Appendix B

Assessment of MESA Issues for Rare Species Under Remedial Alternatives

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APPENDIX B

Assessment of MESA Issues for Rare Species

Under Remedial Alternatives

Housatonic River
Rest of River

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Assessment of MESA Issues for Rare Species Under Remedial Alternatives

Introduction

The Housatonic River and its approximate 10-year floodplain from the confluence of the East and West Branches (Confluence) to Woods Pond Dam, known as the Primary Study Area (PSA), constitute habitat for abundant and diverse populations of state-listed rare plant and wildlife species as defined under the Massachusetts Endangered Species Act (MESA), M.G.L. ch. 131A, and its implementing regulations at 321 CMR 10.00. MESA defines state-listed rare species as follows:

1. "Endangered" (E) species are native species which are in danger of extinction throughout all or part of their range, or which are in danger of extirpation from Massachusetts, as documented by biological research and inventory.

2. "Threatened" (T) species are native species which are likely to become endangered in the foreseeable future, or which are declining or rare as determined by biological research and inventory.

3. "Special concern" (SC) species are native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occur in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened within Massachusetts.

In this document, the terms “state-listed” or “rare” are used as collective terms to encompass all three categories referred to above. The MESA regulations require that the criteria for determining Endangered, Threatened, or Special Concern status be based on biological data, including, but not limited to:

(a) taxonomic status;
(b) reproductive and population status and trends;
(c) whether the species is native or has been introduced;
(d) vulnerability, as determined by threats to the species or its habitat;
(e) specialization, as determined by unique habitat requirements;
(f) restricted distribution, as determined by limited or disjunct geographic range; and
(g) rarity, as determined by a limited number of occurrences or by occurrence in limited numbers.

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife employs these criteria, as further detailed in “Listing Endangered Species in Massachusetts: The Basis, Criteria, and Procedure for Listing Endangered, Threatened, and Special Concern Species” (NHESP, 2008) to develop the list of state-listed rare species. NHESP also defines, pursuant to MESA, Priority Habitats of state-listed species based on records of the observation of the state-listed species within the past 25 years. NHESP delineates these Priority Habitats based upon the “best scientific evidence available”, including the examination of individual occurrence records in the context of species listing status, and applies the following criteria: the nature and/or significance of the occurrence as it relates to the conservation and protection of the species, including but not limited to, evidence of breeding, persistence, life stages present, number of individuals, extent of necessary supporting habitat, and proximity to other occurrences. For each species, NHESP prepares habitat mapping guidelines that identify the important habitat features, and that describe the methodology by which Priority Habitats are delineated.

The overall Priority Habitat designated by the NHESP in the Housatonic River Valley between the Confluence and Woods Pond Dam are shown on Figure 1. NHESP has to date identified 28 state-listed rare plants and wildlife within this area, and has established specific Priority Habitats for those species. As also shown on Figure 1, virtually the entire PSA is located within the overall Priority Habitat in this stretch. Collectively, 1038 acres of the PSA, which represent approximately 98% of the PSA, fall within Priority Habitat. Table 1 identifies the 28 species for which NHESP has designated Priority Habitats between the Confluence and Woods Pond Dam. At least five additional state-listed species have also been determined to be present in

the PSA by Woodlot Alternatives (2002). These species are listed at the bottom of Table 1. NHESP is currently conducting a two-year detailed survey to further investigate the presence of state-listed rare species within the Upper Housatonic River Valley.

In view of the documented occurrence of these rare species and the associated high quality and unique habitat conditions within the PSA, an important consideration in the evaluation of remedial alternatives is the avoidance, minimization, and mitigation of impacts to these MESA-listed species. The level of effort and complexity involved in such an assessment is exceptional in the Commonwealth. The occurrence of 28 rare species over a large (>1,000 acres) area of diverse habitats, with evaluations required of 12 alternatives, would typically justify a multi-year effort. Drawing upon the resources of ten biologists, an intensive, concerted effort has consolidated this into several months of effort. To this end the following process has been undertaken:

1. Consideration of the habitat conditions in each of the species-specific Priority Habitats as mapped by NHESP, employing the available information from previous studies and supplemented with additional field reconnaissance;

2. Assessment of the specific habitat requirements for each species for which Priority Habitat has been mapped in the PSA, including the full life-cycle, and consideration of the habitat suitability for the species within each of the reaches of the Housatonic River and floodplain in the PSA;

3. Evaluation of the short-term and long-term impacts to each species and their habitats that would result from the implementation of each of the sediment and floodplain soil remedial alternatives, including access and staging area requirements;

4. Consideration of measures that would avoid and/or minimize impacts to each species in connection with the implementation of each remedial alternative;

5. Assessment of whether the activities inherent in the implementation of each remedial alternative in each Priority Habitat would, despite the measures specified in Step 4 above, result in a species "take" as defined under MESA (see discussion below), and if so whether the "take" would involve a significant portion of the local species population.

6. If there would be a "take" but that take would not be of a significant portion of a local species population, an assessment of whether measures could be undertaken which would result in a net benefit to the affected species.

The MESA regulations define "take" at 321 CMR 10.02as follows: "in reference to animals [take] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity"; and…"in reference to plants ['take'] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…" A "take" is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be taken; and (2) measures can be taken that would result in a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

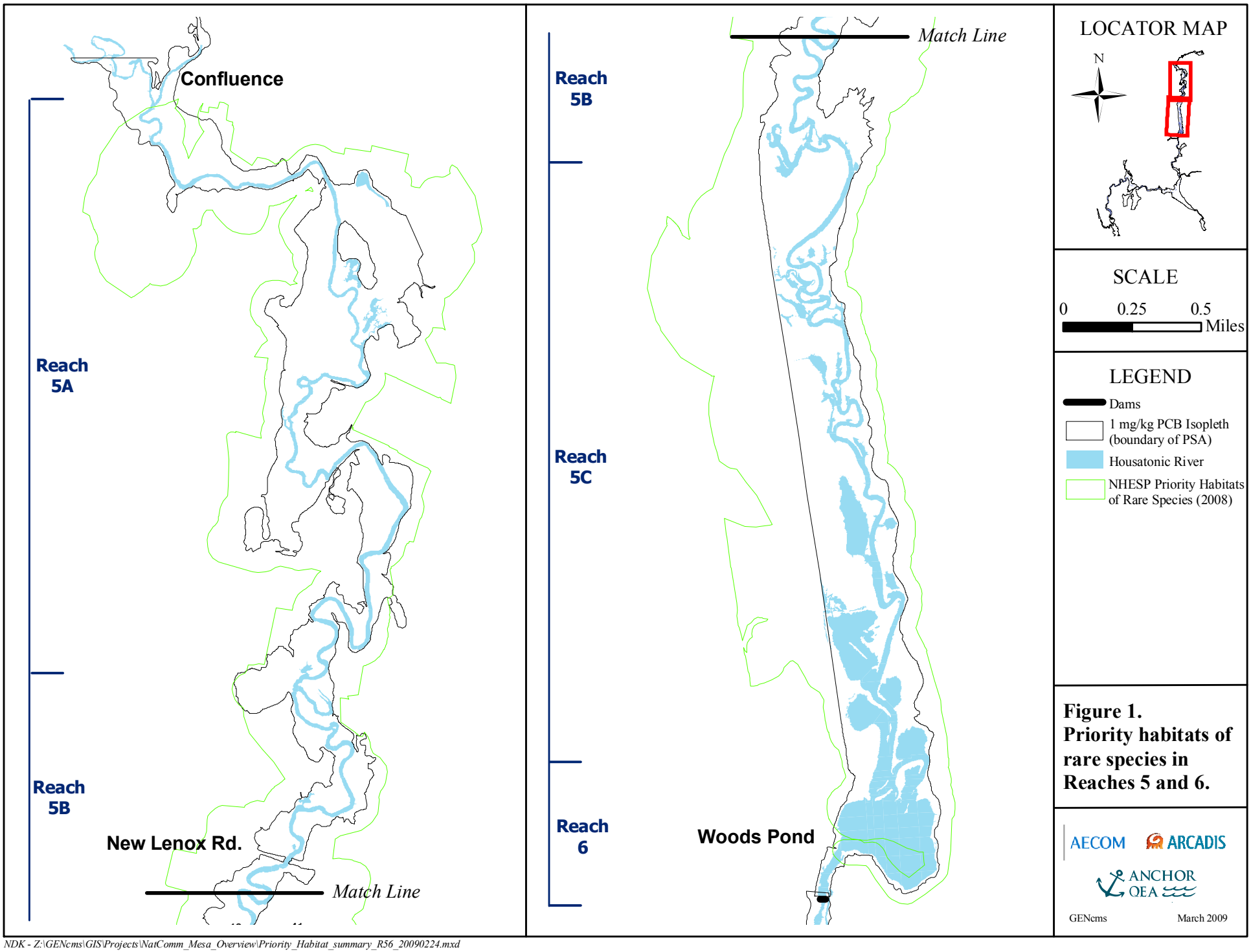

Figure 1.
Priority habitats of rare species in Reaches 5 and 6.

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Table 1: State-Listed Rare Species Identified by NHESP within the PSA

Common Name	Scientific Name	State Listing	Acreage of Priority Habitat in PSA	Acreage of Priority Habitat	Presence by Reach			
					5A	5B	5C	6
Wood Turtle	*Glyptemys insculpta*	SC	712	1320	X	X	X	
Jefferson Salamander	*Ambystoma jeffersonianum*	SC	40	105		X	X	
American Bittern	*Botaurus lentiginosus*	E	796	1545	X	X	X	X
Bald Eagle	*Haliaeetus leucocephalus*	E	201	320			X	
Common Moorhen	*Gallinula chloropus*	SC	408	744	X		X	X
Water Shrew	*Sorex palustris*	SC	39	41			X	
American Clam Shrimp	*Limnadia lenticularis*	SC	8	0			X	
Arrow Clubtail	*Stylurus spiniceps*	T	709	923	X	X	X	
Brook Snaketail	*Ophiogomphus aspersus*	SC	48	78	X			
Mustard White (Butterfly)	*Pieris napi oleracea*	T	509	783	X	X		
Riffle Snaketail	*Ophiogomphus carolus*	T	106	147	X			
Triangle Floater	*Alasmidonta undulata*	SC	119	173	X			
Zebra Clubtail	*Stylurus scudderi*	SC	701	912	X	X	X	
Bristly Buttercup	*Ranunculus pensylvanicus*	SC	66	73	X		X	
Bur Oak	*Quercus macrocarpa*	SC	440	834		X	X	X
Crooked-Stem Aster	*Symphyotrichum prenanthoides*	T	24	38		X		
Culver's Root	*Veronicastrum virginicum*	T	2	6	X			
Fen cuckoo flower	*Cardamine pratensis* var. *palustris*	T	0.33	10	X			
Foxtail Sedge	*Carex alopecoidea*	T	78	192		X		
Gray's Sedge	*Carex grayi*	T	158	214			X	
Hairy Wild Rye	*Elymus villosus*	E	49	91	X			
Hemlock Parsley	*Conioselinum chinense*	SC	6	40			X	
Intermediate Spike-Rush	*Eleocharis intermedia*	T	387	490	X	X	X	
Long-Styled Sanicle	*Sanicula odorata*	T	0	59			X	

Common Name	Scientific Name	State Listing	Acreage of Priority Habitat in PSA	Acreage of Priority Habitat	Presence by Reach			
					5A	5B	5C	6
Narrow-Leaved Spring Beauty	*Claytonia virginica*	E	33	51		X		
Straight-Leaved Pondweed	*Potamogeton strictifolius*	E	0.16	57	X			
Wapato	*Sagittaria cuneata*	T	839	1166	X	X	X	X
White Adder's-Mouth	*Malaxis monophyllos var. brachypoda*	E	11	75	X			
At least five additional state-listed rare species have also been documented within the PSA: northern harrier; sharp-shinned hawk, northern parula, backpoll warbler, and black maple.								

Detailed MESA assessments for each of the 28 species with NHESP-mapped Priority Habitats have been conducted, along with more general assessments of five other state-listed species that have been incidentally documented in the PSA, but which are not currently included in the

NHESP Priority Habitat database. In conducting the MESA assessments, detailed metrics of the impacts to each species' Priority Habitat were developed and analyzed based on the hypothetical execution each of the FP and SED remedial alternatives. These evaluations included quantification of the direct impacts within each river reach of each Priority Habitat, measured by each of the various types of remedial methods/measures involved under each alternative – including the impacts that would be caused to non-target areas, through the construction of access roads and staging areas. Contemporary and accepted scientific literature and other sources (e.g., NHESP fact sheets and conservation/management guidelines) were consulted to support the habitat suitability conclusions arrived at for each species, as well as the sensitivity of each species to various changes in habitat or other environmental disruptions.

As described above, the first consideration in the MESA assessment process is whether the impacts incurred on the habitat of each state-listed species are likely to result in a "take" as defined at 321 CMR 10.02. The regulatory definitions of "take" – which are different for plants versus animals - have been used with respect to the specific remedial work activities for each alternative to formulate a determination of whether an actual take is likely to occur. As an example, for the wood turtle, Table 2 lists the construction activities involved within the wood turtle Priority Habitat and the categories of "take" that may result from these activities:

Table 2: Construction Activities within Wood Turtle Habitat and Categories of "Take"

Construction Activity	Categories of "Take" Likely or Possibly Triggered
Vegetation cutting	Harass; Harm; Disrupt nesting, breeding, feeding, and migration
Vegetation grubbing	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; possibly Kill (direct mortality)
De-watering	Harass; Harm; Disrupt nesting, breeding, feeding, and migration
Floodplain soil excavation, removal, and backfilling	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; likely Kill (direct mortality)
Riverbank excavation, backfill, and stabilization	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; likely Kill (direct mortality)
River bottom excavation and backfill	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; likely Kill (direct mortality)

Construction Activity	Categories of "Take" Likely or Possibly Triggered
River bottom and backwater thin layer capping	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; possible Kill (direct mortality)
Access road and staging area construction	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; possibly Kill (direct mortality)
Stream crossing	Harass; Harm; Disrupt nesting, breeding, feeding, and migration
Truck and excavation equipment traffic	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; possibly Kill (direct mortality)
Soil transport, deposition, and grading	Harass; Harm; Disrupt nesting, breeding, feeding, and migration; possibly Kill (direct mortality)
Human foot traffic	Harass
Landscaping/planting	Harass

In addition to an assessment of the physical construction activities, a determination of a "take" requires consideration of numerous interactive factors, including:

- The extent of actually suitable habitat within each Priority Habitat for the subject species;
- The percentage of Priority Habitat affected;
- The duration and timing of the remedial activities as they relate to the life cycle requirements of the subject species;
- The population dynamics of the subject species within the local area and region;
- The viable and/or practicable habitat impact avoidance and minimization measures that could be employed for different construction activities; and
- The indirect effects of the construction activities and whether they could result in long-term consequences relative to habitat suitability (e.g., elimination of mature forest or hardening of a riverbank essential to a life cycle requirement, or the colonization of invasive species resulting in a deterioration of habitat suitability).

For each species for which it was determined that a given alternative would cause a take, an evaluation was then conducted to determine if said work would result in a take of a significant portion of the local population. For this purpose, the local population of each species was considered to be that which is situated within the Priority Habitat area (or areas) defined by NHESP for the Housatonic River Valley between the Confluence and Woods Pond Dam. Impacts to less than 10% of the Priority Habitat were generally considered to impact less than a significant portion of the local population. Impacts to greater than 20% of the Priority Habitat were generally considered to impact a significant portion of the local population. Impacts to between 10 and 20% of the Priority Habitat were qualitatively evaluated on a case-by-case basis. However, the appropriateness of these general rules was evaluated in each case. For example, in-river remediation that would impact a large portion of the Priority Habitat of a plant species that does not normally inhabit riverine areas was not considered in the calculation of "significant portion" for that species. Conversely, an impact to a vernal pool that was a small portion of the overall Priority Habitat of a species was considered "significant" if the vernal pool provided breeding habitat for this species. In addition, remediation of riverbank areas, which are expressed as linear feet rather than as a surface area, was considered separately from the proportional figures for species that are likely to inhabit the riverbank. For example, remediation of more than 83,000 linear feet of riverbank habitat through the wood turtle Priority Habitat was determined to result in a take of a significant portion of the local wood turtle population even if the associated SED alternative would otherwise impact less than 10% of the overall wood turtle Priority Habitat. In other cases, the overall magnitude of work

within a Priority Habitat could warrant a finding of impact to a significant portion of the population despite the proportion of the impacted Priority Habitat being less than 20%.

An important limitation of these MESA assessments is that, consistent with the Corrective Measures Study, SED and FP alternatives were evaluated as separate, stand-alone actions. During real-world implementation, the impacts from a SED alternative will be additive to the impacts from an FP alternative (even though access and staging areas would be coordinated). Accordingly, assessments should be conducted that consider the cumulative impacts of combined SED and FP alternatives. Similarly, what is extremely important to consider but which is not reflected in any of the individual MESA assessments is the challenge of designing and executing a remedial program that balances all the different life cycle and habitat needs of 28 different rare species representing a number of different taxa (e.g., aquatic invertebrates, piscivorous birds, marsh-nesting birds, semi-terrestrial amphibians and reptiles, plants of forest-floors, canopy-dwelling invertebrates). While a formal reconciliation of these species requirements was not conducted as part of the individual MESA assessments, Figure 2 provides an example that illustrates the limited construction "window" for all of the state-listed rare species known to have overlapping habitats within the PSA.

For those alternatives that would result in an impact to less than a significant portion of the local population of a state-listed species, consideration was then given to whether a net benefit could be achieved for that species as defined by MESA -- i.e., "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity." For some species, there are specific conservation and management measures that are known to have been implemented and accepted as contributing to a "net benefit" of the species. In other cases (e.g., where relatively little is known about the species and/or where no targeted management programs exist or have been implemented), it cannot be established that a conservation and management plan could be developed that would achieve a "net benefit" for the species. Further, in many cases, given the unique high quality of the habitat features in the PSA and the substantial alteration of that habitat under many of the remedial alternatives, achieving a net benefit at this site does not appear to be feasible or practicable, especially for those alternatives with greater impacts. Moreover, management measures for any one species would need to be integrated and coordinated with requirements for and impacts to other rare species within the PSA, with potential conflicts arising.

The Housatonic River and its floodplain communities between the Confluence and Woods Pond function as a contiguous riparian corridor providing a roughly 10-mile stretch of diverse riverine and wetland/floodplain habitats that offer relative seclusion and excellent conditions for numerous state-listed rare species of plants and wildlife. There are no comparable riverine/floodplain habitat systems within the region that offer such a refuge. As habitat impacts increase through the various alternatives, and particularly as SED and FP alternatives are combined, the cumulative effects have the potential to result in a significant fragmentation of the riparian habitat, and result in substantially greater risk to the local populations of rare species from invasive and predatory species (e.g., plants such as *Phragmites* or wildlife such as raccoons and skunks). Attachment 1 to this Appendix lists invasive plant species that are of concern in the PSA under restoration scenarios, and summarizes control options for them. These issues raise concerns for sustaining the populations of such vulnerable species given the disruptions to the habitat that many of the remedial alternatives will cause, despite the most diligent management measures to mitigate the impacts.

Figure 2. Construction Timing to Minimize Rare Species Impacts in Reach 5A

Common Name	Latin Name	Construction Windows to Minimize Impacts to Rare Species in Reach 5A[1]											
		Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
American bittern	*Botaurus lentiginosus*												
Arrow clubtail	*Stylurus spiniceps*												
Bristly buttercup	*Ranunculus pensylvanicus*												
Brook snaketail	*Ophiogomphus asperses*												
Common moorhen	*Gallinula chloropus*												
Culver's root	*Veronicastrum virginicum*												
Fen cuckoo flower	*Cardamine pratensis* var. *palustris*												
Hairy wild rye	*Elymus villosus*												
Intermediate spike-rush	*Eleocharis intermedia*												
Mustard white (Butterfly)	*Pieris oleracea*												
Riffle snaketail	*Ophiogomphus carolus*												
Straight-leaved pondweed	*Potamogeton strictifolius*												
Triangle floater	*Alasmidonta undulate*												
Wapato	*Sagittaria cuneata*												
White adder's-mouth	*Malaxis monophyllos var. brachypoda*												
Wood turtle	*Glyptemys insculpta*												
Zebra clubtail	*Stylurus scudderi*												

[1] Green cells indicate time periods in which construction activities would have relatively less impacts, based on the life history cycles of each species. Red cells indicate time periods in which construction activities would have substantial impacts to the species.

APPENDIX B
Assessment of MESA Issues for Rare Species Under Remedial Alternatives

Table of Contents

Each Section Contains Three Tables:

- An Overview of the Species' Habitat Alterations by Remedial Alternatives
- An Assessment of MESA Issues for the Species under Sediment Alternatives
- An Assessment of MESA Issues for the Species under Floodplain Alternatives

Each Section also contains a figure presenting the MNHESP-mapped Priority Habitat for the species.

A. Wood Turtle (*Glyptemys insculpta*)

A. Wood Turtle (*Glyptemys insculpta*) MESA Assessment

A-1. Summary of Species Life Cycle and Habitat Requirements

Wood turtles are found in both aquatic and terrestrial habitats. While they require clear, moving water, such as rivers, streams and creeks, they will also utilize a variety of shallow wetlands, such as swamps, bogs, and seasonal pools. Wood turtles will use a wide variety of terrestrial habitats and generally prefer a mosaic of different community types located near the water. Wood turtles require this wide range of habitats for food availability, thermoregulation, nesting and over-wintering. They will use emergent logs or grassy, sandy, and muddy banks for basking. During the summer months they feed in early successional fields, hayfields, and forests. Habitat ranges vary wildly and NHESP estimates that home ranges from streams can be as far as a half mile. Wood turtles spend the winter hibernating within the stream and generally stay fully submerged from November until temperatures increase in the spring (typically mid-March). The species may spend the winter alone or in communal hibernacula with several wood turtles. Wood turtles will utilize a variety of areas such as muddy banks, stream bottoms, deep pools, in-stream woody debris piles, and abandoned muskrat burrows for winter hibernacula. Wood turtles emerge from the stream in mid-March to April depending on seasonal temperatures and begin using the surrounding terrestrial habitat close to the waters edge for feeding and basking. Wood Turtles are opportunistic omnivores; their diet consists of both plant and animal matter that is consumed on land and in the water. Although the peaks in mating activity occur in the spring and fall, wood turtles are known to mate opportunistically throughout their activity period. Copulation usually takes place within the water and a female may mate with multiple individuals over the course of the active season. Nesting usually takes place in open areas with sand and gravel substrate during the month of June and females may travel long distances in search of proper nesting areas. The hatchlings emerge from the eggs in August and September. Wood turtles are very long lived (may live up to 100 years in age) and they reach sexual maturity very slowly. Wood turtles have shown extreme fidelity to use of the same habitat features year after year, such as basking on the same downed log along the riverbank. The wood turtle is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Species of Special Concern (NHESP 2008).

A-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the wood turtle occurs within the PSA throughout the entirety of Reach 5A, the entirety of Reach 5B, and through roughly the northern half of Reach 5C, as shown on Figure A at the end of this section. It is not estimated to occur in Reach 6, likely due to the effects of the Woods Pond dam. The areal extent of the habitat is broad and includes the main stem of the river, backwaters, and floodplain. The total Priority Habitat area of the wood turtle is roughly 1320 acres, with 712 acres in the PSA. Habitat conditions within Reaches 5A and 5B are particularly favorable for wood turtles.

A-3. Impacts of Remedial Alternatives on Wood Turtle Priority Habitat

A-3-1. Overview

Table A-1 summarizes the areal extent of work within the wood turtle Priority Habitat for the different remedial alternatives. The Housatonic River and associated riparian area provide habitat conditions with high suitability for many of the life cycle requirements of the wood turtle. The river flows through mature transitional floodplain forest in the upper reaches of the Priority Habitat area, with interspersed areas of shrub swamp and vernal pools throughout. River conditions are predominantly mid-gradient meandering flow over sandy bottom with occasional gravel and cobble substrate. Riverbanks are variable, but often consist of sand/silt/muck deposits with significant mature woody vegetation and associated high quality habitat features. Both the river bottom and banks offer suitable habitat for a variety of life cycle requirements of the wood turtle, particularly for hibernation. Below Holmes Road the floodplain of the Housatonic River broadens out over an

outwash plain, with diverse bordering wetland communities interspersed along numerous headwater streams flowing to the Housatonic from the adjacent highlands. River conditions are predominantly low-gradient meandering flow over sandy bottom with siltier and muck conditions more predominant in the areas of less current.

All SED alternatives except for SED 1 and SED 2 would involve a significant alteration of the wood turtle habitat. The in-river sediment removal and backfill/capping activities, as well as the riverbank remediation work, will affect the winter hibernation habitats of the wood turtle within such areas as muddy banks, stream bottoms, deep pools, in-stream woody debris piles, and abandoned muskrat burrows. Thus, excavation of these habitats during the winter has a strong probability of causing direct mortality of any individuals in the area of work. Since these habitats are also likely to be used during other periods of the year during the typical movements of the species along the river and through adjacent habitats, the remediation work during other seasons will also disrupt those activities of the wood turtle. SED 3 through SED 8 will all disturb over 50% of the river bottom and riverbank habitat within the wood turtle Priority Habitat zone.

FP 3 through FP 7 also involve substantial alteration of wood turtle habitats; even FP 3, the least extensive of these alternatives, will involve clearing, grubbing, soil excavation, dewatering, backfilling, construction equipment access and operation, sediment stockpiling, and related activities over approximately 62 acres of wood turtle Priority Habitat. Carefully controlled measures implemented under the FP 2 alternative may limit the impacts to wood turtle habitat to a degree which will not significantly affect the local population; approximately 20 acres of wood turtle habitat will be disturbed under FP 2. Alternatives SED 3 through SED 7 and FP 3 through FP 7 will each result in a significant fragmentation of the wood turtle habitat, and result in substantially greater risk to the local population from predatory species such as raccoons and skunks.

Table A-1: Wood Turtle Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Wood Turtle Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation within Wood Turtle Priority Habitat (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas within Wood Turtle Priority Habitat (acres)	Estimated Duration of Work (years)**
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5A	41 (excavation/capping) 55660 lf riverbank remediation	52	8
	5B	27976 lf riverbank remediation	28	<1
	5C	3 (thin-layer capping)	1	<1
SED 4	5A	42 (excavation/capping) 4 (thin-layer capping) 55660 lf riverbank remediation	52	8
	5B	11 (excavation/capping) 17 (thin-layer capping) 27976 lf riverbank remediation	28	3
	5C	24 (thin-layer capping) 3 (engineered cap)	5	5
SED 5	5A	42 (excavation/capping) 4 (thin-layer capping) 55660 lf riverbank remediation	52	8
	5B	25 (excavation/capping) 2 (thin-layer capping) 27976 lf riverbank remediation	18	5
	5C	21 (excavation/capping) 3 (thin-layer capping) 3 (engineered cap)	6	4

Remedial Alternative	Reach with Affected Habitat	Description of Wood Turtle Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation within Wood Turtle Priority Habitat (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas within Wood Turtle Priority Habitat (acres)	Estimated Duration of Work (years)**
SED 6	5A	42 (excavation/capping) 6 (thin-layer capping) 55660 lf riverbank remediation	52	8
	5B	25 (excavation/capping) 7 (thin-layer capping) 27976 lf riverbank remediation	28	5
	5C	26 (excavation/capping) 8 (thin-layer capping)	0.7	6
SED 7	5A	42 (excavation/capping) 6 (thin-layer capping) 55660 lf riverbank remediation	52	10
	5B	29 (excavation/capping) 3 (thin-layer capping) 27976 lf riverbank remediation	28	6
	5C	28 (excavation/capping) 6 (thin-layer capping)	0.7	7
SED 8	5A	49 (excavation/backfill) 55660 lf riverbank remediation	52	12
	5B	34 (excavation/backfill) 27976 lf riverbank remediation	28	7
	5C	36 (excavation/backfill)	0.7	17
FP 1	N/A – No Action	0	0	0
FP 2	5A	9 (excavation/backfill)	5	1
	5B	0.8 (excavation/backfill)	3.4	
	5C	0.4 (excavation/backfill)	2.6	
FP 3	5A	23 (excavation/backfill)	13	3
	5B	9 (excavation/backfill)	6	
	5C	7 (excavation/backfill)	4	
FP 4	5A	40 (excavation/backfill)	15	4
	5B	16 (excavation/backfill)	10	
	5C	10 (excavation/backfill)	4	
FP 5	5A	27 (excavation/backfill)	10	4
	5B	11 (excavation/backfill)	7	
	5C	17 (excavation/backfill)	4	
FP 6	5A	80 (excavation/backfill)	13	13
	5B	54 (excavation/backfill)	10	
	5C	36 (excavation/backfill)	6	
FP 7	5A	141 (excavation/backfill)	10	22
	5B	71 (excavation/backfill)	8	
	5C	41 (excavation/backfill)	4	

*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur only in Reaches 5A and 5B, and will extend over 83,660 linear feet for all alternatives. All direct impacts under FP alternatives are to floodplain/wetland habitats. **Duration of work figures are for entire alternative scope; work area just within wood turtle habitat zone may be less.

A-3-2. Description of Specific Impacts by River Segments

Reach 5A

From the confluence of the East and West Branches to the Pomeroy Avenue Bridge, the Housatonic River and associated riparian area provide habitat conditions with high suitability for many of the life cycle requirements of the wood turtle. The river flows through mature transitional floodplain forest in this reach,

with interspersed areas of shrub swamp and vernal pools throughout. Woodlot (2002) documents a number of wood turtle observations in the vicinity of the confluence. River conditions are predominantly mid-gradient meandering flow over sandy bottom with occasional gravel and cobble substrate. Riverbanks are variable, but often consist of sand/silt/muck deposits with significant mature woody vegetation and associated high quality habitat features. Both the river bottom and banks offer suitable habitat for a variety of life cycle requirements of the wood turtle, particularly for hibernation. Between Pomeroy Avenue and Holmes Road the habitat conditions remain suitable for the wood turtle, particularly as a dispersal corridor, although the floodplain forests become less broad along the river in this area. Below Holmes Road the floodplain of the Housatonic River broadens out over an outwash plain, with diverse bordering wetland communities interspersed along numerous headwater streams flowing to the Housatonic from the adjacent highlands. River conditions are predominantly low-gradient meandering flow over sandy bottom with siltier and muck conditions more predominant in the areas of less current. Riverbanks remain variable, still consisting of sand/silt/muck deposits with significant mature woody vegetation and associated high quality habitat features. Both the river bottom and banks offer suitable habitat for a variety of life cycle requirements of the wood turtle, particularly for overwintering. The wood turtle Priority Habitat within Reach 5A comprises nearly 700 acres, with 367 acres in the PSA.

Work activities involved for each alternative relative to the wood turtle habitats in this section of the river are summarized as follows:

SED 1: No activities.

SED 2: Monitored natural recovery (MNR) will result in no direct adverse impacts on wood turtle habitat.

SED 3, SED 4, SED 5, and SED 6: These alternatives all involve similar remedial measures within Reach 5A. The work involves removal of the top 2 feet of river bottom material, followed by capping. In addition, the erodible riverbanks will be excavated and reconstructed using armoring material to prevent erosion and/or biostabilization measures to encourage re-establishment of the native plant community and natural wildlife habitat features. This work will necessarily directly impact the wood turtle habitats throughout this reach, with an estimated impact area of 41 acres and approximately 55,660 linear feet of riverbank remediation involved for each alternative. SED 5 and SED 6 also involve thin-layer capping in a number of backwater pool areas, all of which are potential wood turtle habitats. Access road construction and staging areas will also disturb an additional 52 acres within the wood turtle habitat zone; 15 staging areas for the soil removal are anticipated to be required.

SED 7 and SED 8: For this segment of the river SED 7 involves sediment removal of the top 3 to 3.5 feet of river bottom material with backfill of clean sediments; SED 8 will increase this removal depth to 4 feet. The erodible riverbanks will be excavated and reconstructed as in the prior alternatives. Approximately 55,660 linear feet of riverbank and approximately 47 to 49 acres of river bottom habitat will be remediated in Reach 5A under these alternatives. SED 7 also involves thin-layer capping in several backwater pool areas south of Holmes Road, while SED 8 will involve removal of the top two feet of soil in these pools followed by backfilling. Over 62,000 linear feet of access roads (covering roughly 28 acres) will be required within the floodplain wood turtle habitat bordering the river in this stretch; 15 staging areas (comprising 24 acres) for the soil removal are also anticipated to be required for these alternatives.

FP 1: No activities.

FP 2: FP 2 involves more than ten discrete areas of soil removal and restoration within the floodplain of Reach 5A, totaling approximately 9.5 acres of direct impact. Several of these removal areas directly border the river itself. Just south of Holmes Road several removal areas occur over transitional floodplain forest and nearby open meadows with scattered shrub cover that border backwater ponded areas, and these along with an adjacent elevated upland landform provide excellent wood turtle habitat and potential nesting sites. Access for these areas is anticipated from Holmes Road to the north; however, the access road will extend through potential migratory, feeding, breeding, and even nesting habitat of the wood turtle. Additional

removals will occur south of this area within floodplain forest that borders a backwater deep marsh and ponded area that provide potential wood turtle habitat. Access to these areas is anticipated to be from the east across open fields; however, a temporary crossing of the river will be required to access the westerly area. Staging is anticipated in the open fields to the east. Overall, approximately 7,250 linear feet of access roads (covering roughly 3 acres) will be required for the Reach 5A floodplain remedial activity; five staging areas for the soil removal are anticipated for this reach, impacting 2 acres of the Priority Habitat zone for the wood turtle.

FP 3, FP 4, and FP 5: These three alternatives all involve a similar extent of soil removal activities within this upper reach of the Housatonic River, and the affected area of remediation for all three is considerably more than what is involved under alternative FP 2. Soil removals will occur within roughly 23 to 40 acres of primarily mature floodplain/wetland forest, most of which directly border the river. In addition, these alternatives will involve remediation of several vernal pool areas (roughly 6 acres in FP 3 and 4, and 1 acre in FP 5) all of which contribute to making the habitat favorable for wood turtles. Approximately 10,000 to 20,000 linear feet of access roads (covering roughly 6-9 acres) will be required for the Reach 5A floodplain remedial activity; 10 to 13 staging areas for the soil removal are anticipated for this reach, impacting an additional 4 to 6 acres of the Priority Habitat zone for the wood turtle. Overall impact areas within the wood turtle Priority Habitat of Reach 5A under these alternatives range from 37 to 55 acres.

FP 6 and FP 7: FP 6 and FP 7 involve soil removal and stabilization over a substantial portion of the forested floodplain along this stretch of the river, totaling 93 to 151 acres of direct impact; approximately 60 to 70% of the impact area is to forested floodplain wetland. Most of these removal areas directly border the river itself. A number of vernal pool and associated backwater flooding areas will be included within the remediation areas, along with deep and shallow marshes, shrub swamps, and wet meadows in the floodplain. Approximately 7,800 to 14,400 linear feet of access roads (covering roughly 4 to 7 acres) will be required for this remedial activity, extending in from the west and east sides of the floodplain; 15 staging areas for the soil removal are anticipated to be required, impacting an additional 6 acres of the Priority Habitat zone for the wood turtle in this reach.

Reach 5B

Reach 5B continues to provide high quality habitat conditions for breeding, feeding, and dispersal activities of the wood turtle, as well as some potential nesting habitat. Below the WWTP the floodplain of the Housatonic River maintains the meandering pattern with diverse bordering wetland communities. River conditions continue with predominantly low-gradient meandering flow over sandy bottom with siltier and muck conditions more predominant in the areas of less current. Riverbanks are variable, but often consist of sand/silt/muck deposits; the significant mature woody vegetation on the riverbanks tends to grade into more shrub and herbaceous cover south of New Lenox Road. Both the river bottom and banks continue to offer suitable habitat for a variety of life cycle requirements of the wood turtle, particularly for overwintering and foraging.

Work activities involved for each alternative relative to the wood turtle habitats in this section of the river are summarized as follows:

SED1: No activities.

SED 2 and SED 3: These two alternatives involve MNR within the river bottom sediments in Reach 5B, which will result in no direct impacts within this reach. SED 3 does involve riverbank remediation throughout Reach 5B, for a total reconstruction of approximately 28,000 linear feet of riverbank. This will require construction of approximately 35,640 linear feet (16 acres) of access roads and seven staging areas over 12 acres within the wood turtle habitat zone.

SED 4: SED 4 north of New Lenox Road involves removal of the top two feet of the river bottom sediments, followed by capping, along with removal and reconstruction of the erodible riverbanks. Approximately 28,000 linear feet of riverbank and approximately 11 acres of river bottom habitat will be remediated within Reach 5B.

One large (17-acre) backwater/remnant oxbow will also be subject to thin-layer capping near the northern limit of Reach 5B. South of New Lenox Road the in-river work under SED 4 involves just thin-layer capping, although the bank removal/stabilization work will extend throughout Reach 5B. SED 4 will also require construction of approximately 35,640 linear feet (16 acres) of access roads and seven staging areas over 12 acres within the wood turtle habitat zone

SED 5 and SED 6: These two alternatives involve very similar work activities within Reach 5B. Removal of the top two feet of the river, followed by capping, is involved throughout this stretch for SED 5 and SED 6. Under both alternatives, the erodible riverbanks will be excavated and reconstructed using armoring material and/or bio-stabilization measures. Approximately 28,000 linear feet of riverbank and approximately 25 acres of river bottom habitat will be remediated in this reach. SED 5 and SED 6 also involve thin-layer capping in several backwater pool areas, all of which are potential wood turtle habitats; the extent of this activity is greater in SED 6 than in SED 5 (7 acres vs. 2 acres). Approximately 35,600 linear feet of access roads (covering roughly 16 acres) will be required within the floodplain wood turtle habitat bordering the river in this stretch; seven staging areas covering 12 acres are anticipated to be required within wood turtle habitat zone.

SED 7 and SED 8: Within Reach 5B, SED 7 involves sediment removal of the top 2.5 feet of river bottom material with backfill of clean sediments; SED 8 will increase this removal depth to 3.5 feet. The erodible riverbanks will be excavated and reconstructed using armoring material and/or biostabilization measures. Approximately 28,000 linear feet of riverbank and approximately 29 acres of river bottom habitat will be remediated in Reach 5B under SED 7, while SED 8 increases this to 34 acres. SED 7 also involves thin-layer capping over three acres of backwater pool areas, while SED 8 will involve removal of the top two feet of soil in these pools followed by backfilling. Approximately 35,600 linear feet of access roads (covering roughly 16 acres) will be required within the floodplain wood turtle habitat bordering the river in this stretch; seven staging areas for the soil removal are also anticipated to be required for these alternatives, encompassing 12 acres within the wood turtle habitat zone.

FP1: No activities.

FP 2: Within Reach 5B north of New Lenox Road, FP 2 involves several small soil removal areas along the west side of the river. Habitat conditions for the wood turtle remain favorable throughout this reach; however, potential impacts appear minimal due to the limited removal areas. The only remaining Reach 5B removal area under FP 2 within wood turtle Priority Habitat is just south of New Lenox Road, around the canoe launch area. Total impacts within the wood turtle Priority Habitat due to the removals amount to 0.8 acre; however an additional 3.4 acres of impact will occur due to access road and staging areas. These areas exhibit more open, wet meadow and marsh habitat.

FP 3, FP 4, and FP 5: These three alternatives all involve a similar extent of soil removal activities within Reach 5B, and the affected area of remediation for all three is considerably more than what is involved under alternative FP 2. Soil removals will occur within roughly 9 to 16 acres of wood turtle Priority Habitat, including mature floodplain forest and emergent wetlands, most of which directly border on the river. In addition, these alternatives will involve remediation of several vernal pool areas, which contribute to the favorability of the habitat for wood turtles. Access road and staging areas will alter an additional 6 to 10 acres of wood turtle habitat in Reach 5B for these alternatives; accordingly, total wood turtle habitat impacts for these alternatives in Reach 5B range from 15 to 26 acres.

FP 6 and FP 7: FP 6 and FP 7 involve soil removal and stabilization over a substantial portion of the forested floodplain along this stretch of the river, totaling 54 to 71 acres of direct impact; 30 to 40% of these removal areas are to forested wetland, and more than 40% of the impact areas are to emergent or shrub wetlands. Most of these removal areas directly border the river itself. A number of vernal pool and associated backwater flooding areas will be included within the remediation areas. Approximately 8,600 to 10,000 linear feet of access roads (covering roughly 4 to 5 acres) will be required for this remedial activity, extending in from the west and east sides of the floodplain; more than ten staging areas for the soil removal are

anticipated to be required, impacting an additional 4 to 5 acres of the Priority Habitat zone for the wood turtle in this reach.

Reach 5C

As noted above, south of New Lenox Road the Housatonic River becomes a lower gradient system, with increased meanders, backwater areas from remnant oxbows, and a predominantly silty-muck bottom. These conditions extend to the southern limit of Reach 5C; the limit of the identified Priority Habitat of the wood turtle extends roughly one-half through Reach 5C. While habitat suitability for the wood turtle is not as optimum through this stretch as in Reaches 5A and 5B, the area remains potentially significant for migration, foraging, and overwintering. Numerous vernal pool/backwater flooding areas are located within the floodplain along the river through this area, although the larger backwater areas are south of the wood turtle Priority Habitat.

SED1: No activities.

SED 2 and SED 3: Within Reach 5C these alternatives involve MNR and no riverbank remediation, which will result in no direct impacts on wood turtle habitat. SED 3 also involves thin-layer capping in the southern extent of the wood turtle Priority Habitat zone; approximately 3 acres will be treated in this fashion.

SED 4: Within the wood turtle habitat that extends into Reach 5C, SED 4 involves thin-layer capping over most of the area (24 acres), with an engineered cap over the river bottom in the southern portion of the wood turtle habitat (3 acres). Two staging areas on four acres with 2600 linear feet (1 acre) of access roads are anticipated to be required.

SED 5, SED 6 and SED 7: These three alternatives involve generally similar work activities within Reach 5C. Removal of the top two feet of the river, followed by capping or backfill to the original grade, is involved throughout most of the wood turtle habitat zone within Reach 5C (21 acres in SED 5, up to 28 acres in SED 7). SED 5 also involves an engineered cap of three acres of the river bottom in the most southern portion of the wood turtle habitat. Thin-layer capping will be performed in a number of backwater pool areas within wood turtle habitat; the extent of this activity is greater in SED 6 (8 acres) than in SED 5 (3 acres), while SED 7 will remove the top foot of sediment in six acres in these areas. Approximately 2700 linear feet of access roads (covering roughly 1 acre) will be required within the floodplain wood turtle habitat bordering the river in this stretch for SED 5, with slightly less (1600 linear feet over 0.7 acre) for SED 6 and SED 7. Four staging areas (requiring 5 acres) for the sediment removal are anticipated for SED 5; a larger centralized staging area is anticipated for SED 6 and SED 7, but it is anticipated that it can be placed outside of the wood turtle habitat zone.

SED 8: SED 8 within Reach 5C involves removal of the top three feet of sediment within the wood turtle habitat (both within the river and in large backwater areas), followed by backfilling, with the top two feet of sediment removed from a number of smaller backwater pool areas followed by backfilling; work will occur over 36 acres of riverine habitat. Approximately 1600 linear feet of access roads (covering 0.7 acre) will be required within the wood turtle habitat zone. A large centralized staging area is anticipated for SED 8, although this feature could be located outside of the wood turtle Priority Habitat.

FP1: No activities.

FP 2: Within the Reach 5C portion of the wood turtle Priority Habitat, FP 2 involves several small soil removal areas along the east side of the river, totaling roughly 0.4 acre in area. Habitat conditions for the wood turtle remain favorable throughout this reach; however, potential impacts appear minimal due to the limited removal areas. These areas exhibit more open, wet meadow and marsh habitat. Access roads and two staging areas are involved in this area that would result in an additional impact of 2.6 acres of wood turtle Priority Habitat, for a total impact of roughly 3 acres under FP 2 within Reach 5C.

FP 3, FP 4, and FP 5: These three alternatives all involve similar, although progressively greater, extents of soil removal activities within Reach 5C, and the affected area of remediation for all three is considerably more than what is involved under alternative FP 2. Soil removals will occur within roughly 7 to 17 acres of diverse floodplain communities, most of which directly border on the river. In addition, these alternatives will involve remediation of several vernal pool areas, which contribute to the favorability of the habitat for wood turtles. Approximately 6,300 to 7,600 linear feet of access roads (covering roughly 4 to 6 acres) will be required for these remedial alternatives, along with roughly 1 acre of impact for 2 to 4 staging areas.

FP 6 and FP 7: FP 6 and FP 7 involve soil removal and stabilization over a substantial portion of the forested floodplain along this stretch of the river, totaling 36 to 41 acres of direct impact; under FP 6 nearly 40% of this impact is forested wetland in the floodplain, while this rises to over 80% under FP 7. Most of these removal areas directly border the river itself. A number of vernal pools (3 to 5 acres) and associated backwater flooding areas will be included within the remediation areas. Approximately 5,000 to 8,500 linear feet of access roads (covering roughly 2 to 4 acres) will be required for these remedial alternatives; 6 to 7 staging areas for the soil removal are anticipated to be required over 2 acres of wood turtle habitat.

A-3-3. Summary of Potential Impacts to Wood Turtles

The in-river sediment removal and backfill/capping activities, as well as the riverbank remediation work, will affect the hibernation habitats of the wood turtle. As noted above, this species tends to spend the winter in a variety of areas such as muddy banks, stream bottoms, deep pools, in-stream woody debris piles, and abandoned muskrat burrows for winter hibernacula. Accordingly, excavation of these habitats during the winter has a strong probability of causing direct mortality of any individuals in the area of work. In general, sandy stream bottoms are preferred by wood turtles, so heavy armoring with stone may reduce the suitability for overwintering at least in the short term; loss of habitat due to riverbank remediation will similarly reduce the capacity of this resource to provide hibernacula.

These habitats are also likely to be used during other periods of the year during the typical movements of the species along the river and through adjacent habitats. Males of the species are particularly prone to remaining along the river and its banks during the summer. The excavation and backfilling of river bottom habitats and removal of mature habitat features on the riverbanks represent severe disruptions to the wood turtle, as they are highly sensitive to disturbances which are much less invasive than these actions. Wood turtles have shown extreme fidelity to use of the same habitat features year after year, such as basking on the same downed log along the riverbank and use of the same hibernacula each year (IPFW 2004). The likelihood of wood turtles returning to habitats that are severely disrupted is remote, particularly where the population is isolated and comparable refuge habitats are limited such as the case here.

Alterations of wood turtle habitat for access road and staging area construction under SED 3 through SED 8 will result in the direct alteration of up to 80 acres of wood turtle Priority Habitat, and will also result in significant long-term fragmentation of the habitat area. In addition, construction equipment poses a threat for direct mortality of turtles, such as truck traffic hitting turtles crossing access roads. The open, exposed areas associated with construction areas may attract females for nesting, with subsequent construction vehicles impacting either or both the females or the deposited eggs. This work also poses a high potential for colonization of invasive plant species, which lead to a deterioration in the habitat quality for the wood turtle.

Floodplain remediation alternatives will similarly have direct impacts from the clearing/grubbing of trees, sediment removal and backfilling, and also access road and staging area construction. These activities, if conducted in the winter, could have limited direct mortality; however, the impact from habitat loss will be in direct proportion to the extent of vegetative cover removal. Areas that have changed from mature forested cover to early successional planted cover are unlikely to offer suitable habitat characteristics to support wood turtle feeding, nesting, or dispersal activities for many years. As described above, the access road and staging area construction activities pose threats to wood turtles via direct mortality as well as long-term habitat disruption.

Research has demonstrated that even indirect human effects are a threat to wood turtle populations. In a 20-year study in Connecticut there was a demonstrated decrease in wood turtle populations by increased recreational use of protected turtle habitat (Garber and Burger 1995). Even within a protected park, secondary effects of human use were enough to adversely affect the wood turtle population. Habitat modification, vehicular-based mortality, and increased predation from invasive species such as raccoons and skunks (whose populations increase with increasing human disturbance) are considered factors in the reduction of wood turtle populations. Habitat fragmentation and modifications are considered primary threats to wood turtle populations. Most populations now exist in isolated patches where gene flow between local populations is rare, leading to a loss of genetic diversity. The ability for turtles to move out of these isolated patches during habitat disruptions is limited, and attempts at such movements are risky.

Life-cycle factors also put wood turtle populations at risk. As noted by NHESP in its fact sheet on this species (NHESP 2007), wood turtle "hatchling and juvenile survival is very low and the time to sexual maturity is long. These characteristics are compensated by adults living a long time and reproducing for many years. Adult survivorship must be very high to sustain a viable population. These characteristics make wood turtle vulnerable to human disturbances. Population declines of wood turtles have likely been caused by hay-mowing operations, development of wooded stream banks, roadway casualties, incidental collection for pets, unnaturally inflated rates of predation in suburban and urban areas, forestry and agricultural activities and pollution of streams." Wood turtle conservation biologists stress the significance of contiguous riparian corridors, including riparian forested cover, for the maintenance of wood turtle populations. Minimizing physical alterations along stream corridors, such as channelization, impoundment, and removal of woody debris are cited as management recommendations for maintaining wood turtle populations (IPFW 2004). The Housatonic River within the PSA functions as a contiguous corridor providing a roughly 10-mile stretch of diverse riverine and wetland/floodplain habitats that offer relative seclusion and excellent conditions for the wood turtle. There are no comparable riverine/floodplain habitat conditions within the region that offer refuges for such rare wildlife species. SED 3 through SED 8 and FP 3 through FP 7 will each result in a significant fragmentation of the wood turtle habitat, and result in substantially greater risk to the local population from predatory species such as raccoons and skunks. In short, due to the unique life history requirements of wood turtles that use and move through many of the aquatic and floodplain habitats of the PSA, the proposed combination of remediation activities would be severely damaging to this species under SED 3 through SED 8 and FP 3 through FP 7.

A-4. Assessment of MESA Issues for Wood Turtle

MESA regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity …." The determination of a "take" requires consideration of numerous factors, including the habitat conditions and relative significance/abundance of same for the subject species, the project activities and extent relative to the species' habitat, and the duration and timing of the activities relative to the life cycle requirements of the subject species. A "take" is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of the MESA issues for the wood turtle is summarized in Table A-2 for the sediment alternatives and Table A-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table A-2, all SED alternatives except for SED 1 and SED 2 would involve a take of the wood turtle as defined in MESA. As discussed above, the in-river sediment removal and backfill/capping activities, as well as the riverbank remediation work, will affect the winter hibernation habitats of the wood turtle within such areas as muddy banks, stream bottoms, deep pools, in-stream woody debris piles, and abandoned muskrat burrows. Thus, excavation of these habitats during the winter has a strong probability of causing direct mortality of any individuals in the area of work. Since these habitats are also likely to be used during other periods of the year during the typical movements of the species along the river and through adjacent habitats, the remediation work during other seasons will also constitute a take by disrupting those habitats.

Since even SED 3 (the least invasive of the sediment removal alternatives) will remove the river bottom habitats and riverbanks along roughly 50% of the wood turtle Priority Habitat zone, SED 3 through SED 8 are all likely to impact a significant portion of the local wood turtle population. Although this work will be spread out over a multi-year period (ranging from about 10 to 50 years), the extent and severity of disturbance during any given year within the wood turtle habitat zone will entail a significant disruption to the movements and habits of the wood turtle population and will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative across years, resulting in a long-term impact to a significant portion of the local population. SED 3 through SED 7 and FP 3 through FP 7 will each result in a significant fragmentation of the wood turtle habitat, and result in substantially greater risk to the local population from predatory species such as raccoons and skunks. Moreover, the changed character of the riverbanks and adjacent floodplain habitats from the access and staging areas as a function of tree clearing is expected to reduce habitat suitability for wood turtles for many years to come due to SED 3 through SED 8. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable.

As shown in Table A-3, while FP 2 will cause a take of the wood turtle in the absence of management measures, a take could potentially be avoided through carefully designed and implemented management measures. Such measures would include detailed field investigations to locate wood turtles, use of transmitters to maintain locational data, re-location of wood turtles during work periods, and intensive monitoring and use of barriers to control wood turtle movements outside of work zones. Should it be determined that FP 2 would result in a take of wood turtle despite such measures, it is unlikely that it would constitute a take of a significant portion of the local wood turtle population due to the limited extent and duration of remedial activities associated with the FP 2 actions. Under the condition that a take of an insignificant portion of the local population will occur under FP 2, the development of a long-term net benefit plan appears feasible. Such a plan might entail habitat enhancement measures to provide more suitable wood turtle nesting areas along the river corridor in protected locations. Other measures that could be considered to contribute to a net benefit finding include: controlling recreational use, particularly off-road vehicular traffic; providing public education on the species to discourage collection for pets; providing road crossing structures in identified key locations where such crossings connect habitat units; controlling factors that encourage predators such as raccoons and skunks; use of conservation restrictions, particularly for permanent protection of high quality habitats; implementation of mowing and construction timelines and restrictions; and long-term monitoring and collection of biological data on the local wood turtle population. Given the limited areas of impact under the FP 2 scenario, the development of a net benefit plan incorporating one or more of these measures appears feasible.

All other FP alternatives (FP 3 through FP 7) involve activities in such substantial degree and extent that a take could not likely be avoided. For example, even FP 3, the least extensive of the remaining alternatives, will involve clearing, grubbing, soil excavation, dewatering, backfilling, construction equipment access and operation, sediment stockpiling, and related activities over approximately 62 acres of wood turtle Priority Habitat over a three-year period. Given the extent of this work over the entire stretch of the wood turtle habitat zone, it is unlikely that intensive monitoring and management could avoid a take, and the take is likely to impact a significant portion of the local population. While the total impact area of FP 3 is limited to 4.7% of the wood turtle Priority Habitat, the exceptional quality and diversity of the habitats to be disturbed, as well as the central location of the disturbances through the core of the wood turtle Priority Habitat along the Housatonic River, indicates that a significant portion of the local population will be affected by this alternative.

As with the SED alternatives, the effects of remediation activities will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative between years, resulting in a long-term impact to a significant portion of the local population. The seasonal patterns of wood turtle movements across varied habitats and over considerable distances make avoidance of impacts to wood turtles particularly difficult. The amount of wood turtle habitat impacted increases progressively through the FP alternatives to a maximum amount of wood turtle habitat altered under FP 7 at 275 acres, which obviously become progressively more deleterious to the wood turtle population. Since these alternatives would all impact a significant portion of the local wood turtle population, the development of a net benefit plan is not applicable under MESA.

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Woodlot Alternatives. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Project: GE/Housatonic River Project, Pittsfield, Massachusetts. Topsham, ME.

Table A-2: Assessment of MESA Issues for Wood Turtle under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take; only monitoring.	NA	NA	NA
SED 3	Yes. Excavation of river in Reach 5A and riverbanks in Reaches 5A and 5B, all of which are located in wood turtle habitat, together with construction of access roads and staging areas in wood turtle floodplain habitats, would cause a take. More than 40 acres of river bottom habitat would be excavated and backfilled, and over 83,000 linear feet of riverbank habitat will be remediated. Take would include harassment; disruption of nesting, breeding, feeding, and migration (including hibernation); and potentially direct mortality.	No. Due to necessary extent of excavation and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. The impact of river bottom removal and capping along with riverbank remediation over roughly 50% of the wood turtle habitat zone would likely impact a significant portion of the local wood turtle population. Although this work will be spread out over an 8-year period, the effects of remediation activities during any one year will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative across years, resulting in a long-term impact to a significant portion of the local population. Moreover, the changed character of the riverbanks and adjacent floodplain habitats from the access and staging areas as a function of tree clearing is expected to reduce habitat suitability for wood turtles for many years to come.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 4	Yes. Extensive amount of excavation and capping, over more than 53 acres of river bottom wood turtle habitat, together with 45 acres of thin-layer capping and 83,600 linear feet of riverbank remediation in Reaches 5A and 5B and construction of access roads and staging areas in wood turtle floodplain habitat, would cause a take. Take would include harassment; disruption of nesting, breeding, feeding, and migration (including hibernation); and potentially direct mortality.	No. Due to necessary extent of excavation and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. The impact of river bottom removal and backfill along with riverbank remediation over roughly 70% of the wood turtle habitat zone would likely impact a significant portion of the local wood turtle population. Although this work will be spread out over a 15-year period, the effects of remediation activities during any one year will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative across years, resulting in a long-term impact to a significant portion of the local population. Moreover, the changed character of the riverbanks and adjacent floodplain habitats from the access and staging areas as a function of tree clearing is expected to reduce habitat suitability for wood turtles for many years to come.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.
SED 5 through 8	Yes. Extensive amount of excavation and capping/backfilling of 88 acres (SED 5) to 119 acres (SED 8) of river bottom wood turtle habitat, together with 83,600 linear feet of riverbank remediation in Reaches 5A and 5B and construction of access roads and staging areas in wood turtle floodplain	No. Due to necessary extent of excavation and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. Due to widespread impact on wood turtle habitat, including majority of river bottom and riverbank habitat in PSA, SED 5 through 8 would likely impact a substantial portion of local wood turtle population. Although this work will be spread out over an 18- to 51-	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
	habitat, would cause a take. Take would include harassment; disruption of nesting, breeding, feeding, and migration (including hibernation); and potentially direct mortality.		year period, the effects of remediation activities during any one year will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative across years, resulting in a long-term impact to a significant portion of the local population. Moreover, the changed character of the riverbanks and adjacent floodplain habitats from the access and staging areas as a function of tree clearing is expected to reduce habitat suitability for wood turtles for many years to come.	

Table A-3: Assessment of MESA Issues for Wood Turtle under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Yes. FP 2 will involve clearing, grubbing, soil excavation, dewatering, backfilling, construction equipment access and operation, sediment stockpiling, and related activities over approximately 20 acres of wood turtle Priority Habitat over a one-year period. Take would include harassment and disruption of nesting, breeding, feeding, and migration; and potentially direct mortality.	Possibly. Due to relatively limited areas of soil removal and access roads/staging areas in wood turtle habitat and limited duration of remediation (1 year), it may be feasible to avoid a take through management measures, including field investigations to identify and track wood turtles, re-location of any wood turtles identified, and barriers to prevent entry of wood turtles into work areas. However, said measures may still be considered a take if re-location efforts are extensive enough.	No. Impact areas are relatively small and localized in relation to overall wood turtle habitat in PSA (less than 2%); thus, if a take should occur, the temporary loss of habitat in those areas would not impact a significant portion of the local population. Management measures, including field investigations to identify and track wood turtles, re-location of any wood turtles identified, and barriers to prevent entry of wood turtles into work areas, could minimize the impact to an insignificant portion of the local population.	Yes. If a take could be limited to an insignificant portion of the local population, a long-term net benefit plan involving on-site habitat enhancement measures appears feasible. The plan could involve the creation, preservation, and management of more optimum nesting areas for wood turtle within the riparian corridor, along with supporting operational controls on recreational use and vehicular traffic, potential conservation restrictions, and long-term biological monitoring.
FP 3, FP 4, and FP 5	Yes. FP 3 through FP 5 will involve clearing, grubbing, soil excavation, dewatering, backfilling, construction equipment access and operation, sediment stockpiling, and related activities over approximately 62 to 95 acres of wood turtle Priority Habitat	Unlikely. Due to necessary extent and duration of excavation and other construction activities over 62 to 95 acres of wood turtle Priority Habitat, there	Yes. While the total impact area is limited to 4.7 to 7.2% of the wood turtle Priority Habitat, the exceptional quality and diversity of the habitats to be disturbed, as well as the central location of the disturbances through the core of the	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
	over a 3 to 4 year period. Take would include harassment and disruption of nesting, breeding, feeding, and migration; and potentially direct mortality. Given the extent of the impacted habitat, a take in the form of harassment and disruption of nesting, breeding, feeding, and migration; and potentially direct mortality is expected.	would be no feasible means of modifying or scheduling the work to avoid a take, particularly in the form of disruption of feeding and migration activities. While intensive management measures could be implemented, including field investigations to identify and track wood turtles, re-location of any wood turtles identified, and barriers to prevent entry of wood turtles into work areas, said measures are not likely to avoid a take due to the extensive areas involved.	wood turtle Priority Habitat along the Housatonic River, indicates that a significant portion of the local population will be affected by these alternatives. Although this work will be spread out over a 4-year period, the effects of remediation activities during any one year will remain as a habitat alteration adverse to the wood turtle for many years, even with progressive habitat restoration measures. Accordingly, the impacts to the wood turtle will be cumulative across years, resulting in a long-term impact to a significant portion of the local population. Moreover, the changed character of the floodplain habitats from the access and staging areas as a function of tree clearing is expected to reduce habitat suitability for wood turtles for many years to come.	

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. FP 6 and FP 7 will involve clearing, grubbing, soil excavation, dewatering, backfilling, construction equipment access and operation, sediment stockpiling, and related activities over approximately 200 and 275 acres, respectively, of wood turtle Priority Habitat over 13- and 22-year periods, respectively. Take would include harassment and disruption of nesting, breeding, feeding, and migration; and potentially direct mortality.	No. Due to necessary extent of excavation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. Due to the impact on an extensive and central portion of wood turtle Priority Habitat, FP 6 and FP 7 would impact a substantial portion of local wood turtle population. The impacts would occur over 15% and 21% of the wood turtle Priority Habitat, and include areas of diverse floodplain wetland communities, including forested wetlands, shrub and emergent wetlands, vernal pools and other backwater habitats.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

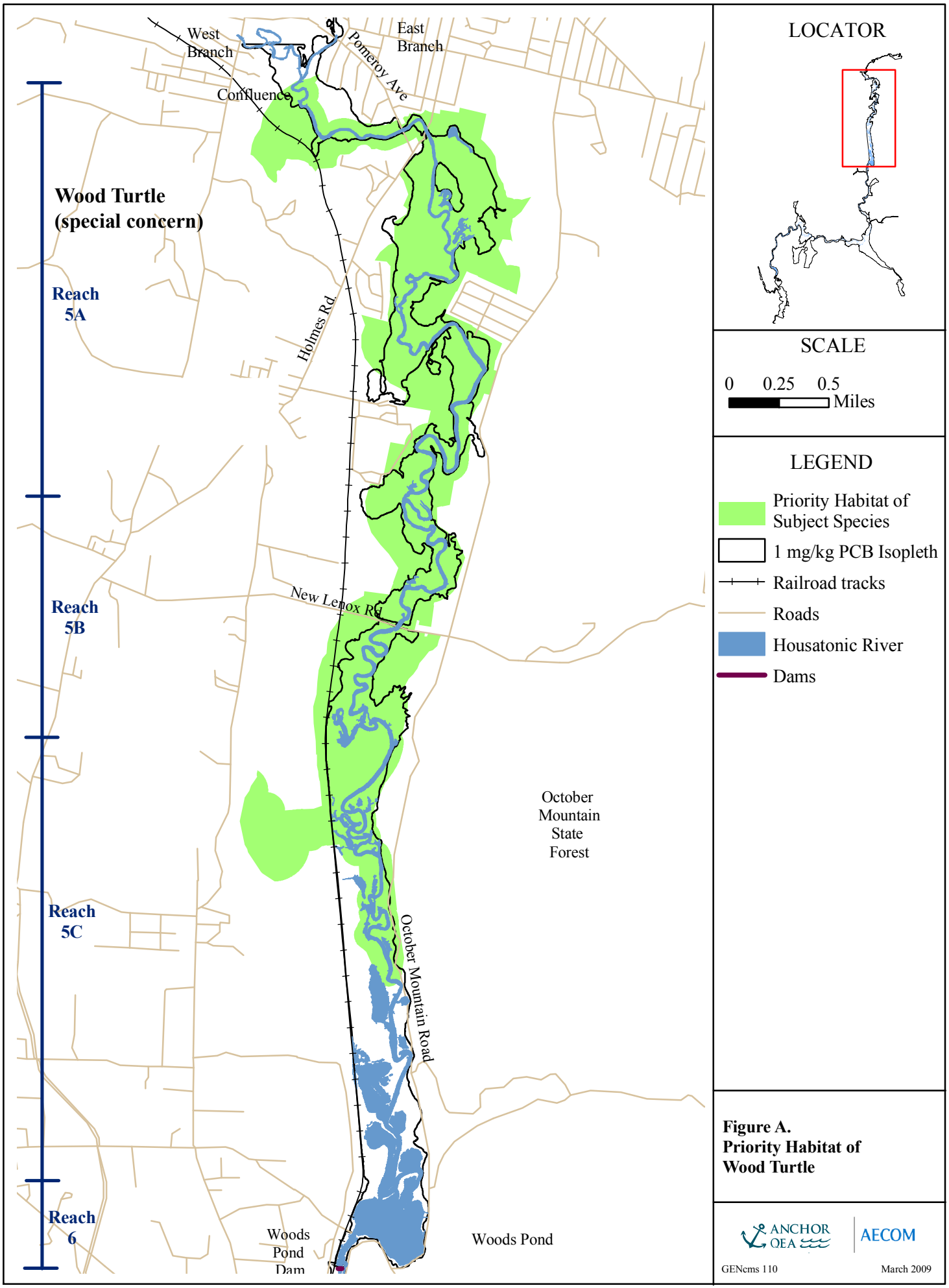

Figure A.
Priority Habitat of Wood Turtle

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B. Jefferson Salamander (*Ambystoma jeffersonianum*)

B. Jefferson Salamander (*Ambystoma jeffersonianum*) MESA Assessment

B-1. Summary of Species Life Cycle and Habitat Requirements

Jefferson salamanders are primarily terrestrial salamanders with a preference for well drained deciduous forests or mixed forests in proximity (movements of 250 to 1600 meters are documented) to small vernal pools or fishless ponds surrounded by alder, red maple, buttonbush, and dogwood. Adults hide beneath leaf litter, loose soil, and stones, or in rotting logs, rodent burrows, or subterranean burrows which they excavate. Jefferson salamanders hibernate underground during the winter months, usually near breeding sites. In March and April (sometimes as early as February), Jefferson salamanders begin to migrate to breeding ponds when the first early warm spring rains or other conditions of high humidity and above-freezing temperatures trigger the migration. They congregate in large numbers at temporary ponds with males arriving at the breeding sites a few days prior to the females. Vernal pools, or temporary ponds, are necessary for reproduction and need to be full of dead and decaying leaves for cover and overhanging bushes or grasses for egg deposition. Eggs are laid in small transparent masses of 12 to 75 eggs. Egg counts may range from 140 to 280. Young larvae hatch about 30 to 45 days later from the egg masses and remain in the breeding pools 2 to 4 months until site and weather conditions are suitable for emigration from the pools. Larvae are cannibalistic and are voracious eaters, preying on insect larvae and other small aquatic animals. No overwintering of larvae has been reported in Massachusetts, so by late August larvae have metamorphosed completely into air-breathing adults. Emigration usually occurs in mid-July to August. Adult Jefferson salamanders are rarely seen outside of the breeding season, but are presumed to eat earthworms and other invertebrates underground. Jefferson salamanders produce noxious skin secretions from specialized poison glands in their tail and are thus rarely preyed upon by native predators. The Jefferson salamander is a state-listed Species of Special Concern in Massachusetts (NHESP 2008).

B-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the Jefferson salamander in the PSA is limited to wet meadow, shrub swamp, transitional floodplain forest, and vernal pool habitat in the floodplain community in the southern section of Reach 5B and the northern portion of Reach 5C, as shown on Figure B at the end of this section. The areal extent of the habitat primarily exists in the floodplain community just north of Yokun Brook. The habitat is located within and around a series of EPA-identified vernal pools referred to as 46-VP-1 through 46-VP-5. The total Priority Habitat of the Jefferson salamander population mapped by NHESP is approximately 105 acres, of which 40 acres are within the PSA and approximately 9 acres of which have been identified as vernal pool habitat. According to the Ecological Characterization of the Housatonic River (Woodlot 2002), adult Jefferson salamanders were trapped and identified within vernal pool 46-VP-5 during a 1998 survey. The Woodlot report also identified Jefferson salamander egg masses in vernal pool 23A-VP-1 which is located in Reach 5A to the north of the WWTP and is located outside of NHESP-mapped Priority Habitat.

B-3. Impacts of Remedial Alternatives on Jefferson Salamander Habitat

B-3-1. Overview

Table B-1 summarizes the areal extent and duration of work within Jefferson salamander habitat for all alternatives. Alternatives SED 1 through SED 3 involve no construction activities within the Jefferson salamander Priority Habitat. Alternatives SED 4 through SED 7 all involve approximately 0.3 to 0.4 acre of activity (thin-layer capping or sediment removal) in the northern part of Reach 5C within this habitat, and SED 8 would involve sediment removal in about 0.6 acre of this habitat. However, these activities would take place within the river channel and/or backwaters, which would not be expected to be used by Jefferson

salamanders. No additional impacts are anticipated due to access road and staging areas within Jefferson salamander habitat for the SED alternatives.

FP 2 involves soil removal/backfilling within approximately 0.1 acre of floodplain wetlands situated in the Jefferson salamander Priority Habitat, and FP 3 through FP 7 involve such remediation within 3 to 8 acres of such habitat. In addition, all these alternatives involve additional impacts of 1.2 to 1.8 acres within such habitat for access roads and staging areas. Floodplain remediation activities will impact Jefferson salamander Priority Habitat by altering floodplain emergent marshes, scrub-shrub wetlands, forested wetlands, and vernal pool habitat contained within the work areas.

Table B-1. Jefferson Salamander Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Jefferson Salamander Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5B 5C	0 0	0 0	NA
SED 4	5B 5C	0 0.3 ac (thin-layer capping)	0 0	NA 5
SED 5	5B 5C	0 0.3 ac (excavation/capping)	0 0	NA 4
SED 6	5B 5C	0 0.3 ac (excavation/capping) 0.04 ac (thin-layer capping)	0 0	NA 6
SED 7	5B 5C	0 0.3 ac (excavation/capping) 0.04 ac (thin-layer capping)	0 0	NA 7
SED 8	5B 5C	0.2 ac (excavation/capping) 0.4 ac (excavation/capping)	0 0	7 17
FP 1	N/A – No Action	0		
FP 2	5B 5C	0 0.1 ac (excavation/backfill)	0.2 ac habitat removal 1.5 ac habitat removal	1
FP 3	5B 5C	0 3 ac (excavation/backfill)	0 1.2 ac habitat removal	3
FP 4	5B 5C	0 3 ac (excavation/backfill)	0.45 ac habitat removal 1.2 ac habitat removal	4
FP 5	5B 5C	0 7 ac (excavation/backfill)	0.3 ac habitat removal 1.5 ac habitat removal	4
FP 6	5B 5C	0 7 ac (excavation/backfill)	0.32 ac habitat removal 1.1 ac habitat removal	13
FP 7	5B 5C	0.1 Ac (excavation/backfill) 8 ac (excavation/backfill)	0.33 ac habitat removal 0.9 ac habitat removal	22

*The Priority Habitat for this species is only mapped in Reaches 5B and 5C.
**All direct impacts under SED alternatives are to riverine and backwater habitats; FP and access/staging impacts are primarily to floodplain wetland habitats.
***Duration of work figures refer to work within entire Reach; work within Priority Habitat area would be less.

B-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for Jefferson salamander is not found in Reach 5A although this species has been identified in this reach (Woodlot 2002).

Reach 5B

Priority Habitat for Jefferson salamander is identified in wet meadow, shrub swamp, and transitional floodplain forest habitats found in a small area (approximately 6 acres) in the southern section of Reach 5B where several oxbows and river meanders are present. No impact to Jefferson salamander habitat in Reach 5B will occur under alternatives SED 1 through SED 7. SED 8 involves the excavation of 0.2 acre of sediment in the river and backwater areas in Reach 5B within the Jefferson salamander Priority Habitat. No activities associated with construction of access roads or staging areas for the SED alternatives are situated within Jefferson salamander habitat in Reach 5B.

