.3 *TSM Alternatives*: This alternative requires only minor land disturbance, and therefore does not result in impacts to geologic units.

5.5.2.4 *TDM/Transit Alternatives*: This alternative does not require disturbance of the land and therefore does not result in impacts to geologic units.

5.5.2.5 *New Location - Full Build Alternatives*: The 92PD, $E_{(4)}$ and $E_{(2)}$ alternatives would require cuts into rock outcrops of Plainfield schist and gneiss (Area 5), which is considered "locally pyritic" in areas of central Montville. Though it has not been classified specifically as such in Waterford, it is noted as a precaution. Pyritic units have been known to react when exposed to the atmosphere and surface water causing acidic runoff. The Plainfield formation, however, is not known to be problematic.

The greatest amount of impact to geologic units among the alternatives occurs for the $F_{(4)}$, $F_{(2)}$, $G_{(4)}$ and $G_{(2)}$ alternatives. Of all the alternatives, the F and G alignments would require the deepest rock cuts. The largest (49 m. (160 ft.)) is east of the proposed Route 161 interchange (Area 4). The bedrock through this area is part of the same formation as that of Area 5 described above.

Another area of concern is Walnut Hill (Area 1) which is crossed by alignments $F_{(4)}$, $F_{(2)}$, $G_{(4)}$ and $G_{(2)}$ over bedrock consisting of the Brimfield schists. This geologic formation has been problematic in other areas, including the built section of Route 11 north of the study area where an iron sulfide component that may create acidic conditions when in contact with the atmosphere and surface waters was identified. Additionally, certain members of the gneisses and schists within the Plainfield formation involved in rock cuts in Areas 2 and 4 may include units that are pyritic.

5.5.2.6 *New Location - Partial Build Alternatives*: The $H_{(4)}$ and $H_{(2)}$ alternatives impact Area 1, where bedrock consists of the Brimfield schists. This geologic formation has been problematic in other areas, including the built section of Route 11 north of the study area, due to an iron sulfide component created acidic conditions in freshwater streams and ponds after coming in contact with the atmosphere and surface waters. Alignments $H_{(4)}$ and $H_{(2)}$ also impact Area 3. Though rock cuts may be substantial in this area (24± m. (81± ft.)), a thick surficial covering of glacial till may prevent disturbance of bedrock. This area is underlain by the same potentially pyritic Plainfield schists that were described in the previous areas.

5.5.2.7 *Preferred Alternative*: Impacts to geologic features would be the same for the preferred alternative as those identified for the DEIS E alternatives (Section 5.5.2.5). The magnitude, however, would be less because of the reduced roadway cross-section and minimization of earth cuts. It is noted that as with the DEIS E alternatives, there is some potential that rock cuts south of the Montville/Waterford town line, east of Route 161 in East Lyme could expose bedrock of the Plainfield formation that contains pyritic minerals in some areas.

5.5.2.8 *Mitigation Measures – Geologic Features*: Due to concerted efforts made to design alternatives that will avoid wetlands and other resources, it is most likely that roadway alignments will not be able to shift appreciably in order to avoid cuts through hills and ridges. Mitigation for impact to geologic units would primarily involve testing of bedrock in areas indicated in Figure 5-15 prior to major rock cutting to ascertain potential problems with iron sulfide leachate. Mitigative measures may be necessary to reduce the likelihood of water quality problems. Such measures would include treatment technologies recommended in FHWA guidance documents and would be implemented in cooperation with DEP. Measures that may be employed could include placement of inert rock or loamy material around rock cut areas to reduce opportunities for weathering and/or to neutralize acid leachate. Another example of such treatment is the detention of runoff in a sedimentation basin, where it could be neutralized with a basic additive prior to release. Impact avoidance includes ensuring that excavated rock from these units is not used as a construction material. Mitigation of other surface water impacts is discussed in detail in Section 5.5.5.

5.5.3 WATER RESOURCES AND WATER QUALITY

New roadway construction and operation can be expected to affect surface and groundwater supplies by increasing stormwater flow, decreasing flood storage area and degrading water quality through discharge of roadway pollutants. Water quality impacts, described in the following text, were determined by using the FHWA model *Pollutant Loadings and Impacts from Highway Stormwater Runoff* (FHWA-RD-88-007, 1990). This is a probabilistic dilution model similar to the models developed and applied in the EPA's Nationwide Urban Runoff Program (NURP).

Spill prevention measures were also examined, as the construction of the alternatives could potentially impact public drinking water supply sources. The purpose of spill prevention measures is to provide controls which will intercept roadway runoff so that, in the event of an accidental hazardous release, the spill can be contained and cleaned up before reaching surface or groundwater.

5.5.3.1 *Estimating Effects of Stormwater Discharges*: The FHWA has developed a procedure to determine the impact of roadway runoff on water quality. This model determines not only the magnitude of pollutant concentration but also the frequency of occurrence of in-stream concentrations of pollutants from roadway runoff. The calculated in-stream concentrations are compared with the EPA's criteria for aquatic life protection. This comparison provides a basis for evaluating the potential for roadway runoff to cause pollutants that exceed water quality criteria. The average concentration of a pollutant in the total runoff produced by an individual storm event is designated in the model as "event mean concentration".

For stream water quality analysis, which is based on protection of aquatic life, the principal roadway pollutants of concern are heavy metals. Heavy metals concentrations derived from vehicular traffic can occur in roadway runoff at concentrations high enough to affect aquatic organisms. Lead, copper, and zinc are the dominant toxic pollutants carried by roadway runoff. The initial pollutant concentrations used for water quality analysis are the 50% median values, representing the median event concentration (i.e., 50% of the sites had higher and 50% had lower concentrations). The mean event concentrations are 0.054 mg/l for copper, 0.4 mg/l for lead and 0.329 mg/l for zinc.

5.5.4 SURFACE WATER IMPACTS

Discharges into the surface waterbodies within the project area must meet acceptable water quality criteria prior to discharge since some of the waterbodies are used as a source for a public water supply; therefore, the dilution capability of the receiving water, which is an input in the FHWA model, has not been applied. The model inputs were modified so that there was no dilution "credit" of the receiving waterbody. This was accomplished by having no or very little flow originating from the upriver watershed. Thus, there would be no runoff generated from upriver of the roadway's discharge point. By eliminating upriver runoff from contributing to the receiving waterbody, there can be no dilution. The pollutant concentrations resulting from this type of analysis are calculated as "end of pipe" pollutant levels. The "end of pipe" concentrations represent a worst case scenario of roadway runoff discharge impact on water quality because even under a low flow condition, the surface waterbodies would provide some dilution, dispersion, and decay of the pollutants and thereby decrease pollutant concentrations.

5.5.4.1 *No Build Alternative*: With no construction activity and no increases in impervious surface, impacts to water resources and water quality associated with the no build alternative would be expected to be negligible. Operational impacts resulting from vehicular use of the existing roadway system would be expected to continue and likely increase as traffic volumes increase.

Otherwise, existing conditions would be expected to continue generally in their present form, in the absence of other actions which would affect water resources and water quality in the project area.

Under the no build scenario, there would also be no initiatives pursued specifically to improve water quality. That is, drainage system upgrades, a gross particle separator and spill containment structure would not be installed and a spill prevention and control program would not be put into effect.

5.5.4.2 *TSM Alternatives*: The TSM scenario, as described, would involve only minor construction and, therefore, no serious effects to surface waters would be expected. There would also be no initiatives pursued specifically to improve water quality. That is, drainage system upgrades, a gross particle separator and spill containment structure would not be installed and a spill prevention and control program would not be put into effect.

5.5.4.3 *TDM/Transit Alternatives* Under the TDM/transit alternatives, existing drainage facilities would not be altered. No initiatives such as installation of drainage system upgrades, a gross particle separator and spill containment structure or development of a spill prevention plan would be programmed.

5.5.4.4 *Build Alternatives and Preferred Alternative*: For the water quality analysis, a worst-case scenario was evaluated for the widening and the new alignment alternatives, including the preferred alternative. Although there are different alternatives within the widening and new alignment alternatives, the impact on water quality from all alternatives will be relatively similar. This occurs because each of the roadway alternatives involves generally the same ratio of stream flow to runoff flow (since dilution is not considered); thus, the pollutant concentrations are relatively the same.

For the Route 82 and 85 widening alternatives and the new alignment alternatives, a slight difference in pollutant concentrations would result from the variation between the area of roadway pavement and the area of the roadway right-of-way at discharge locations. Land area within the roadway right-of-way that is not pavement would provide some dilution in concentration of the roadway pollutant. However, this difference is considered minor and is not included in the water quality analysis, as it would not affect the model results.

For water quality analysis, all of the new expressway alignments are examined together since they would have relatively the same impact, given that they will discharge into the same surface waterbodies. The FHWA model predicts the probability or number of storms producing concentrations that exceed EPA's acute aquatic life criteria. Table 5-34 shows the percentage of storm events that would likely result in concentrations exceeding EPA's target values for all alternatives within each of the affected watersheds.

A large percentage of the storms are predicted to exceed the acute aquatic life criteria. This is not surprising given the combination of no dilution and a relatively large area of pavement. Further, the "end of pipe" concentrations do not consider any treatment of the runoff prior to discharging into the waterbodies. The roadway runoff in this analysis is essentially conveyed directly into the receiving waterbody. Over a three-year period, an average of 360 storm events can be anticipated. The copper criterion will be exceeded in about 358 of the storm events (99.54%), the lead criterion in 351 storm events (97.64%) and the zinc criterion in 269 storm events (74.73%). Since the majority of storm events will produce concentrations of heavy metals that exceed acute aquatic life criteria, stormwater treatment prior to discharge is considered appropriate for all build alternatives.

TABLE 5-34
PERCENTAGE OF STORMS EXCEEDING ACUTE CRITERIA

WATERSHED	WIDENING ALTERNATIVES			NEW ALIGNMENT ALTERNATIVES		
	COPPER	LEAD	ZINC	COPPER	LEAD	ZINC
Harris Brook	98.55%	97.64%	74.73%	99.54%	96.54%	74.53%
Latimer Brook	98.55%	97.64%	74.73%	99.54%	96.54%	74.53%
Oil Mill Brook	98.55%	97.64%	74.73%	99.54%	96.54%	74.53%
Aquatic Life Criteria (mg/l)	0.004	0.011	0.084	0.004	0.011	0.084

It should be strongly emphasized that exceeding the acute aquatic life criteria does not pose an immediate threat to Lake Konomoc or other public drinking water supply areas. As discussed in Section 4.5.5, the water quality sampling data show that the levels for all three metals are well below aquatic life and drinking water criterion. This result occurs because there appears to be relatively low levels of background concentrations of these metals in the streams and there appears to be sufficient mixing capacity to dilute the metals contained in the roadway runoff.

Impacts to surface water quality may also occur with potential introduction of acidic runoff from pyritic bedrock newly exposed from road cuts. Rock cut areas for any of the new expressway alternatives that may contain pyritic components were shown on Figure 5-15 and described in Table 5-31. Pyritic bedrock contains iron sulfides that are susceptible to weathering when exposed to the atmosphere and surface water. The resultant leachate can cause a substantial enough drop in the pH of receiving waters to be detrimental to aquatic life.

5.5.5 MITIGATION MEASURES - SURFACE WATER IMPACTS

It will be necessary to incorporate mitigation measures into design plans if any of the build alternatives are selected to reduce pollutant concentrations of the roadway stormwater runoff before it enters the receiving waterbody. Generally, these methods are referred to as BMPs and stormwater treatment measures.

Mitigation measures for surface water impacts for any of the build alternatives will be part of a mitigation and compensation plan to be developed for the selected alternative during the design and permitting phase of the project. Comprehensive measures developed for the preferred alternative, but are applicable to all the build alternatives, are included in the Mitigation and Compensation Framework dated April 2006 (Appendix C). These measures include:

- BMPs in accordance with the Connecticut Guidelines for Soil Erosion and Sedimentation Control (DEP 2002) to minimize sedimentation impacts on the water quality of perennial and intermittent streams and wetlands, and to protect wetland functions and values (e.g. fish/shellfish, aquatic invertebrate, and other wildlife habitat, nutrient removal/ retention/transformation, sediment/toxicant retention, etc).

- Stormwater treatment systems designed in accordance with the 2004 Connecticut Stormwater Quality Manual (DEP 2004) and ConnDOT Drainage Manual (ConnDOT 2000) to minimize roadway runoff to streams and wetlands to protect aquatic functions and values (e.g. nutrient production and export, surface water flow patterns and groundwater recharge and discharge, wildlife habitat, etc.).

- Stormwater systems designed to provide the level of treatment necessary to ensure that stormwater discharges will not result in degradation of the physical, chemical or biological integrity of the receiving waters.

BMPs are structural and nonstructural measures, which can prevent or reduce nonpoint source pollutants from entering receiving waters. Structural measures include the use of built structures designed to treat stormwater pollutants and separate sediment from the stormwater prior to the stormwater being discharged into surface waters. Non-structural techniques (e.g., sweeping of roadway areas) are operational activities, which prevent the introduction of sediment into surface waters. The following sections discuss potential BMPs and stormwater treatment measures to mitigate the impact of the roadway alternatives on the receiving surface waters.

5.5.5.1 *No Build Alternative*: The no build alternative would not involve any roadway improvements or construction other than routine maintenance of the existing facility. As a result, the existing stormwater system would remain in place; a closed drainage system and installation of spill containment measures would not occur. With the projected increase in vehicular traffic, increased levels of potentially harmful substances in roadway runoff could be expected to enter adjacent receiving waters and wetlands.

5.5.5.2 *Route 82 and Route 85 Widening Alternatives*: These alternatives would add pavement to the existing roadway area. Routes 82 and 85 are currently serviced by a closed pipe stormwater drainage system. The design intent would be to modify the existing storm drainage system to accommodate the additional pavement area. BMPs required for water quality enhancement would need to be compatible with the existing drainage system.

The proposed stormwater management system for Route 85 would actually consist of two separate systems: one for watershed runoff and one for roadway runoff containing roadway and vehicle pollutants. The watershed drainage network would be designed to intercept overland flows, or "clean" stormwater from all non-roadway sources. Runoff would drain to grassed areas, swales or riprap-lined channels to detain flows and aid in removal of sediments prior to draining to the reservoir. A separate stormwater collection system would isolate and treat roadway runoff prior to discharge, protecting the reservoirs from a number of potentially harmful substances that are typically present in highway runoff.

All stormwater runoff from the roadway and adjacent impervious areas would be collected in a series of catch basins within closed stormwater drainage systems and directed to retention ponds (wet basins) for treatment. The proposed system would utilize a two stage approach for the treatment of roadway runoff. Stormwater outletting from the collection system would first discharge into a spill containment structure for gross particle and oil separation; it would then be discharged to the basin for the second stage of treatment, the removal of sediment-related pollutants and nutrients.

The effectiveness of vegetated basins and swales in treating roadway runoff has been demonstrated and documented in many studies. Vegetated basins and swales, augmented with use of sedimentation separation chambers, are considered the most suitable methods for stormwater management and water
considered the most suitable methods for stormwater management and water
quality mitigation for the widening alternatives. Vegetated basins allow the roadway runoff to flow at shallow depths through wide, relatively flat vegetated areas prior to being discharged into the receiving waterbodies. Stormwater runoff velocities would be reduced by detention and the vegetation. Contaminants contained in the roadway runoff would be treated when passed through these vegetated basins by filtration, settlement and

adsorption. The contaminants would be transformed through the biological degradation, assimilation by microbial action, and assimilation by rooted vegetation. Utilizing wetland vegetation species in constructed wetlands would enhance contaminant removal. Research (Schuller, 1996) has shown that up to 80% TSS removal can be obtained from properly constructed wetland areas. Since a percentage of the heavy metals are attached to the sediment, removing the sediment would also remove heavy metals.

Several areas have been identified as being potentially suitable locations for the construction of new wetlands areas. These areas are discussed as part of the overall wetland mitigation program (Section 5.6.) The size of these areas would vary depending on the quantity of roadway drainage and the amount of land available at any given location. To the greatest extent possible, the bottom elevations of the vegetated basins would be designed to allow for the permanent establishment of wetland vegetation.

Under the widening alternatives, some sections of Routes 82 and 85 would not be suitable for a vegetated wetland stormwater quality enhancement area because of the lack of available land area or the incompatibility of adjoining land uses. As an alternative design option, the roadway runoff from these areas could be piped to a patented type catchbasin, which functions as an oil/sediment separator, before discharging to the receiving surface waters. There are several types of these catchbasins currently on the market that use high rate sedimentation capture and can obtain up to 80% TSS removal.

5.5.5.3 *TSM Alternative*: The TSM alternative would implement spot improvements that would add pavement to the existing roadway cross-section. Structural and non-structural BMPs would be used to control runoff and protect water quality during construction as on a permanent basis. Routes 82 and 85 have existing stormwater systems; these systems would be upgraded, in the vicinity of the improvements, to facilitate handling the additional runoff from the increased pavement area. BMPs would likely include grass-lined drainage swales, sediment basins, and, if necessary an oil and/or particle separation system.

5.5.5.4 *TDM/Transit Alternative*: This alternative, similar to the no build alternative, would not involve any construction activities along Routes 82 and 85. The existing stormwater system would remain in place, with no water quality BMP improvements scheduled.

5.5.5.5 *New Location - Full Build, Partial Build and Preferred Alternatives*: The new alignment alternatives, including the preferred alternative, involve new roadway construction in generally undeveloped areas. The majority of each new alignment is not limited by an existing roadway section or adjacent development. The typical sections for the new alignment alternatives would promote overland sheet flow, minimize curbing, and include water quality swales for collecting and conveying stormwater runoff designed in accordance with the Connecticut Stormwater Quality Manual. Water quality swales can be an effective BMP for water quality enhancement. The primary components of swales for water quality enhancement are the length of the swale and the velocity of the stormwater runoff as it travels through the swale; pollutant removal efficiency of grass swales increases proportionately to their length (FHWA 1988b). Maximizing the length and minimizing the velocity will result in greater removal efficiency. A length of at least 100 linear feet per acre of impervious area should be used (TRB, 1993). Other general design guidelines (e.g., Schueler, 1987) include:

- Swale slopes should be graded as close to zero as possible;
- A dense cover of erosion resistant, water tolerant vegetation should to be established;
- Underlying soils should have high permeability; and
- Check dams should be installed in swales to promote infiltration and sediment retention.

The water quality swale would be constructed in compliance with the design guidelines to achieve maximum removal efficiency. A removal rate of 80% can be obtained by detaining the stormwater runoff and allowing it to infiltrate into the ground. However, because of the topographic characteristics in the area of the proposed new alignment alternatives, specifically steep slopes, the grass swales may not be able to retain the stormwater for an adequate period of time to maximize infiltration in some areas. For those roadway sections, supplementary treatment would be provided by sedimentation basins.

Wet ponds or sedimentation basins use a permanent pool of water as the primary mechanism to treat stormwater. The pool of water allows settling of sediments (including fine sediments) and removal of soluble pollutants. Wet ponds also can be used as detention basin to control the peak rate of stormwater runoff. This can be accomplished by having additional dry storage capacity. The relationship of the volume of the permanent pool in the basin to the runoff from the surrounding watershed is what determines the basin's pollutant removal efficiency. The basin’s efficiency can also be enhanced by constructing it as a series of ponds, the primary component being a deep, permanent pool.

Other components, such as a shallow marsh or sediment forebay, would be included in the basin. The basic operation of a wet pond is that the incoming stormwater from a storm event displaces the water already present in the pool. This stormwater remains in the basin until displaced by runoff from another storm event. The quiet condition of the water in the basin between storm events produces settling which results in the deposition of particulates, including fine sediments, in the basin. The permanent pool also serves to protect deposited sediments from resuspension during large storm events. Another advantage of wet ponds is the biological activity of algae and fringe wetland vegetation, which reduces the concentration of soluble pollutants. Basins have a moderate to high capacity for removing most roadway pollutants and can achieve an 80% TSS removal rate.

Where rock cuts occur through bedrock with a potential pyritic (iron sulfide) component, testing of the rock should occur prior to disturbance. Mitigative measures may be necessary to reduce the likelihood of water quality problems. Measures that may be employed could include placement of inert rock or loamy material around rock cut areas to reduce opportunities for weathering and/or to neutralize acid leachate.

5.5.5.6 *Performance Standards for Stormwater Mitigation*: Using the FHWA model, the design parameters for the obtaining 80% TSS reduction were used to determine the impact of mitigation measures on surface water resources. Since both the widening alternatives and the new alignment alternatives would be designed to incorporate adequate mitigation measures to obtain 80% TSS reduction, the FHWA analysis applies to all alternatives.

Table 5-35 shows the percentage of storm events that would produce pollutant levels that exceed acute aquatic criteria and NURP suggested values, respectively. With application of the appropriate mitigation measures, the number of storm events producing pollutant levels that exceed the acute criteria for lead values would decrease from over 90% to about 4%; for zinc, exceedances would decrease from over 90% to about 21%. With the mitigation measures, the pollutant concentrations for lead and zinc levels are below the NURP values and therefore there are no storm events that will exceed NURP levels.

TABLE 5-35
PERCENTAGE OF STORMS EXCEEDING ACUTE CRITERIA WITH MITIGATION

WATERSHED	COPPER		LEAD		ZINC	
	ACUTE	NURP	ACUTE	NURP	ACUTE	NURP
Harris Brook	92.32%	11.89%	3.84%	0.00%	21.39%	0.00%
Latimer Brook	92.32%	11.83%	3.84%	0.00%	21.39%	0.00%
Oil Mill Brook	92.32%	11.91%	3.84%	0.00%	21.39%	0.00%

The number of storm events producing pollutant levels exceeding the acute criteria for copper, however, remains quite high. The acute marine value for copper is relatively low and therefore difficult to meet. About 40% of the copper concentration is in soluble form. To further reduce the copper concentration, the soluble form of copper must be reduced. Evidence suggests that macrophytes can increase removal rates through biological and chemical processes.

5.5.6 Roadway Deicing Impacts

Deicing chemicals applied to roadways to remove ice and snow are predominantly salts consisting of sodium and chloride. These chemicals are carried by surface runoff and can be a potential threat to water quality. The potential impact of using roadway deicing salts on water quality has been evaluated using a simple dilution model. The model assumes that an average concentration of chloride and sodium in the roadway runoff is discharged instantaneously into a well-mixed receiving waterbody. It also assumes that all salt applied to the roadway will travel to the stream and no salt will be retained within the soils.

The following additional assumptions were used in the analysis:

- Mean flow of runoff during storm event is derived from the long term rainfall records for the winter months of October to March with a 0.95 runoff factor from the roadways;
- Mean stream flow and background stream concentrations for sodium and chloride are obtained from Latimer Brook which were found in the reference document *Lower Thames and Coastal River Basin* (Thomas Cervione, & Grossman, 1968);
- Mean chloride and sodium concentrations in the roadway runoff is based on an average annual salt loading rate of 300 pounds per lane mile;
- The average sodium concentration, based on the molecular weight ratio of chloride and sodium ions in sodium chloride is 61% chloride and 39% sodium.

The predicted seasonal increase of sodium and chloride concentrations from the proposed roadway widening alternatives and the new alignment alternatives are shown in Table 5-36.

Table 5-36
Existing and Predicted Sodium and Chloride Concentrations in Latimer Brook

	Existing (mg/l)	Average runoff concentration (mg/l)	Predicted (mg/l)	Change (mg/l)	Water Quality Criteria (mg/l)[1]
Sodium Concentration	3.70	3.21	3.70	0.00	20.00
Chloride Concentration	4.00	5.00	4.01	0.01	None

[1] Not to exceed criteria for Connecticut Class AA surface waterbodies (DEP December 17, 2002).

Relatively no change in the concentrations for sodium and chloride is indicated as a result of the project. Seasonal salt application was diluted by the average precipitation falling on the roadway pavement surfaces from October to March and the average stream flow during those months. Since the average total river flow is relatively high compared to the roadway runoff flow and the background concentrations of sodium and chloride in the river are relatively low, there is relatively no change in the sodium and chloride concentrations in Latimer Brook.

The results of this analysis do not necessarily apply to the public water reservoirs located in the project area. Sodium and chloride concentration in Lake Konomoc water samples were higher than those recorded in Latimer Brook. For the years 1995 and 1996, the sodium concentration in Lake Konomoc water samples was 4.6 mg/l and 7.9 mg/l. For the same years, the chloride concentration in Lake Konomoc water samples was 10.0 mg/l and 13.0 mg/l. In a worst case scenario that assumes the roadway concentration for sodium and chloride was added directly to the existing concentrations in Lake Konomoc, the concentrations would still be below the drinking water standards (28 mg/l sodium notification level and 250 mg/l chloride, DPH 2006). This represents a worst case scenario in that there would be some dilution of the roadway concentrations.

5.5.7 GROUNDWATER IMPACTS

Groundwater aquifers are not as threatened by pollutants in roadway runoff as are streams (EPA, 1983). Soils, principally the upper layers, function as a filter by removing pollutants from runoff before they can entry into the groundwater. Heavy metals are readily immobilized and absorbed within the first centimeters of soil (EPA, 1981). Only very mobile pollutants will leach through a thick, unsaturated soil.

Of the pollutants generated by roadway runoff, heavy metals such as copper, lead and zinc are readily absorbed by soil particles. By absorption, the soil immobilizes the heavy metals and prevents them from entering the groundwater. Deicing chemicals such as sodium and chloride are not as readily absorbed by soil particles. Sodium can be absorbed to some degree by the soil but chloride is very soluble and can easily enter and persist in groundwater. Potential impacts to groundwater would be confined to the runoff of salts during deicing of roadway surfaces. These impacts would be localized and limited given that sufficient dilution occurs within the regional groundwater system.

5.5.7.1 *Comparison of Groundwater Impacts*: Potential impacts to groundwater resources would consist primarily of alterations to the amount of groundwater recharge area. Table 5-37 shows the roadway area over the high yield aquifer for each of the alternatives.

The proposed increases in impervious surface would result in the loss of recharge areas associated with high water production coarse-grained stratified drift aquifers. The area of the roadway alternatives over the aquifer, based on typical cross-sections shown in Figures 3a-3e, was measured to assess the potential for impact of each of the alternatives. The location of the alternatives in relation to the high yield aquifer is shown on Figure 4-21.

The four-lane alternatives have more travel lanes and, thus, more impervious area; the four-lane alternatives would, obviously, impact the most areas of high yield aquifer as compared with the two-lane alternatives. Of the four-lane alternatives, $W_{(4)}$ would impact the greatest area of high yield aquifer (3.5 ha. (8.7 ac.)). Preferred alternative $E_{(4)}$m-V3 has one of the lowest impacts, .68 ha. (1.7 ac.)

TABLE 5-37
AREA OF IMPACT TO HIGH YIELD AQUIFERS BY ALTERNATIVE

ALTERNATIVE	AREA HECTARES	AREA ACRES
No build	N/I	N/I
$W_{(4)}$	3.5	8.7
$W_{(4)}$m	1.8	4.3
$W_{(2)}$	1.3	3.3
TSM	0.2	0.5
TDM/Transit	N/I	N/I
92PD	1.6	4.1
$E_{(4)}$	1.4	3.5
$E_{(2)}$	0.5	1.1
$F_{(4)}$	1.9	4.6
$F_{(2)}$	0.8	2.1
$G_{(4)}$	2.9	7.2
$G_{(2)}$	1.1	2.6
$H_{(4)}$	3.0	7.3
$H_{(2)}$	1.0	2.5
$E_{(4)}$m-V3	.68	1.7

N/I = No impact or negligible impact

5.5.8 PUBLIC WATER SUPPLY IMPACTS

Surface water and groundwater resources associated with the PSGNLU water system are considered one of the most important water resources within the project area. The water quality analysis (Section 5.5.6) showed that sodium and chloride inputs from deicing chemicals would be well below the established drinking water criteria. Future water quality of the PSGNLU system would be protected by the mitigation measures proposed for water quality enhancement.

5.5.8.1 *Stormwater Management*: The new alignment alternatives would use grass channels to intercept runoff and convey stormwater to detention basins. For the widening alternatives, the existing stormwater closed pipe system would be upgraded by adding water enhancement structures. Where the roadway is over the high yield aquifer, lined grass channels would be used. The channel would have an impermeable layer of soil or synthetic material to prevent infiltration of surface runoff into the soil. During construction, the ditch would be excavated to a depth that would allow covering the liner or membrane with one foot of soil. Loam or humus is then spread on the top of the soil and the area is seeded. This method offers the advantage of protecting the aquifer while removing pollutants from runoff. Runoff is carried away from the aquifer and discharged into detention/retention basins.

At the outlet of the grass channels, detention/retention wet ponds may be provided to contain the runoff before discharging it into surface waters. The wet ponds serve two functions. First, the basins provide additional pollutant removal through sedimentation. Second, they function as the primary containment area for accidental spills. The proposed drainage system may also contain oil and sediments traps. These traps may be located just prior to the detention/retention basins and wetland areas and would provide for the removal of floatable hydrocarbons and sediment.

5.5.8.2 *Accidental Hazardous Release*: Another area of concern to the PSGNLU water system is the potential for an accidental spill of toxic or hazardous substances. Existing Route 85 and all the widen/upgrade alternatives would be adjacent to Lake Konomoc and other public water resource areas. Because of the potential for contamination of public water supply resources in the event of a spill, special mitigation measures need to be considered.