Of the FP alternatives, only FP 7 involves any sediment removal within the Reach 5B portion of the Jefferson salamander habitat, with 0.1 acre of sediment excavation/backfilling. However, all the FP alternatives would involve some impacts (< 0.5 acre) due to access road/staging area construction. These activities would impact Jefferson salamander habitat by removing vegetation, leaf litter and downed woody debris from the forest floor, fragmenting the habitat, and potentially causing direct mortality from equipment traffic and excavation activities. This work would also impact vernal pool habitat that provides breeding habitat for Jefferson salamander.

Reach 5C

Priority Habitat for Jefferson salamander is identified in the wet meadow, shrub, swamp, transitional floodplain forest, and vernal pool habitat in the northern portion of Reach 5C. The habitat surrounds a series of EPA-identified vernal pools referred to as 46-VP-1 through 46-VP-5. No impact to Jefferson salamander habitat will occur in Reach 5C under alternatives SED 1 through SED 3. SED 4 and SED 5 remediation work impacts 0.3 acre of priority habitat due to thin-layer capping in river and backwater priority habitat. Alternatives SED 6 and SED 7 impact 0.3 acre of river and backwater priority habitat due to excavation of 1 to 2 ft. of sediment and 0.04 acre of river and backwater priority habitat due to thin-layer capping. SED 8 impacts 0.4 acre of river and backwater habitat due to excavation of 2 to 6 ft. of sediment. No activities associated with construction of access roads or staging areas are situated within Jefferson salamander habitat in Reach 5C.

Within Reach 5C, FP 2 involves work within 1.6 acres of floodplain wetlands situated in the Jefferson salamander Priority Habitat, including soil removal/backfilling (0.1 acre) and road access and staging areas (1.5 acres). The impact areas increase to 4.2 to 4.65 acres under FP 3 and FP 4, to 8.6 to 8.8 acres under FP 5 and FP 6, and to 9.33 acres under FP 7. These activities would impact Jefferson salamander habitat by removing vegetation, leaf litter and downed woody debris from the forest floor, fragmenting the habitat, and potentially causing direct mortality from equipment traffic and excavation activities. This work would also impact vernal pool habitat that provides breeding habitat for Jefferson salamander.

Reach 6

Priority Habitat for Jefferson salamander is not found in Reach 6.

B-4 Assessment of MESA Issues for Jefferson Salamander under Remedial Alternatives

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “ in reference to animals means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity…” A “take” is only permissible under MESA

regulations if a project proponent can demonstrate: 1) that an insignificant portion of the local population will be impacted by the project; and 2) if the proponent agrees to carry out a conservation and management plan for the species (on or off-site, and approved by the Director of the MA Division of Fisheries & Wildlife) that provides a long-term net benefit to the conservation of the species. The MESA regulations define "net benefit" at 321 CMR 10.02 as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the Jefferson salamander is summarized in Table B-2 for the sediment alternatives and Table B-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table B-2, sediment alternatives SED 1 through SED 3 do not involve any work within the Priority Habitat of the Jefferson salamander and SED 4 through SED 8 are unlikely to result in a take of the Jefferson salamander. The remedial actions associated with the latter alternatives involve minimal impacts to Jefferson salamander habitat (0.3 to 0.6 acre), and are within habitats unlikely to be utilized by this species. Jefferson salamander habitat appears to be associated with vernal pools 46-VP-1 through 46-VP-5 and the surrounding wet meadow, scrub swamp and transitional floodplain forest habitats in the lower section of Reach 5B and the upper part of Reach 5C. The sediment alternatives do not impact any of the EPA-identified vernal pools or surrounding forested floodplain communities located within Jefferson salamander Priority Habitat. Further, the SED alternatives would not involve construction of access roads or staging areas within the mapped Jefferson salamander habitat.

As shown in Table B-3, all FP alternatives except FP 1 will involve a take of this species through the construction work in the Priority Habitat for this species. That work will disrupt the breeding and migratory activities of these salamanders, and could result in direct killing of eggs, larvae and possibly adults if the work is performed during periods when the salamanders are present at various stages of their life cycle. However, FP 2 would affect only 1.7% of the Jefferson salamander Priority Habitat, including only 0.1 acre of impact from soil remediation and an additional 1.7 acres of access road and staging area impacts, which could be modified to avoid or minimize impacts on critical habitat such as vernal pools. As such, that alternative would not be expected to affect a significant portion of the local population. FP 3 through FP 7 involve increasing amounts of direct impacts within Jefferson salamander Priority Habitat and all of them impact several of the EPA-identified vernal pools. Given the impacts to vernal pool habitat which is critical to successful Jefferson salamander breeding, FP 3 through FP 7 will impact a significant portion of the Jefferson salamander population within the PSA. While restricting work activities to winter months to avoid the breeding period may reduce some impacts to this species over the short term, the impacts to the forested communities in which the Jefferson salamander spends most of its lifecycle are so extensive that it will take decades before those areas are once again adequate habitat. Moreover, conducting sediment excavation in and around vernal pools during the winter months will not avoid impacts to hibernating Jefferson salamanders, which often return to overwinter near their natal pool, thus causing significant mortality. Additional mortality is likely for salamanders using forested habitats in all seasons from floodplain excavations, access roads, and staging areas.

Given the impact of FP 3 through FP 7 on a significant portion of the local population, a net benefit plan for this species is not applicable under MESA for these alternatives.

For alternative FP 2, potential conservation and management measures to achieve a net benefit for the species should be evaluated. Based on a review of the literature, the elements of a conservation and management plan can be identified. Potential elements of such a plan might include: relocation of access roads and staging areas to the greatest extent possible outside critical habitat such as vernal pools and

surrounding forested buffers; use of conservation restrictions, particularly for permanent protection of unaffected high quality habitats; and long-term monitoring and collection of biological data on the local Jefferson salamander population. However, given the high quality of the existing habitat, including the remaining habitat proximate to the work area which is unaffected by the remediation which is critical to this species, it cannot be established whether such a plan would in fact achieve a net benefit for this species.

References:

Degraaf and Yamasaki. 2001. New England Wildlife. University Press of New England, Hanover, NH.

NHESP. 2007. Fact Sheet for Jefferson Salamander (*Ambystoma jeffersonianum*). Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

NHESP. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table B-2: Assessment of MESA Issues for Jefferson Salamander Under Sediment Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No. MNR only.	NA	NA	NA
SED 3	No. No work in mapped Jefferson salamander habitat.	NA	NA	NA
SED 4 through SED 8	Unlikely. Excavation of sediment or thin-layer capping in small areas (0.3 to 0.6 acre) of river or backwater areas would not occur within any of the EPA-identified vernal pools or surrounding forested floodplain communities within Jefferson salamander Priority Habitat.	NA	NA	NA

Table B-3: Assessment of MESA Issues for Jefferson Salamander Under Floodplain Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2	Yes. FP 2 involves work within 1.8 acres of floodplain wetlands situated in the Jefferson salamander Priority Habitat, including soil removal/backfilling (0.1 acre) and road access and staging areas (1.7 acres) within wooded floodplain habitat. That work will disrupt the breeding and migratory activities of these salamanders, and could result in direct killing if the work is performed during periods when the salamanders are present in the ponds.	Possibly. Due to limited areas of soil removal and access roads/staging areas in Priority Habitat area and likely limited duration of remediation (1 year), it may be feasible to avoid or minimize a take through designing access roads and staging areas to avoid critical habitat for this species (vernal pools and surrounding forested habitat).	No. Activities impact only 1.7% of the Jefferson salamander Priority Habitat and access roads and staging areas may be designed to avoid critical habitat.	Cannot be established. Based on a review of the literature, the elements of a conservation and management plan to benefit this species, consisting of measures for the preservation, enhancement or expansion of habitat supporting this species, can be identified. However, given the high quality of remaining existing habitat proximate to the work area, it cannot be determined that such a plan would achieve a net benefit for the species.
FP 3 through FP 7	Yes. These alternatives involve 3 to 8 acres of clearing, grubbing, and soil removal in the floodplain within Jefferson salamander habitat, including a network of vernal pools within the work area or in close proximity. An additional 1.2 to 1.65 acres of habitat loss and fragmentation will occur due to access road and staging area construction. These activities will disrupt the breeding and migratory activities of the salamanders, and could result in direct killing if the work is performed during periods when the salamanders are present in the ponds.	No. Direct loss of habitat within forested habitat and vernal pools results in an unavoidable take.	Yes. Since these alternatives directly impact EPA-identified vernal pools which support confirmed Jefferson salamander breeding, they would affect a significant portion of the local population.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

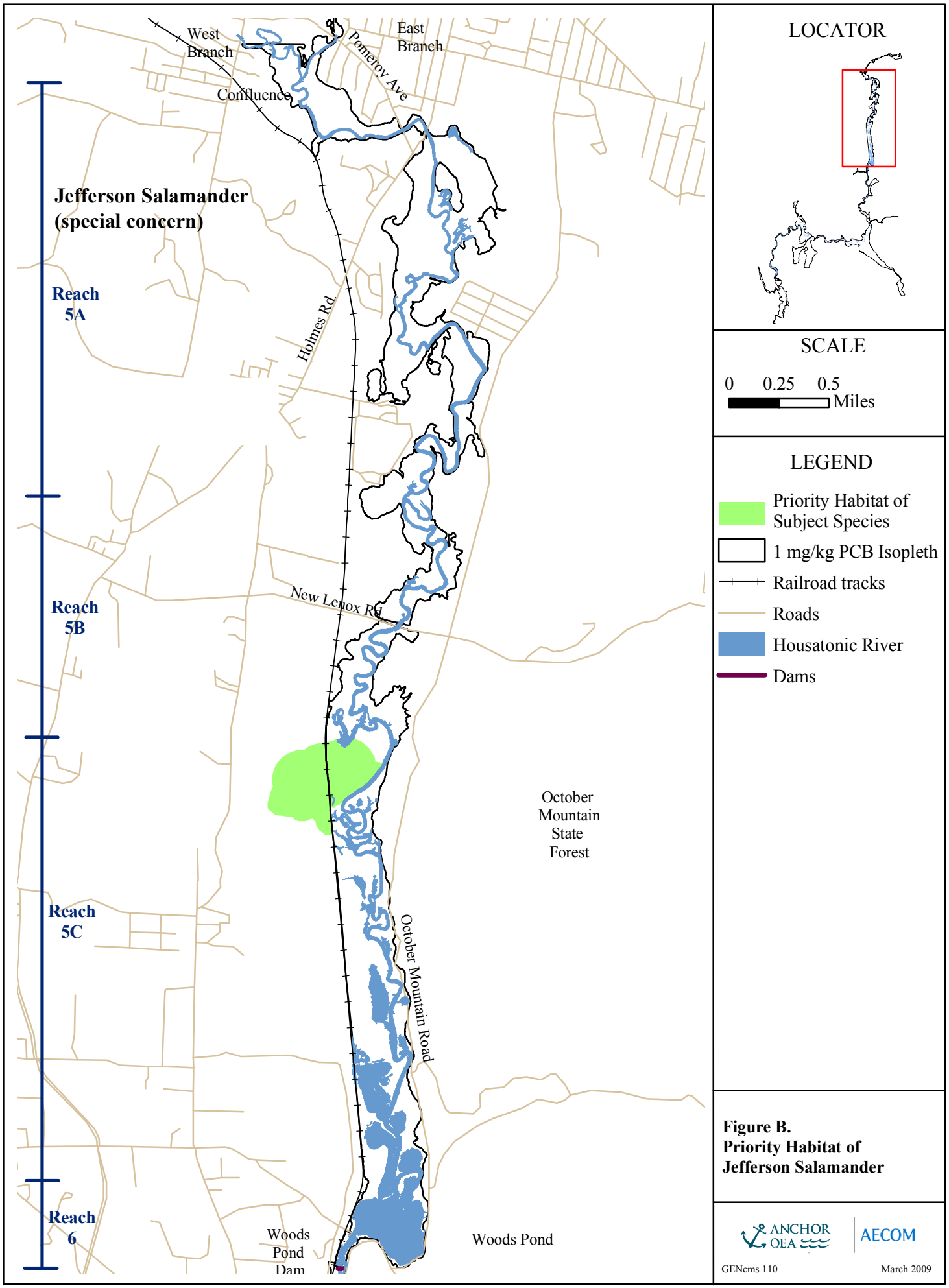

Figure B.
Priority Habitat of Jefferson Salamander

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C. American Bittern (*Botaurus lentiginosus*)

C. American Bittern (*Botaurus lentiginosus*) MESA Assessment

C-1. Summary of Species Life Cycle and Habitat Requirements

The American bittern inhabits freshwater and brackish wetlands, including marshes, meadows, bogs, and fens, where it dwells in emergent vegetation such as cattails, sedges, and rushes. The bittern will occasionally utilize upland grasslands for foraging and nesting. Motionless American bitterns greatly resemble marsh vegetation or debris and the bittern relies on this camouflage to escape the notice of predators and to catch its prey. Preferred foods include frogs, small snakes and eels, salamanders, crayfish, fish, and occasionally mice and grasshoppers caught on visits to wet meadows and grasslands.

The American bittern migrates from its winter habitat in the southern United States and arrives in Massachusetts in April. Courtship behavior begins with males stalking females, displaying their white plumes and calling in loud, guttural "pumps." By the end of May, the calls have stopped and the female builds a nest of reeds and grasses on the ground in dense vegetation. Bitterns prefer expansive areas of contiguous wetlands; home ranges of 500-1000 acres are documented (Dechant et al 2003). Bitterns prefer wet meadows for nesting sites, but are known to construct platforms of vegetation a foot above water or nest in uplands adjacent to wetlands. They also occasionally nest in upland fields adjacent to water. A clutch will generally have 4 to 5 eggs and will hatch within 24 to 29 days. The chicks become fledglings after 14 days and by the end of the summer, juvenile bitterns begin to wander away from the nest. There is only one clutch per year and the female will continue to tend to her young throughout the summer. Males are territorial and will remain in the vicinity of the nest site. Migration to habitat in the southern U.S. is during October and November, and by December, most bitterns have left Massachusetts. The American bittern is a state-listed Endangered Species in Massachusetts (NHESP 2008).

C-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the American bittern occurs in the PSA within all Reaches (see Figure C at the end of this section). In Reach 5A, this habitat covers a large area just south of the confluence and west of Holmes Road. Coverage begins again on the east side of Holmes Road and continues until the lower fifth of Reach 5A. Priority Habitat for this species covers the lower two-thirds of Reach 5B and continues unbroken through Reach 5C, and into the top half of Reach 6. The areal extent of the habitat includes the main stem of the Housatonic River, moderately alkaline lake/pond, shallow and deep emergent marsh, wet meadow, transitional floodplain forest, red maple swamp, shrub swamp, cultural grassland, riverine point bar/beach, and Woods Pond. The total Priority Habitat area of the American bittern is approximately 1,545 acres, of which 796 are within the PSA.

C-3. Impacts of Remedial Alternatives on American Bittern Habitat

C-3-1. Overview

Table C1 summarizes the areal extent and duration of work within NHESP mapped American bittern habitat for all the remedial alternatives. SED 1 involves no construction-related activities. SED 2 is limited to monitored natural recovery only and will not adversely impact mapped bittern habitat. SED 3 through SED 8 involves increasing activity within that habitat. SED 3 involves 17 acres of excavation and 58 acres of thin-layer capping within the river channel; SED 4 involves 40 acres of excavation, 97 acres of thin layer capping, and 37 acres of engineered capping in-river and in backwater areas; SED 5 involves 56 acres of excavation, 79 acres of thin layer capping, and 39 acres of engineered capping in-river and in backwater areas. SED 6 involves 123 acres of excavation, 53 acres of thin layer capping, and 2 acres of engineered capping in-river and in backwater areas. SED 7 involves 138 acres of excavation, 39 acres of thin layer capping, and 2 acres

of engineered capping in-river and in backwater areas. SED 8 involves 195 acres of river and backwater excavation. SED 3 through SED 8 will all involve riverbank remediation of up to approximately 26,433 linear feet and up to 47 acres of access road and staging area construction impacts. No riverbank remediation is planned for Reaches 5C and 6. Though American bitterns prefer emergent wetlands (shallow and deep emergent marsh, shrub swamp, wet meadow) as foraging, breeding, nesting, and protective cover habitat, they will also utilize shoreline areas for foraging, and occasionally dry fields adjacent to water as foraging and nesting habitat. The bittern's habitat extends over the majority of the PSA and work for alternatives SED 3 through SED 8 will result in a take of the American bittern by reducing prey species, removing vegetation used for nesting and cover, and fragmenting its habit.

Floodplain remediation alternatives FP2 through FP7 will impact this species' Priority Habitat within all reaches by altering wet meadow, shrub swamp, and shallow emergent marsh communities. Direct impacts to American bittern habitat from floodplain remediation will range from approximately 7 acres in FP 2 up to 204 acres in FP 7. Construction of access roads and staging areas in support of floodplain remediation activities within all reaches would have significant impact to American bittern primary habitat and would impact up to 41 acres of mapped Priority Habitat. The bittern's habitat extends over the majority of the PSA and work for alternatives FP 2 through FP 7 will reduce prey species, remove vegetation used for nesting and cover, and fragment the habitat of the American bittern.

Table C-1. American Bittern Mapped Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of American Bittern Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A	17 ac (excavation) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	8
	5B	0	18 ac (habitat removal)	<1
	5C	37 ac (thin-layer capping)	4 ac (habitat removal)	1
	6	21 ac (thin-layer capping)	0.05 ac (habitat removal)	1
SED 4	5A	17 ac (excavation) 4 ac (thin-layer capping) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	8
	5B	4 ac (excavation) 15 ac (thin-layer capping) 19772 lf of riverbank (remediation)	18 ac (habitat removal)	3
	5C	76 ac (thin-layer capping) 37 ac (engineered capping)	12 ac (habitat removal)	2
	6	19 ac (excavation) 2 ac (thin-layer capping)	0.05 ac (habitat removal)	2

Remedial Alternative	Reach with Affected Habitat	Description of American Bittern Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 5	5A	17 ac (excavation) 4 ac (thin-layer capping) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	8
	5B	18 ac (excavation) 0.3 ac (thin-layer capping) 19772 lf of riverbank (remediation)	18 ac (habitat removal)	5
	5C	21 ac (excavation) 55 ac (thin-layer capping) 37 ac (engineered capping)	16 ac (habitat removal)	2
	6	19 ac (thin-layer capping) 2 ac (engineered capping)	0.05 ac (habitat removal)	2.5
SED 6	5A	17 ac (excavation) 6 ac (thin-layer capping) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	8
	5B	18 ac (excavation) 5 ac (thin-layer capping) 19772 lf of riverbank (remediation)	18 ac (habitat removal)	5
	5C	69 ac (excavation 42 ac (thin-layer capping)	7 ac (habitat removal)	4
	6	19 ac (excavation) 2 ac (engineered capping)	0	2.5
SED 7	5A	17 ac (excavation) 6 ac (thin-layer capping) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	9
	5B	20 ac (excavation) 3 ac (thin-layer capping) 19772 lf of riverbank (remediation)	18 ac (habitat removal)	6
	5C	82 ac (excavation) 30 ac (thin-layer capping)	7 ac (habitat removal)	4
	6	19 ac (excavation) 2 ac (engineered capping)	0	3.5
SED 8	5A	24 ac (excavation) 26433 lf of riverbank (remediation)	22 ac (habitat removal)	11
	5B	25 ac (excavation) 19772 lf of riverbank (remediation)	18 ac (habitat removal)	6
	5C	125 ac (excavation)	7 ac (habitat removal)	10
	6	21 ac (excavation)	0	11
FP 1	N/A – No Action	0	0	0
FP 2	5A	6 ac (habitat removal)	4 ac (habitat removal)	1
	5B	0.8 ac (habitat removal)	2.5 ac (habitat removal)	
	5C	0.4 ac (habitat removal)	3 ac (habitat removal)	
FP 3	5A	16 ac (habitat removal)	8 ac (habitat removal)	3
	5B	7 ac (habitat removal)	5 ac (habitat removal)	
	5C	7 ac (habitat removal)	5 ac (habitat removal)	
	6	0.01 ac (habitat removal)	0.07 ac (habitat removal)	
FP 4	5A	27 ac (habitat removal)	9 ac (habitat removal)	4
	5B	10 ac (habitat removal)	7 ac (habitat removal)	
	5C	11 ac (habitat removal)	7 ac (habitat removal)	
	6	0.01 ac (habitat removal)	0.07 ac (habitat removal)	

Remedial Alternative	Reach with Affected Habitat	Description of American Bittern Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
FP 5	5A 5B 5C 6	20 ac (habitat removal) 10 ac (habitat removal) 19 ac (habitat removal) 0.2 ac (habitat removal)	6 ac (habitat removal) 5 ac (habitat removal) 10 ac (habitat removal) 0.5 ac (habitat removal)	4
FP 6	5A 5B 5C 6	55 ac (habitat removal) 34 ac (habitat removal) 50 ac (habitat removal) 1 ac (habitat removal)	7 ac (habitat removal) 6 ac (habitat removal) 11 ac (habitat removal) 0.05 ac (habitat removal)	13
FP 7	5A 5B 5C 6	88 ac (habitat removal) 44 ac (habitat removal) 70 ac (habitat removal) 2 ac (habitat removal)	5 ac (habitat removal) 5 ac (habitat removal) 11 ac (habitat removal) 0.3 ac (habitat removal)	22
*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur only in Reaches 5A and 5B.				

C-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for the American bittern is found in three separate mapped areas within Reach 5A (511 acres total). It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and floodplain areas. Floodplain and backwater areas within the Reach 5A contains relatively little bittern primary habitat (wet meadow, shrub swamp, and shallow emergent marsh community types). Shoreline areas and riverbank within this reach may also be utilized by bitterns for foraging.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within American bittern Priority Habitat in Reach 5A. SED 3 involves 17 acres of river channel excavation of sediment to a depth of 2 feet below surface grade and backfilling with clean fill. SED 4 and SED 5 involve 17 acres of river channel excavation/backfilling to 1.5 to 2 feet and 4 acres of thin-layer capping in backwater areas. SED 6 and SED 7 involve 17 acres of river channel excavation/backfilling to 1 to 2 feet and 6 acres of thin-layer capping in backwater areas. SED 8 involves 24 acres of river channel and backwater excavation/backfilling. SED 3 through SED 8 all involve riverbank remediation of approximately 26433 linear feet. Riverbank remediation activities will impact this species as it provides potential foraging habitat.

Access road construction and staging areas will disturb up to an additional 22 acres within the Priority Habitat of Reach 5A under alternatives SED 3 through SED 8. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain emergent wetland vegetation will result in impacts to this species. The estimated timeframe for completing the various sediment alternatives in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately 6 acres of American bittern Priority Habitat within Reach 5A. FP 3 involves approximately 16 acres of soil removal and backfilling in Priority Habitat. FP 4 involves approximately 27 acres of soil removal and backfilling in Priority Habitat, and FP 5 involves approximately 20 acres. FP 6 involves soil removal and backfilling in approximately 55 acres and FP 7 involves soil removal and backfilling in approximately 88 acres of Priority Habitat. Access roads and staging areas will impact another 4 to 9 acres of suitable habitat. Where these activities occur in emergent

wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain emergent wetland vegetation will result in impacts to this species. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 5B

NHESP Priority Habitat for the American bittern is found throughout the southern half of Reach 5B (250 acres total). It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and floodplain areas. Floodplain and backwater areas within the PSA contain bittern primary habitat (wet meadow, shrub swamp, and shallow emergent marsh community types). Shoreline areas and riverbank within this reach may also be utilized by bitterns.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within American bittern Priority Habitat in Reach 5B. There is no remediation planned under SED 3. SED 4 involves 4 acres of river channel excavation/backfilling to 1.5 to 2 feet and 15 acres of thin-layer capping in backwater areas. SED 5 involves 18 acres of river channel excavation/backfilling to 1.5 to 2 feet and 0.3 acre of thin-layer capping in backwater areas. SED 6 involves 18 acres of river channel excavation/backfilling to 1 to 2 feet and 5 acres of thin-layer capping in backwater areas. SED 7 involves 20 acres of river channel excavation/backfilling to 1 to 2 feet and 3 acres of thin-layer capping in backwater areas. SED 8 involves 25 acres of river channel and backwater excavation/backfilling. SED 3 through SED 8 all involve riverbank remediation of approximately 19772 linear feet. Riverbank remediation activities will impact this species as it provides potential foraging habitat.

Access road construction and staging areas will disturb up to an additional 18 acres within the Priority Habitat of Reach 5B under alternatives SED 3 through SED 8. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various sediment alternatives in Reach 5B is <1 years for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately <1 acre of American bittern Priority Habitat within Reach 5A. FP 3 involves approximately 7 acres of soil removal and backfilling in Priority Habitat. FP 4 and FP 5 involve approximately 10 acres of soil removal and backfilling in Priority Habitat. FP 6 involves soil removal and backfilling in approximately 34 acres and FP 7 involves soil removal and backfilling in approximately 44 acres of Priority Habitat. Access roads and staging areas will impact another 2.5 to 7 acres of suitable habitat. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 5C

NHESP Priority Habitat for the American bittern is found throughout Reach 5C (751 acres total). It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and floodplain areas. Floodplain and backwater areas within the PSA contain primary bittern habitat (wet meadow, shrub swamp, and shallow emergent marsh community types). Shoreline areas and riverbank within this reach may also be utilized by bitterns.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within American bittern Priority Habitat in Reach 5C. SED 3 involves 37 acres of thin layer capping. SED 4 involves 76 acres of thin-layer capping and 37 acres of engineered capping. SED 5 involves 21 acres of river channel excavation/backfilling to 1.5 to 2 feet, 55 acres of thin-layer capping and 37 acres of engineered capping. SED 6 involves 69 acres of river channel excavation/backfilling

to 1 to 2 feet and 42 acres of thin-layer capping in backwater areas. SED 7 involves 82 acres of river channel excavation/backfilling to 1 to 2 feet and 30 acres of thin-layer capping in backwater areas. SED 8 involves 125 acres of river channel and backwater excavation/backfilling. No riverbank remediation is planned for Reach 5C.

Access road construction and staging areas will disturb up to an additional 16 acres within the Priority Habitat of Reach 5C under alternatives SED 3 through SED 8. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various sediment alternatives in Reach 5C is 1 year for SED 3, 2 years for SED 4 and SED 5, 4 years for SED 6 and SED 7, and 10 years for SED 8.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately <1 acre of American bittern Priority Habitat within Reach 5B. FP 3 involves approximately 7 acres of soil removal and backfilling; FP 4 involves approximately 11 acres of soil removal and backfilling; FP 5 involves approximately 19 acres of soil removal and backfilling; FP 6 involves approximately 50 acres of soil removal and backfilling and FP 7 involves approximately 70 acres of soil removal and backfilling within Priority Habitat. Access roads and staging areas will impact another 2.5 to 7 acres of suitable habitat. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 6

NHESP Priority Habitat for the American bittern is found throughout the northern half of Reach 6 (32 acres total). It includes the main channel and shore of the Housatonic River, contiguous backwater and floodplain areas, and moderately alkaline lake/pond (Woods Pond). Floodplain and backwater areas within the PSA contain primary bittern habitat (wet meadow, shrub swamp, and shallow emergent marsh community types). Shoreline areas and shallow areas within Woods Pond may also be utilized by bitterns.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within American bittern Priority Habitat in Reach 6. SED 3 involves 21 acres of thin-layer capping in backwater areas. SED 4 involves 19 acres of river channel excavation/backfilling to 1.5 to 2 feet and 2 acres of thin-layer capping in backwater areas. SED 5 involves 19 acres of thin-layer capping and 2 acres of engineered capping. SED 6 and SED 7 involve 19 acres of river channel excavation/backfilling to 1 to 2 feet and 2 acres of engineered capping. SED 8 involves 21 acres of river channel and backwater excavation/backfilling. No riverbank remediation is planned for Reach 6.

Access road construction and staging areas will disturb <1 acre within the Priority Habitat of Reach 6 under alternatives SED 3 through SED 8. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various sediment alternatives in Reach 6 is 1 year for SED 3, 2 years for SED 4, 2.5 years for SED and SED 6, 3.5 years for SED 7, and 11 years for SED 8.

FP 1 and FP 2 involve no activities. FP 3, FP 4, and FP 5 involve <1 acre of soil removal and backfilling in Priority Habitat within Reach 6. FP 6 involves soil removal and backfilling in approximately 1 acre, and FP 7 involves soil removal and backfilling in approximately 2 acres of Priority Habitat. Access roads and staging areas will impact <1 acre of habitat. Where these activities occur in emergent wetlands including wet meadow and shrub swamp communities, the potential for impacts to American bittern exists. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

C-4. Assessment of MESA Issues for American Bittern

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity…." A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term Net Benefit to the conservation of the species. "Net Benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the American bittern is summarized in Table C-2 for the sediment alternatives and Table C-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table C-2, except for SED 1 and SED 2, all SED alternatives within all Reaches of the PSA would likely constitute a take of American bittern. Excavation, engineered capping, thin-layer capping and riverbank remediation will cause a take by disrupting nesting, breeding and/or feeding activities of this species, either through direct alteration/removal of primary wetland habitat (for construction of access roads and staging areas), or through behavioral disturbance due to construction activities within nearby open water and shoreline areas. Although direct mortalities might be avoided by executing work in late fall or winter while species is residing in southern United States, such activities would not prevent a take due to a deterioration of the extent and quality of this species' emergent wetlands habitats, with associated impacts to prey species. Remedial work involved with SED 3 impacts approximately 8% of the mapped American bittern habitat, and will involve alteration of roughly 26,400 lf of riverbank habitat. This work is unlikely to adversely affect a significant portion of the local population. SED 4 through SED 8 impact between 14.5% and 15.5% of the mapped habitat, along with 46,000 lf of riverbank habitat. The magnitude of this work (227-242 acres) and its location through the center of the Priority Habitat are likely to also have indirect adverse effects to this species well beyond the limits of work due to noise and associated construction impacts. Accordingly, SED 4 through SED 8 are expected to result in an impact to a significant portion of the local American bittern population.

As shown in Table C-3, all of the floodplain remedial alternatives except for FP 1 would result in a take of the American bittern. Impacts include direct alteration of primary habitat, removal of prey species, habitat fragmentation and potential direct mortality to nesting birds or young. Remedial work involved with FP 2 impacts approximately 0.5% of the total mapped American bittern habitat. FP 3 through FP 5 impacts approximately 3 to 5% of the Priority Habitat. FP 6 and FP 7 impact 10.5% and 14.6%, respectively. Up to approximately 1.5% of the total FP impacts to Priority Habitat are related to construction of access roads and staging areas. It is difficult to assess whether the impacts from these activities would affect a significant portion of the local American bittern population. Since this species is territorial, it will be broadly distributed across available habitats, and thus specific predictions of breeding, nesting, resting, or foraging locations are extremely difficult to make. As a result, depending on the specific locations of the work relative to bittern locations, even small disturbances or encroachments could affect a significant portion of the local population of this state-listed endangered species. Nevertheless, it would be reasonable to conclude that: (a) alternative FP 2, due to its impact on less than 0.5% of the Priority Habitat, would not affect a significant portion of the local American bittern population; (b) alternatives FP 3 through FP 5, given the small percentage of their impacts within mapped Priority Habitat, are less likely to impact a significant portion of the local population than larger alternatives: and (c) FP 6 and FP 7, due to the overall large extent of their impacts (164 acres and 225 acres, respectively), and the distribution of these impacts across are likely to impact a significant portion of the local population.

For those alternatives which involve a take that does not affect a significant portion of the local American bittern local population, the effectiveness of a long term net benefit plan for this species cannot currently be established. Based on a review of the relevant literature, restoration and protection of large wetland habitats are the primary management goals for the American bittern (Dechant et al 2003); specific habitat management measures to enhance conditions for this species are generally untested. Given the high quality of the existing habitat, the potential for establishing a net benefit by way of additional habitat management is remote.

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Table C-2: Assessment of MESA Issues for American Bittern Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take due to monitored natural recover only	NA	NA	NA
SED 3	Yes. Excavation/capping, engineered capping, thin-layer capping and shoreline remediation within all Reaches 5A, 5C and 6. Alteration of 125 acres of the Priority Habitat zone will cause a take by "harassing" or "disrupting" the species feeding, breeding or nesting activity. Removal of any emergent wetlands or wet meadow for access roads and staging areas will alter primary nesting, feeding, breeding, and protective cover habitat. Construction within these reaches may also disrupt migration patterns, deterring individuals from returning to the area. A temporary loss of prey species in all reaches where work will be performed following in-river and riverbank remediation is also likely.	No. Direct mortalities could be avoided by executing work in late fall or winter while species is residing in southern United States, but this will not prevent loss of habitat and impacts on prey species.	Unlikely. Only 8% of mapped American bittern habitat within the Priority Habitat zone will be impacted, along with roughly 26,400 lf of riverbank.	Cannot be established. The only established management technique for this species involves restoring and protecting large wetland areas. Specific habitat management measures to enhance conditions for this species are generally untested. Given the high quality of the existing habitat, the potential for establishing a net benefit is remote.
SED 4 through SED 8	Yes. Excavation/capping, engineered capping, thin-layer capping and shoreline remediation within all Reaches of the Priority Habitat zone will cause a take by	No. Direct mortalities could be avoided by executing work in late fall or winter while species is residing in southern United States, but	Yes. Between 227-242 acres (14.5% to 15.5%) of mapped American bittern Priority Habitat zone will be impacted, along with	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
	"harassing" or "disrupting" the species feeding, breeding or nesting activity. Overall habitat impacts range from 227 to 242 acres, along with roughly 46,000 lf of riverbank remediation. Removal of any emergent wetlands or wet meadow for access roads and staging areas will alter primary nesting, feeding, breeding, and protective cover habitat. Construction within these reaches may also disrupt migration patterns, deterring individuals from returning to the area. A temporary loss of prey species in all reaches following in-river and riverbank remediation is also likely.	this will not prevent loss of habitat and impacts on prey species.	roughly 46,000 lf of riverbank that provides important foraging habitat. This work will occur through the center of the Priority Habitat, and is likely to have indirect adverse effects to this species far beyond the limits of work.	

Table C-3: Assessment of MESA Issues for American Bittern Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2	Yes. Over 16 acres of the American bittern Priority Habitat will be altered under this alternative. A take will occur through the "harassment" or "disruption" of local individuals through disturbance of feeding, breeding or nesting activity due to construction activities. Construction may also disrupt migrational patterns, deterring individuals from returning to the area.	Possible. The impacted area is less than 1% of the total Priority Habitat and therefore a take might be avoided by redesigning access and staging areas to avoid primary habitat and timing construction for the winter months.	No. If a take could not be avoided, it would not impact a significant portion of the local population because the impacted area is only 1% of the total Priority Habitat.	Cannot be established. The only established management technique for this species involves restoring and protecting large wetland areas. Specific habitat management measures to enhance conditions for this species are generally untested. Given the high quality of the existing habitat, the potential for establishing a net benefit is remote.
FP 3 through FP 5	Yes. Overall bittern habitat impacts from these alternatives range from 48-71 acres. A take will occur through the "harassment" or "disruption" of local individuals through disturbance of feeding, breeding or nesting activity due to construction activities. Construction may also disrupt migrational patterns, deterring individuals from returning to the area.	No. These alternatives impact approximately 3 to 5% of the American bittern Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take is difficult. Impacts might be minimized by executing work in late fall or winter while species is residing south of New England, but this will not prevent habitat impacts or disruption to the bittern.	Uncertain. Impacts under these alternatives relative to the overall Priority Habitat are only 3 to 5%, but impacts occur within the species primary habitat and the extent of impacts depends on the specific locations of the work in relation to the specific locations of bittern breeding, nesting, resting, or foraging locations.	Cannot be established. See FP 2 above.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. Impacts will occur to 164 and 225 acres of floodplain, respectively. A take will occur through the "harassment" or "disruption" of local individuals through disturbance of feeding, breeding or nesting activity due to construction activities. Construction may also disrupt migrational patterns, deterring individuals from returning to the area.	No. These alternatives impact approximately 10.5 to 14.6 % of the American bittern Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take would be difficult. Sequencing and phasing the work to avoid this species is impracticable considering the magnitude of the work.	Yes. Impacts under these alternatives relative to the overall Priority Habitat are 10.5 to 14.6%, with impacts to 164 and 225 acres of floodplain respectively. The large area of primary habitat to be impacted by these alternatives will result in a significant impact on the population since this species relies on large wetland areas.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

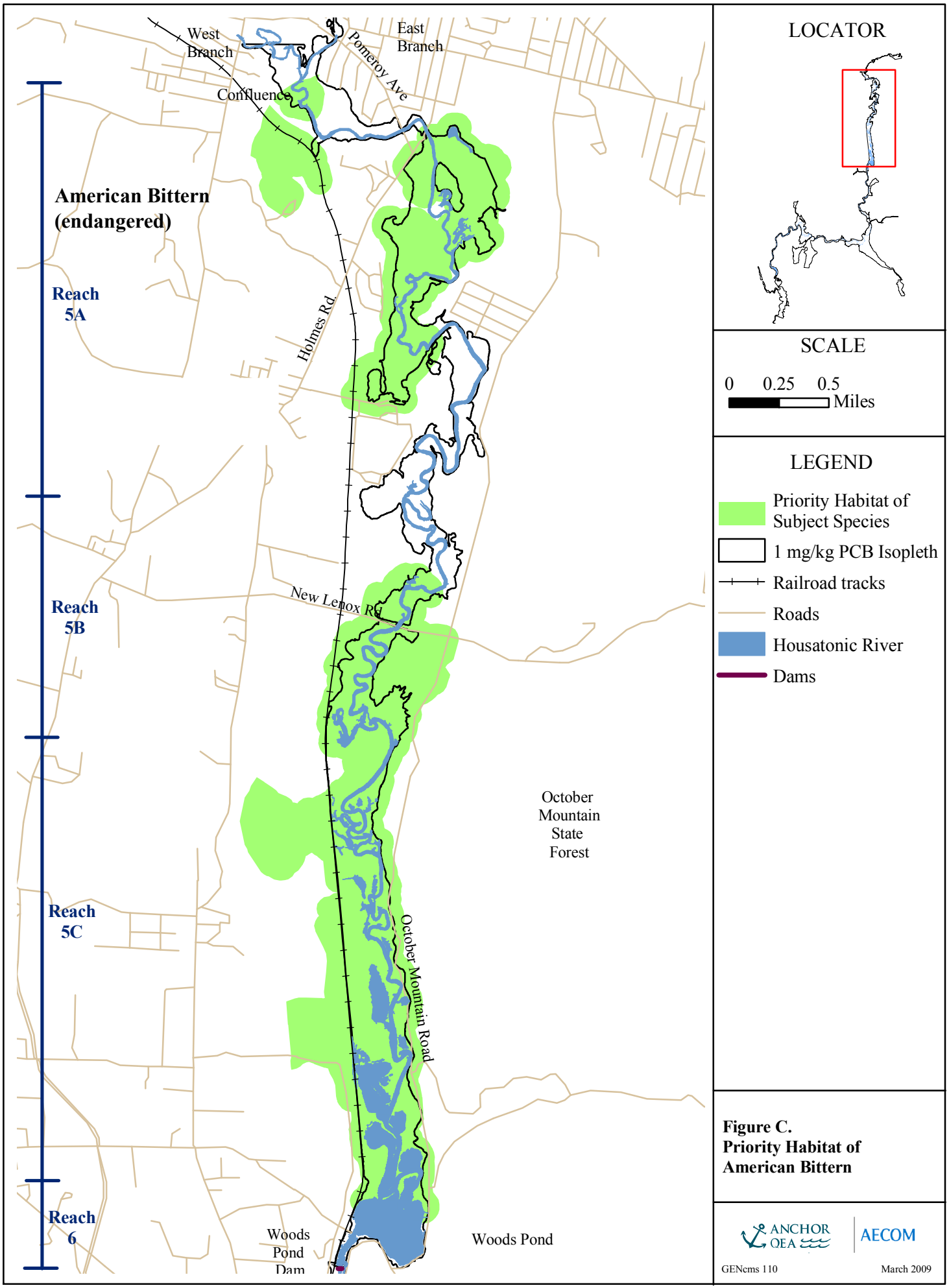

Figure C.
Priority Habitat of American Bittern

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D. Bald Eagle (*Haliaeetus leucocephalus*)

D. Bald Eagle (*Haliaeetus leucocephalus*) MESA Assessment

D-1. Summary of Species Life Cycle and Habitat Requirements

The bald eagle usually inhabits coastal areas, estuaries, and larger inland waters. This species requires a high amount of water-to-land edge incorporating stands of forest for nesting and trees projecting above the forest canopy for perching, an adequate supply of moderate-sized to large fish, an unimpeded view, and reasonable freedom from human disturbance. When available, fish (both marine and freshwater) is the bald eagle's preferred food. Birds, especially waterfowl, small mammals and carrion, particularly dead fish, are also in the eagle's diet. Wintering eagles require suitable roost trees for communal night roosting.

The breeding and nesting season for bald eagles in Massachusetts begins in March. Courtship occurs in mid-to late-winter, with pairs then mating for life. Sexual maturity is reached at four to six years of age. After courtship, the mated pair builds a large nest made with sticks and lined with sprigs of pine, grasses, and other soft materials. The male eagle collects the nest material and delivers it to his mate, who is responsible for most of the actual nest construction. Once the nesting site is chosen, the mated pair will return every year to the same site and add to the existing structure. The nests are located in hardwoods or conifers from 30 to 120 feet above the ground and may measure up to 12 feet high and 8.5 feet wide, with a weight of hundreds of pounds. Trees selected (also for roosting and sometimes perching) are typically older trees, taller than their surroundings.

The female bald eagle lays one to three (two average) dull white eggs several days apart, usually by in late March or early April. The eggs are incubated for approximately 35 days until hatching. Ten weeks after hatching, chicks begin making short flights and by late fall the adults will no longer care for their young. Most bald eagles appear to nest within 200 miles of where they hatched. In winter, eagles of all ages gather in large numbers in areas with open water where fish or other food sources are abundant. The bald eagle is a state-listed Endangered Species in Massachusetts (NHESP 2008).

D-2. Species Presence within PSA

According to NHESP database information, Priority Habitat of the bald eagle in the PSA occurs in the lower half of Reach 5C, as shown in Figure D at the end of this section. The areal extent of mapped habitat includes the main stem of the Housatonic River, moderately alkaline lake/pond, shallow and deep emergent marsh, wet meadow, transitional floodplain forest, high-terrace floodplain forest, red oak/sugar maple transition forest, northern hardwoods hemlock/white pine forest, red maple swamp, shrub swamp, cultural grassland, riverine point bar/beach. Typical preferred habitat found within Reach 5C includes large bodies of water in open areas that are relatively free from human disturbance. According to Woodlot Alternatives, Inc. (Woodlot 2002), during field surveys conducted within the PSA (1998-2000), bald eagles were only infrequently encountered during spring and fall migration (7 individuals total) and were most commonly observed flying, feeding, or perching in the vicinity of Woods Pond (1 individual) and backwaters north of the pond (3 individuals). One individual was observed along the main channel of the river approximately 700 feet northeast of the backwaters area. According to Woodlot (2002), no nesting is known to occur within the PSA. The total Priority Habitat of the bald eagle is 320 acres; however, only 201 acres of Priority Habitat occurs within the PSA.

D-3. Impacts of Remedial Alternatives on Bald Eagle Habitat

D-3-1. Overview

Table D-1 summarizes the areal extent and duration of work within NHESP-mapped bald eagle habitat for all the remedial alternatives that will occur within that section of Reach 5C. SED 1 involves no construction-related activities. SED 2 is limited to monitored natural recovery only and will not adversely impact mapped

bald eagle habitat. SED 3 through SED 8 involve increasing activity within Priority Habitat. SED 3 will impact 21 acres of river channel by thin-layer capping. SED 4 through SED 8 will impact 68 to 72 acres of river channel and backwater areas through excavation, thin-layer capping and/or engineered capping. SED 3 through SED 8 will involve up to 7 acres of access road and staging area construction impacts. No riverbank remediation is planned for Reach 5C. Work within the river channel and backwaters north of Woods Pond (excavation, capping) may cause a temporary reduction in the eagle's primary food resource (fish), and discourage foraging activity through behavioral disturbance.

Remediation activities within floodplains or construction of access roads and staging areas adjacent to the river may impact potential eagle nesting, perching or roosting sites, either through behavioral disturbance or by the removal of large trees. These sites likely occur within adjacent forested areas including the transitional floodplain and black ash-red maple-tamarack calcareous seepage swamp community types. Direct impacts to bald eagle habitat from floodplain remediation along with access and staging area impacts will range from 4.5 acres in FP 3 to up to 39 acres in FP 7.

Table D-1. Bald Eagle Mapped Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Bald Eagle Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5C	21 ac (thin layer-capping)	0.3 ac (habitat removal)	0.5
SED 4	5C	47 ac (thin-layer capping) 21 ac (engineered capping)	7 ac (habitat removal)	1.4
SED 5	5C	43 ac (thin-layer capping) 21 ac (engineered capping) 5 ac (excavation)	7 ac (habitat removal)	1.4
SED 6	5C	28 ac (thin-layer capping) 34 ac (excavation)	0	2.4
SED 7	5C	17 ac (thin-layer capping) 45 ac (excavation)	0	2.4
SED 8	5C	72 ac (excavation)	0	4.5
FP 1	N/A – No Action	0	0	0
FP 2	N/A – No construction	0	0	NA
FP 3	5C	3 ac (habitat removal)	1.5 ac (habitat removal)	3
FP 4	5C	3 ac (habitat removal)	2 ac (habitat removal)	4
FP 5	5C	4 ac (habitat removal)	5 ac (habitat removal)	4
FP 6	5C	20 ac (habitat removal)	5 ac (habitat removal)	13
FP 7	5C	34 ac (habitat removal)	5 ac (habitat removal)	22
*All direct impacts under SED alternatives are to riverine habitats				

D-3-2. Description of Specific Impacts by River Segment

Reach 5A and Reach 5B

Priority Habitat for bald eagle is not identified in Reach 5A or Reach 5B.

Reach 5C

Priority Habitat for the bald eagle is found throughout the lower half of Reach 5C of the PSA, which includes the main channel of the Housatonic River, the northern extent of Woods Pond, as well as contiguous backwater and wetland areas. This area includes both forested floodplain habitat which could potentially be used for nesting, roosting and perching, as well as open backwater habitat used for foraging.

Alternatives SED 1 and SED 2 will not impact bald eagle Priority Habitat. SED 3 will cause direct in-river impacts to the portion of Reach 5C located within mapped bald eagle habitat, due to 21 acres of thin-layer capping. SED 4 would involve 47 acres of thin-layer capping and 21 acres of engineered capping; SED 5 would involve 5 acres of excavation, 43 acres of thin-layer capping, and 21 acres of engineered capping; SED 6 would involve 28 acres of thin-layer capping and 34 acres of excavation; SED 7 would involve 45 acres of excavation and 17 acres of thin-layer capping; and SED 8 would involve 72 acres of excavation within the river and backwater areas. There will be no riverbank removal and stabilization within Reach 5C. An additional 0.3 acre under SED 3 and 7 acres under SED 4 and SED 5 will be impacted due to the construction and use of access roads and staging areas. Work within the river channel and backwaters north of Woods Pond (excavation, capping) may cause a temporary reduction in the eagle's primary food resource (fish), and discourage foraging activity through behavioral disturbance. The estimated timeframe for work in bald eagle habitat within Reach 5C is 0.5 years for SED 3, 1.4 years for SED 4 and SED 5, 2.4 years for SED 6 and SED 7, and 4.5 years for SED 8.

FP 1 and FP 2 involve no construction work within mapped bald eagle habitat. Direct impacts from removal of vegetation and excavation of soil in the floodplain within bald eagle Priority Habitat will affect 3 acres for FP 3 and FP 4, 4 acres for FP 5, 20 acres for FP 6, and 34 acres for FP 7. Between 1.5 and 5 acres of mapped habitat will also be impacted due to construction of access roads and staging areas. Remediation activities within floodplains or construction of access roads and staging areas adjacent to the river may impact potential eagle nesting, perching or roosting sites, either through behavioral disturbance or by the removal of large trees. These sites likely occur within adjacent forested areas including the transitional floodplain and black ash-red maple-tamarack calcareous seepage swamp community types. The estimated timeframe for completing all work under FP 3 is 3 years; FP 4 and FP 5 is 4 years; FP 6 is 13 years; and FP 7 is 22 years.

D-4. Assessment of MESA Issues for Bald Eagle

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity…." A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the bald eagle is summarized in Table D-2 for the sediment alternatives and Table D-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such

judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table D-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the bald eagle. Although nesting individuals have not been observed in the PSA, excavation, engineered capping, and/or thin-layer capping in the lower half of Reach 5C of the PSA would impact bald eagles' foraging habitat and cause an interruption of availability of food resources (fish). In addition, if any bald eagles are present in the area, these activities would cause a take by harassing or disrupting the eagles through behavioral disturbance and alteration of its habitat. Bald eagles are particularly sensitive to human disturbance. Actions that could be taken to minimize effects on bald eagles include establishing buffer zones around any roosting sites that are identified, and prohibiting or limiting work within those buffer zones for a given period after a sighting. However, such measures will not eliminate the takes due to the effects on foraging, which will occur under any of these SED alternatives, as river remediation will affect the availability of fish. Additional impacts may result from extended duration of work within the PSA (2.4 to 4.5 years for SED 6 through SED 8). Continual disruption of habitat may eliminate usage of the PSA by the bald eagle or cause significant shifts in migrational patterns.

Remedial work involved with SED 3 impacts approximately 7% of the total mapped bald eagle habitat, SED 4, SED 5 and SED 8 impact approximately 23%, and SED 6 and SED 7 impacts approximately 19%. SED 3 is not anticipated to impact a significant portion of the local population. Since SED 4 through SED 8 impact such a large percentage of riverine and backwater habitats utilized for foraging, it is expected that a significant portion of the local species population will be impacted.

As shown in Table D-3, all of the floodplain remedial alternatives except for FP 1 and FP 2 would result in a take of the bald eagle. This take would include behavioral disturbance of any bald eagles present or direct removal and alteration of bald eagle habitat due to the removal of large trees which could potentially be utilized for roosting or perching. Again, while the use of buffer zones as discussed above will reduce direct impacts of remediation on bald eagles, it would not avoid a take due to disruption of terrestrial prey species and the removal of potential roosting and perching habitat. Impacts to the bald eagle Priority Habitat are less than 3% for FP 3 through FP 5, and rise to 8% for FP 6 and 12% for FP 7. Given the non-breeding status of the bald eagle at present in the PSA, and the absence of any direct effect of the floodplain alternatives on the eagles' foraging habitat for fish, these alternatives are not anticipated to impact a significant portion of the local bald eagle population.

A long-term net benefit plan for the bald eagle may be applicable under MESA for SED 3 and FP 3 through FP 7. Based on a review of the literature, potential elements of a conservation and management plan for this species can be identified. These include habitat management, conservation restrictions, public education, and long-term monitoring with collection of biological data contributing to knowledge of the species. However, any of these measures would need to be integrated and coordinated with requirements for and impacts to other rare species within the PSA. Given the high quality of the existing habitat, and the significant alteration of prime portions of that habitat that would occur under SED 3 and FP 3 through FP 7, it cannot be established that implementation of such a plan will provide an overall long-term net benefit to this species.

References:

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Stokes. 1996. Stokes Field Guide to Birds, Eastern Region. Little, Brown and Company.

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table D-2: Assessment of MESA Issues for Bald Eagle Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no construction activities	NA	NA	NA
SED 2	No take; MNR only	NA	NA	NA
SED 3	Yes. Thin-layer capping within the main river channel would cause a take by disrupting foraging. Work within riverbed may also temporarily impact populations of species' primary food source (fish). Construction of access and staging areas will impact potential bald eagle nesting, perching or roosting habitat.	No. The impacted area impacts 7% of the bald eagle Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take would not be feasible. Establishment of buffer zones around any roosting sites identified and prohibiting or limiting work within those buffer zones for a given period after a sighting may minimize impacts, but cannot avoid a take due to the effect on foraging habitat and the availability of fish prey.	No. This alternative impacts only 7% of the bald eagle Priority Habitat.	Cannot be established. Based on review of the literature, the elements of a conservation and management plan for this species can be identified. However, given the quality of the existing habitat and nature of the takes in this alternative it cannot be determined that such a plan will achieve a net benefit for the species.
SED 4 through SED 8	Yes. Excavation, engineered capping, and thin-layer capping would impact foraging habitat and cause a take by disrupting foraging. Work within river may also temporarily impact populations of this species' primary food source (fish). Construction of access and staging areas for SED 4 and SED 5 will impact 7 acres of potential bald eagle perching or roosting habitat.	No. These alternatives impact 19 to 23% of the bald eagle Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take would not be feasible. Establishment of buffer zones around any roosting sites identified and prohibiting or limiting work within those buffer zones for a given period after a sighting may minimize impacts, but cannot avoid a take due to the effect on forging habitat and the availability of fish prey.	Yes. 19 to 23% of mapped eagle habitat within the Priority Habitat will be impacted. This work occurs over the majority of the species' foraging habitat, and directly impacts the availability of the bald eagle's primary food source (fish).	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA

Table D-3: Assessment of MESA Issues for Bald Eagle Under Floodplain (FP) Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1 and 2	No take due to no action	NA	NA	NA
FP 3, FP 4, and FP 5	Yes. Though soil removal activities and access road/staging areas are occurring in a relatively small portion (1.5 to 2 acres) of Reach 5C within the Priority Habitat zone, a take will occur due to the "harassment" or "disruption" of local individuals through behavioral disturbance of feeding, resting, or roosting (or nesting activity) due to construction activities. Construction may also disrupt migrational patterns, deterring individuals from returning to the area.	Possibly. The impacted area is only 1.4% to 3% of the total Priority Habitat and therefore a take might be avoided. Establishment of buffer zones around any roosting sites identified and prohibiting or limiting work within those buffer zones for a given period after a sighting may minimize impacts, but it is uncertain whether a take due to impacts on perching and roosting habitat could be avoided.	No. If a take cannot be avoided, it would not affect a significant portion of the local population, since the impacted area is only 1.4% to 3% of the total Priority Habitat.	Cannot be established. Based on review of the literature, the elements of a conservation and management plan for this species can be identified. However, given the quality of the existing habitat and nature of the takes in this alternative it cannot be determined that such a plan will achieve a net benefit for the species.
FP 6 and FP 7	Yes. A take will occur through the "harassment" or "disruption" of local individuals through behavioral disturbance of feeding, resting, or roosting (or nesting activity) due to construction activities. Construction may also disrupt migrational patterns, deterring individuals from returning to the area.	No. The impacted area is approximately 8 to 12% of the bald eagle Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take would not be feasible. Establishment of buffer zones around any roosting sites identified and prohibiting or limiting work within those buffer zones for a given period after a sighting may minimize impacts, but cannot avoid a take due to the effect on perching and roosting habitat.	No. The impacted area is approximately 8 to 12% of the bald eagle Priority Habitat, but no nesting individuals have been observed in the PSA, non-nesting birds may find habitat outside of the PSA, and floodplain remediation is not expected to have a significant adverse effect on the availability of fish for the eagle.	Cannot be established for the same reasons described above for FP 3 through FP 5.

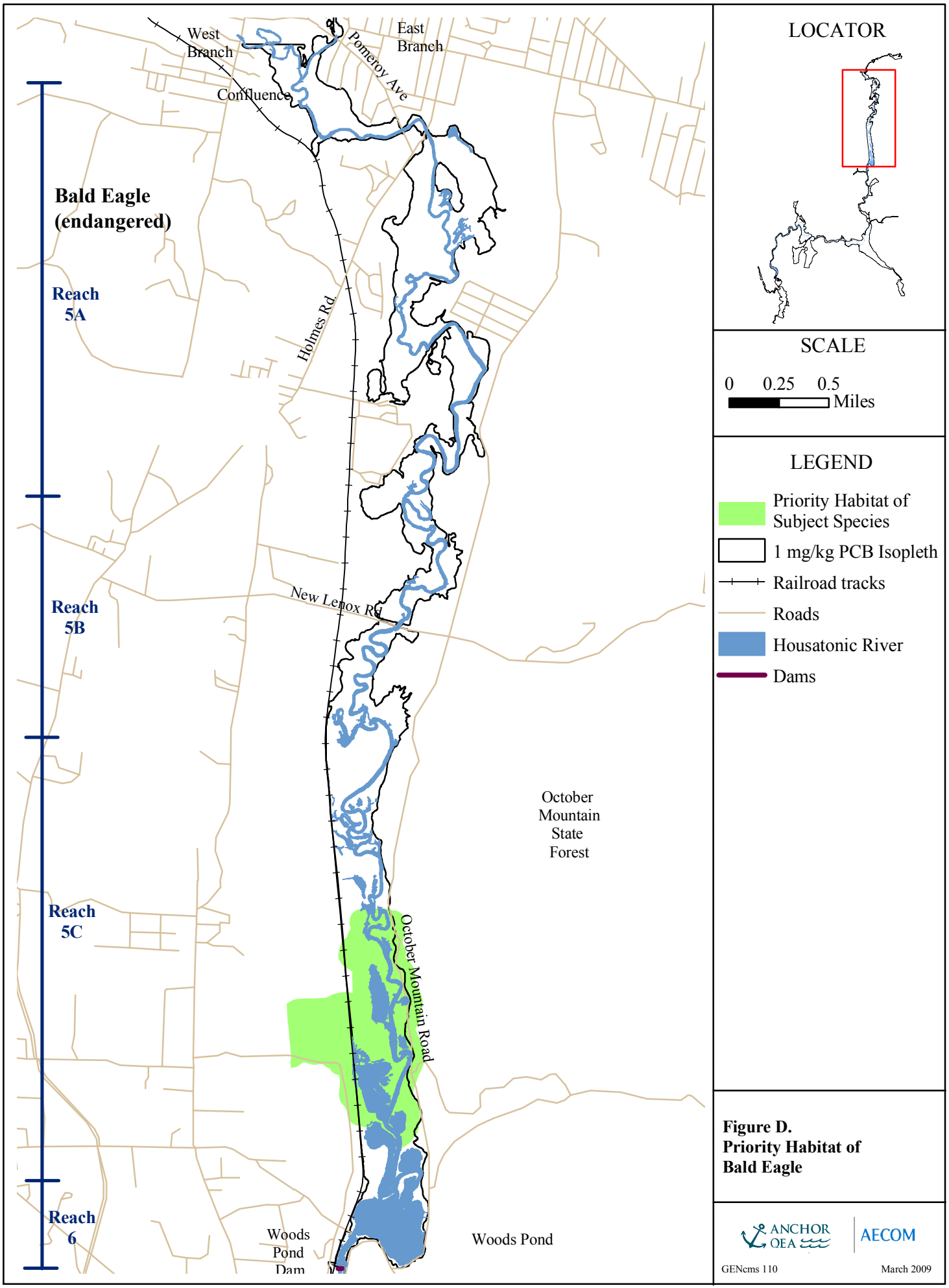

Figure D.
Priority Habitat of Bald Eagle

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E. Common Moorhen (*Gallinula chloropus*)

E. Common Moorhen (*Gallinula chloropus*) MESA Assessment

E-1. Summary of Species Life Cycle and Habitat Requirements

The common moorhen is a bird that inhabits large freshwater marshes and ponds with cattails (*Typha* spp.) and other emergent vegetation. It generally keeps to the cover of dense vegetation and feeds by wading or diving at the edges of open water. Preferred habitat is shallow bodies of water with dense stands of emergent vegetation interspersed with areas of open water. Though common moorhens prefer emergent wetlands as foraging, breeding, nesting, and protective cover habitat, they also utilize margins of lakes, ponds, and slow-flowing rivers and streams as feeding areas. Its diet consists of plant material, mosquitoes, spiders, tadpoles, insect larvae, fruits, and seeds.

The common moorhen migrates from wintering ranges in the southern US to Massachusetts in late April to May. Nesting begins in May and ends in early June. Males build several nests on a mating pair's territory; once the young have hatched and left their original nests to wander through the marsh, they use these extra nests as places to spend the night. Nests are built of dead marsh plants into a platform at water's edge or in floating, dense vegetation (NHESP 1986). Incubation of the 5 to 12 eggs is carried out by either parent and lasts for about 21 days. The male cares for the first-hatched chicks while the female incubates the remaining eggs. Young leave the nest very soon after hatching, can feed independently in 3 weeks, and can fly in 6 to 7 weeks, though they remain with the parents for some time thereafter. Growth is very slow and chicks do not reach adult size until 2 months of age. Occasionally there are two broods in a season, and rarely a third. Migration back to wintering grounds begins in late September and October. The common moorhen is a state-listed Species of Special Concern in Massachusetts (NHESP 2008).

E-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the common moorhen occurs within the PSA in a small portion of the lower half of Reach 5A, throughout Reach 5C, and in the mid-to-upper section of Reach 6, as shown in Figure E at the end of this section. The areal extent of mapped habitat includes the main stem of the Housatonic River, shallow and deep emergent marsh, wet meadow, transitional floodplain forest, high-terrace floodplain forest, red oak/sugar maple transition forest, northern hardwoods hemlock/white pine forest, red maple swamp, shrub swamp habitats, and open water habitat in Woods Pond. The total Priority Habitat area of the common moorhen is approximately 744 acres, of which 408 acres are within the PSA.

E-3. Impacts of Remedial Alternatives on Common Moorhen Habitat

E-3-1. Overview

Table E-1 summarizes the areal extent and duration of work within NHESP mapped common moorhen habitat for all the remedial alternatives. SED 1 involves no construction-related activities. SED 2 is limited to monitored natural recovery only and will not adversely impact mapped moorhen habitat. SED 3 through SED 8 involves increasing levels of activity within that habitat.

As noted above, common moorhens utilize the margins of lakes, ponds, and slow-flowing rivers and streams as feeding areas, and therefore the SED alternatives involve work within habitat likely to be used by this species. SED 3 will impact the river channel through excavation and thin-layer capping. SED 4 through SED 8 will impact the river channel and backwater areas through excavation, thin layer capping, and engineered capping. SED 3 through SED 8 will all involve riverbank remediation of approximately 1,665

linear feet and up to 10 acres of access road and staging area construction impacts. No riverbank remediation is planned for Reaches 5C and 6.

Floodplain remediation alternatives FP 2 through FP 7 within Reaches 5A, 5C and 6 will potentially impact this species by altering preferred habitat, primarily within wet meadow, shrub swamp, and shallow emergent marsh community types. Direct impacts to common moorhen habitat from floodplain remediation along with access and staging area impacts will range from less than 1 acre in FP 2 up to 62 acres in FP 7. Construction of access roads and staging areas for these alternatives would impact up to 10 acres. Floodplain remediation activities and construction of access roads and staging areas within Reaches 5A, 5C, and 6 would impact primary common moorhen habitat (wet meadows, shallow and deep emergent marshes, and areas with emergent woody vegetation) within the floodplain of the Housatonic River.

Table E-1. Common Moorhen Mapped Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Common Moorhen Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A	1 ac (excavation/capping) 1,665 lf of riverbank remediation	1 ac (habitat removal)	8
	5C	37 ac (thin-layer capping)	3 ac (habitat removal)	<1
	6	35 ac (thin-layer capping)	0.05 ac (habitat removal)	1.5
SED 4	5A	1 ac (excavation/capping) 1,665 lf of riverbank remediation	1 ac (habitat removal)	8
	5C	67 ac (thin-layer capping) 37 ac (engineered capping)	9 ac (habitat removal)	2
	6	27 ac (excavation/capping) 8 ac (thin-layer capping)	0.05 ac (habitat removal)	2.5
SED 5	5A	1 ac (excavation/capping) 1,665 lf of riverbank remediation	1 ac (habitat removal)	8
	5C	15 ac (excavation/capping) 53 ac (thin-layer capping) 37 ac (engineered capping)	10 ac (habitat removal)	3
	6	27 ac (excavation/capping) 8 ac (engineered capping)	0.05 ac (habitat removal)	2.5
SED 6	5A	1 ac (excavation/capping) 1,665 lf of riverbank remediation	1 ac (habitat removal)	8
	5C	62 ac (excavation/capping) 41 ac (thin-layer capping)	5.2 ac (habitat removal)	4
	6	27 ac (excavation/capping) 8 ac (engineered capping)	0	2.5

Remedial Alternative	Reach with Affected Habitat	Description of Common Moorhen Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 7	5A 5C 6	1ac (excavation/capping) 1,665 lf of riverbank remediation 75 ac (excavation/capping) 28 ac (thin-layer capping) 27 ac (excavation/capping) 8 ac (engineered capping)	1 ac (habitat removal) 5.2 ac (habitat removal) 0	9.5 4 3.5
SED 8	5A 5C 6	1 ac (excavation/capping) 1,665 lf of riverbank remediation 116 ac (excavation/capping) 35 ac (excavation/capping)	1 ac (habitat removal) 5.2 ac (habitat removal) 0	11.5 7 11
FP 1	N/A – No Action	0	0	0
FP 2	5C	<1 ac (habitat removal)	0.43 ac (habitat removal)	1
FP 3	5A, 5C 6	1 ac (habitat removal) 4 ac (habitat removal) <1 ac (habitat removal)	1.5 ac (habitat removal) 2.5 ac (habitat removal) 0.07 ac (habitat removal)	3
FP 4	5A 5C 6	2 ac (habitat removal) 5 ac (habitat removal) <1 ac (habitat removal)	1.2 ac (habitat removal) 4 ac (habitat removal) 0.07 ac (habitat removal)	4
FP 5	5A 5C 6	<1 ac (habitat removal) 10 ac (habitat removal) <1 ac (habitat removal)	0.1 ac (habitat removal) 7 ac (habitat removal) 0.5 ac (habitat removal)	4
FP 6	5A 5C 6	4 ac (habitat removal) 38 ac (habitat removal) 1 ac (habitat removal)	0.6 ac (habitat removal) 9 ac (habitat removal) 0.05 (habitat removal)	13
FP 7	5A 5C 6	9 ac (habitat removal) 51 ac (habitat removal) 2 ac (habitat removal)	0.8 ac (habitat removal) 8 ac (habitat removal) 0.3 ac (habitat removal)	22
*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur only in Reach 5A.				

E-3-2. Description of Specific Impacts by River Segment

Reach 5A

NHESP Priority Habitat for common moorhen is found in a small section (42 acres) within the lower half of Reach 5A of the PSA, to the southwest of Joseph Drive. It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and forested floodplain habitat. The vegetated wetlands contains little wet meadow and emergent marsh habitat which is the primary moorhen foraging, breeding, nesting, and protective cover habitat.

SED 1 and SED 2 will have no direct impact to the portion of Reach 5A located within NHESP mapped moorhen habitat. SED 3 through SED 8 will cause 1 acre of in-river impacts within Reach 5A due to excavation/capping. Moorhens do not typically utilize open deepwater areas, but construction activities performed within open water areas will deter/disturb birds attempting to nest within the vicinity, or deter them from utilizing the shoreline for foraging. Shoreline areas will be impacted in SED 3 through SED 8 due to 1,665 lf of riverbank remediation, directly impacting preferred moorhen habitat as these birds are known to utilize shorelines (margins) of water bodies as feeding areas. An additional 1 acre of impact from SED 3 through SED 8 would occur to moorhen Priority Habitat due to construction of access roads and staging areas however, direct impact to preferred moorhen foraging, breeding, nesting and protective cover habitat (emergent wetlands) may be avoided if staging areas and roads are built primarily within forested areas. The estimated timeframe for work in common moorhen habitat within Reach 5A is 8 years for SED 3 through SED 6, 9.5 years for SED 7, and 11.5 years for SED 8.

FP 1 and FP 2 involve no construction work in floodplains within mapped common moorhen habitat. FP 3 through FP 7 involve direct remediation excavation and backfilling in the floodplain within the common moorhen Priority Habitat. Impacts will affect 1 acre of floodplain wetland for FP 3, 2 acres for FP 4, less than 1 acre for FP 5, 4 acres for FP 6, and 9 acres for FP 7. Up to 1.5 acres of mapped habitat will also be directly impacted due to construction of access roads and staging areas. The estimated timeframe for all floodplain work within the PSA is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 5B

There is no NHESP mapped moorhen habitat within Reach 5B.

Reach 5C

NHESP Priority Habitat for common moorhen is found extensively throughout Reach 5C (651 acres) of the PSA, which includes the main channel and shore of the Housatonic River, the mid-to-upper section of Woods Pond, and contiguous backwater, emergent marsh, and shrub swamp areas. Emergent wetlands (shallow and deep emergent marshes) are found throughout Reach 5C and are the preferred moorhen foraging, breeding, nesting, and protective cover habitat.

SED 1 and SED 2 will have no direct impact to the portion of Reach 5C located within NHESP mapped moorhen habitat. SED 3 through SED 8 will cause direct in-river and associated backwater impacts within mapped habitat due to a combination of excavation/capping, thin-layer capping, and engineered capping. No shoreline remediation is planned for Reach 5C. SED 3 will involve 37 acres of thin-layer capping in the downstream half of Reach 5C; SED 4 will involve 37 acres of engineered capping and 67 acres of thin-layer capping; SED 5 will involve a 15 acres of excavation/capping, 37 acres of engineered capping, and 53 acres of thin-layer capping; SED 6 will involve 62 acres of excavation/capping and 41 acres of thin-layer capping; SED 7 will involve 75 acres of excavation/capping and 28 acres of thin-layer capping; and SED 8 would involve 116 acres of excavation/capping.

Primary common moorhen habitat (areas of deep emergent marsh within backwaters north of Woods Pond) will be directly impacted due to thin-layer capping and/or excavation activities in Reach 5C. Construction activities within open water areas will deter/disturb birds attempting to nest within the vicinity or deter them from utilizing shoreline areas. Direct impacts to primary moorhen foraging, breeding, nesting, and protective cover habitat from construction of up to 5 acres of access roads and staging areas may be minimized by using existing roadways or designing the roads to avoid the moorhen's primary habitat. The estimated timeframe for work in common moorhen habitat within Reach 5C is <1 year for SED 3, 2 years for SED 4, 3 years for SED 5, 4 years for SED 6 and SED 7, and 7 years for SED 8.

FP 1 involves no construction work in floodplains within mapped common moorhen habitat. FP 2 through 7 involves increasing amounts of impacts within Reach 5C. Direct remediation excavation and backfilling in the

floodplain within the common moorhen Priority Habitat zone will affect 4 acre for FP 3, 5 acres for FP 4, 10 acres for FP 5, 38 acres for FP 6, and 51 acres for FP 7. Up to 9 acres of mapped habitat will also be directly impacted due to construction of access roads and staging areas. This work will directly impact primary moorhen foraging, breeding, nesting, and protective cover habitat. The estimated timeframe for all floodplain work within the PSA is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 6

Common moorhen Priority Habitat in Reach 6 is the upper portion of Woods Pond (50 acres), which contains large areas of deep and shallow emergent wetlands and backwater areas which are the primary habitats of the common moorhen.

SED 1 and SED 2 will have no direct impact to the portion of Reach 5C located within NHESP mapped moorhen habitat. SED 3 would involve 35 acres of thin-layer capping; SED 4 through SED 7 would involve 27 acres of excavation/capping and 8 acres of thin-layer capping; and SED 8 would involve 35 acres of excavation/capping. There will be no riverbank remediation in Reach 6. There will be <1 acre of impacts to mapped moorhen Priority Habitat due to access road and staging area construction in Reach 6. Construction activities within open water areas will deter/disturb birds attempting to nest within the vicinity or deter them from utilizing shoreline areas of Woods Pond. The estimated timeframe for work in common moorhen habitat within Reach 6 is 1.5 year for SED 3, 2.5 years for SED 4 through SED 6, 3.5 years for SED 7, and 11 years for SED 8.