Mitigation measures for any of the widen/upgrade alternatives would include spill response protocol and physical containment of the release. Containment structures, designed to provide a controlled condition to allow clean up before runoff enters the receiving waterbody, would be integral to any of the widening project plans. Coordination with DEP, DPH and the water company would be carried out for any work that would affect water company land, or the public water supply watershed.

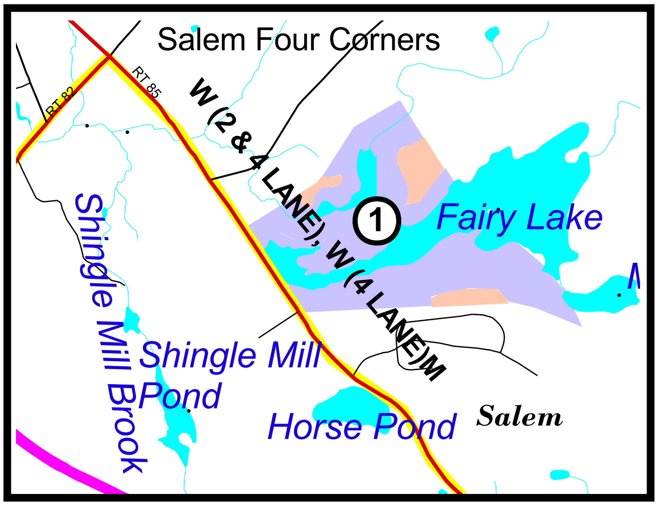
5.5.9 PUBLIC WATER SUPPLY WATERSHED LANDS (CLASS I AND CLASS II LANDS)

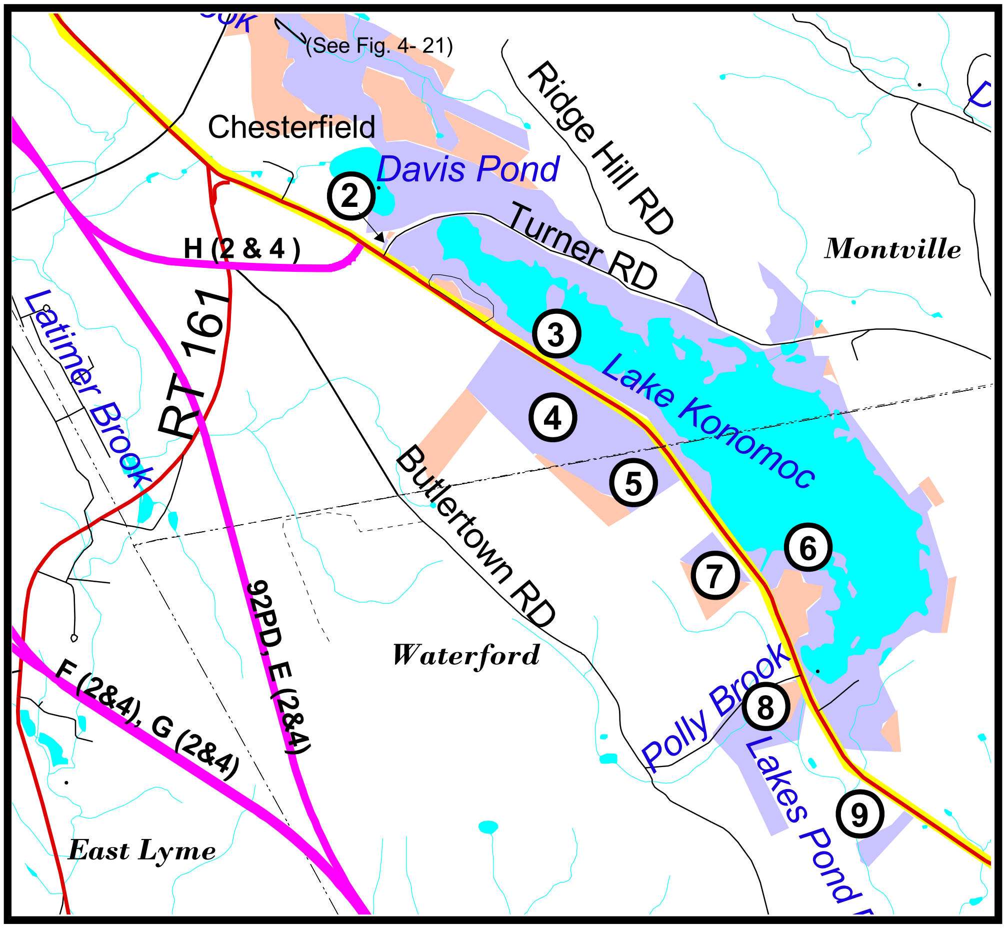
Any of the described alternatives that encompass the widening of Route 85 would require the taking/change in use of water company lands owned by the City of New London and managed by PSGNLU. Potentially impacted parcels containing Class I and Class II water supply watershed lands are depicted in Figure 5-16 and a summary of the areas of Class I and II lands affected appears in Table 5-38.

5.5.9.1 *No Build Alternative*: Under the no build alternative, it would be unlikely that any of the routine maintenance activities or minor improvements would take place outside the existing Route 85 right-of-way or designated maintenance easements. The currently-planned spot safety improvements for Route 85, which are considered part of the no build condition, will minimally, and temporarily, affect Class I and II water company lands in the vicinity of Lakewood Drive in Montville. Subsequent maintenance of drainage system components, including pipes, grit chambers and check dams installed within several easements on Parcel No. 3, located on the east side of Route 85 proximal to Lake Konomoc, will require future access. No transfer of ownership of water company lands is planned. Water company land access and maintenance rights in favor of ConnDOT would be granted by easement. Under the no build scenario, no taking or change of use to public water supply watershed lands would be required.

5.5.9.2 *Route 82 and 85 Widening Alternatives*: Construction of any of the proposed road widening scenarios ($W_{(4)}$, $W_{(4)}$m, and $W_{(2)}$) would result in the taking of water company land. In addition to the alternative-specific areas noted below, two or three 0.4± ha. (1± ac.) tracts of land may need to be acquired for the placement of a two-stage gross particle/oil water separator and detention pond(s) on each parcel to be used for the treatment of stormwater runoff prior to discharge to either Fairy Lake, Lake Konomoc or Polly Brook. Tracts potentially located on water company Parcel Nos. 1, 3, 6, or 8 or on other privately-owned property may be suitable sites for placement of these stormwater management devices.

Alternative $W_{(4)}$, the full four-lane road widening alternative, would require the acquisition of the most Class I and Class II land of all of the alternatives evaluated . A total of 2.99 ha. (7.39 ac.) of Class I designated land and 0.52 ha. (1.28 ac.) of Class II land would be taken from the nine parcels in order to widen Route 85 to four lanes.





N

LEGEND

- (1) Parcel Identification Numbers
- Class I Water Company Lands
- Class II Water Company Lands
- Expressway Alternatives
- Route 82/85 Widening/Upgrade Alternatives
- Waterbodies and Streams

State of Connecticut Department of Transportation
Federal Highway Administration
ROUTE 82/85/11
ENVIRONMENTAL IMPACT STATEMENT (EIS)
IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD
STATE PROJECT #120-81

CLASS I & II WATER COMPANY LANDS IMPACTS

Notes:

Sources:
Hydrology: CTDEP Natural Resources Center GIS Database 1994
Class I&II Lands: Delineated by Maguire Group, Inc.

800 0 800 1600 2400 Feet
200 0 200 400 600 Meters

December 1998

Figure 5-16

Table 5-38
Public Water Supply Watershed Lands (Class I & Class II) Subject to Taking/Change of Use

Parcel Number	Location	Land Class	Alternative $W_{(4)}$	$W_{(2)}$	$W_{(4)}M$	$H_{(4)}$	$H_{(2)}$
1	Fairy Lake, Salem	Class I	0.01 ha. (0.03 ac.)	0.01 ha. (0.01 ac.)	0.01 ha. (0.01 ac.)	N/I	N/I
2	North of Lake Konomoc, Montville	Class I	0.01 ha. (0.03 ac.)	<0.01 ha. (0.01 ac.)	0.01 ha. (0.01 ac.)	0.01 ha. (0.03 ac.)	<0.01 ha. (0.01 ac.)
3	Lake Konomoc, Montville	Class I	1.15 ha. (2.85 ac.)	1.21 ha. (3.00 ac.)	1.18 ha. (2.91 ac.)	1.15 ha. (2.85 ac.)	1.21 ha. (3.00 ac.)
		Class II	0.35 ha. (0.87 ac.)	0.38 ha. (0.95 ac.)	0.34 ha. (0.84 ac.)	0.35 ha. (0.87 ac.)	0.38 ha. (0.95 ac.)
4	West of Route 85, Montville	Class I	0.22 ha. (0.54 ac.)	0.03 ha. (0.07 ac.)	0.03 ha. (0.06 ac.)	0.22 ha. (0.54 ac.)	0.03 ha. (0.07 ac.)
5	West of Route 85, Waterford	Class I	0.14 ha. (0.34 ac.)	0.05 ha. (0.11 ac.)	0.01 ha. (0.02 ac.)	0.14 ha. (0.34 ac.)	0.05 ha. (0.11 ac.)
6	Lake Konomoc, Waterford	Class I	1.13 ha. (2.80 ac.)	1.05 ha. (2.58 ac.)	1.12 ha. (2.77 ac.)	1.13 ha. (2.80 ac.)	1.05 ha. (2.58 ac.)
		Class II	0.16 ha. (0.40 ac.)	0.08 ha. (0.20 ac.)	0.10 ha. (0.24 ac.)	0.16 ha. (0.40 ac.)	0.08 ha. (0.20 ac.)
7	West of Route 85, Waterford	Class I	0.25 ha. (0.61 ac.)	0.04 ha. (0.10 ac.)	0.08 ha. (0.19 ac.)	0.25 ha. (0.61 ac.)	0.04 ha. (0.10 ac.)
8	West of Route 85, Across from Lake Konomoc spillway, Waterford	Class I	0.03 ha. (0.07 ac.)	N/I	<0.01 ha. (0.01 ac.)	0.03 ha. (0.07 ac.)	N/I
		Class II	0.01 ha. (0.01 ac.)	N/I	<0.01 ha. (<0.01 ac.)	0.01 ha. (0.01 ac.)	N/I
9	Polly Brook well area, Waterford	Class I	0.05 ha. (0.12 ac.)	0.03 ha. (0.08 ac.)	0.03 ha. (0.08 ac.)	0.05 ha. (0.12 ac.)	0.03 ha. (0.08 ac.)
Total		Class I	2.99 ha. (7.39 ac.)	2.42 ha. (5.96 ac.)	2.47 ha. (6.06 ac.)	2.98 ha. (7.36 ac.)	2.41 ha. (5.95 ac.)
		Class II	0.52 ha. (1.28 ac.)	0.46 ha. (1.15 ac.)	0.44 ha. (1.09 ac.)	0.52 ha. (1.28 ac.)	0.46 ha. (1.15 ac.)

*Water Company Lands (City of New London)
N/I = No impact or negligible impact

Alternative $W_{(4)}$m would also take Class I and II land from all nine parcels; however, the area involved would be somewhat less than that required for Alternative $W_{(4)}$. Change of use of approximately 2.47 ha. (6.06 ac.) of Class I and 0.44 ha. (1.09 ac.) of Class II water company land would be required to construct Alternative $W_{(4)}$m.

Implementation of the two-lane widening of Route 85, Alternative $W_{(2)}$, would require the acquisition of 2.42 ha. (5.96 ac.) of Class I land and 0.46 ha. (1.15 ac.) of Class II land from eight of the nine water company parcels.

5.5.9.3 *TSM Alternatives*: TSM improvements would not be expected to require any permanent takes or alteration of public water supply watershed lands. Minor construction projects could be initiated as part of the implementation of TSM measures, however, it is likely that any required physical alteration of the roadway could be accomplished within the right-of-way area. Any temporary impacts associated with construction, such as increased runoff, would require use of BMPs and potential mitigation to ensure protection of water supply resources.

5.5.9.4 *TDM/Transit Alternatives*: Implementation of TDM/transit initiatives would be expected to have no impact upon public water supply watershed lands.

5.5.9.5 *New Location - Full Build Alternatives and Preferred Alternative*: The 92PD, $E_{(4)}$, $E_{(2)}$, $F_{(4)}$, $F_{(2)}$, $G_{(4),}$ and $G_{(2)}$ alternatives, and preferred alternative $E_{(4)}$m-V3, being located to the west of and at least 450 m. (1,500 ft.) from Route 85, would not require the taking of any water company owned land and, therefore, would not impact designated Class I or II land.

5.5.9.6 *New Location - Partial Build Alternatives*: Alternatives $H_{(4)}$ and $H_{(2)}$, which incorporate the widening of Route 85 south of the proposed touchdown point on Route 85, would require the taking of water company lands in the vicinity of Lake Konomoc. The four-lane widening of Route 85 associated with Alternative $H_{(4)}$ would necessitate acquisition of Class I and II water company lands comprising 2.98 ha. (7.36 ac.) of Class I lands and 0.52 ha. (1.28 ac.) of designated Class II lands.

Alternative $H_{(2)}$ incorporates two-lane widening of Route 85 south of the proposed interchange location. A total of 2.41 ha. (5.95 ac.) of Class I land and 0.46 ha. (1.15 ac.) of Class II land fronting on Route 85 would be taken. As described for the widening alternatives, both the $H_{(4)}$ and $H_{(2)}$ alternatives would likely also require additional parcel acquisition for stormwater management purposes.

5.5.10 MITIGATION MEASURES - CLASS I AND CLASS II LAND IMPACTS

The full build alternatives, including the preferred alternative, do not affect this resource; therefore, mitigation measures for Class I and II land would not be necessary.

Selection of any of the widening or partial build alternatives would require the taking of water company-owned lands for construction in the vicinity of the public water supply reservoirs. This would require a change of use permit from DPH and development of a comprehensive construction mitigation program describing measures that would be employed before, during, and after construction on Route 85. The overall sensitivity of the project area, especially in the immediate vicinity of the reservoirs, would require strict safeguards to protect the public water supply and watershed resources. Construction specifications and sequencing, as well as long-term operational safeguards and enforcement mechanisms, would be developed to ensure protection of the reservoirs and the surrounding environment. Protective measures including a stormwater management plan and BMPs for environmental protection during construction, which incorporate sediment and erosion control measures, would apply.

It is anticipated that a stormwater management system would have a positive impact on purity of the water supply. The system would be designed to ensure adequate pretreatment of stormwater runoff prior to discharge to the reservoirs. It would also incorporate a spill containment structure(s) and retention basin(s) which would receive and treat all roadway runoff. The basins would be designed with sufficient capacity to contain not only 100-year storm flows, but also spills that could occur during an accident event that would threaten to degrade public water supply lands. The system would allow for isolation of spills so that clean-up procedures could be initiated before there is an opportunity for the reservoir to become contaminated.

Several supplementary protection measures and/or restrictions will be developed for the immediate vicinity of the reservoirs; however, most of the road construction, excavation and grading within the subject parcels appears to be far enough from critical resource features so that additional restrictions will not be necessary. The basic controls, BMPs and construction phasing that would be imposed throughout the corridor would be sufficient to protect watershed lands within and adjoining most of the parcels.

5.5.10.1 *Contingency Planning and Spill Response Measures*: Through a program of good design and BMPs, highway runoff and highway maintenance practices that contribute to pollutant loading can be effectively reduced or eliminated. However, because of its unpredictable nature, an accidental release that could suddenly introduce a large quantity of toxic material into the reservoir poses a potentially greater threat to the quality of the reservoir.

As an NHS-designated roadway, Route 85 now carries, and would likely continue to carry, all types of motor vehicles, including those hauling hazardous materials. While the likelihood of an accident remains remote, a release could potentially occur as a result of an overturned or leaking tanker containing fuel oil, gasoline or other chemicals, or large vehicle fires or accidents where fire department washdown is necessary. Regardless of the precautions that will be observed during the construction of any of the proposed alternatives, equipment failure or other unforseen events could result in a spill or accidental release.

A carefully detailed emergency response program would greatly reduce the risk of contamination to resources in the corridor in the event of such an accident. Prompt recognition of, and response to, a spill or release is critical to ensuring protection of the reservoirs and adjacent watershed lands. In the event of an accidental spill while Route 85 is under construction, construction workers on the site would have to be instructed in response protocol, system operation and containment procedures. A spill prevention and response plan would be developed for any water company-owned land subject to taking in conjunction with a roadway improvement.

5.6 Wetland Resources

5.6.1 Description of Wetland Impacts

Direct, indirect, permanent and temporary wetland impacts can be expected in conjunction with any of the proposed alternatives outlined, herein. Direct, permanent impacts would occur primarily as a result of placement of clean fill material within wetlands and the excavation of wetland soils. Along the widening alternatives, the existing toe of slope would be extended to various widths to accommodate the two- and four-lane alternatives. The alternatives on new location would involve the placement of fill in primarily undisturbed wetland areas. Fill material would be placed across the entire cross-section of the road rather than adjacent to previously disturbed areas, as in the widening alternatives. For this reason, the alternatives on new alignment would each have greater overall direct impact areas than the widening alternatives.

In addition to fill material, concrete abutments and piers associated with bridge structures would also be constructed within wetlands; these installations would affect smaller areas of wetland area than placement of fill material.

Indirect permanent impacts would include impacts such as alteration in hydrology, stormwater discharge, potential drainage of wetlands in proximity to large roadway cuts, and the introduction of invasive species within wetlands along the roadway. Fill placed in wetland and upland areas could alter groundwater flow patterns, disrupting hydrological inputs to some wetlands, while increasing it to others. The compaction of roadway base material affords little groundwater movement. The installation of bridges, and especially culverts, may alter or impede flow velocities from existing conditions.

Ponded areas and increased water levels during storm events could be created in areas which are crossed by the roadway and fitted with a culvert. Channelization of watercourses could increase flow velocities, and in turn, increase the potential for erosion and the need for future maintenance.

As previously stated, all of the alignments on new location would involve extensive rock cuts. Although the cut slope footprint would cause direct impacts to wetland areas, they may also cause indirect impacts to wetland areas by draining nearby groundwater reserves. Additionally, since rock cuts are invariably blasted with explosives, fissures and cracks could be formed throughout the bedrock adjacent to the blasting areas and drain groundwater from perched wetland areas.

Temporary impacts to wetlands would occur during construction activities. These impacts would result from a variety of activities such as cutting of vegetation, disturbance of wetland soils by machinery, temporary diversion of watercourses, dewatering of work areas within wetland boundaries, discharge of dewatering flow, construction of temporary bridging, installation of erosion and sedimentation controls, temporary increases in water temperature and turbidity, and installation of sheet piling.

5.6.1.1 *ACOE Impact Assessment Methodology*: The ACOE Methodology for wetland evaluation and impact assessment was used as the basis for assessing impacts associated with each project alternative. Phase I of the ACOE Methodology, carried out early in the process, generally includes constraint mapping and screening of alternatives. Phase II focuses on evaluation of the functions and values of those wetlands that are expected to be impacted, as well as further avoidance and minimization of likely wetland impact areas. Subsequent selection of the LEDPA, following the DEIS public comment period, was based on the functions and values assessment and efforts to avoid and minimize impacts. Finally, mitigation measures are developed for the selected alternative which replaces the functions and values lost as a result of unavoidable impacts.

5.6.1.2 *Impacted Functions and Values*: Impacts to corridor area wetlands could potentially affect all thirteen functions and values, as discussed in Section 4.6.2. The functions and values assessment undertaken revealed that the principal function with the greatest impact for all the build alternatives is wildlife habitat. The principal function with the second greatest impact would be groundwater recharge/discharge (most sites within the corridor are discharge areas). The least-affected functions and values are recreation, education, uniqueness/heritage, visual/aesthetics, and finfish habitat; these functions and values are not impacted to a great extent because they are encountered less often.

5.6.1.3 *Notable Wetland Areas*: Eight wetland areas were identified as notable wetlands within the corridor (Figure 4-24). Each of these areas would be directly or indirectly impacted by one or more alternatives. Care would be taken to avoid and minimize unavoidable impacts to these notable wetland areas since they all have unique and important functions such as endangered species habitat, surface water supply, floodflow alteration, and wildlife habitat. The greatest potential threat to these areas would be impact during construction. Temporary impacts including erosion, sedimentation and clearing of forest lands are all impacts which could be detrimental to water quality within these areas if proper controls were not incorporated in the design.

A summary of wetland impacts for each of the alternatives is shown in Table 5-39.

TABLE 5-39
WETLAND IMPACT SUMMARY [1] BY ALTERNATIVE

ALTERNATIVE	ALL WETLANDS		NOTABLE WETLANDS		CROSSINGS [2]
	NUMBER OF IMPACT AREAS	TOTAL IMPACTED AREA	NUMBER OF IMPACT AREAS[4]	TOTAL IMPACTED AREA	NUMBER OF IMPACT AREAS
No build	N/I [3]	N/I	N/I	N/I	N/I
TSM	7	0.26 ha. (0.65 ac.)	4	0.22 ha. (0.54 ac.)	2
TDM/Transit	N/I	N/I	N/I	N/I	N/I
$W_{(4)}$	62	2.07 ha. (5.12 ac.)	9	0.81 ha. (1.99 ac.)	10
$W_{(4)}$m	55	1.52 ha. (3.77 ac.)	10	0.60 ha. (1.48 ac.)	10
$W_{(2)}$	53	1.37 ha. (3.37 ac.)	9	0.61 ha. (1.49 ac.)	10
92PD	46	14.17 ha. (35.01 ac.)	4	0.69 ha. (1.70 ac.)	8
$E_{(4)}$	44	14.27 ha. (35.26 ac.)	4	0.69 ha. (1.70 ac.)	8
$E_{(2)}$	33	7.89 ha. (19.50 ac.)	4	0.31 ha. (0.76 ac.)	8
$F_{(4)}$	37	11.62 ha. (28.72 ac.)	3	1.88 ha. (4.64 ac.)	5
$F_{(2)}$	24	6.21 ha. (15.35 ac.)	4	1.22 ha. (3.02 ac.)	5
$G_{(4)}$	35	13.23 ha. (32.69 ac.)	3	1.88 ha. (4.64 ac.)	5
$G_{(2)}$	24	7.93 ha. (19.59 ac.)	4	1.22 ha. (3.02 ac.)	5
$H_{(4)}$	36	4.40 ha. (10.87 ac.)	3	0.93 ha. (2.30 ac.)	5
$H_{(2)}$	30	3.0 ha. (7.41 ac.)	3	0.66 ha. (1.64 ac.)	5
$E_{(4)}$m-V3	46	6.7 ha. (16.6 ac.)	3	1.34 ha. (3.3 ac.)	8

(1) ACOE §404 wetland permit application
(2) Refers to perennial stream crossings
(3) N/I = no impact or negligible impact
(4) In some cases, a notable wetland may be impacted in more than one area

5.6.1.4 *Seasonal Pools*: The direct impact to each pool depression is the measurable disturbances associated with roadway construction such as cut, fill, grading, or construction of the roadway footprint. Thirty-seven seasonal pools were identified within the study corridor.

Impacts to seasonal pools vary among alternatives, although all full build alternatives share impacts to seasonal pools in the vicinity of the interchange. Table 5-28 in section 5.4 shows a comparison of direct impacts to seasonal pools by alternative.

Indirect impacts to seasonal pools would consist of the area of disturbance (e.g., the limit of cut, fill, grading, vegetation removal, etc.) associated with the proposed alignment that encroaches within the pool envelope (pool edge to 30 m. [100 ft.]), and the critical terrestrial habitat (between 30-230 m. [100-750 ft,] from the pool edge), based on Calhoun and Klemens (2002). Detailed methodologies for assessment of indirect impact can be found in the *Seasonal Pool Inventory and Evaluation Report* (2006).

5.6.2 COMPARISON OF WETLAND IMPACTS

Twelve build alternatives were carried into the Phase II assessment of wetland impacts. The preferred alternative was chosen from these alternatives and further modified to avoid and minimize wetland impacts. The no build and TDM/transit alternatives would have no quantifiable wetland impacts since they do not involve planned new construction. The TSM alternative would include minor intersection improvements, and therefore would have minor quantifiable impacts to wetlands. Unlike the widening alternatives which focus on an established transportation corridor, the new alignments on new location would impact both previously disturbed and undisturbed wetlands since they are aligned through developed and undeveloped areas. Impacts to seasonal pools vary among alternatives, although all full build alternatives share impacts to seasonal pools in the vicinity of the interchange. Table 5-28 in section 5.4 shows a comparison of direct impacts to seasonal pools by alternative.

Each of the new alignment alternatives were located to avoid as many major wetland areas as possible and still maintain appropriate geometric standards (Section 3.3). The alignments were shifted to avoid wetlands or, if avoidance was not possible, the alternatives were generally aligned across the narrower portions of the wetlands. The north and south termini of the proposed Route 11 are considered fixed so there is little opportunity for further avoidance near these locations. Since the northern terminus of Route 11 has already been partially constructed south of Route 82 in Salem for approximately 0.8 km (0.5 mi) and includes bridges, drainage structures and a large rock cut, it was considered most practical to utilize this portion of the roadway to avoid additional wetland impacts to undisturbed areas. Also, the southern terminus of the alignments occupying a new location is proposed at the I-95/I-395 intersection near the

East Lyme/Waterford town line. In prior studies, this terminus location was determined to be the most practicable. Although the northern and southern portions of the new expressway alternatives could not be shifted appreciably, the area between these limits offered considerable latitude for altering roadway alignment. Therefore, although each of the proposed expressway alignments utilize the same northern and southern termini, they follow different routes through the corridor.

5.6.2.1 *No Build Alternative*: Under the no build scenario, there would be no wetland impacts directly attributable to road construction. However, corridor-area wetlands would likely experience continuous, incremental degradation caused by increased traffic and other growth-related factors. Based on growth trends and traffic forecasts, it is likely that developable lands in the vicinity of Routes 82 and 85 would continue to be developed and traffic volumes would continue to increase (Sections 4.1 and 5.1). Stormwater runoff would have higher levels of pollutants resulting from the increased numbers of vehicles, increasing the potential for pollution of nearby wetlands. No seasonal pools would be impacted by this alternative.

5.6.2.2 *Route 82 and 85 Widening Alternatives*: Of all the widening alternatives, the $W_{(2)}$ alternative would directly impact the least amount of wetland area, approximately 1.37 ha. (3.37 ac.), followed closely by the $W_{(4)}$m alternative at 1.52 ha. (3.77 ac.). The $W_{(4)}$ alternative would impact approximately 2.07 ha. (5.12 ac.) of wetland, although this impact area is still less than any of the new expressway alignment alternatives.

Because the widening alternatives follow along the same general alignment as the existing Routes 82 and 85, impacts are generally limited to sliver takes along the edge of the roadway. The wetland areas associated with the widening alternatives are different from wetlands impacted by the other alternatives in that the majority of them have been previously disturbed and/or modified by human activity.

For purposes of quantifying wetland impacts, the wetland areas between the edge of the existing roadway and limits of the cut and/or fill slopes are considered impacted by the alternative. Because the widening alternatives follow along the same general alignment as the existing Routes 82 and 85, impacts are generally limited to sliver takes along the edge of the roadway. The wetland areas associated with the widening alternatives are different from wetlands impacted by the other alternatives in that the majority of them have been previously disturbed and/or modified by human activity. The initial construction of Routes 82 and 85 required filling of wetland areas, bridging and culverting watercourses, draining, and ponding of wetland areas. Direct impacts to wetlands as a result of a widening alternative consist of the extension of the existing roadway side slope into wetland areas with the placement of fill or excavation of material in a cut situation. Impacts will not extend across the entire cross-section of the proposed roadway. Likewise, existing culverts would need to be extended to the appropriate length. Indirect impacts would consist of minimal increases in stormwater and potential drainage of adjacent wetlands in cut areas.

Many wetland types are found in association with the widening alternatives. The majority of wetlands directly impacted by the widening alternatives are deciduous forested red maple swamps. There are, however, scrub-shrub, emergent and open water wetlands located adjacent to the widening alternatives as well. The $W_{(2)}$ alternative would impact 0.50 ha. (1.23 ac.) of palustrine forested wetland and 0.48 ha. (1.18 ac.) of PFO/RIV wetland. The $W_{(4)}$m would impact 0.51 ha. (1.25 ac.) of palustrine forested wetland and 0.44 ha. (1.09 ac.) of PFO/RIV wetland. $W_{(4)}$ would impact 0.70 ha. (1.72 ac.) of palustrine forested wetland and 0.68 ha. (1.68 ac.) of PFO/RIV wetland. The widening alternatives have the greatest number of stream crossings, as compared to the other alignments.

A number of principal functions would be impacted by the widening alternatives. It is important to note that some wetlands had more than one principal function, therefore if it was impacted, that impact area would be included in more than one function category. The $W_{(2)}$ alternative would impact 0.59 ha. (1.45 ac.) of wetland with sediment/shoreline stabilization as its principal function, and 0.48 ha. (1.18 ac.) of wetland with sediment/toxicant retention as its principal function. The $W_{(4)}$m would impact 0.53 ha. (1.32 ac.) of wetland with wildlife habitat as its principal function, and 0.47 ha. (1.16 ac.) of wetland with sediment/toxicant retention as its principal function. $W_{(4)}$ would impact 0.79 ha. (1.95 ac.) of wetland with sediment/shoreline stabilization as its principal function, and 0.73 ha (1.81 ac.) of wetland with wildlife habitat as its principal function. Impacts to other principal functions range from 0 ha. to 0.60 ha. (1.48 ac.).

Two notable wetlands, Harris Brook and Latimer Brook, would be impacted by the $W_{(4)}$ or $W_{(2)}$ alternatives. Alternative $W_{(4)}$m would impact three notable wetlands, Harris Brook, Latimer Brook and Horse Pond. Alternatives $W_{(4)}$ and $W_{(2)}$ would impact Harris Brook in four separate areas and Latimer Brook in five areas. Alternative $W_{(4)}$m would also impact Harris Brook and Latimer Brook in four and five areas, respectively, but would also impact Horse Pond in one area.

Since all three of these notable wetlands are located adjacent to the existing Route 85, they would be impacted by side-slope encroachment as a result of widening the road. The notable wetlands listed above have been previously affected by Route 85 construction. Impacts such as encroachment, channelization and bridging have been the main impacts to these wetlands, however, long term effects such as erosion and sedimentation were also observed in some areas. Widening of the existing roadway would have similar types of impacts to the wetlands. In addition to these impacts, the potential exists for indirect impacts to Lake Konomoc. Since this wetland is an important water supply area, it will not be impacted directly; however, the potential exists for minor water quality disturbances during construction.

Because this wetland is such an important resource, heavy mitigative measures, including erosion and sedimentation controls, would be incorporated into the design and construction phases of work to Route 85 within its watershed. One seasonal pool would be impacted by the widening alternatives.

5.6.2.3 *TSM Alternative*: Under the TSM alternative, intersection improvements would be initiated along Routes 82 and 85. As a result of these improvements, there would be minor wetland impacts, 0.26 ha. (0.65 ac.), directly attributable to road construction. Impacts would be confined to the intersection of Routes 82 and 85, were there would be roadway improvements, as described in Section 5.1.1.1. In addition to these direct impacts, wetlands along Routes 82 and 85 would likely experience continuous, incremental degradation resulting from increased traffic and other growth-related factors, as in the no build alternative. Based on growth trends and traffic forecasts, it is likely that developable lands in the vicinity of Routes 82 and 85 would continue to be developed and traffic volumes would continue to increase (Sections 4.1 and 5.1). Stormwater runoff would have higher levels of pollutants as a result of the increased numbers of vehicles, increasing the potential for pollution of nearby wetlands. This alternative would affect one notable wetland, Harris Brook, in four separate impact areas. No seasonal pools would be impacted by the TSM alternative.

5.6.2.4 *TDM/Transit Alternative*: Under this alternative, like the no build scenario, there would be no wetland impacts directly attributable to road construction. However, corridor-area wetlands would likely experience continuous, incremental degradation resulting from increased traffic and other growth-related factors. It is likely that developable lands in the vicinity of Routes 82 and 85 would continue to be developed and traffic volumes would continue to increase (Sections 4.1 and 5.1). Stormwater runoff would have higher levels of pollutants as a result of the increased numbers of vehicles, increasing the potential for pollution of nearby wetlands. No seasonal pools would be impacted by the TDM/Transit alternative.

5.6.2.5 *New Location - Full Build Alternatives*: The majority of wetland areas associated with any of the full build alternatives are functioning as undisturbed, natural wetland areas. Some wetland areas located near development, however, have been previously disturbed by human activity. Direct impacts to wetlands and seasonal pools would consist of the deposition of fill material in wetland areas and the excavation of wetland areas to construct the roadway below the existing grade. These fills and cuts would extend over the entire cross-section of the proposed roadway. Also, this alternative would require the installation of piers within some wetland areas to facilitate construction of bridge structures. Indirect impacts would consist of the potential drainage of wetland areas beyond cut limits; the alteration of groundwater hydrology near the roadway; the channelization of watercourses near culverts and bridges; and the introduction of invasive plant and animal species into previously undisturbed natural areas. Indirect impacts to seasonal pools would consist of loss of upland habitat surrounding the pool in the pool envelope and the critical terrestrial habitat.

Potential impacts to wetlands, wetland functions and values and seasonal pools vary among the full build alternatives; therefore, each is discussed individually, below.

92PD Alternative: The 92PD alternative would impact approximately 14.17 ha. (35.01 ac.) of wetlands within the corridor. Because this alternative is on new location, it will involve extensive cuts and fills to construct a roadway which meets AASHTO standards and maintains transportation functionality.

The 92PD alignment would impact a number of different wetland types within the corridor. Palustrine forested wetlands would constitute the wetland type of the greatest impact, with 6.47 ha. (15.97 ac.). Riverine wetland types show the second highest impact areas, with 7.6 ha. (12.9 ac). Since scrub/shrub, emergent and open water wetlands are less common along this alternative, wetlands of these types would experience little to no impact.

A number of principal functions would be impacted by the 92PD alignment. It is important to note that some wetlands had more than one principal function. Therefore if a wetland with more than one principal function was impacted, that impact area would be included more than once. The principal function with the greatest impact, 9.13 ha. (22.56 ac.), is wildlife habitat. Wetlands with a principal function of groundwater recharge/discharge would have the second highest impact of 7.97 ha. (19.69 ac.) impact. Impacts to other principal functions range from 0 ha. to 3.00 ha. (7.42 ac.).

Three notable wetlands would be impacted by the 92PD alternative: Shingle Mill Brook, Grassy Hill wet meadow, and Latimer Brook. The Shingle Mill Brook wetland would be impacted in two areas (one on each side of the brook); the other two wetlands would each be impacted in one area only. This alternative would cross the Shingle Mill Brook area at its narrowest point utilizing a natural peninsula of upland. Additionally, the brook would be bridged over the wetland, thereby greatly reducing impacts associated with installation of abutments and piers only. The Grassy Hill wet meadow would also be impacted by this alternative. This area, located between Grassy Hill Road and Latimer Brook, could not be avoided since it must be used as an abutment area for the two bridges passing over Grassy Hill Road and Latimer Brook. This wetland would be filled with clean fill material, thereby impacting most of the wetland and greatly reducing its functional value. Alternative 92PD also impacts the eastern edge of the Latimer Brook system, north of Route 161. Because the roadway would impact only the edge of this system, with no direct impacts to Latimer Brook, the functional integrity of the system would generally remain intact. Three seasonal pools would be directly impacted by this alternative.

E Alternatives: The $E_{(4)}$ and $E_{(2)}$ alternatives would impact approximately 14.27 ha. (35.26 ac.) and 7.89 ha. (19.50 ac.), respectively, of wetlands within the corridor. Like the 92PD, these alternatives are on new location and would involve extensive cuts and fills to construct the roadway.

The E alternatives would impact a number of different wetland types within the corridor. Consistent with the corridor, palustrine forested wetlands are the most common type along the alternative, and would therefore constitute the greatest impact area, 6.7 ha. (16.54 ac.) for $E_{(4)}$ and 3.41 ha. (8.43 ac.) for $E_{(2)}$. The riverine wetland type has the second largest impact area of 3.12 ha. (7.71 ac.) for $E_{(4)}$ and 2.38 ha. (5.87 ac.) for $E_{(2)}$. Since scrub/shrub, emergent and open water wetlands are less common along this alternative, these wetland types show little to no impact.

The E alternatives will impact a number of different principal functions. Since some wetlands had more than one principal function, it is important to note that if these wetlands are impacted, that impact area would be included in more than one principal function category. The principal function with the greatest impact for the $E_{(4)}$ and $E_{(2)}$ alternatives is wildlife habitat, with 8.94 ha. (22.09 ac.) and 4.88 ha. (12.06 ac.), respectively, affected. Wetlands with a principal function of groundwater recharge/discharge would have the second largest impact of 8.20 ha. (20.26 ac.) and 4.26 ha. (10.51 ac.), respectively, for the $E_{(4)}$ and $E_{(2)}$ alternatives. Impacts to other principal functions range from 0 ha. to 3.04 ha. (7.52 ac.).

Three notable wetlands would be impacted by the E Alternatives: Shingle Mill Brook, Grassy Hill wet meadow, and Latimer Brook. In total, four areas would be impacted; Shingle Mill Brook would be impacted in two separate areas and the other notable wetlands would each be impacted in one area. The E alternatives would cross the Shingle Mill Brook area at its narrowest point, utilizing a natural peninsula of upland. Also, the brook would be bridged over the wetland, thereby confining impacts to the vicinity of abutments and piers. The Grassy Hill wet meadow would also be impacted by these alternatives. This area, located between Grassy Hill Road and Latimer Brook, would be filled with clean fill material to construct bridge abutments for crossing Latimer Brook and Grassy Hill Road. This would impact most of the wetland and diminish its functional value. These alternatives would also impact the eastern edge of the Latimer Brook system, north of Route 161; however, because the roadway would impact only the edge of this system with no direct impacts to Latimer Brook, the functional integrity of the system would generally remain intact. Two seasonal pools would be directly impacted by this alternative.

F Alternatives: The $F_{(4)}$ and $F_{(2)}$ alternatives would impact approximately 11.62 ha. (28.72 ac.) and 6.21 ha. (15.35 ac.), respectively, of wetlands within the corridor. Like the other alternatives on new location, this alignment will involve extensive cuts and fills to construct the roadway.

The F alternatives would impact a number of different wetland types within the corridor. Consistent with the corridor, palustrine forested wetlands are the most common wetland type along the F alignment. The $F_{(4)}$ and $F_{(2)}$ alternatives would impact 6.94 ha. (17.13 ac.) and 4.23 ha. (10.44 ac.) of PFO wetland, respectively. The $F_{(4)}$ and $F_{(2)}$ alternatives would impact 1.61 ha. (3.98 ac.) and 1.39 ha. (3.43 ac.) of riverine wetland, respectively. Since scrub/shrub, emergent and open water wetlands are less common along this alternative, these wetland types show little to no impact.

The F alternatives would impact a number of different principal functions. Because some wetlands had more than one principal function, it is important to note that if impacted, the specific impact area would be included in more than one principal function category. The principal function with the greatest impact is wildlife habitat, with 8.47 ha. (20.93 ac.) for the $F_{(4)}$ and 4.55 ha. (11.24 ac.) for the $F_{(2)}$. Wetlands with a principal function of groundwater recharge/discharge would have the second largest impact of 7.13 ha. (17.61 ac.) for the $F_{(4)}$ and 3.72 ha. (9.20 ac.) for the $F_{(2)}$. Impacts to other principal functions range from 0 ha. to 2.65 ha. (6.55 ac.).

Two notable wetlands, Shingle Mill Brook and Wetland PD-12A, would be impacted by the F Alternatives. Shingle Mill Brook would be impacted in two areas by either the $F_{(4)}$ or $F_{(2)}$ alternatives. The F alternatives would cross the Shingle Mill Brook area at its narrowest point, utilizing a natural peninsula of upland. To reduce impacts to the wetlands, the brook would be bridged, thereby confining impacts to the vicinity of the proposed abutments and piers. Wetland PD-12A would be impacted in one area by Alternative $F_{(4)}$ and in two areas by Alternative $F_{(2)}$. The PD-12 wetland area would be crossed by the F alignment perpendicular to the long portion of the wetland, bisecting the wetland. This area would be filled and culverted, rather than bridged, as the watercourse here is small and intermittent in nature. Five seasonal pools would be directly impacted by this alternative.

G Alternatives: The $G_{(4)}$ and $G_{(2)}$ alternatives would impact approximately 13.23 ha. (32.69 ac.) and 7.93 ha. (19.59 ac.), respectively, of wetlands within the corridor. This alignment, like the other alternatives on new location, will involve extensive cuts and fills to construct the roadway.

The G alternatives would impact a number of different wetland types within the corridor. Consistent with the corridor, palustrine forested wetlands are the most common wetland type along the G alignment. The $G_{(4)}$ and $G_{(2)}$ alternatives would impact 7.30 ha. (18.02 ac.) and 4.29 ha. (10.59 ac.) of PFO wetland, respectively. The second highest impacts of the $G_{(4)}$ and $G_{(2)}$ alternatives were different. The $G_{(4)}$ alternative would impact 1.87 ha. (4.63 ac.) of riverine wetlands, and the $G_{(2)}$ alternative would impact 1.32 ha. (3.25 ac.) of POW/SS/EM wetland.

The G alternatives would impact a number of different principal functions. Some wetlands had more than one principal function, therefore, it is important to note that where this occurs, the impact area is included in more than one function category. The principal function with the greatest impact is wildlife habitat, with 10.88 ha. (26.87 ac.) impacted under $G_{(4)}$ and 6.49 ha. (16.02 ac.) impacted under the $G_{(2)}$ alternative. Wetlands with a principal function of groundwater recharge/discharge will have the second largest impact of 7.25 ha. (17.91 ac.) for the $G_{(4)}$ and 3.72 ha. (9.20 ac.) for the $G_{(2)}$ alternative. Impacts to other principal functions range from 0 ha. to 3.97 ha. (9.8 ac.).

Two notable wetlands would be impacted by the G Alternatives: Shingle Mill Brook and Wetland PD-12A. Shingle Mill Brook would be impacted in two areas by either the $G_{(4)}$ or $G_{(2)}$ alternatives. Wetland PD-12A would be impacted in one area by Alternative $G_{(4)}$ and in two areas by Alternative $G_{(2)}$. The G alternatives would cross the Shingle Mill Brook area at its narrowest point, utilizing a natural peninsula of upland. To reduce impacts to the wetlands, the brook would be bridged, thereby confining impacts to the vicinity of the proposed abutments and piers. The PD-12 wetland area would be crossed by the G alignment perpendicular to the long portion of the wetland, bisecting the wetland. This area would be filled and culverted, rather than bridged, as the watercourse here is small and intermittent in nature. Five seasonal pools would be directly impacted by this alternative.

5.6.2.6 *New Location - Partial Build Alternatives*: The $H_{(4)}$ and $H_{(2)}$ alternatives would impact approximately 4.40 ha. (10.87 ac.) and 3.0 ha. (7.41 ac.), respectively, of wetlands within the corridor. Of this, 3.51 ha. (8.67 ac.) and 2.43 ha. (6.01 ac.) would be on new location for the $H_{(4)}$ and $H_{(2)}$ alternatives, respectively. The $H_{(4)}$ and $H_{(2)}$ alternatives would impact 0.89 ha. (2.19 ac.) and 0.57 ha. (1.40 ac.) respectively, along their Route 85 widening portion. The majority of impacts are concentrated along the section of roadway on new location.

The H alternatives would impact a number of different wetland types within the corridor. Consistent with the corridor, palustrine forested wetlands are the most common wetland type along the H alignment. The $H_{(4)}$ and $H_{(2)}$ alternatives would impact 2.54 ha. (6.25 ac.) and 1.90 ha. (4.69 ac.) of PFO wetland, respectively. The $H_{(4)}$ and $H_{(2)}$ alternatives would impact 0.85 ha. (2.10 ac.) and 0.58 ha. (1.43 ac.) of riverine wetland, respectively. Since scrub/shrub, emergent and open water wetlands are less common along this alternative, these wetland types show little to no impact.

The H alternatives would impact a number of different principal functions. The principal function with the greatest impact is wildlife habitat, with 3.57 ha. (8.82 ac.) for the $H_{(4)}$. Wetlands with a principal function of groundwater recharge/discharge will have the second largest impact of 1.38 ha. (3.41 ac.). Impacts to other principal functions range from 0 ha. to 1.37 ha. (3.38 ac.). Since some wetlands had more than one principal function, it is important to note that if these wetlands are impacted, the impact area would be included in more than one principal function category.

The H Alternatives would impact two notable wetlands, Shingle Mill Brook and the Grassy Hill wet meadow. Either the $H_{(4)}$ or $H_{(2)}$ alternatives would impact the Shingle Mill Brook wetland in two areas and the Grassy Hill wet meadow in one area. Like the other alternatives on new location, the H alternatives would cross the Shingle Mill Brook area at its narrowest point, utilizing a natural peninsula of upland. To reduce impacts to the wetlands, the brook would be bridged, thereby confining impacts to the vicinity of the proposed abutments and piers. The Grassy Hill wet meadow would also be impacted by either of the H alternatives. This area, located between Grassy Hill Road and Latimer Brook, would be filled with clean fill material to construct bridge abutments for crossing Latimer brook and Grassy Hill Road. This would impact most of the wetland and diminish its functional value. In addition to these impacts, the potential exists for indirect impacts to Lake Konomoc. Since this wetland is an important water supply area, it will not be impacted directly, however, the potential exists for minor water quality disturbances during construction. Because this wetland is such an important resource, heavy mitigative measures, including erosion and sedimentation controls, would be incorporated into the design and construction phases of work to Route 85 within its watershed. Three seasonal pools would be directly impacted by this alternative.

5.6.2.7 *Preferred Alternative*: The $E_{(4)}$m-V3 alternative would impact approximately 6.7 ha. (16.6 ac.) of wetlands within the corridor. Like the E alternative, this alternative is on new location and would involve extensive cuts and fills to construct the roadway, although this potential has been reduced through minimization measures. Table 5-40 shows the individual wetland impacts associated with the construction of the project, and the subregional watersheds in which the impacts occur. Direct impacts were calculated based on field delineations discussed in Section 4.6.

TABLE 5-40
DIRECT WETLAND IMPACTS – PREFERRED ALTERNATIVE $E_{(4)}$M-V3

WETLAND ID#	IMPACT AREA (AC)	WATERSHED	LOCATION	COMMENT
PD-1	0.01	HB	Directly south of rock cut	
PD-1	0.01	HB	Directly south of rock cut	Bridge
PD-2B	0.02	HB	Single Mill Brook crossing	Bridge-1 Pier
PD-2C	0.68	HB	South of Shingle Mill Brook	
PD-3A	0.02	HB	East of Fawn Run	
PD-3A	0.08	LB	East of Fawn Run	
PD-3A	0.13	LB	East of Fawn Run	Bridge-1 Pier
PD-3B	0.44	LB	East of Fawn Run	
PD-3C	0.34	LB	East of Fawn Run	
PD-4A	0.03	LB	North of Salem Turnpike	Bridge-2 Piers
PD-5A	3.14	LB	South of Salem Turnpike	
PD-5C	0.07	LB	South of Salem Turnpike	
PD-5D	0.12	LB	Northwest of Daisy Hill	
PD-5D	0.32	LB	Northwest of Daisy Hill	
E2	0.28	LB	Power lines south of Daisy Hill	
E2	0.08	LB	Power lines south of Daisy Hill	
E2	0.04	LB	Power lines south of Daisy Hill	
E3	0.07	LB	South of power lines	
E4	0.02	LB	South of power lines	Bridge-1 Pier
PD-7	0.05	LB	North of Grassy Hill Road	
PD-8A	0.01	LB	South of Grassy Hill Road	Bridge-1 Pier
PD-9C	0.32	LB	Immediately North of Rt. 161	
PD-9A	3.27	LB	Immediately North of Rt. 161	Bridge-1 Pier
PD-10A	0.04	LB	Immediately North of Rt. 161	
PD-10A	0.31	LB	Immediately South of Rt. 161	
PD-11A	0.67	LB	South of Route 161	
PD-11B	1.15	LB	South of Route 161	
PD-13D	0.21	LB	Northeast of Grouse Circle	
PD-13C	0.19	LB	Northeast of Grouse Circle	
PD-13B	0.27	LB	Northeast of Grouse Circle	
PD-13A	0.03	LB	Northeast of Grouse Circle	Bridge-2 Piers
PD-15	0.60	NR	I-95 Interchange	
PD-15	0.66	NR	I-95 Interchange	
PD-16A	0.96	NR	I-95 Interchange	
PD-16B	0.28	NR	I-95 Interchange	
PD-16B	0.43	NR	I-95 Interchange	
PD-16B	0.62	NR	I-95 Interchange	
PD-17B	0.52	OM	I-95 Interchange	
PD-18A	0.01	NR	I-95 Interchange	
PD-19	0.07	OM	I-95 Interchange	
TOTAL	**16.6**			

HB = Harris Brook Subregional Watershed   LB = Latimer Brook Subregional Watershed
NR = Niantic River Brook Subregional Watershed   OM = Oil Mill Brook Watershed

As indicated, the greatest impact areas occur in the Latimer Brook subregional watershed, with 4.73 ha (11.7 ac) of impact area. The wetland impact areas and their respective functions and values are depicted on Figures D-1 through D-9 in Appendix D.

The E(4)m-V3 alternative would impact a number of different wetland types within the corridor as shown in Table 5-41. Consistent with the corridor, palustrine forested wetlands are the most common type along the alternative, and would therefore constitute the greatest impact area, 3.45 ha. (8.52 ac.). The palustrine forested/scrub-shrub wetland type has the second largest impact area of 1.43 ha. (3.54 ac.). The third and fourth most impacted wetland types are the palustrine forested and palustrine open water/scrub-shrub/emergent wetland types, at 0.72 ha. (1.77 ac.) and 0.39 ha. (0.96 ac.), respectively. Since lacustrine, emergent and open water wetlands are less common along this alternative, these wetland types show little to no impact.

TABLE 5-41
DIRECT IMPACTS TO WETLANDS BY TYPE– PREFERRED ALTERNATIVE $E_{(4)}$M-V3

WETLAND TYPE [1]	IMPACTED AREA [2]	
	HECTARES	ACRES
Palustrine forested	3.45	8.52
Palustrine forested / scrub-shrub	1.43	3.54
Palustrine scrub-shrub / emergent / open water	0.39	0.96
Riverine	0.37	0.91
Palustrine forested / riverine	0.72	1.77
Palustrine scrub-shrub / emergent	0.17	0.43
Palustrine forested / scrub-shrub / emergent	0.02	0.05
Palustrine forested / open water	0.03	0.07
Palustrine open water	0.01	0.02

[1] Cowardin, et. al., 1979
[2] Wetland types not listed have no direct impact

The direct impact to each function and value, including both principal and secondary, is listed in Table 5-42. It is important to note that each wetland area exhibits more than one function or value; therefore, these areas cannot be summed to reflect the total wetland impact of the preferred alternative. For example, Wetland PD-2B would have a direct impact of 0.01 ha (0.02 ac), however, this wetland has 13 functions; therefore 0.01 ha (0.02 ac) would apply to each of the 13 functions and values.

Like the other new location build alternatives, the function most impacted by the preferred alternative is wildlife habitat. It was estimated that 4.43 ha. (10.93 ac.) would be affected where it is a principal function and 2.3 ha. (5.67

ac.) would be affected where it is a secondary function. Wetlands with a primary or secondary function of groundwater recharge/discharge would comprise the second largest impact, with impacts to 3.24 ha. (8.0 ac.) as a principal function and 2.84 ha. (7.02 ac.) impacted as a secondary function.

TABLE 5-42
DIRECT IMPACTS TO PRINCIPAL AND SECONDARY WETLAND FUNCTIONS AND VALUES – PREFERRED ALTERNATIVE $E_{(4)}$M-V3

WETLAND FUNCTION / VALUE	IMPACTED AREA [1]	
	HECTARES	ACRES
Groundwater recharge / discharge	6.08	15.02
Flood flow	2.1	5.18
Fish and Shellfish	1.4	3.45
Sediment / toxicant retention	2.68	6.61
Nutrient removal / transformation	4.55	11.23
Production export	3.28	8.09
Shoreline stabilization	2.82	6.97
Wildlife habitat	6.7	16.6
Recreation	0.53	1.3
Education	0.02	0.05
Uniqueness/heritage	0.48	1.18
Visual / aesthetics	0.4	0.99
Endangered species habitat	0.47	1.17
Other	0	0

(1)Wetlands may have more than one function or value; therefore these areas cannot be summed to reflect the total wetland impact for the preferred alternative

Temporary direct impacts to wetlands would occur during construction activities. These impacts would result from a variety of activities such as cutting of vegetation, disturbance of wetland soils by machinery, temporary diversion of watercourses, dewatering of work areas within wetland boundaries, discharge of dewatering flows, construction of temporary bridging, installation of erosion and sedimentation controls, temporary increases in water temperature and turbidity, and installation of sheet piling.

Cutting of wetland vegetation would be required for construction of temporary access roads and clear zones. Temporary disturbance of wetland soils would occur in access areas where construction equipment would have no upland access alternative. Installation of sedimentation and erosion controls would generally be located in upland areas, however, some erosion and sedimentation controls would need to be located within wetlands, such as sheet piles, temporary diversion dams, and filter fence. In the vicinity of bridge locations along the alignment, temporary construction roads would need to be built to access bridge pier and abutment areas.

Indirect Impacts: Wetland hydrology would be impacted where the preferred alternative crosses wetlands within the corridor. The installation of culverts at wetland crossings would not only potentially impact low flow rates, but also storm event flows. Any storm events greater than the design year would be detained upstream of the roadway, thereby affecting normal flows upstream and downstream of the roadway. Flows downstream of the roadway would be less than existing conditions, and flows would be greater upstream of the roadway.

In some situations, construction of the roadway could alter hydrology within portions of a wetland system. The compact nature of roadway fill material does not typically allow rapid groundwater movement, therefore, hydrologic inflow or outflow within the system could change. Changes in the characteristics of adjacent wetlands would be most likely to occur in cut slopes where the roadway elevation would be lower than the wetland surface elevation.

Under the preferred alternative, ten new bridges or additional bridge spans were added to the concept plan that were not included under the DEIS $E_{(4)}$ alternative. This addition was for the primary purpose of avoiding and minimizing impacts to wetlands. Due to the minimized cross-section of the roadway, bridges in the DEIS $E_{(4)}$ alternative were reduced from double bridges (one for each northbound and southbound lane) to single bridges (northbound and southbound lane on one bridge). Also, spans were added to many of these bridges to reduce impacts to wetlands from bridge abutments. Nevertheless, bridge piers would be located, in most cases, within wetlands. The pier would sometimes be located within a watercourse, such as the Shingle Mill Brook crossing. These piers would have direct impacts to the wetland; however, they would also have indirect impacts to some extent. In these areas, the pier would affect the hydrology of the watercourse, especially during storm events. Piers will be designed to minimize disturbance to the hydrological characteristics of the watercourse, while providing effective scour proofing at the pier footing. The bridges proposed over wetlands PD-1, PD-2B, PD-3A, PD-4A, and PD-13 would likely affect the watercourses below them due to pier impacts on surface hydrology.

Short sections of watercourses would be channelized at the inlets and outlets of culverts installed under roadways. Channelized watercourses tend to have high water velocities due to loss of stream meanders and roughness, thereby exacerbating and accelerating bank and channel erosion. Channelized streams also tend to have reduced aquatic habitat characteristics.

Stormwater impacts due to sedimentation and other constituents of concern were discussed in Section 5.5.3 and 5.5.4. Potential invasive species impacts to wetlands were discussed in Section 5.4.1.3.

Three notable wetlands would be impacted by the preferred alternative: Shingle Mill Brook, Grassy Hill wet meadow, and Latimer Brook. Each wetland would be impacted in one area. The $E_{(4)}$m-V3 alternative would cross the Shingle Mill Brook area at its narrowest point, utilizing a natural peninsula of upland. Also, the brook would be bridged over the wetland, thereby confining impacts to only the vicinity of the pier. The Grassy Hill wet meadow would also be impacted by this alternative. This area, located between Grassy Hill Road and Latimer Brook, would be impacted only to construct a bridge pier for crossing Latimer Brook. This would impact only a small portion of the wetland and would not greatly diminish its functional value. This alternative would also impact the eastern edge of the Latimer Brook system, north of Route 161; however, because the roadway would impact only the edge of this system with no direct impacts to Latimer Brook, the functional integrity of the system would generally remain intact. In addition, many of the wetland areas in this system would be bridged, further reducing impacts.

Of the 37 seasonal pools inventoried, four pools would be directly impacted. Portions of SP-14, SP-21, and SP-24 would be directly impacted, whereas all of SP-25 (0.50 ac) would be lost. This represents a total loss of approximately 0.23 ha. (0.58 ac.) of seasonal pool habitat, or 11.2% of the total seasonal pool area within the surveyed corridor. This direct impact, 0.23 ha. (0.58 ac.) is included in the overall direct wetland impact of 6.7 ha. (16.6 ac.). A summary of the direct (pool area) impact is summarized in Tables 5-43.

TABLE 5-43
DIRECT IMPACTS TO SEASONAL POOLS
PREFERRED ALTERNATIVE $E_{(4)}$m-V3

SEASONAL POOL[1]	POOL SIZE (AC)	DIRECT IMPACT TO SEASONAL POOL	
		ha	ac
SP-14	1.00	0.003	0.006
SP-21	0.05	0.002	0.004
SP-24	0.27	0.030	0.074
SP-25	0.50	0.204	0.50
Total	**1.82**	**0.24**	**0.58**

[1] Seasonal pool numbering system from *Seasonal Pool Inventory and Evaluation Report* (2006)

Twenty-eight pools would be indirectly impacted through the loss of upland habitat area. The preferred alternative would impact the critical terrestrial habitat

(100-750 ft.) of all 28 pools, totaling 80.1 ha. (198.4 ac.). Of the 28 pools, the roadway would impact the pool envelope (pool edge to 100 ft.) of 7 pools, totaling 2.5 ha. (6.18 ac.).

5.6.3 IMPACT MINIMIZATION

In the early stages of alternatives development, avoidance of wetland areas was a primary consideration. The F and G alternatives under study were suggested by the resource agencies to avoid/minimize wetland impacts and have been aligned to attempt to avoid major wetland areas within the corridor. Nevertheless, some wetland areas would still be impacted. These impacts are considered unavoidable within the context of striving to fulfill the project purposes and corridor-wide transportation objectives and balanced against the need to avoid or minimize impact to other sensitive environmental, historical, and community resources as well.