FP 1 and FP 2 involve no construction work in floodplains within mapped common moorhen habitat. FP 2 through 7 involve removal of vegetation and excavation of contaminated soil in the Reach 6 floodplain. This work will affect less than 1 acre for FP 3, through FP5, 1 acre for FP 6, and 2 acres for FP 7. Within Reach 6, less than 1 acre of mapped habitat will be directly impacted due to construction of access roads and staging areas under alternatives FP 3 through FP 7. The estimated timeframe for all floodplain work within the PSA is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

E-4. Assessment of MESA Issues for Common Moorhen

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “in reference to animals [‘take’] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity….” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for the common moorhen is summarized in Table E-2 for the sediment alternatives and Table E-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table E-2, except for SED 1 and SED 2, all SED alternatives within Reaches 5A, 5C, and 6 would constitute a take of common moorhen. Excavation, engineered capping, thin-layer capping and riverbank remediation will cause a take by disrupting nesting, breeding and/or feeding activities of this species either through direct alteration/removal of preferred wetland habitat (for construction of access roads and

staging areas) or indirectly through behavioral disturbance due to construction activities within nearby open water and shoreline areas. Direct mortalities might be avoided by executing work in late fall or winter while this species is residing south of New England, if that or other phasing were practicable. However, these measures cannot prevent loss of nesting, breeding, and/or feeding habitat. Remedial work involved with SED 3 impacts approximately 10% of the mapped common moorhen habitat. SED 4 through SED 8 impact between 19% and 21% of the mapped common moorhen habitat. SED 4 through SED 8 will impact a significant portion of the common moorhen population, while SED 3 will likely not.

As shown in Table E-3, all of the floodplain remedial alternatives except for FP 1 would result in a take of the common moorhen through alteration of preferred nesting, feeding, breeding, and protective cover habitat, behavioral disturbance of feeding, breeding or nesting activity due to construction activities, and a likely loss of prey species. However, it is likely that a take could be avoided under FP 2, since only a small portion of the overall Priority Habitat area of the common moorhen will be affected (~1 acre). FP 3 through FP 5 involve greater impacts (9-19 acres), but remain a small enough portion of the Priority Habitat (< 3%) that these alternatives would not impact a significant portion of the local population. Similarly, while FP 6 and FP 7 impact a considerable acreage (54-71 acres) of the overall Priority Habitat zone of the common moorhen, the portion of the affected Priority Habitat (7-9%) is unlikely to impact a significant portion of the local moorhen population.

For those alternatives which involve a take of an insignificant portion of the common moorhen local population (SED 3, FP 2 through FP 7), the feasibility and likely effectiveness of a long term net benefit plan for this species cannot be established. Based on a review of the relevant literature, specific habitat management measures to enhance conditions for this species are unknown and untested. There is insufficient information to identify potential elements of a conservation and management plan or to determine whether such measures together could achieve an overall long-term net benefit for this species.

References:

NHESP. 1986. Common moorhen (*Gallinula chloropus*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

NHESP. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Table E-2: Assessment of MESA Issues for Common Moorhen under Sediment (SED) Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take; only monitoring.	NA	NA	NA
SED 3	Yes. Excavation/capping, thin-layer capping, and riverbank remediation within Reaches 5A, 5C and 6 will alter 73 acres in the Priority Habitat zone, and will cause a take by harassing or disrupting the species feeding, breeding, or nesting activity due to construction within the river channel and bank. In addition, construction of access roads and staging areas will cause a take through direct alteration/removal of preferred wetland habitat.	No. Approximately 10% of the Priority Habitat will be impacted, which is too large a portion to make avoiding a take feasible. Direct mortalities might be avoided by executing work in late fall or winter while species is residing south of New England, and phasing could minimize impacts. However, loss of feeding, breeding, and nesting habitat cannot be avoided.	No. Only 10% of the Priority Habitat will be impacted. All impacts will be within the river channel and its bank which is not this species' primary habitat.	Cannot be established. A literature review did not indicate specific habitat management measures that are known to enhance conditions for this species. Therefore there is insufficient information to identify the elements of a conservation and management plan or to determine whether such a plan would achieve a net benefit for the species.
SED 4 through SED 8	Yes. Excavation/capping, thin-layer capping, engineered capping and riverbank remediation within Reaches 5A, 5C and 6 will alter roughly 150 acres in the Priority Habitat zone, and will cause a take by harassing or disrupting the species feeding, breeding, or nesting activity due to construction within the river channel and associated bank and back water areas. Access and staging areas will cause additional alteration of preferred wetland habitat.	No. 19 to 21% of the Priority Habitat zone will be impacted, which is too large a portion to make avoiding a take feasible. Direct mortalities might be avoided by executing work in late fall or winter while species is residing south of New England, and phasing of construction activities could allow for temporary refuges. However, loss of feeding, breeding, and nesting habitat cannot be avoided.	Yes. 19 to 21% of the Priority Habitat will be impacted under these alternatives. Habitat impacts under these alternatives likely include the loss of preferred habitat conditions that likely support breeding and foraging activity.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table A-3: Assessment of MESA Issues for Wood Turtle under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Possible. Though soil removal activities and access road/staging areas would occur in a relatively small portion (<1 acre) of Reach 5C within the Priority Habitat zone, none of which is preferred moorhen habitat, a take could occur through the harassment or disruption of local individuals through behavioral disturbance of feeding, breeding or nesting activity due to construction activities.	Likely. Direct mortalities might be avoided by executing work in late fall or winter while species is residing south of New England, and phasing of construction activities. Further, the impacted area is a sufficiently small portion of the total Priority Habitat (0.2%) that an adverse impact on that habitat can likely be avoided	No. If a take cannot be avoided, it would not affect a significant portion of the local population, since the impacts under this alternative relative to the overall Priority Habitat is small (0.2 %), and impacts are not within species' preferred habitat.	Cannot be established. A literature review did not indicate specific habitat management measures that are known to enhance conditions for this species. Therefore there is insufficient information to identify the elements of a conservation and management plan or to determine whether such a plan would achieve a net benefit for the species.
FP 3 through FP 5	Yes. Soil removal activities and access road/staging areas would involve direct impacts (disruption) to 9-19 acres of the mapped Priority Habitat. This take would include direct alteration of preferred nesting, feeding, breeding, and protective cover habitat, behavioral disturbance of feeding, breeding or nesting activity due to construction activities, and a likely loss of prey species. Soil excavation is also likely to substantially remove the seed bank of native plants utilized by moorhens, which is also a take.	Possible. Direct mortalities might be avoided by executing work in late fall or winter while species is residing south of New England, and phasing of construction activities could allow for temporary refuges. However, disturbance of 9-19 acres of habitat may remain as an adverse impact even though the impacted area is a small portion of the total Priority Habitat (less than 1% up to 2.5%).	No. If a take cannot be avoided, it would not affect a significant portion of the local population, since the impacts under this alternative relative to the overall Priority Habitat zone of the common moorhen are small (less than 2.5%).	Cannot be established, for reasons described under FP 2.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. Soil removal activities and access road/staging areas would involve direct impacts (disruption) to 54-71 acres of preferred moorhen habitat areas within the mapped Priority Habitat. This take would include direct alteration of preferred nesting, feeding, breeding, and protective cover habitat, behavioral disturbance of feeding, breeding or nesting activity due to construction activities, and a likely loss of prey species.	No. 7 to 9% of the Priority Habitat zone will be impacted, which is too large a portion to make avoiding a take feasible. Direct mortalities might be avoided by executing work in late fall or winter while species is residing south of New England, and phasing of construction activities could allow for temporary refuges. However, loss of feeding, breeding, and nesting habitat cannot be avoided	No. While these alternatives impact a considerable acreage (54-71 acres), of the overall Priority Habitat zone of the common moorhen, the portion of the affected Priority Habitat (7-9%) is unlikely to impact a significant portion of the local moorhen population.	Cannot be established, for reasons described under FP 2.

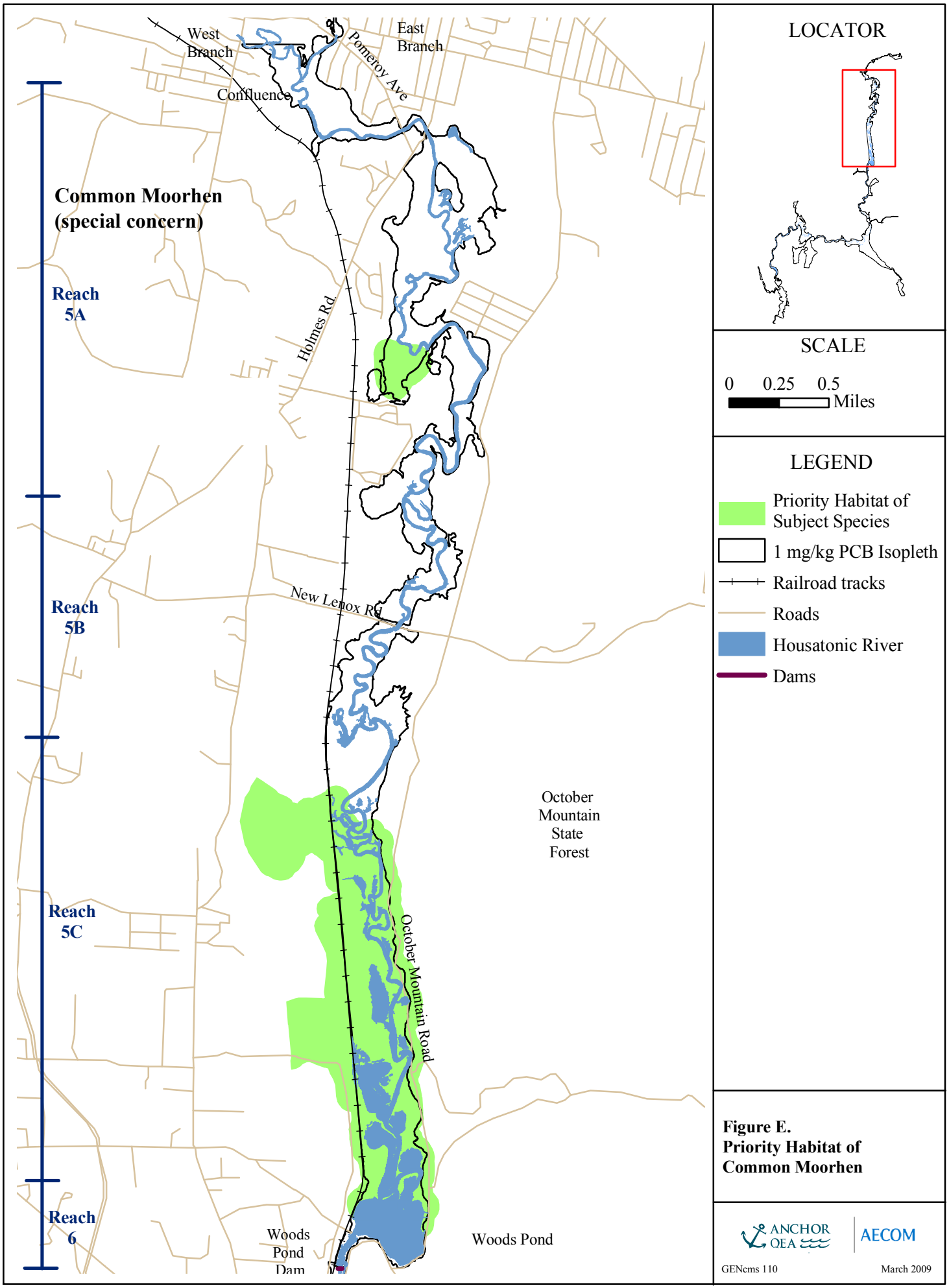

Figure E.
Priority Habitat of Common Moorhen

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F. Water Shrew (*Sorex palustris*)

F. Water Shrew (*Sorex palustris*) MESA Assessment

F-1. Summary of Species Life Cycle and Habitat Requirements

The water shrew (*Sorex palustris*) is a terrestrial mammal found near rivers and streams with exposed banks, rocks, and downed logs along the watercourses. High-gradient or swift flowing streams with shrub and herbaceous vegetation along the bank offers preferred habitat. Water shrews also inhabit wet areas bordering lakes and ponds, backwater sloughs, and beaver impoundments where moss-lined burrows are hidden between tangles of roots along undercut banks or boulders along the banks. A secretive and elusive species, water shrews use small surface runways under bank overhangs, fallen logs, woody debris, and brush piles for concealment and cover. Underground runways created by mice and moles are also used to conceal movement. The water shrew is mainly a crepuscular species, with peak levels of activity reportedly occurring at dawn and dusk; however it also forages during the day and night. Water shrews are active throughout the year and are generally extremely active when awake. Periods of deep slumber are also reported and may help to reduce metabolic demands during the winter months. Water shrews are insectivorous and when awake forage excitedly for short periods of time. Foraging involves darting around actively in search of invertebrates and aquatic insects, including mayfly larvae, caddis fly larvae, and stone fly larvae, and other insects including beetles and crickets. Snails, flatworms, small fish and fish eggs, and salamander larvae supplement their diet. Some plant material is also eaten. Aquatic species are located as the water shrew swims underwater in search of prey. Water shrews are active divers and use their large webbed hind feet to propel themselves along the bottom of the water in search of prey. Foraging is directed by multiple senses including smell, hearing, and touch as their eyesight is poorly developed. Whiskers along their long, pointed, snouts may help locate food underwater by picking up vibrations from their prey.

The breeding season for the water shrew is reported to begin in February and continue into August. Nest material in the streamside burrows consists of dried moss or other vegetation. Females reportedly produce 2 to 3 litters each year with 3 to 10 (commonly 6) young in each litter. The gestation period is reported to be 21 days. Young are weaned in about three weeks and once weaned leave the nest for a solitary life. Longevity is believed to be 18 months, but the average life span is less than a year. The water shrew is a state-listed Species of Special Concern in Massachusetts (NHESP 2008).

F-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the water shrew in the PSA is limited to a small area in the middle section of Reach 5C, as shown on Figure F at the end of this section. The total Priority Habitat for water shrew covers approximately 41 acres, with 39 acres of the Priority Habitat located within the PSA. The areal extent of the mapped habitat includes the main channel and backwaters of the Housatonic River, black ash-red maple-tamarack calcareous seepage swamp, transitional floodplain forest, shrub swamp and moderately alkaline lake/pond. The water shrew will utilize a diverse type of habitats but is generally found in forested habitats around waterbodies. One observation of the water shrew was documented within the mapped Priority Habitat in 2002. According to the observation form, this specimen was found dead and floating within the confines of the river (Woodlot 2002).

F-3. Impacts of Remedial Alternatives on Water Shrew Habitat

F-3-1. Overview

The Housatonic River within the PSA functions as a contiguous riparian corridor providing a roughly 10-mile stretch of diverse riverine and wetland/floodplain habitats that offer relative seclusion and excellent conditions for the water shrew. The Housatonic River within the water shrew Priority Habitat portion of Reach 5C is a low gradient system with substantial meanders, backwater pools, remnant oxbows, and a predominantly silt-muck bottom. These aquatic habitats along with the bordering wetland communities (including wet meadows,

shrub swamps, and transitional floodplain forests) provide ideal conditions for the water shrew. Table F-1 summarizes the areal extent and duration of work within water shrew habitat for all construction alternatives. SED 1 involves no construction-related activities. SED 2 is limited to monitoring natural recovery only and will not adversely impact mapped water shrew habitat. Alternative SED 3 will impact 4 acres and SED 4 through SED 8 will impact 7 to 8 acres of river bottom and backwater habitats. SED 4 and SED 5 involve 0.5 acre of habitat alteration due to construction of access roads and a single staging area. No other sediment remedial alternatives involve access road or staging area impacts to the Priority Habitat of the water shrew.

Floodplain alternative FP 1 involves no construction-related activity. FP 2 will cause no impacts to mapped water shrew Priority Habitat. FP 3 through FP 5 will impact 2 acres of habitat; FP 6 will impact 10 acres of habitat; and FP 7 will impact 7 acres of habitat by removing vegetation and excavating impacted soils. FP 3 through FP 7 will each impact between 0.6 and 1.5 acres of habitat as well, due to the construction of access roads and staging areas. Floodplain remediation alternatives FP 3 through FP 7 will impact mapped water shrew habitat by clearing forested swamps, floodplain forests, and open woodland edges within the work areas. Excavation within the floodplain will cause loss of habitat and may cause direct mortality to water shrew from the operation of excavation equipment. The loss of cover from living plants and downed woody debris will likely increase predation from both terrestrial species such as weasels and mink and aerial predators such as hawks and owls.

Table F-1. Water Shrew Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Water Shrew Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5C	4 ac (thin-layer capping)	0	<1
SED 4	5C	3 ac (thin-layer capping) 4 ac (engineered capping)	0.5 ac habitat removal	4
SED 5	5C	3 ac (excavation/capping) 0.1 ac; (thin-layer capping) 4 ac (engineered capping)	0.5 ac habitat removal	4
SED 6	5C	7 ac (excavation/capping) 0.9 ac; (thin-layer capping)	0	6
SED 7	5C	7 ac (excavation/capping) 0.1 ac; (thin-layer capping)	0	7
SED 8	5C	7 ac (excavation/capping)	0	17
FP 1	N/A – No Action	0	0	
FP 2	5C	0	0	0
FP 3	5C	2 ac habitat removal	0.42 ac habitat removal	3
FP 4	5C	2 ac habitat removal	0.63ac habitat removal	4
FP 5	5C	2 ac habitat removal	1.5 ac habitat removal	4
FP 6	5C	10 ac habitat removal	0.8 ac habitat removal	13
FP 7	5C	7 ac habitat removal	1.1 ac habitat removal	22

*This species Priority Habitat occurs only in Reach 5C.
**All direct impacts under SED alternatives are to riverine, riverbank and backwater habitats. FP impacts and access/staging area impacts are primarily to floodplain wetland habitats.
***Duration of work figures are for the entire Reach; work within the Priority Habitat portion may be less.

F-3-2. Description of Specific Remediation Activities Relative to Water Shrew Habitat by River Segments

Reach 5A

Priority Habitat for water shrew is not identified in Reach 5A.

Reach 5B

Priority Habitat for water shrew is not identified in Reach 5B.

Reach 5C

Priority Habitat for water shrew is identified in the lower section of Reach 5C. The Housatonic River within Reach 5C is a low gradient system with substantial meanders, backwater pools, remnant oxbows, and a predominantly silt-muck bottom. Mapped water shrew habitat covers approximately 41 acres in the lower section of Reach 5C where the bordering wetland communities include wet meadows, shrub swamps, and transitional floodplain forests. Water shrew habitat within Reach 5C is not altered under alternatives SED 1 and SED 2. Alternative SED 3 involves 4 acres of habitat alteration due to thin-layer capping in the river. SED 4 involves 3 acres of habitat alteration due to thin-layer capping in river and backwater areas, 4 acres of engineered capping in the river channel. SED 5 impacts 3 acres due to 1.5 to 2 feet of sediment removal and backfilling in the river; 0.1 acre due to thin-layer capping in river and backwater areas, and 4 acres of habitat alteration due to engineered capping in the river. SED 6 involves 1 to 2 feet of sediment removal and backfilling over 7 acres in river and backwater areas and 0.9 acre of habitat alteration due to thin-layer capping in river and backwater areas. SED 8 involves 7 acres of habitat alteration due to the removal of 2 to 6 feet of sediment removal and backfilling in river and backwater areas. SED 3 and SED 4 also involve 0.1 acre of access road construction impacts and 0.4 acre of habitat alteration due to construction of a single staging area. No other sediment remedial alternatives involve access road or staging area impacts. The absence of riverbank remediation work in Reach 5C limits the alteration of preferred bank habitat which is used by water shrews for foraging and nesting. The estimated timeframe for completing the remediation work under alternative SED 3 is less than one year; 3 years for SED 4 and SED 5; 4 years for SED 6 and SED 7and 14 years for SED 8.

Floodplain alternative FP 1 involves no construction related activity. FP 2 will cause no direct impacts to mapped Priority Habitat. FP 3 through FP 5 will impact 2 acres of habitat, FP 6 will impact 10 acres of habitat and FP 7 will impact 7 acres of habitat by removing vegetation and excavating impacted soils. FP 3 through FP 7 will each impact between 0.6 and 1.5 acres of habitat due to the construction of access roads and staging areas. Floodplain remediation alternatives FP 3 through FP 7 will impact mapped water shrew habitat by clearing forested swamps, floodplain forests, and open woodland edges within the work areas. The estimated timeframe for completing the remediation work under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 6

Priority Habitat for water shrew is not identified in Reach 6.

F-3-3. Summary of Potential Impacts to Water Shrew

The in-river sediment removal and backfill/capping activities will affect the water shrew by reducing the amount of prey species within the river and backwater areas as well as along the shoreline of the banks where preferred habitat for this species exists. The removal of the downed woody debris and beaver dams

within the river system will impact the water shrew as this species utilizes these habitat features for cover and hunting.

Floodplain remedial activities will have direct impacts from the clearing/grubbing of trees, soil removal and backfilling. Excavation within the floodplain will cause loss of habitat and may cause direct mortality to water shrew from equipment operation. The impact from habitat loss will be in direct proportion to the extent of vegetative cover and soil removal. The effects of FP 2 through FP 7 could result in long term fragmentation of the water shrew's habitat. Alterations of water shrew habitat for access road and staging area construction will result in similar negative impacts in the floodplain due to remedial activities. In addition, construction equipment poses a threat for direct mortality of shrews, such as truck and heavy equipment traffic hitting water shrews crossing access roads.

Habitat modification, vehicular-based mortality, increased predation from both terrestrial species such as mink and weasel and aerial predators such as hawks and owls are considered factors in the reduction of the water shrew population. Habitat modifications which reduce vegetative cover and downed woody debris are considered primary threats to water shrew populations. In addition, it is likely that habitat alterations outside of the mapped water shrew Priority Habitat will also affect the capacity of the Priority Habitat itself to support this species.

F-4. Assessment of MESA Issues for Water Shrew under Remedial Alternatives

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity …." The determination of a "take" requires consideration of numerous factors, including the habitat conditions and relative significance/abundance of same for the subject species, the project activities and extent relative to the species' habitat, and the duration and timing of the activities relative to the life cycle requirements of the subject species. A "take" is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the water shrew is summarized in Table F-2 for the sediment alternatives and Table F-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

Water shrew habitat is associated with riverbank and associated riparian communities bordering the Housatonic River in the lower section of Reach 5C. As shown in Table F-2, all of the sediment alternatives other than SED 1 and SED 2 would result in a take of the water shrew as these alternatives would disrupt the feeding and migratory activity of this species. SED 4 and SED 5 also involve 0.5 acre of habitat alteration due to construction of access roads and a single staging area. Construction of roadways and staging areas will reduce vegetative cover, fragment habitats and potentially cause direct mortality from equipment traffic. Remedial activities under alternative SED 3 will impact 10% and alternatives and SED 4 through SED 8 will impact between 17% and 18% of total mapped water shrew Priority Habitat. However, the riverbank in Reach 5C, which is a primary habitat for the water shrew, will not be impacted by sediment remedial activities. Since the impacts to potentially suitable habitat within the mapped Priority Habitat are relatively small and do not

include the species' primary habitat, the remediation work in these SED alternatives will not impact a significant portion of the water shrew population.

As shown in Table F-3, all floodplain alternatives other than FP 1 and FP 2 would result in a take of the water shrew. FP 3 through FP 7 will impact floodplain forest communities which are preferred habitat for the water shrew. FP 3 through FP 5 will impact between 6% and 9%, FP 6 will impact 26% and FP 7 will impact 20% of the total mapped water shrew Priority Habitat. Floodplain remedial activities will have direct impacts from the clearing/grubbing of trees, soil removal and backfilling. These activities will reduce vegetative cover, fragment habitats and potentially cause direct mortality from equipment traffic. It is estimated that since FP 3 through FP 5 would impact less than 10% of the water shrew Priority Habitat, they would not affect a significant portion of the local population. By contrast, FP 6 and FP 7 will impact a significant portion of the water shrew population due to the high level of floodplain impacts involved ($\geq$ 20% of the water shrew Priority Habitat).

Timing the construction activities to coincide with the species' more dormant period in the winter months would likely reduce direct mortality from equipment traffic; however, this would not reduce mortality from excavation activities. Such measures could minimize but not avoid, or materially reduce the significance of, expected takes.

For those alternatives which involve a take of a less than significant portion of the local water shrew population (SED 3 through SED 8, and FP 3 through FP 5), there is insufficient information to determine whether a conservation and management plan could be developed that would achieve a net benefit for this species, since based on a literature review specific habitat management measures to enhance conditions for this species are unknown and untested.

References:

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Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table F-2: Assessment of MESA Issues for Water Shrew Under Sediment Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take due to monitoring natural recovery only.	NA	NA	NA
SED 3	Yes. Thin-layer capping of 4 acres in the river will affect feeding activities due to impacts on prey species and direct disruption of the water shrew's in-river movements and feeding.	No. There are no practicable measures that could be implemented to conduct this work and avoid impacting the water shrew or its habitat.	No. 10% of the Priority Habitat will be impacted. Impacts to the river channel are not within primary habitat of the water shrew, and no riverbank remedial activities would be conducted within the mapped Priority Habitat.	Cannot be established. A review of the relevant literature confirms that specific habitat management measures to enhance conditions for this species are unknown and untested. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether such measures would achieve a net benefit for this species.
SED 4 through SED 8	Yes. Excavation of sediment and backfilling and thin-layer capping in river and/or backwater areas within 7 to 8 acres of water shrew habitat will impact feeding and migratory activity due to impacts on prey species, a reduction of structure within the river, and disruption of the water shrew's use of the riverine habitat. Access road and staging area construction will reduce cover, fragment habitat and potentially cause direct mortality.	No. There are no practicable measures that could be implemented to conduct this work and avoid impacting the water shrew or its habitat.	No. Although total impact will occur to 17 to 20% of the Priority Habitat, impacts to the river channel and backwater areas are not within primary habitat of the water shrew, and no riverbank remedial activities would be conducted within the mapped Priority Habitat.	Cannot be established. A review of the relevant literature confirms that specific habitat management measures to enhance conditions for this species are unknown and untested. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether such measures would achieve a net benefit for this species.

Table F-3: Assessment of MESA Issues for Water Shrew Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2	No take due to no remedial work in water shrew habitat.	NA	NA	NA
FP 3 through FP 5	Yes. These alternatives will impact 2 to 3 acres of suitable water shrew habitat. Soil removal activities and access road/staging areas will involve loss of canopy trees and vegetative cover and a related take of young and adults. This take would include harassment, disruption of breeding, development and feeding, and potentially direct mortality.	No. Water shrews are not readily located for monitoring and management of work activities which could avoid this species. Loss of vegetative cover will affect habitat for an extended period of time.	No. Remedial activities impact only 6% to 9% of total habitat under FP 3 through FP 5.	Cannot be established. A review of the relevant literature confirms that specific habitat management measures to enhance conditions for this species are unknown and untested. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether such measures would achieve a net benefit for this species.
FP 6 through FP 7	Yes. These alternatives will impact 8 to 11 acres of suitable water shrew habitat. Soil removal activities and access road/staging areas will involve loss of canopy trees and vegetative cover and a related take of young and adults. This take would include harassment, disruption of breeding, development and feeding, and potentially direct mortality.	No. Water shrews are not readily located for monitoring and management of work activities which could avoid this species. Loss of vegetative cover will affect habitat for an extended period of time.	Yes. Remedial activities impact 20% to 26% under FP 6 and FP 7. Much of these impacts occur in forested floodplain habitat or near riverbanks, which are favorable habitats for the water shrew.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

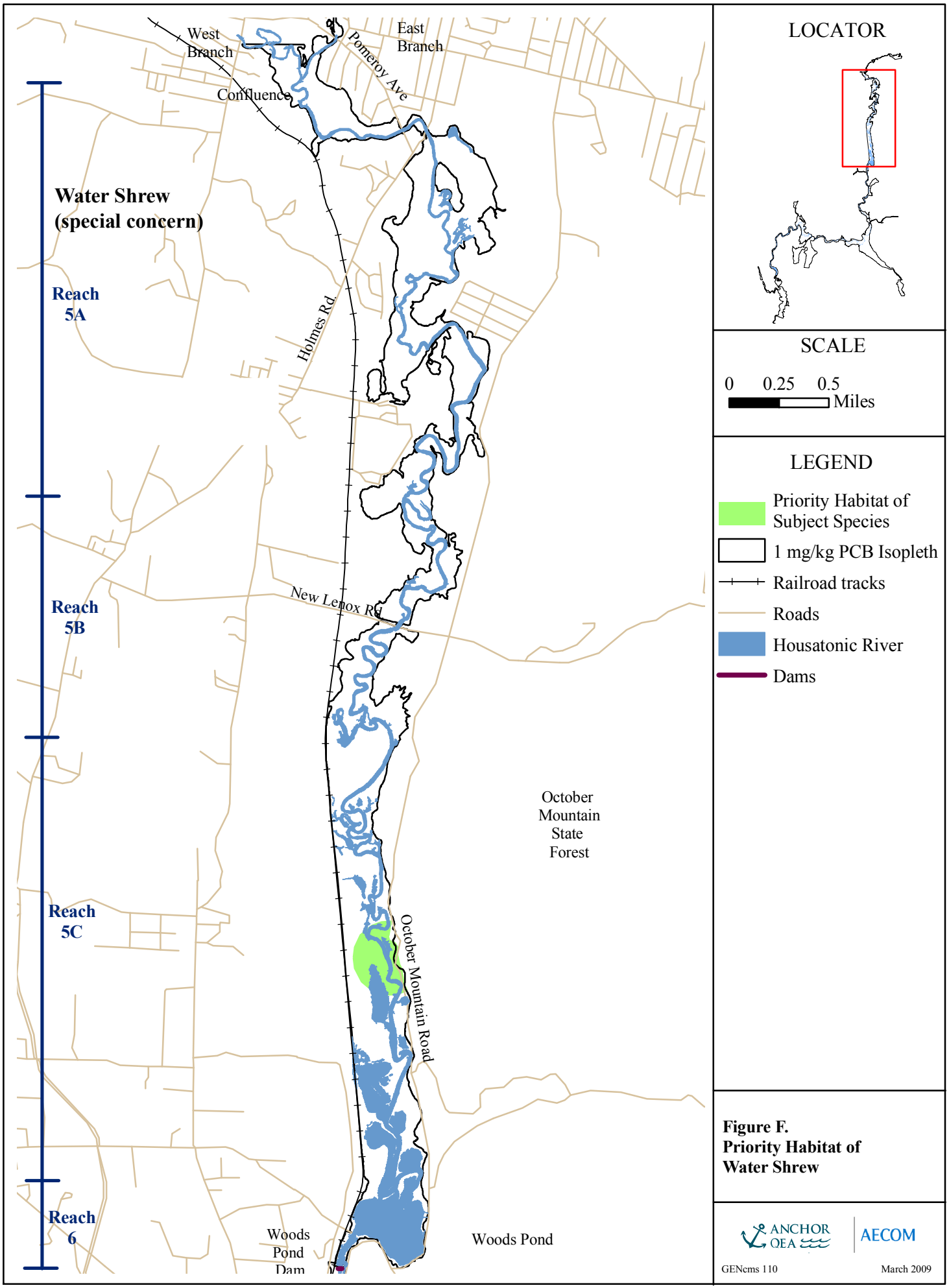

Figure F.
Priority Habitat of Water Shrew

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G. American Clam Shrimp (*Limnadia lenticularis*)

G. American Clam Shrimp (*Limnadia lenticularis*) MESA Assessment

G-1. Summary of Species Life Cycle and Habitat Requirements

The American clam shrimp is a freshwater crustacean (Class Branchiopoda) found in vernal pools with short wet periods of 2 to 3 months duration. Specimens have been found in ephemeral pools ranging from shallow depressions in farm fields and pastures in Massachusetts to isolated depressions in hardwood forests. When environmental conditions are favorable, young shrimp hatch from resting eggs and after a series of successive molts reach maturity in 4 to 11 days. Adult shrimp can be found moving through vegetation on the pool bottom where they collect food by drawing water into their carapace and filtering out food particles. Reproduction is by parthenogenesis; the female carries resting eggs under the carapace and the eggs are released as the female molts. The life span of the American clam shrimp is short and there is usually only one generation per wet period in the ephemeral pools. Adults generally die before the pools dry or are stranded and die as the pool dries. The resting eggs may remain dormant is dry pools for several years if favorable conditions are absent over a period of years. American clam shrimp populations are not found consistently in the same pool year after year, as their presence depends on favorable environmental conditions. The American clam shrimp is a state-listed Species of Special Concern in Massachusetts (NHESP 2004).

G-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the American clam shrimp occurs entirely outside of the PSA. The habitat is located in a small area west of the Housatonic Rail Road bed adjacent to the bottom third of Reach 5C, just south of Willow Creek as shown on Figure G at the end of this section. The total Priority Habitat area of the American clam shrimp is approximately 8 acres. American clam shrimp populations are not reported to occur in Reaches 5A, 5B, or 6. The areal extent of the habitat is located within shrub swamp, deep emergent marsh, red maple swamp and cultural grassland communities. The population is not located in one of the 68 EPA identified vernal pools.

G-3. Impact of Remedial Alternatives on American Clam Shrimp Habitat

None of the planned remedial activities involved in any of the sediment, floodplain, or treatment/disposition alternatives will impact the mapped Priority Habitat of the American clam shrimp, as no activities are involved within the Priority Habitat under any of these alternatives. Accordingly, none of these alternatives will involve a “take” of this species under the Massachusetts Endangered Species Act (MESA).

References:

Natural Heritage and Endangered Species Program (NHESP). 2004. Fact Sheet for American clam shrimp (*Limnadia lenticularis*). Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

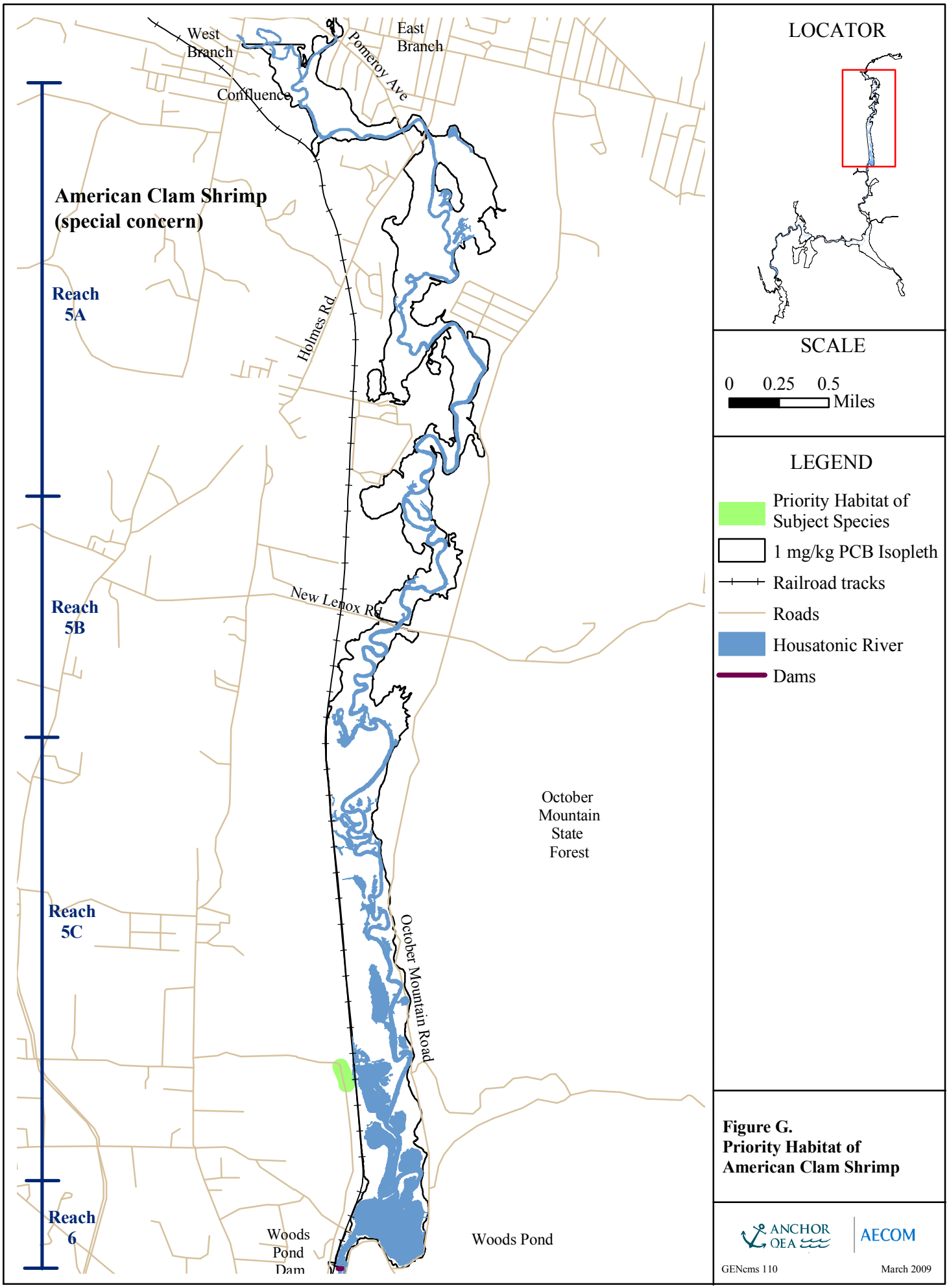

Figure G.
Priority Habitat of American Clam Shrimp

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H. Arrow Clubtail (*Stylurus spiniceps*)

H. Arrow Clubtail (*Stylurus spiniceps*) MESA Assessment

H-1. Summary of Species Life Cycle and Habitat Requirements

The arrow clubtail is a dragonfly of the family Gomphidae, which are nearly all burrowers and predators. It is a threatened species under the Massachusetts Endangered Species Act (MESA) (NHESP 2008). The larvae of the arrow clubtail prefer silty to sandy substrates in running water, with a moderate oxygen requirement and usually near-neutral to slightly basic pH (Hart and Fuller 1974, Merritt and Cummins 1978, NHESP 2007). Larvae are found near the surface of the sediment (within the upper inch), where they develop over at least a year-long period, possibly two to three years. Larvae are ambush predators, attacking passing invertebrates or even small fish from the substrate. When ready to emerge as adults, typically in the last half of June, larvae climb onto exposed rocks, emergent woody debris, or emergent vegetation, the exoskeleton splits, and adults emerge. After the wings adequately unfurl and dry, the adult arrow clubtail flies into adjacent woodland to hide high in the trees and continue to develop. Short feeding flights result in the capture of small insects. After one to several weeks, adults return to the stream to both feed and mate. This family is mainly "short flight" species; they need substantial perching places, usually woody debris, live woody plants, and rocks, as they move along the stream. Gravid females lay eggs singly or in small clusters by touching their abdomens to the water surface, normally in July through September. The eggs incubate over one to two weeks and hatch into larvae which re-initiate the life cycle. Adults may live out the rest of the summer far from the stream, often in dense woodland, where they are believed to spend most of their time high in the trees.

H-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the arrow clubtail occurs within the PSA throughout Reaches 5A, 5B and 5C, from the confluence of the East and West Branches to the inlet of Woods Pond, but does not include Reach 6, Woods Pond (shown on Figure H at the end of this section). The Woodlot Alternatives (2002) ecological characterization of the PSA confirmed the presence of this species. The area of Priority Habitat associated with Reach 5A is 353 acres, while that for Reach 5B is 199 acres and that for Reach 5C is 371 acres, for a total of 923 acres. However, the portion of the Priority Habitat that is actually within the PSA, is only 709 acres. The areal extent of the larval habitat includes the main stem of the river, plus the banks for eclosion (emergence as adults). The areal extent of adult habitat is broader and includes the main stem of the river, backwaters, floodplain and some adjacent upland forests or scrubland. The NHESP Priority Habitat designation extends into these areas to some extent. Adults can actually be found further from the river at times, but any additional range is not evaluated in this assessment. This species needs trees in the adult stage, so areas where the stream corridor is densely forested offer the best habitat for this species.

H-3. Impacts of Remedial Alternatives on Arrow Clubtail Habitat

H-3-1. Overview

Table H-1 summarizes the areal extent and duration of work within arrow clubtail habitat for all the remedial alternatives. SED 1 and SED 2 involve no construction in arrow clubtail habitat, while SED 3 through SED 8 involve increasing activity within that habitat. SED 3 will affect approximately 58% of the larval arrow clubtail habitat, the main channel of the river. SED 4 through SED 8 impact all larval arrow clubtail habitat. Backwaters are not a major larval habitat, as larvae prefer flowing water, but backwaters do represent feeding and breeding areas for adults and are included as impacted areas under SED alternatives.

Table H-1. Arrow Clubtail Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Arrow Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A	41 ac (excavation/capping) 55660 lf of riverbank (remediation)	Up to 40 ac (adult habitat removal)	8
	5B	27976 lf of riverbank (remediation)	Up to 21 ac (adult habitat removal)	<1
	5C	23 ac (thin-layer capping)	<1 ac (adult habitat removal)	1
SED 4	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	11 ac (excavation/capping) 27976 lf of riverbank remediation 17 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	3
	5C	70 ac (thin-layer capping) 23 ac (engineered capping)	Up to 9 ac (adult habitat removal)	2
SED 5	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	25 ac (excavation/capping) 27976 lf of riverbank remediation 2 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	5
	5C	21 ac (excavation/capping) 49 ac (thin-layer capping) 23 ac (engineered capping)	Up to 12 ac (adult habitat removal)	2
SED 6	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	25 ac (excavation/capping) 27976 lf of riverbank remediation 7 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	5
	5C	53 ac (excavation/capping) 39 ac (thin-layer capping)	Up to 2 ac (adult habitat removal)	4

Remedial Alternative	Reach with Affected Habitat	Description of Arrow Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 7	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	9
	5B	29 ac (excavation/capping) 27976 lf of riverbank remediation 3 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	6
	5C	64 ac (excavation/capping) 27 ac (thin-layer capping)	Up to 2 ac (adult habitat removal)	4
SED 8	5A	45 ac (excavation/capping) 55660 lf of riverbank (remediation)	Up to 40 ac (adult habitat removal)	11
	5B	34 ac (excavation/capping) 27976 lf of riverbank remediation	Up to 21 ac (adult habitat removal)	6
	5C	104 ac (excavation/capping)	Up to 2 ac (adult habitat removal)	10
FP 1	N/A – No Action	0	0	0
FP 2	5A	7.4 ac Clearing for remediation	2.3 ac Clearing for access roads	1
	5B	0.8 ac Clearing for remediation	1.0 ac Clearing for staging areas	
	5C	0.4 ac Clearing for remediation	2.3 ac Clearing for access roads 0.3 ac Clearing for staging areas 1.4 ac Clearing for access roads 0.6 ac Clearing for staging areas	
FP 3	5A	20 ac Clearing for remediation	6.6 ac Clearing for access roads	3
	5B	7.9 ac Clearing for remediation	3.0 ac Clearing for staging areas	
	5C	6.0 ac Clearing for remediation	2.4 ac Clearing for access roads 1.4 ac Clearing for staging areas 3.0 ac Clearing for access roads 0.8 ac Clearing for staging areas	

Remedial Alternative	Reach with Affected Habitat	Description of Arrow Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
FP 4	5A 5B 5C	36 ac Clearing for remediation 14.4 ac Clearing for remediation 10.3 ac Clearing for remediation	7.8 ac Clearing for access roads 4.1 ac Clearing for staging areas 5.1 ac Clearing for access roads 3.5 ac Clearing for staging areas 3.5 ac Clearing for access roads 1.8 ac Clearing for staging areas	4
FP 5	5A 5B 5C	25.3 ac Clearing for remediation 10.1 ac Clearing for remediation 15.8 ac Clearing for remediation	4.9 ac Clearing for access roads 2.4 ac Clearing for staging areas 2.7 ac Clearing for access roads 2.4 ac Clearing for staging areas 5.5 ac Clearing for access road 1.7 ac Clearing for staging areas	4
FP 6	5A 5B 5C	75.4 ac Clearing for remediation 48.0 ac Clearing for remediation 40.7 ac Clearing for remediation	5.9 ac Clearing for access roads 3.7 ac Clearing for staging areas 3.5 ac Clearing for access roads 2.8 ac Clearing for staging areas 5.4 ac Clearing for access roads 3.5 ac Clearing for staging areas	13

Remedial Alternative	Reach with Affected Habitat	Description of Arrow Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
FP 7	5A	130 ac Clearing for remediation	2.6 ac Clearing for access roads	22
	5B	61.8 ac Clearing for remediation	3.8 ac Clearing for staging areas	
	5C	61.6 ac Clearing for remediation	2.9 ac Clearing for access roads	
			2.2 ac Clearing for staging areas	
			3.9 ac Clearing for access roads	
			4.0 ac Clearing for staging areas	

Forested areas bordering the river are important to the life cycle of the arrow clubtail, and are included in the NHESP Priority Habitat designation. Remediation activities in the floodplain alternatives would affect arrow clubtail habitat by removal of the large trees needed by adults, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no tree clearing, while FP 2 through FP 5 would involve a range of tree removal that is not expected to significantly affect arrow clubtail unless the specific areas cleared of trees have exceptionally high habitat value and nearby remaining trees are not suitable. FP 6 and FP 7 affect much larger areas and would likely significantly affect this species. The combined effects of SED and FP alternatives should be considered in evaluating overall impact.

H-3-2. Description of Specific Remediation Activities Relative to Arrow Clutbtail Habitat by River Segments

Reach 5A

Priority Habitat for arrow clubtail is found throughout Reach 5A, from the confluence of the East and West Branches to the Pittsfield WWTF discharge. Except for SED 1 and SED 2, which involve no construction activities, all the SED alternatives would involve sediment removal, followed by capping or backfilling, throughout Reach 5A. These activities would impact the entirety of the roughly 27,830 linear feet of river and associated banks and immediately adjacent land area in Reach 5A that are listed as Priority Habitat for the arrow clubtail. Sediment removal will also remove the larval forms, even at the shallowest depths of planned excavation. Organisms used as food would also be removed. Backfill and capping will bury and kill any remaining larvae, although the resulting surficial substrate would be suitable for recolonization by arrow clubtail if any remain to repopulate remediated areas. Removal of bank vegetation will adversely alter habitat for emerging and adult arrow clubtails; loss of mature trees is especially damaging, as the adults need these as roosting sites during early development and between feeding flights. The estimated timeframe for work in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

Forested areas bordering the river are important to the life cycle of the arrow clubtail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives will affect arrow clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of tree clearing. FP 1 involves no tree clearing. FP 2 would involve only a relatively

small amount of tree removal (Table H1), impacting up to 10.7 acres (3%) of Priority Habitat for this species. The impacted area for FP 3 is 29.6 acres (8%). For FP 4 the impacted area increases to 47.9 acres (14%), while for FP 5 the impacted area declines to 32.6 acres (9%). Under FP 6 and FP 7, the impacted area increases to 85 and 136 acres (24 and 39%), respectively. Tree clearing would represent a threat to a significant portion of adult arrow clubtails in Reach 5A for FP 6 and FP 7, and possibly for FP 4 if tree clearing is not minimized.

Access road construction and staging areas also involve clearing of forested cover within Reach 5A for SED 3 through SED 8 as well as for FP 2 through FP 8. Any overlap of forest clearing with the Priority Habitat zone of the arrow clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3 through SED 8, 26 acres of access road and 14 acres of staging areas would be constructed in association with Reach 5A. Some of this area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 40 acres (11%) of Priority Habitat in Reach 5A.

Reach 5B

Priority Habitat for arrow clubtail is found throughout Reach 5B, from the Pittsfield WWTF discharge to slightly downstream of New Lenox Road. All the sediment alternatives except for SED 1 and SED 2 would impact this habitat. SED 4 would involve a combination of removal and thin-layer capping in this reach, and SED 5 through SED 8 would involve sediment removal followed by capping or backfilling throughout this reach. Direct removal of larval forms (nymphs) is unavoidable, and alteration of sediment features may reduce habitat suitability. While SED 3 would not involve in-river remediation in this reach, it would involve riverbank removal and stabilization. SED 4 through SED 8 would also include such riverbank remediation. This remediation will require considerable tree removal on the banks down to New Lenox Road, reducing essential habitat for adults. South of New Lenox Road, the amount of trees on the riverbank diminishes considerably, but the value of individual trees therefore increases for adults of this species, so losses by clearing remain important. In total, SED 4 through SED 8 would impact the entirety of the roughly 14,000 linear feet of river and associated banks and immediately adjacent land area in Reach 5B that are listed as Priority Habitat for the arrow clubtail, while SED 3 would impact the riverbanks in this reach. The estimated timeframe for work in Reach 5B is less than 1 year for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

As noted above, forested areas bordering the river are important to the life cycle of the arrow clubtail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives would affect arrow clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no tree clearing. FP 2 would involve only a small amount of tree removal (Table H1), impacting up to 3.4 acres (2%) of Priority Habitat for this species. The impacted area for FP 3 is 11.7 acres (6%). For FP 4 the impacted area increases to 23 acres (12%), while for FP 5 the impacted area declines to 15.2 acres (8%). Under FP 6 and FP 7, the impacted area increases to 54.3 and 66.9 acres (27 and 34%), respectively. Tree clearing would represent a threat to a significant portion of adult arrow clubtails in Reach 5B for FP 6 and FP 7, and possibly for FP 4 if tree clearing is not minimized.

Access road construction and staging areas also involve clearing of forested cover within Reach 5B for SED 3 through SED 8 as well as for FP 2 through FP 8. As in Reach 5A, any overlap of forest clearing with the Priority Habitat zone of the arrow clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3 through SED 8, 15 acres of access road and 6 acres of staging areas would be constructed in association with Reach 5B. Some of this

area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 21 acres (11%) of Priority Habitat in Reach 5B.

Reach 5C

Priority Habitat for arrow clubtail is found throughout Reach 5C, from slightly downstream of New Lenox Road to the inlet to Woods Pond. In addition to the flowing portion of the river channel, there are significant backwater areas in Reach 5C, sometimes separated into a Reach 5D but kept as part of Reach 5C in this analysis. Backwaters are not considered habitat for larval stages, which prefer flowing water, but would be viable feeding and mating areas for the adults. Except for SED 1 and SED 2, all the SED alternatives would have some impact on the arrow clubtail habitat in this reach. SED 3 would involve thin-layer capping in the downstream-most half of Reach 5C (23 acres); SED 4 would involve a combination of engineered capping (23 acres) and thin-layer capping (70 acres) in this reach; SED 5 would involve a combination of removal (21 acres), engineered capping (23 acres) and thin-layer capping (49 acres); and SED 6 through SED 8 would involve removal followed by capping or backfilling throughout this reach (104 acres over about 23,000 linear feet).

The impacts of all removal activities in SED 5 through SED 8 are functionally similar; nymphs are found near the sediment surface and would be removed in any sediment removal scenario. The short-term impacts of capping or backfilling includes killing any larvae present through burial and smothering. Longer term effects will depend on the nature of the material used; sand should be a suitable substrate for recolonization by arrow clubtails, but gravel would not support this species. Overall, SED 4 through SED 8 would impact the entirety of the roughly 23,000 linear feet of river in this reach that are listed as Priority Habitat for the arrow clubtail, and SED 3 would impact approximately 10,000 linear feet of river listed as Priority Habitat. The estimated timeframe for work in Reach 5C and the backwaters is about 1 year for SED 3, 2 years for SED 4 and SED 5, 4 years for SED 6 and SED 7, and 10 years for SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

As noted above, forested areas bordering the river are important to the life cycle of the arrow clubtail, and are included in the NHESP Priority Habitat designation. In general, forested cover immediately bordering the river is considerably less in Reach 5C than north of New Lenox Road, but those forested areas that are present would be very valuable as adult habitat. The remediation activities involved in the floodplain alternatives would affect arrow clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no tree clearing. FP 2 through FP 5 may require no tree cutting in Reach 5C; 2.4 to 23 acres of clearing (representing <1 to 6% of the Priority Habitat in this reach) is expected, but trees might be avoided in this more open area. Under FP 6 and FP 7 the impacted area increases to 49.6 and 69.5 acres (13 and 19%), respectively. Tree clearing would represent a threat to a significant portion of adult arrow clubtails in Reach 5C for FP 6 and FP 7 if tree clearing was not actively avoided.

Access road construction and staging areas also involve clearing of forested cover within Reach 5C for SED 3 through SED 8 as well as for FP 2 through FP 8. As in the more upstream reaches, any overlap of forest clearing with the Priority Habitat zone of the arrow clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3, less than 1 acre of access road and no staging areas would be constructed in association with Reach 5C. For SED 4, 2 acres of access road and 7 acres of staging areas would be constructed, nearly all of which overlap with arrow clubtail Priority Habitat. For SED 5, 2 acres of access road and 10 acres of staging areas would be constructed, nearly all of which overlap with arrow clubtail Priority Habitat. For SED 6, SED 7 and SED 8, only 1 acre of access road and 1 acre of staging areas would be constructed, all of which overlap with arrow clubtail Priority Habitat. Overall, no more than 3% of the Priority Habitat in Reach 5C would be threatened by this activity.

H-4. Assessment of MESA Issues for Arrow Clubtail

The MESA regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity…." A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the arrow clubtail is summarized in Table H-2 for the sediment alternatives and Table H-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table H-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the arrow clubtail. At a minimum, the documented feeding habitat of the larval form of the species would undergo significant alteration as a result of each of the alternatives. Direct removal of larvae during the sediment removal process is unavoidable, and extracting the nymphs from removed sediment is infeasible. Capping of Priority Habitat will also result in a take; even thin-layer capping, adding about 6 inches of sand to existing substrate, is expected to kill any nymphs present. Under SED 3, Reach 5B and the upstream half of Reach 5C would not be disturbed, but for SED 4 through SED 8, all riverine Priority Habitat for the arrow clubtail will be affected. Additional take of adults is expected through tree removal as part of bank remediation in Reaches 5A and 5B and floodplain remediation and access construction/staging in all three portions of Reach 5.

As also shown in Table H-2, SED 3 through SED 8 would all impact a significant portion of the local population of arrow clubtails in the PSA. As noted above, these alternatives would affect the majority (SED 3) or all (SED 4 through SED 8) of the arrow clubtail habitat. Phasing of the construction activities over the remediation period could allow for temporary refuges and recolonization of restored river areas by arrow clubtails from upstream or downstream areas not yet disturbed, where the substrate is suitable upon completion of the construction, but the rate of construction is expected to cover distances too large each year to allow effective colonization from the nearest undisturbed area harboring this species. In any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer. Moreover, the changed character of the banks and adjacent floodplain and forested areas as a function of tree clearing is expected to reduce habitat suitability for adults for many years to come, further limiting recolonization. Due to the impact on a significant portion of the population, the requirement for a long-term net benefit plan is not applicable under MESA.

As shown in Table H-3, all of the floodplain alternatives except for FP 1 would result in a take of the arrow clubtail. At a minimum, the known shelter and feeding habitat of the adult form of the species (i.e., trees) would undergo alteration as a result of each of the alternatives. The floodplain alternatives would have less potential for a direct take (i.e., killing clubtails) than the SED alternatives. However, FP alternatives involving work within the Priority Habitat of the arrow clubtail would adversely affect the feeding, breeding, and migratory habitat of adults through removal of trees. As the loss of mature trees cannot be mitigated in a single year, adult habitat would be lost. Avoidance of tree cutting would reduce the impact of the FP alternatives on this species.

The impact of these floodplain alternatives on the local population of arrow clubtails would thus depend on the extent of tree clearing. FP 2 through FP 5 involve a relatively small portion of floodplain (16.5 to 86.4 acres, or 2 to 9% of the Priority Habitat), and thus sufficient forested habitat would remain for the adults to find other trees in which to roost. As a result, the associated take is not expected to impact a significant portion of the local population. FP 6 and FP 7 represent much greater threats to adults through tree cutting (up to 20 and 30% of Priority Habitat, respectively) and would likely result in an impact on a significant portion of the local population**.**

For those alternatives that would involve a take but would not impact a significant portion of the local population (FP 2 through FP 5), conservation and management measures would not result in a long-term net benefit to this species. There is no additional river area that could become habitat for larval forms, and the tree cover is currently adequate to support the riverine population. Thus, there is no indication that expanding the forest area would aid this species, particularly if the abundance of larval forms in the river is greatly depressed or even eliminated by riverine remediation under SED 3 through SED 8. In this situation, habitat expansion within the Housatonic River area is not a viable approach for this species. In short, given the high quality of the existing habitat and limits on its expansion, a long-term net benefit plan involving habitat enhancement or expansion measures appears highly unlikely to provide long-term net benefit to this species.

References:

Hart, C.W. Jr. and S.L.H. Fuller. 1974. Pollution Ecology of Freshwater Invertebrates. Academic Press, New York, New York.

Merritt, R.W. and K.W. Cummins. 1978. An Introduction to Aquatic Insects of North America. Kendall Hunt Publishers, Dubuque, IA.

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NHESP. 2008. Natural Heritage Endangered Species Program database of protected species. Westborough, MA.

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Table H2: Assessment of MESA Issues for Arrow Clubtail Under Sediment Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take; only monitoring	NA	NA	NA
SED 3	Yes. Excavation of river in Reach 5A would cause a take of larval forms by direct removal and alteration of feeding habitat. Capping of excavated areas would cause a further take of any remaining or immigrating larvae. Thin-layer capping in Reach 5C will harm additional larvae. Additional take of adults, either directly for summer construction work or indirectly through habitat loss, will occur through tree removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat in Reach 5A and half the Priority Habitat in Reach 5C will be impacted. Phasing of construction activities will not prevent loss of a significant portion of the population, because the rate of construction would cover distances too large each year to allow effective colonization from the nearest undisturbed area, and in any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.
SED 4 through 8	Yes. Combination of excavation and thin-layer or engineered capping of river in Reaches 5A, 5B and 5C would cause a take of larval forms by direct removal and alteration of feeding habitat throughout the Priority Habitat within the PSA. Additional take of adults is expected through tree removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation and backfill, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat within the PSA will be impacted. Phasing of construction activities will not prevent loss of a significant portion of the population, because the rate of construction would cover distances too large each year to allow effective colonization from the nearest undisturbed area, and in any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table H3: Assessment of MESA Issues for Arrow Clubtail Under Floodplain Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2 through FP 5	Yes. Soil removal activities and access road/staging areas would involve tree removal and a related take of adults in 16.5 to 86.4 acres of the Priority Habitat. This take would include harassment and disruption of the feeding, breeding, and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would all require removal of trees, which would cause a take.	No. Larval forms would be unaffected, and only a relatively small portion of forested habitat would be subject to potential tree removal (<10% of the Priority Habitat) over a one- to four-year period. Sufficient forest exists for adults to find other trees in which to roost.	No. Conservation measures such as expansion of tree cover could be fostered over an extended period of years, but would have no significant effect on larval populations, which will limit adults that could use the enhanced habitat years in the future. Therefore, a conservation and management plan would not provide overall net benefit to the species.
FP 6 & FP 7	Yes. Soil removal activities and access road/staging areas would involve tree removal and a related take of adults. This take would include harassment and disruption of the feeding, breeding, and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of trees, which would cause a take.	Yes. Extensive areas subject to tree removal (189 to 272 acres within Priority Habitat, or 21 to 30%) are expected to affect adult survival, breeding success, and feeding and migratory activity for a significant portion of the local population.	NA. Since these alternatives would impact a significant portion of the local population, a net benefit is not applicable under MESA.

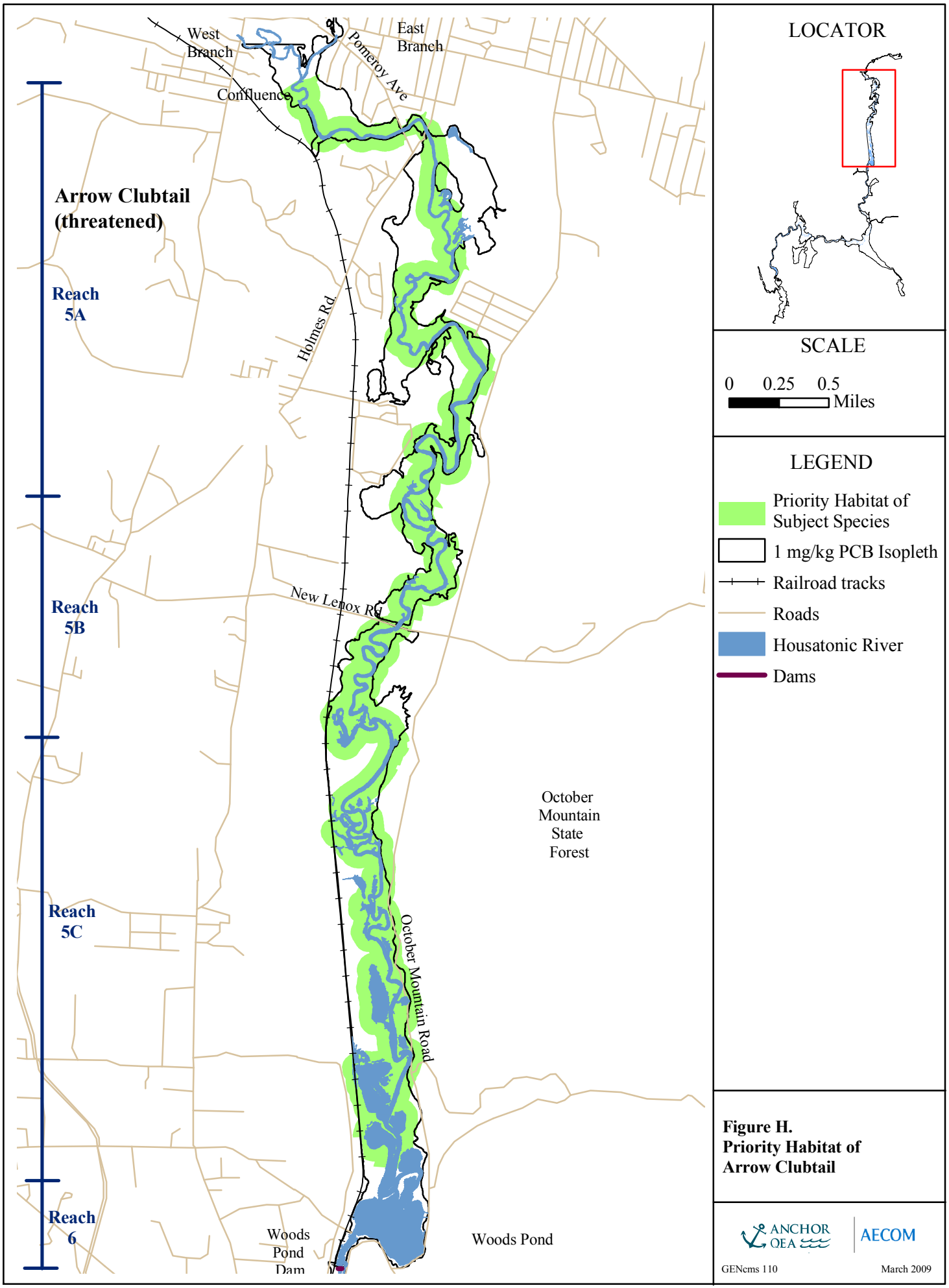

Figure H.
Priority Habitat of Arrow Clubtail

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I. Brook Snaketail (*Ophiogomphus aspersus*)

I. Brook Snaketail (*Ophiogomphus aspersus*) MESA Assessment

I-1. Summary of Species Life Cycle and Habitat Requirements

The brook snaketail is a dragonfly of the family Gomphidae, which are nearly all burrowers and predators. It is a state-designated species of special concern under the Massachusetts Endangered Species Act (MESA) (NHESP 2008). The larvae of the brook snaketail prefer sandy substrates in clear running water, and have a relatively high oxygen requirement among this family (Hart and Fuller 1974, Merritt and Cummins 1978, NHESP 2007). A near-neutral to slightly basic pH is preferred. Larvae are found near the surface of the sediment (within the upper inch), where they develop over at least a year-long period, possibly two to three years. Larvae are ambush predators, attacking passing invertebrates or even small fish from the substrate. When ready to emerge as adults, typically in the last half of May, larvae climb onto banks (open sandy to gravelly substrate, rocks or woody debris), the exoskeleton splits, and adults emerge. After the wings adequately unfurl and dry, the adult brook snaketail usually flies into adjacent woodland or shrubland to hide among vegetation and continue to develop. Short feeding flights result in the capture of small insects. After one to several weeks, adults return to the stream to both feed and mate. This family is mainly "short flight" species; they need substantial perching places, usually woody debris, live woody plants, and rocks, as they move along the stream. Gravid females lay eggs singly or in small clusters by touching their abdomens to the water surface in riffle zones, normally between mid-June and late August. The eggs incubate over one to two weeks and hatch into larvae which re-initiate the life cycle. Adults may live out the rest of the summer far from the stream, often in dense woodland.

I-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the brook snaketail occurs within the PSA in the upstream portion of Reach 5A (shown in Figure I at the end of this section), from the confluence of the East and West Branches to Holmes Road, overlapping with but not extending as far downstream as the Priority Habitat of the riffle snaketail, a close relative. The brook snaketail was identified within Reach 5A during the Woodlot Alternatives (2002) assessment. The area of Priority Habitat associated with Reach 5A is 78 acres. However, the portion of the Priority Habitat that is actually within the PSA is only 48 acres. The areal extent of the larval habitat includes the main stem of the river, plus the banks for eclosion (emergence as adults). The areal extent of adult habitat is broader and includes the main stem of the river, backwaters, floodplain and some adjacent upland forests or scrubland. The NHESP Priority Habitat designation extends into these areas to some extent. Adults can actually be found further from the river at times, but any additional range is not evaluated in this assessment.

I-3. Impacts of Remedial Alternatives on Brook Snaketail Habitat

I-3-1. Overview

Table I-1 summarizes the areal extent and duration of work within brook snaketail habitat for all the remedial alternatives. SED 1 and SED 2 involve no construction in brook snaketail habitat, while SED 3 through SED 8 impact all larval brook snaketail habitat, which is restricted to the upstream quarter of Reach 5A, the main channel of the river. Backwaters are not present in this area.

Forested or shrubland areas bordering the river are important to the life cycle of the brook snaketail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives will affect brook snaketail habitat by removal of the trees and shrubs needed by adults of this species, with the extent of impact proportional to the extent of clearing. FP 1 involves no clearing, while FP 2 and FP 3 involve a relatively small area of floodplain and are not expected to impact a significant portion of

the local population. FP 4 and FP 5 impact about 14% of the Priority Habitat for this species; this could be significant if the area to be cleared is high quality habitat for the adults of this species. FP 6 and FP 7 represent greater threats to adults through extensive vegetative clearing and are expected to impact a significant portion of the local population in the PSA. The combined effects of SED and FP alternatives should be considered in evaluating overall impact.

Table I-1. Brook Snaketail Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Brook Snaketail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3 – SED 8	5A	8 ac (excavation/capping) 13,602 lf of riverbank (remediation)	Up to 9 ac (adult habitat removal)	8 to 11
FP 1	N/A – No Action	0	0	0
FP 2	5A	0.4 ac (Clearing for remediation)	0.7 ac (Clearing for access)	1
FP 3	5A	5.4 ac (Clearing for remediation)	1.3 ac (Clearing for access) 0.4 ac (Clearing for staging)	3
FP 4	5A	8.7 ac (Clearing for remediation)	1.7 ac (Clearing for access) 0.4 ac (Clearing for staging)	4
FP 5	5A	8.6 ac (Clearing for remediation)	1.6 ac (Clearing for access) 0.8 ac (Clearing for staging)	4
FP 6	5A	19.7 ac (Clearing for remediation)	1.0 ac (Clearing for access) 0.7 ac (Clearing for staging)	13
FP 7	5A	27.9 ac (Clearing for remediation)	0.5 ac (Clearing for access) 0.7 ac (Clearing for staging)	22

*This species is known to occur only within Reach 5A.
**Impacts under SED remediation work are to riverine and riverbank habitats. Impacts under FP alternatives and access road/staging areas are to floodplain wetland habitats.
***Duration of work figures are for the entire Reach 5A; work within the Priority Habitat portion may be less.

I-3-2. Description of Specific Remediation Activities Relative to Brook Snaketail Habitat by River Segments

Reach 5A

Priority Habitat for brook snaketail is found throughout Reach 5A, from the confluence of the East and West Branches to Holmes Road. Except for SED 1 and SED 2, which involve no construction activities, all the SED alternatives would involve sediment removal, followed by capping or backfilling, throughout Reach 5A. These activities would impact the entirety of the roughly 6,800 linear feet of river and associated banks and

immediately adjacent land area in Reach 5A upstream of Holmes Road that are listed as Priority Habitat for the brook snaketail. Sediment removal will also remove the larval forms, even at the shallowest depths of planned excavation. Organisms used as food would also be removed. Backfill and capping will bury and kill any remaining larvae, although the resulting surficial substrate may be suitable for recolonization by brook snaketail if any remain to repopulate remediated areas. Removal of bank vegetation will adversely alter habitat for emerging and adult brook snaketails, as the adults need shrubs or trees as roosting sites during early development and between feeding flights. The estimated timeframe for work in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8, but all work in the portion of Reach 5A that is habitat for brook snaketails would be completed in less time. Not all Priority Habitat would be impacted in all years, but the entire area listed as brook snaketail habitat would be altered in too short a time period to allow recolonization from unimpacted area within the Priority Habitat.

Forested or shrubland areas bordering the river are important to the life cycle of the brook snaketail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives will affect brook snaketail habitat by removal of the trees and shrubs needed by adults of this species, with the extent of impact proportional to the extent of clearing. FP 1 involves no vegetation clearing. FP 2 would involve only a small amount of vegetation removal (Table I-1), impacting up to 1.1 acres (1%) of Priority Habitat for this species. The impacted area for FP 3 is 7.1 acres (9%). For FP 4 the impacted area increases to 10.8 acres (14%), and is similar for FP 5 at 11.0 acres (14%). Under FP 6 and FP 7 the impacted area increases to 21.4 and 29.1 acres (27 and 37% of Priority Habitat area), respectively. Vegetation clearing would represent a threat to a significant portion of adult brook snaketails in Reach 5A for FP 6 and FP 7 and possibly for FP 4 and FP 5 as well, as discussed further below.

Access road construction and staging areas also involve clearing of vegetated cover within Reach 5A for SED 3 through SED 8 as well as for FP 2 through FP 8. Any overlap of vegetative clearing with the Priority Habitat zone of the brook snaketail would impact this species, either directly or through habitat alteration, as adults use trees and shrubs at substantial distance from the stream of origin and could be directly affected by any removal during the summer when adults are present. For SED 3 through SED 8, 6 acres of access road and 3 acres of staging areas would be constructed in association with Reach 5A. Some of this area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 9 acres (12%) of Priority Habitat in Reach 5A.

Reach 5B

The NHESP does not list any brook snaketail Priority Habitat in Reach 5B.

Reach 5C

The NHESP does not list any brook snaketail Priority Habitat in Reach 5C.

I-4. Assessment of MESA Issues for Brook Snaketail

The MESA regulations define “take” at 321 CMR 10.02: “in reference to animals [‘take’] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity….” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for the brook snaketail is summarized in Table I-2 for the sediment alternatives and Table I-3 for the floodplain alternatives. These tables identify, for each alternative: (a)

whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table I-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the brook snaketail. At a minimum, the documented feeding habitat of the larval form of the species would undergo significant alteration as a result of each of the alternatives. Direct removal of larvae during the sediment removal process is unavoidable, and extracting the nymphs from removed sediment is infeasible. Capping of Priority Habitat will also result in a take; the addition of at least 2 ft of backfill is expected to kill any nymphs present. Additional take of adults is expected through tree and shrub removal as part of bank remediation, floodplain remediation, and access construction/staging.