The general minimization techniques that were used to develop the alignment concepts were revisited and applied to the LEDPA to further reduce the area of impacted wetlands. Following selection of the LEDPA, more detailed site information was developed, including field delineated wetlands. Minimization techniques would include:

- Minor geometric adjustments to shift the alignments to avoid wetland areas;
- Increasing the steepness of slopes along the edge of the roadway, where appropriate, within wetland areas to decrease the impacted area;
- Securing a design exception/modification of AASHTO standards in extreme situations to reduce the footprint of the roadway; and
- Use of additional and/or longer bridges in the roadway design, where warranted, to further reduce impacts to wetland areas.

Minor shifting of the alignments which already are impacting a particular wetland area could reduce impacts to the portion of the wetland with higher functions and values, although it may not decrease the actual area of impact. Steeper side slopes along the roadway within wetland areas reduce the area of impact by reducing the footprint of the overall roadway. It may also have an effect similar to avoidance in that portions of the wetland with higher functions and values may be impacted less.

The $E_{(4)}$m-V3 alternative maintained the basic $E_{(4)}$ alignment, but it was modified to reduce the width of the roadway cross section, thereby minimizing impacts to wetlands. This was largely accomplished by reducing the median width between the northbound and southbound lanes and separating the directions of travel with a concrete barrier. In addition, the conceptual plan for $E_{(4)}$m called for constructing additional bridges or bridge spans to minimize impacts to wetlands where crossings were unavoidable. Also, the $E_{(4)}$m-V3 alternative was modified again from the basic $E_{(4)}$ alignment by shifting a portion of the alignment to reduce impacts to aquatic resources and a large habitat block (Habitat Block No. 2).

Although the preferred alternative was realigned in its southern portion to reduce impacts to Habitat Block No. 2, the realignment was designed in such a way as to avoid and minimize impacts to wetlands within and adjacent to the new section of the alignment.

Under the preferred alternative, ten new bridges or additional bridge spans were added to the concept plan that were not included under the $E_{(4)}$ alternative. This addition was for the primary purpose of avoiding and minimizing impacts to wetlands. A bridge over Oil Mill Brook eliminates approximately 85 m. (280 ft.) of culvert. Due to the minimized cross-section of the roadway, bridges in the $E_{(4)}$ alternative were reduced from double bridges (one for each northbound and southbound lane) to single bridges (northbound and southbound lane on one bridge). Also, spans were added to many of these bridges to reduce impacts to wetlands from bridge abutments.

Applying these impact minimization measures to the roadway design will assure that the "devastating" and "irreversible" impact predicted by the EPA during their public hearing statement on April 7, 1999 would not transpire (See Comments and Responses section). The testimony provided by Drs. Niering and Goodwin (comment letter April 26, 1999) provides evidence to the contrary for the built portions of Route 11. This evidence is quoted or paraphrased as follows:

- "Beaver activity adjacent to the completed portion of Route 11 had created over 60 ac. of high quality wetlands over the past decades since the road was built, far more than the wetlands impacted in the proposed completion of the road [Route 11]".

- The beaver activity that has occurred uninterrupted along the built portions of Route 11 has helped to improve the biodiversity of the East Branch of the Eight Mile River

- Despite the fact that Route 11 traverses the East Branch of the Eight Mile River, the river has been found to have excellent water quality. Recent studies done for the Eight Mile River Watershed Project have documented the excellent water quality in both upstream and downstream reaches of the river from Route 11.

- The excellent water quality of the East Branch of the Eight Mile River has prompted DEP to consider the feasibility of restoring anadromous fish runs on this drainage.

- Largely due to conservation easements and the return of beaver activity, fauna formerly absent from the area due to impacts from former land use (e.g., agriculture) have since returned to conserved land along the built portion of Route 11, including river otter, mink, Hooded Mergansers, Black Duck, and rails.

The ability of beavers to create high value wetland systems is exemplified within the project area at the Shingle Mill Brook crossing. Repeated beaver flooding along this drainage has contributed significantly to the areal extent of the impounded waters along this drainage. Vegetation changes in response to this beaver created wetland are apparent as portions of the palustrine and upland forest covers have changed to interspersed scrub-shrub, emergent or open water zones. Standing dead wood has increased from flooded upland trees creating suitable nesting sites, roosting sites, or both for Great Blue Heron, Wood Duck, raptors, and woodpeckers, as well as Tree Swallow, Eastern Bluebird, and other cavity nesting passerines.

5.6.4 Mitigation Measures

Given the degree of impact associated with any of the build alternatives, a comprehensive short-term and long-term mitigation program will be necessary to offset physical and functional loss of wetlands. Mitigation measures could include a number of practices and methods to reduce temporary and permanent impacts to wetland areas within the corridor. An intensive and comprehensive mitigation program would be necessary during construction of any of the roadway alignment alternatives to stabilize disturbed areas and prevent pollution of wetlands by sedimentation. Also, long-term mitigation is needed to ensure maintenance of fully functional wetland systems in the corridor. A framework for mitigation and compensation of direct and indirect wetland impacts was developed by the interagency working group. It will serve as a guide for the preparation of a comprehensive mitigation plan to be undertaken during the design and permitting phase of the project. The Mitigation and Compensation Framework is provided in Appendix C.

The roadway would be designed utilizing effective grading and planting plans that would serve to minimize sedimentation and erosion of soils and maximize pollutant renovation. Where feasible, runoff could be directed to gently-graded slopes and grassed swales in non-wetland areas; appropriate vegetation would be specified for those areas, based on site-specific conditions such as expected moisture content, water velocity, aspect to sunlight, and whether or not the area will be maintained.

Typical mitigation measures that may be included as part of a specified mitigation program for any of the Route 82/85/11 options could include:

- BMPs - installation and diligent long-term maintenance of erosion and sediment controls measures before, during, and after construction activities to reduce introduction of pollutants to wetland areas (BMPs and stormwater system design are discussed in greater detail in Section 5.5);
- Design of a stormwater system which utilizes mitigative structures such as deep catch basins, oil/water separators, detention basins, and treatment areas such as grass swales and created wetlands;

- Roadway design which incorporates grading and planting regimes which discourage erosion and sedimentation of disturbed areas;
- Utilization of appropriate roadway structures such as culverts and bridges to reduce impacts to rivers and assure proper hydrology;
- Stormwater system designs which mitigate impacts from toxic liquid spills within watershed areas;
- Stormwater system designs which avoid or mitigate for direct discharge to high value wetlands; and
- Construction of wetland areas to compensate for wetland acres lost and functions and values lost resulting from road construction.
- Construction of seasonal pool areas to compensate for seasonal pools impacted as a result of road construction.

The incorporation of design considerations that allow a more permeable roadway conducive for migrating fauna, especially lower mobility fauna such as herpetofauna associated with seasonal pools (i.e. anurans, caudates, chelonids), would also be incorporated into the roadway design. Passageways or oversized culverts under raised roadways would be installed to facilitate movement of herpetofauna from seasonal pools to and from other resource areas. The incorporation of oversize bridges over large wetlands and stream corridors would also allow unimpeded passage of these animals. Techniques not currently incorporated in the concept design, but to be considered in the design and permitting phase, are low angle versus perpendicular and steep-angle curbing to allow herpetofauna to climb up off of the road surface onto the road shoulder. Also to be considered are short-height retaining walls, which would discourage herpetofauna from crossing the roadway at certain points, and would direct these animals to under-road culverts for safe crossing.

5.6.4.1 *Compensatory Mitigation/Constructed Wetlands*: Compensatory mitigation includes wetland establishment, restoration, enhancement, and protection and maintenance (ACOE, 2002). Once the avoidance and minimization techniques have been exhausted, and all other types of mitigation have been utilized to prevent temporary, direct and indirect impacts to wetlands, the unavoidable impacts which do occur must be compensated for according to federal and state guidance. Each of the alternatives would have different and unique unavoidable impacts in terms of the total area of impact, the types of wetlands impacted and the functions and values of those wetlands. The object of compensatory mitigation is to replace functions and values lost on an in-kind basis and at an equal or greater ratio of area. Therefore, the intended functions and values of the constructed wetlands would be tailored to offset specific impacts associated with the LEDPA. As a result, the preferred alternative would require wetland compensation with a heavy emphasis on wildlife habitat, groundwater discharge/recharge, sediment/toxicant retention, and sediment/shoreline stabilization.

Establishment: Establishment of wetlands consists of the construction of functioning wetland areas in existing upland areas through the manipulation of the physical, chemical and biological characteristics of the site. Important considerations include, but are not limited to: soil type, topography, hydrology, biological characteristics, and ownership. Generally, upland areas are excavated to the appropriate depth to modify the soil surface/groundwater relationship. Under these conditions, hydric soil conditions would form, in which hydrophitic vegetation could be planted and would successfully grow. Soils are also amended with organic materials to increase organic matter content. Many times, microtopography and/or small upland areas are integrated into the design to improve habitat value, especially if the end result is a palustrine forested wetland.

Restoration: Restoration of wetlands can include either re-establishment or rehabilitation of wetland areas which have been directly or indirectly degraded by historic human activities. The goal is to return impacted wetland functions or values by modifications to the physical, chemical or biological environment in the wetland. Wetland re-establishment results in a gain in wetland acreage, while rehabilitation does not result in additional wetland acreage. An example of wetland re-establishment would be the removal of fill material from a wetland area, and the re-establishment of that wetland through grading and planting techniques.

Enhancement: Enhancement consists of physical, chemical or biological modifications to existing wetland areas with the intent of improving specific functions or values. Modifications could include changes in the growth stage or composition of vegetation within the wetland or changes in hydrology. Enhancement can result in both increases and decreases of specific functions or values of the wetland. It does not result in a gain in wetland acres, only modification to particular wetland functions or values. No specific enhancement areas have been identified for the preferred alternative, however, enhancement may be practical in association with the proposed restoration and establishment sites.

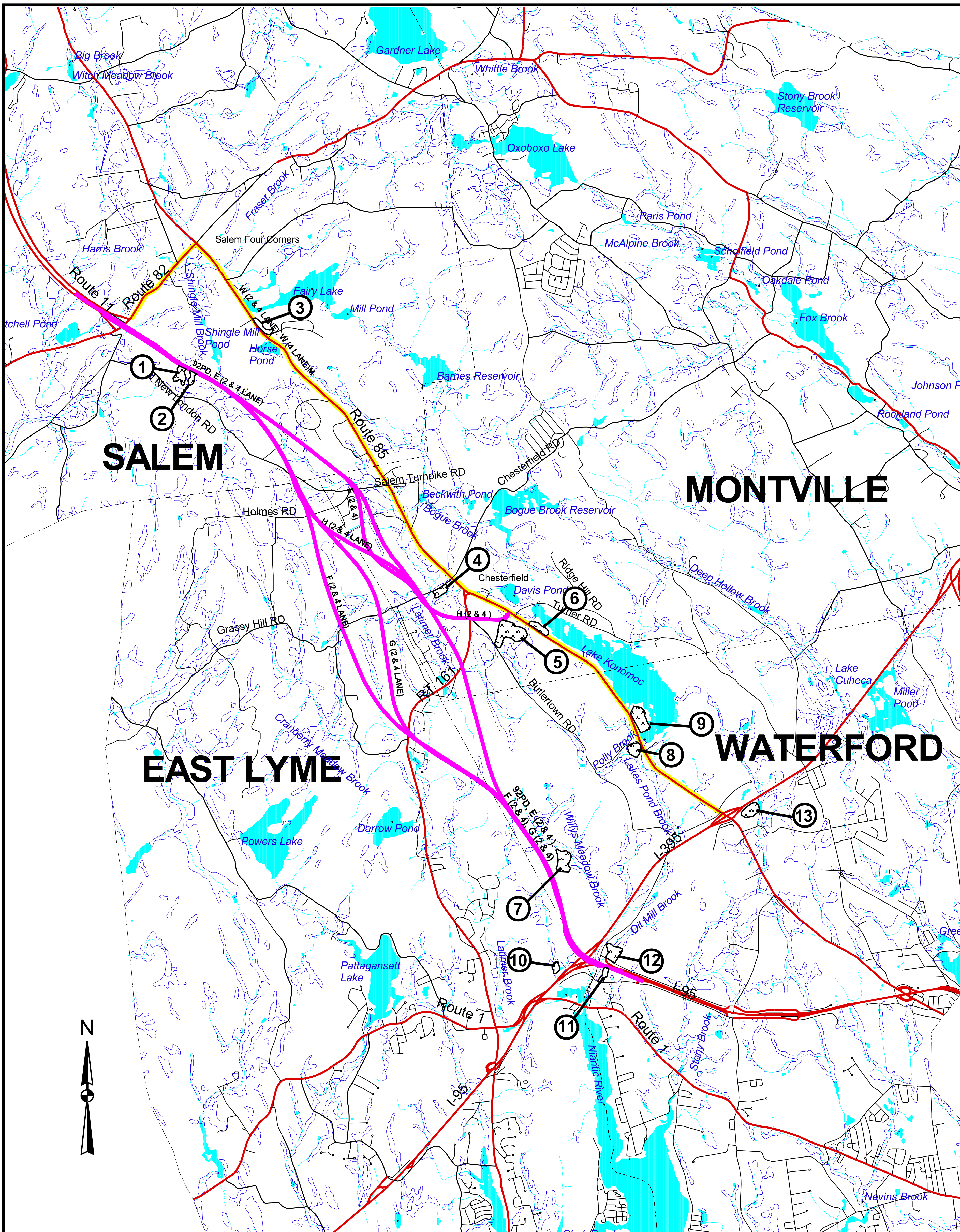
Wetland Protection and Maintenance: Protection and maintenance of wetland areas will include purchasing land or easements with existing wetlands, and preserving the land through various mechanisms. Maintenance measures may be warranted in some areas to maintain wetland integrity. This technique, in conjunction with the wetland mitigation techniques above, would help create and/or maintain wetland linkage through undeveloped corridors.

Establishment of seasonal pools would mitigate losses of these areas as a result of the roadway construction. Paramount in seasonal pool design would be creation of adequate hydrology to sustain the pool community, adequate surrounding upland habitat, appropriate vegetation, structural components (e.g. woody debris, boulders, etc.), and organic soils (donor soils if possible). The full range of variability in physical parameters (i.e., depth and size of pools) and ecological diversity in natural pool complexes would be considered in design details as habitat diversity and variation will help to enhance the pool's ability to buffer against climatic variability (Sutter and Francisco, 1998). Attention to microhabitat variability would increase the functions and values of the newly constructed seasonal pool habitat.

Re-establishment of seasonal pools would consist of improvements to pools previously impacted by human activities. Historical human activities such as direct filling of existing seasonal pools, clearing of vegetation within or in the upland habitat areas of existing seasonal pools, introduction of invasive plant species, and introduction of untreated stormwater inputs to seasonal pools are all forms of previous impact. Enhancement of existing seasonal pools could include amendment of soils within the pool, addition of wood debris in the pool, or modifications to vegetation in the pool or its surrounding upland habitat area.

5.6.4.2 *Potential Mitigation Sites*: Several candidate sites were identified and evaluated during corridor wetland investigations to determine their viability as wetland creation sites. As a result, thirteen potential mitigation sites have been identified within the corridor to compensate for unavoidable wetland impacts (see Figure 5-17). These areas were initially identified based on review of topographic mapping, NRCS soil mapping and field investigation. Topographic mapping was used to identify areas considered to be suitable for wetland creation. Areas with level or slightly sloped topography were considered to be superior sites to those with steep slopes. Flat areas generally provide better hydrologic conditions and ease of construction for wetland areas. Mitigation sites were generally identified in areas adjacent to existing wetlands, since favorable hydrologic conditions are expected to be present and more predictable in those areas.

Potential wetland creation sites should be located based on factors and characteristics such as ownership, topography, geology, hydrology, soils, climate and weather, biological characteristics, and federal and state regulations (Hammer, 1992). Some of the sites identified are located on ConnDOT-owned land while others are located on watershed lands and private land. Climate and weather will have more importance during the design specification phase of the process, as all of the potential sites have very similar climatic features. Biological characteristics of potential compensation sites are important since areas which have existing populations of invasive species should be avoided if possible. Also, the existing biological composition of wetlands in the vicinity of a particular site may give insight as



LEGEND

- Potential Wetland Mitigation Sites
- Expressway Alternatives
- RT 82/85 Widening/Upgrade Alternatives
- Wetlands
- Waterbodies and Streams

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82/85/11

ENVIRONMENTAL IMPACT STATEMENT (EIS)

IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

STATE PROJECT #120-81

POTENTIAL WETLAND MITIGATION SITES

Notes:

Sources:
Hydrology: CTDEP Natural Resources Center GIS Database 1994

3000 0 3000 6000 Feet

500 0 500 1000 Meters

July 1998

Figure 5-17

to which species grow best under localized site conditions. Table 5-44 summarizes the potential wetland mitigation areas.

TABLE 5-44
SUMMARY OF POTENTIAL WETLAND MITIGATION SITES

SITE ID NUMBER	SIZE[1]	OWNERSHIP	SITE DESCRIPTION	FLOOD FLOW COMPENSATION[2]
1	1.5 ha. (3.6 ac.)	Private	Upland forest area associated with existing forested wetlands; wetland creation	No
2	1 ha. (2.5 ac.)	Private	Upland forest area associated with existing forested wetlands; wetland creation	No
3	3.6 ha. (9 ac.)	Municipal[3]/ Private	Forested upland and wetland area; wetland creation and enhancement	No
4	2.7 ha. (6.6 ac.)	State/Private	Flat, non-forested upland area associated with Latimer Brook wetland system; wetland creation	Yes
5	15 ha. (36 ac.)	Private	Forest and field upland area located adjacent to existing hilltop wetlands; wetland creation	No
6	4 ha. (10 ac.)	Municipal	Forested upland area located on watershed lands; wetland creation	No
7	6 ha. (15 ac.)	Private	Forested upland area associated with large wetland system; wetland creation	Yes
8	5.7 ha. (14 ac.)	Municipal	Non-forested gravel pit area adjacent to existing wetlands; wetland creation	Yes
9	11 ha. (28 ac.)	Municipal	Flat, non-forested upland area located on watershed lands; wetland creation	No
10	1.4 ha. (3.5 ac.)	Private	Sandy, non-forested upland area located between two wetland systems; wetland creation	No
11	1.2 ha. (2.9 ac.)	Private	Forested upland area located between two existing wetlands; wetland creation	No
12	4.9 ha. (12 ac.)	Private	Flat, old upland field area located adjacent to existing wetland system; wetland creation and enhancement	No
13	6.5 ha. (16 ac.)	Private	Upland and wetland agriculture field adjacent to larger wetland area; wetland creation and enhancement	Yes

(1) Areas of potential mitigation sites are the largest practicable, based on limited site investigation
(2) Is the wetland mitigation area located adjacent to the 100-yr floodplain and will it have the potential for floodflow compensation
(3) Municipal areas are all water supply watershed lands owned by the City of New London Water Department and mansged by PSGNLU

Since the previous studies for the Route 82/85/11 corridor did not identify or study mitigation sites, there is no data available for groundwater elevations, etc. of these potential sites. The NRCS Soil Survey, however, does provide average high water table data which, when used with soil mapping, can be used as an additional guideline for mitigation site identification. Generally, soil types, which are moderately well drained or well drained, have higher annual water tables than faster draining soil types. Areas of moderately well drained soils generally make good wetland mitigation sites since they have higher water tables, are quite flat, contain some hydrophytic vegetation seed stock, and have similar soil characteristics as wetland soils.

During the mitigation planning efforts of the Route 11 working group (see Section 7), these potential mitigation sites were further screened based on criteria such as size, soil type, ownership, and cover type. Four sites, listed in Table 5-45, were selected for further study during the preparation of the 2003 Draft Statement of Wetland and Wildlife Habitat Blocks Impacts and Compensation Plan (refer to Section 5.4). These and other sites will be evaluated further during the preparation of the comprehensive mitigation plan during the design and permitting phase of this project. The mitigation plan will be developed as outlined in the Mitigation and Compensation Framework (Appendix C).

TABLE 5-45
SELECTED WETLAND MITIGATION STUDY SITES

SITE	DESCRIPTION
Route 161 vicinity	Establishment of 4.7 ha. (11.6 ac.) of palustrine wetland. Private land; former gravel pit, mining area, site M3. Mitigation site will provide compensation for principal functions and values directly impacted by preferred alternative.
Route 161 vicinity	Establishment of 2.0 ha. (5.0 ac.) of palustrine wetland. Private land; active hayfield, site M4. Mitigation sites will provide compensation for principal functions and values directly impacted by preferred alternative.
Latimer Brook at I-95	Rehabilitation of 965 linear m. by 4.6 m. wide (3,165 linear ft. by 15 ft.) of streambank along Latimer Brook, site M5. Private and State of Connecticut right-of-way land; eroded banks and exposed soils with brushy vegetation. Equivalent to 0.4 ha (1.1 ac) of replacement for direct impact to fish habitat function and shoreline stabilization function.
Latimer Brook at I-95	Replace existing fish ladder at Latimer Brook dam; improve fish passage within Latimer Brook I-95 culvert, site M6. State of Connecticut right-of-way land. Provides additional fish habitat mitigation for Latimer Brook watershed.
Total	Total establishment of 6.7 ha. (16.6 ac.) of palustrine wetland to provide compensation for principal functions and values directly impacted by preferred alternative. Additional .4 ha. (1.1 ac.) streambank restoration to compensate fish habitat and shoreline stabilization not compensated in 16.6 ac. establishment areas.

Potential sites for seasonal pool mitigation occur throughout the corridor. Since most seasonal pools in the corridor are relatively small, these establishment sites would be sited near the locations of existing seasonal pool impact areas. In this way, existing populations of herpetofauna and other species utilizing the impacted pool would have a new pool to use after roadway construction. Seasonal pool establishment areas would be sited in areas with sufficient undisturbed surrounding upland habitat (i.e. forest or woodland). Seasonal pool establishment sites would be sited in large catchment areas to increase water depth and prolong flooding (Payne, 1992).

5.6.4.3 *Functional Replacement*: The wetland mitigation areas will be designed to replace in-kind functions, where feasible, of wetland functions and values lost resulting from impacts of the preferred alternative. It is apparent through the wetland functions and values assessment that the principal function with the greatest impact for all the build alternatives is wildlife habitat. The principal function with the second greatest impact would be groundwater recharge/discharge, although most sites within the corridor are discharge areas. Other common functions which would be impacted are floodflow alteration, fish habitat, sediment/toxicant retention, nutrient removal, shoreline stabilization, and production export. Wetland creation areas can be designed to replace each of the 13 functions and values described under the ACOE Methodology (ACOE 1995). Many of these functions can be replaced within a single wetland creation site. For example, wildlife habitat and floodflow alteration functions can easily be replaced by a single, properly designed constructed wetland area.

The wetland type with the greatest impact for all build alternatives would be forested wetlands; most of these areas are red maple swamps. The wetland type with the second highest impacts is riverine wetlands, which in this corridor are usually associated with forested wetlands. For the preferred alternative, the second highest impact is to palustrine forested/scrub-shrub wetlands. Other wetland types such as scrub/shrub, emergent and open water wetlands would also be impacted. In-kind replacement of these wetland types would be desirable in a mitigation plan. Based on the types of wetlands impacted and the functions and values impacted by the proposed alternatives, forested wetlands with wildlife habitat functions would constitute the majority of wetland compensation sites.

Specific functional replacement requirements for the preferred alternative will include mitigation and compensation for seasonal pools directly and indirectly impacted by the roadway.

5.6.4.4 *Long-Term Maintenance Measures*: Long-term maintenance of the roadway stormwater system is an important aspect of post-construction protection of wetland areas. Routine cleaning of sediment and debris from catch basin sumps, pipe openings of culverts, catch basin grates, drainage ditches, and sedimentation ponds, on a regularly-scheduled basis, helps keep the system functioning. A functioning system will continue to remove sediment and suspended particulate matter, as well as other pollutants from stormwater.

Long-term monitoring of wetland compensation sites assures that these areas continue to function as designed. Hydrology, soils, and especially vegetation diversity, density, and survivorship are documented to assure a healthy wetland system. If invasive vegetative species are discovered within a wetland area, these species are removed or destroyed per specific remediation plans built into the mitigation plan. If any aspect of the mitigation site does not meet the criteria of a successful mitigation site, the contractor may be recalled to the site to rectify the problem. Generally, monitoring of wetland compensation sites is on-going for 5 years, with yearly progress report submittals to the regulatory agencies. Provisions are included in the Mitigation and Compensation Framework for the preparation of a site monitoring and assessment plan.

5.7 FLOODPLAINS AND FLOODWAYS

5.7.1 FLOODPLAIN IMPACTS

Construction associated with any of the roadway alternatives, including preferred alternative $E_{(4)}$m-V3, would impact floodplain areas by encroaching upon the storage area for floodwaters. Increased flood heights and increased downstream flooding could result from a loss of flood storage capacity. The floodplain areas impacted by the construction of the roadway alternatives are shown on Table 5-46 and in Figure 4-27. The size of the impact area for each of the roadway alternatives on floodplain was determined from FEMA mapping. The FIRM maps identify areas subject to flooding. The roadway alternatives were overlaid on these maps to determine floodplain impacts.

Most of the roadway alternatives will impact floodplain areas to some degree. These impacts are not, as discrete impacts, considered serious; the floodplain areas are small in size, and mitigation measures would be used to compensate for the minimal loss of flood storage areas. However, the cumulative effect of incremental losses in flood storage area should be examined as part of subsequent hydrologic analyses undertaken during the project design phase.

TABLE 5-46
IMPACTS TO DESIGNATED FLOODPLAINS BY ALTERNATIVE

ALTERNATIVE	AREA	
	HECTARES	ACRES
No build	N/I	N/I
$W_{(4)}$	1.6	3.9
$W_{(4)}$m	1.1	2.7
$W_{(2)}$	1.0	2.4
TSM	0.2	0.5
TDM/transit	N/I	N/I
92PD	2.7	6.6
$E_{(4)}$	2.3	5.6
$E_{(2)}$	1.2	3.0
$F_{(4)}$	1.8	4.5
$F_{(2)}$	0.7	1.6
$G_{(4)}$	2.3	5.8
$G_{(2)}$	1.0	2.4
$H_{(4)}$	1.2	3.0
$H_{(2)}$	0.6	1.5
$E_{(4)}$m-V3	1.17	2.9

N/I = No impact or negligible impact

5.7.2 *Mitigation Measures*: Compensatory flood storage areas would be designated, as necessary, to balance the loss and would be constructed on the outside edges of the roadway. This would be accomplished by excavating beyond the existing edge of the floodplain or by excavating within the floodplain to increase the depth of the storage area. In all cases the compensatory storage would be located in the same reach of the same waterways as the affected floodplain. Compensatory storage area would be provided in conjunction with the wetland mitigation compensatory area, as appropriate. Any excavation of compensatory flood storage area within existing floodplain soils would produce additional wetland impacts since floodplain soils are defined as wetlands in Connecticut.

5.8 LAND USE AND COMMUNITY CHARACTERISTICS

Although quantitative data presented herein (e.g. property values and tax rates) may have changed since the draft of this document was originally published, the relative comparison among alternatives is still valid. Updated information is provided for the assessment of the preferred alternative.

An analysis of the indirect impacts related to induced growth and changes in land use is provided in Section 5.18.

5.8.1 TRANSPORTATION IMPROVEMENT IMPACTS UPON PATTERNS OF DEVELOPMENT

Potential advantages may be anticipated with transportation corridor improvements. Improved roadway access provided by completion of the Route 11 corridor with respect to increased volume capacity and speed will result in decreased travel time to destinations within and outside the region. Beneficiaries of travel timesavings include private and commercial vehicles as well as response times for public emergency, ambulance, fire and police services.

Improved safety conditions, as the result of improved roadway geometry and more efficient distribution of traffic volumes, may reduce the accident rate. Reduced accident rates translate to a reduction in expenditures associates with accident cost; e.g., personal (injury/fatality), medical, property damage, vehicle repair, and all costs related to the insurance industry. The efficient distribution of traffic burden throughout a community also improves the movement of goods and services, while promoting increased safety for pedestrian movements as well as vehicles, and becomes an integral part of the local aesthetic. Transportation improvements also increase opportunities for development of services like commuter lots and public transit related to limited access highways adding conveniences for local users.

Potential disadvantages may also occur with selected transportation improvements. Changes in transportation patterns can cause rerouting of high volume traffic such that businesses experience diminished patronage. Transportation improvements that create physical barriers (large earth cuts and fills) tend to inhibit road and utility expansion.

5.8.2 COMMUNITY GOALS AND NEIGHBORHOOD COHESION

5.8.2.1 *Community Goals*: While there are variations in syntax, the goals expressed by each of the corridor towns, Salem, Montville, East Lyme and Waterford, in their respective Plans of Conservation and Development are fundamentally very similar. Transportation improvements may have potential positive - impacts on these community goals. Occasions for the towns to purchase unused state land takings could afford an opportunity to increase local open space. Improved access to the region is one of many factors including jobs, relative affordability, availability of land, quality of life and the ongoing population shift to suburban and rural areas that may increase housing demand. Proximity of land areas to high volume traffic corridors may create housing density options; i.e., higher density developments in close proximity and lower density developments away from the corridor. High volume transportation corridors may also provide immediate venues for commercial/business and industrial growth as well as demand for residential development in those areas serviced by the corridor.

In terms of potential negative impacts, improvements to existing roads and/or construction of new roads results in physical change to the original environment. The nature of that change may be subject to criticism based on the perception of its impact to traffic volume increases and physical alteration of the visual surroundings.

Concentrations of development tend to occur along high volume roadways and at points of access/egress to limited access highways. If this consequence is not a part of a general plan of development, the effect on a given community may be considered adverse.

5.8.2.2 *Neighborhood Cohesion*: Either the construction of a new highway on a new location or the widening of the existing Routes 82 and 85 have the potential to impact local neighborhood characteristics. Private property takings from developed areas as a result of transportation improvements have a greater potential to bisect or infringe upon the existing community structure and impact a larger population than would similar construction in undeveloped areas.

Widening of Routes 82 and 85 could impact local communities by creating a greater barrier to pedestrian, bicycle, and automobile traffic which presents a more dangerous arrangement for these modes of transportation to cross the road. In this way, the residential and commercial development located on opposite sides of the arterial may become isolated from each other in time. In addition, property taking necessary to widen the roadway would infringe upon front yards and, in some cases, take nearby dwellings or commercial establishments currently located in close proximity to the roadway. Such property taking may be perceived by local residents and business persons as an undesirable impact to the character of the community. The four-lane widening alternatives ($W_{(4)}$ and $W_{(4)}$m) would pose a greater adverse impact to neighborhood cohesion than the two-lane upgrade ($W_{(2)}$). Local concern for the possible community effects associated with widening the existing roadways has been clearly expressed by elected officials in the corridor communities.

In the case of a new, limited access expressway on new location, the highway would serve as a physical barrier to block movement from one neighborhood to another. Connections to nearby developments would be allowed only at specific locations along secondary roads where highway over- or underpasses are provided. Communities that may have had contact through abutting properties via foot paths would become isolated from each other, creating smaller, fragmented residential areas. The prospect of dividing an existing neighborhood with a new expressway would be considered a greater impact to the quality of life and sense of community enjoyed by residents than would fewer property takes along the edge of such a residential development that would directly impact a smaller, isolated area. All of these effects tend to be perceived negatively in that they may ultimately result in a reduction in property values.

The 92PD, $E_{(4)}$, $E_{(2)}$, and $E_{(4)}$m-V3 alternatives would have the effect of physically separating several existing subdivisions in Salem and Montville including the Daisy Hill Drive subdivision where approximately half of the residences would be affected. Although the F and G alignments would adversely impact residences on Fawn Run in Salem and in the vicinity of Holmes Road, Walnut Hill Road and Route 161 in East Lyme, the alternatives would traverse the less developed, west side of the corridor away from more intensely developed areas. Alternative G would also be located in close proximity to an additional subdivision on Cardinal Road in East Lyme. In addition, Alternatives F and G would affect a new church currently under construction on Route 161 in East Lyme that is viewed by many as a center of community activity; this taking would be an unfavorable and unacceptable impact to local neighborhood cohesion.

The partial build expressway alternatives would have impacts similar to the full build alternatives by adversely affecting residential areas in the northern part of the corridor as well as the impacts described for the widening alternatives south of the touchdown point on Route 85.

During the development of preferred alternative $E_{(4)}$m-V3, all possible measures for avoiding neighborhoods and community facilities were considered. The selection of the V3 alignment over the V1 alignment was done to avoid neighborhoods to the west (refer to Section 3.4.3) while still reducing natural resources impacts. The reduced roadway cross section places the roadway farther from neighborhoods in many areas.

5.8.3 PRIVATE PROPERTY IMPACTS (TAKINGS)

Takings impacts vary in both number and type, based on the nature of the transportation improvement considered. Widening generally requires an incremental taking along a corridor with established land uses that may not vary appreciably as a result of the taking action. While a widening can result in the taking of structures as well as land area and can also require earth cuts and fills, takings required to construct a new transportation corridor are typically more extensive in terms of overall impact. The following discussion of impacts to private property is based upon information gathered from town tax assessor's maps, aerial photographs, and limited field observation and represents an estimate of those impacts that would result from the various alternatives. Property impacts estimated for the preferred alternative are presented separately in Section 5.8.3.7.

Although implementation of a widening alternative would impact the greatest number of parcels in the corridor, the amount of land that would need to be acquired would be relatively small. In contrast, land acquisition requirements, in area, are considerably greater and variable for the new location alternatives. For land use discussion purposes, takings are differentiated to show the number and type of structural takings as well as residential and non-residential categories of acreage impacted on a corridor-wide basis (Table 5-47). Structure and acreage impacts are further detailed by municipality in Tables 5-48 through 5-52. Areas shown on the tables indicate the acreage that would be taken both as the minimum required for highway right-of-way purposes as well as from adjoining land that would be taken as a consequence of land-locking a parcel, leaving an unusable portion of land, or creating a lot that is non-conforming to local zoning regulations. Corridor area maps (Figures 5-18a through 5-18f) illustrate land acquisition areas by alternative in relation to local zoning.

5.8.3.1 *No Build Alternative*: Following the implementation of currently planned spot safety improvements to Route 85, no further modifications to the existing roadway system are anticipated. Routine maintenance activities would be confined to the existing right-of-way or dedicated easements. Therefore, no property taking would result from the no build scenario.

5.8.3.2 *Route 82 and 85 Widening Alternatives*: Possible impacts resulting from the widening of the existing Routes 82 and 85 are varied. Adverse economic impacts associated with widening include the devaluation of property (especially residential) as the result of increased traffic volumes and front yard property takes and the associated incremental loss of taxable private properties

TABLE 5-47
SUMMARY OF PROPERTY TAKES BY LAND USE (ALL FOUR TOWNS)

ALTERNATIVE[1]	PARTIAL TAKES					COMPLETE TAKES					TOTAL NUMBER OF AFFECTED PARCELS
	TOTAL	DEVELOPED PARCELS			UNDEVELOPED PARCELS	TOTAL	DEVELOPED PARCELS			UNDEVELOPED PARCELS	
		RESIDENTIAL	COMMERCIAL/ INDUSTRIAL	OTHER[2]			RESIDENTIAL	COMMERCIAL/ INDUSTRIAL	OTHER[1]		
No Build	0	0	0	0	0	0	0	0	0	0	0
$W_{(4)}$	153	93	17	16	27	25	18	5	1	1	178
$W_{(4)}$m	135	79	17	15	24	21	15	5	0	1	156
$W_{(2)}$	118	72	17	11	18	10	9	1	0	0	128
TSM	12	3	7	1	1	3	2	1	0	0	15
TDM/Transit	0	0	0	0	0	0	0	0	0	0	0
92PD	51	19	5	0	27	51	31	5	1	14	102
$E_{(4)}$	52	18	5	0	29	41	18	5	1	17	93
$E_{(2)}$	26	5	0	0	21	21	12	0	1	8	47
$F_{(4)}$	47	10	5	4	28	47	24	5	1	17	94
$F_{(2)}$	31	6	0	4	21	24	14	0	1	9	55
$G_{(4)}$	48	8	5	2	33	59	34	5	1	19	107
$G_{(2)}$	29	4	0	2	23	35	23	0	1	11	64
$H_{(4)}$	57	17	7	12	21	25	20	2	1	2	82
$H_{(2)}$	47	14	6	9	18	17	14	0	1	2	64

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Land uses in this category include agricultural, institutional/public service, and water company lands.

TABLE 5-48
TOTAL PROPERTY IMPACT SUMMARY BY ALTERNATIVE (ALL FOUR TOWNS)

ALTERNATIVE[1]	NUMBER OF STRUCTURES POTENTIALLY AFFECTED					ESTIMATED LAND ACQUISITION AREAS		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL / COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND[2]
No Build	0	0	0	0	0	0	0	0
$W_{(4)}$	82	32	7	42	1	20.2 ha. (49.9 ac.)	12.5 ha. (30.8 ac.)	7.7 ha. (19.1 ac.)
$W_{(4)}$m	67	27	7	32	1	13.3 ha. (32.8 ac.)	7.6 ha. (18.8 ac.)	5.7 ha. (14.0 ac.)
$W_{(2)}$	44	17	3	24	0	7.8 ha. (19.3 ac.)	5.5 ha. (13.5 ac.)	2.3 ha. (5.8 ac.)
TSM	7	2	3	2	0	0.94 ha. (2.4 ac.)	0.04 ha. (0.1 ac.)	0.9 ha. (2.3 ac.)
TDM/Transit	0	0	0	0	0	0	0	0
92PD	81	31	16	34	0	274.5 ha. (678.3 ac.)	249.3 ha. (616.1 ac.)	25.2 ha. (62.2 ac.)
$E_{(4)}$	70	22	16	32	0	276.9 ha. (684.2 ac.)	251.7 ha. (622.0 ac.)	25.2 ha. (62.2 ac.)
$E_{(2)}$	33	13	0	20	0	234.6 ha. (579.6 ac.)	226.7 ha. (560.2 ac.)	7.9 ha. (19.4 ac.)
$F_{(4)}$	79	29	16	32	2	293.6 ha. (725.4 ac.)	245.0 ha. (605.4 ac.)	48.6 ha. (120.0 ac.)
$F_{(2)}$	33	16	0	15	2	252.6 ha. (624.1 ac.)	222.1 ha. (548.8 ac.)	30.5 ha. (75.3 ac.)
$G_{(4)}$	88	38	16	32	2	278.7 ha. (688.6 ac.)	230.1 ha. (568.6 ac.)	48.6 ha. (120.0 ac.)
$G_{(2)}$	42	24	0	16	2	204.9 ha. (506.3 ac.)	174.4 ha. (431.0 ac.)	30.5 ha. (75.3 ac.)
$H_{(4)}$	65	28	1	36	0	115.3 ha. (284.8 ac.)	106.3 ha. (262.6 ac.)	9.0 ha. (22.2 ac.)
$H_{(2)}$	45	20	0	25	0	90.5 ha. (223.5 ac.)	85.5ha. (211.2 ac.)	5.0 ha. (12.3 ac.)

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Includes land zoned for commercial, industrial, governmental, or special uses.

TABLE 5-49
PROPERTY IMPACT SUMMARY BY ALTERNATIVE - SALEM

ALTERNATIVE[1]	NUMBER OF STRUCTURES POTENTIALLY AFFECTED					ESTIMATED LAND ACQUISITION AREAS		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL / COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND[2]
No Build	0	0	0	0	0	0	0	0
$W_{(4)}$	13	6	3	4	0	6.6 ha. (16.2 ac.)	4.1 ha. (10.1 ac.)	2.5 ha. (6.1 ac.)
$W_{(4)}$m	13	6	3	4	0	4.3 ha. (10.7 ac.)	2.7 ha. (6.7 ac.)	1.6 ha. (4.0 ac.)
$W_{(2)}$	9	4	2	3	0	3.1 ha. (7.6 ac.)	1.9 ha. (4.7 ac.)	1.2 ha. (2.9 ac.)
TSM	2	0	2	0	0	0.5 ha. (1.2 ac.)	0	0.5 ha. (1.2 ac.)
TDM/Transit	0	0	0	0	0	0	0	0
92PD	0	0	0	0	0	2.8 ha. (7.0 ac.)	2.8 ha. (7.0 ac.)	0
$E_{(4)}$	0	0	0	0	0	2.8 ha. (7.0 ac.)	2.8 ha. (7.0 ac.)	0
$E_{(2)}$	0	0	0	0	0	0	0	0
$F_{(4)}$	11	6	0	5	0	37.6 ha. (93.0 ac.)	37.6 ha. (93.0 ac.)	0
$F_{(2)}$	10	5	0	5	0	34.2 ha. (84.4 ac.)	34.2 ha. (84.4 ac.)	0
$G_{(4)}$	11	6	0	5	0	37.6 ha. (93.0 ac.)	37.6 ha. (93.0 ac.)	0
$G_{(2)}$	10	5	0	5	0	34.2 ha. (84.4 ac.)	34.2 ha. (84.4 ac.)	0
$H_{(4)}$	11	6	0	5	0	37.6 ha. (93.0 ac.)	37.6 ha. (93.0 ac.)	0
$H_{(2)}$	10	5	0	5	0	34.2 ha. (84.4 ac.)	34.2 ha. (84.4 ac.)	0

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Includes land zoned for commercial, industrial, governmental, or special uses.

TABLE 5-50
PROPERTY IMPACT SUMMARY BY ALTERNATIVE - MONTVILLE

ALTERNATIVE[1]	NUMBER OF STRUCTURES POTENTIALLY AFFECTED					ESTIMATED LAND ACQUISITION AREAS		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL / COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND[2]
No Build	0	0	0	0	0	0	0	0
$W_{(4)}$	40	13	4	22	1	6.6 ha. (16.3 ac.)	2.8 ha. (6.9 ac.)	3.8 ha. (9.4 ac.)
$W_{(4)}$m	34	12	4	17	1	5.3 ha. (13.3 ac.)	2.3 ha. (5.8 ac.)	3.0 ha. (7.5 ac.)
$W_{(2)}$	16	5	1	10	0	2.4 ha. (6.0 ac.)	1.7 ha. (4.3 ac.)	0.7 ha. (1.7 ac.)
TSM	5	2	1	2	0	0.5 ha. (1.2 ac.)	0.04 ha. (0.1 ac.)	0.4 ha. (1.1 ac.)
TDM/Transit	0	0	0	0	0	0	0	0
92PD	48	23	0	25	0	101.7 ha. (251.4 ac.)	94.1 ha. (232.6 ac.)	7.6 ha. (18.8 ac.)
$E_{(4)}$	37	14	0	23	0	104.1 ha. (257.3 ac.)	96.5 ha. (238.5 ac.)	7.6 ha. (18.8 ac.)
$E_{(2)}$	31	13	0	18	0	93.4 ha. (230.7 ac.)	86.2 ha. (213.0 ac.)	7.2 ha. (17.7 ac.)
$F_{(4)}$	0	0	0	0	0	0	0	0
$F_{(2)}$	0	0	0	0	0	0	0	0
$G_{(4)}$	0	0	0	0	0	0	0	0
$G_{(2)}$	0	0	0	0	0	0	0	0
$H_{(4)}$	22	6	1	15	0	57.3 ha. (141.6 ac.)	49.8 ha. (123.0 ac.)	7.5 ha. (18.6 ac.)
$H_{(2)}$	13	4	0	9	0	45.0 ha. (111.1 ac.)	40.5 ha. (100.0 ac.)	4.5 ha. (11.1 ac.)

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Includes land zoned for commercial, industrial, governmental, or special uses.

TABLE 5-51
PROPERTY IMPACT SUMMARY BY ALTERNATIVE - WATERFORD

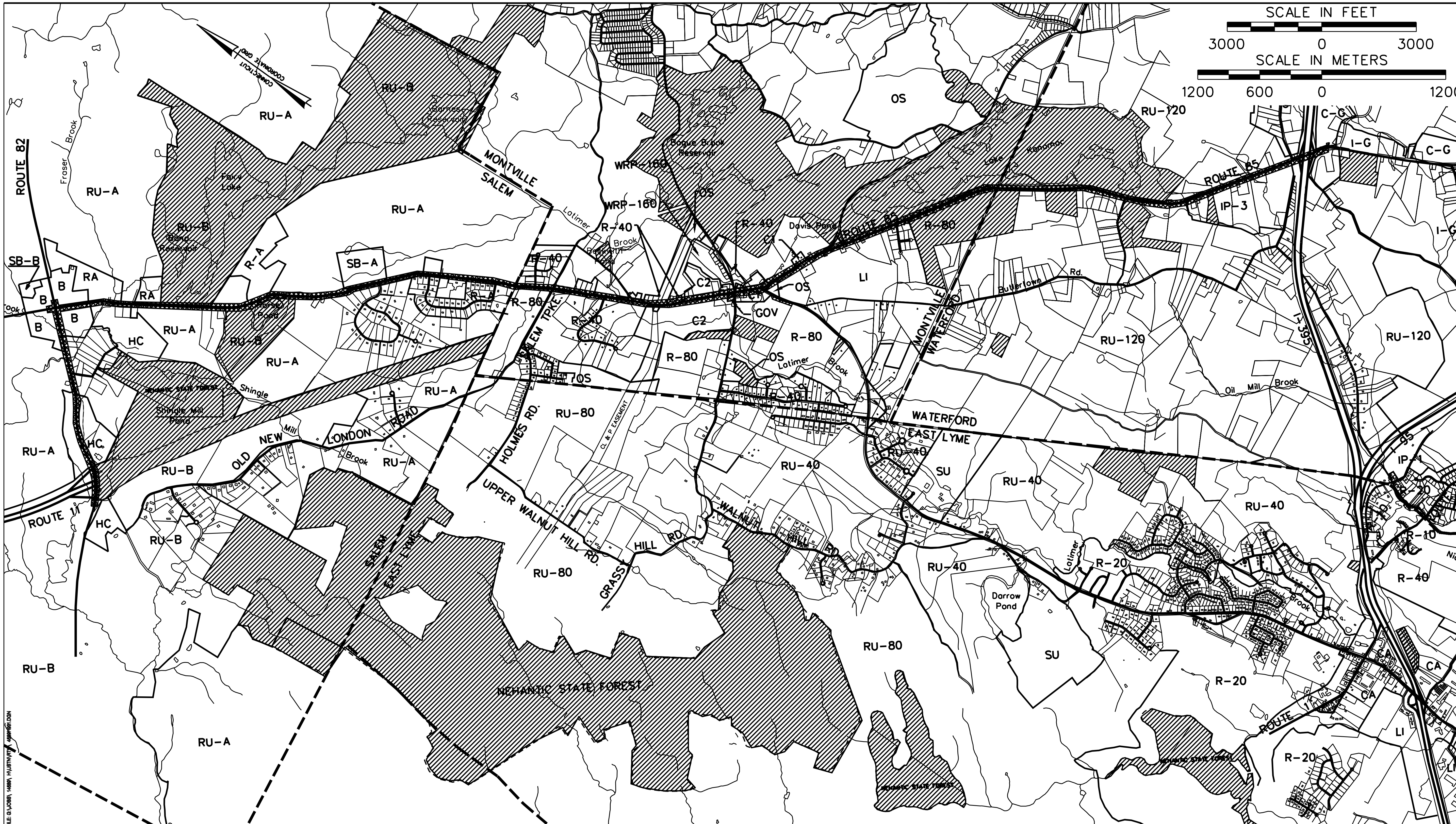
ALTERNATIVE[1]	NUMBER OF STRUCTURES POTENTIALLY AFFECTED					ESTIMATED LAND ACQUISITION AREAS		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL / COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND[2]
No Build	0	0	0	0	0	0	0	0
$W_{(4)}$	29	13	0	16	0	7.1 ha. (17.4 ac.)	5.6 ha. (13.8 ac.)	1.5 ha. (3.6 ac.)
$W_{(4)}$m	20	9	0	11	0	3.5 ha. (8.8 ac.)	2.5 ha. (6.3 ac.)	1.0 ha. (2.5 ac.)
$W_{(2)}$	19	8	0	11	0	2.3 ha. (5.7 ac.)	1.8 ha. (4.5 ac.)	0.5 ha. (1.2 ac.)
TSM	0	0	0	0	0	0	0	0
TDM/Transit	0	0	0	0	0	0	0	0
92PD	2	0	0	2	0	119.1 ha. (294.2 ac.)	118.4 ha. (292.5 ac.)	0.7 ha. (1.7 ac.)
$E_{(4)}$	2	0	0	2	0	119.1 ha. (294.2 ac.)	118.4 ha. (292.5 ac.)	0.7 ha. (1.7 ac.)
$E_{(2)}$	2	0	0	2	0	115.3 ha. (285.0 ac.)	114.6 ha. (283.3 ac.)	0.7 ha. (1.7 ac.)
$F_{(4)}$	2	0	0	2	0	69.4 ha. (171.5 ac.)	68.7 ha. (169.8 ac.)	0.7 ha. (1.7 ac.)
$F_{(2)}$	2	0	0	2	0	67.8 ha. (167.5 ac.)	67.1 ha. (165.8 ac.)	0.7 ha. (1.7 ac.)
$G_{(4)}$	2	0	0	2	0	69.4 ha. (171.5 ac.)	68.7 ha. (169.8 ac.)	0.7 ha. (1.7 ac.)
$G_{(2)}$	2	0	0	2	0	67.8 ha. (167.5 ac.)	67.1 ha. (165.8 ac.)	0.7 ha. (1.7 ac.)
$H_{(4)}$	29	13	0	16	0	7.1 ha. (17.4 ac.)	5.6 ha. (13.8 ac.)	1.5 ha. (3.6 ac.)
$H_{(2)}$	19	8	0	11	0	2.3 ha. (5.7 ac.)	1.8 ha. (4.5 ac.)	0.5 ha. (1.2 ac.)

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Includes land zoned for commercial, industrial, governmental, or special uses.

TABLE 5-52
PROPERTY IMPACT SUMMARY BY ALTERNATIVE - EAST LYME

ALTERNATIVE[1]	Number of Structures Potentially Affected					Estimated Land Acquisition Areas		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL / COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND[2]
No Build	0	0	0	0	0	0	0	0
$W_{(4)}$	0	0	0	0	0	0	0	0
$W_{(4)}$m	0	0	0	0	0	0	0	0
$W_{(2)}$	0	0	0	0	0	0	0	0
TSM	0	0	0	0	0	0	0	0
TDM/Transit	0	0	0	0	0	0	0	0
92PD	31	8	16	7	0	50.9 ha. (125.7 ac.)	34.0 ha. (84.0 ac.)	16.9 ha. (41.7 ac.)
$E_{(4)}$	31	8	16	7	0	50.9 ha. (125.7 ac.)	34.0 ha. (84.0 ac.)	16.9 ha. (41.7 ac.)
$E_{(2)}$	0	0	0	0	0	25.9 ha. (63.9 ac.)	25.9 ha. (63.9 ac.)	0
$F_{(4)}$	66	23	16	25	2	186.5 ha. (460.9 ac.)	138.6 ha. (342.6 ac.)	47.9 ha. (118.3 ac.)
$F_{(2)}$	21	11	0	8	2	150.6 ha. (372.2 ac.)	120.8 ha. (298.6 ac.)	29.8 ha. (73.6 ac.)
$G_{(4)}$	75	32	16	25	2	171.6 ha. (424.1 ac.)	123.7 ha. (305.8 ac.)	47.9 ha. (118.3 ac.)
$G_{(2)}$	30	19	0	9	2	103.0 ha. (254.4 ac.)	73.2 ha. (180.8 ac.)	29.8 ha. (73.6 ac.)
$H_{(4)}$	3	3	0	0	0	13.3 ha. (32.8 ac.)	13.3 ha. (32.8 ac.)	0
$H_{(2)}$	3	3	0	0	0	9.0 ha. (22.3 ac.)	9.0 ha. (22.3 ac.)	0

(1) 1998 alternatives; impacts of the preferred alternative are presented in Section 5.8.3.7.
(2) Includes land zoned for commercial, industrial, governmental, or special uses.



ZONING LEGEND

EAST LYME
CA - COMMERCIAL
LI - LIGHT INDUSTRIAL
R-10 - RESIDENTIAL
R-20 - RESIDENTIAL
RU-40 - RURAL RESIDENTIAL
RU-80 - RURAL RESIDENTIAL
RU-120 RURAL RESIDENTIAL
SU - SPECIAL USE

MONTVILLE
C1 - COMMERCIAL 1 DISTRICT
C2 - COMMERCIAL 2 DISTRICT
GOV - GOVERNMENT
OS - OPEN SPACE DISTRICT
R-20 - RESIDENTIAL DISTRICT
R-40 - RESIDENTIAL DISTRICT
R-80 - RESIDENTIAL DISTRICT
WRP-160 - WATER RESOURCE PROTECTION DISTRICT

SALEM
B- BUSINESS ZONE
CR - COMMERCIAL RECREATION ZONE
GOV - GOVERNMENT
HC - HIGHWAY COMMERCIAL ZONE
I - INDUSTRIAL
R-A - RESIDENTIAL ZONE A
RU-A - RURAL ZONE A
RU-B - RURAL ZONE B
SB-A - SPECIAL BUSINESS ZONE A
SB-B - SPECIAL BUSINESS ZONE B

WATERFORD
C-G - GENERAL COMMERCIAL DISTRICT
C-R - REGIONAL COMMERCIAL DISTRICT
I-C - INDUSTRIAL COMMERCIAL DISTRICT
I-G - GENERAL INDUSTRIAL DISTRICT
I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
R-40 - LOW DENSITY RESIDENTIAL DISTRICT
RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

ZONING BOUNDARY
TOWN / CITY LINE
R.O.W. LINE / PROPERTY LINE
WATER COURSE / WATER BODY
LOCAL ROADS
STATE ROADS
STATE FOREST
STATE & MUNICIPAL OWNED LAND
ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)
IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE W(4)
ZONING AND ACQUISITION IMPACTS

Figure 5-18a

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ZONING LEGEND

EAST LYME
CA - COMMERCIAL
LI - LIGHT INDUSTRIAL
R-10 - RESIDENTIAL
R-20 - RESIDENTIAL
RU-40 - RURAL RESIDENTIAL
RU-80 - RURAL RESIDENTIAL
RU-120 RURAL RESIDENTIAL
SU - SPECIAL USE

MONTVILLE
C1 - COMMERCIAL 1 DISTRICT
C2 - COMMERCIAL 2 DISTRICT
GOV - GOVERNMENT
OS - OPEN SPACE DISTRICT
R-20 - RESIDENTIAL DISTRICT
R-40 - RESIDENTIAL DISTRICT
R-80 - RESIDENTIAL DISTRICT
WRP-160 - WATER RESOURCE PROTECTION DISTRICT

SALEM
B- BUSINESS ZONE
CR - COMMERCIAL RECREATION ZONE
GOV - GOVERNMENT
HC - HIGHWAY COMMERCIAL ZONE
I - INDUSTRIAL
R-A - RESIDENTIAL ZONE A
RU-A - RURAL ZONE A
RU-B - RURAL ZONE B
SB-A - SPECIAL BUSINESS ZONE A
SB-B - SPECIAL BUSINESS ZONE B

WATERFORD
C-G - GENERAL COMMERCIAL DISTRICT
C-R - REGIONAL COMMERCIAL DISTRICT
I-C - INDUSTRIAL COMMERCIAL DISTRICT
I-G - GENERAL INDUSTRIAL DISTRICT
I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
R-40 - LOW DENSITY RESIDENTIAL DISTRICT
RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

ZONING BOUNDARY
TOWN / CITY LINE
R.O.W. LINE / PROPERTY LINE
WATER COURSE / WATER BODY
LOCAL ROADS
STATE ROADS
STATE FOREST
STATE & MUNICIPAL OWNED LAND
ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)
IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE 92 PD
ZONING AND ACQUISITION IMPACTS

Figure 5–18b

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ZONING LEGEND

EAST LYME
- CA - COMMERCIAL
- LI - LIGHT INDUSTRIAL
- R-10 - RESIDENTIAL
- R-20 - RESIDENTIAL
- RU-40 - RURAL RESIDENTIAL
- RU-80 - RURAL RESIDENTIAL
- RU-120 RURAL RESIDENTIAL
- SU - SPECIAL USE

MONTVILLE
- C1 - COMMERCIAL 1 DISTRICT
- C2 - COMMERCIAL 2 DISTRICT
- GOV - GOVERNMENT
- OS - OPEN SPACE DISTRICT
- R-20 - RESIDENTIAL DISTRICT
- R-40 - RESIDENTIAL DISTRICT
- R-80 - RESIDENTIAL DISTRICT
- WRP-160 - WATER RESOURCE PROTECTION DISTRICT

SALEM
- B- BUSINESS ZONE
- CR - COMMERCIAL RECREATION ZONE
- GOV - GOVERNMENT
- HC - HIGHWAY COMMERCIAL ZONE
- I - INDUSTRIAL
- R-A - RESIDENTIAL ZONE A
- RU-A - RURAL ZONE A
- RU-B - RURAL ZONE B
- SB-A - SPECIAL BUSINESS ZONE A
- SB-B - SPECIAL BUSINESS ZONE B

WATERFORD
- C-G - GENERAL COMMERCIAL DISTRICT
- C-R - REGIONAL COMMERCIAL DISTRICT
- I-C - INDUSTRIAL COMMERCIAL DISTRICT
- I-G - GENERAL INDUSTRIAL DISTRICT
- I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
- IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
- IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
- R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
- R-40 - LOW DENSITY RESIDENTIAL DISTRICT
- RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

- ZONING BOUNDARY
- TOWN / CITY LINE
- R.O.W. LINE / PROPERTY LINE
- WATER COURSE / WATER BODY
- LOCAL ROADS
- STATE ROADS
- STATE FOREST
- STATE & MUNICIPAL OWNED LAND
- ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)

IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE E(4)
ZONING AND ACQUISITION IMPACTS

Figure 5–18c

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ZONING LEGEND

EAST LYME
CA - COMMERCIAL
LI - LIGHT INDUSTRIAL
R-10 - RESIDENTIAL
R-20 - RESIDENTIAL
RU-40 - RURAL RESIDENTIAL
RU-80 - RURAL RESIDENTIAL
RU-120 RURAL RESIDENTIAL
SU - SPECIAL USE

MONTVILLE
C1 - COMMERCIAL 1 DISTRICT
C2 - COMMERCIAL 2 DISTRICT
GOV - GOVERNMENT
OS - OPEN SPACE DISTRICT
R-20 - RESIDENTIAL DISTRICT
R-40 - RESIDENTIAL DISTRICT
R-80 - RESIDENTIAL DISTRICT
WRP-160 - WATER RESOURCE PROTECTION DISTRICT

SALEM
B- BUSINESS ZONE
CR - COMMERCIAL RECREATION ZONE
GOV - GOVERNMENT
HC - HIGHWAY COMMERCIAL ZONE
I - INDUSTRIAL
R-A - RESIDENTIAL ZONE A
RU-A - RURAL ZONE A
RU-B - RURAL ZONE B
SB-A - SPECIAL BUSINESS ZONE A
SB-B - SPECIAL BUSINESS ZONE B