As also shown in Table I-2, SED 3 through SED 8 would impact a significant portion of the local population of brook snaketails. These alternatives would all affect the entirety of the brook snaketail habitat. Phasing of the construction activities over the remediation period would not prevent a significant impact because, given the limited extent of the brook snaketail habitat, work within that habitat and the attendant alteration of the habitat would occur within too short a time period to allow recolonization of restored areas from unimpacted areas within the Priority Habitat. Furthermore, substrate suitability after construction will be low where gravel/rock is used as the upper layer. In addition, the changed character of the banks and adjacent floodplain as a function of vegetative clearing is expected to reduce habitat suitability for adults for many years to come, further limiting recolonization. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable.

As shown in Table I-3, all of the floodplain alternatives except for FP 1 would result in a take of the brook snaketail. At a minimum, the known shelter and feeding habitat of the adult form of the species (i.e., trees and shrubs) would undergo alteration as a result of each of the alternatives. The floodplain alternatives would have less potential for a direct take (i.e., killing snaketails) than the SED alternatives. However, FP alternatives involving work within the Priority Habitat of the brook snaketail would adversely affect the feeding and migratory habitat of adults through removal of trees and shrubs. As the loss of woody vegetation cannot be mitigated in a single year, adult habitat would be lost.

The impact of these floodplain alternatives on the local population of brook snaketails would thus depend on the extent of vegetation clearing. FP 2 and FP 3 involve a relatively small area of floodplain (1.1 to 7.1 acres, or 1 to 9% of the Priority Habitat), and thus sufficient forested habitat would remain for the adults to find other trees in which to roost. As a result, the associated take is not expected to impact a significant portion of the local population. FP 4 and FP 5 impact about 11 acres, or 14% of the Priority Habitat for this species; this could be significant if the area to be cleared is high quality habitat for the adults of this species. FP 6 and FP 7 represent much greater threats to adults through vegetative clearing (up to 27 and 37% of Priority Habitat, respectively) and would be expected to result in an impact on a significant portion of the local population.

For those alternatives that would involve a take but would not impact a significant portion of the local population (FP 2 and FP 3), conservation and management measures would not result in a long-term net benefit to this species. There is no additional river area that could become habitat for larval forms for more than a short time; and attempting to extend suitable conditions for this species beyond the current limits would not last, as riverine processes would facilitate erosion and deposition until conditions similar to those found now recurred. In addition, the existing vegetative cover is sufficient to support the adult population; and thus there is no indication that expanding the forest area would aid this species, particularly if the abundance of larval forms in the river is greatly depressed or even eliminated by riverine remediation under SED 3 through SED 8. In this situation, habitat expansion within Housatonic River corridor area is not a viable approach for this species. In short, given the high quality of the existing habitat and limits on its expansion, a long-term net

benefit plan involving habitat enhancement or expansion measures would not provide a long-term net benefit to this species.

References:

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NHESP. 2008. Natural Heritage Endangered Species Program database of protected species. Westborough, MA.

Woodlot Alternatives. 2002. Environmental Remediation Project: GE/Housatonic River Project, Pittsfield, Massachusetts. Topsham, ME.

Table I-2: Assessment of MESA Issues for Brook Snaketail Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take; only monitoring	NA	NA	NA
SED 3 through SED 8	Yes. Excavation of river in Reach 5A would cause a take of larval forms by direct removal and alteration of feeding habitat. Capping of excavated areas would cause a further take of any remaining or immigrating larvae. Additional take of adults, either directly for summer construction work or indirectly through habitat loss, will occur through tree and shrub removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat is in Reach 5A, and that entire habitat will be impacted by all these SED alternatives. Phasing of construction activities will not prevent loss of a significant portion of the population, because work within, and the attendant alteration of, the brook snaketail habitat would occur within too short a time period to allow recolonization of restored areas from unimpacted areas. Moreover, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table I-3: Assessment of MESA Issues for Brook Snaketail Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2 & FP 3	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of woody vegetation, which would cause a take.	No. Larval forms would be unaffected, and only a small area of forested habitat would be subject to vegetation removal (1.1 to 7.1 ac, <10% of Priority Habitat) over a short time period. Adults can find other trees and shrubs in which to roost.	No. Conservation and management measures such as expansion of woody cover could be fostered over an extended period of years, but would have no significant effect on larval populations, which will limit adults that could use any enhanced habitat years in the future. Therefore, a conservation and management plan would not provide net benefit to the species.
FP 4 & FP 5	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of woody vegetation, which would cause a take.	Possibly. Larval forms would be unaffected, but the area of forested habitat that would be subject to vegetative removal (11 ac, 14% of Priority Habitat) over a three-year period may result in an impact on a significant portion of the local population if that area is high quality habitat for this species.	No. Conservation and management plan would not provide long-term net benefit to the species, for the same reasons given above.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 & FP 7	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of woody vegetation, which would cause a take.	Yes. Extensive areas subject to vegetative clearing (21.4 to 29.1 acres, or 27 to 37% of Priority Habitat) expected to affect adult survival, breeding success, and feeding and migratory activity for a significant portion of the local population.	NA. Since these alternatives would impact a significant portion of the local population, a net benefit is not applicable under MESA.

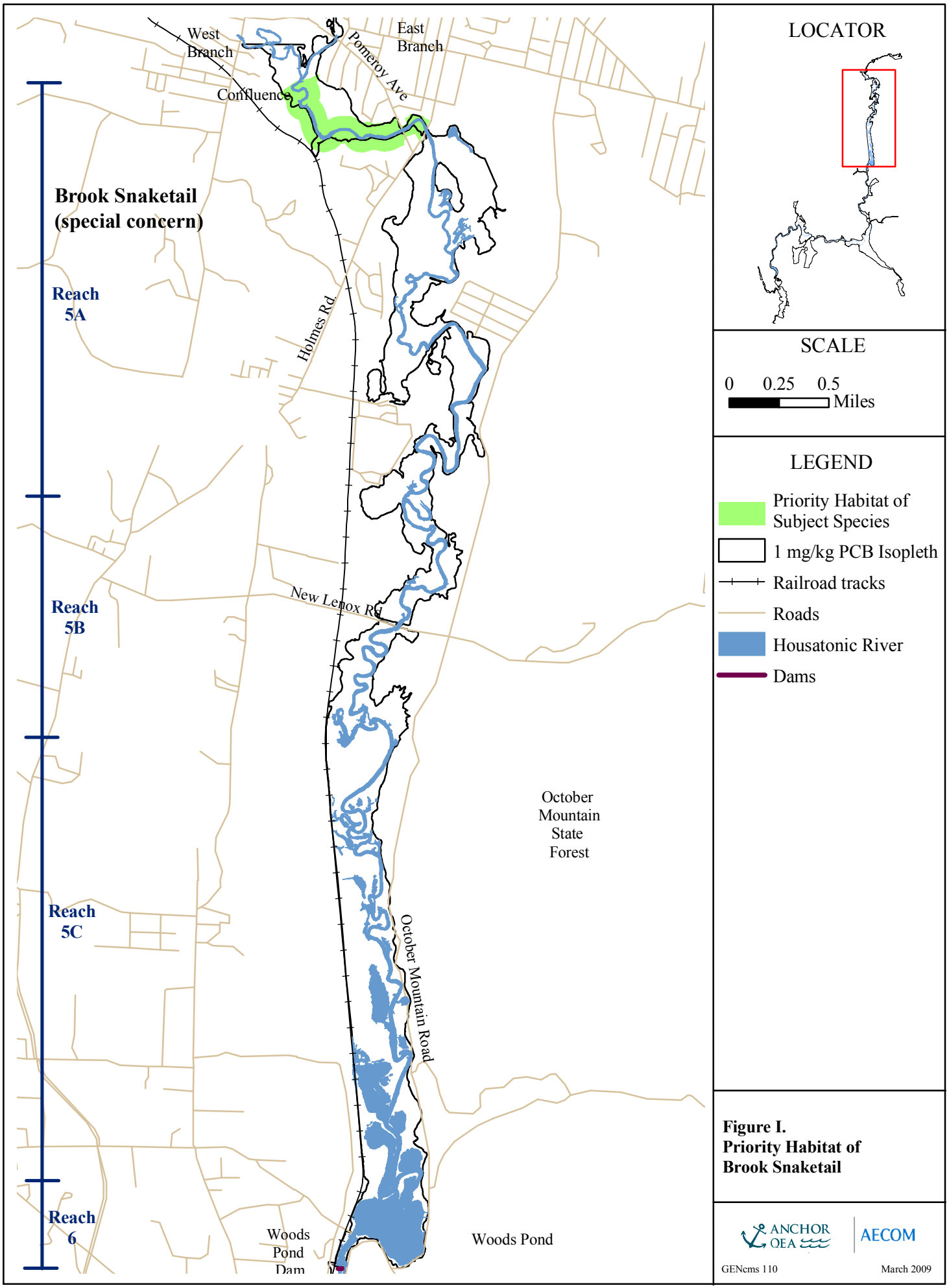

Figure I.
Priority Habitat of Brook Snaketail

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J. Mustard White (Butterfly)(*Pieris napi oleracea*)

J. Mustard White (*Pieris napi oleracea*) MESA Assessment

J-1. Summary of Species Life Cycle and Habitat Requirements

Mustard white (*Pieris napi oleracea*) butterflies are typically found in the understory and along edges of moist, rich, open deciduous woodlands. Nearby open areas including meadows and bogs are also utilized. Toothwort (*Dentaria diphylla*), an herbaceous woodland plant, is an essential larval host. Other larval hosts include cuckoo-flower (*Cardamine pratensis*), which is found in swamps and wet woods; rape (*Brassica rapa*), which is found in hayfields and on roadsides; watercress (*Nasturtium officinale*), which is found only in wet areas with running water; rock-cress (*Arabis spp.*) which is sparsely dispersed on rock ledges; and other mustard (Cruciferae) species. Use of mustards varies greatly with season and location, but toothwort is the preferred host where available. Adult food sources are usually the flowers of mustards, many of which bloom from earliest spring to late fall.

There are three flight periods for the mustard white in Massachusetts: late April to mid-June; early July to early August; and late August to the third week in September (C. Leahy, 2008). Mustard whites can emerge in up to three broods corresponding to the flight periods, the spring broods are generally restricted to the edge of woodlands while later broods are found in more open areas, though never far from woods. A third brood will overwinter. Adult males will patrol open areas in search of receptive females during warm daylight hours. The flight of the butterfly is rapid and close to the ground. Females deposit single eggs on the underside of the leaves of host plants. Adults are attracted to garlic mustard (*Alliaria officinalis*), common winter cress (*Barbarea vulgaris*) and field pennycress (*Thlaspi arvense*) as potential host plants, but these plants do not support larval growth. Mustard white butterflies overwinter as pupae (or chrysalis). The mustard white is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Threatened Species (NHESP 2008).

J-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the mustard white butterfly within the PSA occurs in most of Reach 5A just south of the Pittsfield city limits, within all of Reach 5B, and in the northernmost portion of Reach 5C, as shown on Figure J at the end of this section. There is no mapped Priority Habitat in Reach 6. The total Priority Habitat area of the mustard white butterfly is 783 acres, of which 509 acres are within the PSA. The areal extent of the habitat includes the main stem of the Housatonic River, moderately alkaline lake/pond, shallow and deep emergent marsh, wet meadow, transitional floodplain forest, high-terrace floodplain forest, red oak/sugar maple transition forest, northern hardwoods hemlock/white pine forest, red maple swamp, shrub swamp, cultural grassland, and riverine point bar/beach. Although the mustard white's primary habitat is moist deciduous woodlands, this species utilizes a diversity of habitats and could be found within or at the edges of all these communities.

J-3. Impacts of Remedial Alternatives on Mustard White Habitat

J-3-1. Overview

Table J-1 summarizes the areal extent and duration of work within NHESP mapped mustard white habitat for all the remedial alternatives. SED 1 involves no construction-related activities. SED 2 is limited to monitoring natural recovery and will not adversely impact mapped mustard white habitat. SED 3 through SED 8 involves increasing levels of remediation activities within mapped mustard white habitat. SED 3 will impact 33 acres of river channel by excavating 2 feet of sediment. SED 4 through SED 8 will impact between 45 and 77 acres of river and backwater areas through excavation and thin-layer capping. SED 3 through SED 8 will all involve riverbank remediation of approximately 70,000 linear feet and approximately 60 acres of access road and staging area construction impacts. Mustard white butterflies prefer rich deciduous woodlands and nearby open areas such as meadows and emergent wetlands, but they do not utilize aquatic habitat; therefore, in-

river and backwater remediation activities are not expected to directly impact this species. However the riverbank remediation and access road/staging area construction may impact this species. Any areas of excavation, backfilling, deposition, clearing, or grubbing of areas that currently support the growth of food plants (various native garlics) will result in direct impacts to this species. Riverbanks are likely areas to support the growth of such plants.

Floodplain remedial activities under FP2 through FP7 will potentially impact this species by altering floodplain habitats, primarily within transitional floodplain forest, wet meadow, and shallow emergent marsh community types. Alternatives FP 2 through FP 5 impact 11 to 47 acres of Priority Habitat and impacts increase under alternatives FP 6 and FP 7 to 106 to 181 acres. Construction of access roads and staging areas for these alternatives would impact an additional 6 to 20 acres. In addition to direct removal of plants, the excavation of soil may also remove the seeds of mustard white food plants known to occur within the PSA, reducing the repository of these species' seed banks and thereby adversely affecting the long-term viability of the mustard white. Backfilling with non-indigenous sediments is not expected to contain the seeds of these species, and therefore the establishment of newly exposed moist sediments from backfilling will not have the same potential for the re-growth of these plants. Moreover, such altered conditions are prime for the colonization of numerous invasive species, and these are likely to have a competitive advantage over the mustard white food sources.

Table J-1. Mustard White Butterfly Mapped Habitat Alterations, by Remedial Alternative.

Remedial Alternative	Reach with Affected Habitat	Description of Mustard White Butterfly Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A	33 ac (excavation/capping) 41,928 lf of riverbank remediation	34 ac	8
	5B	27,976 lf of riverbank remediation	25 ac	<1
	5C	0	1 ac	<1
SED 4	5A	34 ac (excavation/capping) 4 ac (thin layer capping) 41,928 lf of riverbank remediation	34 ac	8
	5B	11 ac (excavation/capping) 17 ac (thin layer capping) 27,976 lf of riverbank remediation	25 ac	3
	5C	2 ac (thin-layer capping)	1 ac	<1
SED 5	5A	34 ac (excavation/capping) 4 ac (thin layer capping) 41,928 lf of riverbank remediation	34 ac	8
	5B	25 ac (excavation/capping) 2 ac (thin layer capping) 27,976 lf of riverbank remediation	25 ac	5
	5C	2 ac (excavation/capping) 0.3 ac (thin layer capping)	2 ac	1.5

Remedial Alternative	Reach with Affected Habitat	Description of Mustard White Butterfly Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 6	5A	34 ac (excavation/capping) 6 ac (thin layer capping) 27,976 lf of riverbank remediation	34 ac	8
	5B	25 ac (excavation/capping) 7 ac (thin layer capping) 27,976 lf of riverbank remediation	25 ac	5
	5C	2 ac (excavation/capping) 0.06 ac (thin layer capping)	1 ac	1.5
SED 7	5A	34 ac (excavation/capping) 6 ac (thin layer capping) 41,928 lf of riverbank remediation	34 ac	9.5
	5B	29 ac (excavation/capping) 3 ac (thin layer capping) 27,976 lf of riverbank remediation	25 ac	6
	5C	2 ac (excavation/capping) 0.04 ac (thin layer capping)	1 ac	1.5
SED 8	5A	41 ac (excavation/capping) 41,928 lf of riverbank remediation	34 ac	11.5
	5B	34 ac (excavation/capping) 27,976 lf of riverbank remediation	25 ac	6.5
	5C	2 ac (excavation/capping)	1 ac	2.5
FP 1	N/A – No Action	0	0	0
FP 2	5A 5B 5C	9 ac (habitat removal) 0.8 ac (habitat removal) 0.1 ac (habitat removal)	3 ac (habitat removal) 2.5 ac (habitat removal) 0.1 ac (habitat removal)	1
FP 3	5A 5B 5C	18 ac (habitat removal) 9 ac (habitat removal) 0.8 ac (habitat removal)	11 ac (habitat removal) 5 ac (habitat removal) 0.4 ac (habitat removal)	3
FP 4	5A 5B 5C	31 ac (habitat removal) 15 ac (habitat removal) 1 ac (habitat removal)	11 ac (habitat removal) 9 ac (habitat removal) 0.8 (habitat removal)	4
FP 5	5A 5B 5C	18 ac (habitat removal) 11 ac (habitat removal) 2 ac (habitat removal)	5 (habitat removal) 6 ac (habitat removal) 1.1 ac (habitat removal)	4
FP 6	5A 5B 5C	61 ac (habitat removal) 51 ac (habitat removal) 4 ac (habitat removal)	9 ac (habitat removal) 8 ac (habitat removal) 1.5 ac (habitat removal)	13
FP 7	5A 5B 5C	114 ac (habitat removal) 64 ac (habitat removal) 7 ac (habitat removal)	5 ac (habitat removal) 6 ac (habitat removal) 1.5 ac (habitat removal)	22

*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur in only Reaches 5A and 5B. All direct impacts under FP alternatives are to floodplain and palustrine wetlands in the PSA.

J-3-2. Description of Specific Impacts by River Segment

Reach 5A

NHESP Priority Habitat for the mustard white butterfly is found throughout Reach 5A (467 acres) from immediately south of Holmes Road Bridge to the WWTP. It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and floodplain areas. Floodplain areas within the PSA contain preferred mustard white habitat (transitional floodplain forests) which are known to contain both larval and adult food plants. Adjacent open areas within these reaches may also be utilized (shallow emergent marsh, wet meadows).

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within mustard white Priority Habitat in Reach 5A. SED 3 involves 33 acres of river channel excavation of sediment to a depth of 2 feet below surface grade and backfilling with clean fill. SED 4 and SED 5 involve 34 acres of river channel excavation/backfilling to 1.5 to 2 feet and 4 acres of thin-layer capping in backwater areas. SED 6 involves 34 acres of river channel excavation/backfilling to 1 to 2 feet and 6 acres of thin-layer capping in backwater areas. SED 7 involves 34 acres of river channel excavation/backfilling to 1 to 3.5 feet and 6 acres of thin-layer capping in backwater areas. SED 8 involves 41 acres of river channel and backwater excavation/backfilling. SED 3 through SED 8 all involve riverbank remediation of approximately 42,000 linear feet. The mustard white does not utilize aquatic habitat and the river and backwater areas are not adequate habitat for the plants used for feeding and as larval hosts. Riverbank remediation activities will impact this species as it provides potential habitat for these plants.

Access road construction and staging areas will disturb an additional 34 acres within the Priority Habitat of Reach 5A under alternatives SED 3 through SED 8. Where these activities occur in floodplain forests and wet meadow communities, the potential for impacts to mustard white exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain food and host plants will result in impacts to this species. The estimated timeframe for completing the various sediment alternatives in Reach 5A is 8 years for SED 3 through SED 6, 9.5 years for SED 7, and 11.5 years for SED 8.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately 9 acres of mustard white Priority Habitat within Reach 5A. FP 3 and FP 5 involve soil removal and backfilling in approximately 18 acres of Priority Habitat. FP 4 involves soil removal and backfilling in approximately 31 acres of Priority Habitat. FP 6 involves soil removal and backfilling in approximately 61 acres and FP 7 involves soil removal and backfilling in approximately 114 acres of Priority Habitat. The majority of this is within transitional floodplain forest, which is the primary habitat for this species. Access roads and staging areas will impact another 3 to 11 acres of suitable habitat. Where these activities occur in floodplain forests and wet meadow communities, the potential for impacts to mustard white exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain food and host plants will result in impacts to this species. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 5B

NHESP Priority Habitat for the mustard white butterfly is found throughout all of Reach 5B (322 acres). It includes the main channel and shore of the Housatonic River, as well as contiguous backwater and floodplain areas. Floodplain areas within the PSA contain preferred mustard white habitat (transitional floodplain forests) which are known to contain both larval and adult food plants. Adjacent open areas within these reaches may also be utilized (shallow emergent marsh, wet meadows).

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment remedial activities within mustard white Priority Habitat in Reach 5B. SED 3 involves riverbank remediation only. SED 4 involves 11 acres of river channel excavation/backfilling to 1.5 to 2 feet

and 17 acres of thin-layer capping in backwater areas. SED 5 involves 25 acres of river channel excavation/backfilling to 1 to 2 feet and 2 acres of thin-layer capping in backwater areas. SED 6 involves 25 acres of river channel excavation/backfilling to 1 to 3.5 feet and 7 acres of thin-layer capping in backwater areas. SED 7 involves 29 acres of river channel excavation/backfilling to 1 to 3.5 feet and 3 acres of thin-layer capping in backwater areas. SED 8 involves 34 acres of river channel and backwater excavation/backfilling. SED 3 through SED 8 all involve riverbank remediation of approximately 28,000 linear feet. The mustard white does not utilize aquatic habitat and the river and backwater areas are not adequate habitat for the plants used for feeding and as larval hosts. Riverbank remediation activities will impact this species as it provides potential habitat for these plants.

Access road construction and staging areas will disturb an additional 25 acres within the Priority Habitat of Reach 5B under alternatives SED 3 through SED 8. Where these activities occur in floodplain forests and wet meadow communities, the potential for impacts to mustard white exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain food and host plants will result in impacts to this species. The estimated timeframe for completing the various sediment alternatives in Reach 5B is less than 1 year for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, 6 years for SED 7 and 6.5 years for SED 8.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately 0.8 acre of mustard white Priority Habitat within Reach 5B. FP 3 involves soil removal and backfilling in approximately 9 acres of Priority Habitat. FP 4 involves soil removal and backfilling in approximately 15 acres of Priority Habitat. FP 5 involves soil removal and backfilling in approximately 11 acres of Priority Habitat. FP 6 involves soil removal and backfilling in approximately 51 acres of Priority Habitat and FP 7 involves soil removal and backfilling in approximately 64 acres of Priority Habitat. The majority of this is within transitional floodplain forest, which is the primary habitat for this species. Access roads and staging areas will impact another 2 to 9 acres of suitable habitat. Where these activities occur in floodplain forests and wet meadow communities, the potential for impacts to mustard white exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain food and host plants will result in impacts to this species. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 5C

A small section (23 acres) of NHESP Priority Habitat for the mustard white butterfly is found in the uppermost section of Reach 5C of the PSA, approximately 2,500 feet south of New Lenox Road. It includes the main channel and shore of the Housatonic River as well as floodplain areas. Floodplain areas contain preferred mustard white habitat (transitional floodplain forests). Adjacent open areas may also be utilized (shallow emergent marsh, wet meadows).

SED 1 through SED 2 will have no direct impact to the portion of Reach 5C located within NHESP mapped mustard white habitat. SED 4 through SED 8 will cause direct in-river impacts due to 2 acres of excavation/backfilling. SED 5 through SED 7 will impact an additional 0.04 to 0.3 acre due to thin-layer capping. Mustard white butterflies do not typically utilize open water areas, and no riverbank remediation is planned for Reach 5C, so this work is not anticipated to have significant direct effects to this species. An additional 1 to 2 acres of impacts from SED 3 through SED 8 would occur to NHESP mapped habitat due to construction of access roads and staging areas, and this work will occur within suitable habitat for the mustard white. The estimated timeframe for completing the various sediment alternatives in Reach 5B is between 1 and 2.5 years.

FP 1 involves no activities. FP2 involves soil removal and backfilling in approximately 0.1 acre of mustard white Priority Habitat within Reach 5C. FP 3 involves soil removal and backfilling in approximately 0.8 acre of Priority Habitat. FP 4 involves soil removal and backfilling in approximately 1 acre of Priority Habitat. FP 5 involves soil removal and backfilling in approximately 2 acres of Priority Habitat. FP 6 involves soil removal and backfilling in approximately 4 acres of Priority Habitat and FP 7 involves soil removal and backfilling in

approximately 7 acres of Priority Habitat. The majority of this is within transitional floodplain forest, which is the primary habitat for this species. Access roads and staging areas will impact another 0.1 to 1.5 acres of suitable habitat. Where these activities occur in floodplain forests and wet meadow communities, the potential for impacts to mustard white exists. Excavation, backfilling, deposition, clearing, or grubbing of areas which contain food and host plants will result in impacts to this species. The estimated timeframe for completing the various floodplain alternatives in all reaches is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 6

There is no NHESP mapped mustard white habitat within Reach 6.

J-4. Assessment of MESA Issues for Mustard White Butterfly

MESA regulations define "take" at 321 CMR 10.02: "in reference to animals ['take'] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity…." A "take" is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the mustard white butterfly is summarized in Table J-2 for the sediment alternatives and Table J-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table J-2, except for SED 1 and SED 2, all sediment remedial alternatives result in a take of mustard white butterfly. Excavation, engineered capping, and thin-layer capping activities will not result in a take, as the mustard white butterflies primarily inhabit moist, open deciduous woodlands and adjacent open areas (emergent wetlands, wet meadows), but not open water habitats. However, riverbank remediation and construction of staging areas and access roads through areas that contain larval and/or adult food plants will cause a take of this species through destruction of food resources or through direct mortality. Remedial work involved with SED 3 impacts approximately 12% of the total mapped mustard white habitat and SED 4 through SED 8 impacts approximately 16 to 17% of the total mapped mustard white habitat. Approximately one-half of these impacts (over 60 acres) associated with SED 3 through SED 8 will occur in suitable floodplain habitat for the mustard white. When these impacts are paired with 70,000 lf of riverbank remediation activities throughout all the Priority Habitat within Reaches 5A and 5B, the take will likely involve a significant portion of the local mustard white population. Accordingly, a net benefit plan is not applicable under MESA for these alternatives.

As shown in Table J-3, all of the floodplain remedial alternatives except for FP 1 would result in a take of the mustard white butterfly. Soil removal activities and access road/staging areas planned in FP 2 through FP 7 would involve disturbance of primary habitat for this species within Reaches 5A, 5B, and 5C. This take would include direct alteration of habitat, removal of food plants, or even direct mortality. Remedial work involved with FP 2 through FP 5 impacts 2 to 9% of the total mapped mustard white Priority Habitat; these proportions are likely small enough to avoid impacting a significant portion of the local population. FP 6 impacts 17% and FP 7 impacts 25% of the total mapped mustard white Priority Habitat. The extent of impacts under FP 6 and

FP 7 are substantial enough to result in a take of a significant portion of the local population of the mustard white butterfly and a net benefit plan is not applicable under MESA for these alternatives.

A long-term net benefit for the mustard white butterfly under FP 2 may be feasible. Based on a review of the literature, potential conservation and management measures include utilization of a planting plan to increase the native food plants for both larvae and adults, particularly toothwort (as well as other native garlics). Such a plan could also include the manual removal of non-native food plants that are known to be detrimental to larvae (garlic mustard, common winter cress, field pennycress). However, any of these measures would need to be integrated and coordinated with requirements for and impacts to other rare species within the PSA. Because FP 3 through FP 5 involve a more substantial area of Priority Habitat impacts (43 to 68 acres), it cannot be established that an actual "net benefit" to the species could be realized under those circumstances. Considering the high quality of the existing habitat conditions, and the disturbances that would be associated with alternatives FP 3 through FP 5, the capacity of the PSA to support a sensitive species such as the mustard white butterfly may be significantly impaired. The disturbances associated with the remedial activities of these alternatives FP 3 through FP 5 also increase the opportunity for the expansion of invasive species, which could impair the habitat conditions required by this butterfly. Therefore, although appropriate individual elements of a conservation and management plan can be identified, it is not possible to conclude that such measures would provide an overall net benefit to the species.

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Table J-2: Assessment of MESA Issues for Mustard White under Sediment (SED) Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take; only monitoring.	NA	NA	NA
SED 3 through SED 8	Yes. Riverbank remediation soil removal activities and access road/staging areas would involve direct impacts (disruption) to preferred habitat areas within mustard white Priority Habitat. This take would include direct alteration of habitat and likely destruction of preferred food plants, including potential mortality to pupae or eggs.	No. Access road and staging areas impact 8% of the total Priority Habitat and there is little chance that all suitable habitats could be avoided. 70,000 linear feet of riverbank remediation will also unavoidably impact suitable habitat.	Likely. Impacts to this species' habitat within the PSA from SED alternatives occur primarily through construction of access roads and staging areas in suitable floodplain habitats (approximately 8% of mapped Priority Habitat), as well as the extensive length of riverbank remediation within the Priority Habitat. These would likely lead to significant destruction of habitat and food plants as well as direct mortality to pupae or eggs.	NA. The impacts will be to a significant portion of the local population, therefore a net benefit is not applicable under MESA.

Table J-3: Assessment of MESA Issues for Mustard White Butterfly under Floodplain (FP) Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Yes. Soil removal activities and access road/staging areas would involve direct impacts (disruption) to nearly 16 acres of suitable habitat areas within the mapped mustard white Priority Habitat zone. This take would include direct alteration of habitat and likely destruction of preferred food plants, including potential mortality to pupae or eggs. Soil excavation is also likely to remove the seed bank of food plants.	Possibly. The impacted area is a relatively small portion of the total Priority Habitat area (2%), and therefore a "take" might be avoided through management efforts. While seasonal restrictions for the construction may limit direct mortality to this species, habitat impacts will remain for many years after construction.	No. This alternative impacts only 2% of the total Priority Habitat.	Yes. Based on a review of the literature, applicable conservation and management measures including a planting plan that increases the native food plants for both larvae and adults, particularly toothwort (as well as other native garlics), and the manual removal of non-native food plants that are known to be detrimental to larvae (garlic mustard, common winter cress, field pennycress), would achieve a net benefit for this species relative to the impacts of FP 2.
FP 3 through FP 5	Yes. Soil removal activities and access road/staging areas would involve direct impacts (disruption) to 43 to 68 acres of suitable habitat areas within the mapped mustard white Priority Habitat zone. This take would include direct alteration of habitat and likely destruction of preferred food plants, including potential mortality to pupae or eggs. Soil excavation is also likely to remove the seed bank of food plants.	No. The impacted area ranges from approximately 6% to approximately 9% of the mustard white Priority Habitat; this is a large enough portion of the Priority Habitat area that avoidance of a take would not be feasible. While seasonal restrictions for the construction may limit direct mortality to this species, habitat impacts will remain for many years after construction.	No. Despite the relatively large acreage of impact, these alternatives impact only 6 to 9% of the total Priority Habitat.	Cannot be established. Based on a review of the literature, the elements of a conservation and management plan to benefit this species can be identified, but given the high quality of the habitat and the nature of the takes associated with these alternatives, it cannot be determined whether such a plan will achieve a net benefit for the species.

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 6 through FP 7	Yes. Soil removal activities and access road/staging areas would involve direct impacts (disruption) to 135 to 198 acres of suitable habitat areas within the mapped mustard white Priority Habitat zone. This take would include direct alteration of habitat and likely destruction of preferred food plants, including potential mortality to pupae or eggs. Soil excavation is also likely to remove the seed bank of food plants.	No. These alternatives result in an extensive area of the Priority Habitat, resulting in an unavoidable take. While seasonal restrictions for the construction may limit direct mortality to this species, habitat impacts will remain for many years after construction.	Yes. Approximately 17 to 25% of suitable mustard white Priority Habitat will be affected by these activities.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

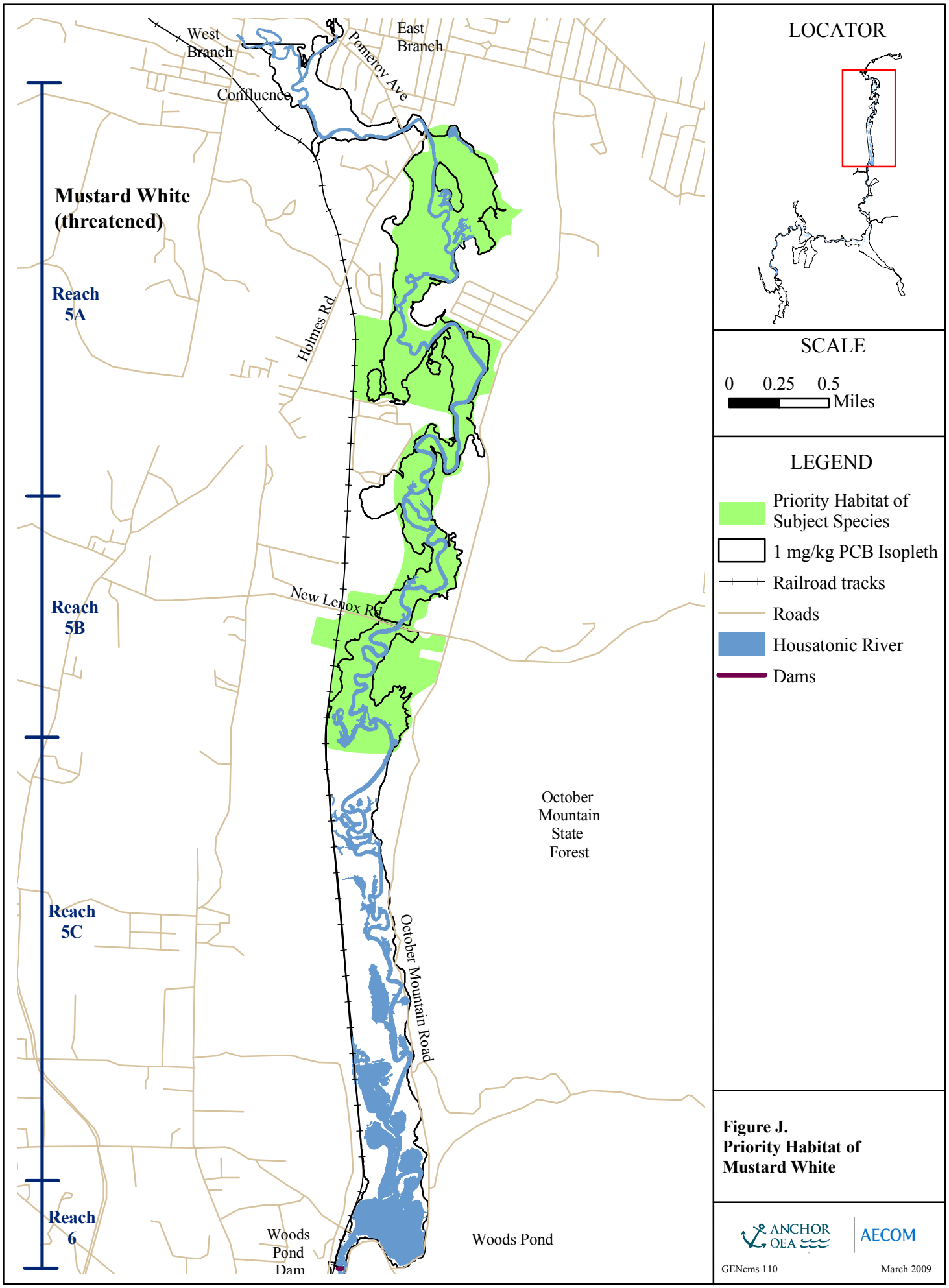

Figure J.
Priority Habitat of Mustard White

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K. Riffle Snaketail (*Ophiogomphus carolus*)

K. Riffle Snaketail (*Ophiogomphus carolus*) MESA Assessment

K-1. Summary of Species Life Cycle and Habitat Requirements

The riffle snaketail is a dragonfly of the family Gomphidae, which are nearly all burrowers and predators. It is a state-listed threatened species under the Massachusetts Endangered Species Act (MESA) (NHESP 2008). The larvae of the riffle snaketail prefer sandy substrates in clear running water, and have a relatively high oxygen requirement among this family (Hart and Fuller 1974, Merritt and Cummins 1978, NHESP 2007). A near-neutral to slightly basic pH is preferred. Larvae are found near the surface of the sediment (within the upper inch), where they develop over at least a year-long period, possibly two to three years. Larvae are ambush predators, attacking passing invertebrates or even small fish from the substrate. When ready to emerge as adults, typically in the last half of May, larvae climb onto banks (open sandy to gravelly substrate, rocks or woody debris), the exoskeleton splits, and adults emerge. After the wings adequately unfurl and dry, the adult riffle snaketail usually flies into adjacent woodland or shrubland to hide among vegetation and continue to develop. Short feeding flights result in the capture of small insects. After one to several weeks, adults return to the stream to both feed and mate. This family is mainly "short flight" species; they need substantial perching places, usually woody debris, live woody plants, and rocks, as they move along the stream. Gravid females lay eggs singly or in small clusters by touching their abdomens to the water surface in riffle zones, normally in June and July. The eggs incubate over one to two weeks and hatch into larvae which re-initiate the life cycle. Adults may live out the rest of the summer far from the stream, often in dense woodland.

K-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the riffle snaketail occurs within the PSA only in the upstream portion of Reach 5A, from the confluence of the East and West Branches to a point just upstream of the Joseph Road housing development off East New Lenox Road (shown in Figure K at the end of this section). The Woodlot Alternatives (2002) ecological characterization of the PSA confirmed the presence of this species. The area of Priority Habitat associated with Reach 5A is 147 acres. However, the portion of the Priority Habitat that is actually within the PSA is only 106 acres. The areal extent of the larval habitat includes the main stem of the river, plus the banks for eclosion (emergence as adults). The areal extent of adult habitat is broader and includes the main stem of the river, backwaters, floodplain and some adjacent upland forests or scrubland. The NHESP Priority Habitat designation extends into these areas to some extent. Adults can actually be found further from the river at times, but any additional range is not evaluated in this assessment.

K-3. Impacts of Remedial Alternatives on Riffle Snaketail Habitat

K-3-1. Overview

Table K-1 summarizes the areal extent and duration of work within riffle snaketail habitat for all the remedial alternatives. SED 1 and SED 2 involve no construction in riffle snaketail habitat, while SED 3 through SED 8 impact the entire mapped larval riffle snaketail habitat, which is restricted to the upstream half of Reach 5A. There are just a few backwater areas in this reach, which represent feeding and breeding habitat for adult riffle snaketails.

The remediation activities involved in the floodplain alternatives will affect riffle snaketail habitat by removal of the trees and shrubs needed by adults of this species, with the extent of impact proportional to the extent of clearing. FP 1 involves no clearing. FP 2, FP 3 and FP 5 involve a relatively small area of floodplain, could impact <10% of the Priority Habitat, and are not expected to impact a significant portion of the local

population. FP 4 impacts about 15% of the Priority Habitat for this species; this could be significant if the area to be cleared is high quality habitat for the adults of this species. FP 6 and FP 7 represent greater threats to adults through extensive vegetative clearing and are expected to impact a significant portion of the local population in the Priority Habitat. The combined effects of SED and FP alternatives should be considered in evaluating overall impact.

Table K1. Riffle Snaketail Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Riffle Snaketail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3 – SED 8	5A	18 ac (excavation/capping) 23,059 lf of riverbank (remediation)	Up to 18 ac (adult habitat removal)	8 to 11
FP 1	N/A – No Action	0	0	0
FP 2	5A	4.8 ac (Clearing for remediation)	1.8 ac (Clearing for access) 0.6 ac (Clearing for staging)	1
FP 3	5A	10.5 ac (Clearing for remediation)	2.5 ac (Clearing for access) 1.1 ac (Clearing for staging)	3
FP 4	5A	17.9 ac (Clearing for remediation)	3.5 ac (Clearing for access) 1.5 ac (Clearing for staging)	4
FP 5	5A	10.4 ac (Clearing for remediation)	2.2 ac (Clearing for access) 1.1 ac (Clearing for staging)	4
FP 6	5A	34.3 ac (Clearing for remediation)	2.6 ac (Clearing for access) 2.0 ac (Clearing for staging)	13
FP 7	5A	55.8 ac (Clearing for remediation)	1.0 ac (Clearing for access) 1.3 ac (Clearing for staging)	22

*This species is known to occur only within Reach 5A.
**Impacts under SED remediation work are to riverine and riverbank habitats. Impacts under FP alternatives and access road/staging areas are to floodplain wetland habitats.
***Duration of work figures are for the entire Reach 5A; work within the Priority Habitat portion may be less.

K-3-2. Description of Specific Remediation Activities Relative to Riffle Snaketail Habitat by River Segments

Reach 5A

Priority Habitat for riffle snaketail is found throughout Reach 5A, from the confluence of the East and West Branches to a point just upstream of the Joseph Road housing development off East New Lenox Road. Except for SED 1 and SED 2, which involve no construction activities, all the SED alternatives would involve sediment removal, followed by capping or backfilling, throughout Reach 5A. These activities would impact the entirety of the roughly 11,500 linear feet of river and associated banks and immediately adjacent land area in the upstream half of Reach 5A that are listed as Priority Habitat for the riffle snaketail. Sediment removal will

also remove the larval forms, even at the shallowest depths of planned excavation. Organisms used as food would also be removed. Backfill and capping will bury and kill any remaining larvae. Removal of bank vegetation will adversely alter habitat for emerging and adult riffle snaketails, as the adults need shrubs or trees as roosting sites during early development and between feeding flights. The estimated timeframe for work in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8, but it is expected that all work in the portion of Reach 5A that is habitat for riffle snaketails would be completed in 4 to 5 years. Not all Priority Habitat would be impacted in all years, but with work proceeding in the downstream direction and no habitat in the upstream direction, recolonization during the construction period from unimpacted areas will be greatly constrained and the population will be greatly diminished or eliminated.

Forested or shrubland areas bordering the river are important to the life cycle of the riffle snaketail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives will affect riffle snaketail habitat by removal of the trees and shrubs needed by adults of this species, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no vegetation clearing. FP 2 would involve only a relatively small amount of vegetation removal (Table K1), impacting up to 7.2 acres (5%) of Priority Habitat for this species. The impacted area for FP 3 is 14.1 acres (10%). For FP 4 the impacted area increases to 22.9 acres (15%), while for FP 5 the impacted area declines to 13.7 acres (9%). Under FP 6 and FP 7 the impacted area increases to 38.9 and 58.1 acres (20 and 39% of the Priority Habitat area), respectively.

Access road construction and staging areas also involve clearing of vegetated cover within Reach 5A for SED 3 through SED 8 as well as for FP 2 through FP 8. Any overlap of vegetative clearing with the Priority Habitat zone of the riffle snaketail would affect this species, either directly or through habitat alteration, as adults use trees and shrubs at substantial distance from the stream of origin and could be directly affected by any removal during the summer when adults are present. For SED 3 through SED 8, 11 acres of access road and 7 acres of staging areas would be constructed in association with Reach 5A. Some of this area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 18 acres (12%) of Priority Habitat in Reach 5A.

Reach 5B

The NHESP does not list any riffle snaketail Priority Habitat in Reach 5B.

Reach 5C

The NHESP does not list any riffle snaketail Priority Habitat in Reach 5C.

K-4. Assessment of MESA Issues for Riffle Snaketail

The MESA regulations define “take” at 321 CMR 10.02: “in reference to animals [‘take’] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity….” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for the riffle snaketail is summarized in Table K-2 for the sediment alternatives and Table K-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such

judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table K-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the riffle snaketail. At a minimum, the documented feeding habitat of the larval form of the species would undergo significant alteration as a result of each of the alternatives. Direct removal of larvae during the sediment removal process is unavoidable, and extracting the nymphs from removed sediment is infeasible. Capping of Priority Habitat will also result in a take; the addition of at least 2 ft of backfill is expected to kill any nymphs present. Additional take of adults is expected through tree and shrub removal as part of bank remediation, floodplain remediation, and access construction/staging.

As also shown in Table K-2, SED 3 through SED 8 would impact a significant portion of the local population of riffle snaketails. These alternatives would all affect the entirety of the riffle snaketail habitat. Phasing of the construction activities over the remediation period could allow for temporary refuges and recolonization of restored river areas by riffle snaketails from upstream or downstream areas not yet disturbed, where the substrate is suitable upon completion of the construction, but the rate of construction is expected to cover distances too large each year to allow effective recolonization from the nearest as-yet undisturbed area harboring this species. In any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer. Moreover, the changed character of the banks and adjacent floodplain as a function of vegetative clearing is expected to reduce habitat suitability for adults for many years to come, further limiting recolonization. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable.

As shown in Table K-3, all of the floodplain alternatives except for FP 1 would result in a take of the riffle snaketail. At a minimum, the known shelter and feeding habitat of the adult form of the species (i.e., trees and shrubs) would undergo alteration as a result of each of the alternatives. The floodplain alternatives would have less potential for a direct take (i.e., killing snaketails) than the SED alternatives. However, FP alternatives involving work within the Priority Habitat of the riffle snaketail would adversely affect the feeding and migratory habitat of adults through removal of trees and shrubs. As the loss of woody vegetation cannot be mitigated in a single year, adult habitat would be lost.

The degree of impact of these floodplain alternatives on the local population of riffle snaketails would depend on the extent of vegetation clearing. FP 2, FP 3 and FP 5 involve a relatively small area of floodplain (7.2 to 14.1 acres, or 5 to 10% of the Priority Habitat), and thus sufficient forested habitat would remain for the adults to find other trees in which to roost. As a result, the associated take is not expected to impact a significant portion of the population. FP 4 impacts 22.9 acres, or 15% of the Priority Habitat for this species; this could be significant if the area to be cleared is high quality habitat for the adults of this species. FP 6 and FP 7 represent much greater threats to adults through vegetative clearing (up to 20 and 39% of Priority Habitat, respectively) and would be expected to result in a take of a significant portion of the population within the PSA.

For those alternatives that would involve a take but would not impact a significant portion of the local population (FP 2, FP 3 and FP 5), there do not appear to be any feasible measures that would result in a long-term net benefit. As discussed above for the SED alternatives, there is no additional river area that could become habitat for larval forms for more than a short time; and attempting to extend suitable conditions for this species beyond the current limits would not last, as riverine processes would facilitate erosion and deposition until conditions similar to those found now recurred. In addition, there is no indication that expanded forest area for the adult population would aid this species, particularly if the abundance of larval forms in the river is greatly depressed or even eliminated by riverine remediation under SED 3 through SED 8. In this situation, habitat expansion within Housatonic River corridor area is not a viable approach for this species.

References:

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Merritt, R.W. and K.W. Cummins. 1978. An Introduction to Aquatic Insects of North America. Kendall Hunt Publishers, Dubuque, IA.

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Table K-2: Assessment of MESA Issues for Riffle Snaketail Under Sediment Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take; only monitoring	NA	NA	NA
SED 3 through SED 8	Yes. Excavation of river in Reach 5A would cause a take of larval forms by direct removal and alteration of feeding habitat. Capping of excavated areas would cause a further take of any remaining or immigrating larvae. Additional take of adults, either directly for summer construction work or indirectly through habitat loss, will occur through tree and shrub removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat is in Reach 5A and that entire habitat will be impacted by all these alternatives. Phasing of construction activities will not prevent loss of a significant portion of the population, because the rate of construction would cover distances too large each year to allow effective colonization from the nearest undisturbed area, and in any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table K-3: Assessment of MESA Issues for Riffle Snaketail Under Floodplain Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2, FP 3 & FP 5	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of woody vegetation, which would cause a take.	No. Larval forms would be unaffected, and only a small area of forested habitat would be subject to vegetation removal (7.2 to 14.1 ac, <10% of Priority Habitat) over a one-year period. Adults can find other trees and shrubs in which to roost.	No. Given the nature of the takes that are inherent in these alternatives, a conservation and management plan would not achieve a net benefit for the species. Expansion of woody cover could be fostered over an extended period of years, but would have no significant effect on larval populations, which will limit adults that could use any enhanced habitat for years in the future.
FP 4	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. This alternative would require removal of woody vegetation, which would cause a take.	Possible. Larval forms would be unaffected, but the area of forested habitat that would be subject to vegetation removal (22.9 ac, 15% of Priority Habitat) over a three-year period may result in impacting a significant portion of the local population if that area is high quality habitat for this species.	No, for reasons described for FP 2, 3 and 5 above.

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 6 & FP 7	Yes. Soil removal activities and access road/staging areas would involve woody vegetation removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of woody vegetation, which would cause a take.	Yes. Extensive areas subject to vegetative clearing (38.9 to 58.1 acres, or 20 to 39% of Priority Habitat) are expected to affect adult survival, breeding success, and feeding and migratory activity for a significant portion of the local population.	NA. Since these alternatives would take a significant portion of the local population, a net benefit is not applicable under MESA.

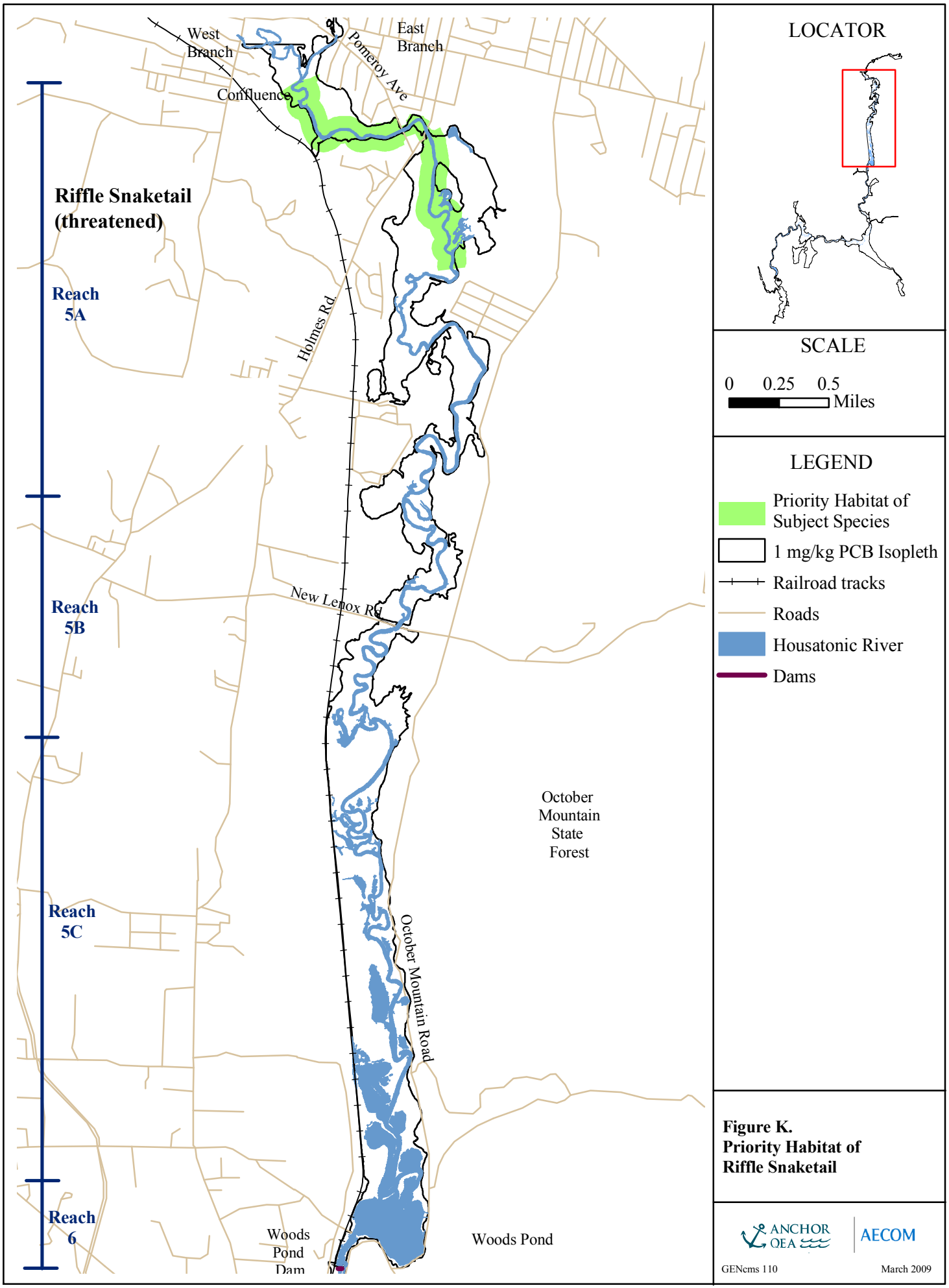

Figure K.
Priority Habitat of Riffle Snaketail

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L. Triangle Floater (*Alasmidonta undulata*)

L. Triangle Floater (*Alasmidonta undulata*) MESA Assessment

L-1. Summary of Species Life Cycle and Habitat Requirements

The triangle floater is a small mussel species that prefers low gradient rivers with flowing water and sand and gravel substrate, but it can be found in lentic (lake) habitats as well, and can survive in a wide variety of substrate types (Nedeau et al. 2000, NHESP 2007). It is a state-listed Species of Special Concern under the Massachusetts Endangered Species Act (MESA) (NHESP 2008). As sedentary filter feeders, triangle floaters remove particles from passing water and digest the organic matter. Reproduction involves fertilization through sperm released by males and taken in along with food in the filtering process by females during summer, with parasitic larvae (glochidia) produced the following spring. The glochidia must attach to a vertebrate host, in this case multiple common fish species (including sunfish, bass, shiners, dace and suckers), where they grow and eventually drop off to develop into adults on the bottom. Young, small mussels may remain buried most of the time, while older, larger specimens are normally found protruding from the sediment or wedged between rocks. Mobility is minimal after the glochidia stage. Individuals are believed to live for 8 to 20 years in Massachusetts.

L-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the triangle floater occurs within the PSA in Reach 5A, extending about 28,230 feet downstream from the confluence of the east and west branches, beyond Holmes Road to a point near the Joseph Road housing development off East New Lenox Road (shown in Figure L at the end of this section). This species has a clear preference for packed gravel areas, which are relatively rare in the PSA and restricted to the upstream half of Reach 5A. The Woodlot Alternatives (2002) ecological characterization of the PSA confirmed the presence of this species; however, only a few individuals of the triangle floater have been found in the Housatonic River. The area of Priority Habitat associated with Reach 5A is about 173 acres, although this includes some bank and adjacent land that would not actually be usable by this species. This is an obligate aquatic species, being found only in the river itself and not using the banks or adjacent land in any stage of its life cycle. The riverine portion of the listed Priority Habitat area is approximately 22 acres. Additionally, the portion of the Priority Habitat that is actually within the PSA is only 119 acres. The triangle floater is not known to occur in Reaches 5B, 5C, or 6, or in any of the backwater or floodplain areas.

L-3. Impacts of Remedial Alternatives on Triangle Floater Habitat

L-3-1. Overview

Table L-1 summarizes the areal extent and duration of work within triangle floater habitat for all the remedial alternatives. SED 1 and SED 2 involve no construction in triangle floater habitat, while SED 3 through SED 8 involve extensive activity over the entire habitat of this species, which is restricted to the upstream half of Reach 5A. SED 3 through SED 8 impact all triangle floaters known for this river reach by activities in the main channel of the river.

Floodplain remediation activities have the potential to alter riverine habitat through sedimentation and loss of shading. Likewise, construction of access roads and staging areas represent an indirect threat to the triangle floater. FP 2, FP 3 and FP 5 involve relatively small areas of triangle floater Priority Habitat. FP 6 and FP 7 involve the clearing of large areas and would likely significantly impact triangle floaters. FP 4 involves an intermediate level of disturbance. The combined effects of SED and FP alternatives should be considered in evaluating overall impact.

Table L-1. Triangle Floater Habitat Alterations, by Remedial Alternative.

Remedial Alternative	Reach with Affected Habitat*	Description of Triangle Floater Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3 – SED 8	5A	22 ac (excavation/capping) 28,237 lf of riverbank (remediation)	Up to 20 ac (possible sedimentation and lighting/temperature changes)	8 to 11
FP 1	N/A – No Action	0	0	0
FP 2	5A	6.1 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	2.4 ac (possible sedimentation and lighting/temperature changes)	1
FP 3	5A	13.0 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	3.7 ac (possible sedimentation and lighting/temperature changes)	3
FP 4	5A	22.8 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	5.4 ac (possible sedimentation and lighting/temperature changes)	4
FP 5	5A	13.9 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	4.0 ac (possible sedimentation and lighting/temperature changes)	4
FP 6	5A	42.0 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	4.8 ac (possible sedimentation and lighting/temperature changes)	13
FP 7	5A	67.1 ac (possible sedimentation and lighting/temperature changes from remediation habitat impacts)	2.7 ac (possible sedimentation and lighting/temperature changes)	22

*This species is known to occur only within Reach 5A.
**Impacts under SED remediation work are to riverine and riverbank habitats. Impacts under FP alternatives and access road/staging areas are to floodplain wetland habitats.
***Duration of work figures are for the entire Reach 5A; work within the Priority Habitat portion may be less.

L-3-2. Description of Specific Remediation Activities Relative to Triangle Floater Habitat by River Segments

Reach 5A

Priority Habitat for triangle floater is found in the upstream half of Reach 5A, from the confluence of the East and West Branches to a point near the Joseph Road housing development off East New Lenox Road. Except for SED 1 and SED 2, which involve no construction activities, all the SED alternatives would involve sediment removal, followed by capping or backfilling, throughout Reach 5A. These activities would impact the entirety of the roughly 14,100 linear feet of river in Reach 5A mapped as Priority Habitat for the triangle floater. Sediment removal will also remove the adult forms, even at the shallowest depths of planned excavation. Backfill and capping will bury and kill any remaining mussels, Removal of bank vegetation will promote sedimentation and reduce shade for the river, which could affect the mussels. The estimated timeframe for work in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8, but it is expected that all work in the portion of Reach 5A that is habitat for triangle floaters would be completed in less time. Not all Priority Habitat would be impacted in all years, but the entire area listed as triangle floater habitat would be altered in too short a time period to allow recolonization from unimpacted area within the Priority Habitat. Very few triangle floaters have been found in the PSA; the loss of any would be considered significant.

Forested or shrubland areas bordering the river are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives may affect triangle floater habitat by removal of vegetation and induction of sedimentation, with the extent of potential impact proportional to the extent of clearing. Sedimentation, temperature changes, and related water quality and food alterations within the river may accompany work in the floodplain. FP 1 involves no clearing and FP 2 would involve only a small amount of disturbance (Table L-1), about 8.5 acres or 5% of the Priority Habitat within the PSA. Impacted area in the floodplain increases in FP 3 (16.6 acres, 10%) and FP 4 (28.2 acres, 16%), then decreases in FP 5 (17.8 acres, 10%), and increases markedly in FP 6 (46.9 acres, 27%) and FP 7 (69.8 acres, 40%).

Access road construction and staging areas also involve clearing of vegetated cover within Reach 5A for SED 3 through SED 8 as well as for FP 2 through FP 8. Any overlap of vegetative clearing with the Priority Habitat of the triangle floater could represent a take through habitat alteration, if riverine conditions are affected such that triangle floater habitat is reduced. For SED 3 through SED 8, up to 20 acres of access road and staging areas would be constructed in association with Reach 5A. Some of this may overlap with activity in the FP alternatives, but could affect up to 12% of additional Priority Habitat.

Reach 5B

The NHESP does not list any triangle floater Priority Habitat in Reach 5B.

Reach 5C

The NHESP does not list any triangle floater Priority Habitat in Reach 5C.

L-4. Assessment of MESA Issues for Triangle Floater

The MESA regulations define “take” at 321 CMR 10.02: “in reference to animals [‘take’] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity….” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and

that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the triangle floater is summarized in Table L-2 for the sediment alternatives and Table L-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table L-2, all of the SED alternatives except for SED 1 and SED 2 would result in a take of the triangle floater. The documented habitat of the species would undergo significant alteration as a result of SED 3 through SED 8. Direct removal of mussels present during the sediment removal process is unavoidable, and extracting the mussels from removed sediment is infeasible. Direct removal of adults during the sediment removal process might be avoided by relocating visible triangle floaters prior to excavation, but younger mussels may not be visible, and it is unlikely that suitable habitat can be found for relocated mussels. Excavation of the river in Reach 5A under SED 3 through SED 6 would involve removal of the top two feet of the river bottom sediments, affecting any mussels not relocated and the fish that host the glochidia (larval) stage. Impacts are functionally the same for SED 7 and SED 8 despite the deeper excavation of those alternatives (up to four feet deep), as this species does not burrow especially deep. Capping of excavated areas would result in a further take, since the addition of at least 2 ft of backfill is expected to kill any remaining mussels present

As also shown in Table L-2, it is anticipated that SED 3 through SED 8 would impact a significant portion of the local population. These alternatives would all affect the entirety of the triangle floater habitat. Phasing of the construction activities over the remediation period would not allow for temporary refuges and recolonization of restored river areas by triangle floaters from upstream or downstream areas not yet disturbed; there are too few triangle floaters in the river, and the life cycle requires access to fish for the larval stage to move any significant distance. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable.

As shown in Table L-3, all of the floodplain alternatives except for FP 1 could result in a take of the triangle floater through habitat alteration. The floodplain alternatives would not cause a direct take (i.e., killing mussels), but FP alternatives involving work within the Priority Habitat of the triangle floater could adversely affect the feeding and breeding habitat of adults through sedimentation and loss of shading. The potential for impact increases with increased clearing. FP 2, FP 3 and FP 5 involve 5%, 10% and 10% of the Priority Habitat, respectively, and then only outside the actual area habitable by the mussels; with proper construction techniques, a take of significant percentage of the local mussel population is not expected under these alternatives. FP 4 affects 16% of the Priority Habitat. It is possible that sufficient sedimentation impacts could occur at that level of disturbance to affect a significant portion of the population. FP 6 and FP 7 impact 27% and 40% of the Priority Habitat, respectively. Impacts from sedimentation on the in-stream habitat are expected at that level of disturbance and a take of a significant portion of the population is expected.

For those FP alternatives that could involve a take but would not impact a significant portion of the local population (FP 2, FP 3 and FP 5, possibly FP 4), potential conservation and management measures are unlikely to provide an overall net benefit to this species. Based on review of the literature, specific habitat management measures to enhance conditions for this species are unknown and untested. The SED alternatives will severely impact the existing population, independent of any FP activities. Given the small population despite suitable existing habitat, the establishment of a net benefit through floodplain habitat enhancement or alteration appears highly unlikely.

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NHESP. 2008. Natural Heritage Endangered Species Program database of protected species. Westborough, MA.

Nedeau, E.J., M.A. McCullough and B.I. Swartz. 2000. The Freshwater Mussels of Maine. ME Dep. Inland Fisheries and Wildlife, Augusta, ME.

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Table L-2: Assessment of MESA Issues for Triangle Floater Under Sediment Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would Take Occur?	Could Take Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take; only monitoring	NA	NA	NA
SED 3 through SED 8	Yes. Excavation of river in Reach 5A would cause a take of mussels by direct removal and alteration of habitat. Capping of excavated areas would cause a further take of any remaining mussels. Additional take of adults could occur during bank remediation and access construction, but could be minimized with proper planning.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation, presence of mussels at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat is in Reach 5A and that entire habitat will be impacted by these SED alternatives. The population is so small that any loss of triangle floaters would be considered to impact a significant portion of the local population.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table L-3: Assessment of MESA Issues for Triangle Floater Under Floodplain Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2, FP 3 & FP 5	Possibly. Soil removal activities and access road/staging areas would involve vegetative clearing of a small portion of Priority Habitat. This could adversely affect the breeding and feeding habitat of adults (a take) through sedimentation and loss of shading.	Possibly. Exercise of proper erosion controls and limiting removal of any floodplain trees that currently shade the river in areas of triangle floater habitat might avoid a take.	No. Clearing within Reach 5A floodplain associated with these alternatives should have limited indirect impact on prime in-stream Priority Habitat and is unlikely to affect a significant portion of local population.	No. Given the currently small population despite apparently suitable habitat, the absence of known and tested management strategies for this species, and the severe impacts of the SED alternatives on the existing population independent of these FP alternatives, a conservation and management plan would not provide a long-term net benefit to this species.
FP 4	Possibly. Soil removal activities and access road/staging areas would involve vegetative clearing of a moderate portion (29 acres) of Priority Habitat. This could adversely affect the breeding and feeding habitat of adults (a take) through sedimentation and loss of shading.	Unlikely. Given extent of floodplain removals, it is unlikely any take resulting from habitat alteration due to tree removal could be avoided.	Possibly. Clearing within Reach 5A floodplain is extensive enough (17%) that resulting alteration of in-stream triangle floater habitat might affect significant portion of local population.	No, for same reasons given above for FP 2, 3 and 5, or not applicable if the impact is to a significant portion of the local population.

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 6 & FP 7	Yes. Soil removal activities and access road/staging areas would involve vegetative clearing of a large portion (42 to 61 acres) of Priority Habitat. This would be expected to adversely affect the breeding and feeding habitat of adults (a take) through sedimentation and loss of shading.	No. The impacted area is large enough to that impacts on the in-stream portion of Priority Habitat could not be avoided.	Yes. The impacted area is 27% to 40% of listed Priority Habitat. The clearing of this area is large enough that the resulting alteration of in-stream habitat would be expected to impact a significant portion of the local population.	NA, since the impact is to a significant portion of the local population.

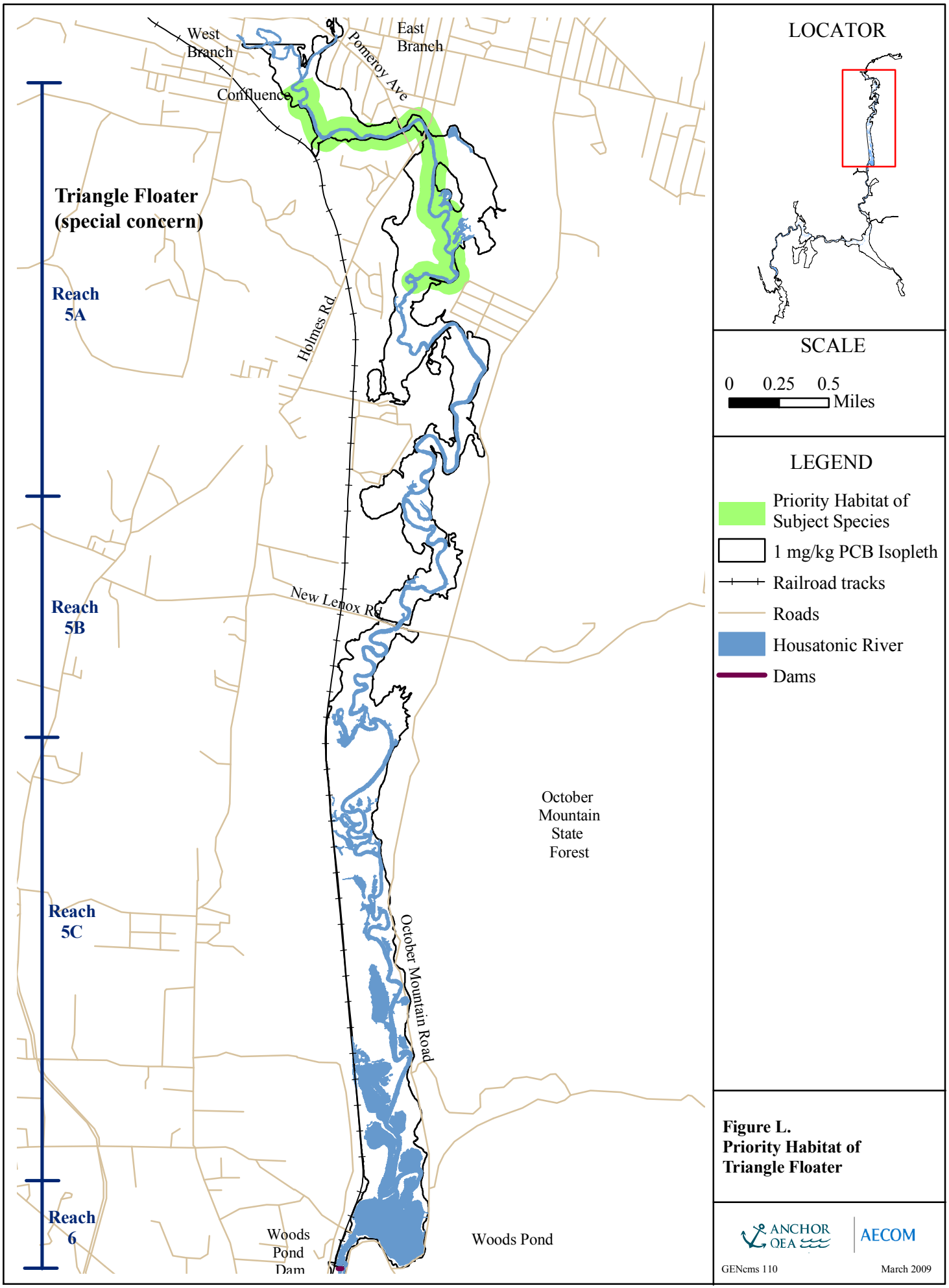

Figure L.
Priority Habitat of Triangle Floater

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M. Zebra Clubtail (*Stylurus scudderi*)

M. Zebra Clubtail (*Stylurus scudderi*) MESA Assessment

M-1. Summary of Species Life Cycle and Habitat Requirements

The zebra clubtail is a dragonfly of the family Gomphidae, which are nearly all burrowers and predators. It is a state-listed Species of Special Concern under the Massachusetts Endangered Species Act (MESA) (NHESP 2008). The larvae of the zebra clubtail prefer silty to sandy substrates in running water, with a moderate oxygen requirement and usually near-neutral to slightly basic pH (Hart and Fuller 1974, Merritt and Cummins 1978, NHESP 2007). Larvae are found near the surface of the sediment (within the upper inch), where they develop over at least a year-long period, possibly two to three years. Larvae are ambush predators, attacking passing invertebrates or even small fish from the substrate. When ready to emerge as adults, typically in early July, larvae climb onto the river bank, sometimes using exposed rocks, emergent woody debris, or emergent vegetation, the exoskeleton splits, and adults emerge. After the wings adequately unfurl and dry, the adult zebra clubtail flies into adjacent woodland to hide in the trees and continue to develop. Short feeding flights result in the capture of small insects. After one to several weeks, adults return to the stream to both feed and mate. This family is mainly "short flight" species; they need substantial perching places, usually woody debris, live woody plants, and rocks, as they move along the stream. Gravid females lay eggs singly or in small clusters by touching their abdomens to the water surface, normally in July into September. The eggs incubate over one to two weeks and hatch into larvae which re-initiate the life cycle. Adults may live out the rest of the summer far from the stream, often in dense woodland.

M-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the zebra clubtail occurs within the PSA throughout Reaches 5A, 5B and 5C, from the confluence of the East and West Branches to the inlet of Woods Pond, but does not include Reach 6, Woods Pond (shown in Figure M at the end of this section). The Woodlot Alternatives (2002) ecological characterization of the PSA confirmed the presence of this species. The area of Priority Habitat associated with Reach 5A is 352 acres, while that for Reach 5B is 198 acres and that for Reach 5C is 362 acres, for a total of 912 acres. However, the portion of the Priority Habitat that is actually within the PSA is only 701 acres. The areal extent of the larval habitat includes the main stem of the river, plus the banks for eclosion (emergence as adults). The areal extent of adult habitat is broader and includes the main stem of the river, backwaters, floodplain and some adjacent upland forests or scrubland. The NHESP Priority Habitat designation extends into these areas to some extent. Adults can actually be found further from the river at times, but any additional range is not evaluated in this assessment. This species needs large trees in the adult stage, so areas where the stream corridor is densely forested offer the best habitat for this species.