WATERFORD
C-G - GENERAL COMMERCIAL DISTRICT
C-R - REGIONAL COMMERCIAL DISTRICT
I-C - INDUSTRIAL COMMERCIAL DISTRICT
I-G - GENERAL INDUSTRIAL DISTRICT
I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
R-40 - LOW DENSITY RESIDENTIAL DISTRICT
RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

ZONING BOUNDARY
TOWN / CITY LINE
R.O.W. LINE / PROPERTY LINE
WATER COURSE / WATER BODY
LOCAL ROADS
STATE ROADS
STATE FOREST
STATE & MUNICIPAL OWNED LAND
ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)
IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE F(4)
ZONING AND ACQUISITION IMPACTS

Figure 5–18d

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ZONING LEGEND			
EAST LYME	MONTVILLE	SALEM	WATERFORD
CA - COMMERCIAL	C1 - COMMERCIAL 1 DISTRICT	B- BUSINESS ZONE	C-G - GENERAL COMMERCIAL DISTRICT
LI - LIGHT INDUSTRIAL	C2 - COMMERCIAL 2 DISTRICT	CR - COMMERCIAL RECREATION ZONE	C-R - REGIONAL COMMERCIAL DISTRICT
R-10 - RESIDENTIAL	GOV - GOVERNMENT	GOV - GOVERNMENT	I-C - INDUSTRIAL COMMERCIAL DISTRICT
R-20 - RESIDENTIAL	OS - OPEN SPACE DISTRICT	HC - HIGHWAY COMMERCIAL ZONE	I-G - GENERAL INDUSTRIAL DISTRICT
RU-40 - RURAL RESIDENTIAL	R-20 - RESIDENTIAL DISTRICT	I - INDUSTRIAL	I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
RU-80 - RURAL RESIDENTIAL	R-40 - RESIDENTIAL DISTRICT	R-A - RESIDENTIAL ZONE A	IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
RU-120 RURAL RESIDENTIAL	R-80 - RESIDENTIAL DISTRICT	RU-A - RURAL ZONE A	IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
SU - SPECIAL USE	WRP-160 - WATER RESOURCE PROTECTION DISTRICT	RU-B - RURAL ZONE B	R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
		SB-A - SPECIAL BUSINESS ZONE A	R-40 - LOW DENSITY RESIDENTIAL DISTRICT
		SB-B - SPECIAL BUSINESS ZONE B	RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

- ZONING BOUNDARY
- TOWN / CITY LINE
- R.O.W. LINE / PROPERTY LINE
- WATER COURSE / WATER BODY
- LOCAL ROADS
- STATE ROADS
- STATE FOREST
- STATE & MUNICIPAL OWNED LAND
- ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)

IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE G(4)
ZONING AND ACQUISITION IMPACTS

Figure 5–18e

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ZONING LEGEND

EAST LYME
CA - COMMERCIAL
LI - LIGHT INDUSTRIAL
R-10 - RESIDENTIAL
R-20 - RESIDENTIAL
RU-40 - RURAL RESIDENTIAL
RU-80 - RURAL RESIDENTIAL
RU-120 RURAL RESIDENTIAL
SU - SPECIAL USE

MONTVILLE
C1 - COMMERCIAL 1 DISTRICT
C2 - COMMERCIAL 2 DISTRICT
GOV - GOVERNMENT
OS - OPEN SPACE DISTRICT
R-20 - RESIDENTIAL DISTRICT
R-40 - RESIDENTIAL DISTRICT
R-80 - RESIDENTIAL DISTRICT
WRP-160 - WATER RESOURCE PROTECTION DISTRICT

SALEM
B- BUSINESS ZONE
CR - COMMERCIAL RECREATION ZONE
GOV - GOVERNMENT
HC - HIGHWAY COMMERCIAL ZONE
I - INDUSTRIAL
R-A - RESIDENTIAL ZONE A
RU-A - RURAL ZONE A
RU-B - RURAL ZONE B
SB-A - SPECIAL BUSINESS ZONE A
SB-B - SPECIAL BUSINESS ZONE B

WATERFORD
C-G - GENERAL COMMERCIAL DISTRICT
C-R - REGIONAL COMMERCIAL DISTRICT
I-C - INDUSTRIAL COMMERCIAL DISTRICT
I-G - GENERAL INDUSTRIAL DISTRICT
I-MF - INDUSTRIAL MULTI-FAMILY DISTRICT
IP-1 - GENERAL INDUSTRIAL PARK DISTRICT
IP-3 - SPECIAL AQUIFER INDUSTRIAL PARK DISTRICT
R-20 - MEDIUM DENSITY RESIDENTIAL DISTRICT
R-40 - LOW DENSITY RESIDENTIAL DISTRICT
RU-120 - RURAL RESIDENTIAL DISTRICT

MAP LEGEND

ZONING BOUNDARY
TOWN / CITY LINE
R.O.W. LINE / PROPERTY LINE
WATER COURSE / WATER BODY
LOCAL ROADS
STATE ROADS
STATE FOREST
STATE & MUNICIPAL OWNED LAND
ZONING & ACQUISITION IMPACT AREA

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82 /85 /11 CORRIDOR
ENVIRONMENTAL IMPACT STATEMENT (EIS)

IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

ALTERNATIVE H(4)
ZONING AND ACQUISTION IMPACTS

Figure 5–18f

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to the town. Loss of front yard to accommodate a widened roadway may impact existing parking facilities critical to the viability of certain types of business enterprises or may create non-conforming lots with respect to frontage/yard dimensions and/or lot area zone requirements. The taking of structures located proximal to the road would require tenant relocation of former residences and businesses or could result in partial or complete demolition of potentially significant historic structures (buildings, etc.).

Of all of the alternatives under study, the widening alternatives would affect the greatest number of parcels in the Route 82/85/11 corridor. Alternative $W_{(4)}$ would have the most impact and require land acquisition (partial or total) from an estimated 178 parcels and the taking of 32 dwellings fronting on Routes 82 and 85. Approximately 20.2 ha. (49.9 ac.) of land would need to be acquired to implement this alternative. The sections of Route 85 that would incur the most impact to existing structures include Salem Four Corners where two commercial buildings and a gas station pump island would be adversely affected; the Chesterfield Four Corners area in Montville where several commercial establishments, residences, and the Chesterfield Fire House would be impacted; and a residential area located north of the Waterford Speedbowl.

Alternative $W_{(4)}$m would impact slightly fewer parcels than Alternative $W_{(4)}$ with takes from an estimated 156 parcels including 27 dwellings. The same areas impacted by Alternative $W_{(4)}$ would also be affected by this alternative, although the number of residences taken would decrease slightly. The Chesterfield Fire House may also be adversely affected, depending upon whether sufficient distance would remain for maneuvering emergency vehicles.

Of the three widening options, Alternative $W_{(2)}$ would impact the fewest number of parcels and structures and approximately 7.8 ha.. (19.3 ac.) of land. For all of the widening alternatives, impacts to residential properties (partial and complete takes) would account for approximately 60% of the affected parcels while undeveloped parcels comprise approximately 15% of the total.

5.8.3.3 *TSM Alternative*: Potential traffic safety modifications to the existing Routes 82 and 85 could include the widening of the roads to accommodate left-turning vehicles at key intersections. In addition to land acquisition along the right-of-way in proposed areas, such improvements may also require complete or partial takes of commercial buildings at Salem Four Corners and commercial establishments and private residences located at the intersections of Grassy Hill Road and Route 161 with Route 85.

5.8.3.4 *TDM/Transit Alternatives:* The TDM/Transit Alternative is not expected to result in any private property acquisition or structural displacements.

5.8.3.5 *New Location - Full Build Alternatives*: New roadway construction on a new location would require the taking of private properties, resulting in a loss of taxable income to towns. Structural displacements would require tenant relocation of affected residences. Of the four-lane, full build expressway alternatives examined, Alternative $G_{(4)}$ would adversely impact the most parcels and structures, with takes from 107 properties including 38 dwellings. Alternative $F_{(4),}$ however, would require the greatest areal acquisition of all alternatives at 293.6 ha. (725.4 ac.).

Of the four-lane, full build alternatives, Alternative $E_{(4)}$ would require land acquisition from the fewest total number of parcels at 93 and would take the least number of dwellings at 22 The 92PD alignment would result in private property impacts intermediate to Alternatives $G_{(4)}$ and $E_{(4)}$.

The $F_{(4)}$ and $G_{(4)}$ alignments would affect residences on Fawn Run in Salem; Holmes Road, Grassy Hill Road, Walnut Hill Road, Route 161, and Westchester Drive in East Lyme; as well as the newly constructed St. Matthias Church located on Route 161 in East Lyme. Most dwellings that would be taken to implement Alternative 92PD would occur in the Daisy Hill Drive subdivision with additional residences on Grassy Hill Road, Route 161, and Silver Falls Road in Montville also affected. Alternative $E_{(4)}$ would impact residences in the same general area as 92PD except that it would bypass most of Daisy Hill Drive. In addition to impacts to residential areas, large undeveloped or agricultural parcels would be taken in portions of East Lyme ($F_{(4)}$ and $G_{(4)}$), Montville (92PD and $E_{(4)}$), and Waterford (all alignments). Implementation of the four-lane, full build alternatives (92PD, $E_{(4)}$, $F_{(4)}$, and $G_{(4)}$) would also result in impacts to a large commercial area centered at the Route 161/I-95 interchange in East Lyme. Little additional property acquisition in Salem would be necessary as the State of Connecticut already owns a substantial right-of-way extending from the current Route 11 terminus south to the Salem/Montville town line.

Generally, the two-lane, full expressway alternatives would impact fewer parcels and would require fewer structural takings in comparison to their four-lane counterparts. Alternative $E_{(2)}$ would result in the least impact to private property. The most property impact resulting from a two-lane expressway would be caused by Alternative $G_{(2)}$, which would affect 64 parcels as well as displace 24 dwellings. This alternative, along with Alternative $F_{(2)}$, would also affect the St. Matthias Church. Alternative $F_{(2)}$ would result in property impacts intermediate to $E_{(2)}$ and $G_{(2)}$.

The developed and undeveloped areas affected by the two-lane expressway alternatives are similar to those affected by the respective four-lane alternatives. For the two- and four-lane, full expressway alternatives, approximately 40% to 60% of the property takes would represent undeveloped land in the corridor, while 35% to 50% of the parcels support residential uses.

5.8.3.6 *New Location - Partial Build Alternatives*: The $H_{(4)}$ and $H_{(2)}$ alternatives would result in overall property impacts that are intermediate to those of the widening and full expressway alternatives described above. The $H_{(4)}$ alignment would result in estimated takes from 82 parcels including 28 dwellings; this alternative would also affect 115.3 ha. (284.8 ac.) of land. Residential areas affected would include Fawn Run in Salem, Holmes Road in East Lyme, Grassy Hill Road in Montville, and the area north of the Waterford Speedbowl on Route 85 in Waterford. The Chesterfield Fire House and the two Four Corners areas would not be affected by the partial expressway alternatives because of the location of the Alternative H touchdown point south of Route 161.

Impacts resulting from $H_{(2)}$ are less than those from $H_{(4)}$, but would still result in takes from 65 parcels including 20 dwellings. For Alternatives $H_{(2)}$ and $H_{(4)}$, approximately 44% of the parcels affected are developed for residential use, and 30% of the parcels would represent undeveloped land.

5.8.3.7 *Preferred Alternative*: The preferred alternative would result in similar land use impacts as the other full build alternatives, except along the Waterford-East Lyme town boundary. Because the southern portion of the $E_{(4)}$m-V3 alignment was rerouted into East Lyme to avoid fragmenting Habitat Block No. 2, properties that were previously unaffected by the full build alternatives would now be directly impacted, while property impacts in Waterford would be reduced. Although there would not be any taking of homes in East Lyme, neighborhoods along the east side of Route 161, such as Grouse Circle, are now within approximately 300 m. (985 ft.) of the proposed roadway.

Construction of the preferred alternative would involve the total acquisition of 20 property parcels and partial acquisition of land from 29 parcels. The total acquisition of 11 residential dwellings would be required. The total land area that would need to be acquired for the construction of the roadway would be approximately 219 ha. (540 ac). Additional areas may be required for right-of-way depending upon final design. The cost of property acquisition was estimated to range between $18.36 million and $20.1 million (2006 values). A summary of property impacts is provided on Tables 5-53 and 5-54 and the locations are shown in Appendix E.

TABLE 5-53
SUMMARY OF PROPERTY PARCEL LAND USE IMPACTS BY TOWN – PREFERRED ALTERNATIVE $E_{(4)}$M-V3

ALTERNATIVE	PARTIAL TAKES					COMPLETE TAKES					TOTAL NUMBER OF AFFECTED PARCELS
	TOTAL	DEVELOPED PARCELS			UNDEVELOPED PARCELS	TOTAL	DEVELOPED PARCELS			UNDEVELOPED PARCELS	
		RESIDENTIAL	COMMERCIAL/ INDUSTRIAL	OTHER(1)			RESIDENTIAL	COMMERCIAL/ INDUSTRIAL	OTHER(1)		
Salem	1	1	0	0	0	1	0	0	0	1	2
Montville	17	8	2	1	6	10	10	0	0	0	27
Waterford	3	0	0	0	3	1	0	0	0	1	4
East Lyme	8	2	0	1	5	8	0	0	0	8	16
TOTAL	29	11	2	2	14	20	10	0	0	10	49

(1) Land uses in this category are agricultural and special use.

TABLE 5-54
PROPERTY IMPACT SUMMARY – PREFERRED ALTERNATIVE $E_{(4)}$M-V3 (ALL FOUR TOWNS)

ALTERNATIVE	NUMBER OF STRUCTURES POTENTIALLY AFFECTED					ESTIMATED LAND ACQUISITION AREAS		
	TOTAL NUMBER	DWELLINGS	COMMERCIAL/ INDUSTRIAL	OUTBUILDINGS	INSTITUTIONAL/ COMMUNITY SERVICE	TOTAL AREA	RESIDENTIAL LAND	NON-RESIDENTIAL LAND(1)
$E_{(4)}$m-V3	24	11	0	13	0	219 ha. (540 ac.)	209 ha. (517 ac.)	9 ha. (23 ac.)

(1) Includes land zoned for commercial, light industrial, open space, and special use.

Of the 49 parcels that would be impacted, 24 are undeveloped, 21 are developed for residential use, 2 for light industrial and 1 is a recreational vehicle park. Zoning designations on the developed and undeveloped parcels include 42 residential, 5 commercial or industrial, 1 special use and 1 open space.

Of the properties affected, most are zoned residential and are located in Montville. Of 27 impacted properties in Montville, 10 would be full acquisitions involving 11 houses. Two of these are new houses constructed since publication of the DEIS in 1999. East Lyme would have 16 properties impacted, including 8 full acquisitions.

Impacts would occur on 5 commercial and industrial properties. Partial takes would be required on 2 light industrial parcels in Montville along Route 161. Full acquisitions would be necessary for 3 currently undeveloped, commercial properties along I-95 in East Lyme. Partial and complete acquisitions would occur on 4 undeveloped residential properties in East Lyme that each contains a portion of land adjacent to I-95 that is zoned commercial. Additionally, 1 parcel in Montville zoned open space, and 1 parcel in East Lyme zoned special use, would be partially impacted.

Because the state of Connecticut previously acquired a 500 foot wide right-of-way through Salem, only 2 properties would be affected. These impacts occur outside the state land because an adjustment was made in the alignment to avoid wetlands. Only 4 properties in Waterford would be affected because the alignment was moved west into East Lyme to avoid resources in Habitat Block No. 2.

Based upon planning level estimates, the properties listed on Table 5-55 may be affected by full or partial acquisitions required for construction of the preferred alternative.

During the impact minimization process for the preferred alternative, efforts were made to avoid residences. Use of an arterial cross section rather than a full size expressway reduced the number of property impacts by approximately 50%, however complete avoidance of all properties was impossible. As discussed in Section 3.4, the $E_{(4)}$m-V3 alternative was a compromise between avoidance of forest fragmentation and maintaining an alignment that was as far as possible from neighborhoods.

Property Acquisition Displacements

The required 11 house acquisitions consist mainly of single-family homes, and it is estimated that 11 families would be displaced. Additionally, one affected

TABLE 5-55
POTENTIAL PROPERTY ACQUISITIONS – PREFERRED ALTERNATIVE $E_{(4)}$M-V3

PROPERTY ADDRESS	TOWN	PROPERTY IMPACT	PROPERTY TYPE
947 Grassy Hill Road	Montville	Full Acquisition	Residence
970 Grassy Hill Road	Montville	Full Acquisition	Residence
542 Flanders Road	Montville	Full Acquisition	Residence
536 Flanders Road	Montville	Full Acquisition	Residence
474 Route 161	Montville	Full Acquisition	Residence
11 Silver Falls Road	Montville	Full Acquisition	Residence
1 Silver Falls Road	Montville	Full Acquisition	Residence
7 Silver Falls Road	Montville	Full Acquisition	Residence
15 Silver Falls Road	Montville	Full Acquisition	Residence
27 Silver Falls Road	Montville	Full Acquisition	Residence
Chesterfield Road	East Lyme	Full Acquisition	Undeveloped
I-95	East Lyme	Full Acquisition	Undeveloped
I-95	East Lyme	Full Acquisition	Undeveloped
I-95	East Lyme	Full Acquisition	Undeveloped
I-95	East Lyme	Full Acquisition	Undeveloped
I-95	East Lyme	Full Acquisition	Undeveloped
Old New London Road	Salem	Full Acquisition	Undeveloped
286 Pember Road	Waterford	Full Acquisition	Undeveloped
95 Beckwith Hill Drive	Salem	Partial Acquisition	Residence
35 Salem Turnpike	Montville	Partial Acquisition	Residence
Salem Turnpike	Montville	Partial Acquisition	Residence
31 Daisy Hill Drive	Montville	Partial Acquisition	Residence
35 Daisy Hill Drive	Montville	Partial Acquisition	Residence
39 Daisy Hill Drive	Montville	Partial Acquisition	Residence
43 Daisy Hill Drive	Montville	Partial Acquisition	Residence
47 Daisy Hill Drive	Montville	Partial Acquisition	Residence
Maiville Drive	Montville	Partial Acquisition	Undeveloped
Grassy Hill Road	Montville	Partial Acquisition	Undeveloped
985 Grassy Hill Road	Montville	Partial Acquisition	Undeveloped
Grassy Hill Road	Montville	Partial Acquisition	Agricultural
516 Flanders Road	Montville	Partial Acquisition	Residence
Route 161	Montville	Partial Acquisition	Undeveloped
Route 161	Montville	Partial Acquisition	Undeveloped
300 Butlertown Road	Montville	Partial Acquisition	Residence/undev.
Silver Falls Road	Montville	Partial Acquisition	Undeveloped
39 Silver Falls Road	Montville	Partial Acquisition	Residence
55 Pember Road	Waterford	Partial Acquisition	Undeveloped
275 Pember Road	Waterford	Partial Acquisition	Undeveloped
54 Oil Mill Road	Waterford	Partial Acquisition	Undeveloped
301 Chesterfield Road	East Lyme	Partial Acquisition	RV park
Chesterfield Road	East Lyme	Partial Acquisition	Undeveloped
Chesterfield Road	East Lyme	Partial Acquisition	Undeveloped
80 Quailcrest Road	East Lyme	Partial Acquisition	Residence
Chesterfield Road	East Lyme	Partial Acquisition	Undeveloped
51 Grouse Circle	East Lyme	Partial Acquisition	Residence
Grouse Circle	East Lyme	Partial Acquisition	Undeveloped
Goldfinch Terrace	East Lyme	Partial Acquisition	Undeveloped
I-95	East Lyme	Partial Acquisition	Undeveloped
I-95	East Lyme	Partial Acquisition	Undeveloped

dwelling contains a part-time home-based business that employs two people. Therefore, two jobs would be displaced by the preferred alternative.

Property Acquisition for Mitigation Purposes

Compensatory mitigation for impacts to wetlands and wildlife habitat will include the acquisition of available undeveloped land within or near the corridor. The total area of potential acquisition, as defined in the Mitigation and Compensation Framework 2006 (Appendix C), would be a minimum of 278 ha. (686 ac.) that would be preserved to compensate for wetland and wildlife habitat impacts. Specific properties will be identified as part of the mitigation and compensation plan to be developed during the design and permitting phase of the project.

5.8.4 Municipal Tax Base Impacts Resulting from Property Acquisitions

The reconstruction of existing roadway infrastructure or the construction of a new highway in the corridor would require the acquisition of private properties that are currently a source of taxable income to the respective towns. Removal of property and associated buildings from a town's tax roll would result in the permanent loss of annual tax revenue to the town that would have a cumulative effect over subsequent years. A decrease in taxable income to a municipality could adversely affect funding for a variety of public works, educational, or social service programs that serve the needs of local residents. Depending on the magnitude of the impact to the tax base, potential transportation-related or associated economic benefit derived from a build alternative may be offset by the loss of tax revenue to a municipality. Generally, implementation of any of the full build expressway alternatives would require the acquisition of the greatest land area and would result in a proportionally greater loss to local tax bases than the partial build expressway or Route 82 and 85 widening options.

Table 5-56 summarizes the total estimated cost of right-of-way acquisition as well as the resulting impacts to the local tax bases that would occur for each alternative. Tables 5-57, 5-58, 5-59 and 5-60 detail estimated right-of-way acquisition costs and impacts to the tax bases for each of the four towns in the study corridor. In determining right-of-way acquisition costs, land values were derived from 1997 grand list data showing gross assessment values for different land use classifications within each town, and average market prices of residences within each town were obtained from DECD (1994 data). This information, together with current mill rates, was used to determine potential impacts to local tax bases that would result from each alternative.

Tax base impacts for preferred alternative $E_{(4)}$m-V3 were estimated for affected properties from actual property assessment records based on 2001-2002 town revaluations, 2006 market values estimated from average increases in sales prices since 2001, 2006 mill rates, and 2006 grand lists (State Register 2006).

TABLE 5-56
TOTAL ESTIMATED RIGHT-OF-WAY ACQUISITION COST AND TAX BASE IMPACTS [1]
(ALL FOUR CORRIDOR-AREA TOWNS)

ALTERNATIVE	ESTIMATED MARKET VALUE OF TAKINGS	ESTIMATED PROPERTY TAX VALUE [2]	TOTAL LOST PROPERTY TAXES [3]	PERCENT OF AREA TAX BASE IMPACTED [4]
No Build	0	0	0	0
$W_{(4)}$	$5,893,000	$4,125,100	$90,500	0.14%
$W_{(4)}$m	$4,559,900	$3,191,900	$72,700	0.10%
$W_{(2)}$	$2,695,500	$1,886,900	$40,900	0.06%
TSM	$686,700	$480,700	$13,200	0.02%
TDM/Transit	0	0	0	0
92PD	$28,885,900	$20,220,100	$454,600	0.66%
$E_{(4)}$	$28,137,800	$19,696,500	$441,000	0.65%
$E_{(2)}$	$20,957,300	$14,670,100	$306,300	0.48%
$F_{(4)}$	$38,895,800	$27,227,100	$697,100	0.89%
$F_{(2)}$	$30,505,600	$21,353,900	$536,600	0.70%
$G_{(4)}$	$38,458,600	$26,921,000	$688,600	0.88%
$G_{(2)}$	$26,138,800	$18,297,200	$452,500	0.60%
$H_{(4)}$	$11,721,100	$8,204,800	$200,100	0.27%
$H_{(2)}$	$8,172,600	$5,720,800	$144,000	0.19%
$E_{(4)m}$-V3 [5]	$12,852,000	$8,996,400	$263,300	0.17%

(1) Tax base impacts resulting from property takings only.
(2) Value represents estimated gross assessment of takings (70% of market value).
(3) Sum of lost property taxes for each town.
(4) Estimated gross assessment value of property takes in the four towns as a percentage of the real estate grand lists of the towns combined.
(5) Estimated from 2006 grand lists, tax rates, property assessments (2001-2002 revaluations) and estimated 2006 market values.

TABLE 5-57
ESTIMATED RIGHT-OF-WAY ACQUISITION COSTS AND TAX BASE IMPACTS [1]
TOWN OF SALEM

ALTERNATIVE	ESTIMATED MARKET VALUE OF TAKINGS	ESTIMATED PROPERTY TAX VALUE [2]	TOTAL LOST PROPERTY TAXES [3]	PERCENT OF TAX BASE IMPACTED [4]
No Build	0	0	0	0
$W_{(4)}$	$1,168,600	$818,000	$23,700	0.52%
$W_{(4)}$m	$1,049,500	$734,700	$21,300	0.46%
$W_{(2)}$	$712,800	$499,000	$14,500	0.31%
TSM	$312,700	$218,900	$6,300	0.14%
TDM/Transit	0	0	0	0
92PD	$76,200	$53,300	$1,500	0.03%
$E_{(4)}$	$76,200	$53,300	$1,500	0.03%
$E_{(2)}$	0	0	0	0
$F_{(4)}$	$1,837,800	$1,286,500	$37,300	0.81%
$F_{(2)}$	$1,610,300	$1,127,200	$32,700	0.71%
$G_{(4)}$	$1,837,800	$1,286,500	$37,300	0.81%
$G_{(2)}$	$1,610,300	$1,127,200	$32,700	0.71%
$H_{(4)}$	$1,837,800	$1,286,500	$37,300	0.81%
$H_{(2)}$	$1,610,300	$1,127,200	$32,700	0.71%
$E_{(4)}$m-V3 [5]	$10,300	$7,200	$200	<0.01%

(1) Tax base impacts resulting from property takings only.
(2) Value represents estimated gross assessment of takings (70% of market value).
(3) Value represents the product of the property tax value and the current mill rate (29.00).
(4) Estimated gross assessment value of property takes as a percentage of the total real estate grand list.
(5) Estimated from 2006 grand lists, tax rates, property assessments (2001-2002 revaluations) and estimated 2006 market values.

TABLE 5-58
ESTIMATED RIGHT-OF-WAY ACQUISITION COSTS AND TAX BASE IMPACTS [1]
TOWN OF MONTVILLE

ALTERNATIVE	ESTIMATED MARKET VALUE OF TAKINGS	ESTIMATED PROPERTY TAX VALUE [2]	TOTAL LOST PROPERTY TAXES [3]	PERCENT OF TAX BASE IMPACTED [4]
No Build	0	0	0	0
$W_{(4)}$	$2,249,300	$1,574,500	$40,900	0.29%
$W_{(4)}$m	$1,898,300	$1,328,800	$34,500	0.25%
$W_{(2)}$	$734,000	$513,800	$13,400	0.10%
TSM	$374,000	$261,800	$6,800	0.05%
TDM/Transit	0	0	0	0
92PD	$9,390,100	$6,573,100	$170,900	1.22%
$E_{(4)}$	$8,642,000	$6,049,400	$157,300	1.12%
$E_{(2)}$	$7,870,900	$5,509,600	$143,300	1.02%
$F_{(4)}$	0	0	0	0
$F_{(2)}$	0	0	0	0
$G_{(4)}$	0	0	0	0
$G_{(2)}$	0	0	0	0
$H_{(4)}$	$5,445,600	$3,811,900	$99,100	0.71%
$H_{(2)}$	$3,842,400	$2,689,700	$69,900	0.50%
$E_{(4)}$m-V3 [5]	$8,188,000	$5,731,600	$171,100	0.56%

(1) Tax base impacts resulting from property takings only.
(2) Value represents estimated gross assessment of takings (70% of market value).
(3) Value represents the product of the property tax value and the current mill rate (26.00).
(4) Estimated gross assessment value of property takes as a percentage of the total real estate grand list.
(5) Estimated from 2006 grand lists, tax rates, property assessments (2001-2002 revaluations) and estimated 2006 market values.

TABLE 5-59
ESTIMATED RIGHT-OF-WAY ACQUISITION COSTS AND TAX BASE IMPACTS [1]
TOWN OF WATERFORD

ALTERNATIVE	ESTIMATED MARKET VALUE OF TAKINGS	ESTIMATED PROPERTY TAX VALUE [2]	TOTAL LOST PROPERTY TAXES [3]	PERCENT OF TAX BASE IMPACTED [4]
No Build	0	0	0	0
$W_{(4)}$	$2,475,200	$1,732,600	$25,900	0.11%
$W_{(4)}$m	$1,612,100	$1,128,500	$16,800	0.07%
$W_{(2)}$	$1,248,700	$874,100	$13,100	0.05%
TSM	0	0	0	0
TDM/Transit	0	0	0	0
92PD	$10,421,700	$7,295,200	$108,900	0.46%
$E_{(4)}$	$10,421,700	$7,295,200	$108,900	0.46%
$E_{(2)}$	$10,097,100	$7,068,000	$105,500	0.44%
$F_{(4)}$	$6,092,800	$4,265,000	$63,700	0.27%
$F_{(2)}$	$5,951,700	$4,166,200	$62,200	0.26%
$G_{(4)}$	$6,092,800	$4,265,000	$63,700	0.27%
$G_{(2)}$	$5,951,700	$4,166,200	$62,200	0.26%
$H_{(4)}$	$2,475,200	$1,732,600	$25,900	0.11%
$H_{(2)}$	$1,248,700	$874,100	$13,100	0.05%
$E_{(4)}$m-V3 [5]	$90,000	$63,000	$1,300	<0.01%

(1) Tax base impacts resulting from property takings only.
(2) Value represents estimated gross assessment of takings (70% of market value).
(3) Value represents the product of the property tax value and the current mill rate (14.93).
(4) Estimated gross assessment value of property takes as a percentage of the total real estate grand list.
(5) Estimated from 2006 grand lists, tax rates, property assessments (2001-2002 revaluations) and estimated 2006 market values.