M-3. Impacts of Remedial Alternatives on Zebra Clubtail Habitat

M-3-1. Overview

Table M-1 summarizes the areal extent and duration of work within zebra clubtail habitat for all the remedial alternatives. SED 1 and SED 2 involve no construction in zebra clubtail habitat, while SED 3 through SED 8 involve increasing activity within that habitat. SED 3 will affect approximately 58% of the larval zebra clubtail habitat, the main channel of the river. SED 4 through SED 8 impact all larval zebra clubtail habitat. Backwaters are not a major larval habitat, as larvae prefer flowing water, but backwaters do represent feeding and breeding areas for adults and are included as impacted areas under the SED alternatives.

Table M-1. Zebra Clubtail Habitat Alterations, by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Zebra Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A	41 ac (excavation/capping) 55660 lf of riverbank (remediation)	Up to 40 ac (adult habitat removal)	8
	5B	27976 lf of riverbank (remediation)	Up to 21 ac (adult habitat removal)	<1
	5C	23 ac (thin-layer capping)	<1 ac (adult habitat removal)	1
SED 4	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	11 ac (excavation/capping) 27976 lf of riverbank remediation 17 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	3
	5C	70 ac (thin-layer capping) 23 ac (engineered capping)	Up to 9 ac (adult habitat removal)	2
SED 5	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	25 ac (excavation/capping) 27976 lf of riverbank remediation 2 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	5
	5C	21 ac (excavation/capping) 49 ac (thin-layer capping) 23 ac (engineered capping)	Up to 12 ac (adult habitat removal)	2
SED 6	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	8
	5B	25 ac (excavation/capping) 27976 lf of riverbank remediation 7 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	5
	5C	53 ac (excavation/capping) 39 ac (thin-layer capping)	Up to 2 ac (adult habitat removal)	4
SED 7	5A	42 ac (excavation/capping) 55660 lf of riverbank (remediation) 3 ac (thin-layer capping)	Up to 40 ac (adult habitat removal)	9
	5B	29 ac (excavation/capping) 27976 lf of riverbank remediation 3 ac (thin-layer capping)	Up to 21 ac (adult habitat removal)	6
	5C	64 ac (excavation/capping) 27 ac (thin-layer capping)	Up to 2 ac (adult habitat removal)	4

Remedial Alternative	Reach with Affected Habitat	Description of Zebra Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 8	5A 5B 5C	45 ac (excavation/capping) 55660 lf of riverbank (remediation) 34 ac (excavation/capping) 27976 lf of riverbank remediation 104 ac (excavation/capping)	Up to 40 ac (adult habitat removal) Up to 21 ac (adult habitat removal) Up to 2 ac (adult habitat removal)	11 6 10
FP 1	N/A – No Action	0	0	0
FP 2	5A 5B 5C	7.4 ac Clearing for remediation 0.8 ac Clearing for remediation 0.4 ac Clearing for remediation	2.3 ac Clearing for access roads 1.0 ac Clearing for staging areas 2.3 ac Clearing for access roads 0.3 ac Clearing for staging areas 1.4 ac Clearing for access roads 0.6 ac Clearing for staging areas	1
FP 3	5A 5B 5C	20 ac Clearing for remediation 7.9 ac Clearing for remediation 6.0 ac Clearing for remediation	6.6 ac Clearing for access roads 3.0 ac Clearing for staging areas 2.4 ac Clearing for access roads 1.4 ac Clearing for staging areas 3.0 ac Clearing for access roads 0.8 ac Clearing for staging areas	3
FP 4	5A 5B 5C	36 ac Clearing for remediation 14.4 ac Clearing for remediation 10.3 ac Clearing for remediation	7.8 ac Clearing for access roads 4.1 ac Clearing for staging areas 5.1 ac Clearing for access roads 3.5 ac Clearing for staging areas 3.5 ac Clearing for access roads 1.8 ac Clearing for staging areas	4

Remedial Alternative	Reach with Affected Habitat	Description of Zebra Clubtail Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
FP 5	5A 5B 5C	25.3 ac Clearing for remediation 10.1 ac Clearing for remediation 15.8 ac Clearing for remediation	4.9 ac Clearing for access roads 2.4 ac Clearing for staging areas 2.7 ac Clearing for access roads 2.4 ac Clearing for staging areas 5.5 ac Clearing for access road 1.7 ac Clearing for staging areas	4
FP 6	5A 5B 5C	75.4 ac Clearing for remediation 48.0 ac Clearing for remediation 40.7 ac Clearing for remediation	5.9 ac Clearing for access roads 3.7 ac Clearing for staging areas 3.5 ac Clearing for access roads 2.8 ac Clearing for staging areas 5.4 ac Clearing for access roads 3.5 ac Clearing for staging areas	13
FP 7	5A 5B 5C	130 ac Clearing for remediation 61.8 ac Clearing for remediation 61.6 ac Clearing for remediation	2.6 ac Clearing for access roads 3.8 ac Clearing for staging areas 2.9 ac Clearing for access roads 2.2 ac Clearing for staging areas 3.9 ac Clearing for access roads 4.0 ac Clearing for staging areas	22

Forested areas bordering the river are important to the life cycle of the zebra clubtail, and are included in the NHESP Priority Habitat designation. Remediation activities in the floodplain alternatives would affect zebra clubtail habitat by removal of the large trees needed by adults, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no tree clearing, while FP 2 through FP 5 would involve a range of tree removal that is not expected to significantly affect arrow clubtail unless the specific areas cleared of trees have exceptionally high habitat value and nearby remaining trees are not suitable. FP 6 and FP 7 affect much larger areas and would likely significantly affect this species and its habitat. The combined effects of SED and FP alternatives should be considered in evaluating overall impact.

M-3-2. Description of Specific Remediation Activities Relative to Zebra Clubtail Habitat by River Segments

Reach 5A

Priority Habitat for zebra clubtail is found throughout Reach 5A, from the confluence of the East and West Branches to the Pittsfield WWTF discharge. Except for SED 1 and SED 2, which involve no construction activities, all the SED alternatives would involve sediment removal, followed by capping or backfilling, throughout Reach 5A. These activities would impact the entirety of the roughly 27,830 linear feet of river and associated banks and immediately adjacent land area in Reach 5A that are listed as Priority Habitat for the zebra clubtail. Sediment removal will also remove the larval forms, even at the shallowest depths of planned excavation. Organisms used as food would also be removed. Backfill and capping will bury and kill any remaining larvae, although the resulting surficial substrate would be suitable for recolonization by zebra clubtail if any remain to repopulate remediated areas. Removal of bank vegetation will adversely alter habitat for emerging and adult zebra clubtails; loss of mature trees is especially damaging, as the adults need these as roosting sites during early development and between feeding flights. The estimated timeframe for work in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

Forested areas bordering the river are important to the life cycle of the zebra clubtail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives will affect zebra clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of tree clearing for access, staging and remediation. FP 1 involves no tree clearing. FP 2 would involve only a relatively small amount of tree removal (Table M1), impacting up to 10.7 acres (3%) of Priority Habitat for this species. The impacted area for FP 3 is 29.6 acres (8%). For FP 4 the impacted area increases to 47.9 acres (14%), while for FP 5 the impacted area declines slightly to 32.6 acres (9%). Under FP 6 and FP 7, the impacted area increases to 85 and 136 acres (24 and 39% of Priority Habitat area), respectively. Tree clearing would represent a threat to a significant portion of adult zebra clubtails in Reach 5A for FP 6 and FP 7, and possibly for FP 4 if tree clearing is not minimized.

Access road construction and staging areas also involve clearing of forested cover within Reach 5A for SED 3 through SED 8 as well as for FP 2 through FP 8. Any overlap of forest clearing with the Priority Habitat zone of the zebra clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3 through SED 8, 26 acres of access road and 14 acres of staging areas would be constructed in association with Reach 5A. Some of this area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 40 acres (11%) of Priority Habitat in Reach 5A.

Reach 5B

Priority Habitat for zebra clubtail is found throughout Reach 5B, from the Pittsfield WWTF discharge to slightly downstream of New Lenox Road. All the sediment alternatives except for SED 1 and SED 2 would impact this habitat. SED 4 would involve a combination of removal and thin-layer capping in this reach, and SED 5 through SED 8 would involve sediment removal followed by capping or backfilling throughout this reach. Direct removal of larval forms (nymphs) is unavoidable, and alteration of sediment features may reduce habitat suitability. While SED 3 would not involve in-river remediation in this reach, it would involve riverbank removal and stabilization. SED 4 through SED 8 would also include such riverbank remediation. This remediation will require considerable tree removal on the banks down to New Lenox Road, reducing essential habitat for adults. South of New Lenox Road, the amount of trees on the riverbank diminishes considerably, but the value of individual trees therefore increases for adults of this species, so losses by clearing remain important. In total, SED 4 through SED 8 would impact the entirety of the roughly 14,000 linear feet of river

and associated banks and immediately adjacent land area in Reach 5B that are listed as Priority Habitat for the zebra clubtail, while SED 3 would impact the riverbanks in this reach. The estimated timeframe for work in Reach 5B is less than 1 year for SED 3**,** 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

As noted above, forested areas bordering the river are important to the life cycle of the zebra clubtail, and are included in the NHESP Priority Habitat designation. The remediation activities involved in the floodplain alternatives would affect zebra clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of clearing for access, staging and remediation. FP 1 involves no tree clearing. FP 2 would involve only a small amount of tree removal (Table M1), impacting up to 3.4 acres (2%) of Priority Habitat for this species. The impacted area for FP 3 is 11.7 acres (6%). For FP 4 the impacted area increases to 23 acres (12%), while for FP 5 the impacted area declines to 15.2 acres (8%). Under FP 6 and FP 7, the impacted area increases to 54.3 and 66.9 acres (27 and 34% of Priority Habitat area), respectively. Tree clearing would represent a threat to a significant portion of adult zebra clubtails in Reach 5B for FP 6 and FP 7, and possibly for FP 4 if tree clearing is not minimized.

Access road construction and staging areas also involve clearing of forested cover within Reach 5B for SED 3 through SED 8 as well as for FP 2 through FP 8. As in Reach 5A, any overlap of forest clearing with the Priority Habitat zone of the zebra clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3 through SED 8, 15 acres of access road and 6 acres of staging areas would be constructed in association with Reach 5B. Some of this area may overlap with FP alternative sites for access roads and staging areas, but there is potential for this activity to impact up to 21 acres (11%) of Priority Habitat in Reach 5B.

Reach 5C

Priority Habitat for zebra clubtail is found throughout Reach 5C, from slightly downstream of New Lenox Road to the inlet to Woods Pond. In addition to the flowing portion of the river channel, there are significant backwater areas in Reach 5C, sometimes separated into a Reach 5D but considered part of Reach 5C in this analysis. Backwaters are not considered habitat for larval stages, which prefer flowing water, but would be viable feeding and mating areas for the adults. Except for SED 1 and SED 2, all the SED alternatives would have some impact on the zebra clubtail habitat in this reach. SED 3 would involve thin-layer capping in the downstream-most half of Reach 5C (23 acres); SED 4 would involve a combination of engineered capping (23 acres) and thin-layer capping (70 acres) in this reach; SED 5 would involve a combination of removal (21 acres), engineered capping (23 acres) and thin-layer capping (49 acres); and SED 6 through SED 8 would involve removal followed by capping or backfilling throughout this reach (104 acres over about 23,000 linear feet). However, no riverbank excavation is planned in this reach.

The impacts of all removal activities in SED 5 through SED 8 are functionally similar; nymphs are found near the sediment surface and would be removed in any sediment removal scenario. The short-term impacts of capping or backfilling includes killing any larvae present through burial and smothering. Longer term effects will depend on the nature of the material used; sand should be a suitable substrate for recolonization by zebra clubtails, but gravel would not support this species.

Overall, SED 4 through SED 8 would impact the entirety of the roughly 23,000 linear feet of river in this reach that are listed as Priority Habitat for the zebra clubtail, and SED 3 would impact approximately 10,000 linear feet of river listed as Priority Habitat. The estimated timeframe for work in Reach 5C and the backwaters is about 1 year for SED 3, 2 years for SED 4 and SED 5, 4 years for SED 6 and SED 7, and 10 years for SED 8. Not all Priority Habitat would be impacted in all years, but at expected remediation construction rates (a substantial length of riverine habitat each year), recolonization of disturbed areas from the closest undisturbed areas will be limited.

As noted above, forested areas bordering the river are important to the life cycle of the zebra clubtail, and are included in the NHESP Priority Habitat designation. In general, forested cover immediately bordering the river is considerably less in Reach 5C than north of New Lenox Road, but those forested areas that are present are very valuable as adult habitat. The remediation activities involved in the floodplain alternatives would affect zebra clubtail habitat by removal of the trees needed by adults of this species, with the extent of impact proportional to the extent of clearing. FP 1 involves no tree clearing. FP 2 through FP 5 may require no tree cutting in Reach 5C; 2.4 to 23 acres would be subject to some vegetative clearing (representing <1 to 6% of the Priority Habitat in this reach), but trees might be avoided in this more open area. Under FP 6 and FP 7 the impacted area increases to 49.6 and 69.5 acres (14 and 19% of Priority Habitat), respectively. Tree clearing is a threat to adult zebra clubtails in Reach 5C for FP 6 and FP 7; with 30 to 40 acres of impacts to forested areas involved within Reach 5C, avoidance of tree clearing is not practicable.

Access road construction and staging areas also involve clearing of forested cover within Reach 5C for SED 3 through SED 8 as well as for FP 2 through FP 8. As in the more upstream reaches, any overlap of forest clearing with the Priority Habitat zone of the zebra clubtail would impact this species, either directly or through habitat alteration, as adults use trees at substantial distance from the stream of origin and could be directly affected by any tree removal during the summer when adults are present. For SED 3, less than 1 acre of access road and no staging areas would be constructed in association with Reach 5C. For SED 4, 2 acres of access road and 7 acres of staging areas would be constructed, nearly all of which overlap with zebra clubtail Priority Habitat. For SED 5, 2 acres of access road and 10 acres of staging areas would be constructed, nearly all of which overlap with zebra clubtail Priority Habitat. For SED 6, SED 7 and SED 8, only 1 acre of access road and 1 acre of staging areas would be constructed, all of which overlap with zebra clubtail Priority Habitat. Overall, no more than 3% of the Priority Habitat in Reach 5C would be threatened by this activity.

M-4. Assessment of MESA Issues for Zebra Clubtail

The MESA regulations define “take” at 321 CMR 10.02: “in reference to animals [‘take’] means to harass, harm, pursue, hunt, shoot, hound, kill, capture, collect, process, disrupt the nesting, breeding, feeding, or migratory activity….” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for the zebra clubtail is summarized in Table M-2 for the sediment alternatives and Table M-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), if such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table M-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the zebra clubtail. At a minimum, the documented feeding habitat of the larval form of the species would undergo significant alteration as a result of each of the alternatives. Direct removal of larvae during the sediment removal process is unavoidable, and extracting the nymphs from removed sediment is infeasible. Capping of Priority Habitat will also result in a take; even thin-layer capping, adding about 6 inches of sand to existing substrate, is expected to kill any nymphs present. Under SED 3, Reach 5B and the upstream half of Reach 5C would not be disturbed, but for SED 4 through SED 8, all riverine Priority Habitat for the zebra clubtail will be affected. Additional take of adults is expected through tree removal as part of bank remediation in Reaches 5A and 5B and floodplain remediation and access construction/staging in all three portions of Reach 5.

As also shown in Table M-2, SED 3 through SED 8 would all impact a significant portion of the local population of zebra clubtails in the PSA. As noted above, these alternatives would affect the majority (SED 3) or all (SED 4 – SED 8) of the zebra clubtail habitat. Phasing of the construction activities over the remediation period could allow for temporary refuges and recolonization of restored river areas by zebra clubtails from upstream or downstream areas not yet disturbed, where the substrate is suitable upon completion of the construction, but the rate of construction is expected to cover distances too large each year to allow effective colonization from the nearest undisturbed area harboring this species. In any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer. Moreover, the changed character of the banks and adjacent floodplain and forested areas as a function of tree clearing is expected to reduce habitat suitability for adults for many years to come, further limiting recolonization. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable.

As shown in Table M-3, all of the floodplain alternatives except for FP 1 would result in a take of the zebra clubtail. At a minimum, the known shelter and feeding habitat of the adult form of the species (i.e., trees) would undergo alteration as a result of each of the alternatives. The floodplain alternatives would have less potential for a direct take (i.e., killing zebra clubtails) than the sediment alternatives. However, FP alternatives involving work within the Priority Habitat of the zebra clubtail would adversely affect the feeding and migratory habitat of adults through removal of trees. Avoidance of tree cutting would reduce the impact of the FP alternatives on this species.

The impact of these floodplain alternatives on the local population of zebra clubtails would thus depend on the extent of tree clearing. FP 2 through FP 5 involve a relatively small area of floodplain (16.5 to 86.4 acres, or 2 to 9% of the Priority Habitat), and thus sufficient forested habitat would remain for the adults to find other trees in which to roost. As a result, the associated take is not expected to impact a significant portion of the local population. FP 6 and FP 7 represent much greater threats to adults through tree cutting (up to 21 and 30% of Priority Habitat, respectively) and would be expected to result in an impact on a significant portion of the population in the PSA**.**

For those alternatives that would involve a take but would not impact a significant portion of the local population (FP 2 through FP 5), conservation and management measures would not result in a long-term net benefit to this species. There is no additional river area that could become habitat for larval forms, and the tree cover is currently adequate to support the riverine population. Thus, there is no indication that expanding the forest area would aid this species, particularly if the abundance of larval forms in the river is greatly depressed or even eliminated by riverine remediation under SED 3 through SED 8. In this situation, habitat expansion within the Housatonic River corridor area is not a viable approach for this species. In short, given the high quality of the existing habitat and limits on its expansion, a long-term net benefit plan involving floodplain habitat enhancement or expansion would not provide long-term net benefit to this species.

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Table M-2: Assessment of MESA Issues for Zebra Clubtail Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take; only monitoring	NA	NA	NA
SED 3	Yes. Excavation of river in Reach 5A would cause a take of larval forms by direct removal and alteration of feeding habitat. Capping of excavated areas would cause a further take of any remaining or immigrating larvae. Thin-layer capping in Reach 5C will harm additional larvae. Additional take of adults, either directly in summer construction work or indirectly through habitat loss, will occur through tree removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat in Reaches 5A and half the Priority Habitat in Reach 5C will be impacted. Phasing of construction activities will not prevent loss of a significant portion of the population, because the rate of construction would cover distances too large each year to allow effective colonization from the nearest undisturbed area, and in any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 4 through SED 8	Yes. Combination of excavation and thin-layer or engineered capping of river in Reaches 5A, 5B and 5C would cause a take of larval forms by direct removal and alteration of feeding habitat throughout the Priority Habitat within the PSA. Additional take of adults is expected through tree removal as part of bank remediation and access construction.	No. Due to direct overlap of Priority Habitat with areas targeted for excavation and backfill, presence of larval stages at all times, and duration of remediation, there would be no feasible means of modifying or scheduling the work to avoid a take.	Yes. All Priority Habitat within the PSA will be impacted. Phasing of construction activities will not prevent loss of a significant portion of the population, because the rate of construction would cover distances too large each year to allow effective colonization from the nearest undisturbed area, and in any event, substrate suitability after construction will be low where gravel/rock is used as the upper layer.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table M-3: Assessment of MESA Issues for Zebra Clubtail Under Floodplain Alternatives

Alternative	Assessment of Take		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would Take Occur?	Could Take Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2 through FP 5	Yes. Soil removal activities and access road/staging areas would involve tree removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of trees, which would cause a take.	No. Larval forms would be unaffected, and only a relatively small portion of forested habitat would be subject to potential tree removal (<10% of the Priority Habitat area). Sufficient forest area will remain for adults to find other trees in which to roost.	No. Conservation measures such as expansion of tree cover could be fostered over an extended period of years, but would have no significant effect on larval populations, which will limit adults that could use the enhanced habitat years in the future. Therefore, a conservation and management plan would not provide overall net benefit to the species.
FP 6 & FP 7	Yes. Soil removal activities and access road/staging areas would involve tree removal and a related take of adults. This take would include harassment and disruption of the feeding and migratory activity of adults. Direct mortality of adults could also occur during vegetation clearing during the summer.	No. These alternatives would require removal of trees, which would cause a take.	Yes. Extensive areas subject to tree removal (189 to 272 acres within Priority Habitat, or 21 to 30%) are expected to affect adult survival, breeding success, and feeding and migratory activity for a significant portion of the local population.	NA. Since these alternatives would impact a significant portion of the local population, a net benefit is not applicable under MESA.

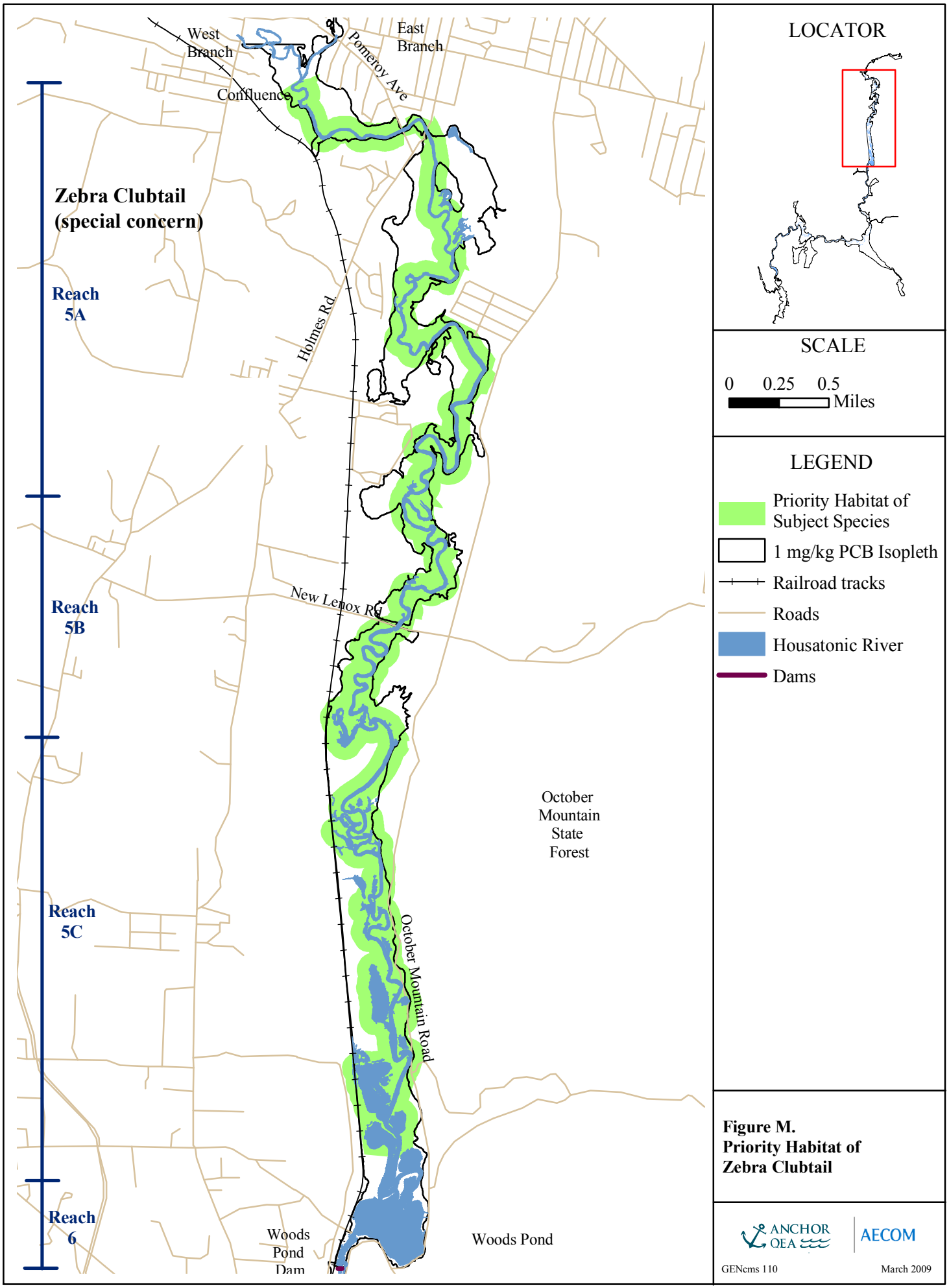

Figure M.
Priority Habitat of Zebra Clubtail

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N. Bristly Buttercup (*Ranunculus pensylvanicus*)

N. Bristly Buttercup (*Ranunculus pensylvanicus*) MESA Assessment

N-1. Summary of Species Life Cycle and Habitat Requirements

Bristly buttercup (*Ranunculus pensylvanicus*) is an annual or short-lived perennial member of the buttercup family (Ranuculaceae). Plants develop from a fibrous root system. Stiff, bristly, spreading hairs cover the tall stems (1 to 2.25 ft) and give the stems a distinctive pubescence. The small (0.6 to 0.8 cm wide), pale yellow flowers are comprised of 5 egg-shaped petals which become whitish with age. Cauline leaves and basal leaves are alternate, toothed, and deeply lobed. The small fruits (achenes) are arranged in short cylindrical heads. Bristly buttercup may be incapable of vegetative spreading, but is able to colonize a variety of habitats including marshes, bogs, moist clearings, wet woods, stream banks, and ditches under open to filtered sunlight. Bristly buttercup frequently inhabits disturbed areas and managed wetland communities in utility corridors. Massachusetts populations have been documented in emergent marshes, vernal pools, seasonally flooded riverbanks, wet swales, shrub swamps, and openings in floodplain forests on alluvial soils.

Higher vascular plant species found growing in association with bristly buttercup in Massachusetts include beggar-ticks (*Bidens* spp.), jewelweed (*Impatiens capensis*), water-horehound (*Lycopus* spp.), false nettle (*Boehmeria cylindrica*), marsh fern (*Thelypteris palustris*), monkey flower (*Mimulus ringens*), and sensitive fern (*Onoclea sensibilis*). Bristly buttercup populations are currently known to occur in Berkshire, Franklin, Hampden, Hampshire, and Worcester Counties. Bristly buttercup is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Species of Special Concern (NHESP 2008).

N-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the bristly buttercup occurs within the PSA in the northern section of Reach 5A and in the lower section of Reach 5C as shown in Figure N at the end of this section. The total Priority Habitat area of bristly buttercup is approximately 73 acres (61 acres in Reach 5A and 12 acres in Reach 5C); 66 acres of the Priority Habitat fall within the PSA. Habitats used by this species include riverbanks along the main stem of the Housatonic River, transitional floodplain forests, wet meadows, shallow emergent marshes, shrub swamps, red maple swamps, calcareous seepages, and black ash-red maple-tamarack swamps. Information provided by the NHESP Fact Sheet for this state-listed species suggests that bristly buttercup is able to grow successfully in many different habitats.

N-3. Impacts of Remedial Alternatives on Bristly Buttercup Habitat

N-3-1. Overview

Table N-1 summarizes the areal extent and duration of work within bristly buttercup habitat for all remediation and construction alternatives. Since SED 1 involves no construction related activities and SED 2 is limited to monitoring natural recovery (MNR); with no direct remediation impacts, bristly buttercup habitat will not be impacted under these alternatives. For SED 3 through SED 8, approximately 15 to 16 acres of riverine and backwater habitat will be impacted by sediment excavation/backfilling, thin-layer capping, or engineered capping along with the needed access roads and staging areas within this Priority Habitat area. In addition, all these SED alternatives will involve 9,340 linear feet of riverbank remediation. While the bristly buttercup is not expected to occur within the river channel or most backwater habitats, the riverbanks along the Housatonic River provide suitable conditions for the growth of this species, particularly in streamside seep areas that are somewhat open to sunlight; plants on the riverbank will be impacted by the riverbank remedial work resulting in direct mortality to any bristly buttercup plants within the work area. The various wetland and floodplain habitats in which the access roads and staging areas will be located also provide suitable habitat for this species, and therefore these activities could result in direct mortality to any bristly buttercup plants in impacted forested swamps and floodplain forest habitat. As the species is principally an annual species, or

short-lived perennial, populations may not occur in the same place from year to year, and it may not be possible to construct access roads and staging areas outside favorable bristly buttercup habitat.

FP 1 involves no construction-related activity. FP 2 through FP 7 will cause different levels of impact to mapped habitat within Reach 5A and Reach 5C through vegetation removal and excavation/backfilling in floodplain habitats and through the construction of access roads and staging areas in the floodplain habitats. Impacts would occur in emergent marshes, wet meadows, shrub swamps, red maple swamps, and transitional floodplain forest habitats where populations of bristly buttercup might occur. Overall impacts (sediment removal with access/staging areas) within bristly buttercup Priority Habitat will range from 4.5 acres under FP 2, 7.8 to 8.7 acres under FP 3 and FP 5, respectively, 13.8 acres under FP 4, and 25.9 to 35.8 acres under FP 6 through FP 7, respectively. Excavation of floodplain habitat will cause direct mortality to any bristly buttercup plants within the work area, as will the construction of access roads and staging areas in locations that support this species.

Table N-1. Bristly Buttercup Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Bristly Buttercup Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5A 5C	7 ac (excavation/capping) 9,340 lf riverbank remediation. 4 ac (thin-layer capping)	4.02 ac habitat removal 0	8 <1
SED 4	5A 5C	7 ac (excavation/capping) 0.4 ac (thin-layer capping) 9,340 lf riverbank remediation 0.3 ac (thin-layer capping) 4 ac (engineered capping)	4.02 ac habitat removal 0.06 ac habitat removal	8 5
SED 5	5A 5C	7 ac (excavation/capping) 0.4 ac (thin-layer capping) 9,340 lf riverbank remediation 0.3 ac (thin-layer capping) 4 ac (engineered capping)	4.02 ac habitat removal 0.04 ac habitat removal	8 4
SED 6	5A 5C	7 ac (excavation/backfilling) 0.3 ac (thin-layer capping) 9,340 lf riverbank remediation 4 ac (excavation/backfilling) 0.6 ac (thin-layer capping)	4.02 ac habitat removal 0	8 6
SED 7	5A 5C	7 ac (excavation/capping) 0.3 ac (thin-layer capping) 9,340 lf riverbank remediation 4 ac(excavation/capping) 0.4 ac (thin-layer capping)	4.02 ac habitat removal 0	10 7
SED 8	5A 5C	7 ac (excavation/capping) 9,340 lf riverbank remediation 5 ac (excavation/capping)	4.02 ac habitat removal 0	12 17

Remedial Alternative	Reach with Affected Habitat*	Description of Bristly Buttercup Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
FP 1	N/A – No Action	0	0	0
FP 2	5A	3 ac (excavation/backfill)	1.5 ac habitat removal	1
FP 3	5A 5C	6 ac (excavation/backfill) 0.1 ac (excavation/backfill)	1.5 ac habitat removal 0.2 ac habitat removal	3
FP 4	5A 5C	12 ac (excavation/backfill) 0.1 ac (excavation/backfill)	1.5 ac habitat removal 0.2 ac habitat removal	4
FP 5	5A 5C	6 ac (excavation/backfill) 0.5 ac (excavation/backfill)	1.8 ac habitat removal 0.4 ac habitat removal	4
FP 6	5A 5C	22 ac (excavation/backfill) 2 ac (excavation/backfill)	1.6 ac habitat removal (0.3 ac habitat removal	13
FP 7	5A 5C	33 ac (excavation/backfill) 2 ac (excavation/backfill)	0.6 ac habitat removal 0.2 ac habitat removal	22

*This species occurs only within Reach 5A and Reach 5C.
**Impacts under SED remediation work are to riverine and riverbank habitats. Impacts under FP alternatives and access road/staging areas are to floodplain wetland habitats.
***Duration of work figures are for the entire Reach; work within the Priority Habitat portion may be less.

N-3-2. Description of Specific Remediation Activities Relative to Bristly Buttercup Priority Habitat by River Segments

Reach 5A

Priority Habitat for bristly buttercup in Reach 5A is reported from vegetated wetlands associated with the main channel of the Housatonic River to the northwest of the Joseph Drive subdivision. Shallow emergent marshes, wet meadows, shrub swamps, and forested swamps along the river corridor provide suitable habitat conditions for bristly buttercup populations.

Sediment alternatives SED 1 and SED 2 involve no impacts to mapped Priority Habitat for bristly buttercup. SED 3 through SED 8 will each impact 7 acres of river channel through excavation of sediment and backfilling with clean sand. SED 4 through SED 7 will also involve 0.3-0.4 acres of thin-layer capping in the river within the Reach 5A Priority Habitat of bristly buttercup. In addition SED 3 through SED 8 will impact approximately 9,340 linear feet of riverbank in bristly buttercup Priority Habitat. SED 3 through SED 8 all involve access road and staging area construction impacts of approximately 4 acres within the mapped Priority Habitat of the bristly buttercup. Thin-layer capping, sediment removal and backfilling in the main river channel and backwater areas are not likely to kill bristly buttercup plants as this species does not grow in aquatic habitats, however, riverbank remediation will directly impact primary habitat for the bristly buttercup. Since the bristly buttercup may grow within several floodplain community types, construction of access roads and staging areas will impact bristly buttercup habitat. In addition to the threat of direct mortality, excavation will reduce the potential seed bank of this species and the disturbances associated with the remedial activities increase the opportunity for expansion of invasive species, which typically have a competitive advantage over a rare species such as the bristly buttercup. The estimated timeframe for completing the remediation work under alternatives SED 3 through SED 6 is 8 years; 10 years for SED 7; and 12 years for SED 8.

Flood plain alternative FP 1 involves no construction related activity. FP 2 impacts 3 acres of floodplain habitat due to vegetation removal and excavation of soils; FP 3 and FP 5 impact 6 acres of habitat; FP 4 impacts 12 acres; FP 6 impacts 22 acres; and FP 7 impacts 33 acres. FP 2 through FP 7 all involve access

road construction and staging area impacts of approximately 0.6-1.8 acres within the mapped Priority Habitat of the bristly buttercup. Since the bristly buttercup may grow within several community types, excavation of soils and construction of access roads and staging areas will impact bristly buttercup habitat. In addition to the threat of direct mortality, excavation will reduce the potential seed bank of this species and the disturbances associated with the remedial activities increase the opportunity for expansion of invasive species, which typically have a competitive advantage over a rare species such as the bristly buttercup. The estimated timeframe for completing all remediation work under FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 5B

Priority Habitat for bristly buttercup is not identified in Reach 5B.

Reach 5C

The Housatonic River within Reach 5C is a lower gradient system with increased meanders, backwater pools, remnant oxbows, and a silt to muck substrate. Priority Habitat for bristly buttercup is identified 3 miles south of New Lenox Road where shallow emergent marsh, wet meadow, and shrub swamp habitats border the river channel. These floodplain communities provide suitable habitat for the bristly buttercup.

Sediment alternatives SED 1 and SED 2 involve no impacts to mapped Priority Habitat for bristly buttercup. SED 3 through SED 8 have similar river bottom impacts in Reach 5C, with 4-5 acres of excavation or capping involved. SED 4 and SED 5 involve less than 0.1 acre of access road and staging area construction, while the other SED alternatives have no impacts from access or staging. Thin-layer capping, sediment removal and backfilling in the main river channel and backwater areas is not likely to kill bristly buttercup plants as this species does not grow in aquatic habitats. No riverbank remediation occurs within Reach 5C and it is unlikely that the very small amount of construction associated with access roads and staging areas will negatively impact this species. The estimated timeframe for completing the remediation work under alternatives SED 3 through SED 6 is 8 years; 10 years for SED 7; and 12 years for SED 8.

Flood plain alternative FP 1 and FP 2 involve no construction related activity within Reach 5C bristly buttercup Priority Habitat. FP 3 and FP 4 impact 0.1 acre of floodplain habitat due to vegetation removal and excavation of impacted soils; FP 5 impacts 0.5 acre of habitat; and FP 6 and FP 7 impact 2 acres. FP 3 through FP 7 involve access road and staging area construction impacts of 0.2-0.4 acre. Since the bristly buttercup may grow within several community types, excavation of contaminated soils and construction of access roads and staging areas will impact bristly buttercup habitat. In addition to the threat of direct mortality, excavation will reduce the potential seed bank of this species and the disturbances associated with the remedial activities increase the opportunity for expansion of invasive species, which typically have a competitive advantage over a rare species such as the bristly buttercup.

The estimated timeframe for completing all remediation work under FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 6

Priority Habitat for bristly buttercup is not identified in Reach 6.

N-4. Assessment of MESA Issues for Bristly Buttercup Under Remedial Alternatives

MESA regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to “collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…” A take is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. “Net

benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for bristly buttercup is summarized in Table N-2 for the sediment alternatives and Table N-3 for the floodplain alternatives. These tables identify for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), where such judgments are now possible, whether it would be feasible to develop a long-term Net Benefit plan and what that plan might involve.

As shown in Table N-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the bristly buttercup. At a minimum, the riverbank remediation would result in the loss of seasonally flooded riverbanks along the river margins that provide habitat for bristly buttercup and would kill any bristly buttercup plants present there. In addition, the excavation of sediments and bank soils may remove the seeds of the bristly buttercup, reducing the repository of this species seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. The removal of the seed bank is a "take" under MESA**.** Due to the extensive length of riverbank remediation (9,340 linear feet) along with impacts to an additional 4 acres (5%) of the Priority Habitat of this species for access roads and staging areas, and the related direct mortalities and removal of seed bank, these sediment alternatives are likely to impact a significant portion of the local population. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

As shown in Table N-3, all of the floodplain alternatives except for FP 1 would result in a take of the bristly buttercup due to direct mortality of any bristly buttercup specimens present in the affected areas and the removal of the seed bank. Under FP 2, the total impact area (4.5 acres) is only 6% of the Priority Habitat area, which would not result in an impact to a significant portion of the local population. Impacts under FP 3 and FP 5 remain small enough (less than 8 acres, or 10% of the Priority Habitat) that a take of a significant portion of the local population would not occur. FP 4, FP 6 and FP 7 result in more substantial losses of habitat due to the more extensive floodplain remediation work planned; 14, 26, and 36 acres of the Priority Habitat will be impacted under these alternatives, amounting to 19%, 36%, and 49% of the total Priority Habitat, respectively. Such extensive impacts would affect a significant portion of the local population.

Since alternatives FP 4, FP 6 and FP 7 impact a significant portion of the local population, a net benefit is not applicable under MESA. Since FP 2, FP 3, and FP 5 would not impact a significant portion of the local population, a net benefit to the species may be considered under MESA. However, based on review of the relevant literature, little is known about conservation strategies for this species. As a result, it cannot be established that a conservation and management plan would achieve an overall "net benefit" for this species, given the adverse impacts from the remediation.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2006. Bristly Buttercup (Ranunculus pennsylvanicus) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

Table N-2: Assessment of MESA Issues for Bristly Buttercup Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take due to Monitored Natural Recovery only.	NA	NA	NA
SED 3 through 8	Yes. While sediment removal in river and thin-layer and/or engineered capping in river and backwater areas will not alter suitable bristly buttercup habitat, the remediation of 9,340 linear feet of riverbank that provides ideal habitat for this species, along with the impacts to 4 acres of floodplain wetland that also is suitable habitat, will result in a take of this species. Excavation will also remove the seeds of this species, which would be a take pursuant to MESA.	No. Riverbank remediation along areas that support the bristly buttercup could not be modified to avoid a take. Access roads and staging areas may be modified, but because of annual variations in location of plants such measures would not be expected completely to avoid impacts to this species. Sediment removal that contains seeds of this species could not be altered to retain the seeds within the habitat zone.	Yes. The extensive length of riverbank remediation (9,340 linear feet) added to the alteration of an additional 5% of the Priority Habitat of this species by access roads and staging areas is likely to impact a significant portion of the local population.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table N-3: Assessment of MESA Issues for Bristly Buttercup Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Yes. Take will occur due to remedial work in 3 acres of suitable bristly buttercup habitat, as well as the construction of access and staging areas over 1.5 acres of suitable habitat. Excavation will also remove the seeds of this species, which would be a take pursuant to MESA.	No. While access road and staging areas may be modified to avoid or minimize impact on bristly buttercup colonies, any remediation within areas that support this species could not be conducted in a manner that would avoid a take.	No. This work impacts only 6% of the total Priority Habitat for this species.	Cannot be established. Based on review of the relevant literature, little is known about conservation strategies for this species. As a result, it cannot be established that a conservation and management plan would achieve an overall "net benefit" for this species, given the adverse impacts from the remediation.
FP 3 and FP 5	Yes. Take will occur due to remedial work in 6 to 6.5 acres of suitable bristly buttercup habitat, as well as the construction of access and staging areas in 1.2 to 1.7 acres of suitable habitat. Excavation will also remove the seeds of this species, which would be a take pursuant to MESA.	No. While access road and staging areas may be modified to avoid bristly buttercup colonies, any remediation within areas that support this species could not be conducted in a manner that would avoid a take.	Unlikely. This work impacts 10% of the total Priority Habitat for this species, and the overall acreage of impact is not large.	Cannot be established. Based on review of the relevant literature, little is known about conservation strategies for this species. As a result, it cannot be established that a conservation and management plan would achieve an overall "net benefit" for this species, given the adverse impacts from the remediation.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 4, FP 6 and FP 7	Yes. Take will occur due to remedial work in 12, 24 and 35 acres, respectively, of suitable bristly buttercup habitat, as well as the construction of access and staging areas over 0.8 to 1.9 acres of suitable habitat. Seed removal will also be a take.	No. While access road and staging areas may be modified to avoid bristly buttercup colonies, any remediation within areas that support this species could not be conducted in a manner that would avoid a take.	Yes. This work impacts 19%, 35%, and 49% of the total Priority Habitat for this species, respectively.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

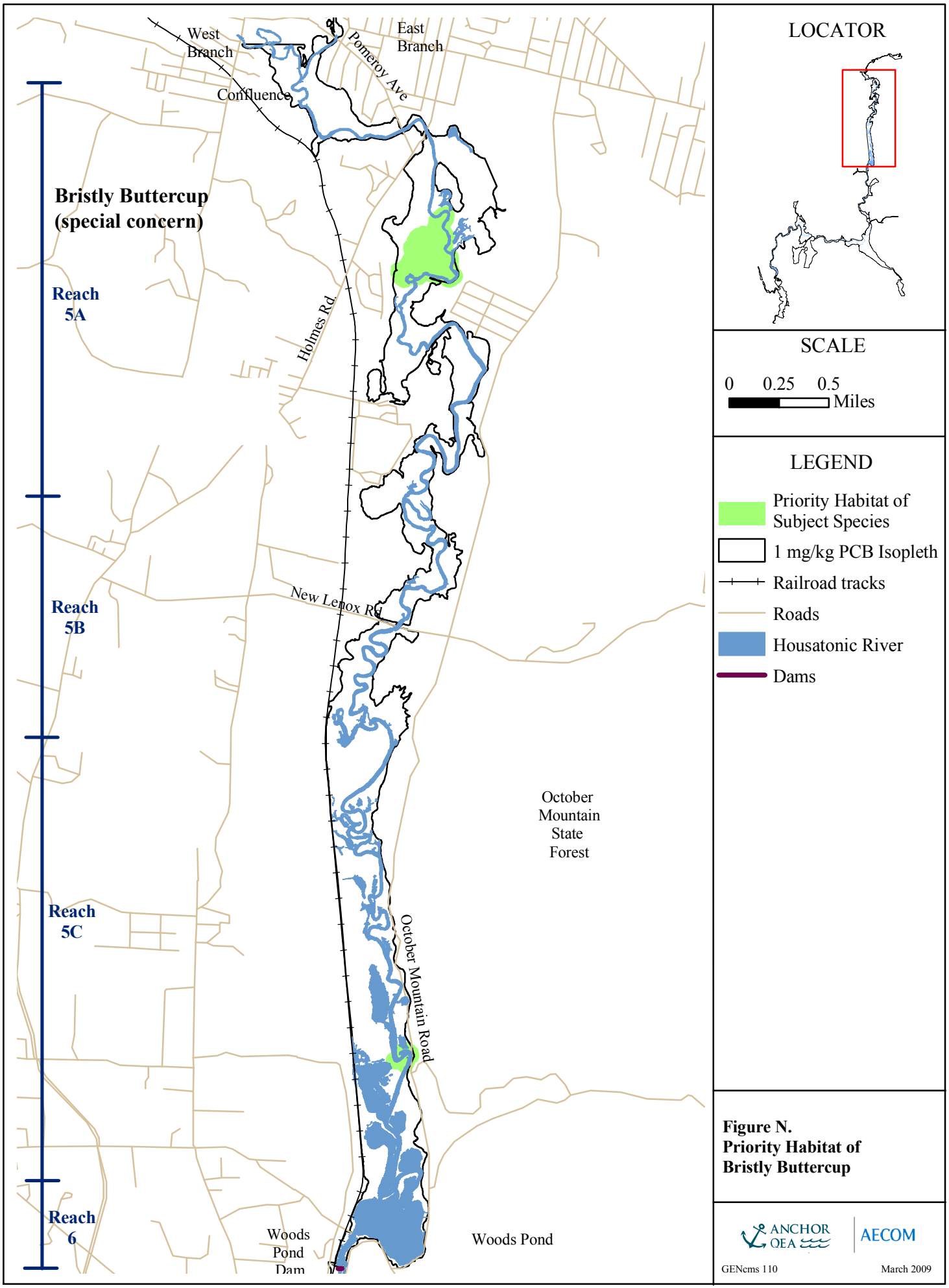

Figure N.
Priority Habitat of Bristly Buttercup

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O. Bur Oak (*Quercus macrocarpa*)

O. Bur Oak (*Quercus macrocarpa*) MESA Assessment

O-1. Summary of Species Life Cycle and Habitat Requirements

Bur oak, or mossy-cup oak (*Quercus macrocarpa*), is a member of the Beech Family (Fagaceae). Mature trees reach heights of up to 160 feet (50 m). The alternate leaves are lustrous green above with a pale fuzzy undersurface having 4 to 7 pairs of rounded lobes and deep U-shaped sinuses. The acorn of the bur oak is large (1 to 1.5 inches long) with a deep, saucer-shaped cup with a fringe-like edge. Bur oak trees start to bear fruit at about 35 years of age and produce heavy seed crops every 2 to 3 years. Bur oak occurs in several habitats including forested fens, forested swamps, floodplain forests influenced by calcareous (alkaline or basic) seepage water, and in mesic to wet sites in shady areas subject to seasonal flooding. Bur oaks may also occur in bottomlands and moist to dry, rich woods in open areas. Associated species include green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*), American elm (*Ulmus americana*), red maple (*Acer rubrum*), white pine (*Pinus strobus*), American larch (*Larix laricina*), yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadenis*), and swamp white oak (*Quercus bicolor*), a similar-looking oak species. Ironwood (*Carpinus caroliniana*) and various shrub species may also be present in association with bur oak. Current records for bur oak specimens in Massachusetts are confined to Berkshire County except for a single occurrence in Hampshire County. Bur oak is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Species of Special Concern (NHESP 2008).

O-2. Species Presence within PSA

According to NHESP database information, Priority Habitat for bur oak in the PSA occurs in the extreme downstream section of Reach 5B, extensively throughout Reach 5C, and in Reach 6 as shown in Figure O at the end of this section. The areal extent of the mapped habitat is broad and includes the main channel of the Housatonic River and contiguous backwater areas where a variety of natural communities occur. These communities include shallow emergent marshes, deep emergent marshes, wet meadows, shrub swamps, and floodplain forests. The total Priority Habitat for bur oak is approximately 834 acres, with 440 acres of this occurring in the PSA. Woodlot (2002) documented the occurrence of the bur oak at numerous locations within this portion of the PSA.

O-3. Impacts of Remedial Alternatives on Bur Oak Habitat

O-3-1. Overview

Table O-1 summarizes the areal extent and duration of work within bur oak habitat for all the remedial alternatives. SED 1 involves no action. SED 2 is limited to monitored natural recovery (MNR); it involves no direct construction work and therefore would not impact bur oak Priority Habitat. SED 3 through SED 8 each involve about 2,700 linear feet of riverbank remediation along Reach 5B; sediment excavation, thin-layer capping, and engineered capping along the main stem of the river and backwater areas, and access road/staging area construction within Priority Habitat of the species. SED 3 would have the least amount of impacts totaling approximately 63 acres of thin-layer capping and 4 acres of impacts due to access roads and staging areas. SED 4 through SED 8 would each impact nearly twice as much Priority Habitat through sediment removal, thin-layer capping, and engineered capping as well as access road/staging area construction. Total impacts for these combined activities vary from 130 acres to 144 acres for alternatives SED 4 through SED 8. Staging and access road construction would impact an additional 7 to 13 acres under the SED alternatives. Though these sediment removal and capping activities will occur throughout Priority Habitat, they are unlikely to have a direct affect on bur oak where they occur in the river channel or other open water areas, as these are not considered suitable habitat for this species. Riverbank remediation (as would occur within the Reach 5B portion of the Priority Habitat) has greater potential to result in direct impacts to bur oak than the in-river remediation.

Floodplain alternative FP 1 consists of no action. FP 2 through FP 7 will impact the bur oak by altering suitable habitat throughout the floodplain, including forested swamps and floodplains. Overall impacts within the floodplain would result from sediment removal and backfilling activities as well as access road and staging area construction. These impacts would range from 0.5 acre of sediment removal/backfill and 5 acres of access road/staging area impacts for FP 2, to 69 acres of sediment removal/backfill and 12 acres of access road/staging area impacts for FP 7.

The excavation of sediments would likely remove the acorns of bur oak, reducing the repository of this species' "seed" bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. Backfill with non-indigenous sediments is not expected to contain the acorns of bur oak, and therefore the establishment of newly exposed moist sediments from backfilling would not contribute to the re-growth of this species. Moreover, such disturbed conditions facilitate the colonization of invasive plant species, and these are likely to have a competitive advantage over bur oak following remedial activities.

Table O-1. Bur Oak Habitat Alterations by Remedial Alternative and Reach

Remedial Alternative	Reach with Affected Habitat*	Description of Bur Oak Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5B	2,685 lf of riverbank remediation	1 ac habitat removal	<1
	5C	35 ac (thin-layer capping)	3 ac habitat removal	<1
	6	28 ac (thin-layer capping)	0.05 ac habitat removal	<1
SED 4	5B	3 ac (thin-layer capping) 2,685 lf of riverbank remediation	1 ac habitat removal	3
	5C	64 ac (thin-layer capping) 35 ac (engineered capping)	11 ac habitat removal	3
	6	18 ac (excavation/capping) 11 ac (thin-layer capping)	0.05 ac habitat removal	2
SED 5	5B	2 ac (excavation/capping) 0.3 ac (thin-layer capping) 2,685 linear feet of riverbank	1 ac habitat removal	5
	5C	21 ac (excavation/capping) 43 ac (thin-layer capping) 35 ac (engineered capping)	12 ac habitat removal	3
	6	18 ac (excavation/capping) 11 ac (engineered capping)	0.05 ac habitat removal	2.5
SED 6	5B	2 ac (excavation/capping) 2 ac (thin-layer capping) 2,685 lf of riverbank remediation	1 ac habitat removal	5
	5C	65 ac (excavation/capping) 35 ac (thin-layer capping)	5.7 ac habitat removal	6
	6	18 ac (excavation/capping) 11 ac (engineered capping)	0	2

Remedial Alternative	Reach with Affected Habitat*	Description of Bur Oak Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas	Estimated Duration of Work (years)***
SED 7	5B 5C 6	3 ac (excavation/capping) 1 ac (thin-layer capping) 2,685 lf of riverbank remediation 77 ac (excavation/capping) 24 ac (thin-layer capping) 18 ac (excavation/capping) 11 ac (engineered capping)	1 ac habitat removal 5.7 ac habitat removal 0	6 6 3
SED 8	5B 5C 6	6 ac (excavation/capping) 2,685 lf of riverbank remediation 110 ac (excavation/capping) 28 ac (excavation/capping)	1 ac habitat removal 5.7 ac habitat removal 0	7 17 7
FP 1	N/A – No Action	0	0	N/A
FP 2	5B 5C 6	0 0.4 ac (excavation/backfill) 0.1 ac (excavation/backfill)	1 ac habitat removal 2.8 ac habitat removal 0.6 ac habitat removal	1
FP 3	5B 5C 6	0.8 ac (excavation/backfill) 7 ac (excavation/backfill) 0.3 ac (excavation/backfill)	0.3 ac habitat removal 4.9 ac habitat removal 0.6 ac habitat removal	3
FP 4	5B 5C 6	1 ac (excavation/backfill) 12 ac (excavation/backfill) 0.3 ac (excavation/backfill)	1.1 ac habitat removal 6 ac habitat removal 0.7 ac habitat removal	4
FP 5	5B 5C 6	1 ac (excavation/backfill) 12 ac (excavation/backfill) 0.3 ac (excavation/backfill)	0.4 ac habitat removal 9 ac habitat removal 0.7 ac habitat removal	4
FP 6	5B 5C 6	3 ac (excavation/backfill) 49 ac (excavation/backfill) 1 ac (excavation/backfill)	0.9 ac habitat removal 11 ac habitat removal 0.2 ac habitat removal	13
FP 7	5B 5C 6	3 ac (excavation/backfill) 64 ac (excavation/backfill) 2 ac (excavation/backfill)	0.9 ac habitat removal 10 ac habitat removal 0.7 ac habitat removal	22

*This species only occurs within Reaches 5B, 5C, and 6
**All direct impacts under SED alternatives are to riverine, riverbank and backwater habitats. Riverine and backwater impacts are expressed in acres; riverbank impacts in linear feet. FP and access/staging impacts are primarily to floodplain wetland habitats
***indicates estimated duration to complete entire alternative; work with Priority Habitat portion may be less.

O-3-2. Description of Specific Remediation Activities Relative to Bur Oak Habitat by River Segments

Reach 5A

There is no Priority Habitat for the bur oak in Reach 5A.

Reach 5B

Priority Habitat for bur oak within Reach 5B is fairly small and begins approximately 4,000 feet south of New Lenox Road and extends south into Reach 5C. The Priority Habitat for this species totals approximately 46 acres within Reach 5B; 24 acres of which occur within the PSA. Suitable habitat within the PSA includes a small amount of shrub swamp, forested swamp, and floodplain forests that border the main stem of the river.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives would result in impacts to bur oak Priority Habitat in Reach 5B. SED 3 through SED 8 each include approximately 2,700 linear feet of riverbank remediation. For this work, the riverbanks would be excavated and stabilized by armoring or bioengineering to prevent erosion. The river banks themselves provide habitat for bur oak, and these stabilization activities would cause impacts to specimens of this growing along the banks and adjacent floodplain wetland areas which coincide with areas along the bank to be remediated. SED 4 through SED 8 would also include sediment removal and/or thin-layer capping within the main stem of the river and in backwater areas. SED 4 would involve 3 acres of thin-layer capping within Priority Habitat. SED 5 through 7 would include between 0.3 acre (SED 5) and 2 acres (SED 6) of thin-layer capping in combination with 2 acres (SED 5) to 3 acres (SED 7) of sediment removal of river bottom materials. SED 8 would include 6 acres of sediment removal. Though these sediment removal and capping activities will occur throughout Priority Habitat, they are unlikely to have a direct affect on bur oak where they occur in the river channel or other open water areas, as these are not considered suitable habitat for this species.

Access road construction and staging areas would disturb an additional 1 acre of Priority Habitat in Reach 5B under alternatives SED 3 through SED 8. This work would include excavation, backfilling, deposition, clearing, and/or grubbing activities which, if conducted in bur oak suitable habitat, would have the potential to impact the species' population. The estimated timeframe for completing the various work alternatives in Reach 5B is 1 year for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, 6 years for SED 7, and 7 years for SED 8.

Additional impacts to bur oak habitat would occur from the floodplain remediation alternatives. The risk of impact would be proportional to the extent of clearing, excavation of impacted soils, and backfilling planned under each alternative. FP 1 consists of no action and FP 2 does not propose work within Reach 5B. FP 3 through FP 5 would each result in about 1 acre of impacts due to remediation activities in reach 5B, while FP 6 and FP 7 would cause about 3 acres of disturbance through this work. Any of these activities occurring within prime habitat for bur oak, including forested swamps, and floodplains, have the potential to impact this species.

Access road and staging activities would cause additional impacts to bur oak Priority Habitat under floodplain alternatives FP 2 through FP 7, ranging from 0.3 acre (FP 3) to 1.1 acres (FP 4). The estimated timeframe for completing the remediation work within the entire PSA under FP 2 is 1 year, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7. However, Priority Habitat in Reach 5B for this species would not be affected in all years.

Reach 5C

The Housatonic River within Reach 5C is a low gradient meandering system with increasing backwater pools, remnant oxbows, and silty to mucky substrates. Priority Habitat for bur oak stretches the entire length of Reach 5C and totals approximately 730 acres, 378 acres of which is in within the PSA. Suitable habitat for bur oak is abundant along the floodplain of this reach of the river due to the natural community types of black ash-red maple-tamarack calcareous seepage swamp, red maple swamp, and transitional floodplain forest.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives would result in impacts to bur oak Priority Habitat in Reach 5C. Sediment alternative SED 3 would involve the least amount of impacts -- 35 acres of thin-layer capping within the stream channel and backwater areas within the southern half of Reach 5C. SED 4 would cause greater impacts with a combination of 64 acres of

thin-layer capping and 35 acres of engineered capping in-river along the southern half of the reach. SED 5 is the only alternative that will combine sediment removal, thin-layer capping, and engineered capping in Reach 5C. Sediment removal would occur along the main stem of the river along the northern half of Reach 5C, thin-layer capping will occur in backwater areas throughout the reach, and engineered capping is proposed mainly for the main stem of the river along the southern portion of Reach 5C. These activities would total 99 acres of impacts throughout the reach. SED 6 and SED 7 both involve 100 acres of remedial activities in bur oak habitat, consisting of varied amounts of sediment removal mainly in the channel of the river, and thin-layer capping mainly within backwater areas. SED 8 would cause the most disturbances, resulting in 110 acres of impacts to bur oak Priority Habitat due to in-river sediment excavation of the top 2 to 3 feet along the entire length of Reach 5C and within backwater areas throughout the reach. In addition, SED 6 through SED 8 would each involve 23 acres of impacts to bur oak habitat in this reach due to treatment disposal. The sediment removal and capping activities for alternatives SED 3 through SED 8 will occur throughout Priority Habitat, but are unlikely to have a direct affect on bur oak where these activities affect the river channel and open water areas as these are not considered suitable habitat for this species; however, the overall extent of disturbance associated with most of these alternatives within the Reach 5C portion of the Priority Habitat of the bur oak that the potential for significant indirect impacts (sedimentation, dust, hydrologic changes, etc.) is high.

Access road construction and staging areas would disturb an additional 3 acres under SED 3, 11 acres under SED 4, 12 acres under SED 5, and 6 acres under SED 6, SED 7, and SED 8. This work would likely include excavation, backfilling, deposition, clearing, and/or grubbing activities which, if conducted in bur oak suitable habitat, has the potential to impact the species' population. The estimated timeframe for completing the various work alternatives in the PSA is 1 year for SED 3, 3 years for SED 4 and SED 5, 6 years for SED 6 and SED 7, and 17 years for SED 8.

The risk of impact to bur oak under the floodplain alternatives would be proportional to the extent of clearing, excavation of impacted soils, and backfilling planned under each alternative. FP 1 consists of no action, but FP 2 through FP 7 would cause increasing impacts to Priority Habitat in Reach 5C. FP 2 would cause the least amount of disturbance - to 0.4 acre of transitional floodplain forest adjacent to the river. FP 3 will involve 7 acres of impacts to a variety of natural community types, including floodplain forest. FP 4 and FP 5 each propose 12 acres of remediation and the majority of that work would occur in transitional floodplain forest and red maple swamp. FP 6 and FP 7 would cause the highest amount of impacts to bur oak Priority Habitat, disturbing 49 acres and 64 acres, respectively. Natural communities within the floodplain are varied, but include transitional floodplain forest, red maple swamp, and black ash-red maple-tamarack calcareous seepage swamp, which are all considered suitable habitat for bur oak. Excavation and backfilling in these areas would cause mortality to any bur oak plants occurring within the work areas.

Access road and staging activities would cause additional impacts to bur oak Priority Habitat under floodplain alternatives FP 2 through FP 7, ranging from 2.8 acres (FP 2) to 11 acres (FP 6). These activities would typically cause direct mortalities to individual bur oak trees when conducted in suitable habitat areas. The estimated timeframe for completing the remediation work within Reach 5C under FP 2 is 1 year, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

Reach 6

Reach 6 begins where the Housatonic River opens into Woods Pond and ends at the Woods Pond Dam. bur oak Priority Habitat surrounds almost the entire pond and the natural communities within that habitat consist mainly of a red oak-sugar maple transition forest, red maple swamp, and black ash-red maple- tamarack calcareous seepage swamp. These swamps at the periphery of Woods Pond provide prime habitat for bur oak. Mapped habitat for this species covers a total of 58 acres in Reach 6, 38 acres of which are within the PSA.

Except for SED 1 and SED 2, which require no construction activities, the rest of the sediment alternatives would result in just less than 28 to 29 acres of remedial work within bur oak Priority Habitat. Through

sediment removal, thin-layer capping, and/or engineered capping, the entire area of Woods Pond within Priority Habitat would be impacted. Remedial work in Reach 6 under SED 3 would consist entirely of thin-layer capping, SED 4 would consist of a combination of sediment removal of the top 1.5 feet and thin-layer capping, SED 5 and SED 6 would each consist of a combination of sediment removal of the top 1.5 feet with engineered capping, SED 7 proposes removal of the top 2.5 feet of sediment as well as thin-layer capping, and SED 8 would consist solely of removal of the top 6 feet of sediments in Woods Pond. The sediment removal and capping activities for alternatives SED 3 through SED 8 would occur throughout Priority Habitat in Reach 6, but are unlikely to have an affect on bur oak where they involve open water areas. However, the indirect impacts from the more extensive alternatives (sedimentation, dust, hydrologic changes, etc.) are likely to affect this species.

Access road construction and staging areas would disturb an additional 0.05 acre under alternatives SED 3, SED 4, and SED 5. This work would likely include excavation, backfilling, deposition, clearing, and/or grubbing activities within bur oak suitable habitat, as forested wetlands surround the majority of the pond. No additional impacts due to access road and staging area construction are proposed within bur oak Priority Habitat at Reach 6 under the sediment alternatives. The estimated timeframe for completing the various work alternatives in Reach 6 is about 1 year for SED 3, 2 years for SED 4, SED 5, and SED 6, 3 years for SED 7, and 7 years for SED 8.

Floodplain remediation alternatives would incur relatively small impacts on bur oak Priority Habitat in Reach 6. FP 1 involves no action, but FP 2 through FP 7 would involve 0.1 acre (FP 2) to 2 acres (FP 7) of remedial activities within this habitat. Generally, natural communities composing the floodplain area in Reach 6 consist of forested wetlands which are prime habitat for bur oak.

Additional impacts to Priority Habitat of bur oak within Reach 6 under FP 2 through FP 7 would be caused by access road and staging area construction. These activities would affect less than 1 acre for each of the FP alternatives. The estimated timeframe for completing the floodplain remedial work within bur oak Priority Habitat in the PSA is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7.

O-4. Assessment of MESA Issues for Bur Oak

MESA regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to “collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…” A take is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for bur oak is summarized in Table O-2 for the sediment alternatives and Table O-3 for the floodplain alternatives. These tables identify for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table O-2, all of the sediment alternatives except for SED 1 and SED 2 would likely result in a take due to extensive work within Priority Habitat areas. Remedial actions associated with the removal of river bottom sediments and backfilling in the river channel itself are unlikely to impact bur oak individuals as the species generally occurs in forested swamp, floodplain forest, and bottomland habitats subject to spring

flooding. However, riverbank remediation in Reach 5B and construction of access roads and staging areas in all reaches have the potential to take the bur oak through direct removal of all or a portion of the plants root system or above ground biomass. In addition to direct mortality of bur oak specimens, the excavation of sediments may also remove the acorns of the bur oak, reducing the repository of this species' seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. The removal of the seed bank is a take under MESA. Backfilling with non-indigenous sediments is not expected to carry the acorns of the bur oak, and therefore the establishment of newly exposed moist sediments from backfilling will not have the same potential for the re-growth of this species. Moreover, such conditions are also prime for the colonization of numerous invasive species, and these are likely to have a competitive advantage over bur oak following disturbances. Under alternative SED 3, habitat alterations of mapped habitat in Reach 5B, Reach 5C, and Reach 6 consist of riverbank remediation measures (Reach 5B only), thin-layer capping, and limited habitat alterations due to access road and staging area impacts. Overall, about 8% of the mapped Priority Habitat for this species will be affected under SED 3. Therefore, under this alternative impacts to a significant portion of the local bur oak population are not anticipated, assuming that a concentration of this species does not occur on the riverbank portion to be remediated in Reach 5B. Remediation work associated with SED 4 through SED 8 is substantially more extensive (affecting 143 to 174 acres – 17 to 21% of the Priority Habitat); however the work remains concentrated in habitats not likely to support the bur oak.

Since impacts under alternatives SED 3 through SED 8 would affect only 8 to 21% of the bur oak Priority Habitat, and much of the SED work would be limited to areas that are not actually suitable habitat for the bur oak (I.e., the river channel and other open water areas), an impact to a significant portion of the local bur population is not expected under any of the SED alternatives. Based on review of the literature, potential elements of a conservation and management plan designed to preserve, enhance, or expand habitats capable of supporting this species could be identified. Although transplantation of older saplings may not be efficient due to the bur oaks' very deep tap root, collection of bur oak acorns followed by propagation in greenhouse could be part of the plan with eventual planting in appropriate habitats. The bur oak establishes a rapid root system, is fairly drought tolerant and establishes well on sites free of leaf litter and overstory. Habitat management measures, including the control of invasive species, conservation restrictions, public education, and long-term monitoring with collection of biological data contributing to increased understanding of the habitat preferences for this species would also contribute to a net benefit plan. Expanding the habitat range beyond the currently mapped zone could be considered. However, as discussed below for alternatives FP 3 through 7, it cannot be determined whether such measures would be sufficient to provide a net benefit relative to the type of take of this species associated with SED 3 through 8.

As Table O-3 depicts, no work is proposed for FP 1 so no take would occur under this alternatives. FP2 would not likely result in a take, since FP 2 only consists of 0.5 acre of primary impacts within bur oak Priority Habitat. The 4.4 acres of work associated with access road and staging area construction may be laid out to minimize or avoid bur oak specimens by careful placement of access roads and staging areas. FP 3 through FP 7 would likely result in a take. Work proposed in Priority Habitat under these activities is extensive, as between 14 and 81 acres of soil will be disturbed in potentially suitable habitat for this species under these alternatives. Soil excavation along with access road and staging area construction in these suitable bur oak habitats could result in direct mortalities, and it is possible that acorns of the bur oak would be incidentally collected during excavation. Despite the extensive areas of impact within bur oak Priority Habitat, none of the floodplain remediation alternatives will cause a significant impact to the local population as only 0.6% (FP 2) to 10% (FP 7) of the mapped Priority Habitat will be affected under FP 2 through FP 7.

Conservation and management measures of the type described above for SED 3 through 8 could be identified. However, it should be noted that even with these conceptual measures that may be developed toward a net benefit plan for this species, it cannot be determined whether an actual "net benefit" to the species could be realized under the SED 3 through 8 or FP 3 through 7 alternatives. The described measures would need to be integrated and coordinated with requirements for and impacts to other rare species within the PSA. Considering the high quality of the existing habitat conditions, and the disturbances that would be associated with any of the alternatives, the capacity of the PSA to support a sensitive species

(at least at or near the limit of its range) such as bur oak may be significantly impaired. The disturbances associated with the remedial activities increase the opportunity for the proliferation of invasive species, which typically have a competitive advantage over a rare species such as the bur oak. Given these aspects of the takes involved, it cannot be determined whether such a conservation and management plan would achieve an overall net benefit for the species.

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Table O-2: Assessment of MESA Issues for Bur Oak Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No	NA	NA	NA
SED 2	No	NA	NA	NA
SED 3	Possible. A take could occur if individuals of this species are located along the impacted riverbank or margins of the backwater areas. Sediment removal may remove acorns of this species, which would constitute a take under MESA.	Possible. If individual trees do not occur within or immediately adjacent to the remedial areas or within access road or staging area footprints. This is possible as only up to 8% of the Priority Habitat for this species will be affected under SED 3 and much of that area is not likely suitable habitat for the species. In addition, impacts may be avoided through relocation of access roads and staging areas. However, remediation of 2,700 lf of riverbank and removal of acorns via excavation may unavoidably take this species.	No. Surface area impacts (direct excavation and access/staging areas combined) would occur in only 8% of the Priority Habitat for this species, and it is expected this species would occupy only a fraction of that portion of the Priority Habitat, if at all, as much of it is comprised of unsuitable habitat (the river channel and similar aquatic habitats).	Cannot be established. Based on a review of the literature, the elements of a conservation and management plan geared toward preservation, enhancement, and expansion of habitats supporting this species can be identified. However, given the high quality of the existing habitat conditions, the level of disturbance, and the increased opportunity for the proliferation of invasive species which have a competitive advantage over the bur oak, it cannot be determined that such measures will achieve an overall net benefit for the species.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 4 through SED 8	Yes. Between 141 and 151 acres of impacts from sediment removal and access/staging areas within the Priority Habitat would occur, plus impacts to 2,700 linear feet of riverbank. Both the riverbank remediation and access/staging areas will be situated within favorable habitat for the bur oak. Sediment removal may remove acorns of this species, which would constitute a take under MESA.	No. The extensive area of disturbance within the Priority Habitat would preclude avoiding a take of this species. There are no seasonal or temporal measures that could avoid a take of this species within remediation zones. Impacts may be avoided through relocation of access roads and staging areas, however remediation of 2,700 lf of riverbank and removal of acorns via excavation may unavoidably take this species.	Unlikely. While surface area impacts would occur in about 17% to 21% of the local Priority Habitat for this species, it is expected this species would occupy only a fraction of that portion of the Priority Habitat.	Cannot be established. Although the types of conservation and management measures identified for SED 3 (above) could be implemented, given the high quality of the existing habitat conditions, the level of disturbances, and the increased opportunity for the proliferation of invasive species which have a competitive advantage over the bur oak, it cannot be determined that such measures will achieve an overall net benefit for the species.

Table O-3: Assessment of MESA Issues for Bur Oak Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2	Unlikely. Soil removal and backfilling activities would only affect 0.5 acre and the relatively minor amount of access road/staging area construction (about 4.5 acres) may be modified to avoid individuals of this species or significant repositories of its acorns.	Yes. Since activities are limited in scope for this alternative, it should be possible to avoid direct impacts to individual plants or suitable habitat. It is possible that access road and staging area work could be altered to avoid direct mortality of specimens of this species.	NA	NA
FP 3 – FP 7	Likely. Soil removal and backfilling activities (between 8 and 69 acres) and access road/staging area construction (between 6 and 12 acres) would occur within bur oak Priority Habitat. Most of these activities would occur in suitable habitat for the species. If bur oak was present, this work would cause direct mortality and/or incidental collection of acorns. Sediment removal may remove acorns of this species, which would constitute a take under MESA.	Unlikely. Given the area of impact due to remedial activities (8 to 69 acres) in the widespread distribution of this species, planning for avoidance of the species is problematic. Impacts from access roads and staging areas (6 to 12 acres) could be minimized by adjusting the layout of these features; however complete avoidance of the plants is unlikely.	No. Impacts within Priority Habitat for this species under this alternative are relatively small (about 2% to 10% of the total mapped Priority Habitat area), so despite the large areas impacted it is not expected that a significant portion of the local population would be impacted.	Cannot be established, for reasons discussed above under SED 3 through SED 8.