TABLE 5-60
ESTIMATED RIGHT-OF-WAY ACQUISITION COSTS AND TAX BASE IMPACTS [1]
TOWN OF EAST LYME

ALTERNATIVE	ESTIMATED MARKET VALUE OF TAKINGS	ESTIMATED PROPERTY TAX VALUE [2]	TOTAL LOST PROPERTY TAXES [3]	PERCENT OF TAX BASE IMPACTED [4]
No Build	0	0	0	0
$W_{(4)}$	0	0	0	0
$W_{(4)}m$	0	0	0	0
$W_{(2)}$	0	0	0	0
TSM	0	0	0	0
TDM/Transit	0	0	0	0
92PD	$8,997,900	$6,298,500	$173,200	0.83%
$E_{(4)}$	$8,997,900	$6,298,500	$173,200	0.83%
$E_{(2)}$	$2,989,200	$2,092,400	$57,500	0.28%
$F_{(4)}$	$30,965,100	$21,675,600	$596,100	2.86%
$F_{(2)}$	$22,943,700	$16,060,600	$441,700	2.12%
$G_{(4)}$	$30,527,900	$21,369,500	$587,700	2.81%
$G_{(2)}$	$18,576,800	$13,003,800	$357,600	1.71%
$H_{(4)}$	$1,962,500	$1,373,800	$37,800	0.18%
$H_{(2)}$	$1,471,300	$1,029,900	$28,300	0.14%
$E_{(4)}m$-V3 [5]	$4,563,700	$3,194,600	$90,700	0.23%

(1) Tax base impacts resulting from property takings only.
(2) Value represents estimated gross assessment of takings (70% of market value).
(3) Value represents the product of the property tax value and the current mill rate (27.50).
(4) Estimated gross assessment value of property takes as a percentage of the total real estate grand list.
(5) Estimated from 2006 grand lists, tax rates, property assessments (2001-2002 revaluations) and estimated 2006 market values.

5.8.5 Potential Employment Impacts Resulting from Property Acquisitions

Commercial establishments located within the study corridor tend to be located along the major thoroughfares of Routes 82, 85, 161, and 1 and proximal to the intersections of these state roads with I-95 and I-395 in East Lyme and Waterford. As discussed in Section 5.8, implementation of any of the proposed alternatives with the exception of the no build alternative and the TDM/transit initiatives would require the taking of privately-owned land. In some cases, the takes would include commercial establishments that permanently or relocate out of the region. Potential employment displacements are summarized in Table 5-61 and businesses affected are discussed below.

Table 5-61
Summary of Employees Potentially Displaced

Alternative	Total Number of Employees	Town			
		Salem	Montville	East Lyme	Waterford
No Build	0	0	0	0	0
$W_{(4)}$	23-27	12-14	11-13	0	0
$W_{(4)}$m	23-27	12-14	11-13	0	0
$W_{(2)}$	6	5	1	0	0
TSM	6	5	1	0	0
TDM/Transit	0	0	0	0	0
92PD	72-86	0	2	70-84	0
$E_{(4)}$	72-86	0	2	70-84	0
$E_{(2)}$	2	0	2	0	0
$F_{(4)}$	70-84	0	0	70-84	0
$F_{(2)}$	0	0	0	0	0
$G_{(4)}$	70-84	0	0	70-84	0
$G_{(2)}$	0	0	0	0	0
$H_{(4)}$	5	0	5	0	0
$H_{(2)}$	0	0	0	0	0
$E_{(4)}$m-V3	2	0	2	0	0

5.8.5.1 *No Build Alternative*: The no build alternative would not take any properties and consequently would have no effect on employee displacements.

5.8.5.2 *Route 82 and 85 Widening Alternatives*: Alternatives $W_{(4)}$ and $W_{(4)}$m would potentially take commercial establishments clustered at the Salem Four Corners intersection of Routes 82 and 85 in Salem and at Chesterfield Four Corners at the intersection of Route 85 and Grassy Hill Road in Montville. Businesses potentially affected in Salem include a craft store, an auto sales and service shop, and a gas station/convenience store. In addition, in-home taxidermy and welding/blacksmithing shops located nearby could be taken. In the vicinity of Chesterfield Four Corners, affected commercial establishments could include a hotel/convenience store, a car repair facility, a gas station/convenience store, and a restaurant.

Alternative $W_{(2)}$ would require less land acquisition than the four-lane widening proposals but would still take the craft store and auto shop at Salem Four Corners and the auto repair business at Chesterfield Four Corners. Approximately 25% of the number of employees that could be displaced for the $W_{(4)}$ alternative are affected by takes for the $W_{(2)}$ alternative.

5.8.5.3 *TSM Alternatives*: Proposed widening for the TSM alternatives would occur at the Salem and Chesterfield Four Corners intersections and affect the same businesses as Alternative $W_{(2)}$.

5.8.5.4 *TDM/Transit Alternative*: No takes of commercial establishments in the study corridor are anticipated to implement this alternative.

5.8.5.5 *New Location - Full build Alternatives*: Options for the four-lane, expressway alternatives (92PD, $E_{(4)}$, $F_{(4)}$, and $G_{(4)}$) would have the greatest number of takes from commercial businesses and would adversely affect the greatest number of employees of all the alternatives being studied. Most of the impact would occur in East Lyme in order to reconstruct the interchange at Route 161/I-95 which is included in the four-lane, expressway alternatives. Businesses affected by interchange reconstruction would include a hotel, a self-storage warehouse facility, a vacant gas station, a golf driving range, a restaurant, a deli, a pool supply store, an auto repair facility, and a vacant office/store. In addition to these impacts, an in-home blade sharpening business would be taken in Montville for the 92PD, $E_{(4)}$, and $E_{(2)}$ alternatives.

Aside from the one business potentially affected for the $E_{(2)}$ alternative, the remaining two-lane expressway options would not affect any commercial establishments in the corridor.

5.8.5.6 *New Location - Partial Build Alternatives*: Alternative $H_{(4)}$ would adversely impact a carpet/floor covering business and warehouse located on Route 85 in the area where the expressway would connect to Route 85. Alternative $H_{(2)}$ is not anticipated to have any direct impacts on commercial establishments in the corridor.

5.8.5.7 *Preferred Alternative*: Preferred alternative $E_{(4)}$m-V3 would impact an in-home blade sharpening business in Montville that employs two people, as would alternatives 92PD, $E_{(4)}$, and $E_{(2)}$.

5.8.6 COMPARISON OF LAND USE IMPACTS

5.8.6.1 *No Build Alternative*: Vacant lands within the Route 82/85/11 corridor currently zoned for residential, commercial and industrial uses will continue to infill with development at a rate determined by economic and market property values (more specifically commercial/business) within the corridor. As the Route 82/85/11 corridor (now) vacant lands are developed, traffic burden in the corridor and connecting roadways will increase incrementally. As a consequence, levels of service will drop over time and accident rates will increase; this could potentially affect future property values for those properties abutting the arterials.

5.8.6.2 *Route 82 and 85 Widening Alternative*: Infrastructure replacement, renovation and/or reconstruction, including the widened roadway and new stormwater drainage structures that would be a part of the widening design package, would benefit the town as a capital improvement. Environmental improvements resulting from increased infrastructure efficiency and performance would be an indirect benefit.

Land acquisition could potentially create non-conforming lots. Front and side yard impacts combined with increased traffic volumes within the corridor may tend to devalue residential properties directly impacted by the widening, and to a lesser extent, properties that are accessed via intersecting roadways; i.e., adjacent subdivisions. Takings that involve demolition of buildings may have varied impacts. In some cases, the tenant may have sufficient remaining land to be provided with a choice to rebuild rather than relocate; in other instances, the taking may result in the affected property remaining vacant for some indeterminate period of time. For business properties, mixed effects would occur, depending on the types of businesses affected.

5.8.6.3 *TSM Alternative*: Impacts to land use within the corridor that would be caused by TSM initiatives are considered to be minor. Although few property takings may occur at select intersections along Routes 82 and 85, there would likely be no impact on property values or land use in the towns.

5.8.6.4 *TDM/Transit Alternative*: No land use impacts are anticipated for the TDM/Transit alternative.

5.8.6.5 *New Location- Full Build Alternatives and Preferred Alternative*: Construction of a new expressway with any of the new location alternatives, including the preferred alternative, would require the acquisition of a substantial area of undeveloped private property in comparison to the widening alternatives. This would not only be a loss of tax revenue to area towns, but it would also be a loss of land that could remain in conservation or be developed to derive economic benefit for the owner.

The removal of through traffic from Routes 82 and 85 following the construction of a new expressway would afford an improvement to the congested conditions on these roads and perhaps improve the quality of life of local residents and increase residential property values along the roads. Conversely, existing residences located adjacent to a new expressway may be devalued if the local perception views the location as undesirable based on aesthetics or noise. However, future commercial/industrial and higher density residential growth centered around interchange locations may be anticipated with the improved access and ease of travel presented by a new expressway.

5.8.6.6 *New Location - Partial Build Alternatives*: Land use impacts resulting from partial build expressway scenarios $H_{(4)}$ and $H_{(2)}$ would combine elements of the widening alternatives with the full build expressway options. Property acquisition in the northern half of the corridor where the expressway would be located would include larger tracts of primarily undeveloped land that could remain as such or be developed in the future. These alignments would also come in close proximity to existing subdivisions and may decrease property values. South of the junction with Route 85, Alternative H would require takings from numerous parcels and some structures fronting on the road, also resulting in residential property devaluation. With improved access to a completed Route 11, commercial/industrial businesses may increase in the area near the Route 85 intersection and Butlertown Road in Montville that is currently zoned for this use.

5.8.7 MITIGATION MEASURES – LAND USE AND COMMUNITY CHARACTERISTICS

Relocation assistance would be offered to all displaced persons and businesses in accordance with state and federal regulations.

Connecticut Public Act 88-255 (CGS 8-267a) authorizes all state agencies to comply with the *Federal Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 as amended* (*Uniform Act*) (USC 4601-4655) for federally assisted projects or programs. Public Act 91-78 authorizes ConnDOT to provide relocation assistance to displaced property owners where property acquisitions are required to implement federally funded projects. Under the Uniform Act, relocation payments and/or other assistance would be provided to displaced residents and businesses. Information about ConnDOT's relocation policy information and the Uniform Act is included in Appendix F.

A Conceptual Stage Relocation Needs Assessment was prepared to determine the availability of replacement housing in the corridor; it is provided in Appendix F. The assessment determined that there is a sufficient supply of single-family housing for sale, but there is a shortage of homes for rent.

In cases where a partial property acquisition is required or where a property is bisected, leaving an owner with an unusable portion of property, the state will monetarily compensate owners for any land required or left uneconomic. Should replacement housing become a problem, federal-aid last resort housing procedures will be implemented without discrimination to insure that replacement housing is available prior to highway construction.

Displaced businesses or firms have three options available including relocating to another part of the local area, relocating to another town or outside of the region completely, or liquidation. ConnDOT would provide all possible assistance to owners of displaced businesses in relocating to another location.

Any establishment which chooses to relocate in town would not cause a loss of jobs or income to that community. The business volumes represented by those firms which liquidate or move out of the region would be absorbed by other firms in the area resulting in redistribution rather than a real loss of business activity. This, however, does not diminish the adverse impacts to the owners, employees, and customers of these displaced or liquidated businesses. The ability of a firm to survive relocation can depend on the size of the business, profitability of the operation in an owner-operated establishment. However, there is no way of predicting whether businesses will fail or survive as a result of displacement. Ample replacement land is available in the area and all firms would receive full benefits they are entitled to under the state's relocation policy.

5.9 FARMLAND RESOURCES

5.9.1 FARMLAND IMPACTS

Farmland in the United States is considered a diminishing resource as an outcome of the effects associated with ongoing development patterns that prevent the land from being used for agriculture. This trend is also present in the Connecticut towns of the Route 82/85/11 corridor where farmlands offer the most attractive qualities for building and have thus become the target for subdivision development.

In an effort to curtail the irretrievable loss of farmland, legislation was enacted on a state and federal level to restrict development within areas of prime farmlands. Under the Farmland Protection Policy Act, overall impacts of federally-funded projects to agricultural lands must be assessed using the USDA's Farmland Conversion Impact

Rating Form. After the selection of a preferred alternative, ConnDOT and FHWA must file this form with the NRCS, if required.

Additionally, the Connecticut Department of Agriculture (CTDOA) must review any proposed capital project that would convert 10.1 ha. (25 ac.) or more of prime farmland to non-agricultural use. Several of the alternatives evaluated, herein, would require this review if selected as the preferred alternative. The State Farmlands Protection Program provides help to farm owners wishing to retain their farmlands. The CTDOA was contacted regarding the presence of farmlands in the study area. There are currently no lands within the corridor protected under this program (Dippel, 1998).

5.9.2 COMPARISON OF FARMLAND IMPACTS

Following is a discussion of the direct quantitative impact each alternative may have on areas of prime farmland as a result of right-of-way acquisition requirements. Impacted farmland areas have been assigned identification numbers, depicted on Figure 5-19. Impacts have been estimated by superimposing conceptual engineering designs for each alternative upon designated prime farmland areas (Section 4.9.1). These estimates are summarized in Table 5-62.

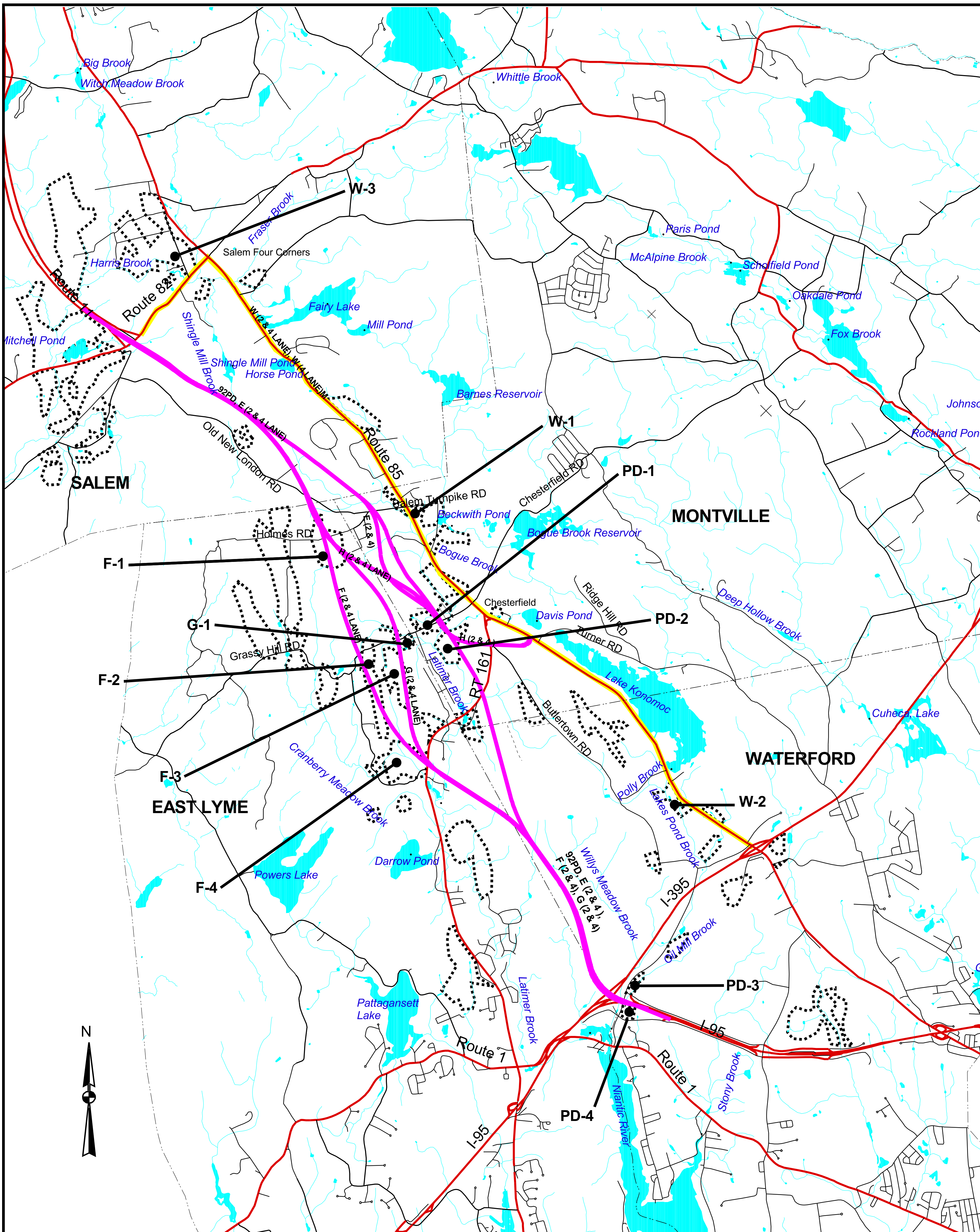
5.9.2.1 *No Build Alternative*: No specific building or improvement activities are planned under the no build scenario that would affect farmlands.

5.9.2.2 *Route 82 and 85 Widening Alternatives*: Any of the widening alternatives for of Routes 82 and 85 would impact three areas of farmland identified as areas W-1, W-2 and W-3. Area W-1 is a wet meadow and is zoned Water Resource Protection, but is not water company land. Area W-2 is primarily forested wetland situated between a three-acre residential zone and an industrial zone. Area W-3 is a very large parcel presently under cultivation for corn and is zoned for business.

The impacts associated with the widening alternatives vary for each scenario; therefore, the three widening alternatives are discussed individually, below.

$W_{(4)}$ Alternative: Impact to areas W-1 and W-2 would be 0.16 ha. (0.39 ac.) and 0.09 ha. (0.23 ac.) respectively. Widening will also require 0.07 ha. (0.17 ac.) of area W-3. The total impact of this alternative is 0.32 ha. (0.78 ac.) representing less than 1% of the total area.

$W_{(4)}$m Alternative: This alternative would impact the same areas as the $W_{(4)}$ alternative, but would require acquisition of slightly less right-of-way. Total impact to farmland areas associated with the modified four-lane alternative would be 0.26 ha. (0.65 ac.).



LEGEND

Designated Prime Farmland

Water Bodies and Streams

Expressway Alternatives

Widening/Upgrade Alternatives RT 82/85

State of Connecticut Department of Transportation
Federal Highway Administration

ROUTE 82/85/11
ENVIRONMENTAL IMPACT STATEMENT (EIS)

IN THE TOWNS OF
EAST LYME, MONTVILLE, SALEM AND WATERFORD

STATE PROJECT #120-81

PRIME FARMLAND IMPACT AREAS

Notes:

Sources:
Prime Farmland: Farms or Undeveloped Farmland Soils
Hydrology: CTDEP Natural Resources Center GIS Database 1994
Farmland Soils: CT DEP/NRCS GIS Database
EIS Alternatives: CTDOT and Maguire Group

2500 0 2500 5000 Feet

500 0 500 1000 1500 Meters

July 1998

Figure 5-19

TABLE 5-62
SUMMARY OF PRIME FARMLAND IMPACTS

ALTERNATIVE	FARMLAND ID # * (AFFECTED AREAS)	TOTAL AREA HECTARES	TOTAL AREA ACRES	IMPACT AREA HECTARES	IMPACT AREA ACRES
No build	--	N/I	N/I	N/I	N/I
$W_{(4)}$	W-1, W-2, W-3	81.66	201.80	0.32	0.78
$W_{(4)}$m	W-1, W-2, W-3	81.66	201.80	0.26	0.65
$W_{(2)}$	W-1, W-2	11.66	28.80	0.18	0.45
TSM	W-1	2.19	5.40	0.12	0.30
TDM/Transit	--	N/I	N/I	N/I	N/I
92PD	PD-1, PD-2, PD-3, PD-4	37.32	92.20	6.32	15.61
$E_{(4)}$	PD-1, PD-2, PD-3, PD-4	37.32	92.20	6.32	15.61
$E_{(2)}$	PD-1, PD-2, PD-3	34.08	84.20	5.93	14.65
$F_{(4)}$	F-1, F-2, F-3, F-4, PD-3, PD-4	108.07	267.02	34.49	85.23
$F_{(2)}$	F-1, F-2, F-3, F-4, PD-3, PD-4	108.07	267.02	30.55	75.48
$G_{(4)}$	F-1, G-1, F-3, F-4, PD-3, PD-4	90.83	224.42	25.58	63.19
$G_{(2)}$	F-1, G-1, F-3, F-4, PD-3, PD-4	90.83	224.42	21.21	52.40
$H_{(4)}$	F-1, PD-1, PD-2, W-2	66.05	163.2	16.73	41.35
$H_{(2)}$	PD-1, PD-2, W-2	39.78	98.30	7.40	18.28
$E_{(4)}$m-V3	PD-1, PD-2	30.80	76.20	3.40	8.40

* See Figure 5-19
N/I = No impact or negligible impact

$W_{(2)}$ Alternative: The two-lane widening alternative would involve the least amount of farmland impact of all the build alternatives. Total farmland area required for the $W_{(2)}$ alternative is 0.18 ha. (0.45 ac.) of areas W-1 and W-2, representing 1.5% of total farmland abutting the areas of roadway requiring additional right-of-way.

5.9.2.3 *TSM Alternatives*: The TSM improvement recommendations, as presented, would impact a small amount of designated farmland near Salem Turnpike (the W-1 area). A total of 0.12 ha. (0.3 ac.) would be impacted under the TSM alternative.

5.9.2.4 *TDM/Transit Alternatives*: Implementation of either TDM or transit measures would not involve alteration of any land areas, therefore, no effect upon designated farmlands would be expected.

5.9.2.5 *New Location - Full Build Alternatives*: Potential farmland impact areas vary by alternative for the routes on new location, therefore each alternative is discussed individually, below.

92PD Alternative: Under the 92PD alignment alternative, the most northerly farmland parcel, PD-1, would incur anticipated impact of 2.33 ha. (5.76 ac.). The impact to area PD-2 is estimated to be 2.93 ha. (7.25 ac.). The 92PD alignment bifurcates these areas which consist of forest (PD-1), old field, and actively cultivated hayfield (PD-2).

Farmland areas PD-3 and PD-4 will also be impacted. Right-of-way requirements in these areas will be a 0.96 ha. and 0.10 ha. (2.36 ac. and .24 ac.), respectively. Total impact area for the 92PD alternative would be 6.32 ha. (15.61 ac.) out of a total farmland area of 37.32 ha. (92.20 ac.), representing a relative farmland loss of 17%. Of this total, 3.4 ha. (8.5 ac.) or 9% is already owned by the State of Connecticut. The remaining 8% is zoned for two-acre residential development.

E Alternatives: For alternative $E_{(4)}$, impacts to prime farmland would be identical to those associated with the 92PD alternative, and would total 6.32 ha. (15.61 ac.). The two-lane alternative, $E_{(2)}$, would result in less area of farmland impact than its four-lane counterpart. Although $E_{(2)}$ provides a reduced footprint, the difference in impact area is marginal, resulting from the cuts and fills required to construct the roadway on either the two-or four-lane alignment. The anticipated area of impact for the $E_{(2)}$ alignment is 5.93 ha. (14.65 ac).

F Alternatives: The more westerly four-lane alignments would require the greatest amount of farmland acquisition of all the alternatives. Areas of impact associated with Alternative $F_{(4)}$ include F-1, which is currently forested, and F-2, a long, narrow tract of land. Alternative $F_{(4)}$ bisects and travels the length of F-1 and F-2, resulting in approximately 9.17 ha. (22.67 ac.) and 11.25 ha. (27.80 ha.) of impacted area, respectively. Area F-3 is located just east of F-2 and west of Cardinal Road. F-2 and F-3 are both fields and are zoned for one-acre residential lots. All four study area towns list farming as a permitted use in areas zoned for lots of one-acre or more. Impact to F-3 would be 4.28 ha. (10.58 ac.) along its eastern edge. At the interchange of Alternative F with Route 161, the northeast edge of area F-4 is traversed, requiring acquisition of 8.73 ha. (21.58 ac.) of farmland. This land is primarily forest with small plots of "garden farms." Like 92PD and the E alternatives, PD-3 and PD-4 are also impacted. The total impact to prime farmland for Alternative $F_{(4)}$ is 34.49 ha. (85.23 ac.), which represents approximately 32% of the prime farmland located proximal to this alignment.

The two-lane alternative, $F_{(2)}$, would impact the same parcels as $F_{(4)}$, however to a slightly lesser degree. The difference between the two- and four-lane alignments is not substantially different given the overall disturbance area resulting from profound cuts and fills. The anticipated area of impact for the two-lane variation would be 30.55 ha. (75.48 ac).

G Alternatives: The $G_{(4)}$ alternative also involves substantial farmland impact. As with Alternative $F_{(4)}$, Alternative $G_{(4)}$ passes through areas F-1, F-3, F-4, PD-3 and PD-4. In addition, it passes through area G-1, where the area of right-of-way impact would be 3.21 ha. (7.93 ac.). This area is zoned for one-acre residential use and is currently covered by fields. The total impact for this alternative is 25.58 ha. (63.19 ac.) or 28% of a total of 90.83 ha. (224.42 ac.) of farmland through which it passes.

As with the F alternatives, impacts to farmlands are not substantially different between two-lane and four-lane alternatives, given the disturbance areas resulting from cuts and fills. $G_{(2)}$, would impact the same parcels as $G_{(4)}$; the total impact area is estimated at 21.21 ha. (52.40 ac.).

5.9.2.6 *New Location - Partial Build Alternatives*: The partial build alternatives, $H_{(4)}$ and $H_{(2)}$, cross previously discussed farmland areas F-1, PD-1 and PD-2. Additionally, the widening of Route 85 would result in a slight impact to area W-2 of 0.09 ha. (0.23 ac.). The total area of impact for the $H_{(4)}$ alternative is 16.73 ha. (41.35 ac.) out of a total area of 66.05 ha. (163.20 ac.), or 30% of the total farmland traversed by the four-lane alternative. The $H_{(2)}$ alternative would result in a total impact of 7.4 ha. (18.28 ac.) or 20% of the whole.

5.9.2.7 *Preferred Alternative:* Preferred alternative $E_{(4)}$m-V3 would impact 3.4 ha (8.4 ac) of prime farmland. The impact would occur on four privately-owned parcels of land located on the north and south sides of Grassy Hill Road in Montville. Of the impacted land, 2.3 ha (5.8 ac) are currently active hayfields and the remaining area of impact contains residential land uses. This impact would not preclude the use of the remainder of the parcels for farming. Access from Grassy Hill Road to adjoining fields would be maintained.

Formal review by the Connecticut Department of Agriculture is not required for the preferred alternative because less than 25 ac. will be converted to non-farm use, and the land is not under the protection of the State Farmland Preservation Program. In accordance with the Farmland Protection Policy Act of 1981, and after consultation with the Natural Resources Conservation Service (NRCS), a Farmland Conversion Impact Rating Form For Corridor Type Projects (NRCS-CPA-106) was completed and entered into the project files. The preferred alternative does not exceed the threshold of total site assessment points that would require further review by the NRCS.

5.9.3 Mitigation Measures

Replacement of agricultural land is not a viable mitigation measure in this corridor. The topography, many wetlands, streams and lands already under development reduce the feasibility of locating additional suitable cropland. Given the dispersed nature of resources in the corridor, shifting of the proposed alignments to completely avoid farmland areas would only result in comparable impacts to other farmland areas or resources such as wetlands or developed parcels.

Possible mitigation options could be employed to try to minimize the extent to which a farmland area is impacted. Examples of these types of measures include:

- Minor shifts in expressway alignments where possible to minimize total impact to high-quality soils and avoid bifurcation of farm fields;
- Minimization of right-of-way in farmland areas; and/or
- Provision of access between any farm parcels that are fragmented as a result of the new roadway.

5.10 Socioeconomic Environment

There have been no significant changes in the socioeconomic environment since the draft of this document was published that would change the impact analysis presented herein. Where additional or updated information has been collected that is pertinent to this analysis, such information has been added or previous information updated.

An analysis of the indirect impacts related to induced growth and changes in land use is provided in Section 5.18.

5.10.1 Comparison of Socioeconomic Impacts

5.10.1.1 *No Build Alternative*: Under the no build condition, growth within the corridor would be generally governed by regional and state trends only; i.e., not specifically influenced by a considerable change to the existing transportation system. Regional and state growth trends would, to some extent, be influenced locally by the implementation of town policies and objectives currently advocated in the existing plans of development.

The anticipated increases in traffic volumes that are expected along Routes 82 and 85 would likely affect corridor-area business. Depending on the type and location of individual business, the effects could be either positive or negative. Ease of access would be a principal factor affecting the ability of an individual business to thrive. While some types of businesses (e.g., gas stations, convenience stores) would likely benefit from the increase in motorists, other businesses might not be able to attract customers if traffic congestion or poor access are perceived as substantial impediments to would-be patrons.

The anticipated increase in traffic and congestion along Routes 82 and 82 would likely deter further residential construction, especially where direct access from either of these routes would be required.

According to the Salem officials and the Salem Economic Development Commission, lack of a direct highway link to I-95 has hampered economic development of their industrial park near the Route 11 interchange at Witchmeadow Road and the highway commercial zones on Route 82. This is predicted to continue under the no build scenario, which is contrary to the economic goals and objectives of the town and would constitute an adverse economic impact. In the meantime, the town is searching for alternatives to highway-oriented or industrial development.

Under the no build alternative it is very likely that the commercial and industrial zones as well as the proposed right-of-way for Route 11 would become increasingly attractive for residential development. This would have an adverse economic effect on the town of Salem.

5.10.1.2 *Route 82 and 85 Widening Alternatives*: The anticipated increase in traffic volumes would provide a direct growth impact on the Route 82 and 85 corridor. In addition, secondary impacts would likely accrue in adjacent communities that are directly linked to Route 85 and/or are secondarily linked via I-395 and I-95. To some degree, there would be related growth impacts to lands accessible from Route 85 via the local road network. Initial impacts would probably be an incrementally greater increase in residential growth as a result of the improved access. Later impacts may be growth in existing and proposed commercial and industrial zoned lands, again resulting from the increased traffic volumes along the Route 82 and 85 corridor.

5.10.1.3 *TSM Alternative*: Safety improvements to key intersections located along Route 85 would not have a considerable effect on the growth and development of the four towns. The reduction in traffic congestion to these areas may result in slight increases in commercial and residential growth stemming from increased accessibility to nearby businesses and subdivision roads.

5.10.1.4 *TDM/Transit Alternative*: Transit opportunities connecting to major shopping areas such as the Crystal Mall or to medical facilities in the New London area may be favorable to lower income individuals as well as the growing elderly population. However, expansion of transit opportunities via SEAT's proposed W Route would likely have only a nominal impact given the projected ridership figures.

The addition of expressway-related services such as commuter parking areas and promotion of ridesharing would supplement local transportation opportunities in the corridor. Benefits would accrue to the general employed population and assist the growing demand for services to the elderly population. Related benefits may be realized by the tourism industry both on a local and regional scale.

While some benefits may be realized, the TDM/Transit alternative would not be expected to have a substantial effect on socioeconomic resources within the corridor towns.

5.10.1.5 *New Location - Full Build Alternatives and Preferred Alternative*: The full build alternatives, 92PD, $E_{(4)}$, $E_{(2)}$, $F_{(4)}$, $F_{(2)}$, $G_{(4)}$, $G_{(2)}$, and preferred alternative $E_{(4)}$m-V3 would be likely to effect a change in existing transportation patterns. Regarding travel incentives related to time savings, the expressway alternatives would, conceivably, provide the greatest benefit to local and linked communities with respect to the growth of the housing market, employment opportunities and, ultimately, income distribution. To explore this potential relative to the extension of Route 11, information collected for the traffic analysis (Section 5.1) regarding travel speeds through the corridor was used to make a generalized comparison of travel times for the existing roadway and for the proposed new section of Route 11. The travel time reduction was estimated to be between 2 and 8 minutes. This information, along with other data collected, suggests that the effective decrease in travel time afforded by the new 8.5-mile roadway section would not be a substantial catalyst for new residential growth that would not occur otherwise, or change projected rates of population or housing growth within the study area. This analysis is discussed further in Section 5.18.

Following are discussions under each of the major socioeconomic categories as they relate to the corridor area study.

Population: An increase in population within the study area may be expected as an outcome of regional trends toward growth in the suburban and rural towns, and the resultant growth in both single-family and multi-family housing units. This growth pattern is compatible with the four town plans of development, as all have expressed objectives to improve affordable housing opportunities. More affordable housing invites first time buyers. Despite the state projected trend (OPM 1998) of a steadily decreasing young adult population through the year 2005, the increased access to the four town area would provide an attractive venue for the young adult segment of the population.

Potential new commercial/industrial growth locally, and improved access to larger urban centers of employment, may provide a strong market of potential buyers of affordable housing for a wide spectrum of the population, including minority populations, which are the fastest growing in the state (OPM 1998). Improved access and increases in the availability of affordable housing may combine to attract a greater share of minority population in the region. However, very little affordable housing, such as rental property, is being constructed in the study area. The price of single-family homes has increased 50% since 2000 and this remains the primary development market (SCCOG 2004). The trend for an ever-increasing rate of growth in the older-aged population would place pressure on communities having good accessibility to provide housing and community services for this segment of the population. An increase in the development of age-restricted housing has occurred in the study area, as it has statewide, and developers are expressing interest in land currently zoned for industrial or other non-residential uses. Trends in population growth are discussed further in the Indirect and Cumulative Impacts analysis in Section 5.18.

Income: In the short-term, project construction-related work would generate income for all job categories related to the construction industry. New development directly related to the improved access would continue to employ the construction industry. New jobs may also be created as a result of a local increase in commercial/industrial land uses. Improved access between regional urban centers, combined with the growth of export-oriented industry, the entertainment industry, and related transportation industry would have a collective, positive effect on jobs and income levels. Increased growth in the general population translates to an increase in purchase of consumer goods, which in turn would positively affect local convenience consumer markets as well as the larger commercial centers.

Employment: Commercial/industrial growth resulting from improved access would provide more employment opportunities within the region. Towns recommend the consolidation of commercial/industrial land uses with expanded acreage into those areas now served by efficient transportation corridors. Improved access would provide greater incentive to develop within these designated land use areas.

The trend toward export-oriented industries and fostering of the "industry cluster" concept, combined with the growing entertainment and transportation-related job market that is unique to the southeastern Connecticut region, would benefit from any improved access projects associated with the I-395/I-95 transportation corridors. Economic growth trends are also discussed in Section 5.18.

Real Estate: Growth of affordable housing opportunities, resulting from improved access to work force opportunities found in nearby urban centers, would also provide more options for those on fixed incomes. Changes in town plans of development and zoning regulations may occur in order to increase areas available for multi-family and cluster development; this goal is compatible with the expected increased housing demand resulting from improved access to the towns. Potential growth in housing is evaluation in Section 5.18.

5.10.1.6 *New Location - Partial Build Alternatives*: The partial build alternatives, $H_{(4)}$ and $H_{(2)}$, would affect many of the same impacts experienced under the full build alternatives. However, improved accessibility to the more urban areas and regional workplaces would be somewhat reduced as compared with the full build alternatives. Existing transportation patterns would remain similar for the portion of Route 85 south of the expressway's point of intersection.

5.10.2 MUNICIPAL SERVICE IMPACTS

As discussed in Section 5.10.1, implementation of a full build expressway alternative, including the preferred alternative, would likely result in the most growth of commercial and industrial land uses caused by the improved mobility within the corridor. The increase in accessibility and development would have impacts on the delivery of various municipal services to the four towns as described below. Following are discussions related to each of the major municipal services that could be affected by the transportation alternatives.

5.10.2.1 *Police Protection/Fire Protection*: All emergency services would realize some benefit from a completed expressway as it would create a time savings for response to police emergencies. Fire districts currently shared by adjoining towns would realize similar benefits. The widening scenarios would afford some increase in travel time for emergency vehicles in comparison to the no build, TSM, and TDM/Transit alternatives. Under the no build condition, increased traffic and congestion during peak periods would hamper emergency response efforts.

5.10.2.2 *Emergency Medical/Health Services*: As with police and fire emergencies, medical services would also be expedited for emergency and non-emergency situations in the event of expressway completion. More affordable age-restricted housing for those on fixed incomes combined with the trend for a growing aged population would tend to increase local elderly populations, which would create a greater demand for family and health care facilities in the study area towns.

5.10.2.3 *Education Facilities/Library Facilities*: Based on population trends for the state (OPM 1995), high school enrollments would continue to increase each year through 2020. An enhanced employment market and related housing opportunities associated with improved transportation access could affect local school populations. Current school capacities and forecasts for future needs are based in large part on OPM forecasted trends. The level of new development projected to occur within the corridor as a result of the preferred alternative is not expected to generate employment and/or housing growth that would affect projected school enrollments (see Sections 5.10.1.5 and 5.18 for more details).

5.10.3 ENVIRONMENTAL JUSTICE

As the primary means of evaluating impacts relative to environmental justice considerations, U.S. 1990 census data and state of Connecticut data, as compiled by the DECD, were evaluated. A review of the 2000 census data as well as corridor property assessment information indicate that data cited below continues to be applicable for use in this analysis.

With the exception of the Town of Salem, where an estimated 49% of the population lives within block 68, (Figure 4-28) all other affected blocks represent under 10% of their respective town populations. Using minority population percent distributions for each town as the scale of reference balanced against the block data for each town, the relative percentage variances between town wide and block statistics is considered small. Similarly, per capita income variation between towns is considered small (within 20%) and all towns are above the average per capita income for New London County.

When considered in the context of the overall Route 82/85/11 corridor study area, socioeconomic impacts extend over the full spectrum of zoned land uses including residential densities that range from 0.2 ha. (0.5 ac.) to 1.2 ha. (3 ac.) single-family lot restrictions. The analysis demonstrated that on a census block basis, within the Route 11 corridor project area of impact, none of the study alternatives or the preferred alternative would have a disproportionately high and adverse impact on a minority or low income population.

5.11 HISTORIC, CULTURAL AND ARCHAEOLOGICAL RESOURCES

5.11.1 COMPARISON OF HISTORIC ARCHITECTURAL IMPACTS

Impacts to NRHP-eligible historic resources of the corridor (Table 4-62; Figure 4-31) were analyzed based on their proximity to the proposed alternatives and the degree to which each property would be impacted. Some resources would be directly impacted and demolition or removal of a structure or structures would be necessary. Other properties may be indirectly adversely affected by the nearness of the roadway project (i.e., reduction in the rural character of a house's setting). In the case of historic cemeteries, it is not unusual to discover burials outside the present-day boundaries; therefore, even if road construction takes place outside the apparent boundary, the piece of land taken should be checked for possible burials.

The anticipated number of NRHP-eligible historic resources impacted by each alternative, and cemeteries that are not eligible but are protected by CT General Statute Section 10-388, is provided in Table 5-63. The anticipated level of impact, if any, on each historic property is summarized in Table 5-64. Preferred alternative $E_{(4)}$m-V3 avoided all potential impacts to eligible architectural resources and cemeteries. Determination of eligibility was made after professional review of the corridor and in consultation with SHPO. Properties eligible for the NRHP receive protection under Section 4(f) of the Department of Transportation Act of 1966 which stipulates that prior to use of such properties, it must be determined that no feasible alternative exists that avoids this use and that the project includes all possible planning to minimize harm to these resources. A detailed Draft Section 4(f) Evaluation was prepared for the DEIS. Because the preferred alternative does not affect NRHP-eligible historic resources, a final Section 4(f) Evaluation is not required for these historic resources.

TABLE 5-63
SUMMARY OF IMPACTS TO NRHP-ELIGIBLE RESOURCES BY ALTERNATIVE

ALTERNATIVE	ELIGIBLE RESOURCES	NON-ELIGIBLE HISTORIC CEMETERIES
No build	0	0
$W_{(4)}$	10	1
$W_{(4)}$m	10	1
$W_{(2)}$	10	1
TSM	0	0
TDM/Transit	0	0
92PD	1	0
$E_{(4)}$	1	0
$E_{(2)}$	0	0
$F_{(4)}$	2	0
$F_{(2)}$	1	0
$G_{(4)}$	2	1
$G_{(2)}$	1	1
$H_{(4)}$	4	0
$H_{(2)}$	4	0
$E_{(4)}$m-V3	0	0

.

Table 5-64
Historic/Architectural Resource Impacts

Site ID	Description	Impact*	Alternative: $E_{(4)}$m-V3	TSM	TDM/ Transit	$W_{(4)}$	$W_{(4)}$m	$W_{(2)}$	92PD	$E_{(4)}$	$E_{(2)}$	$F_{(4)}$	$F_{(2)}$	$G_{(4)}$	$G_{(2)}$	$H_{(4)}$	$H_{(2)}$
E	House, c.1800	Indirect										×	×	×	×	×	×
H	House, c. 1865	No impact															
I	Holmes Cemetery[1]	Direct												×	×		
J	House, c.1870	No impact															
K	House, c.1770	No impact															
L	House, c.1790	No impact															
M	D.W.Stanton House	No impact															
N	House, c.1800	Indirect				×	×	×									
O	Barn, c.1850	Indirect				×	×	×									
S	Elijah Ransom House	Indirect				×	×	×									
T	Raymond Cemetery	No impact															
U	Latimer Farm	Indirect				×	×	×									
V	DeWolf Cemetery	Indirect (check for outside burials)				×	×	×									
W	House, 18th C	Indirect (encroach upon yard) Direct				 ×	× 	× 									
X	Gilbert Cemetery[1]	Direct (check for outside burials)				×	×	×									
BB	Chesterfield Cemetery	Direct				×	×	×									

TABLE 5-64
HISTORIC/ARCHITECTURAL RESOURCE IMPACTS

SITE ID	DESCRIPTION	IMPACT*	ALTERNATIVE $E_{(4)}$m-V3	TSM	TDM/ Transit	$W_{(4)}$	$W_{(4)}$m	$W_{(2)}$	92PD	$E_{(4)}$	$E_{(2)}$	$F_{(4)}$	$F_{(2)}$	$G_{(4)}$	$G_{(2)}$	$H_{(4)}$	$H_{(2)}$
DD	House, c. 1840	Indirect					✗	✗									✗
		Direct				✗										✗	
FF	E. F. Morgan House	Indirect					✗	✗									✗
		Direct				✗										✗	
HH	Lake Pond Cemetery	Direct (check for outside burials)				✗	✗	✗								✗	✗
KK	Bridge, c.1850	No impact															
LL	Latimer Mill Site	No impact															
MM	Family Cemetery[1]	No impact															
NN	Waller House	Indirect							✗	✗		✗		✗			
OO	Riverhead Cemetery	No impact															
PP	House, c. 1830	No impact															
QQ	House, c. 1760	No impact															
RR	House, c. 1780	No impact															
SS	Waterford Speedbowl	No impact															
TOTAL RESOURCES IMPACTED:		Indirect	0	0	0	5	8	8	1	1	0	2	1	2	1	1	3
		Direct	0	0	0	6	3	3	0	0	0	0	0	1	1	3	1

✗= impacted resources

* Direct = Razing or removal of structure required / Indirect = Reduction of rural quality of setting (impact on private land/landscape features)

[1] Not eligible, but requires protection under state statute.

5.11.1.1 *No Build Alternative*: The no build alternative is not expected to impact historic resources. However, these resources may incur secondary impact resulting from future development in the corridor.

5.11.1.2 *Route 82 and 85 Widening Alternatives*: Since most historical development in the study area occurred along the main turnpikes, the widening of these roads would, logically, result in the greatest impact to historic resources. Any of the three plans for widening Routes 82 and 85, $W_{(4)}$, $W_{(4)}$m or $W_{(2)}$, would appear to cause direct or indirect impact to ten NHRP-eligible properties, including three eligible cemeteries. They would also impact one additional non-eligible historic cemetery located along Route 85. The more substantial the widening, the more severe would be the effects on historic resources.

5.11.1.3 *TSM Alternatives*: The widening of Route 82 associated with the suggested TSM improvements will not affect eligible historic properties.

5.11.1.4 *TDM/Transit Alternatives*: These alternatives are not expected to impact historic resources because they do not involve construction in the vicinity of any of these properties.

5.11.1.5 *New Location - Full Build Alternatives*: The full build alternatives will incur a lesser amount of impact on architectural historic resources in the corridor than the other build alternatives. The two-lane versions of each full build alignment require the least impact, attributable to the reduced disturbance proposed at the I-395/I-95 interchange. Potential impacts vary by alternative for the routes on new location, therefore each alternative is discussed individually, below.

92PD Alternative: The 92PD alignment may indirectly affect one eligible historic property on Gurley Road as a result of construction of the new interchange with I-395/I-95 where a cut line approaches the house located immediately adjacent to I-95.

E Alternatives: Like the 92PD alternative, $E_{(4)}$ may indirectly impact the historic property on Gurley Road near the new I-395\I-95 interchange. Alternative $E_{(2)}$ would not impact historic properties.

F Alternatives: Alternatives $F_{(4)}$ and $F_{(2)}$ appear to indirectly impact one eligible historic house in the northern portion of the alignment. In addition, as is the case with 92PD and $E_{(4)}$, new construction for the interchange with I-395/I-95 required for $F_{(4)}$ appears to indirectly impact a historic property on Gurley Road.

G Alternatives: The $G_{(4)}$ and $G_{(2)}$ alternatives appear to impact one potentially eligible historic house and one non-eligible cemetery in the northern portion of the corridor. Additionally, as mentioned with the previous alternatives, new construction at the interchange with I-395/I-95 required for $G_{(4)}$ appears to impact a historic property on Gurley Road.

5.11.1.6 *New Location - Partial Build Alternatives*: Alternatives $H_{(4)}$ and $H_{(2)}$ appear to impact indirectly one eligible historic house along the new location section of the partial build. Since the partial build touches down on Route 85 south of Route 161, three additional properties, including one eligible cemetery, would be impacted by the Route 85 widening portion of this alternative.

5.11.1.7 *Preferred Alternative*: None of the buildings, structures, districts, or sites identified as eligible for the NRHP would be impacted by preferred alternative $E_{(4)}$m-V3. One NRHP-eligible resource, 21 Gurley Road, is located immediately adjacent to the proposed Route 11/I-95 interchange. The 21 Gurley Road property was revisited by project historians and a representative from the SHPO. After it was determined that this historic resource could be adversely affected by the design of the Route 11/I-95 interchange, avoidance measures were incorporated into the preferred alternative concept plan. The interchange ramps will be designed to avoid any encroachment on this property.

Although the Taber Cemetery, which was identified within the area of the I-395/I-95 interchange improvements, does not fulfill criteria for NRHP eligibility, it was considered in the overall planning effort so that the project could avoid its disturbance.

5.11.2 Mitigation Measures

The conceptual plan for the preferred alternative incorporates measures to avoid impacts to NRHP-eligible historic properties. The FHWA has consulted with the SHPO on the proposed project pursuant to 36 CFR 800 implementing Section 106 of the National Historic Preservation Act and a Memorandum of Agreement (MOA) between FHWA and the SHPO, with concurrence from ConnDOT, has been executed. The MOA contains stipulations for taking into account the effect of the project on historic and potentially significant archaeological resources. The MOA is provided in Appendix G. Stipulations for historic properties are summarized as follows:

- FHWA and/or ConnDOT will provide the SHPO an opportunity to review and comment on all project-related improvements proposed in the vicinity of 21 Gurley Road in East Lyme.
- FHWA and/or ConnDOT shall conduct a pre-construction remote sensing survey to determine boundaries of Taber Cemetery. FHWA and/or ConnDOT shall ensure that a fifty-foot construction free buffer with temporary protective fencing is maintained around the Taber Cemetery during construction.

5.11.3 COMPARISON OF ARCHAEOLOGICAL IMPACTS

5.11.3.1 *No Build Alternative*: The no build alternative is not expected to impact archaeological resources. However, these resources may incur secondary impact resulting from future development in the corridor.

5.11.3.2 *Route 82 and 85 Widening Alternatives*: The $W_{(4)}$, $W_{(4)}$m and $W_{(2)}$ alternatives would impact twenty-four identified archaeological sites. Four of the sites may be associated with standing historic structures (DD, FF, S, U, on Figure 4-29). Because $W_{(4)}$ and $W_{(4)}$m are wider, they are more likely than $W_{(2)}$ to impact as yet discovered archaeological sites or sites associated with standing structures located a greater distance from the existing right-of-way (e.g., N, O, W, on Figure 4-29).

Four cemeteries may be impacted. Under the widening alternatives the road would move close to the front wall of the DeWolf/Latimer/St. John Ukranian Cemetery (V on figure). Although there appears to be a sufficient buffer to avoid impact, it is not unusual for unmarked graves to be found outside cemetery walls. The area outlying the cemetery walls would be checked for burials prior to construction.

The Gilbert Cemetery (X on figure) would be impacted directly. Even if widening halts before the apparent front cemetery boundary, the outside area would be checked for burials. Widening would also directly impact the front part of the Lake Pond Cemetery (HH on figure). Burials may exist outside of the marked walls and the area would be checked. The southeast corner of the Chesterfield Cemetery (BB on figure) would be directly impacted.

Alternatives $W_{(4)}$, $W_{(4)}$m, $W_{(2)}$ and would have the least impact on prehistoric archaeological resources, with Alternative $W_{(2)}$ being the least damaging. These Route 85 alternatives contain only about 25% of the projected site numbers as do the cross-country alternatives. However, they would impact the greatest number of sites associated with historic structures and cemeteries.

5.11.3.3 *TSM Alternative*: The TSM alternative is not expected to result in impacts to archaeologically sensitive areas.

5.11.3.4 *TDM/Transit Alternatives*: Implementation of TDM strategies or expansion of transit opportunities would not be expected to result in impacts to archaeologically sensitive areas.

5.11.3.5 *New Location - Full Build Alternatives*: Potential impacts vary by alternative, therefore each alignment is discussed individually, below. The preferred alternative is discussed in Section 5.11.3.7.

92PD Alternative: Construction of the 92PD alignment would adversely impact at least 25 known prehistoric sites and an estimated 100 more. Many of these sites are likely eligible for the National Register, and it is possible that a large cluster of the sites may qualify for National Register status as a thematic resource group. This alternative would also impact the abandoned Butlertown community (also referred to as Wolf Pit Village) in at least two areas. Although the village's precise boundaries have yet to be identified, they clearly extend along Pember Road, which the 92PD alignment follows and eventually crosses (Figure 4-29). Impacts would be direct because the highest density of sites is located along Pember Road. Butlertown contains at least 14 archaeological sites and is almost certainly eligible for the National Register. It is a significant historic site.

At the interchange of I-395/I-95, possible archaeological remains associated with one historic property (NN) may be impacted. As discussed in the preceding Architectural Resource section, this site comprises historic buildings and potential archaeological sites.

E Alternatives: Like the 92PD alternative, $E_{(4)}$ and $E_{(2)}$ would also adversely impact at least 25 known prehistoric sites and an estimated 100 more. As mentioned above, many of these sites are likely eligible for the National Register, and it is possible that a large cluster of the sites may qualify for National Register status as a thematic resource group. These alternatives would also impact the abandoned Butlertown community. The impact would be direct because the E alignments, like 92PD, extend along and cross Pember Road. Although the village's precise boundaries have yet to be identified, the highest known density of sites is along Pember Road.

Impacts associated with the $E_{(4)}$ alternative in the vicinity of the I-395/I-95 interchange are identical to those for the 92PD; the two-lane alternative differs only in that it avoids the National Register-eligible property near the interchange.

F Alternatives: Both the $F_{(4)}$ and $F_{(2)}$ alternatives would impact a predicted 100 prehistoric sites, many of which potentially qualify for National Register listing. They would also impact a portion of Butlertown, though less severely than Alternatives 92PD or E because the site is crossed in only one area (Figure 4-29).

Probable archaeological remains associated with two historic houses (E, and NN on Figure 4-29) would be impacted by the $F_{(4)}$ alternative; one of these historic houses (E) would be impacted by alternative $F_{(2)}$.

G Alternatives: Like the other full build alternatives, Alternative G would impact an estimated 100 prehistoric sites, many of which are likely eligible for the National Register, and would also affect a portion of Butlertown, though less severely than the 92PD or E alternatives because the site is only crossed in one area.

With the $G_{(4)}$ alignment, impact to archaeological remains associated with the Holmes Cemetery (I on Figure 4-29) is possible, as well as potential archaeological remains associated with two historic structures (E and NN).

Under the $G_{(2)}$ alignment, impacts to potential archaeological remains associated with Holmes Cemetery (I on Figure 4-29) and one historic structure (E) are possible. The two-lane alternative avoids the historic property on Gurley Road near the I-395/I-95 interchange.

5.11.3.6 *New Location - Partial Build Alternatives*: The $H_{(4)}$ and $H_{(2)}$ alternatives would impact a predicted 100 prehistoric sites, a good number of which would potentially be National Register-eligible. They would also likely impact archaeological remains associated with a c. 1800 house (E on Figure 4-29). Resources along Route 85, south of the proposed touchdown of the new location section of the partial build, would also be affected. These would include remains associated with properties DD and FF and cemetery HH. $H_{(4)}$ would be more likely than $H_{(2)}$ to impact these sites directly. Alternatives $H_{(4)}$ and $H_{(2)}$ avoid both impacts to Butlertown and resources on Gurley Road.

5.11.3.7 *Preferred Alternative*: The impact minimization modifications undertaken for preferred alternative $E_{(4)}$m-V3 allowed avoidance of the central core of the eligible Wolf Pit Hills Archaeological District. However, the preferred alternative will affect 16 archaeological sites that are eligible for inclusion in the NRHP (Table 4-47). Seven of the sites are also contributing resources within the collectively eligible Wolf Pit Hills Archaeological District. All but one of these sites will be destroyed by the construction of the proposed highway.

The site of an 18th/19th-century gristmill, the remains of which include a stone dam across Latimer Brook (Site No. 45-49) is in the vicinity of the proposed rehabilitation of an existing fish passage structure. This site is a contributing resource within the potential Wolf Pit Hills Archaeological District, however, project activity in this area will be limited and there will be no additional alterations to the stone dam. Consequently, no adverse effect will occur at this location and no mitigation will be needed for this project activity.

In consultation with the SHPO, it was determined that the preferred alternative would have an adverse effect upon archaeological resources, but that the 16 archaeological sites are chiefly significant for their information value. These sites have minimal value for preservation in place therefore a final Section 4(f) evaluation is not required. Consequently, it is appropriate to mitigate the project effects by undertaking data recovery at the sites. It was also determined that the project had only a minimal effect on the integrity of the potential Wolf

Pit Hills Archaeological District, provided that data recovery was undertaken for the affected sites within the eligible district. An MOA between FHWA and the SHPO, with concurrence from ConnDOT, has been executed for the affected sites. The MOA and correspondence documenting Section 106 consultations are included in the Correspondence section and Appendix G and discussed below under mitigation.

A summary of impacts to archaeological resources is shown on Table 5-65.

TABLE 5-65
SUMMARY OF IMPACTS TO ARCHAEOLOGICAL SITES BY ALTERNATIVE

ALTERNATIVE	KNOWN SITES	PREDICTED SITES	WOLF PIT HILLS IMPACT	SITES ASSOCIATED WITH NRHP-ELIGIBLE HISTORIC STRUCTURES	SITES ASSOCIATED WITH HISTORIC CEMETERIES
No build	0	0	No	0	0
$W_{(4)}$	15	0	No	7	4
$W_{(4)}$m	15	0	No	7	4
$W_{(2)}$	15	0	No	4	4
TSM	0	0	No	0	0
TDM/Transit	0	0	No	0	0
92PD	25 (n/c)	100	Yes	1	0
$E_{(4)}$	25 (n/c)	100	Yes	1	0
$E_{(2)}$	25 (n/c)	100	Yes	0	0
$F_{(4)}$	n/c	100	Yes	2	0
$F_{(2)}$	n/c	100	Yes	1	0
$G_{(4)}$	n/c	100	Yes	2	1
$G_{(2)}$	n/c	100	Yes	1	1
$H_{(4)}$	n/c	100	No	3	1
$H_{(2)}$	n/c	100	No	3	1
$E_{(4)}$m-V3	16 [1]	n/a	Yes	0	0

n/c=not completed for all DEIS alternatives n/a=not applicable
[1] NRHP eligible only

5.11.4 MITIGATION MEASURES

FHWA and/or ConnDOT shall carry out the stipulations included in the MOA (Appendix G) for taking into account the effects of the proposed project on the identified archaeological resources; these are summarized below. For the complete text, refer to the MOA.

- Develop, in consultation with the SHPO, pertinent data recovery plans for the 16 impacted archaeological sites: 45-25, 45-28, 45-29, 45-37, 45-39, 45-42, 45-43, 45-48, 45-49, 86-24, 121-8, 121-10, 121-22, 152-108, 152-129, and 152-134, in accordance with SHPO's Environmental Review Primer for Connecticut's Archaeological Resources.
- Implement appropriate reconnaissance, intensive, and if warranted, data recovery studies for all previously inaccessible areas located within the proposed right-of-way for Route 11, as well as all state-owned property used for temporary storage and work locations, wetland mitigation areas and borrow pits, in accordance with SHPO's Environmental Review Primer for Connecticut's Archaeological Resources.
- Acquire and preserve, to the maximum extent feasible, not to exceed 200 acres, historically associated and archaeologically-sensitive lands with respect to historic archaeological sites 152-132, 152-24, 152-25, 152-26, 152-28, 45-46, 152-29, 152-73, 152-33, 152-34, 152-30, 152-31, and 45-45, substantively the residential core of the potential Wolf Pit Hills archaeological district. Additional lands within or adjacent to the residential core, acquired to comply with terms of a required Section 404 permit to be issued by the ACOE for this project, may also be added to this proposed Wolf Pit Hills State Archaeological Preserve.
- Prepare the appropriate materials for designation of property acquired as a State Archaeological Preserve, pursuant to CGS 10-384, as amended.
- Sponsor the nomination and designation of one archaeological resource in each of the towns of Salem, Montville, East Lyme and Waterford as State Archaeological Preserves, and prepare a public educational booklet for statewide public distribution consistent with the professional standards of the SHPO.
- Develop a public-oriented education component with respect to the data recovery program for the 16 archaeological sites. Summary reports shall be prepared and submitted to the Archaeological Society of Connecticut Bulletin and the Society of Industrial Archaeology New England Chapter Newsletter.
- Reposit all artifacts, photographs and field notes with the Office of the State Archaeologist.