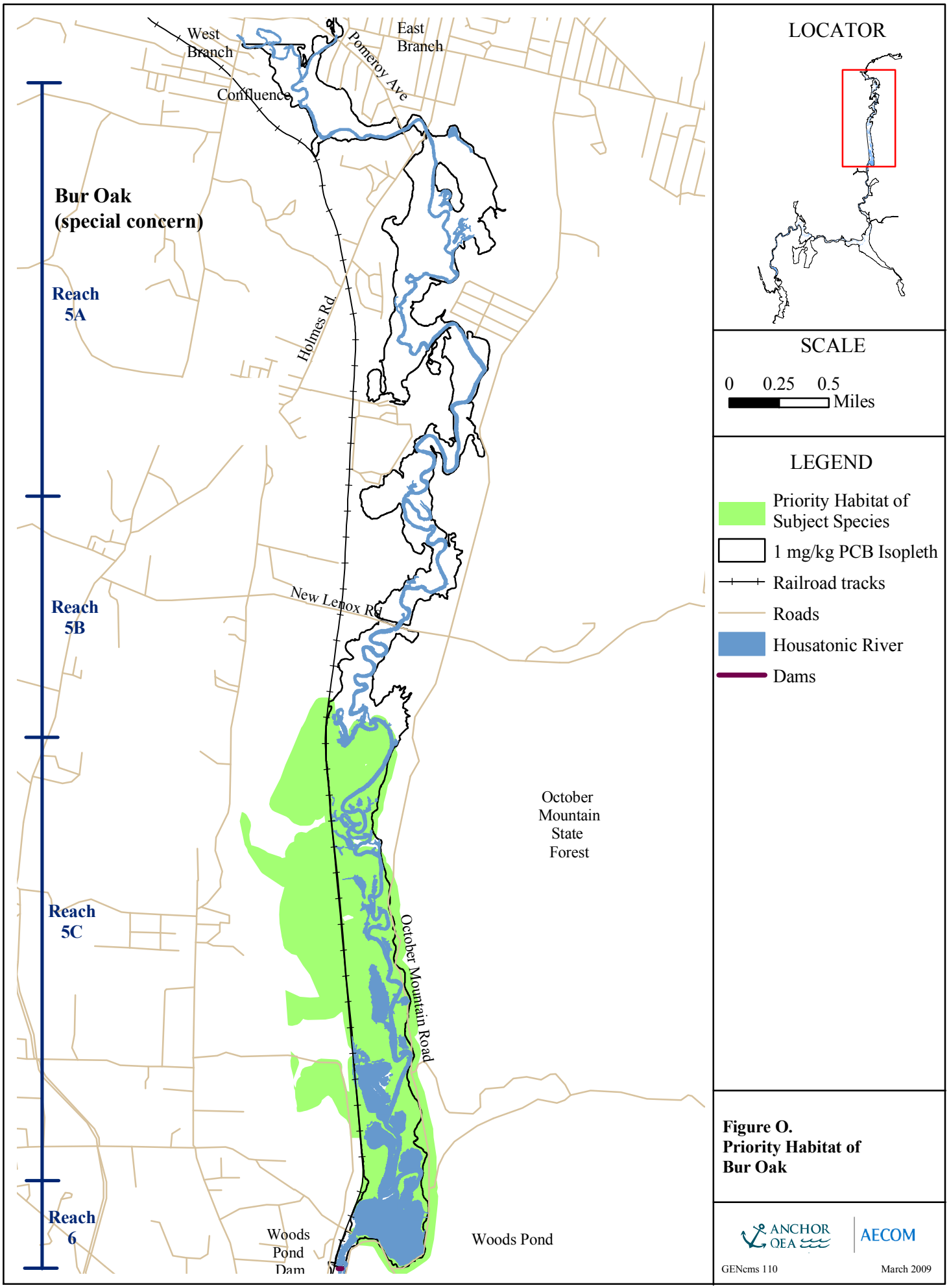

Figure O.
Priority Habitat of Bur Oak

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P. Crooked-Stem Aster (*Symphyotrichum prenanthoides*)

P. Crooked-stem Aster (*Symphyotrichum prenanthoides*) MESA Assessment

P-1. Summary of Species Life Cycle and Habitat Requirements

Crooked-stem aster (*Symphyotrichum prenanthoides*) is an herbaceous perennial arising from elongated, creeping, rhizomes. The stems are erect or ascending, pubescent, and 6 inches to 3 feet (2 to 10 dm) tall, with a pronounced zigzag pattern along the stems due to sharp bends at the nodes. Pale blue to pale purple flowers are in bloom from August to October. Crooked-stem aster in Massachusetts occurs in several habitats ranging from exposed gravel and cobble substrates, rich alluvial soils along river floodplains, and streamside seeps to partially wooded swamps and roadside habitats where they may occur under open to semi-open conditions. In floodplain forest habitats, crooked-stem aster occurs on the banks of rivers and streams at the edge of open woods, where the species is found growing in association with willow (*Salix* sp.), dogwood (*Cornus* spp.), northern horse-balm (*Collinsonia canadensis*), zigzag goldenrod (*Solidago flexicaulis*), and lopseed (*Phryma leptostachya*). Aster associates include purple-stemmed aster (*Symphyotrichum puniceum* = *Aster puniceus*) and Schreber's aster (*Eurybia schreberi* = *Aster schreberi*). Associated canopy dominants include sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), and American elm (*Ulmus americana*). In streamside seepages, crooked-stem aster is found in association with highbush cranberry (*Viburnum trilobum*), yellow touch-me-not (*Impatiens pallida*), common scouring rush (*Equisetum hyemale*), and several species of sedge (*Carex bromides*, *C. scabrata*, and *C. hystericina*). All but one of the extant populations reported in Massachusetts occur in Berkshire County, where the species is reported at sites along the Housatonic, Hoosic, and Green Rivers of Great Barrington and Williamstown (NHESP 2008). Crooked-stem aster is a state-listed Threatened Species in Massachusetts.

P-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat for crooked-stem aster in the PSA occurs only in the southern portion of Reach 5B, approximately 1000 feet below New Lenox Road, as shown on Figure P at the end of this section. The species is not reported within Reach 5A, Reach 5C, or Reach 6. The areal extent of the mapped habitat is confined to the main channel of the Housatonic River and contiguous backwater areas adjacent to the river where a diverse complex of wetland habitats, including shallow emergent marshes, deep emergent marshes, wet meadows, shrub swamps, and floodplain forests are present. The preferred habitat for this species is open forested floodplains, wooded riverbanks and streamside seeps. The total Priority Habitat for crooked-stem aster covers approximately 38 acres; however, only 24 acres of the Priority Habitat is located within the PSA. At least one observation of the crooked-stem aster has been reported along the Housatonic River in Reach 5B within early successional floodplain forest to south of New Lennox Road (Woodlot 2002). Since this species is a perennial which arises from rhizomes, it tends to establish colonies with similar occurrence and distribution from year to year.

P-3. Impacts of Remedial Alternatives on Crooked-stem Aster Habitat

P-3-1. Overview

Table P-1 summarizes the areal extent and duration of work within crooked-stem aster habitat for all the remedial alternatives. Alternatives SED 3 through SED 8 will impact approximately 1,400 linear feet of riverbank via remediation within the crooked-stem aster habitat zone in Reach 5B. Excavation of riverbank habitat will cause direct mortality to any crooked stem aster plants within the work area, as well as remove all rhizomes below the surface grade from which the plant arises. SED 3 will not involve in-river remediation within the crooked-stem aster habitat area. Alternatives SED 4 and SED 5 will impact 1 acre of river bottom and backwater habitats and SED 6 through SED 8 will impact between 4 and 4.3 acres of river bottom and backwater habitats. Thin-layer capping, sediment removal and backfilling in the main river channel and

backwater areas are not likely to impact crooked-stem aster specimens since the species is more likely to occur on the riverbanks and on alluvial soils in forested floodplain habitats. These alternatives will also require work in 3 acres of floodplain habitats for staging and access areas, and this work has potential to impact crooked-stem aster habitat. Any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of crooked-stem aster will result in direct impacts to this species, and sediment removal may reduce the seed bank of this species in the PSA.

Floodplain alternative FP 1 involves no construction-related activity. FP 2 will cause no direct impacts to mapped Priority Habitat of crooked-stem aster from remedial excavation/backfilling; however, 0.4 acre of floodplain within the Priority Habitat will be impacted due to the construction of access roads. Floodplain remediation alternatives FP 3 through FP 7 will impact mapped crooked-stem aster habitat by clearing forested swamps, floodplain forests, and open woodland edges within the work areas. FP 3 through FP 5 will impact 1 to 2 acres of such habitat and FP 6 and FP 7 will impact 5 acres of such habitat. Excavation of floodplain habitat will cause direct mortality to any crooked stem aster plants within the work area, as well as remove all rhizomes below the surface grade from which the plant arises.

Table P-1. Crooked-stem Aster Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Crooked-stem Aster Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5B	1,401 lf riverbank remediation.	3 ac habitat removal	<1
SED 4	5B	1 ac (thin-layer capping) 1,401 lf riverbank remediation.	3 ac habitat removal	3
SED 5	5B	1 ac (excavation/capping) 1,401 lf riverbank remediation	3 ac habitat removal	5
SED 6	5B	1.3 ac (excavation/capping) 3 ac (thin-layer capping) 1,401 lf riverbank remediation.	3 ac habitat removal	5
SED 7	5B	2 ac (excavation/capping) 2 ac (thin-layer capping) 1,401 lf riverbank remediation	3 ac habitat removal	6
SED 8	5B	4 ac (excavation/capping) 1,401 lf riverbank remediation	3 ac habitat removal	7
FP 1	N/A – No Action	0		
FP 2	5B	0	0.4 ac habitat removal	1
FP 3	5B	2 ac (excavation/backfill)	1.1 ac habitat removal	3
FP 4	5B	2 ac (excavation/backfill)	1 ac habitat removal	4
FP 5	5B	1 ac (excavation/backfill)	1 ac habitat removal	4
FP 6	5B	5 ac (excavation/backfill)	1.2 ac habitat removal	13
FP 7	5B	5 ac (excavation/backfill)	1.4 ac habitat removal	22

*Crooked-stem aster Priority Habitat occurs only in Reach 5B.
**All direct impacts under SED alternatives are to riverine, riverbank and backwater habitats.
***Duration of work figures refer to length of time to conduct all work within the reach.

P-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for crooked-stem aster is not identified in Reach 5A.

Reach 5B

Priority Habitat for crooked-stem aster occurs in the lower section of Reach 5B approximately 1,000 feet south of New Lenox Road. Mapped habitat for crooked-stem aster in Reach 5B totals approximately 38 acres and includes associated emergent marshes, scrub thickets, forested swamps, floodplain forests, and other wetland communities bordering the Housatonic River. The portion of the crooked-stem aster Priority Habitat within the PSA is 24 acres, and comprises the more suitable habitat for this species within the Priority Habitat.

Sediment alternatives SED 1 and SED 2 involve no impacts to mapped Priority Habitat for crooked-stem aster, and SED 3 involves no in-river remediation within the crooked-stem aster Priority Habitat. SED 4 impacts 1 acre of mapped habitat due to thin-layer capping in river and backwater areas, and SED 5 impacts 1 acre of mapped habitat due to the removal of 1.5 to 2 feet of river sediment followed by backfilling with clean sand material. SED 6 impacts increase slightly with 1.3 acres of habitat alteration due to 1 to 2 feet of sediment removal and backfilling in river and backwater areas and 3 acres of habitat alteration due to thin-layer capping in river and backwater areas. SED 7 impacts 2 acres of habitat due to 1 to 3.5 feet of sediment removal and backfilling in river and backwater areas and 2 acres of habitat alteration due to thin-layer capping in river and backwater areas. SED 8 impacts 4 acres of habitat due to 2 to 6 feet of sediment removal in river and backwater areas. In addition SED 3 through SED 8 will impact approximately 1,400 linear feet of riverbank. SED 3 through SED 8 all involve access road construction impacts of approximately 3,000 linear feet or 1 acre and staging area impacts of an additional 2 acres within the mapped Priority Habitat of the crooked-stem aster. Impacts from riverbank remedial activities and access and staging area construction will directly impact crooked-stem aster habitat. Thin-layer capping, sediment removal and backfilling in the main river channel and backwater areas is not likely to kill crooked-stem aster specimens since the species is more likely to occur on the riverbanks and on alluvial soils in forested floodplain habitats. The estimated timeframe for completing the remediation work under alternative SED 3 is less than one year; 3 years for SED 4; 5 years for SED 5 and SED 6; 6 years for SED 7; and 7 years for SED 8.

Floodplain alternative FP 1 involves no construction-related activity. FP 2 will cause no direct impacts to mapped Priority Habitat; however, 0.4 acre of floodplain within that habitat will be impacted due to the construction of access roads. FP 3 and FP 4 will remove 2 acres of crooked-stem aster habitat by removing vegetation and excavating impacted soils. FP 5 will remove 1 acre of such habitat by removing vegetation and excavating impacted soils. FP 6 and FP 7 will remove 5 acres of such habitat by removing vegetation and excavating impacted soils. FP 3 through FP 7 also will each impact between 1 and 1.5 acres of crooked-stem aster Priority Habitat due to the construction of access roads and staging areas. Floodplain remediation alternatives FP 3 through FP 7 will impact mapped crooked-stem aster habitat by clearing forested swamps, floodplain forests, and open woodland edges within the work areas. Excavation of floodplain habitat will cause direct mortality to any crooked stem aster plants within the work area, as well as remove all rhizomes below the surface grade from which the plant arises. The estimated timeframe for completing the remediation work under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 5C

Priority Habitat for crooked-stem aster is not identified in Reach 5C

Reach 6

Priority Habitat for crooked-stem aster is not identified in Reach 6

P-4. Assessment of MESA Issues for Crooked-stem Aster under Remedial Alternatives

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to "collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…" A "take" is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for crooked-stem aster is summarized in Table P-2 for the sediment alternatives and Table P-3 for the floodplain alternatives. These tables identify for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table P-2, sediment alternatives SED 1 and SED 2 would not result in a take of the crooked-stem aster, as those alternatives do not involve any construction work. In SED 3 through SED 8, thin-layer capping, sediment removal and backfilling in the main river channel and backwater areas are not likely to kill crooked-stem aster specimens since the species does not grow in these habitats. However, these alternatives will likely result in a take because of the direct construction impacts from riverbank and access road and staging work in crooked-stem aster habitat. The riverbank remedial activities in these alternatives, which would impact 1,400 linear feet of riverbank within the Priority Habitat, would result in impacts to wooded riverbanks and streamside seeps that provide prime habitat for crooked-stem aster populations. In addition, SED 3 through SED 8 all involve access road and staging area construction impacts resulting in 3 acres of habitat loss within the mapped Priority Habitat of the crooked-stem aster. Impacts from access road and staging area construction will directly impact crooked-stem aster habitat such as floodplain forest and wet meadows. In addition to direct killing of mature plants, soil excavation from riverbank and access road/staging area construction is likely to remove this species' seed bank, which is also a take under MESA. Total impacts to the mapped crooked-stem aster Priority Habitat are between 11% and 19% under SED 3 through SED 8; however, less than 10% of the most likely habitat for this species will be impacted, and the extent of riverbank impacts (1,400 lf) are not extensive. Accordingly, it is unlikely that a significant portion of the local population of crooked-stem aster will be impacted by SED 3 through SED 8.

As shown in Table P-3, all floodplain alternatives other than FP 1 and FP 2 are likely to result in a take of the crooked-stem aster. FP 2 involves only 0.4 acre of impacts, which are due to access road construction. It is unlikely that this would result in a take, especially if the access road location could be modified to avoid crooked-stem aster colonies. Even if it did, it would not affect a significant portion of the local population. FP 3 through FP 7 will impact floodplain forest and wet meadow communities, which are preferred habitat for the crooked-stem aster and thus will likely result in a take of this species. FP 3 through FP 5 will impact approximately 3 acres (8%) of the total mapped crooked-stem aster Priority Habitat. Access road and staging area impacts may be minimized by adjusting their locations to avoid specimens of crooked-stem aster identified in proximity to the proposed work areas. Accordingly, these alternatives are not likely to impact a significant portion of the local population. FP 6 and FP 7 will result in impacts to more than 6 acres of crooked-stem aster habitat, or approximately 16% of the Priority Habitat area for this species, and thus will likely impact a significant portion of the local population. Accordingly, a long-term net benefit plan would not be applicable under MESA.

Alternatives SED 3 through SED 8 and FP 2 through FP 5 will avoid an impact to a significant portion of the local crooked-stem aster population; therefore, a long-term net benefit plan would potentially be applicable.

However, based on review of the relevant literature, little is known about conservation strategies for this species. As a result, it cannot be established that a conservation and management plan would achieve an overall net benefit for this species, given the adverse impacts from the remediation and the current high-quality habitat for supporting the crooked-stem aster in the PSA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 1997. Crooked-stem Aster (*Symphyotrichum prenanthoides*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

Table P-2: Assessment of MESA Issues for Crooked-stem Aster Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action	NA	NA	NA
SED 2	No take due to monitoring natural recovery only.	NA	NA	NA
SED 3 through SED 8	Yes. Riverbank remediation activities would impact 1,400 lf of riverbank in the Priority Habitat of the crooked stem aster, which provides good conditions for growth of the species. Access road and staging area construction will occur within floodplain forests and wet meadows which are also preferred habitat. In addition to the direct "take" of mature plants, soil excavation due to riverbank and access/staging area construction are also likely to substantially remove the seed bank of this species, which would also constitute a "take" pursuant to MESA.	No. If plants occur along the riverbank within remediation zones, a "take" will occur. Work for some access roads and staging areas could possibly be modified to avoid documented plant colonies.	Unlikely. Although this work impacts up to 19% of the total Priority Habitat for this species, only several acres (or less than 10% of the Priority Habitat) to be affected contains preferred habitat for the crooked-stem aster. The 1,400 feet of riverbank remediation will also impact preferred habitat for the crooked-stem aster, but is still a limited extent.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies that might benefit this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether such a plan would achieve a net benefit for the species.

Table P-3: Assessment of MESA Issues for Crooked-stem Aster Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action	NA	NA	NA
FP 2	Unlikely. Access road construction impacts only 0.4 acre (1%) of the Priority Habitat for this species. No remedial excavation work will occur with the habitat zone.	Probably. Access road location could possibly be modified to avoid documented plant colonies.	No. Even if a take occurs, the impact area is too small to affect significant portion of local population.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies that might benefit this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether such a plan would achieve a net benefit for the species.
FP 3 through FP 5	Yes. Remediation activities and access road and staging area construction will occur within 2 to 3 acres of floodplain forests and wet meadows, which are preferred habitat for this species.	No. Remediation areas cannot be altered to avoid impacts. However, locations of some access roads and staging areas could possibly be modified to avoid or minimize plant colonies.	No. This work impacts approximately 8% of the total Priority Habitat for this species, and roughly 12% of the portion of the Priority Habitat within the PSA. These impacts are unlikely to affect a significant portion of the local population.	Cannot be established, for the same reasons discussed above for FP 2.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. Remediation activities and access road and staging area construction will occur within substantial areas (>6 acres) of floodplain forests and wet meadows, which are preferred habitat for this species.	No. Remediation areas cannot be altered to avoid impacts. However, locations of some access roads and staging areas could possibly be modified to avoid or minimize plant colonies.	Yes. This work impacts approximately 16% of the total Priority Habitat for this species, and 25% of the portion of this habitat within the PSA. These impacts are likely sufficient to impact a significant portion of the local population.	N/A. Since these alternatives would take a significant portion of the local population, a net benefit is not applicable under MESA.

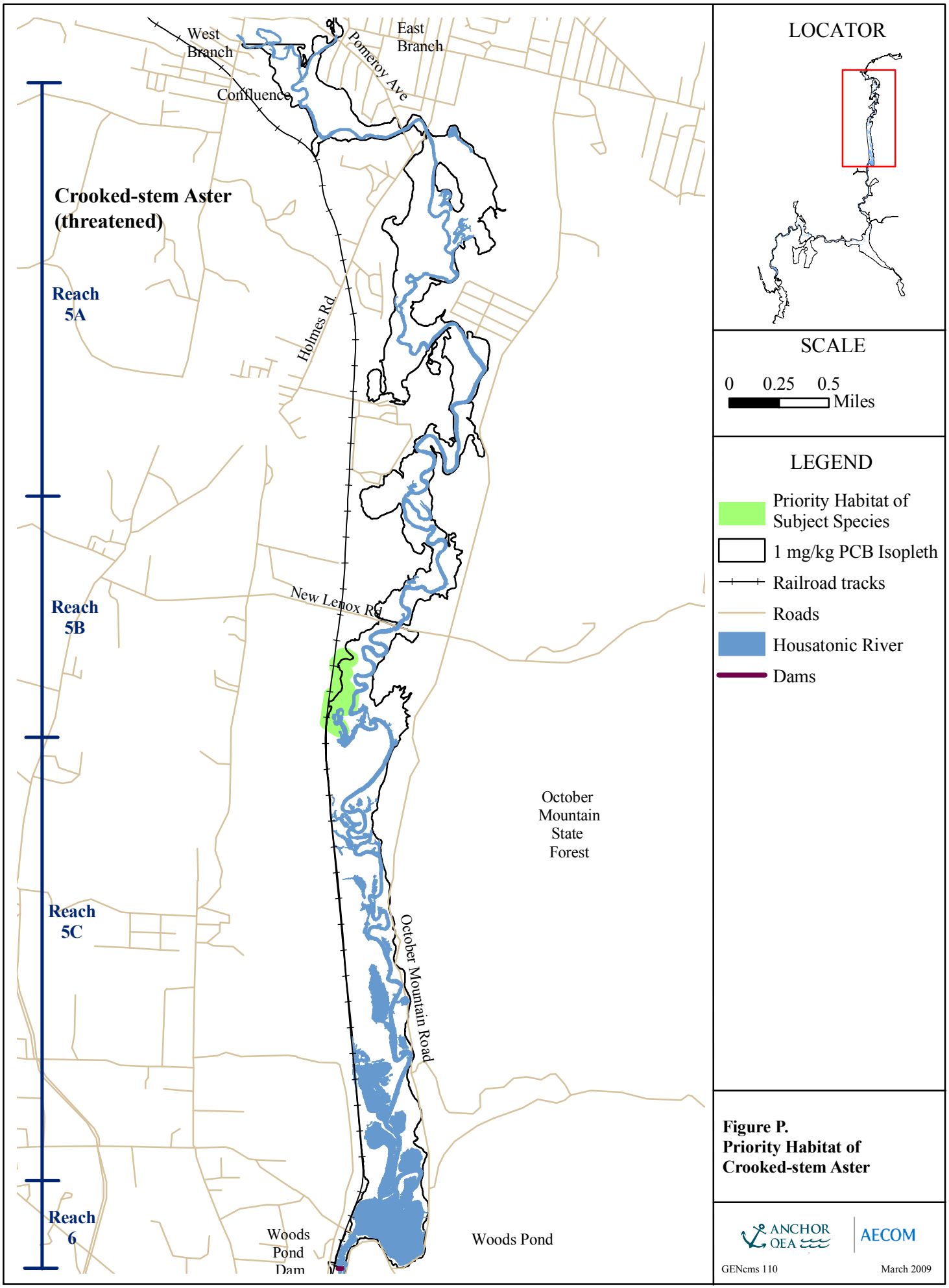

Figure P.
Priority Habitat of Crooked-stem Aster

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Q. Culver's Root (*Veronicastrum virginicum*)

Q. Culver's Root (*Veronicastrum virginicum*) MESA Assessment

Q-1. Summary of Species Life Cycle and Habitat Requirements

Culver's root (*Veronicastrum virginicum*) is a perennial herb and a member of the Figwort family. This plant grows 3 to 6 feet (1 to 2 m) in height and has white flowers that grow in dense spikes. The flowering period for this plant is from June to September. Culver's root occurs in rich soils of moist meadows and woodland areas, preferring ample moisture; however, it will tolerate a dry site once established. Culver's root prefers full sun to light shade. This species is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Threatened Species (NHESP 2008).

Q-2. Species Presence within PSA

According to NHESP database information, the six-acre Priority Habitat of Culver's root overlaps with only a very small portion of the PSA in the northern part of Reach 5A, as shown in Figure Q at the end of this section. The total Priority Habitat area of Culver's root within the PSA is approximately two acres and this area includes transitional floodplain forest and a red oak-sugar maple transitional forest directly adjacent to a residential area.

Q-3. Impacts of Remedial Alternatives on Culver's Root Habitat

None of the SED alternatives will impact the species, either through direct remediation or from the activities associated with construction of access roads and staging areas. FP 2 through FP 6 would not affect the Priority Habitat of this species either. The only remedial alternative that would affect this species is FP 7, which would involve 0.1 acre of impact from primary activities and an additional 0.1 acre of impact due to the construction of access roads and/or staging areas. These impacts would be incurred from canopy removal, soil disturbance (including possible loss of seeds in the bank), and potentially direct mortality to individual plants.

Q-4. Assessment of MESA Issues for Culver's Root

The MESA regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct." A "take" is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

None of the SED alternatives would impact the mapped Priority Habitat of Culver's root; therefore none of these alternatives would cause a take of this species.

As shown in Table Q-1 the only floodplain alternative that would affect the Priority Habitat of Culver's root is FP 7. Under this alternative, 0.1 acre of primary impacts and 0.1 acre of secondary impacts would occur. The total of these impacts is 3% of the Priority Habitat for this species within the PH. Short of conducting an on-site survey for the species, it would be difficult to rule out a take of this species, but the small percentage of habitat affected by the primary impacts of FP 7 (1.5% of overall Priority Habitat), coupled with the option to

modify access road alignments and move staging areas to avoid secondary impacts (1.5 % of the PH) altogether, indicate that any take would not impact a significant portion of the local Culver's root population.

Assuming that a take would occur under FP 7 and would affect an insignificant portion of the local population, a conservation and management plan geared toward enhancement and/or expansion of habitats supporting this species would be potentially applicable. The availability of commercial seed sources for Culver's root may aid in efforts to restore this species within the PSA. However, the genetic suitability of these commercial seed sources compared to native strains in the PSA is a concern, and therefore such commercial stock may not be acceptable. As a result, it cannot be determined whether such plantings or other measures would be appropriate under a conservation and management plan, or whether such measures would achieve an overall net benefit for the species.

References:

NHESP. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

Table Q-1: Assessment of MESA Issues for Culver's Root Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1-6	No take due to no action.	NA	NA	NA
FP 7	Possibly. A total impact of 0.2 acre will occur in suitable habitat for this species. Sediment excavation will also remove seeds, resulting in a take.	Possibly. The removal impacts will only encompass 0.2 acre, so there is a possibility of not directly impacting plants in that limited area. Seeds are dispersed by wind and not likely to be adjacent to plants. Reproduction by new shoots from underground stems would be protected if plants are avoided. The 0.1 acre of access roads and staging areas may be modified to avoid the plants.	No. The impacts are relatively small (3% of Priority Habitat). Accordingly, if a take were not avoidable, the impacts would be limited to an insignificant portion of the local population.	Cannot be established. Assuming that a take would occur under FP 7 and would affect an insignificant portion of the local population, a conservation and management plan geared toward enhancement and/or expansion of habitats supporting this species would be potentially applicable. The availability of commercial seed sources for Culver's root may aid in efforts to restore this species within the PSA. However, the genetic suitability of these commercial seed sources compared to native strains in the PSA is a concern, and therefore such commercial stock may not be acceptable. As a result, it cannot be determined whether such plantings or other measures would be appropriate under a conservation and management plan, or whether such measures would achieve an overall net benefit for the species.

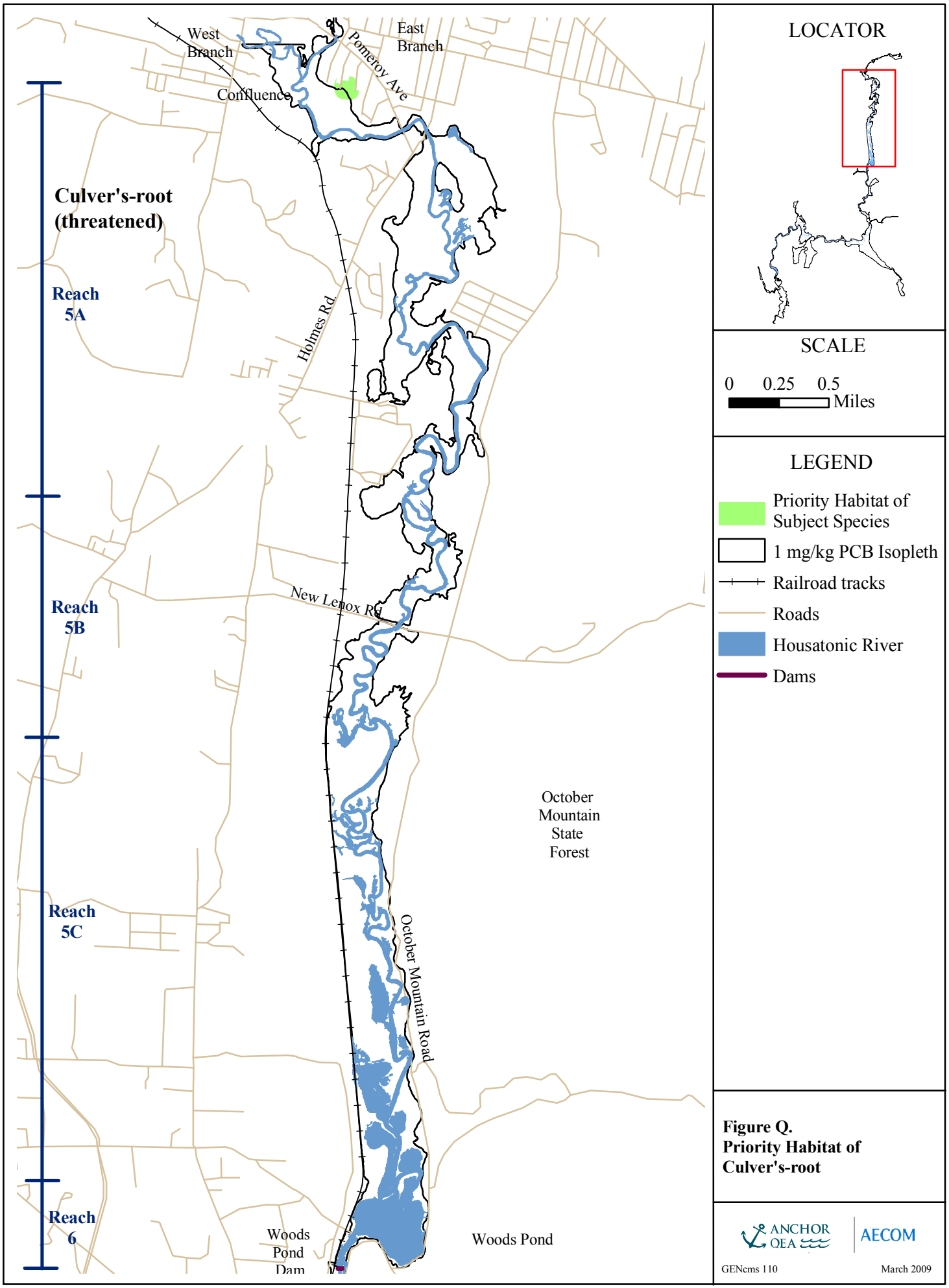

Figure Q.
Priority Habitat of Culver's-root

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R. Fen Cuckoo Flower (*Cardamine pratensis var. palustris*)

R. Fen Cuckoo Flower (*Cardamine pratensis* var. *palustris*) MESA Assessment

R-1. Summary of Species Life Cycle and Habitat Requirements

Fen cuckoo flower (*Cardamine pratensis* var. *palustris*), a member of the mustard family (Cruciferae or Brassicaceae), is a white-flowered, fibrous-rooted, herbaceous perennial, growing approximately 8 inches to 1.5 feet (2 to 5 dm) tall. The plant flowers from mid-May through early June. The fen cuckoo flower's habitats in Massachusetts include open portions of alkaline fens (unforested, peat-forming areas where very cold, nutrient-poor water seeps up to the surface through limey gravel), and calcareous seepage swamps. Among its associated species are spring cress *(Cardamine bulbosa),* speckled alder *(Alnus rugosa),* larch *(Larix laricina)*, tussock sedge *(Carex stricta),* and various willows *(Salix* spp.). The fen cuckoo flower is a state-listed Threatened Species (NHESP 2008).

R-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the fen cuckoo flower occurs along the PSA within Reach 5A northeast of the location where Sackett Brook empties into the Housatonic River as shown on Figure R. The Priority Habitat for this species totals 10 acres; however, the total Priority Habitat within the PSA is only 0.33 acre. Natural communities within this area consist of open water in a moderately alkaline pond, northern hardwoods-hemlock-white pine forest, and red maple swamp. Based on information in the NHESP Fact Sheet for this species, these natural communities are not considered prime habitat for this species.

R-3. Impacts of Remedial Alternatives and Assessment of MESA Issues for the Fen Cuckoo Flower

The planned remedial activities involved in SED 1 through SED 8 and FP 1 through FP 7 will not impact the mapped Priority Habitat of the fen cuckoo flower, as no activities are involved within the Priority Habitat under any of these alternatives.

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct.” A “take” is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

Since none of the remedial alternatives involve activities within the Priority Habitat of the fen cuckoo flower, there will be no impacts to this habitat and a “take” of this species will not occur.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2009. Fen Cuckoo Flower (*Cardamine pratensis* var. *palustris*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

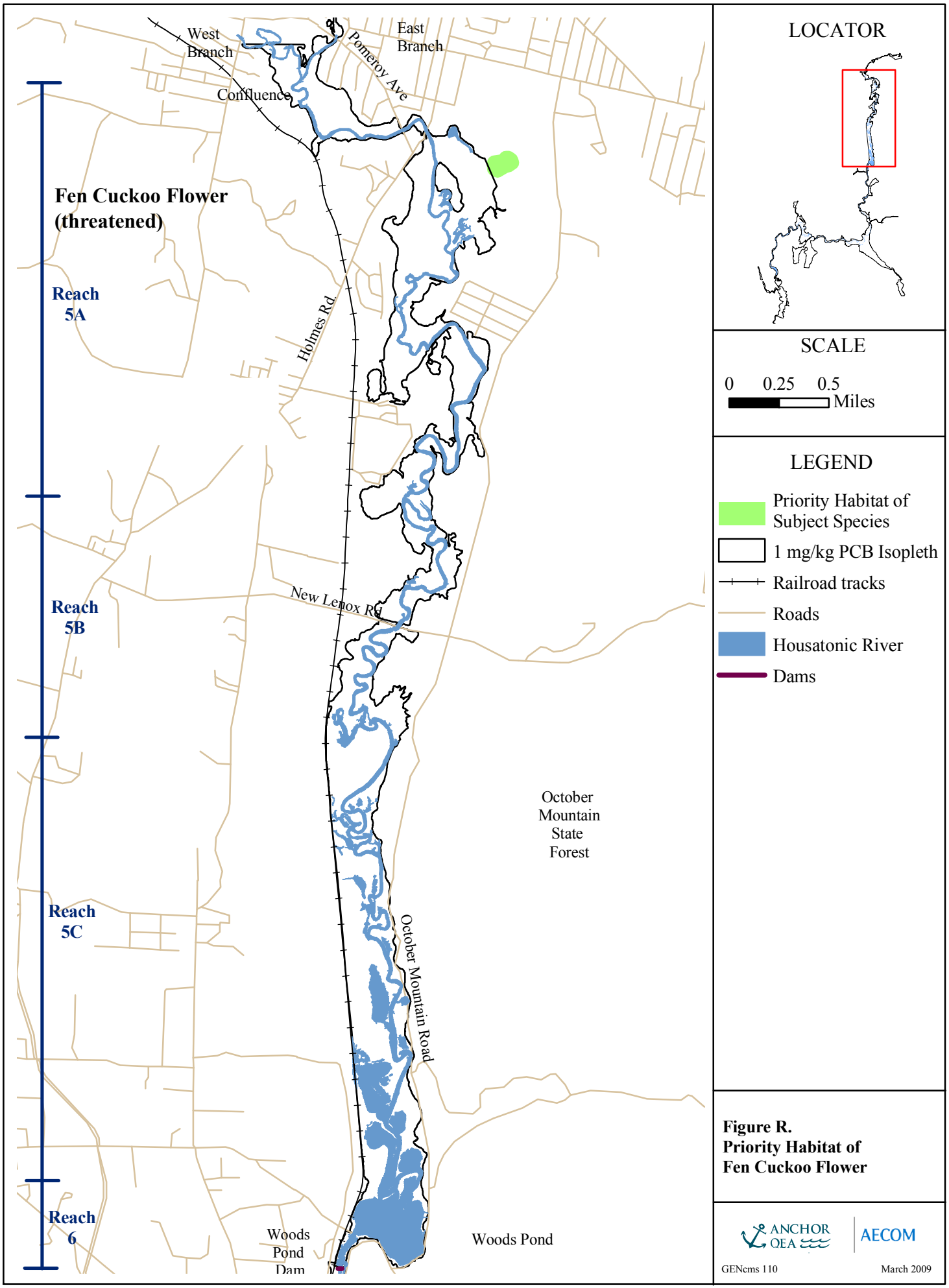

Figure R.
Priority Habitat of Fen Cuckoo Flower

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S. Foxtail Sedge (*Carex alopecoidea*)

S. Foxtail Sedge (*Carex alopecoidea*) MESA Assessment

S-1. Summary of Species Life Cycle and Habitat Requirements

Foxtail sedge (*Carex alopecoidea*), a member of the sedge family (Cyperaceae), is a perennial, herbaceous, grass-like plant. It is densely tufted, growing 1 to 2.5 feet (4 to 8 dm) tall with fruiting stems. Species in this genus have tiny, wind-pollinated flowers that are borne in spikes. Each flower is unisexual. Mature perigynia (a sac-like scale that encloses the flower, and later, the fruit) are present from mid June to mid August. Foxtail sedge grows in floodplain meadows and thickets, generally in alkaline alluvial soils. In Massachusetts, this sedge is typically found with other sedges, grasses, and herbs in open swales within floodplain forests. Associated species include ostrich fern (*Matteuccia struthiopteris*), sensitive fern (*Onoclea sensibilis*), false hellebore (*Veratrum viride*), false nettle (*Boehmeria cylindrica*), clearweed (*Pilea pumila*), rice cut grass (*Leersia oryzoides*), bedstraw (*Galium* spp.), jumpseed (*Polygonum virginianum*), reed canary grass (*Phalaris arundinacea*), and various sedges, including hairy-fruited sedge (*C. trichocarpa*, a state Threatened species), and fox sedge (*C. vulpinoidea*). Associated floodplain forest trees include silver maple (*Acer saccharinum*), basswood (*Tilia americanum*), and American elm (*Ulmus americana*). The foxtail sedge is a state-listed Threatened species in Massachusetts (NHESP 2008). According to NHESP, this species has reported occurrences only in Berkshire and Hampshire counties along the Hoosic, Housatonic, and Westfield Rivers (NHESP 2004).

S-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of foxtail sedge occurs in the PSA primarily within Reach 5B north and south of New Lenox Road, with a small portion of this species' Priority Habitat also extending into the northeast portion of Reach 5C (shown in Figure S at the end of this section). The total Priority Habitat area of foxtail sedge is approximately 192 acres. While only 78 acres of the Priority Habitat are situated within the PSA, the vast majority of the suitable habitat for the foxtail sedge is located within the floodplain wetlands of the PSA. Habitats within this area include the main stem of the river, shallow emergent marsh, wet meadow, transitional floodplain forest, red maple swamp, shrub swamp, cultural grassland, and riverine point bar/beach. Specific locations of foxtail sledge have been reported in Reach 5B north of New Lenox Road (Woodlot 2002).

S-3. Impacts of Remedial Alternatives on Foxtail Sedge Habitat

S-3-1. Overview

Table S-1 summarizes the areal extent and duration of work within foxtail sedge Priority Habitat for all the remedial alternatives. SED 1 involves no construction activities. SED 2 is limited to monitored natural recovery (MNR); it involves no direct construction work and therefore will not impact foxtail sedge Priority Habitat. SED 3 through SED 8 will impact approximately 14,260 linear feet of riverbank via remedial actions within the foxtail sedge Priority Habitat in Reach 5B. The riverbank conditions in Reach 5B offer suitable habitats for the foxtail sedge, as the riverbank just above and below New Lenox Road is not heavily shaded. SED 3 will not involve in-river remediation within the foxtail sedge habitat. SED 4 through SED 8 will impact 13 to 14 acres of river bottom and backwater habitats, however these are not considered likely habitat for the foxtail sedge due to due to the depth and duration of flooding. These alternatives will also require work in 13 acres of floodplain foxtail sedge habitat for staging and access areas. Areas of excavation, backfilling, deposition, clearing, or grubbing in foxtail sedge habitat will result in direct impacts to this species, and soil removal may reduce the seed bank of this species in the PSA. Backfilled sediments are not expected to contain seeds of the foxtail sedge, and the potential for colonization of invasive species at the expense of foxtail sedge growth is high under these conditions.

Floodplain remedial activities under FP 2 through FP 7 will impact this species by altering floodplain habitats, primarily in the wet meadow, transitional floodplain forest and shallow emergent marsh community types. Direct impacts to foxtail sedge Priority Habitat from floodplain remediation along with access and staging area impacts will range from 2.2 acres in connection with FP 2 up to 39 acres in connection with FP 7. In addition to direct removal of plants, the excavation of sediments will also remove the seeds of the foxtail sedge previously deposited in the sediment, reducing the repository of this species' seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. Backfilling with non-indigenous sediments is not expected to contain the seeds of this species, and therefore the establishment of newly exposed moist sediments from backfilling will not have the same potential for the re-growth of foxtail sedge. Moreover, such conditions are also prone to the colonization of numerous invasive species, and these are likely to have a competitive advantage over the foxtail sedge following disturbances.

Table S-1. Foxtail Sedge Mapped Habitat Alterations, by Remedial Alternative.

Remedial Alternative	Reach with Affected Habitat*	Description of Foxtail Sedge Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A - MNR	0	0	0
SED 3	5B	14,267 lf riverbank remediation	13 ac habitat removal	1
SED 4	5B	4 ac (excavation/ capping) 9 ac (thin-layer capping) 14,267 lf riverbank remediation	13 ac habitat removal	3
SED 5	5B	13 ac (excavation/ capping) 14,267 lf riverbank remediation	13 ac habitat removal	5
SED 6	5B	13 ac (excavation/ capping) 0.5 ac (thin-layer capping) 14267 lf of riverbank (remediation)	13 ac habitat removal	5
SED 7	5B	14 ac (excavation/capping) 0.01 ac (thin-layer capping) 14,267 lf riverbank remediation	13 ac habitat removal	6
SED 8	5B	14 ac (excavation/ capping) 14,267 lf riverbank remediation	13 ac habitat removal	7
FP 1	N/A – No Action	0	0	0
FP 2	5B	0.8 ac (excavation/backfill)	1.4 ac habitat removal	1
FP 3	5B	6 ac (excavation/backfill)	2 ac habitat removal	2
FP 4	5B	8 ac (excavation/backfill)	5 ac habitat removal	3
FP 5	5B	8 ac (excavation/backfill)	4 ac habitat removal	3
FP 6	5B 5C	25 ac (excavation/backfill) 1 ac (excavation/backfill)	5 ac habitat removal 0.9 ac habitat removal	7
FP 7	5B 5C	34 ac (excavation/backfill) 2 ac (excavation/backfill)	2.9 ac habitat removal 0.8 ac habitat removal	10

*Foxtail sedge occurs only within Reach 5B and a small portion of Reach 5C.
**Impacts under SED remediation work are to riverine and riverbank habitats. Impacts under FP alternatives and access road/staging areas are to floodplain wetland habitats.
***Duration of work figures are for the entire Reach 5B; work within the Priority Habitat portion may be less.

S-3-2. Description of Specific Impacts by River Segment

Reach 5B and Reach 5C

Mapped habitat for foxtail sedge is only found in the southern half of Reach 5B of the PSA and the northeast portion of Reach 5C along the confluence of Roaring Brook; due to the small area of Reach 5C affected, the area is treated herein collectively. This portion of Reach 5B/5C consists of multiple wetland vegetative community types, including floodplain forest, shrub thickets, and emergent wetlands which are suitable habitat for foxtail sedge in Massachusetts.

SED 1 and SED 2 would not cause any impacts to foxtail sedge Priority Habitat, as no construction activities are planned for these alternatives. All the other SED alternatives involve over 14,260 lf of riverbank remediation within foxtail sedge habitat. This work would have the potential to cause impacts to foxtail sedge Priority Habitats as this species is found growing in open areas within floodplain forests, which may coincide with areas along the bank to be remediated. The riverbank within the foxtail sedge Priority Habitat is relatively open, as tree cover is limited along this stretch of the river's edge. Within the foxtail sedge Priority Habitat, SED 4 through SED 8 involve 13-14 acres of river bottom remediation (excavation /backfilling or thin-layer capping); however these aquatic conditions are not considered likely habitat for the foxtail sedge. Sediment excavation may remove the seed bank of this species along the edges of the riverbank, which would also constitute a take pursuant to MESA. SED 3 through SED 8 will involve alterations of 13 acres of foxtail sedge Priority Habitat within Reach 5B due to staging areas and access roads, and these will occur within floodplain wetland communities that provide suitable habitats to support this species. Any overlap of these construction activities with areas supporting the growth of foxtail sedge will result in direct mortality, and removal of sediment containing foxtail sedge seeds will also reduce the seed bank of this species within the Housatonic River floodplain. The estimated timeframe for work within Reach 5B is 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8; the actual time required to complete the work within the foxtail sedge Priority Habitat would be less than these durations, but has not been specifically calculated.

Floodplain forest associated with the river is important habitat to the foxtail sedge, especially where more open canopy conditions prevail, and is found throughout the Priority Habitat mapped in Reach 5B and in a portion of Reach 5C. Wet meadows and other more open wetland types are also mapped in the area, which also serve as Priority Habitat for foxtail sedge. The floodplain remedial alternatives, consisting of excavation and backfill, would affect Priority Habitat of foxtail sedge and the extent of this impact would be proportional to the extent of the disruption. FP 1 involves no construction work in floodplains within the foxtail sedge Priority Habitat. However, FP 2 through FP 7 involve increasing amounts of impacts to foxtail sedge Priority Habitat. Direct excavation and backfilling in the floodplain within the foxtail sedge Priority Habitat will affect 0.8 acre for FP 2, 6 acres for FP 3, 8 acres for FP 4 and FP 5, 26 acres for FP 6, and 36 acres for FP 7. Access road and staging area alterations within foxtail sedge Priority Habitat for the FP alternatives range from 1.4 to 6 acres. The estimated timeframe for completing the various work alternatives is 1 to 10 years.

S-4. Assessment of MESA Issues for Foxtail Sedge

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to" collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct. " A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net Benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for the foxtail sedge is summarized in Table S-2 for the sediment alternatives and Table S-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take

would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of this species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table S-2, SED 1 and SED 2 would not result in a take of the foxtail sedge, as no construction work is planned for these alternatives. SED 3 through SED 8 will result in an unavoidable take due to the extent of riverbank remediation (over 14,000 lf) in Priority Habitat for the foxtail sedge, and due to the extent of impacts (13 acres) to vegetated floodplain communities offering prime habitat conditions for this species. Since the 78-acre portion of the foxtail sedge Priority Habitat within the PSA provides the most suitable habitat for this species within the overall Priority Habitat, the proportion of the PSA Priority Habitat impacted is likely to impact a significant portion of the local population of the foxtail sedge. Accordingly, a net benefit plan is not applicable under MESA.

As shown in Table S-3, all of the floodplain alternatives except for FP 1 and possibly FP 2 would result in a take of the foxtail sedge. A take could possibly be avoided under FP 2, as only a small portion (1%) of the foxtail sedge Priority Habitat will be impacted, and this area could be reduced by modifying access road and staging areas as a result of site-specific field inventories to locate foxtail sedge colonies. Only under FP 2 are the impacts minor enough to result in an impact to an insignificant portion of the local population. Because FP 2 impacts avoid the take of a significant portion of the local foxtail sedge population, the potential for measures to provide a net benefit to the species should be evaluated. It is not known whether a net benefit plan is feasible. Potential conservation and management measures designed to enhance or expand habitats capable of supporting this species might be developed and evaluated. However, based on the review of relevant literature little is known about conservation strategies for this species. As a result, it cannot be concluded that such a plan would in fact achieve an overall net benefit for this species, given the adverse impacts from the remediation.

The remaining FP alternatives would clearly result in a take of the foxtail sedge. Impacts under FP 3 through FP 5 increase to 8 to 13 acres of currently favorable foxtail sedge habitat, representing 10 to 17% of the PSA-portion of the foxtail sedge Priority Habitat (4 to 7% of the overall Priority Habitat). As a result of the overall large area of disturbance, the relatively large proportion of the PSA habitat to be impacted, and the favorability of this habitat for the foxtail sedge, a significant portion of the local foxtail sedge population would likely be affected. In addition, because soil excavation will result in loss of seed bank for this species, backfilling with soils from outside the floodplain is not likely to replace the seed bank of the foxtail sedge, and this backfilled soil is prone to colonization by invasive species at expense of sensitive native species such as the foxtail sedge. Due to the likely impact on a significant portion of the location population under FP 3 to FP 5, the requirement for a long-term net benefit plan is not applicable under MESA.

The remaining floodplain alternatives (FP 6 and FP7) will result in more substantial direct impacts due to the loss of a substantial portion (40 to 50%) of the PSA foxtail sedge Priority Habitat and 16 to 20% of the overall Priority Habitat, which in turn is likely to cause direct mortality to a significant portion of the local foxtail sedge population. Due to the impact on a significant portion of the location population, the requirement for a long-term net benefit plan is not applicable under MESA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2002. Foxtail Sedge (*Carex alopecoidea*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table S-2: Assessment of MESA Issues for Foxtail Sedge Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take due to Monitored Natural Recover only.	NA	NA	NA
SED 3 through SED 8	Yes. Excavation, thin-layer capping, riverbank remediation (removal and stabilization), or a combination of these activities in Reach 5B of the PSA would cause impacts on the foxtail sedge mapped Priority Habitat. The in-river and backwater work are not expected to directly impact the foxtail sedge, as these are not typical habitats for this species. However, riverbank remediation (over 14,000 lf) has a high potential for a take, as this species is found growing in open areas within floodplain forests, which may coincide with areas along the bank to be remediated. Access road and staging area construction will involve work in 13 acres of optimum foxtail sedge habitat. In addition to direct take of mature plants, sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA. The overall extent of work in the foxtail sedge habitat (13 to 27 acres) indicates that a take will occur.	No. Due to overall large area of foxtail sedge habitat to be disturbed (13 to 27 acres). Excavation of sediments in habitat zone would constitute a take via removal of seed bank even if mature plants can be avoided. Loss of plants in work areas is unavoidable where they overlap. Site-specific inventories could allow for design of access and staging areas to minimize the taking.	Likely. SED 3 through SED 8 all involve work in 13 acres (7%) of the Priority Habitat of the foxtail sedge for access and staging areas within favorable floodplain habitat. Further, over 14,000 lf of riverbank remediation will occur, disturbing habitat offering favorable conditions for the growth of this species. Collectively, these impacts are likely to affect a significant portion of the local foxtail sedge population.	NA. Since there is likely a take of a significant portion of the local population, a net benefit is not applicable under MESA.

Table S-3: Assessment of MESA Issues for Foxtail Sedge Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Yes. Soil removal activities and access road/staging areas would involve direct impacts to suitable habitat areas within the mapped foxtail sedge Priority Habitat zone, although only of a relatively small area (2.2 acres). This work would include direct alteration to habitat and likely killing of plants within the work area, if any occur there. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	Possibly. The impacted area is a relatively small portion of the Priority Habitat area (just over 2 acres, or 1%) and nearly 3% of the foxtail sedge habitat within the PSA, and therefore a take might be avoided through concerted management efforts. Site-specific inventories would be needed to identify locations of foxtail sedge relative to activities to determine if plants could be avoided. Loss of plants in work areas is unavoidable where they overlap. Work for access roads and staging areas could possibly be modified to avoid documented plant colonies.	No. The impacts under this alternative relative to the overall Priority Habitat of the foxtail sedge is small (1.1 %). Accordingly, even if a take is unavoidable, the take could be limited to avoid impacting a significant portion of the local population.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies that might benefit this species. Therefore, there is insufficient information to identify the elements of such a plan for this species or to determine whether such a plan would achieve a net benefit for the species.
FP 3 through FP 5	Yes. Soil removal activities and access road/staging areas would involve direct impacts to preferred habitat areas within the mapped foxtail sedge Priority Habitat zone. This take would include direct	No. The impacted area ranges from 8 to 13 acres of the foxtail sedge Priority Habitat; this is a large enough area that avoidance of a take would	Likely. The relatively large area of impact (8 to 13 acres) under these alternatives, the portion of this work within the foxtail sedge Priority Habitat zone of the PSA (10 to 17%),	NA. Since there is likely a take of a significant portion of the local population, a net benefit is not applicable under MESA.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
	alteration to habitat and likely killing of plants. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA. The total impact area within the foxtail sedge Priority Habitat under these alternatives ranges from 8 to 13 acres, most of which is within high quality habitat for the foxtail sedge. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	not be practicable. Site-specific inventories would be needed to identify locations of foxtail sedge relative to activities to determine if plants could be avoided. Loss of plants in work areas is unavoidable where they overlap. Seed removal via sediment excavation is also unavoidable.	and the favorability of this habitat for this species, indicate that a significant portion of the local population would be impacted.	
FP 6 and FP 7	Yes. Soil removal activities and access road/staging areas would involve direct impacts to preferred habitat areas within the mapped foxtail sedge Priority Habitat zone. This take would include direct alteration to habitat and likely killing of plants. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA. The total impact area within the foxtail sedge Priority Habitat under these alternatives ranges from 31 to 39 acres.	No. These alternatives result in 31 to 39 acres of the foxtail sedge habitat being altered. Further, these alternatives involve substantial losses in habitats likely to support the foxtail sedge. Loss of plants in work areas is unavoidable where they overlap. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	Yes. Approximately 16 to 20% of the overall foxtail sedge habitat zone, and 40 to 50% of the habitat within the PSA, will be affected by these activities. Since the Priority Habitat would be significantly altered and would constitute a large proportion of the identified habitat area to be disturbed, there would be a take of a significant portion of the local population.	NA. Since there is a take of a significant portion of the local population, a net benefit is not applicable under MESA.

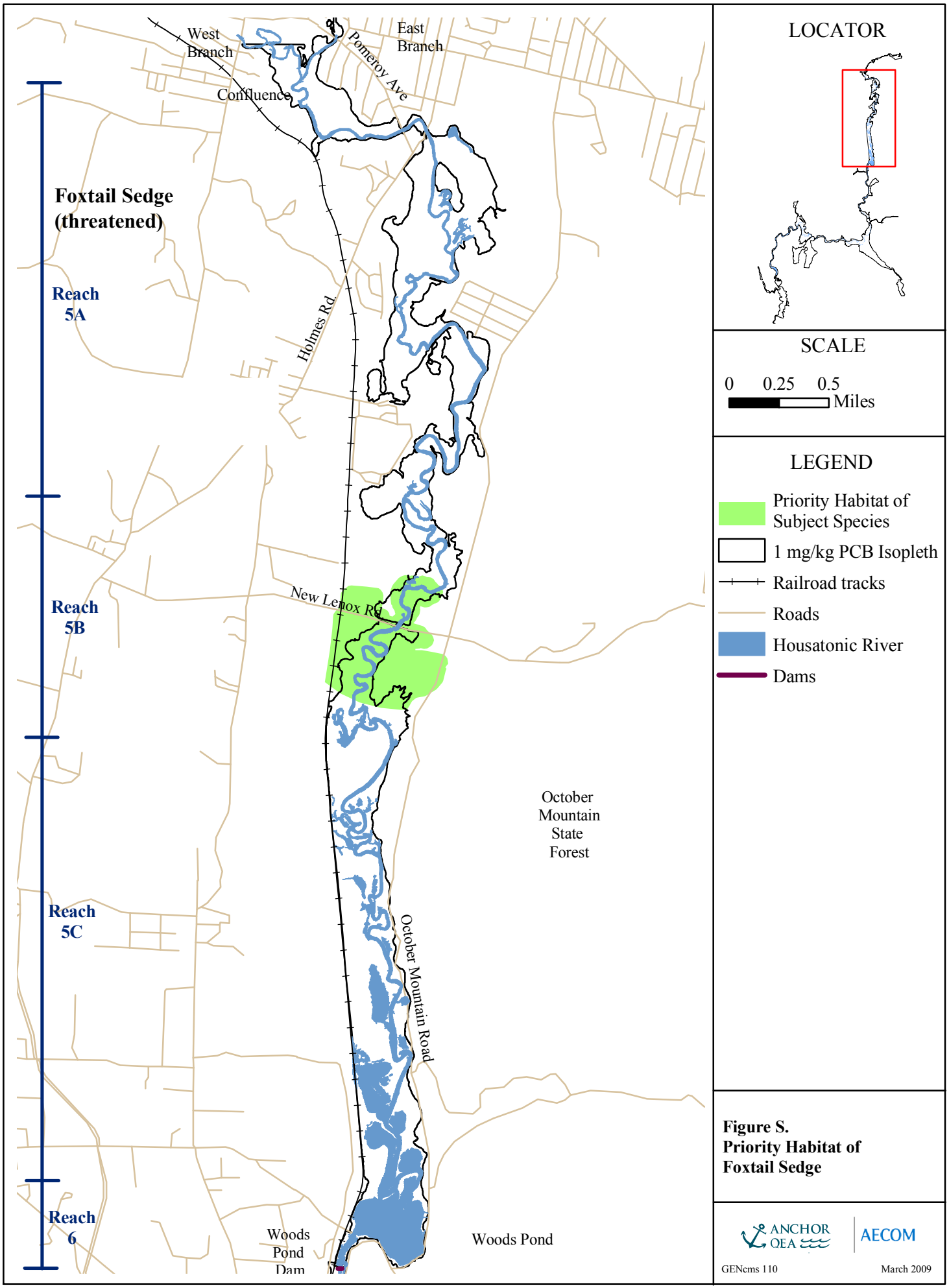

Figure S.
Priority Habitat of Foxtail Sedge

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T. Gray's Sedge (*Carex grayi*)

T. Gray's Sedge (*Carex grayi*) MESA Assessment

T-1. Summary of Species Life Cycle and Habitat Requirements

Gray's sedge (*Carex grayi*) is a perennial member of the sedge family (Cyperaceae) with strongly angled stems. Stems occur in small clusters with firm, broad (4 to 11 mm wide), pale green to gray-green leaves with loose, persistent purplish-red sheaths at the base of the leaves. Mature plants are 1 to 3 feet (3 to 9 dm) tall with a distinctly stalked terminal staminate spike. Pistillate spikes consist of 6 to 30 persistent perigynia which radiate out from a common point to form a globe-shaped spike. The dull, inflated, and strongly veined perigynia are present from June to October. Preferred habitat for this plant in Massachusetts is floodplain forest along major rivers where the floodplain forest is subject to flooding in the spring, wet deciduous forests on alluvial soils, swampy woods, calcareous meadows, and remnants of floodplain forests bordered by open pastures. Information provide by the NHESP Fact Sheet for this state-listed species indicates the preferred habitat of the Gray's sedge is river floodplain forests and remnant floodplain forest strips bordered by pastures (NHESP 2008).

Higher vascular plants found growing in association with Gray's sedge include American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanicus*), pin oak (*Quercus palustis*), silver maple (*Acer saccharinum*), wild onion (*Allium canadense*), and various species of wild rye (*Elymus* spp.). Gray's sedge colonies are currently known to occur in Berkshire, Franklin, Hampshire, and Hampden Counties. Gray's sedge is a state-listed threatened species in Massachusetts (NHESP 2008).

T-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat for Gray's sedge occurs in the PSA only within Reach 5C as shown on Figure T at the end of this section. The species is not reported within Reach 5A, Reach 5B, or Reach 6. The areal extent of the mapped habitat is broad and includes the main channel of the Housatonic River and the contiguous backwater areas which support a diverse complex of wetland habitats, including shallow emergent marshes, deep emergent marshes, wet meadows, shrub swamps, and floodplain forests. The Priority Habitat for Gray's sedge comprises approximately 214 acres, with 158 acres situated within the PSA. The Woodlot Ecological Characterization Report (2002) indicates a documented location of Gray's sedge within calcareous swamp along the west side of the Housatonic River roughly one mile north of Woods Pond.

T-3. Impacts of Remedial Alternatives on Gray's Sedge Habitat

T-3-1. Overview

Table T-1 summarizes the areal extent and duration of work within Gray's sedge habitat for all remedial alternatives. Overall, SED impacts within the Gray's sedge Priority Habitat range from 9 acres of thin-layer capping (SED 3) to a range of 33 to 42 acres of sediment removal/backfilling, thin-layer capping, and engineered capping for SED 4 through SED 8. Although the total area of impacts to Gray's sedge habitat involved in SED 3 through SED 8 ranges from 15 to 20% of the Priority Habitat area, the river channel and backwater areas are not preferred habitats for this species. Gray's sedge is more likely to occur along the riverbank or in the adjacent floodplain than along the river's edge or in deeper backwater areas. The extent of impacts from access roads and staging areas to these habitats of Gray's sedge is minimal from these alternatives.

Floodplain remediation alternatives FP 1 and FP 2 involve no construction-related activities in Gray's sedge habitat. FP 3 through FP 7 will impact Gray's sedge Priority Habitat within Reach 5C due to increasing levels of vegetation removal and excavation and backfilling in floodplain habitats with additional impacts resulting from the construction of access roads and staging areas in floodplain habitats. FP 3 and FP 4 will each

impact 0.8 acre of habitat by removing vegetation and excavating impacted soils in floodplain habitats; an additional 0.5 to 0.8 acre of habitat loss will occur due to access road/staging area construction. Impacts under FP 5 increase to 2 acres of floodplain habitat alteration due to vegetation removal and excavating impacted soils, while access road/staging area impacts increase to 2.9 acres. FP 6 and FP 7 impacts increase significantly to 13 to 16 acres of habitat alteration due to vegetation removal and excavating impacted soils in floodplain habitat, with 3 to 4 acres of access road/staging area impacts. Loss of habitat in emergent marsh, wet meadow, shrub swamp, red maple swamp, and transitional floodplain forest habitats within the work area may impact plants directly or indirectly through the loss of substrates suitable for seed banks or for the establishment of new colonies. Total impacts within the Gray' sedge Priority Habitat are less than 2 acres under FP 3 and FP 4, approximately 5 acres under FP 5, and 16 to 20 acres in FP 6 and FP 7.

Table T-1. Gray's Sedge Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Gray's Sedge Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5C	9 ac (thin-layer capping)	0.1 ac habitat removal	>1
SED 4	5C	28 ac (thin-layer capping) 9 ac (engineered capping)	0.02 ac habitat removal	2
SED 5	5C	5 ac (excavation/capping) 23 ac (thin-layer capping) 9 ac (engineered capping).	0.02 ac habitat removal	3
SED 6	5C	17 ac (excavation/capping) 16 ac (thin-layer capping)	0	4
SED 7	5C	22 ac (excavation/capping) 12 acres (thin-layer capping)	0	4
SED 8	5C	42 ac (excavation/capping).	0	7
FP 1	N/A – No Action	0	0	0
FP 2	5C	0	0	0
FP 3	5C	0.8 ac (excavation/backfill)	0.5 ac habitat removal.	3
FP 4	5C	0.8 ac (excavation/backfill)	1.0 ac habitat removal	4
FP 5	5C	2 ac (excavation/backfill)	2.9 ac habitat removal	4
FP 6	5C	13 ac (excavation/backfill)	2.9 ac habitat removal	13
FP 7	5C	16 ac (excavation/backfill)	4 ac habitat removal	22

*This species occurs only in Reach 5C.
**All direct impacts under SED alternatives are to riverine, riverbank and backwater habitats; FP impacts are to wetland floodplain habitats.
***Duration of work figures reflect work required for the entire reach of the river.

T-3-2. Description of Specific Impacts by River Segment

Reach 5A and Reach 5B

Priority Habitat for Gray's sedge is not identified in Reach 5A or Reach 5B.

Reach 5C

The Housatonic River within Reach 5C is a lower gradient system with increased meanders, backwater pools, remnant oxbows, and a silt to muck substrate. Priority Habitat for Gray's sedge encompasses approximately 214 acres in the lower section of Reach 5C above Woods Pond where suitable habitats, including emergent wetlands, shrub thickets, and floodplain forests border the main stem of the river; 158 acres of the Gray's sedge Priority Habitat is situated within the PSA.

SED 1 involves no construction related activities. SED 2 is limited to monitored natural recovery (MNR); since it involves no direct construction work it does not impact Gray's sedge Priority Habitat. SED 3 will affect 9 acres of Gray's sedge habitat due to thin-layer capping in the river channel in Reach 5C. SED 4 will impact 28 acres of Gray's sedge habitat due to thin-layer capping in the river and backwater areas and 9 acres due to engineered capping in the river. SED 5 involves the removal of 1.5 to 2 ft of sediment and 23 acres of thin-layer capping in river and backwater areas and 9 acres of engineered capping. SED 6 impacts 17 acres of habitat where the top 1 to 2 ft of sediment would be removed and 16 acres of habitat where thin-layer capping in river and backwater habitats would occur in Reach 5C. SED 7 impacts 22 acres of habitat due to the removal of 1 to 3.5 ft of bottom sediments in river and backwater areas and 12 acres of thin-layer capping in river and backwater areas in Reach 5C. SED 8 involves a significant increase in the depth of sediment removal from 1 to 3.5 ft to 2 to 6 ft of sediment in river and backwater areas and an increase in the size of the removal area to 42 acres in Reach 5C. Access road and staging area impacts under SED 3 to SED 8 are all minor (0.1 acre maximum). The estimated timeframe for completing the various remediation alternatives in Reach 5C is less than one year for SED 3; 2 years for SED 4; 3 years for SED 5; 4 years for SED 6 and SED 7; and 7 years for SED 8.

Additional impacts to Gray's sedge habitat will occur through construction-related activities associated with FP alternatives, with the extent of impact proportional to the extent of clearing, excavation of impacted soils, and backfilling planned under each alternative. Since FP 1 and FP 2 involve no construction work in floodplain habitats within the mapped Gray's sedge habitat, Gray's sedge habitat will not be impacted under these alternatives. FP 3 and FP 4 each impact 0.8 acre of Gray's sedge floodplain habitat due to vegetation removal and excavation of impacted soils, and each impact 0.5-1 acre of habitat due to access road construction and staging. FP 5 impacts increase to 2 acres of floodplain habitat alteration due to vegetation removal and excavating impacted soils, while access road impacts increase to 2 acres and staging area impacts increase to 0.9 acre. FP 6 impacts increase substantially to 13 acres of habitat removal due to vegetation removal and excavating impacted soils in floodplain habitat; access road and staging area impacts remain at 2.9 acres. FP 7 impacts increase to 16 acres of habitat removal due to vegetation removal and excavating impacted soils in floodplain habitats. Access road impacts remain at 2 acres, but staging area impacts increase to 2 acres.

Direct remediation excavation and backfilling in floodplain habitat will cause mortality to any Gray's sedge plants occurring within the work areas. Sediment excavation will also remove the seed bank of this species. The estimated timeframe for completing the remediation work within Reach 5C under FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7; the duration of work within the Gray's sedge Priority Habitat area may be less.

T-4. Assessment of MESA Issues for Gray's Sedge Under Remedial Alternatives

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to "collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…" A "take" is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions,

that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

An assessment of these issues for Gray's sedge is summarized in Table T-2 for the sediment alternatives and Table T-3 for the floodplain alternatives. These tables identify for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table T-2, all of the sediment alternatives except for SED 1, SED 2, and SED 3 would likely result in a take of Gray's sedge. Although this species generally occurs in floodplain forest habitats subject to spring flooding rather than along the river channel, remediation work associated with SED 4 to SED 8 is extensive enough (affecting 33 to 42 acres of habitat) that it could potentially kill some Gray's sedge plants or at least remove some of the seed bank for this species (which would also constitute a take), despite work primarily occurring in riverine and backwater areas. However, because the work under these alternatives is out of prime habitat types for the Gray's sedge, an impact to a significant portion of the local population is not expected. It is not known whether a net benefit plan is feasible. Potential conservation and management measures designed to enhance or expand habitats capable of supporting this species might be developed and evaluated. However, based on the review of relevant literature little is known about conservation strategies for this species. As a result, it cannot be concluded that such a plan would in fact achieve an overall net benefit for this species, given the adverse impacts from the remediation.

As shown in Table T-3, all of the floodplain alternatives except for FP 1 and FP 2 would result in a take of Gray's sedge plants. The limited remediation measures planned under FP 3 through FP 5 are not expected to result in an impact to a significant portion of the local population as the loss of mapped Priority Habitat is less than 5%. In addition, habitat removal due to the construction of access roads and/or staging areas may be modified to avoid impacting confirmed populations. For these alternatives, a long-term net benefit plan would potentially be applicable. However, as discussed above, based on a review of the relevant literature, little is known about conservation strategies for this species. Considering the high quality of the existing habitat conditions, the overall floodplain disturbances that would be associated with alternatives FP 3 through FP 5, and the particular vulnerability of a sensitive threatened species such as Gray's sedge, it cannot be established that conservation and management measures could achieve a net benefit for this species.

Habitat removal under FP 6 and FP 7 would impact substantial area (16 to 20 acres) and approximately 7 to 9% of the mapped habitat. With this substantial work within high quality habitat for Gray's sedge, a significant portion of the local population is likely to be impacted.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 1992. Gray's sedge (*Carex grayi*) Fact sheet, Natural Heritage and Endangered Species Program, Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table T-2: Assessment of MESA Issues for Gray's Sedge Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	NA	NA	NA
SED 2	No take due to Monitored Natural Recovery only.	NA	NA	NA
SED 3	No. Only involves thin-layer capping in the river channel where suitable habitat is absent.	NA	NA	NA
SED 4 through SED 8	Likely. Remediation work is extensive enough (affecting 33 to 42 acres of habitat) that, although it would primarily occur in riverine and backwater areas (which are not primary habitats for Gray's sedge), a take of this species is likely either through direct killing of plant or through removal of the seed bank of this species.	Possibly. Riverine and backwater areas are not primary habitat for this species, and locations of access roads and staging areas could possibly be modified to avoid documented plant colonies.	Possible. While these alternatives would impact up to 20% of the Priority Habitat area, affected habitats are not primary habitats for this species.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies that might benefit this species. Therefore, there is insufficient information to identify the elements of such a plan for this species or to determine whether such a plan would achieve a net benefit for the species.

Table T-3: Assessment of MESA Issues for Gray's Sedge Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	No take due to no remedial work in Gray's sedge habitat.	NA	NA	NA
FP 3 through FP 5	Yes. Soil removal activities (0.8 to 2 acres) and access road/staging area construction (0.5 to 2.9 acres) involve direct impacts to habitat areas within the mapped Priority Habitat for Gray's sedge. Clearing, grubbing, soil excavation and backfilling are likely to kill plants and remove the seed bank of this species.	Unlikely. Remediation areas cannot be altered to avoid impacts. However, locations of some access roads and staging areas could possibly be modified to avoid or minimize plant colonies. Seed removal via sediment excavation is also unavoidable.	No. Only a small proportion (2 to 5%) of the Gray's sedge Priority Habitat is impacted under these FP alternatives.	Cannot be established. As discussed above for alternatives SED 4 through 8, there is insufficient information about conservation measures for this species to determine whether a net benefit could be achieved.
FP 6 and FP 7	Yes. Soil removal activities (13 to 16 acres) and access road/staging area construction (2.9 to 4 acres) involve direct impacts to habitat areas within the mapped Gray's sedge Priority Habitat. Clearing, grubbing, soil excavation and backfilling are likely to kill plants and remove the seed bank of this species.	No. The impacted area is substantial (16 to 20 acres overall) and ranges from 7% to 9% of the Gray's sedge Priority Habitat. Remediation areas cannot be altered to avoid impacts. Seed removal via sediment excavation is also unavoidable. However, locations of some access roads and staging areas could possibly be modified to avoid documented plant colonies.	Likely. The relatively large area of impact (16 to 20 acres, 7-9% of total Gray's sedge Priority Habitat) under these alternatives and the portion of this work within the high quality habitat for this species indicate that a significant portion of the local population would likely be impacted.	N/A, since a significant portion of the local population would likely be impacted.

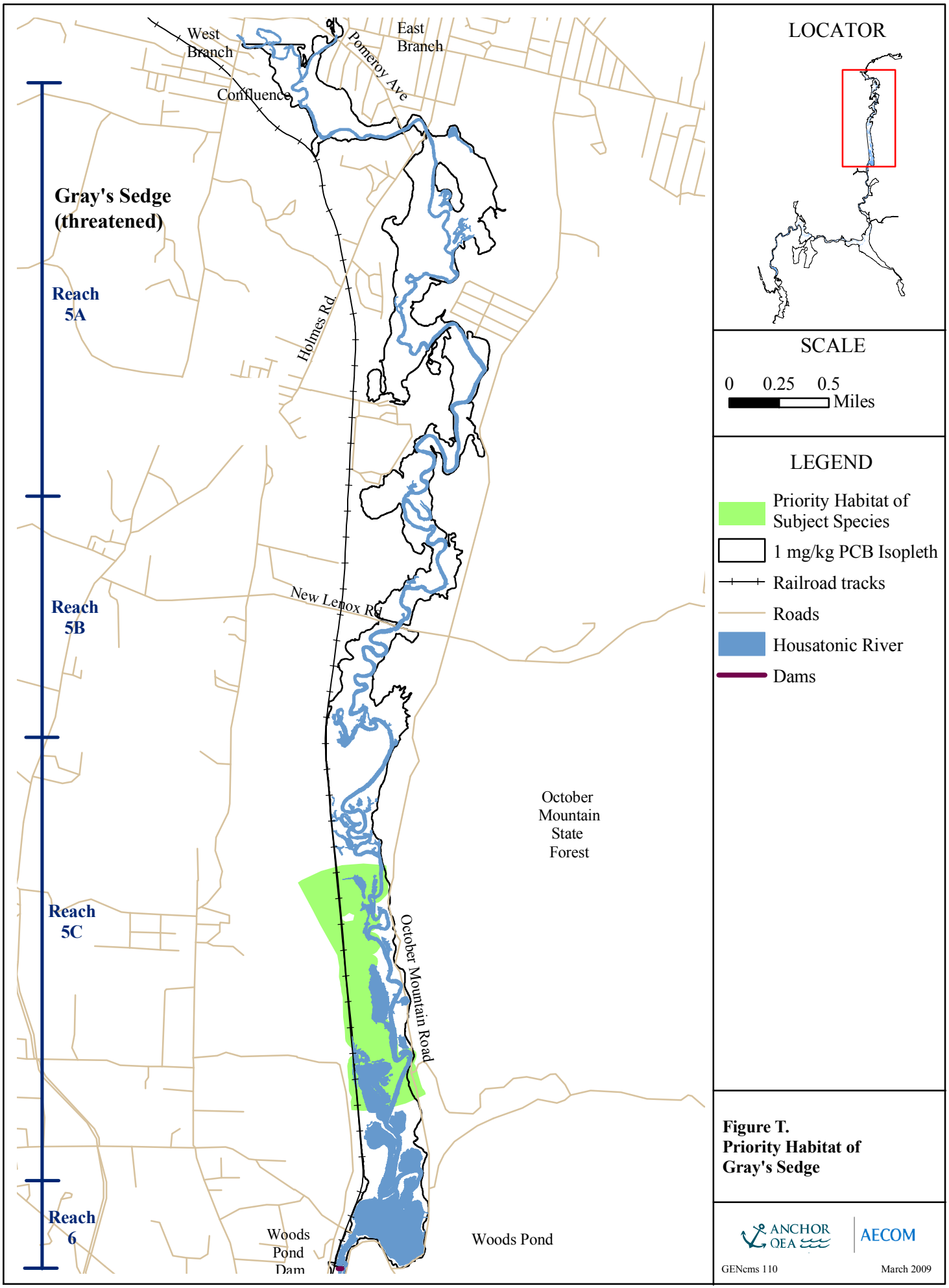

Figure T.
Priority Habitat of Gray's Sedge

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U. Hairy Wild Rye (*Elymus villosus*)

U. Hairy Wild Rye (*Elymus villosus*) MESA Assessment

U-1. Summary of Species Life Cycle and Habitat Requirements

Hairy wild rye (*Elymus villosus*) is an erect, native perennial in the grass family (Graminae or Poaceae) and grows in tufts 2.5 to 4 feet (8 to 10 dm) high. The stems are topped by an elongate terminal spike, which has a very bristly appearance. Hairy wild rye flowers from mid July to mid August. Habitats in Massachusetts include floodplain forests and rich mesic forests (NHESP 1992). These habitats are occasionally to rarely flooded. Associated plant species include silver maple *(Acer saccharinum),* basswood *(Tilia americana),* and various elms *(Ulmus* spp.) and sedges *(Carex* spp.). Hairy wild rye is a state-listed Endangered Species (NHESP 2008).

U-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of hairy wild rye occurs only in Reach 5A as shown on Figure U at the end of this section. The Priority Habitat for this species totals 91 acres, though only about half of this area (49 acres) is located within the PSA. Natural communities within this area include the main stem of the river, transitional floodplain forest, high-terrace floodplain forest, shrub swamp, and agricultural field. The PSA portion of the Priority Habitat contains high quality habitat suitable for hairy wild rye. Specific locations of hairy wild rye have been reported within the forested floodplain along this reach of the Housatonic River (Woodlot 2002).

U-3. Impacts of Remedial Alternatives on Hairy Wild Rye Habitat

U-3-1. Overview

Table U-1 summarizes the areal extent and duration of work within hairy wild rye Priority Habitat for all the remedial alternatives. Sediment alternative SED 1 consists of no action. SED 2 is limited to monitored natural recovery (MNR); it involves no direct construction work and will not impact hairy wild rye Priority Habitat. Alternatives SED 3 through SED 8 would each involve approximately 10 acres of impacts to the main river channel (due to sediment removal/backfill), about 10,060 linear feet of riverbank impacts (due to bank removal/stabilization activities), and 9 acres of additional impacts (due to access roads and staging areas) within hairy wild rye Priority Habitat. The in-river remediation is not expected to directly impact hairy wild rye, as it does not grow in aquatic habitats. However, the riverbank remediation will affect suitable habitats for this species within the Priority Habitat, and access road/staging area construction will also impact suitable habitats.

Floodplain remediation alternative FP 1 consists of no action. FP 2 through FP 7 will cause varied levels of impacts to the hairy wild rye Priority Habitat within Reach 5A through excavation activities. The least amount of impact is associated with FP 2 and would involve 0.2 acres of excavation within the Priority Habitat. FP 3 through FP 5 impact from 0.4 to 2 acres of hairy wild rye Priority habitat by soil excavation. FP 6 and FP 7 involve 4 and 11 acres of excavation within Priority Habitat, respectively. Access roads and staging areas involve additional impacts for alternatives FP 2 through FP 4, FP 6, and FP 7. Impact amounts for this work vary from 0.1 acres for FP 2 to 2.7 acres for FP 6.

Table U-1. Hairy Wild Rye Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat	Description of Hairy Wild Rye Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	8
SED 4	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	8
SED 5	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	8
SED 6	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	8
SED 7	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	10
SED 8	5A	10 ac (excavation/capping) 10058 lf of riverbank remediation	9 ac habitat removal	12
FP 1	N/A – No Action	0	0	0
FP 2	5A	0.2 ac (excavation/backfill)	0.1 ac habitat removal	1
FP 3	5A	1 ac (excavation/backfill)	1.5 ac habitat removal	3
FP 4	5A	2 ac (excavation/backfill)	1.6 ac habitat removal	4
FP 5	5A	0.4 ac (excavation/backfill)	0	4
FP 6	5A	4 ac (excavation/backfill)	2.7 ac habitat removal	13
FP 7	5A	11 ac (excavation/backfill)	1.6 ac habitat removal	22
*All direct impacts under SED alternatives are to riverine and riverbank habitats. All direct impacts under FP alternatives are to floodplain and palustrine wetlands in the PSA.				

U-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for hairy wild rye is documented in the southern portion of Reach 5A and includes the river and associated floodplain. Though the main channel of the river itself is not suitable habitat for hairy wild rye, the riverbank and floodplain within this area provides suitable growing conditions for this species as the riverbank is wooded and floodplain forests are common along this reach.

Except for SED 1 and SED 2, which involve no construction-related activities, all other sediment alternatives involve riverbank remediation and in-river sediment removal within Priority Habitat along Reach 5A. Under alternatives SED 3 through SED 8, erodible riverbanks will be excavated and reconstructed using armoring material and/or biostabilization measures to prevent erosion. This work would impact roughly 10,060 linear feet of riverbanks and land areas immediately adjacent to the banks located within Priority Habitat of hairy wild rye. In addition to riverbank remediation, work associated with SED 3 through SED 6 would include in-river remediation along the main stem of the river consisting of removal of the top 2 feet of river bottom

material. This would directly impact 10 acres of river bottom. SED 7 and SED 8 involve the same areal extent of riverbank remediation (about 10,060 lf) and in-river remediation (10 acres) in the Priority Habitat within Reach 5A, but will increase the depth of in-river sediment removal to 3 to 3.5 feet. No impacts to hairy wild rye would be expected during in-river remediation, as this is not considered prime habitat for the species. However, removal and stabilization of the adjacent riverbanks would pose a threat to the species, as this will have direct impact to suitable habitat for hairy wild rye and would include impacts to floodplain forest areas along the river's edge.

Access road construction and staging areas will disturb an additional 9 acres within hairy wild rye Priority Habitat of Reach 5A under all alternatives (except SED 1 and SED 2, which require no construction activities). Where these activities occur in floodplain forests, the potential for impacts to hairy wild rye exists, as this is considered prime habitat for the subject species in Massachusetts. The estimated timeframe for completing the various sediment alternatives in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8.

Floodplain forest associated with the river is ideal habitat for hairy wild rye. Transitional floodplain forest and high-terrace floodplain forest are common throughout the Priority Habitat mapped in Reach 5A. The floodplain remedial alternatives, consisting of excavation and backfill, would affect habitat of hairy wild rye and the extent of this impact would be proportional to the extent of the disruption. Floodplain alternative FP 1 consists of no action and, therefore, no work within the hairy wild rye habitat zone in Reach 5A. Activities for floodplain alternatives FP 2 through FP 7 would consist of clearing, grubbing, excavation, and backfilling of target areas in varying amounts within Priority Habitat. These activities performed under FP 2 through FP 5 would result in 0.2 acres (FP 2) to 2 acres (FP 4) of impacts within Priority Habitat for hairy wild rye. The majority of this work would occur within transitional floodplain forest. FP 6 and FP 7 involve soil removal over a more substantial portion of the forested area along this stretch of the river, totaling 4 acres and 11 acres of direct impact, respectively; a large portion of this work will occur within transitional floodplain forest as well as high-terrace floodplain forest.

Except for FP 1, which involves no construction, and FP 5 which will only cause impacts directly associated with excavation and backfilling, the remainder of the floodplain alternatives will include construction of access roads and staging areas within the hairy wild rye Priority Habitat, impacting an additional 0.1 acres (FP 2) to 2.7 acres (FP 6) of habitat. Where these activities occur in floodplain forests, the potential for impacts to hairy wild rye exists, as this is considered prime habitat for the subject species in Massachusetts.

The estimated timeframe for completing the various floodplain alternatives in Reach 5A is 1 year for FP 2, 3 years for FP 3, 4 years for FP 4 and FP 5, 13 years for FP 6, and 22 years for FP 7. Opportunity for natural stabilization and recovery of hairy wild rye on the exposed backfilled sediments is not expected, as remedial activities will likely eliminate the existing seed bank and re-establishment of mature floodplain forests will extend over decades once construction is complete. Although literature research indicates that commercial seed is available, the genetic diversity of the seed source may render it unusable. Additionally, the time needed to reestablish mature forest complicates recovery even if hairy wild rye is actively replanted.

U-4. Assessment of MESA Issues for Hairy Wild Rye

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct." A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the planned Project or Activity."

An assessment of these issues for hairy wild rye is summarized in Table U-2 for the sediment alternatives and Table U-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

Table U-2 shows that all of the sediment alternatives, except for SED 1 and SED 2, would result in a take of hairy wild rye. Alternatives SED 3 through SED 8 would each result in approximately 10 acres of direct in-stream disturbance, about 10,060 linear feet of riverbank removal and stabilization, and 9 acres of additional impacts due to access road and staging areas. These activities would cause impacts to about 20% of the Priority Habitat polygon. It is unlikely that the in-stream sediment removal would cause a take as the main channel of the stream does not provide suitable habitat for this species. However, 9 acres of impacts from staging areas and access roads and 10,058 linear feet of riverbank remedial actions would result in the severe disturbance to impacted floodplain forests and riverbank habitats along the river's edge that provide prime habitat for hairy wild rye. The extent of these impacts from SED 3 through SED 8 would cause direct mortality of hairy wild rye in these areas, as well as removal of the seed bank, and would affect a significant portion of the local population.

As shown in Table U-3, the affects of different floodplain alternatives vary. FP 1 consists of no action, so no take would occur. FP 2 and FP 5 will result in a take as construction activities will occur within Priority Habitat, but impacts will be minor – under 0.5 acre for each alternative. This impact represents less than 1% of the Priority Habitat for the hairy wild rye, which would not constitute an impact to a significant portion of the local population. FP 3 and FP 4 will also result in a take as construction activities will occur within Priority Habitat, but impacts will still be minor (less than 2.7 acres) and represent less than 5% of the Priority Habitat for the hairy wild rye; this would also not constitute an impact to a significant portion of the local population. Accordingly, a net benefit to this species may be considered under MESA.

As FP 2 through FP 5 will confine impacts to less than a significant portion of the local population, a conservation and management plan to provide a net benefit to the species, including measures for preservation, enhancement or expansion of habitat supporting this species is potentially applicable. The availability of commercial seed sources for hairy wild rye may aid in efforts to restore this species within the PSA. However, the genetic suitability of these commercial seed sources compared to native strains in the PSA is a concern, and therefore such commercial stock may not be acceptable. As a result, it cannot be determined whether such plantings or other measures would be appropriate under a conservation and management plan, or whether such measures would achieve an overall net benefit for the species.

Table U-3 also summarizes alternatives FP 6 and FP 7, both of which will result in an unavoidable take of the local hairy wild rye population. These alternatives will result in an alteration of 6.7-12.6 acres of floodplain forest, which is considered prime habitat for the species. These impacts amount to 7 to 14% of the total Priority Habitat, or 14-26% of the Priority Habitat within the PSA—which constitutes the most suitable habitat for this species. FP 6 and FP 7 would cause direct mortality to any individuals located within the remediation area. The amount of disturbance in the area will likely substantially reduce the existing seed bank and reduce chances for natural re-establishment of the species in affected areas. Accordingly, a significant portion of the local population will be impacted under FP 6 and FP 7, obviating the consideration of a net benefit under MESA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2006. Hairy Wild Rye (*Elymus villosus*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table U-2: Assessment of MESA Issues for Hairy Wild Rye Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no action.	N/A	N/A	N/A
SED 2	No take due to monitored natural recovery only.	N/A	N/A	N/A
SED 3 through SED 8	Yes. Though in-river work will not likely impact hairy wild rye, remediation of 10,058 linear feet of riverbank and construction of 9 acres of staging and access roads within hairy wild rye habitat will impact portions of floodplain forests that are considered prime habitat of this species. Riverbank remediation will also remove the seeds of this species.	No. Impacts to this species' habitat cannot be avoided, although some impacts may be minimized by adjusting access and staging areas. Suitable habitat would be altered under the planned alternatives; direct mortality of plants in these areas would occur. Seeds within the sediments of the riverbank will be removed.	Yes. Priority Habitat for the hairy wild rye would be significantly altered due to the construction of access roads and staging areas in 9 acres of the Priority Habitat area, resulting in a loss of up to 10% of the total Priority Habitat, or 18% of the PSA Priority Habitat for the species. These impacts, combined with impacts from extensive (>10,000 lf) riverbank remediation, will impact a significant portion of the local population of this species.	N/A. Since there is an impact to a significant portion of the local population, a long-term net benefit is not applicable under MESA.

Table U-3: Assessment of MESA Issues for Hairy Wild Rye Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	N/A	N/A	N/A
FP 2 and FP 5	Yes. Soil removal and backfill activities would involve a small amount (0.3 to 0.4 acre) of alteration to prime habitat (specifically floodplain forest). These activities will lead to direct mortality of any individuals within the work area. Sediment excavation is also likely to remove the seed bank of this species, which would also constitute an unavoidable take pursuant to MESA.	Possibly. Plants may not occur within sediment excavation areas; only a small area (0.1 acre) of impact is related to access road/staging work, which may be adjusted to avoid plants. However, sediment excavation is also likely to remove the seed bank of this species, which would also constitute an unavoidable take pursuant to MESA.	No. Impacts within Priority Habitat for this species under these alternatives are relatively limited (<1% of Priority Habitat).	Cannot be established. The availability of commercial seed sources for hairy wild rye may aid in efforts to restore this species within the PSA. However, the genetic suitability of these commercial seed sources compared to native strains in the PSA is a concern, and therefore such commercial stock may not be acceptable. As a result, it cannot be determined whether such plantings or other measures would be appropriate under a conservation and management plan, or whether such measures would achieve an overall net benefit for the species.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 3 and FP 4	Yes. Soil removal activities and access road/staging areas would involve alteration of 2.5 to 2.6 acres of floodplain forests and habitats within Priority Habitat of hairy wild rye. Sediment excavation is also likely to remove the seed bank of this species, which would also constitute an unavoidable take pursuant to MESA.	No. Impacts to hairy wild rye habitat would be unavoidable. Access and staging areas may be adjusted to reduce impacts, but a take could not be avoided due to remediation activities in floodplain forests and adjacent habitats. Sediment excavation would also take this species by removing the seed bank of this species.	Unlikely. Impact will be limited to less than 5% of the Priority Habitat area.	Cannot be established, as described above for FP 2 and FP 5.
FP 6 and FP 7	Yes. Soil removal activities and access road/staging areas would involve substantial alteration (6.7 to 12.6 acres) of floodplain forests and adjacent habitats within Priority Habitat of hairy wild rye. These activities will lead to direct mortality of any individuals within the work area. Seeds would be removed during sediment excavation, which would also constitute an unavoidable take pursuant to MESA.	No. Due to the scale of this work, temporary impacts to hairy wild rye habitat would be unavoidable. Access and staging areas may be adjusted to reduce impacts, but a take could not be avoided due to remediation activities in floodplain forests and adjacent habitats. Sediment excavation would also remove the seed bank of this species.	Yes. Alteration of 6.7 acres and 12.6 acres under FP 6 and FP 7, respectively, amount to 7 to 14% of the total Priority Habitat, and impact 14 to 26% of the PSA portion which contains the most suitable habitat. Considering the endangered status of this species, these impacts will adversely affect a significant portion of the local population of the hairy wild rye.	NA. Since there is an impact to a significant portion of the local population, a net benefit is not applicable under MESA.

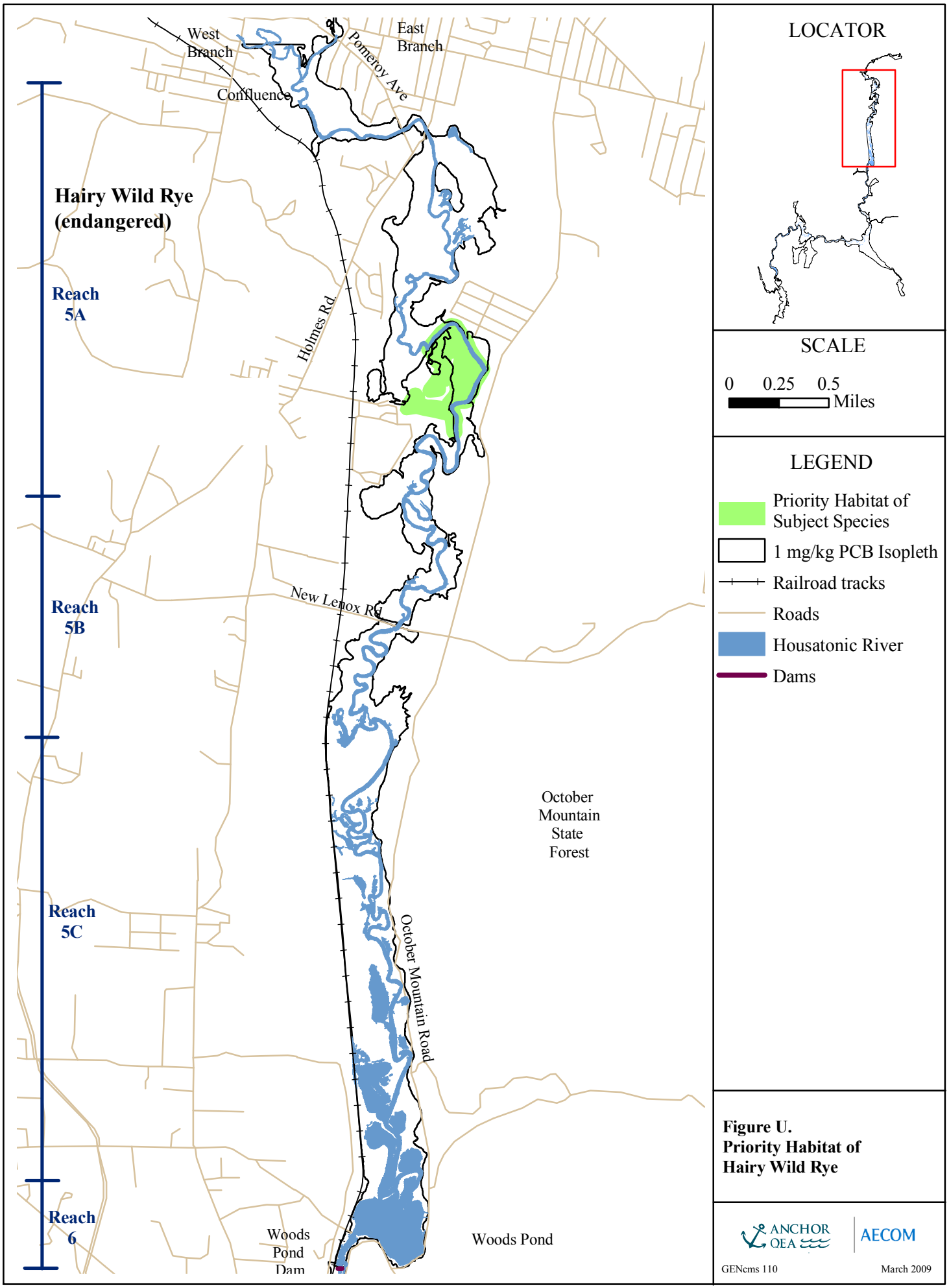

Figure U.
Priority Habitat of Hairy Wild Rye

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V. Hemlock Parsley (*Conioselinum chinense*)

V. Hemlock Parsley (*Conioselinum chinense*) MESA Assessment

V-1. Summary of Species Life Cycle and Habitat Requirements

Hemlock parsley (*Conioselinum chinense*) is a perennial herb in the parsley or angelica family (Apiaceae). It is generally a slender plant, growing to a height of 1 to 5 feet (4 to 15 dm) with small, white flowers occurring in large flat clusters on an unbranched stem. Hemlock parsley blooms from July until September. In Massachusetts, hemlock parsley is usually found in moist environments, such as swamps, wet meadows, bogs or fens, and marshy forests. It can tolerate shady environments and wet, acidic soils, although it is usually found in less acidic (circumneutral to limy) wetlands. It commonly grows in association with trees such as eastern hemlock (*Tsuga canadensis*), black ash (*Fraxinus nigra*), black spruce (*Picea mariana*), red maple (*Acer rubrum*), American larch (*Larix laricinia*), red oak (*Quercus rubra*), and yellow birch (*Betula alleghaniensis*). Other associated species include shrubby cinquefoil (*Dasiphora floribunda*), royal fern (*Osmunda regalis*), sheep laurel (*Kalmia angustifolia*), witch hazel (*Hamamelis virginiana*), and various species of sphagnum moss (*Sphagnum spp*.) and sedge (Carex spp.). Seventeen current occurrences are known in the Commonwealth; most of the sites are in the western half of the state, in Berkshire County. This species is a state-listed Species of Special Concern (NHESP 2008).

V-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of hemlock parsley occurs within the PSA in the northwest portion of Reach 5C, as shown on Figure V at the end of this section. The total Priority Habitat of hemlock parsley is approximately 40 acres in size, however, only 6 acres of mapped habitat occur within the PSA. Habitats within this area include red maple swamp, shrub swamp, and wet meadow. These habitats are considered suitable for hemlock parsley. Since this species is a perennial which is typically found in wetland environments, it tends to establish colonies with similar occurrence and distribution from year to year.

V-3. Impacts of Remedial Alternatives and Assessment of MESA Issues for Hemlock Parsley

The planned remedial activities involved in SED 1 through SED 8 and FP 1 through FP 7 will not impact the mapped Priority Habitat of the hemlock parsley.

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to “collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…” A “take” is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the planned Project or Activity.”

Since there will be no impacts to the Priority Habitat of hemlock parsley under any remedial alternative, a take of this species will not occur.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2008. Hemlock Parsley (*Conioselinum chinense*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

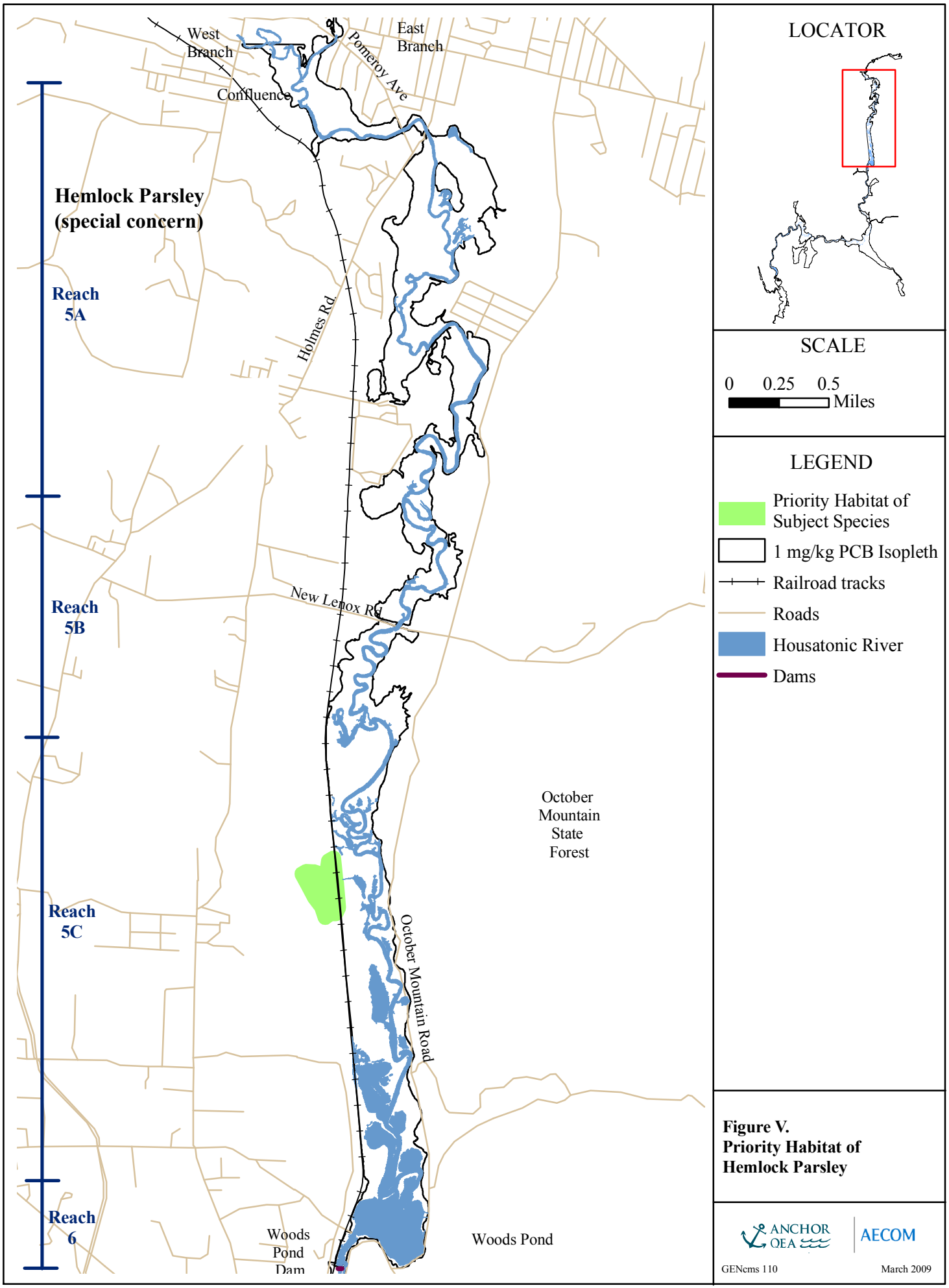

Figure V.
Priority Habitat of Hemlock Parsley

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W. Intermediate Spike-Rush (*Eleocharis intermedia*)

W. Matted (or Intermediate) Spike-rush (*Eleocharis intermedia*) MESA Assessment

W-1. Summary of Species Life Cycle and Habitat Requirements

The matted (or intermediate) spike-rush (or spike-sedge) (*Eleocharis intermedia*) is a small (about 2 to 10 inches tall), densely tufted, annual herbaceous plant species with thin, wiry stems. The matted spike-rush can occur in marshes, freshwater mudflats, or other wet areas with muddy substrates. In Massachusetts, this species is typically found on muddy, alkaline river banks and pond shores, usually during periods of low water when the muddy shores are exposed. Plant species often found in association with the matted spike-rush in Massachusetts include false pimpernel (*Linderia dubia*), nodding bur-marigold (*Bidens cernua*), rice cut-grass (*Leersia oryzoides*) and soft stemmed spike-rush (*Eleocharis obtusa*). The flowering period of this plant is from August into October. The matted spike-rush is a state-listed Threatened species in Massachusetts (NHESP 2008). According to NHESP, this species has reported occurrences within only 14 communities in the Commonwealth, all of which are in western counties (Berkshire, Franklin, and Hampshire counties).

W-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of the matted spike-rush occurs in the PSA throughout portions of Reaches 5A, 5B and 5C from the Holmes Road bridge to the northern portion of Reach 5C, as shown on Figure W at the end of this section. The areal extent of the mapped habitat in the PSA is broad and includes the main channel of the Housatonic River and the contiguous backwater areas which support a diverse complex of wetland habitats, including floodplain forest, emergent marsh, and scrub-shrub wetland habitats. However, preferred habitat is reported to be the exposed muddy substrates associated with shallow emergent marshes, wet meadows, and mud flats along the edges of the river and backwater open water areas. The total Priority Habitat of the matted spike-rush within the PSA is 387 acres; the total Priority Habitat for this species spans 490 acres. Specific locations of the matted spike-rush have been reported along the Housatonic River within Reach 5A west of the Joseph Road area and also in Reach 5B just south of New Lenox Road (Woodlot 2002). As an annual plant, the occurrence and distribution of the matted spike-rush may vary from year to year. The seeds or achenes of these species are distributed by moving water, and germinate when conditions are suitable at the location they are dispersed to.

W-3. Impacts of Remedial Alternatives on Matted Spike-Rush Habitat

W-3-1. Overview

Table W-1 summarizes the areal extent and duration of work within matted spike-rush habitat for all the remedial alternatives. SED 1 involves no construction activities. SED 2 is limited to monitored natural recovery (MNR); it involves no direct construction work and therefore will not impact matted spike-rush Priority Habitat. SED 3 through SED 8 involve increasing levels of remediation activities within matted spike-rush habitat. SED 3 will affect approximately 29 acres of matted spike-rush habitat found along the margins of the main river channel (due to sediment removal/backfill); additional impacts will occur from 55,235 linear feet of riverbank remediation along Reaches 5A and 5B. SED 4 through SED 8 would impact increasing amounts of matted spike-rush habitat as the amount of sediment removal and capping (thin-layer and engineered) increases. Excavation of the margins of the river and toe of slope of the riverbank will directly remove matted spike-rush plants and habitat, at least temporarily, as the preferred habitat (exposed muddy substrates) is excavated. The excavation of sediments may also remove the seeds or achenes of the matted spike-rush, reducing the repository of this species' seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. Backfilling with non-indigenous sediments is not expected to carry the seeds of matted spike-rush, and therefore the establishment of newly exposed moist sediments from backfilling will not enhance the potential for the re-growth of this species. Moreover, such

conditions are also prime for the colonization of numerous invasive species, and these are likely to have a competitive advantage over matted spike-rush following disturbances.

Floodplain remedial activities under FP 3 through FP 7 will impact this species by altering exposed muddy substrates, primarily in the open backwaters and emergent marshes. Overall impacts within the floodplains from sediment removal/backfilling, and access road/staging area construction range from 8 to 12% of Priority Habitat under FP 3 through FP 5 up to 22 to 33% of Priority Habitat under FP 6 and FP 7. FP 2 involves minimal work in open backwater or emergent marsh areas, and work in only 2.7% of the matted spike-rush Priority Habitat overall, so significant impacts from that alternative are not anticipated to matted spike-rush habitats.

Table W-1. Matted Spike-rush Habitat Alterations, by Remedial Alternative.

Remedial Alternative	Reach with Affected Habitat	Description of Matted Spike-rush Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)**
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5A	29 ac (excavation/capping) 35,621 lf riverbank remediation;	25 ac habitat removal	8
	5B	19,614 lf riverbank remediation	13 ac habitat removal	<1
	5C		1 ac habitat removal	<1
SED 4	5A	29 ac (excavation/capping) 4 ac (thin-layer capping) 35,621 lf riverbank (remediation)	25 ac habitat removal	8
	5B	4 ac (excavation/capping) 15 ac (thin-layer capping) 19,614 lf of riverbank remediation	13 ac habitat removal	3
	5C	7 ac (thin-layer capping)	3 ac habitat removal	2
SED 5	5A	29 ac (excavation/capping) 4 ac (thin-layer capping) 35,621 lf of riverbank remediation	25 ac habitat removal	8
	5B	18 ac (excavation/capping) 19,614 lf of riverbank remediation 0.3 ac (thin-layer capping)	13 ac habitat removal	5
	5C	6 ac (excavation/capping) 1 ac (thin-layer capping)	3 ac habitat removal	2
SED 6	5A	29 ac (excavation/capping) 4 ac (thin-layer capping) 35,621 lf of riverbank remediation	25 ac habitat removal	8
	5B	18 ac (excavation/capping) 19,614 lf of riverbank remediation 5 ac (thin-layer capping)	13 ac habitat removal	5
	5C	6 ac (excavation/capping) 0.9 ac (thin-layer capping)	0.6 ac habitat removal	4

Remedial Alternative	Reach with Affected Habitat	Description of Matted Spike-rush Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)**
SED 7	5A	29 ac (excavation/capping) 4 ac (thin-layer capping) 35,621 lf of riverbank remediation	25 ac habitat removal	9
	5B	20 ac (excavation/capping) 3 ac (thin-layer capping) 19,614 lf of riverbank remediation	13 ac habitat removal	6
	5C	6 ac (excavation/capping) 0.9 ac (thin-layer capping)	0.6 ac habitat removal	4
SED 8	5A	34 ac (excavation/capping) 35,621 lf of riverbank remediation	25 ac habitat removal	11
	5B	24 ac (excavation/capping) 19,614 lf of riverbank remediation	13 ac habitat removal	6
	5C	7 ac (excavation/capping)	0.6 ac habitat removal	10
FP 1	N/A – No Action	0	0	0
FP 2	5A	7 ac (excavation/backfill)	1.5 ac habitat removal	1
	5B	0.8 ac (excavation/backfill)	2.04 ac habitat removal	
	5C	0.3 ac (excavation/backfill)	1.4 ac habitat removal	
FP 3	5A	15 ac (excavation/backfill)	9 ac habitat removal	3
	5B	7 ac (excavation/backfill)	2.9 ac habitat removal	
	5C	4 ac (excavation/backfill)	1.5 ac habitat removal	
FP 4	5A	27 ac (excavation/backfill)	8 ac habitat removal	4
	5B	10 ac (excavation/backfill)	5 ac habitat removal	
	5C	5 ac (excavation/backfill)	2.8 ac habitat removal	
FP 5	5A	16 ac (excavation/backfill)	5 ac habitat removal	4
	5B	9 ac (excavation/backfill)	3 ac habitat removal	
	5C	10 ac (excavation/backfill)	2 ac habitat removal	
FP 6	5A	53 ac (excavation/backfill)	7 ac habitat removal	13
	5B	31 ac (excavation/backfill)	5 ac habitat removal	
	5C	12 ac (excavation/backfill)	1.6 ac habitat removal	
FP 7	5A	94 ac (excavation/backfill)	4 ac habitat removal	27
	5B	41 ac (excavation/backfill)	4 ac habitat removal	
	5C	18 ac (excavation/backfill)	1.4 ac habitat removal	

*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur in Reaches 5A and 5B. All direct impacts under FP alternatives are to floodplain and palustrine wetlands in the PSA.
**Duration of work for entire reach; actual time within matted spike-rush Priority Habitat portion will vary.

W-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for matted spike-rush in Reach 5A is reported from below the Holmes Road bridge south to the beginning of Reach 5B opposite the Pittsfield WWTF, and comprises 288 acres. The floodplain along the roughly three river miles between Holmes Road and New Lenox Road provides suitable habitat conditions for

the matted spike-rush, as wet meadows, shallow emergent marsh, and deep emergent marsh habitats become more common along this reach than in the more wooded area north of Holmes Road.

Except for SED 1 and SED 2, which involve no construction-related activities, all of the SED alternatives involve sediment removal, followed by capping or backfilling, throughout Reach 5A. SED 3 through SED 6 involve similar activities within this reach. This work involves removal of the top 2 feet of river bottom material followed by capping. This will directly impact 29 acres of river bottom. The erodible riverbanks will be excavated and reconstructed using armoring material and/or biostabilization measures to prevent erosion. As part of the riverbank remediation, soil removal and stabilization will occur on muddy substrates where colonization by matted spike-rush is possible. These activities would impact the entirety of the roughly 35,621 linear feet of river and associated banks and land areas immediately adjacent to the river in Reach 5A where Priority Habitat for the matted spike-rush is identified. In addition to the in-river work, SED 4, SED 5, and SED 6 also involve thin-layer capping in several backwater pool areas (4 acres), all of which offer suitable habitat (muddy substrates) for this species. SED 7 and SED 8 involve the same aerial extent of in-river remediation in the Reach 5A portion of the matted spike-rush habitat (29 acres), but will increase the depth of sediment removal to 3 to 4 feet. SED 7 also includes 4 acres of thin-layer capping in the backwaters, while SED 8 will involve the excavation and backfilling of 5 acres of backwater matted spike-rush habitat. Any excavation and backfilling that occurs in matted spike-rush growth areas will directly remove and kill the plants (including seeds), and deposition of six inches of sand (i.e., thin-layer capping) over these plants is also expected to result in direct mortality to most if not all of the plants. All of the SED alternatives (except SED 1 and SED 2) involve excavation and backfilling as well as riverbank remediation within the locations documented by Woodlot (2002) as supporting matted spike-rush south of Holmes Road within Reach 5A.

Access road construction and staging areas will disturb an additional 25 acres within the Priority Habitat of Reach 5A under all alternatives. Where these activities occur in open wetland habitats, any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. The estimated timeframe for completing the various work alternatives in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8.

FP 1 involves no activities. FP 2 will require soil removal and backfilling in approximately 7 acres of matted spike-rush Priority Habitat within Reach 5A. The majority of this is within transitional floodplain forest, which is not the prime habitat for this species; however several areas of open marshes will also be impacted from this alternative. Access roads and staging areas will impact another 1.5 acres, including some emergent wetland. Where these activities occur in open wetland habitats, any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species.

FP 3, FP 4, and FP 5 all involve a similar extent of soil removal activities within this upper reach of the Housatonic River, and the area of remediation for all three is considerably larger than for FP 2. Soil removal will occur within approximately 15 to 27 acres of floodplain wetlands bordering the river which provide suitable habitat conditions for matted spike-rush colonies. Seasonal pools within the floodplain forest may also provide habitat for matted spike-rush colonies. Access roads and staging areas will impact another 5 to 9 acres of matted spike-rush Priority Habitat in Reach 5A under these alternatives; where these activities occur in open wetland habitats, any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species.

FP 6 and FP 7 involve soil removal activities over a substantial portion of the floodplain along this stretch of the river, totaling 53 to 94 acres of direct impact and including habitat likely to support the matted spike-rush. Most of these areas directly border the river itself – the area where suitable habitat for the matted spike rush is most likely to be present. Vernal pools and backwater flooding areas within this reach of the river will be included in the remediation areas. Impacts from access roads and staging areas will result in an additional impact to 4 to 7 acres of matted spike-rush Priority Habitat. Where these activities occur in open wetland habitats any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species.

Reach 5B

In Reach 5B, matted spike-rush habitat extends from approximately 2000 feet north of New Lenox Road south to the northern edge of Reach 5C, comprising 139 acres. Reach 5B provides suitable habitat for populations of matted spike-rush where the floodplain of the Housatonic River maintains a meandering pattern with diverse bordering wetland communities and creates seasonally exposed, muddy shoals. River conditions continue with predominantly low-gradient meandering flows over a sandy bottom with silt soils and muck conditions more predominant in the areas of less current. Riverbanks are variable in composition, but often consist of sand/silt/muck deposits. Mature woody vegetation on the riverbanks tends to grade into more scrub-shrub wetlands and herbaceous communities south of New Lenox Road. Muddy substrates associated with the riverbanks, emergent marshes, and wet meadow habitats offer suitable habitat for populations of matted spike-rush. Woodlot (2002) documents the existence of the matted spike-rush just south of New Lenox Road in Reach 5B.

SED 1 involves no activities within this reach; SED 2 involves only MNR in this reach. SED 3 also involves MNR along with riverbank remediation (19,600 lf). SED 4 involves river bottom sediment removal and capping affecting 4 acres of matted spike-rush habitat in Reach 5B, along with 15 acres of thin-layer capping. SED 5 through SED 7 involve 18 to 20 acres of river bottom remediation as well as 0.3 to 5 acres of thin-layer capping. SED 8 involves 24 acres of river bottom excavation and backfilling. Riverbank remediation under SED 4 through SED 8 will occur through 19,614 linear feet of matted spike-rush habitat in Reach 5B, all of which is suitable matted spike-rush habitat along the margins of the river. The documented location of the matted spike-rush plant (Woodlot 2002) south of New Lenox Road would be affected by the riverbank remediation of SED 3 to SED 8, and by the river bottom remediation (thin-layer capping or excavation/backfilling) of SED 4 through SED 8. Any excavation and backfilling that occurs in matted spike-rush growth areas will directly remove and kill the plants, and deposition of six inches of sand (i.e., thin-layer capping) over these plants is also expected to result in direct mortality to most if not all of the plants.

Access road construction and staging areas will disturb an additional 13 acres within the Priority Habitat of Reach 5B under all alternatives. Where these activities occur in open wetland habitats, any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. The estimated timeframe for completing the various work alternatives in Reach 5B is 1 year for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8.

Within Reach 5B, FP2 involves several small soil removal areas along the west side of the river, which, along with access and staging impacts will result in alteration of nearly 3 acres of matted spike-rush Priority Habitat. FP 3, FP 4, and FP 5 all involve a similar extent of soil removal activities within Reach 5B, and the affected area of remediation for all three alternatives is considerably more than what is involved under alternative FP 2. Soil removal will occur in roughly 7 to 10 acres of matted spike-rush Priority Habitat; several vernal pool areas are included in the remediation area, all of which may be matted spike-rush habitat if a muddy substrate is present. Access road and staging areas will impact 3-5 additional acres of matted spike-rush habitat in Reach 5B under FP 3-5.

FP 6 and FP7 involve soil removal and restoration over a substantial area (31 to 41 acres) of the matted spike-rush Priority Habitat along this stretch of the river. Most of these soil removal areas directly border the river itself – the area where suitable habitat for the matted spike-rush is most likely to be present. A number of vernal pool and associated backwater flooding areas will be included within the remediation areas. Access road and staging area impacts associated with these alternatives in Reach 5B will increase impacts by approximately 9 to 14 acres in the Priority Habitat for matted spike-rush.

Reach 5C

The Housatonic River within Reach 5C is a lower gradient system with increased meanders, backwater pools, remnant oxbows, and a predominantly silty-muck bottom, prime habitat for the matted spike-rush. Matted

spike-rush habitat extends into the upstream portion of Reach 5C for approximately 1500 feet, comprising 63 acres within this reach. The lower section of Reach 5C is not identified as containing matted spike-rush habitat.

Work activities involved for each alternative relative to matted spike-rush habitat in this section (Reach 5C) of the river are summarized as follows:

SED 1 involves no activities within this reach; SED 2 and SED 3 involve only MNR within the matted spike-rush habitat portion of Reach 5C. SED 4 involves only thin-layer capping over 7 acres of this habitat zone. SED 5 through SED 7 all involve similar extent of work within the matted spike-rush habitat portion of Reach 5C. Each of these alternatives involve 6 to 7 acres of river bottom remediation and approximately 1 acre of thin-layer capping in backwaters. SED 8 involves 7 acres of sediment removal and backfilling in the river and some backwater areas; this work will incur direct mortality to matted spike-rush plants in the work zone (where there is high potential of this species to occur), and any seed banks of this species will be removed by the excavation. Access road and staging area construction will impact from 0.6 to 3 acres under these alternatives. Where these activities occur in open wetland habitats any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species.

The estimated timeframe for completing the various work alternatives in Reach 5C is up to ten years, however the time would be less within the Priority Habitat portion of this reach for the matted spike-rush.

Within Reach 5C, FP 1 involves no activities. FP2 also involves no activities within Priority Habitat for the matted spike rush. FP 3, FP 4, and FP 5 all involve similar, though progressively greater, extents of soil removal activity within Reach 5C, as the area of remediation within matted spike-rush habitat increases from 4 to 5 to 10 acres. In addition, backwater areas are the subject of remediation and may possess suitable muddy substrates. Access roads and staging areas for FP 3, FP 4, and FP 5 increase impacts to matted spike-rush habitat in this reach by 1.5 to 2.8 acres; while most of these are in forested wetlands, some open wetland types are also affected that offer suitable matted spike-rush habitat.

FP 6 and FP 7 involve soil removal and restoration over 12 to 18 acres of the matted spike-rush Priority Habitat along this stretch of the river. Access roads and staging areas will impact roughly an additional 1.5 acres within the matted spike-rush habitat.

Reach 6

Priority Habitat for matted spike-rush is not identified in Reach 6.

W-4. Assessment of MESA Issues for Matted Spike-rush

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct.” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for the matted spike-rush is summarized in Table W-2 for the sediment alternatives and Table W-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and

(c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it is feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table W-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of the matted spike-rush. At a minimum, the actions associated with the removal of river bottom sediments and erodible riverbanks would result in the loss of exposed muddy substrates along the river margins that provide habitat for matted spike-rush populations. SED 3 through SED 8 all involve direct alteration of locations where the matted spike-rush has been documented to occur (Woodlot 2002). While efforts may be made to avoid these specific locations, given the portion (13 to 21%) of the matted spike-rush Priority Habitat that would be disturbed by excavation, backfilling, thin-layer capping, access road construction, and staging areas in connection with the implementation of SED 3 through SED 8, a direct take in the form of the killing of matted spike-rush will occur. Riverbank remediation will disturb approximately 90% of the river margins through the sedge-rush Priority Habitat area where this species is most likely to occur. Sediment removal is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA; backfilled sediments are not expected to contain seeds of the matted spike-rush, and the potential for colonization of invasive species at the expense of matted spike-rush growth is high under these conditions. Even thin-layer capping, which will require the addition of about 6 inches of sand to existing muddy substrate, is expected to alter the habitat suitability for this species and result in the killing of at least some plants.

Under SED 3, sediment removal within the river, along with riverbank remediation, will affect roughly 60% of the riverine habitat within the matted spike-rush Priority Habitat, including the margins of the river which contain high quality matted spike-rush habitat; riverbank remediation will disturb roughly 90% of the river edges in the matted spike-rush habitat. Overall, all SED 3 activities will affect roughly 13% of the matted spike-rush habitat. Under SED 4 though SED 8, all riverine habitat in the Priority Habitat for matted spike-rush will be affected by in-river remediation, and approximately 90% of the riverbank within spike-rush habitat will be removed; overall 18 to 21% of the spike-rush habitat will be impacted. Given the extent of those effects, each of SED 3 through SED 8 sediment alternatives would likely impact a significant portion of the local matted spike-rush population. Due to the impact on a significant portion of the local population, the requirement for a long-term net benefit plan is not applicable under MESA.

As shown in Table W-3, all of the floodplain alternatives except for FP 1 and possibly FP 2 would result in a take of the matted spike-rush. A take could possibly be avoided under FP 2, as only a small portion (2.7%) of the matted spike-rush Priority Habitat will be impacted, and this area could be reduced by modifying access road and staging areas as a result of site-specific field inventories to locate matted spike-rush colonies. The remaining FP alternatives, however, would clearly result in a take of the matted spike-rush. However, impacts under FP 3 through FP 5 will likely avoid the take of a significant portion of the local matted spike-rush population as only 8 to 12% of the population will be affected and most of this area is not considered optimum habitat. Should impacts be limited to avoid the take of a significant portion of the local matted spike-rush populations, the resulting take would be allowed only if conservation and management measures can be developed which would provide a long-term net benefit to the species. However, based on a review of the relevant literature, little is known about conservation strategies for this species, and therefore it cannot be determined whether the types of measures would contain the appropriate elements of such a plan or would achieve a net benefit for this species.

The remaining floodplain alternatives (FP 6 and FP7) will result in more substantial direct impacts due to the loss of a substantial portion (22 to 33%) of suitable habitat, which in turn is likely to cause direct mortality to a significant portion of the local matted spike-rush population. Due to the impact on a significant portion of the local population, a long-term net benefit plan is not applicable under MESA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 2006. Matted Spike-rush or Spike Sedge (*Eleocharis intermedia*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

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Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River.

Table W-2: Assessment of MESA Issues for Matted Spike-rush Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no construction activities.	NA	NA	NA
SED 2	No take; only monitoring.	NA	NA	NA
SED 3	Yes. Excavation/backfill of 29 acres of river and 55,235 linear feet of riverbank in matted spike-rush habitat will impact muddy substrates that are a primary habitat of this species. Specific documented locations of the matted spike-rush will be affected via excavation/backfilling or thin-layer capping, resulting in direct killing of the plants. Given the extensive riverbank remediation and proportion of the matted spike-rush Priority Habitat that would be disturbed by excavation, backfilling, thin-layer capping, access road construction, and staging areas, a direct take in the form of killing of matted spike-rush under SED 3 appears unavoidable. Access and staging areas will impact 39 acres of matted spike-rush habitat. Where these activities occur in open wetland habitats, the potential for impacts to matted spike-rush exists; any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take	No. Suitable habitat would be altered under this alternative; direct killing of plants in these areas would occur. Seed removal via sediment excavation is also unavoidable.	Yes. Approximately 13% of the matted spike-rush habitat will be affected by these activities, and riverbank remediation will disturb the river margins along roughly 90% of the reach in which this species occurs.	NA, since there is a take of a significant portion of the local population.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
	pursuant to MESA.			
SED 4 through SED 7	Yes. Excavation/backfill of 33 to 55 acres of river, thin-layer capping in 5 to 26 acres of backwater areas, and 55,235 linear feet of riverbank in matted spike-rush habitat will impact muddy substrates that are habitat of this species. Specific documented locations of the matted spike-rush will be affected via excavation/backfilling or thin-layer capping, resulting in direct killing of the plants. Given the extensive riverbank remediation and proportion (18-21%) of the matted spike-rush Priority Habitat that would be disturbed by excavation, backfilling, thin-layer capping, access road construction, and staging areas, a direct take in the form of killing of matted spike-rush under SED 4 through SED 7 is likely. Access and staging areas will impact 38 to 41 acres of matted spike-rush habitat. Where these activities occur in open wetland habitats, the potential for impacts to matted spike-rush exists; any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	No. Direct killing of plants in these areas would occur. Even thin-layer capping which will require the addition of about 6 inches of sand to existing muddy substrate, is expected to alter the habitat suitability for this species and result in killing at least some plants. Seed removal via sediment excavation is also unavoidable.	Yes. Approximately 18 to 21% of the matted spike-rush habitat zone will be affected by these activities, and extensive riverbank remediation will be conducted along areas that provide prime habitat for this species. Priority Habitat for recorded populations would be significantly altered.	NA, since there is a take of a significant portion of the local population.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 8	Yes. Excavation/backfill of 65 acres of river and 55,235 linear feet of riverbank in matted spike-rush habitat will impact muddy substrates that are habitat of this species. Specific documented locations of the matted spike-rush will be remediated via excavation/backfilling or thin-layer capping, resulting in direct killing of the plants. Given the extensive riverbank remediation and proportion (21%) of the matted spike-rush Priority Habitat that would be disturbed by excavation, backfilling, thin-layer capping, access road construction, and staging areas, a direct take in the form of killing of matted spike-rush under SED 8 is likely. Access and staging areas will impact 38 acres of matted spike-rush habitat. Where these activities occur in open wetland habitats, the potential for impacts to matted spike-rush exists; any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. Sediment excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	No. Direct killing of plants in these areas would occur. Seed removal via sediment excavation is also unavoidable.	Yes. Approximately 21% of the matted spike-rush habitat zone will be affected by these activities, and extensive riverbank remediation will be conducted along areas that provide prime habitat for this species. Priority Habitat for recorded populations would be significantly altered.	NA, since there is a take of a significant portion of the local population.

Table W-3: Assessment of MESA Issues for Matted Spike-rush Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no action.	NA	NA	NA
FP 2	Yes. Soil removal activities and access road/staging areas will involve alteration of muddy substrates in wet meadows and shallow emergent marshes. A total area of 13 acres will be impacted within matted spike-rush Priority Habitat. Soil excavation is also likely to remove the seed bank of this species, which would also constitute a take pursuant to MESA.	Possibly. Since activities are limited in scope, it may be possible to avoid direct impacts to individual plants or actual suitable habitat within the Priority Habitat area for access road and staging area work, which comprise 5 acres of the impacts. A field inventory for this species would allow for confirmation of this, as well as configuration of access roads and staging areas that may avoid or minimize direct impacts to this species.	No. Impacts within Priority Habitat for this species under this alternative are relatively small (2.7% of the matted spike-rush Priority Habitat).	Cannot be established. A literature review indicates that little is known about the conservation and management strategies for this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether that plan would achieve a net benefit.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 3 through FP 5	Yes. Soil removal activities and access road/staging areas would involve alteration of muddy substrates in wet meadows, shallow emergent marshes, vernal pools, and other wetland areas that could support matted spike-rush colonies. Total impact areas with the matted spike-rush Priority Habitat range from 39 to 58 acres. Where these activities occur in open wetland habitats, the potential for impacts to matted spike-rush exists; any areas of excavation, backfilling, deposition, clearing, or grubbing that currently support the growth of matted spike-rush will result in direct impacts to this species. Soil excavation is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA.	No. Given the extensive area of impact (39 to 59 acres), and the annual variation in growth and distribution of this species, planning for avoidance of the species is problematic. Site-specific inventories would be needed to identify locations of matted spike-rush plants relative to activities to determine if plants could be avoided or impacts minimized, however the distribution of the species will vary between years. Impacts from access roads and staging areas (10 to 16 acres) could be minimized by adjusting the layout of these features pending site-specific inventories; however complete avoidance of the plants is unlikely. Soil removal would also unavoidably remove the seeds of this species.	Unlikely. These alternatives will impact 8 to 12% of the matted spike-rush Priority Habitat area, including some portions which are not optimum habitat. Site-specific inventories and adjustments in the layout of access roads and staging areas could further reduce the impacts to this species.	Cannot be established. A literature review confirms that little is known about the conservation and management strategies for this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether that plan would achieve a net benefit.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. Soil removal activities and access road/staging areas would involve alteration of muddy substrates in wet meadows, shallow emergent marsh, and other suitable habitats throughout a substantial portion (110 to 162 acres, or 22 to 33%) of the Priority Habitat for this species. Soil removal is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA; backfilled sediments are not expected to contain seeds of the matted spike-rush, and the potential for colonization of invasive species at the expense of spike-rush growth is high under these conditions.	No. Given the extensive area of impact (110 to 162 acres), and the annual variation in growth and distribution of this species, planning for avoidance of the species is problematic. Site-specific inventories would be needed to identify locations of matted spike-rush plants relative to activities to determine if plants could be avoided or impacts minimized; such inventories are complicated by the fact that the distribution of the species will vary between years.	Yes. These alternatives will impact 22 to 33% of the matted spike-rush Priority Habitat area. As impacts include several open wetland habitats likely to support matted spike-rush colonies during some years, a significant portion of the local population is expected to be impacted.	NA. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

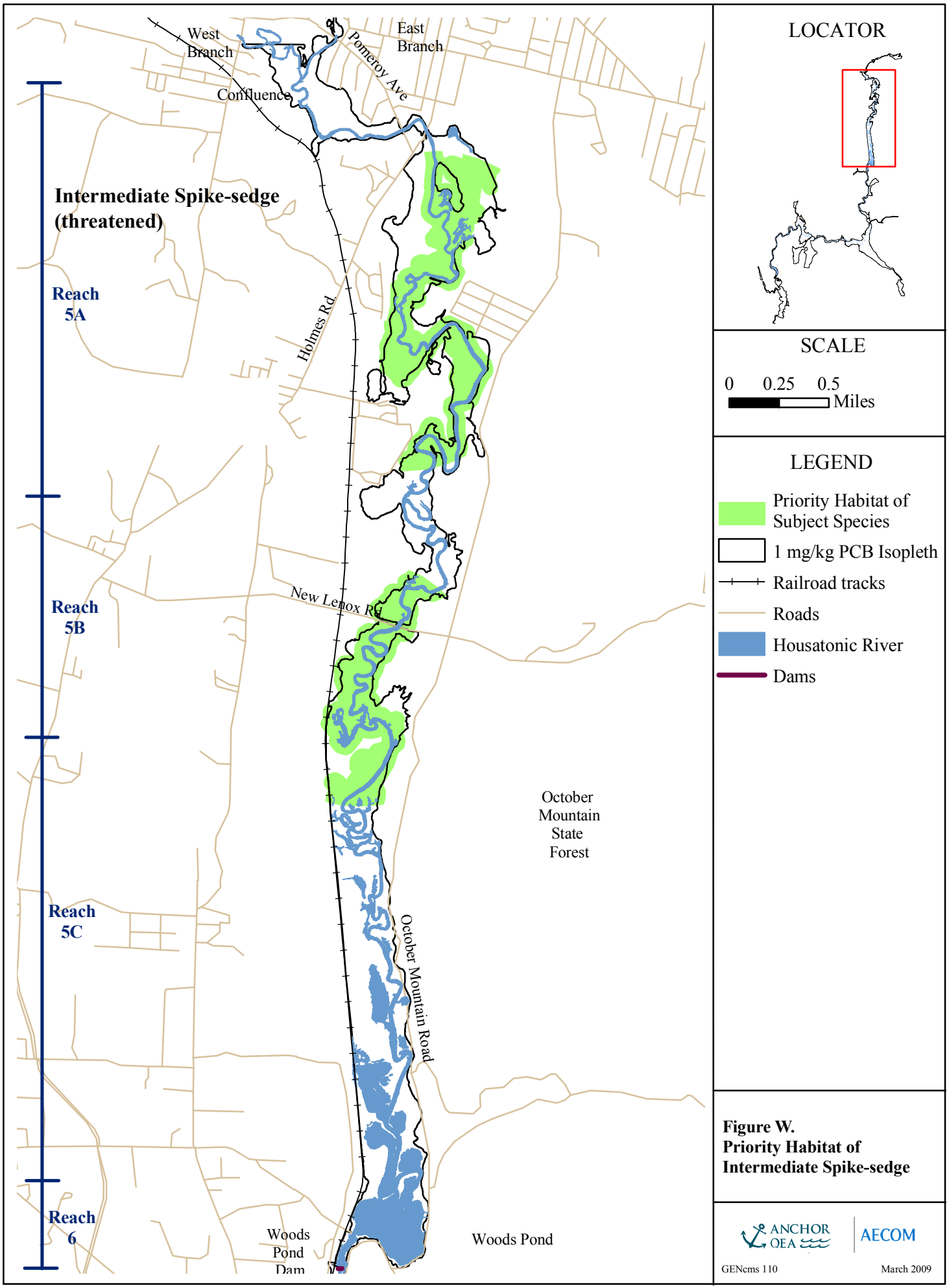

Figure W.
Priority Habitat of Intermediate Spike-sedge

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X. Long-Styled Sanicle (*Sanicula odorata*)

X. Long-Styled Sanicle (*Sanicula odorata*) MESA Assessment

X-1. Summary of Species Life Cycle and Habitat Requirements

Long-styled sanicle (*Sanicula odorata*) is a bristly-fruited herbaceous perennial in the parsley family (Apiaceae or Umbelliferae) that grows up to 3 feet (1 to14 dm) in height. Long-styled sanicle fruits from late July to late August and is found in woodland areas, particularly rich mesic woods, and thickets. In Massachusetts, all current habitats (verified since 1978) are moist woodlands where the soil is fertile and probably circumneutral or slightly alkaline. Associated species include sugar maple (*Acer saccharum*), black ash *(Fraxinus nigra),* white ash *(Fraxinus americana),* large-flowered bellwort (*Uvularia grandiflora*), and wood nettle (*Laportea Canadensis*). All known habitats are either shaded or receive filtered sunlight. The long-styled sanicle is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Threatened Species (NHESP 2008).

X-2. Species Presence within PSA

Priority Habitat of long-styled sanicle is located completely outside of the PSA in Reach 5C, within the floodplain to the west of the Housatonic Rail Road bed as shown on Figure X at the end of this section. The total Priority Habitat of long-styled sanicle is approximately 59 acres in size. Suitable habitats in this area include black ash-red maple-tamarack calcareous seepage swamp. A northern hardwoods-hemlock-white pine forest is likely too acidic for long-styled sanicle and this species does not typically grow within swamps, but suitable habitat for this species could be found within or adjacent to this community type.

X-3. Impacts of Remedial Alternatives and Assessment of MESA Issues for Long-Styled Sanicle

The planned remedial activities involved in SED 1 through SED 8 and FP 1 through FP 7 will not impact the Priority Habitat of the long-styled sanicle.

MESA regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct.” A “take” is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the planned Project or Activity.”

Since there will be no impacts to the Priority Habitat of the long-styled sanicle under any remedial alternative, a take of this species will not occur.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 1994. Long-styled Sanicle (*Sanicula odorata*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

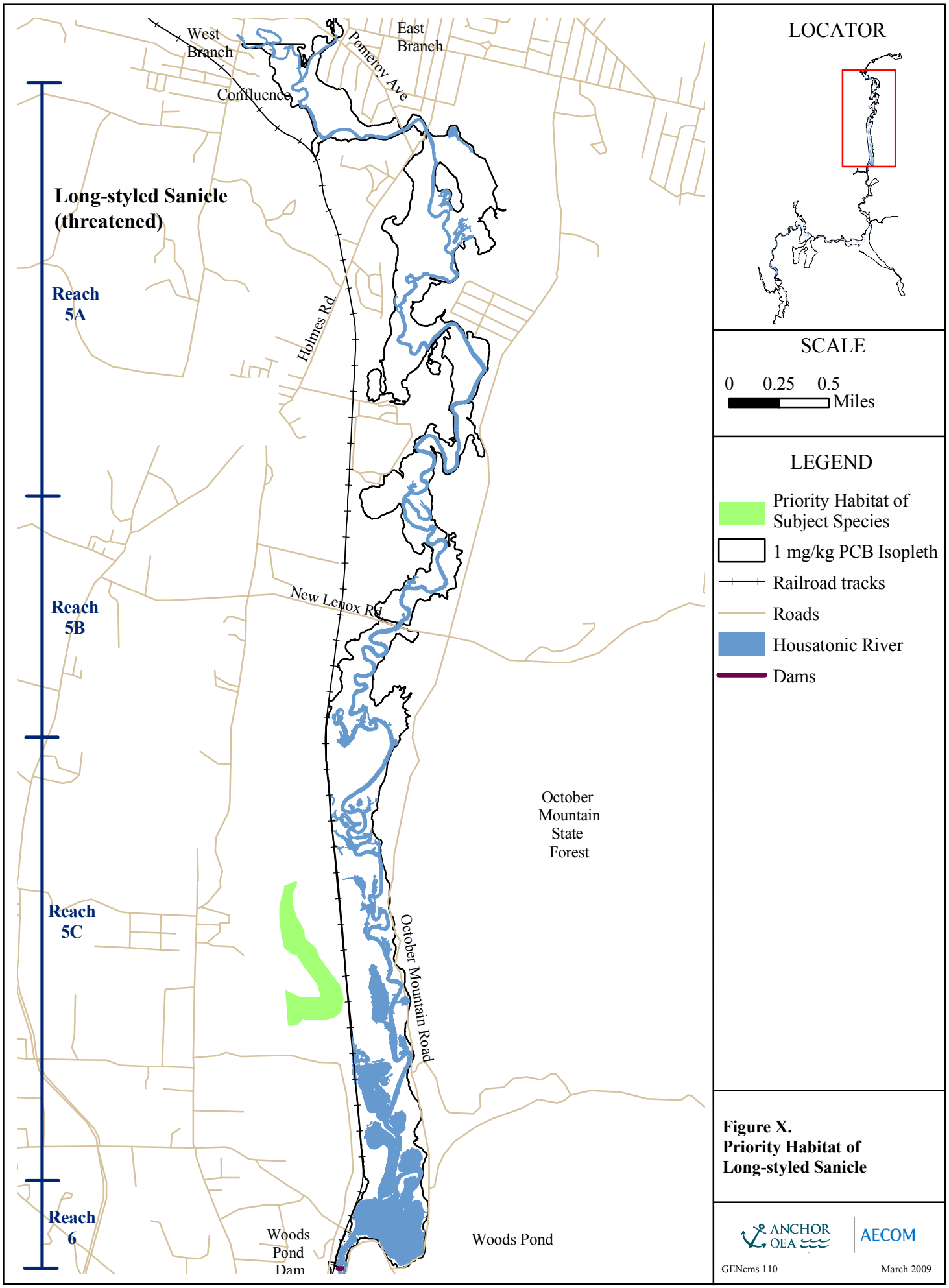

Figure X.
Priority Habitat of Long-styled Sanicle

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Y. Narrow-Leaved Spring Beauty (*Claytonia virginica*)

Y. Narrow-Leaved Spring Beauty (*Claytonia virginica*) MESA Assessment

Y-1. Summary of Species Life Cycle and Habitat Requirements

Narrow-leaved spring beauty (*Claytonia virginica*) is a low-growing spring ephemeral in the Purslane Family (Portulacaceae). Reaching heights of up to 12 inches, narrow-leaved spring beauty produces a loose raceme of five to 15 showy white, pink or rose flowers with five petals and pink-lavender stripes, five stamens, and a three-lobed style. Its cauline leaves are dark green, sessile, opposite, and long (5 to 20 cm) and narrow. Flowers are present from late March to early May. As a spring ephemeral, flowering and seed production is completed before the overhead tree canopy fully develops. Bumble bees, bee flies, and butterflies pollinate the flowers on clear days since the flowers close at night and on cloudy days. Once pollinated the flowers close and the seeds ripen in small capsules. Ripe seeds are ejected from the capsules a short distance from the parent plants. Although perennial, the life cycle is completed by the middle of June at which time the plants wilt and disappear.

Narrow-leaved spring beauty occurs in rich, damp to moist deciduous woods, thickets, floodplain forests, and clearings on alluvial soils subject to seasonal flooding. As evidenced by its affinity for floodplain forests, narrow-leaved spring beauty is tolerant of site disturbance due to seasonal flooding. In Massachusetts, narrow-leaved spring beauty is found in floodplain forests in association with silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), pin oak (*Quercus palustris*), basswood (*Tilia americana*), cottonwood (*Populus deltoides*), and ash (*Fraxinus* spp.). Herbaceous associates include trout lily (*Erythronium americanum*), wood anemone (*Anemone quinquefolia*), purple trillium (*Trillium erectum*), broad-leaved goldenrod (*Solidago flexicaulis*), and wild geranium (*Geranium maculatum*). This species is a state-listed Endangered Species (NHESP 2008). Natural populations of narrow-leaved spring beauty are currently known to occur only in Berkshire, Hampshire, and Hampden Counties in western Massachusetts and Barnstable County in eastern Massachusetts.

Y-2. Species Presence within PSA

The Priority Habitat for narrow-leaved spring beauty occurs in the PSA within Reach 5B - just north of New Lenox Road as shown on Figure Y at the end of this section. The areal extent of the Priority Habitat includes the main channel of the Housatonic River and contiguous areas which support a number of natural communities, including shallow emergent marshes, deep emergent marshes, wet meadows, shrub swamps, high-terrace floodplain forests, transitional floodplain forests and agricultural fields. The Priority Habitat for narrow-leaved spring beauty is approximately 51 acres, with 33 acres in the PSA.

Y-3. Impacts of Remedial Alternatives on Narrow-leaved Spring Beauty Habitat

Y-3-1. Overview

Table Y-1 summarizes the extent and duration of work within narrow-leaved spring beauty habitat for all the remedial alternatives. Impacts to the Priority Habitat of this species from remediation would be confined to the central portion of Reach 5B, as this is the only portion of the PSA where Priority Habitat of this species is documented.

Sediment alternatives SED 1 and SED 2 would not cause any impacts to narrow-leaved spring beauty Priority Habitat, as no construction activities are proposed for these alternatives. All the other SED alternatives involve over 6,000 linear feet of riverbank remediation within narrow-leaved spring beauty habitat, and SED 4 through SED 8 each involves 6.0 acres of sediment removal and backfill within this Priority Habitat. Thin-layer capping would affect the habitat of this species under SED 6 (0.5 acre) and SED 7 (0.01 acre).

Additional impacts from the construction and use of access roads and staging areas would result in 5.0 acres of additional impacts under each of the alternatives SED 3 through SED 8. Impacts to narrow-leaved spring beauty under the SED alternatives would occur mainly through direct excavation and backfill of sediments along the upper portion of the riverbanks - where this species could find suitable micro-habitat. Narrow-leaved spring beauty populations would likely also be lost due to the thin-layer capping and engineered capping work where suitable habitat is present along the margins of the river channel and backwater areas. Sediment removal, backfilling, or capping in the river channel proper is unlikely to destroy narrow-leaved spring beauty populations since this plant is not an aquatic species.

Floodplain forest associated with the river is important habitat for narrow-leaved spring beauty, and these community types are common in Reach 5B. The floodplain remedial alternatives, consisting of excavation and backfilling, would affect the habitat of this species and the extent of this impact would be proportional to the extent of the disruption. FP 1 would involve no impacts. FP 2 would only result in 0.1 acre of direct impacts to the Priority Habitat of narrow-leaved spring beauty, while FP 3 through FP 7 would involve between 2.0 and 17.0 acres of direct impacts of Priority Habitat. Impacts from the construction and use of access roads and staging areas would result in an additional 0.6 to 1.9 acres of impact to Priority Habitat under each of the alternatives FP 2 through FP 7. Any overlap of these construction features with areas supporting the growth of this plant species would result in direct mortality, and removal of soil containing its seeds would also reduce the seed bank of this species within the Housatonic River floodplain.

Table Y-1. Narrow-Leaved Spring Beauty Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Narrow-leaved Spring Beauty Habitat Impacts		
		Impact Area within Species' Priority Habitat from Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5B	6110 lf riverbank remediation	5	> 1
SED 4	5B	6 acres of sediment removal and backfilling; 6110 lf riverbank remediation	5	3
SED 5	5B	6 acres of sediment removal and backfilling; 6110 linear ft riverbank remediation.	5	5
SED 6	5B	6 acres of sediment removal and backfilling; 0.5 acre of thin-layer capping; 6110 linear ft riverbank remediation.	5	5
SED 7	5B	6 acres of sediment removal and backfilling; 0.01 acre of thin-layer capping; 6110 lf riverbank removal.	5	6
SED 8	5B	6 acres of sediment removal and backfilling; 6110 lf riverbank remediation	5	7
FP 1	N/A – No Action	0	0	N/A
FP 2	5B	0.1 acre (excavation/backfill)	0.6	1
FP 3	5B	2 acres (excavation/backfill)	1.4	3
FP 4	5B	5 acres (excavation/backfill)	1.9	4

Remedial Alternative	Reach with Affected Habitat*	Description of Narrow-leaved Spring Beauty Habitat Impacts		
		Impact Area within Species' Priority Habitat from Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
FP 5	5B	2 acres (excavation/backfill)	0.9	4
FP 6	5B	13 acres (excavation/backfill)	1.1	13
FP 7	5B	17 acres (excavation/backfill)	1	22

* Narrow-leaved spring beauty Priority Habitat occurs only in Reach 5B.
**All direct impacts under SED alternatives are to riverine, riverbank and backwater habitats. Riverine and backwater impacts are expressed in acres; riverbank impacts in linear feet.
***Duration of work as estimated for the entire reach; work within actual Priority Habitat portion may be less.

Y-3-2. Description of Specific Impacts

Mapped habitat for the narrow-leaved spring beauty is only found in the central portion of Reach 5B. This portion of the PSA consists of multiple natural communities, including shallow emergent marshes, deep emergent marshes, wet meadows, shrub swamps, high-terrace floodplain forests, transitional floodplain forests and agricultural fields. While narrow-leaved spring beauty could occur in any or all of these habitat types, it is most apt to be found in the forested areas. Floodplain forest habitats subject to spring flooding are more likely to contain suitable habitat for narrow-leaved spring beauty populations than the shallow and deep emergent marshes and shrub swamps within Reach 5B, where flooding cycles are frequent and of long duration. Work in the river channel and vegetated wetlands subject to semi-permanent or permanent flooding - such as shallow and deep emergent marshes - is not likely to alter habitat suitable for narrow-leaved spring beauty. However, the riverbank could support populations of narrow-leaved spring beauty, and the entire riverbank through the Priority Habitat will be remediated under SED 3 through SED 8.

SED 1 involves no construction-related activities and thus no impacts to narrow-leaved spring beauty Priority Habitat. SED 2 is limited to monitoring natural recovery (MNR) and also has no impact on narrow-leaved spring beauty Priority Habitat. SED 3 to SED 8 involve increasing levels of remediation work in narrow-leaved spring beauty Priority Habitat. All of these involve the excavation and reconstruction of erodible riverbanks along 6110 lf of the river in this reach; the riverbank provides suitable Priority Habitat for this species, and therefore this work is likely to impact the species. Alternatives SED 3 through SED 8 each will involve 3.0 acres of Priority Habitat alteration due to the construction of 6398 linear feet of access roads and 2.0 acres of Priority Habitat alteration due to the construction of staging areas. Alternatives SED 4 and SED 5 will impact 6.0 acres of narrow-leaved spring beauty Priority Habitat due to the removal of 1.5 to 2.0 feet of sediment and backfilling in the river channel, in addition to the riverbank remediation. Alternative SED 6 will impact 6.0 acres of narrow-leaved spring beauty Priority Habitat due to 1 to 2 feet of sediment removal and backfilling in river and backwater areas and 0.5 acre of Priority Habitat alteration due to thin-layer capping in river and backwater areas in Reach 5B. Alternative SED 7 increases the depth of sediment removal in the river and backwater areas from 1 to 2 feet to 1 to 3.5 feet with backfilling over 6.0 acres, while reducing the thin-layer capping from 0.5 acre to 0.01 acre in river and backwater areas. SED 8 increases the depth of sediment removal and backfilling in river and backwater areas from 1 to 3.5 feet to 2 to 6 feet and eliminates thin-layer capping in the river and backwater areas. All other Priority Habitat impacts from work (riverbank removal activity, access road construction, and staging area construction) is the same as in alternatives SED 3 through SED 7. The estimated timeframe for sediment remediation within Reach 5B is one to seven years (SED 3 being the shortest and SED 8 the longest).

Floodplain remediation activities for FP 1 involve no construction, therefore no impacts to spring beauty Priority Habitat would occur. FP 2 through FP 7 will impact spring beauty Priority Habitat by altering wet meadows, shrub swamps, red maple swamps, and transitional floodplain forest habitats contained within the

work areas. FP 2 soil removal would impact 0.1 acre of spring beauty Priority Habitat plus an additional 0.6 acre from the construction of access roads and/or staging areas. FP 3 through FP 5 soil remediation would impact 2.0 to 5.0 acres of spring beauty Priority Habitat plus an additional 0.9 to 1.4 acres from the construction of access roads and/or staging areas. FP 6 and FP 7 soil remediation would impact 13.0 to 17.0 acres of spring beauty Priority Habitat plus an additional 1.0 to 1.1 acres from the construction of access roads and/or staging areas. The estimated timeframe for floodplain remediation work within the PSA is 1 to 22 years (FP 2 being the shortest and FP 7 the longest).

Y-4. Assessment of MESA Issues for Narrow-leaved Spring Beauty

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to "collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct…" A take is only permissible under MESA regulations if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and said conservation contribution to the impacted State-listed Species must exceed the harm caused by the proposed Project or Activity."

An assessment of these issues for narrow-leaved spring beauty is summarized in Table Y-2 for the sediment alternatives and Table Y-3 for the floodplain alternatives. These tables identify for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population) to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table Y-2, all of the sediment alternatives except for SED 1 and SED 2 would result in a take due to alteration of Priority Habitat suitable for narrow-leaved spring beauty populations. Remedial actions associated with the removal of river bottom sediments are unlikely to impact narrow-leaved spring beauty colonies as the species generally occurs in floodplain forest habitats, not the river channel itself. However, riverbank remediation work will impact Priority Habitat where mature woody vegetation is established on the riverbank and where flooding occurs, as this is suitable Priority Habitat for the species. In addition to direct killing of narrow-leaved spring beauty specimens, the excavation of soils may also remove the seeds of this species, reducing the repository of the seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. The removal of the seed bank is a take under MESA. Backfilling with non-indigenous sediments is not expected to carry the seeds of narrow-leaved spring beauty, and therefore the establishment of newly exposed moist sediments from backfilling will not have the same potential for the re-growth of this species. Moreover, such disturbed conditions are also prime for the colonization of numerous invasive species, and these are likely to have a competitive advantage over narrow-leaved spring beauty following disturbances. SED 3 through SED 8 all involve greater than one linear mile of riverbank remediation (which includes all riverbank within Priority Habitat), plus 5.0 acres (10% of the Priority Habitat) of floodplain impacts from access roads and/or staging areas. These impacts will affect a large portion of the narrow-leaved spring beauty Priority Habitat and will likely result in a take of a significant portion of the population. Therefore, a net benefit plan for this species is not applicable under MESA.

As shown in Table Y-3, all of the floodplain alternatives except for FP 1 would result in a take of the narrow-leaved spring beauty. This take would be due to floodplain remediation activities occurring in prime habitat which include soil excavation and backfill. If the species is present, these activities will cause direct killing of narrow-leaved spring beauty and will reduce the repository of the seed bank within the PSA and thereby adversely affecting the long-term viability of this species along the Housatonic River. As discussed above, removal of the seed bank is a take under MESA. FP 2 will result in a take; however the relatively small area of impact (0.7 acre or about 2%) indicates that a take of a significant portion of the local population will not

occur. FP 3 through FP 5 will result in a greater impact (2.9 to 6.9 acres); which also is not likely to affect a significant portion of the local population as this is equivalent to only 5.6% to 13.5% of the total area mapped for this population. The impacts to favorable Priority Habitat for this species under FP 6 and FP 7 are substantially greater (14 to 18 acres) and will impact a significant portion of the local population (27 to 35%). Accordingly, a net benefit plan for this species is not applicable under MESA for FP 6 and FP 7.

Since the impacts for FP 2, and FP 3 through FP 5 will likely be limited to less than a significant portion of the local population, the resulting take would be allowed only if conservation and management measures can be developed which would provide a long-term net benefit to the species. However, based on a review of the relevant literature, little is known about conservation strategies for this species, and therefore it cannot be determined whether measures are feasible or appropriate to achieve a net benefit for this species.

References:

NHESP. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

NHESP. 1987. Fact Sheet for Narrow-leaved Spring Beauty (*Claytonia virginica*). Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table Y-2: Assessment of MESA Issues for Narrow-leaved Spring Beauty Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no construction activities.	NA	NA	NA
SED 2	No take; only monitoring.	NA	NA	NA
SED 3 through SED 8	Yes, due to riverbank remediation of over 6,000 lf and construction of 5 acres of access roads and staging areas in the Priority Habitat. These will directly affect the Priority Habitat suitability for this species.	No. A take of plants located along riverbank subject to remediation could not be avoided, but access roads and staging areas may be sited to avoid or minimize impact on plants.	Likely. Remediation of greater than one linear mile of riverbank will impact a significant portion of the local population, plus 10% of the Priority Habitat will be impacted by access road and staging areas.	NA. Since there is a take of a significant portion of the local population, a long-term net benefit is not applicable under MESA.

Table Y-3: Assessment of MESA Issues for Narrow-leaved Spring Beauty Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no construction activties.	NA	NA	NA
FP 2	Yes. A total impact of 0.7 acre will occur in preferred Priority Habitat for this species. Sediment excavation will also remove seeds, resulting in a take.	Possibly. The removal will only impact 0.1 acre, so there is a possibility of not directly impacting plants in that limited area. The 0.6 acre of access roads and staging areas could likely be modified to avoid the plants.	No. The impacts are relatively small (1% of Priority Habitat). Accordingly, if a take were not avoidable, the impacts would be limited to a small portion of the local population.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies for this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether that plan would achieve a net benefit.
FP 3, FP 4 and FP 5	Yes. Remediation activities and access road and staging area construction will occur within 3.4 to 6.9 acres of preferred Priority Habitat for this species. Soil excavation will also remove seeds, resulting in a take.	No. The removal impacts will encompass 3 to 7 acres of preferred spring beauty Priority Habitat, adversely affecting the habitat suitability and likely to directly impact plants. The nearly 1 to 2 acres of access roads and staging areas may be modified to avoid the plants; however, soil removal will also result in a take via seed bank removal.	Not likely. This work will only impact a small portion (5.6% to 13.5%) of the Priority Habitat, and the overall acreage of impact is not large.	Cannot be established. A literature review confirms that little is known about the conservation and management strategies for this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan or to determine whether that plan would achieve a net benefit.

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 6 and FP 7	Yes. Remediation activities and access road and staging area construction will occur within 14 to 18 acres of preferred Priority Habitat for this species. Sediment excavation will also remove seeds, resulting in a take.	No. The removal impacts will encompass 14 to 18 acres of preferred spring beauty Priority Habitat, adversely affecting the Priority Habitat suitability and likely to directly impact plants. Soil removal is also likely to substantially remove the seed bank of this species, which would also constitute a take pursuant to MESA; backfilled sediments are not expected to contain seeds of the matted spike-rush, and the potential for colonization of invasive species at the expense of spike-rush growth is high under these conditions.	Yes. 27% and 35%, respectively of Priority Habitat within PSA will be altered due to primary activities.	NA. Since the impact is to a significant portion of the local population, a long-term net benefit is not applicable under MESA.

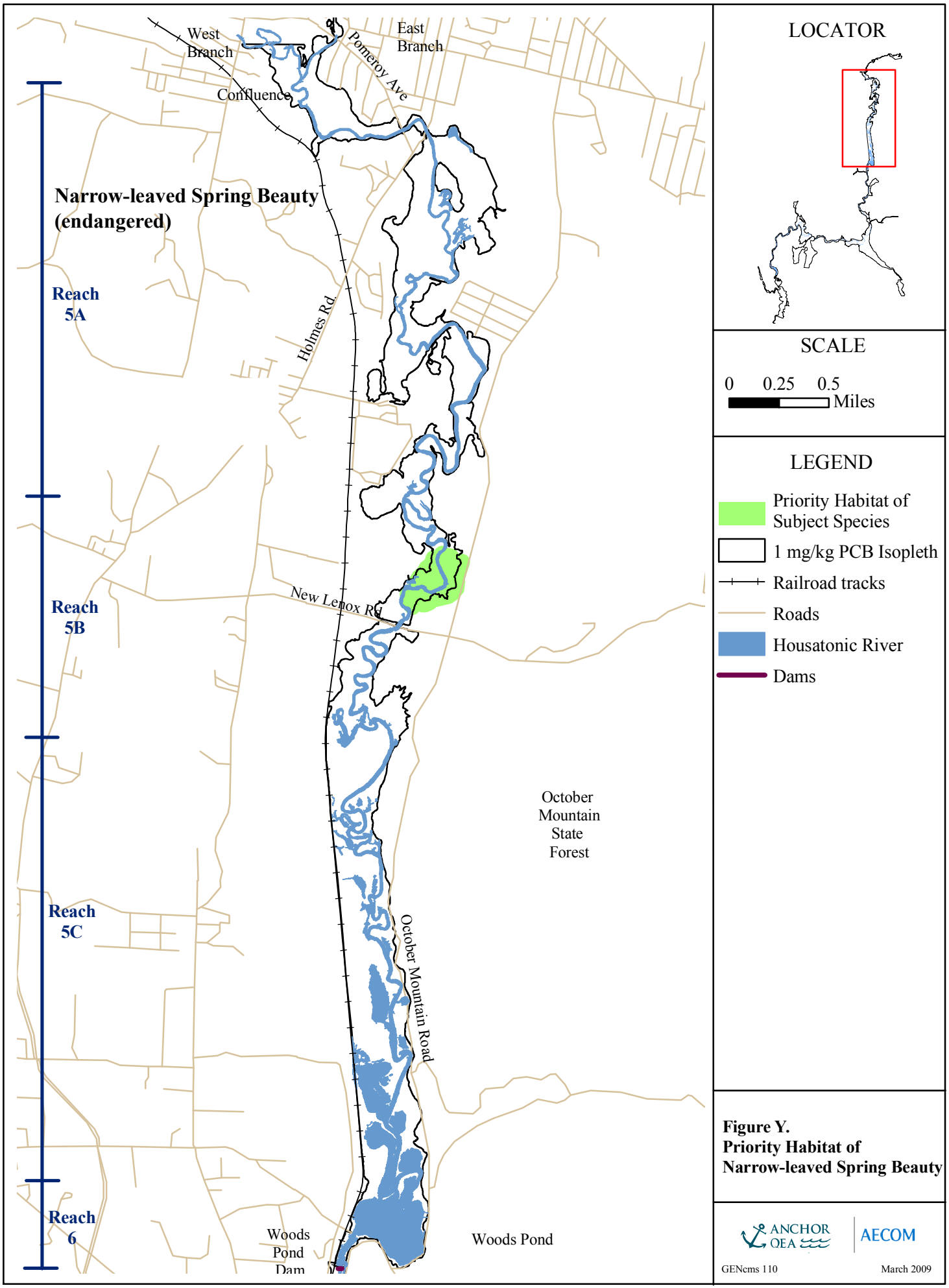

Figure Y.
Priority Habitat of Narrow-leaved Spring Beauty

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Z. Straight-Leaved Pondweed (*Potamogeton strictifolius*)

Z. Straight-leaved Pondweed (*Potamogeton strictifolius*) MESA Assessment

Z-1. Summary of Species Life Cycle and Habitat Requirements

Straight-leaved pondweed (*Potamogeton strictifolius*) is a linear-leaved aquatic plant that grows completely submerged, except for the flowering spikes. This pondweed is an annual and reproduces by seeds and winter buds. It flowers and fruits in summer and fall. Straight-leaved pondweed is generally found in lakes, ponds, and slow-flowing streams. In Massachusetts, it grows in alkaline waters of Berkshire County. This plant is usually found growing alongside other plants favoring alkaline waters such as other members of the *Potamogeton* genus as well as variegated yellow pond-lily (*Nuphar variegate*), whorl-leaf watermilfoil (*Myriophyllum verticillatum*), Canadian waterweed (*Elodea Canadensis*), and coon's tail (*Ceratophyllum demersum*). The straight-leaved pondweed is classified under the Massachusetts Endangered Species Act (MESA) as a state-listed Endangered Species (NHESP 2008).

Z-2. Species Presence within PSA

Priority Habitat for straight-leaved pondweed only occurs in the northwest portion of Reach 5A as shown on Figure Z at the end of this section. The Priority Habitat area for this species totals 57 acres; however, only 0.16 acre of the Priority Habitat is located within the PSA. Natural communities within this Priority Habitat consist of moderately alkaline lake/pond, transitional floodplain forest and medium-gradient stream. Since the NHESP Fact Sheet for this species suggests that it grows completely submerged in lakes, ponds, and slow-flowing streams, it is assumed that the habitat for this species is located within the pond which lies just west of the PSA or in the medium gradient stream which flows from the pond and into the Housatonic River.

Z-3. Impacts of Remedial Alternatives on Straight-leaved Pondweed Habitat

Z-3-1. Overview

As Table Z-1 summarizes, SED 1 through SED 8 will not impact the mapped Priority Habitat for straight-leaved pondweed.

Floodplain remediation alternative FP 1 consists of no action. FP 2 through FP 4 would not include work within mapped habitat of straight-leaved pondweed. FP 5 and FP 7 would impact 0.1 acre of the Priority Habitat by removing vegetation and excavating impacted soils. FP 6 would impact 0.16 acre of habitat by removing vegetation and excavating impacted soils. No access road or staging area construction is associated with FP 2 through FP 7within the pondweed Priority Habitat.

Table Z-1. Straight-Leaved Pondweed Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of Straight-leaved Pondweed Habitat Impacts		
		Priority Habitat Impact by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	0	0	0
SED 2	N/A – MNR	0	0	0
SED 3	5A	0	0	N/A
SED 4	5A	0	0	N/A
SED 5	5A	0	0	N/A

Remedial Alternative	Reach with Affected Habitat*	Description of Straight-leaved Pondweed Habitat Impacts		
		Priority Habitat Impact by Sediment/Soil Remediation (acres or linear feet)	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 6	5A	0	0	N/A
SED 7	5A	0	0	N/A
SED 8	5A	0	0	N/A
FP 1	N/A – No Action	0	0	N/A
FP 2	5A	0	0	N/A
FP 3	5A	0	0	N/A
FP 4	5A	0	0	N/A
FP 5	5A	0.1 ac (excavation/backfill)	0	4
FP 6	5A	0.16 ac (excavation/backfill)	0	13
FP 7	5A	0.1 ac (excavation/backfill)	0	22
*This species' Priority Habitat occurs only in Reach 5A.				

Z-3-2. Description of Specific Impacts by River Segment

Reach 5A

Priority Habitat for straight-leaved pondweed is mapped as a small polygon in the northwest portion of Reach 5A. SED 1 through SED 8 would not impact straight-leaved pondweed habitat as the planned remedial activities do not occur within Priority Habitat for this species.

The floodplain remedial activities under FP 1 through FP 4 would not involve work within Priority Habitat of straight-leaved pondweed. FP 5 through FP 7 construction activities will impact between 0.1 and 0.16 acre of mapped Priority Habitat. Impacts involved with FP 5 through FP 7 will occur within transitional floodplain forests and will not impact the open water habitat required by the straight-leaved pondweed.

The estimated timeframe to complete the work associated with FP 5, FP 6, and FP 7 is 4, 13, and 22 years, respectively, though the Priority Habitat area of the pondweed will require only a portion of these time frames. No access road construction or staging areas would occur within mapped Priority Habitat for straight-leaved pondweed.

Reach 5B

Priority Habitat for straight-leaved pondweed is not identified in Reach 5B.

Reach 5C

Priority Habitat for straight-leaved pondweed is not identified in Reach 5C.

Reach 6

Priority Habitat for straight-leaved pondweed is not identified in Reach 6.

Z-4. Assessment of MESA Issues for Straight-Leaved Pondweed

MESA regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct." A "take" is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity."

The planned remedial activities involved in SED 1 through SED 8 will not impact the mapped Priority Habitat of the straight-leaved pondweed. Accordingly, no take will occur pursuant to MESA.

As shown in Table Z-2, floodplain remedial activities under FP 1 through FP 7 will not cause a take of straight-leaved pondweed. FP 5 through FP 7 will impact between 0.1 and 0.16 acre of transitional floodplain forest within the mapped Priority Habitat. Since the straight-leaved pondweed requires open water habitat to a depth in which it can remain submerged throughout its lifecycle, transitional floodplain forests would not provide adequate habitat for this species. No access road construction or staging areas would occur within mapped Priority Habitat for straight-leaved pondweed. Since no take will occur, a net benefit consideration is not applicable pursuant to MESA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table Z-2: Assessment of MESA Issues for Straight-leaved Pondweed Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1 - FP 4	No take due to no work within Priority Habitat.	N/A	N/A	N/A
FP 5 - FP 7	No. The transitional floodplain forest community which will be impacted is not considered suitable habitat for this species.	N/A	N/A	N/A

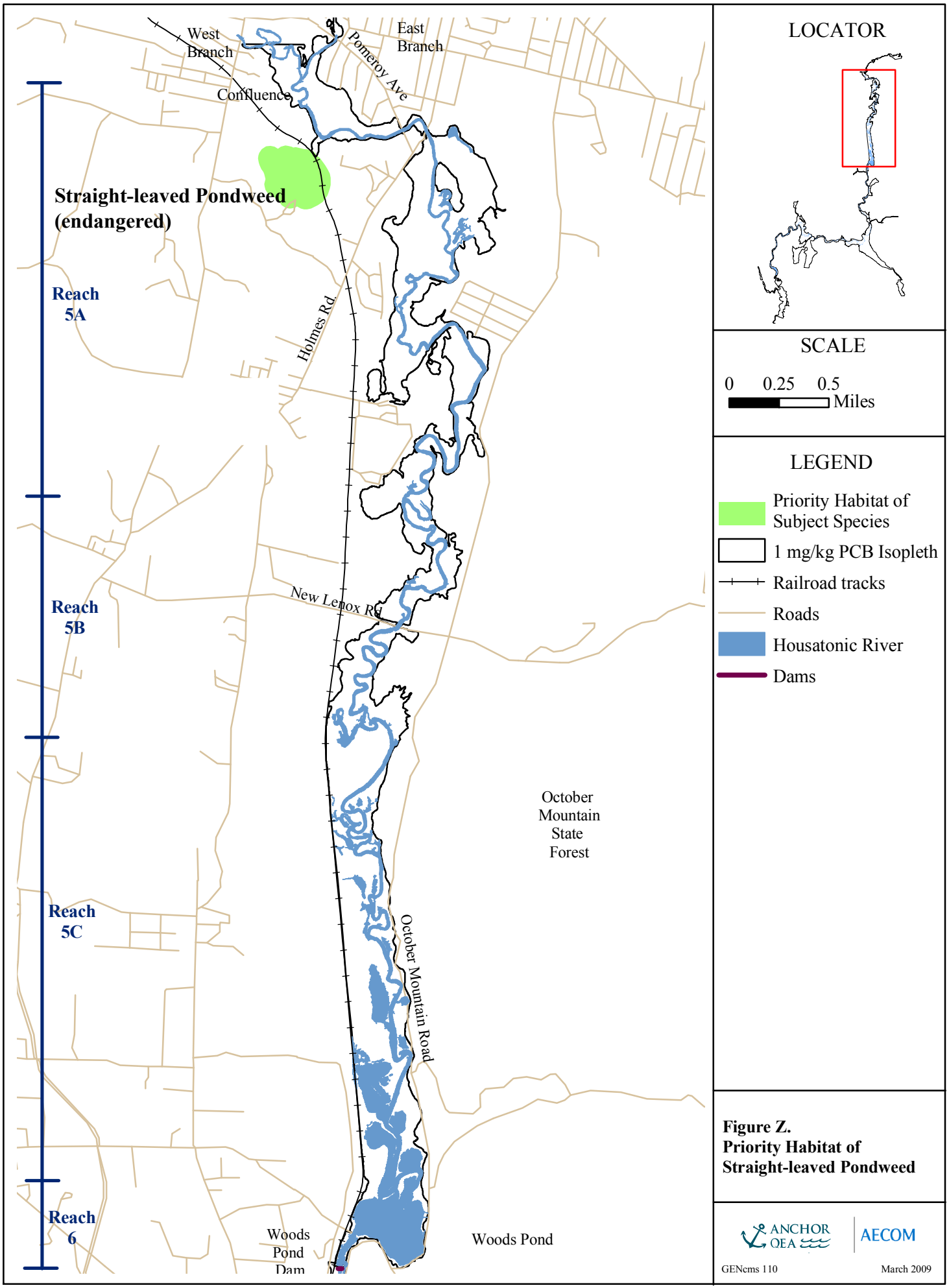

Figure Z.
Priority Habitat of Straight-leaved Pondweed

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AA. Wapato (*Sagittaria cuneata*)

AA. Wapato/Northern Arrowhead (*Sagittaria cuneata*) MESA Assessment

AA-1. Summary of Species Life Cycle and Habitat Requirements

Wapato, or northern arrowhead (*Sagittaria cuneata*), is an aquatic, herbaceous perennial in the water-plantain or arrowhead family (Alismataceae). It may grow either entirely submersed or, more commonly, with its leaves and flower clusters at least partly above the water's surface. Wapato is highly variable, ranging in form from plants with entirely submersed, bladeless, ribbon-like leaves to plants with three-lobed, arrowhead-shaped leaves that are entirely out of the water. Wapato has unisexual flowers; the uppermost flowers on the flower stalk are male and the lower ones female. Wapato flowers from mid July to early September and later forms globose clusters of flat achenes (dry, one-seeded fruits). This species thrives in muddy shores of rivers, ponds, oxbows, and marshes, preferring alkaline waters. Among the plant species associated with wapato are silver maple (*Acer saccharinum*), red maple (*A. rubrum*), and various species of water-plantains (*Alisma* spp.), and pondweeds (*Potamogeton* spp.). Wapato is a state-listed Threatened species (NHESP 2008).

AA-2. Species Presence within PSA

According to NHESP database information, the Priority Habitat of wapato occurs in nearly the entire PSA and is present in Reach 5A, Reach 5B, Reach 5C, and Reach 6 as shown in Figure AA at the end of this section. The total Priority Habitat for this species is 1166 acres, with 839 acres occurring in the PSA. Natural communities within Priority Habitat include the following habitats: the main stem of the river, backwaters, deep emergent marsh, shallow emergent marsh, wet meadow, transitional floodplain forest, high terrace floodplain forest, black-ash-red-maple-tamarack calcareous seepage swamp, red maple swamp, shrub swamp, rich, mesic forest, cultured grassland, northern hardwoods-hemlock-white pine forest, red oak-sugar maple-transitional forest, moderately alkaline lakes/ponds, and successional northern hardwood forest. This species requires total to partial submersion in water during most of its lifecycle and therefore the river channel, backwaters and emergent marshes are the primary habitat for this species.

AA-3. Impacts of Remedial Alternatives on Wapato Habitat

AA-3-1. Overview

Table AA-1 summarizes the areal extent and duration of work within wapato habitat for all the remedial alternatives. SED 1 involves no construction activities. SED 2 is limited to monitoring the natural recovery; it involves no direct construction work and will not impact wapato Priority Habitat. Alternatives SED 3 through SED 8 will impact approximately 74,500 linear feet of riverbank by excavation and stabilization of riverbanks in the wapato Priority Habitat. Excavation of riverbank habitat will cause direct mortality to any wapato plants within the work area, and the riverbanks are favorable habitat for this species. SED 3 will involve approximately 83 acres of in-river remediation within the wapato habitat. SED 4 through SED 8 will impact between 182 and 203 acres of river bottom and backwater habitats. Thin-layer capping, engineered capping, sediment removal and backfilling in the main river channel and backwater areas will kill any wapato specimens within the work area and reduce the seed bank within the PSA. SED 3 through SED 8 will impact between 64 and 75 acres of floodplain habitats for staging and access areas.

Floodplain remediation alternative FP 1 consists of no action. FP 2 through FP 7 would involve increasing levels of impacts to mapped Priority Habitat, altering 20 acres to 276 acres. Impacts to floodplain forest, grassland and wet meadow communities will likely not impact this species; however, impacts to areas which have a more prolonged inundation period such as deep and shallow emergent marshes could cause direct mortality of this species and reduce the seed bank within the PSA.

Table AA-1. Wapato Habitat Alterations by Remedial Alternative.

Remedial Alternative	Reach with Affected Habitat	Description of Wapato Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 1	N/A – No Action	N/A	N/A	N/A
SED 2	N/A – MNR	N/A	N/A	N/A
SED 3	5A	36 ac (excavation/capping) 46,559 lf riverbank remediation	38 ac habitat removal	8
	5B	27,976 lf (riverbank remediation)	24 ac habitat removal	<1
	5C	34 ac (thin-layer capping)	1.9 ac habitat removal	<1
	6	13 ac (thin-layer capping)	0	1
SED 4	5A	37 ac (excavation/capping) 4 ac (thin-layer capping) 46,559 lf riverbank remediation	38 ac habitat removal	8
	5B	11 ac (excavation/capping) 17 ac (thin-layer capping) 27,976 lf riverbank remediation	24 ac habitat removal	3
	5C	66 ac (thin-layer capping) 34 ac (engineered capping) 13 ac (excavation/capping)	10 ac habitat removal	2
	6	.3 ac (thin-layer capping)	0.03 ac habitat removal	2
SED 5	5A	37 ac (excavation/capping) 4 ac (thin-layer capping) 46,559 lf riverbank remediation	38 ac habitat removal	8
	5B	25 ac (excavation/capping) 2 ac (thin-layer capping) 27,976 lf riverbank remediation	24 ac habitat removal	5
	5C	21 ac (excavation/capping) 45 ac (thin-layer capping) 34 ac (engineered capping)	13 ac habitat removal	2
	6	13 ac (excavation/capping) 0.3 ac (engineered capping)	0.03 ac habitat removal	3
SED 6	5A	37 ac (excavation/capping) 6 ac (thin-layer capping) 46,559 lf riverbank remediation	38 ac habitat removal	8
	5B	25 ac (excavation/capping) 7 ac (thin-layer capping) 27,976 lf riverbank remediation	24 ac habitat removal	5
	5C	60 ac (excavation/capping) 38 ac (thin-layer capping)	5.8 ac habitat removal	4
	6	13 ac (excavation/capping) 0.3 (engineered capping)	0	3

Remedial Alternative	Reach with Affected Habitat	Description of Wapato Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)*	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)
SED 7	5A	37 ac (excavation/capping) 6 ac (thin-layer capping) 46,559 lf riverbank remediation	38 ac habitat removal	9
	5B	29 ac (excavation/capping) 3 ac (thin-layer capping) 27,976 lf riverbank remediation	24 ac habitat removal	6
	5C	71 ac (excavation/capping) 28 ac (thin-layer capping)	5.8 ac habitat removal	4
	6	13 ac (excavation/capping) 0.3 ac (engineered capping)	0	4
SED 8	5A	44 ac (excavation/capping) 46,559 lf (riverbank remediation)	38 ac habitat removal	11
	5B	35 ac (excavation/capping) 27,976 lf (riverbank remediation)	24 ac habitat removal	6
	5C	111 ac (excavation/capping)	5.8 ac habitat removal	10
	6	13 ac (excavation/capping)	0	11
FP 1	N/A – No Action	N/A	N/A	N/A
FP 2	5A	8 ac (excavation/backfill)	7 ac habitat removal	1 year total
	5B	1 ac (excavation/backfill)	1.4 ac habitat removal	
	5C	0.4 ac (excavation/backfill)	2.8 ac habitat removal	
FP 3	5A	19 ac (excavation/backfill)	11 ac habitat removal	3 years total
	5B	9 ac (excavation/backfill)	7 ac habitat removal	
	5C	7 ac (excavation/backfill)	2.9 ac habitat removal	
FP 4	5A	34 ac habitat removal	13 ac habitat removal	4 years total
	5B	16 ac habitat removal	10 ac habitat removal	
	5C	11 ac habitat removal	5 ac habitat removal	
FP 5	5A	22 ac habitat removal	8 ac habitat removal	4 years total
	5B	11 ac habitat removal	6 ac habitat removal	
	5C	20 ac habitat removal	7 ac habitat removal	
	6	0.2 ac habitat removal	0.11 ac habitat removal	
FP 6	5A	68 ac habitat removal	11 ac habitat removal	13 years total
	5B	53 ac habitat removal	8 ac habitat removal	
	5C	46 ac habitat removal	10 ac habitat removal	
	6	1 ac habitat removal	0.05 ac habitat removal	
FP 7	5A	121 ac habitat removal	7 ac habitat removal	22 years total
	5B	70 ac habitat removal	8 ac habitat removal	
	5C	61 ac habitat removal	8 ac habitat removal	
	6	0.9 ac habitat removal	0.13 ac habitat removal	

*All direct impacts under SED alternatives are to riverine and riverbank habitats; riverbank remediation would occur in Reaches 5A and 5B.

AA-3-2. Description of Specific Remediation Activities Relative to Wapato Priority Habitat by River Segments

Reach 5A

Priority Habitat for wapato in Reach 5A begins slightly south of the East/West Branch confluence and continues south to Reach 5B. The shorelines and floodplain along this stretch of the Housatonic River provide suitable habitat conditions for wapato, consisting of many shallow emergent marshes, deep emergent marshes, backwaters, and ponds, in addition to the shoreline of the river itself. The river northwest of the Holmes Road Bridge is considered a medium-gradient stream and southeast of this point, it becomes low-gradient and highly meandering. Wapato is more likely to be found in the low-gradient portion, as it prefers muddy substrates that have not been washed away by high-velocity flows.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives involve sediment removal and/or capping, as well as riverbank remediation throughout Reach 5A. SED 3 through SED 6 involves removal of the top 2 feet of river bottom followed by backfill. This would directly impact 36 to 37 acres of river bottom within Priority Habitat of wapato for alternatives SED 3 through SED 6. SED 7 would involve removal of the top 3 to 3.5 feet of sediment and would impact 37 acres. SED 8 proposes to remove the top 4 feet of sediment along reach 5A which would impact 44 acres of river bottom. SED 4 through SED 7 would also involve thin-layer capping in several backwater pool areas, all of which offer potentially suitable habitat for this species. No thin-layer capping is proposed for SED 3 or SED 8. SED 4 and SED 5 would consist of 4 acres of thin-layer capping and SED 6 and SED 7 would consist of 6 acres of thin-layer capping. In addition, SED 3 through SED 8 would include riverbank remediation along Reach 5A. The erodible riverbanks would be excavated and reconstructed using armoring material to prevent erosion and/or bio-stabilization measures to encourage re-establishment of the native plant community. As part of the riverbank remediation, soil removal and stabilization would occur on muddy shorelines where colonization by wapato is likely along the river and in adjacent wetland habitats. This activity would impact 46,559 linear feet of riverbank within Priority Habitat of wapato. Access road construction and staging areas would disturb an additional 28 acres within the Priority Habitat of Reach 5A under alternatives SED 3 through SED 8. Where these activities occur in open wetland habitats and shorelines, the potential for impacts to wapato exists. The estimated timeframe for completing the various work alternatives in Reach 5A is 8 years for SED 3 through SED 6, 9 years for SED 7, and 11 years for SED 8.

Floodplain alternative FP 1 consists of no action. All other floodplain alternatives would have an impact on wapato Priority Habitat in Reach 5A of the PSA. FP 2 impacts 8 acres; FP 3 impacts 19 acres; FP 4 impacts 34 acres; FP 5 impacts 22 acres; FP 6 impacts 68 acres; and FP 7 impacts 121 acres of mapped wapato Priority Habitat due to vegetation clearing and excavation activities. Access road construction and staging areas would disturb an additional 7 to 13 acres within the Priority Habitat of Reach 5A. This work will impact primary wapato habitat where it occurs in areas with muddy substrate and a prolonged inundation period such as emergent marshes. The estimated timeframe for completing all of the remediation work throughout the PSA under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 5B

Reach 5B of the PSA is covered entirely by the wapato Priority Habitat. Suitable habitat for this species, consisting of emergent marsh, shoreline, and backwaters are common throughout this reach. The river channel along Reach 5B is considered low-gradient and has the potential to provide muddy shoreline habitat for wapato.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives would involve impacts to Priority Habitat. SED 3 would result in approximately 27,976 linear feet of riverbank remediation only. SED 4 through SED 8 would require 27,976 linear feet of riverbank remediation within Reach 5B as well, but in addition would include soil excavation and thin-layer capping within the stream

channel. SED 4 impacts 11 acres through excavation and 17 acres due to thin-layer capping; SED 5 impacts 25 acres through excavation and 2 acres due to thin-layer capping; SED 6 impacts 25 acres through excavation and 7 acres due to thin-layer capping; SED 7 impacts 25 acres through excavation and 7 acres due to thin-layer capping; and SED 8 impacts 35 acres due to excavation activities. This work would impact the river channel, muddy shoreline and riverbank areas and backwater habitat that is preferred by wapato. Access road construction and staging areas would disturb an additional 24 acres within the Priority Habitat of Reach 5B under all alternatives. Where these activities occur in open wetland habitats and shorelines, the potential for impacts to wapato exists. The estimated timeframe for completing the various work alternatives in Reach 5B is less than 1 year for SED 3, 3 years for SED 4, 5 years for SED 5 and SED 6, and 6 years for SED 7 and SED 8.

Floodplain alternative FP 1 consists of no action. All other floodplain alternatives would have an impact on wapato Priority Habitat in Reach 5B of the PSA. FP 2 impacts 1 acre; FP 3 impacts 9 acres; FP 4 impacts 16 acres; FP 5 impacts 11 acres; FP 6 impacts 53 acres; and FP 7 impacts 70 acres of mapped wapato Priority Habitat due to vegetation clearing and excavation activities. Access road construction and staging areas would disturb an additional 2 to 10 acres within the Priority Habitat of Reach 5B. This work will impact primary wapato habitat where if it occurs in areas with muddy substrate and a prolonged inundation period such as emergent marshes. These wetland types are commonly found throughout Reach 5B, with an abundance of backwater marshes. The estimated timeframe for completing all of the remediation work throughout the PSA under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 5C

The majority of Reach 5C is covered by two separate portions of wapato Priority Habitat. Only a small portion, approximately 1,000 feet wide, in the central portion of Reach 5C is not mapped as Priority Habitat. Suitable habitat for this species, especially marsh, shoreline, and backwaters are common throughout this reach of the PSA. The river channel along Reach 5C is considered low-gradient and has the potential to provide muddy shoreline habitat for wapato.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives would involve impacts to Priority Habitat in Reach 5C to varying amounts. Sediment remediation work in Reach 5C would not include riverbank remediation. SED 3 would only involve in-river work within the southern half of reach 5C, consisting of 35 acres of thin-layer capping. SED 4 involves 13 acres of excavation, 66 acres of thin-layer capping and 34 acres of engineered capping; SED 5 involves 21 acres of excavation, 45 acres of thin-layer capping and 34 acres of engineered capping; SED 6 involves 60 acres of excavation and 38 acres of thin-layer capping; SED 7 involves 71 acres of excavation and 28 acres of thin-layer capping; and SED 8 involves 111 acres of excavation. Backwaters, ponds and emergent marshes provide muddy shoreline habitats protected from the flowing water of the river, which serve as prime habitat for wapato. Work in these areas would directly impact this species if present. Access road construction and staging areas would disturb an additional 2 to 13 acres within the Priority Habitat of Reach 5C under these alternatives. Where these activities occur in open wetland habitats and shorelines, the potential for impacts to wapato exists. The estimated timeframe for completing the various work alternatives in Reach 5C is 1 year for SED 3, 2 years for SED 4 and SED 5, 4 years for SED 6 and SED 7, and 10 years for SED 8.

Floodplain alternative FP 1 consists of no action. All other floodplain alternatives would have an impact on wapato Priority Habitat in Reach 5C of the PSA. FP 2 impacts less than 1 acre; FP 3 impacts 7 acres; FP 4 impacts 11 acres; FP 5 impacts 20 acres; FP 6 impacts 46 acres; and FP 7 impacts 61 acres of mapped wapato Priority Habitat due to vegetation clearing and excavation activities. Access road construction and staging areas would disturb an additional 3 to 10 acres within the Priority Habitat of Reach 5C. This work will impact wapato habitat only if it occurs in areas with muddy substrate and a prolonged inundation period such as emergent marshes. These wetland types are commonly found throughout Reach 5C, with an abundance of backwater marshes. The estimated timeframe for completing all of the remediation work throughout the

PSA under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

Reach 6

Priority Habitat for wapato is located northernmost portion of Reach 6. The northern shore and mucky shallow areas of Woods Pond provide ideal habitat for wapato; in addition, the northern edge of the pond is bordered by shallow emergent marsh, which is also considered primary habitat for this species.

Except for SED 1 and SED 2, which involve no construction-related activities, all the other SED alternatives would involve impacts to Priority Habitat within Reach 6. SED 3 involves 13 acres of thin-layer capping; SED 4 involves less than 1 acre of thin layer capping: SED 5 through SED 7 involve 13 acres of excavation and less than 1 acre of thin layer capping; and SED 8 involves 13 acres of excavation only. These impacts occur within the shallow muddy substrate of Woods Pond and would cause direct mortality to any wapato plants in the work area and reduce the seed bank for this species in the PSA. Access road construction and staging areas would disturb an additional 0.03 acre within the Priority Habitat of Reach 6 under sediment alternatives SED 4 and SED 5. Where these activities occur in open wetland habitats and shorelines, the potential for impacts to wapato exists. The estimated timeframe for completing the various work alternatives in Reach 6 is 1 year for SED 3, 2 years for SED 4, 2.5 years for SED 5 and SED 6, 3.5 years for SED 7, and 11 years for SED 8.

Floodplain alternative FP 1 consists of no action. FP 2, FP 3, and FP 4 would not involve work within Priority Habitat of wapato in Reach 6. FP 5 through FP 7 involve 1 acre or less of impacts; due to vegetation clearing and excavation activities in Reach 6. Access road construction and staging areas would disturb less than 1 acre of Priority Habitat within Reach 6 under these alternatives. This work will occur within shallow emergent marsh which is a preferred habitat for this species. The estimated timeframe for completing all of the remediation work throughout the PSA under alternative FP 2 is 1 year; 3 years for FP 3; 4 years for FP 4 and FP 5; 13 years for FP 6; and 22 years for FP 7.

AA-4. Assessment of MESA Issues for Wapato

The Massachusetts Endangered Species Act (MESA) regulations define “take” at 321 CMR 10.02: “in reference to plants [‘take’] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct.” A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population would be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. “Net benefit” is defined as “an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the proposed Project or Activity.”

An assessment of these issues for wapato is summarized in Table AA-2 for the sediment alternatives and Table AA-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take, and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table AA-2 below, all of the sediment alternatives except for SED 1 and SED 2 would result in a take of wapato. The remedial actions associated with the removal of river bottom sediments, erodible riverbanks and backwater habitats would result in the loss of muddy inundated substrate that provides habitat for wapato populations; impacts to riverine habitats are extensive (147 to 271 acres), as is the extent of riverbank remediation (74,500 lf). This work would also reduce the seedbank for this species within the PSA.

Excavation, thin-layer capping and engineered capping would directly kill the plants that may be located in these work areas. As remediation extends from upstream to downstream reaches, a major concern relates to the elimination of this species in upstream areas, limiting the long-term potential for it to re-establish itself via water-borne seed dispersal. Given that the impacts within this species' primary habitat are so widespread, alternatives SED 3 through SED 8 would impact a significant portion of the local wapato population.

As summarized in Table AA-3, all of the floodplain alternatives except for FP 1 could potentially result in a take of wapato. Wapato Priority Habitat is widespread throughout all reaches of the PSA. Impacts to floodplain forest, grassland and wet meadow communities will likely not impact this species, however, impacts to areas which have a more prolonged inundation period such as deep and shallow emergent marsh could cause direct mortality of this species and reduce the seed bank within the PSA. Given the extent of impacts (21 to 89 acres) that would occur within the floodplain wetlands of the wapato Priority Habitat under FP 2 through FP 5, a take is possible because sufficient remediation work is proposed in open wetland habitats that are suitable for this species. Excavation may also reduce the seedbank of this species, which would also constitute a take pursuant to MESA. However, the work for FP 2 through FP 5 within 6 to 8% of the Priority Habitat is not likely to cause an impact to a significant portion of the wapato local population.

Accordingly, a long-term net benefit plan involving on-site habitat enhancement measures may be considered under these alternatives (FP 2 through FP 5); such a plan appears feasible. While information on conservation strategies for this species is limited, measures for other species of the *Sagittaria* genus may be applicable. Based upon this, a net benefit plan could be developed geared toward preservation, enhancement, and expansion of habitats supporting this species. Collection of seeds followed by propagation in greenhouses could be part of the plan, with eventual planting in appropriate habitats. Habitat management, including invasives control, along with conservation restrictions, public education, and long-term monitoring with collection of biological data contributing to knowledge of the species would also contribute to a net benefit plan. Expanding the habitat range beyond the currently mapped zone could be considered. However, any of these measures would need to be integrated and coordinated with requirements for and impacts to other rare species within the PSA, and measures will need to address increased opportunity for the expansion of invasive species, which typically have a competitive advantage over a rare species such as wapato.

With impacts to 197 to 276 acres of the wapato Priority Habitat (17 to 24%), FP 6 and FP 7 are likely to result in the take of a significant portion of the wapato local population. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

Natural Heritage and Endangered Species Program. 1992. Wapato (*Sagittaria cuneata*) Fact sheet, Natural Heritage and Endangered Species Program, MA Division of Fisheries and Wildlife, Westborough, MA.

United States Department of Agriculture. Natural Resources Conservation Service Website http://plants.usda.gov/

Woodlot Alternatives, Inc. 2002. Ecological Characterization of the Housatonic River. Environmental Remediation Contract. GE/Housatonic River Project, Pittsfield, MA.

Table AA-2: Assessment of MESA Issues for Wapato Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no construction activities.	N/A	N/A	N/A
SED 2	No take; only monitoring.	N/A	N/A	N/A
SED 3 through SED 8	Yes. Widespread (147 to 271 acres) excavation and thin-layer capping, as well as 74,500 lf of riverbank remediation in the PSA would cause direct mortality to any wapato growing in the work areas and a reduction in the seedbank of this species within the PSA.	No. Construction activities within Priority Habitat are extensive, occur in favorable habitat for this species, and would result in an unavoidable take.	Yes. These alternatives impact a significant portion (13 to 23%) of wapato Priority Habitat and involve 74,500 lf of riverbank remediation which includes favorable habitat for this species along the margins of the river.	N/A. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

Table AA-3: Assessment of MESA Issues for Wapato Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no construction activities.	N/A	N/A	N/A
FP 2 through 5	Possible. Alternatives impact 21 to 89 acres of the Priority Habitat; while much of the impacted habitats are not suitable to support wapato plants, remediation areas do involve emergent wetlands and backwater habitats that provide habitat for this species. Excavations could also remove the seeds of this species.	No. Construction activities within Priority Habitat are extensive, occur in some favorable habitats for this species, and would result in an unavoidable take. While access and staging areas may be adjusted to avoid impacts to this species, the overall extensive area of impact from remediation could not avoid a take of any wapato specimens.	No. Impacts are relatively limited (6 to 8% of the Priority Habitat) and most of the impacts are to habitats not suitable for this species.	Yes, a long-term net benefit plan involving on-site habitat enhancement measures may be considered under these alternatives (FP 2 through FP 5). While information on conservation strategies for this species is limited, measures used for other species of the *Sagittaria* genus may be applicable and a net benefit plan could be developed geared toward preservation, enhancement, and expansion of habitats supporting this species.
FP 6 and FP 7	Yes. These alternatives impact 197 to 276 acres of the Priority Habitat; while much of the impacted habitats are not suitable to support wapato plants, remediation areas do involve emergent wetlands and backwater habitats that provide habitat for this species. Excavations could also remove the seeds of this species.	No. Construction activities within Priority Habitat are extensive, occur in some favorable habitats for this species, and would result in an unavoidable take. While access and staging areas may be adjusted to avoid impacts to this species, the overall extensive area of impact from remediation could not avoid a take of any wapato specimens.	Yes. Alteration of 17 to 24% of the Priority Habitat area. Substantial areas of impact occur within open wetland habitat types that are favorable conditions for this species to grow in.	N/A. Since the impact is to a significant portion of the local population, a net benefit is not applicable under MESA.

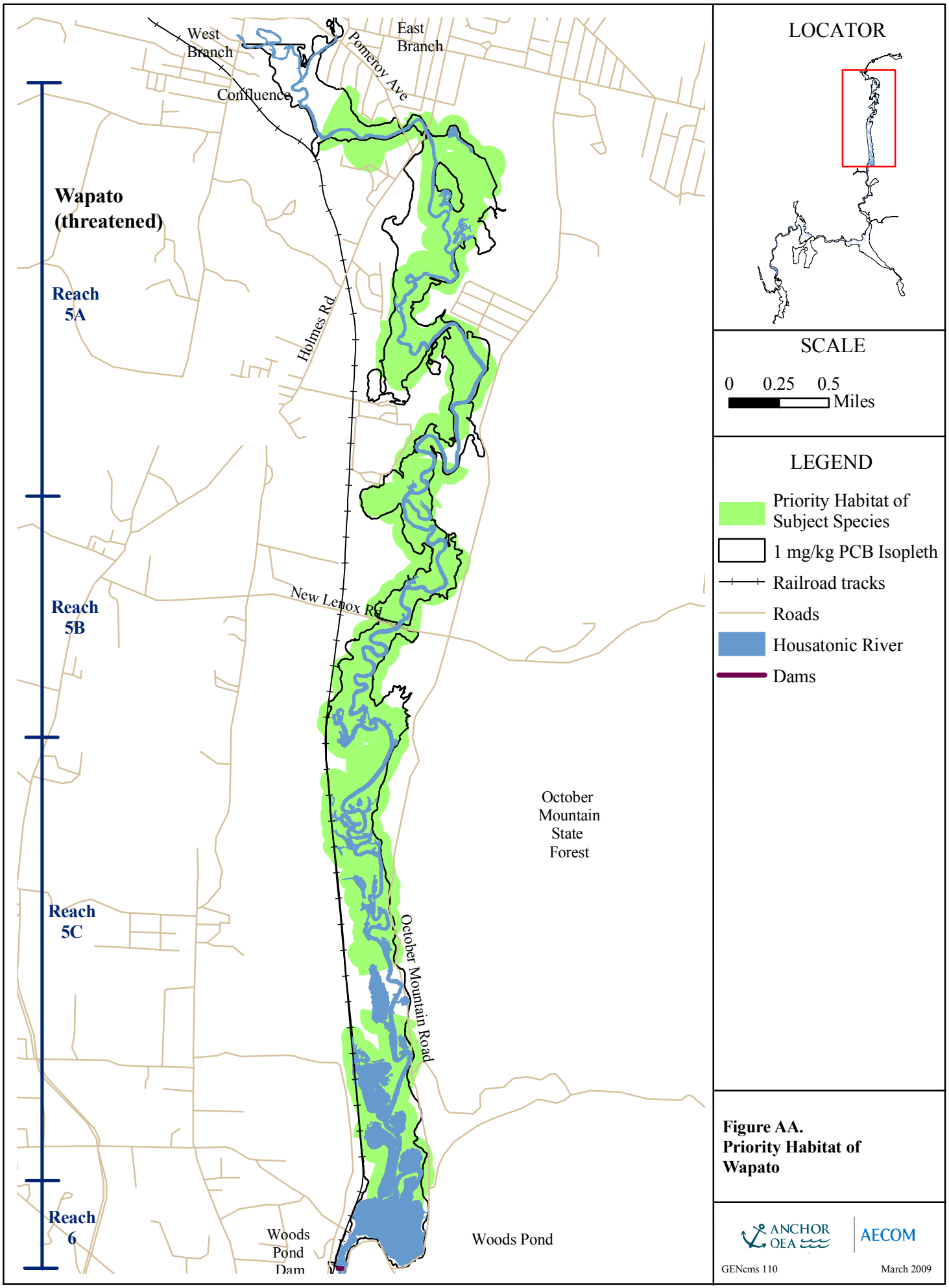

Figure AA.
Priority Habitat of Wapato

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BB. White Adder's-Mouth (*Malaxis monophyllos var. brachypoda*)

BB. White Adder's-Mouth (*Malaxis brachypoda*) MESA Assessment

BB-1. Summary of Species Life Cycle and Habitat Requirements

White adder's-mouth (*Malaxis brachypoda*) is a member of the orchid family. This plant arises from solid tubers and is a slender herb growing to a height of 4 to 10 inches (1 to 2.5 dm). The flowering season for this plant is from June to August. In Massachusetts, white adder's-mouth occurs in shady, wet areas such as swamps and bogs, usually growing in sphagnum moss with little else. The NHESP Fact Sheet for this species suggests that it grows primarily in sphagnum moss in wet areas such as swamps and bogs or in forested fens with highly calcareous water. It also favors forested fens and peatland communities dominated by coniferous trees and influenced by highly calcareous water (NHESP 1985; Schultz 2003). This species is a state-listed Endangered Species (NHESP 2008).

BB-2. Species Presence within PSA

Priority Habitat for white adder's-mouth occurs in Reach 5A of the PSA as shown in Figure BB. The Priority Habitat for this species totals 75 acres, but only 11 acres of this Priority Habitat is in the PSA. The Priority Habitat extends east of the PSA into forested wetlands associated with Sackett Brook and contiguous waterways. Natural communities within this portion of the PSA consist of grasslands, northern hardwoods-hemlock-white pine forest, red maple swamp, shrub swamp, shallow emergent marsh, and moderately alkaline pond. Based upon preferred habitat descriptions, this species is most likely to occur within the palustrine habitats within this portion of the PSA, such as the red maple swamp, shrub swamp, and shallow emergent marsh.

BB-3. Impacts of Remedial Alternatives on White Adder's-Mouth Habitat

BB-3-1. Overview

Table BB-1 summarizes the aerial extent and duration of work within white adder's-mouth Priority Habitat for all the remedial alternatives. SED 1 consists of no action. SED 2 is limited to monitored natural recovery (MNR), which involves no construction work. SED 3 through SED 5 involve no construction within white adder's-mouth mapped Priority Habitat. SED 6 through SED 8 would each cause approximately 2 acres of impacts to the Priority Habitat through excavation or capping activities; however only backwater areas would be impacted and these are not likely habitats for white adder's-mouth plants.

FP 1 consists of no action. FP 5 and FP 6 do not involve work within mapped habitat for white adder's mouth. FP 2, FP 3, FP 4, and FP 7 would impact roughly 0.1 to 0.2 acre of Priority Habitat through soil removal activities. No impacts are related to access road or staging areas.

Table BB-1. White Adder's-Mouth Habitat Alterations by Remedial Alternative

Remedial Alternative	Reach with Affected Habitat*	Description of White Adder's-mouth Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 1	N/A – No Action	0	0	0
SED 2	N/A	0	0	0
SED 3	N/A	0	0	8

Remedial Alternative	Reach with Affected Habitat*	Description of White Adder's-mouth Habitat Impacts		
		Priority Habitat Impacted by Sediment/Soil Remediation (acres or linear feet)**	Additional Impact Area due to Access Road and Staging Areas (acres)	Estimated Duration of Work (years)***
SED 4	N/A	0	0	8
SED 5	N/A	0	0	8
SED 6	5A	2 ac (thin-layer capping)	0	8
SED 7	5A	2 ac (thin-layer capping)	0	9
SED 8	5A	2 ac (excavation/capping)	0	11
FP 1	N/A – No Action	0	0	0
FP 2	5A	0.1 ac (excavation/backfill)	0	1
FP 3	5A	0.09 ac (excavation/backfill)	0	3
FP 4	5A	0.1 ac (excavation/backfill)	0	4
FP 5	N/A	0	0	4
FP 6	N/A	0	0	13
FP 7	5A	0.2 ac (excavation/backfill)	0	22

*This species occurs only in Reach 5A.
**SED impacts are to backwater areas; FP impacts are to floodplain wetlands.
***Duration of work is presented for entire reach.

BB-3-2. Description of Specific Remediation Activities Relative to White Adder's-mouth Priority Habitat by River Segments

Reach 5A

Priority Habitat for white adder's-mouth is located in the northeast region of Reach 5A of the PSA. Natural communities in this portion of the reach are suitable habitat for white adder's-mouth, that include red maple swamp, shrub swamp, and shallow emergent marsh.

SED 1 through SED 5 do not involve construction activities within white adder's-mouth habitat. SED 6 through SED 8 would each involve approximately 2 acres of impact to the Priority Habitat through capping and excavating activities. SED 6 and SED 7 would involve 2 acres of thin-layer capping within a backwater pond of the river situated within the Priority Habitat of this species. SED 8 would impact 2 acres within the same pond, but activities would consist of excavation of the top 2 feet of soil followed by backfill. All impacts associated with SED 6, SED 7, and SED 8 would only affect backwater ponded habitat which is not suitable habitat for white adder's-mouth. The estimated timeframe for completing the work in Reach 5A is 8 years for SED 6, 9 years for SED 7, and 11 years for SED 8; however, work within the Priority Habitat area will be less than these durations.

FP 1 consists of no action. FP 5 and FP 6 do not involve work within white adder's-mouth Priority Habitat. FP 2, FP 3, FP 4, and FP 7 consist of excavation and backfilling activities within the Priority Habitat. Each of these alternatives would involve between 0.09 and 0.2 acre of remediation. This work would occur mostly within emergent and shrub floodplain habitats, which have potential to support the growth of this species and therefore could have a direct impact on white-adder's-mouth populations. The estimated timeframe to complete the work associated with FP 2, FP 3, FP 4, and FP 7 would be 1, 3, 4, and 22 years, respectively, though the work within the Priority Habitat would be shorter in duration. No access road construction or staging areas will occur within Priority Habitat for white adder's-mouth.

Reach 5B

Priority Habitat for white adder's-mouth is not identified in Reach 5B.

Reach 5C

Priority Habitat for white adder's-mouth is not identified in Reach 5C.

Reach 6

Priority Habitat for white adder's-mouth is not identified in Reach 6.

BB-4. Assessment of MESA Issues for White Adder's-mouth

The Massachusetts Endangered Species Act (MESA) regulations define "take" at 321 CMR 10.02: "in reference to plants ['take'] means to collect, pick, kill, transplant, cut or process or attempt to engage or assist in any such conduct." A take is only permissible under MESA if a project proponent: (1) can demonstrate that an insignificant portion of the local population will be impacted by the project; and (2) agrees to carry out a conservation and management plan for the species (on- or off-site) that provides a long-term net benefit to the conservation of the species. "Net benefit" is defined as "an action, or set of actions, that contributes, on its own or in the context of other actions, significantly to the long-term conservation of a State-listed Species and that the conservation contribution to the impacted State-listed Species exceeds the harm caused by the planned Project or Activity."

An assessment of these issues for white adder's-mouth is summarized in Table BB-2 for the sediment alternatives and Table BB-3 for the floodplain alternatives. These tables identify, for each alternative: (a) whether a take would occur, the type of take and whether the take could be avoided; (b) whether any unavoidable take would be likely to impact a significant portion of the local population of the rare species; and (c) if not (i.e., if the alternative would likely affect only an insignificant portion of the local population), to the extent such judgments are now possible, whether it would be feasible to develop a long-term net benefit plan and what that plan might involve.

As shown in Table BB-2, it is unlikely that any sediment alternatives would result in a take of white adder's-mouth. Work associated with SED 6, SED 7, and SED 8 would each consist of 2 acres of impacts to a backwater pond within Priority Habitat. SED 6 and SED 7 consist of thin-layer capping and SED 8 consists of soil removal and backfill within this pond. It is unlikely that this work will impact the species, since white adder's-mouth generally grows on moist sites and not in standing water. Accordingly, no take of this species is likely under the SED alternatives.

As shown in Table BB-3, FP 2, FP 3, FP 4, and FP 7 could result in a take. Construction activities, consisting of soil excavation and backfill, will occur within Priority Habitat in emergent and possibly shrub wetland which are suitable habitat for white adder's-mouth, and this work therefore has the potential to result in direct mortality of any individuals present. These impacts will not affect a significant portion of the population as work within mapped Priority Habitat is fairly limited and will only affect a maximum of 0.2 acre of Priority Habitat (FP 7). Because these floodplain alternatives involve a take of an insignificant portion of the local population, that resulting take would be allowed only if conservation and management measures can be developed which would provide a long-term net benefit to the species. However, based on a review of the relevant literature, little is known about conservation strategies for this species, and therefore there is insufficient information to identify the elements of such a plan or to determine whether such measures would achieve a net benefit for this species (Schultz 2003; USDA NRCS).

References:

Natural Heritage and Endangered Species Program. August 2008. Massachusetts List of Endangered, Threatened and Special Concern Species as published in the Code of Massachusetts Regulations. Natural Heritage & Endangered Species Program. 321 CMR 10.00.

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Table BB-2: Assessment of MESA Issues for White Adder's-mouth Under Sediment Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
SED 1	No take due to no construction activities.	N/A	N/A	N/A
SED 2	No take; monitored Natural recovery only.	N/A	N/A	N/A
SED 3 through SED 5	No. Work will not occur within Priority Habitat of white adder's-mouth.	N/A	N/A	N/A
SED 6 through SED 8	No. Work associated with SED 6, SED 7, and SED 8 would each consist of 2 acres of impacts to a backwater pond within Priority Habitat. SED 6 and SED 7 consist of thin-layer capping and SED 8 consists of soil removal and backfill within this pond. It is unlikely that this work will impact the species, since white adder's-mouth generally grows on moist sites and not in standing water. Accordingly, no take of this species is likely under the SED alternatives.	N/A	N/A	N/A

Table BB-3: Assessment of MESA Issues for White Adder's-mouth Under Floodplain Alternatives

Alternative	Assessment of "Take"		Impact on Significant Portion of Local Population?	Long-Term Net Benefit Plan
	Would "Take" Occur?	Could "Take" Be Avoided?		
FP 1	No take due to no construction activities.	N/A	N/A	N/A
FP 2, FP 3, FP 4 and FP 7	Possibly. Soil removal/backfill activities within Priority Habitat would be conducted in emergent and shrub wetlands which are suitable habitat for this species. Work within these habitats would not be expansive, however (a maximum of 0.2 acre for FP 7).	Possible. Since activities are so limited in scope, it may be possible to avoid direct impacts to individual plants or suitable habitat within the Priority Habitat.	No. Impacts within Priority Habitat for this species under these alternatives are relatively small, and the majority of these impacts do not appear to be in prime habitat areas.	Cannot be established. A literature review indicates that little is known about the conservation and management strategies that might benefit this species. Therefore, there is insufficient information to identify the elements of a conservation and management plan for this species or to determine whether such a plan would achieve a net benefit for the species.
FP 5 and FP 6	No. Work will not occur within Priority Habitat of white adder's-mouth.	N/A	N/A	N/A

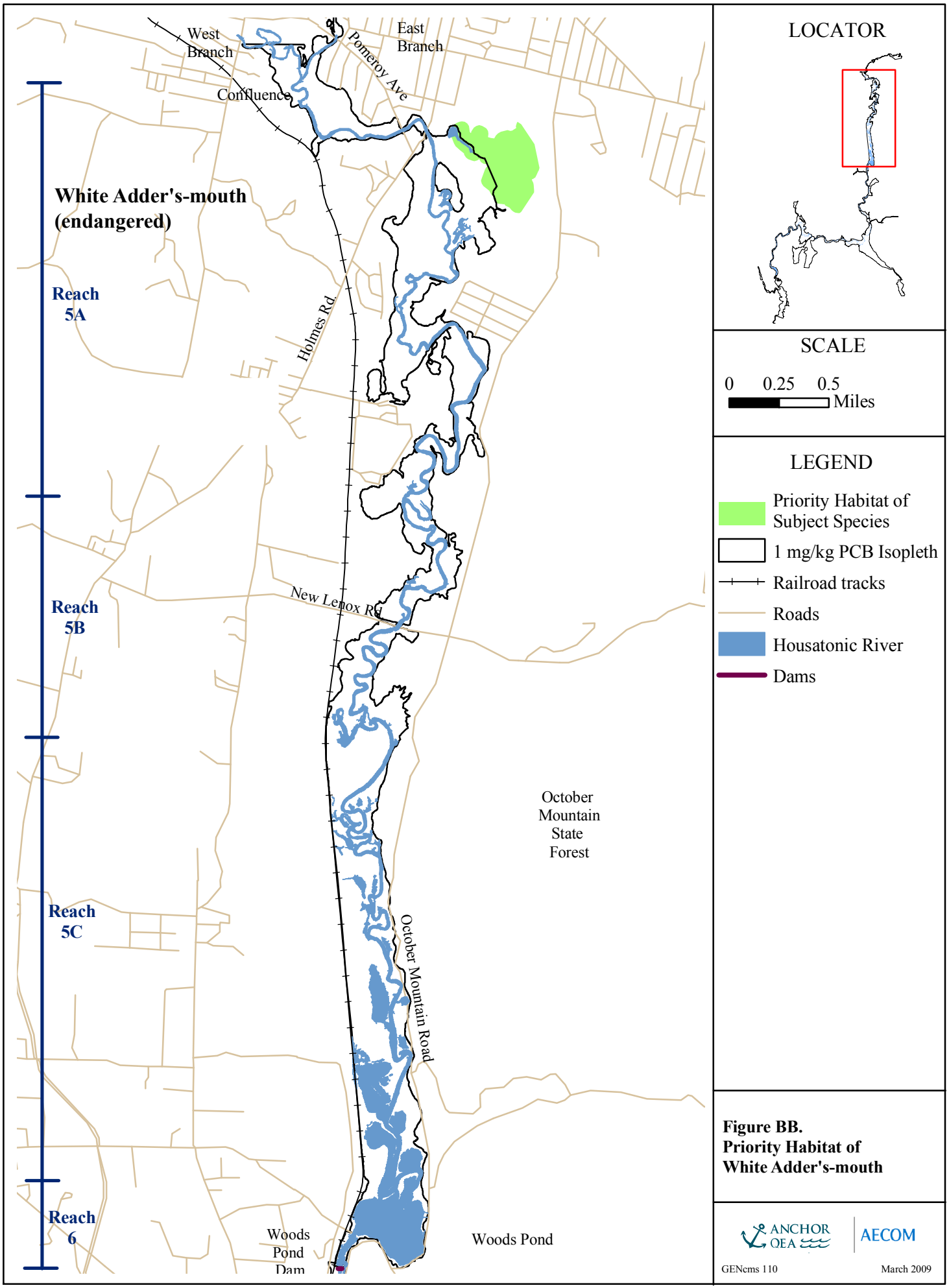

Figure BB.
Priority Habitat of White Adder's-mouth

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CC. Additional Species

CC. Additional Rare Species MESA Assessment

CC-1. Introduction

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) has designated the Primary Study Area (PSA) as Priority Habitat of 28 state-listed rare species.

According to the Woodlot Alternatives Inc. (Woodlot) Ecological Characterization of the Housatonic River (Woodlot 2002), five additional state listed rare species were observed in the PSA even though no specific Priority Habitat for those species has been mapped in the PSA by the NHESP. These species include northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), northern parula (*Parula americana*), blackpoll warbler (*Dendroica striata*) and black maple (*Acer nigrum*). These five species were identified within the PSA during ecological surveys between 1998 and 2000 and rare species observation forms were submitted to NHESP. In addition to these five species, Woodlot also identified several myotis species during their echo-location surveys and they believed, but could not scientifically confirm, that at least one observation was a small-footed myotis (*Myotis leibii*). The small-footed myotis is also a state listed species in Massachusetts. Provided below is a description of each of the five species confirmed to occur in the PSA by Woodlot, and a brief discussion of the remedial impacts which will affect each species' likely habitat in the PSA.

CC-2. Northern Harrier (*Circus cyaneus*)

The northern harrier is a medium-sized raptor (18 inches in length) with an owl-like face, long, rounded, slender wings (wingspan up to 46 inches), and a long, banded tail. Adult males are a pale blue-gray, females and juveniles are dusky brown. Both sexes have a distinct white rump patch easily seen in flight, and long, light orange-yellow legs. Harriers feed by coursing close to the ground, wings held in a shallow "V," or dihedral. Prey items include small mammals, rats, rabbits, birds, snakes, frogs, and other small creatures. Preferred breeding habitat is meadows, grasslands, abandoned fields and inland or coastal marshes. Breeding season in Massachusetts for harriers is typically March through July and is noted for the dramatic aerial courtship display of the male. The nest is built on the ground in open areas among tall, dense clumps of vegetation. On occasion the nest is built over water on a mound of sticks, on a sedge tussock, or on a knoll of dry ground. The female lays 3-9 bluish-white eggs. Incubation is done by both sexes and takes approximately 31-32 days. The male feeds both the female and the young until they are ready to fledge approximately 30-35 days after hatching. Harriers are uncommon in Massachusetts during the summer months; those that do not migrate south winter over in coastal marshes on Cape Cod and the islands. Northern harriers are a state-listed Threatened Species in Massachusetts.

Both male and female harriers were observed in all reaches of the PSA from May through October of 1998-2000 during field surveys conducted by Woodlot. Sightings (14 total) were in a variety of open habitats, usually within shallow emergent marsh areas adjacent to the Housatonic River. Though observers indicated that these birds were adults, it is possible that some of the females observed later in the season (August-October) were also first-year juveniles, due to similar plumage characteristics. NHESP has documented northern harriers breeding within Berkshire County.

Harriers utilize open areas such as wet meadows and shallow emergent marshes and, occasionally other aquatic environments, for foraging and nesting. Remedial floodplain alternatives (FP 3 through FP 7) will remove vegetation and excavate soil from these habitats in the PSA, so these activities would constitute a take of the northern harrier by disrupting its foraging and nesting habitat. The northern harrier could also be impacted due to behavioral disturbance caused by construction activities, as would occur under even the SED 3-8 alternatives. These behavioral patterns may result in short term adjustments in feeding patterns or potentially long term migration pattern changes. Without more specific information on, and evaluation of, the extent of the habitat likely to support this species in the PSA, even a preliminary determination on whether a

take of a significant portion of the local population will occur is not possible. Given the high quality of the existing habitat conditions in the PSA, and the substantial disruption to these habitats that would result from the implementation of most of the remedial alternatives, achieving a net benefit for this species does not appear feasible; specific habitat management measures to enhance conditions for this species are generally untested. Given the high quality of the existing habitat, the potential for establishing a net benefit by way of additional habitat management is remote.

CC-3. Sharp-Shinned Hawk (*Accipiter striatus*)

The sharp-shinned hawk is the smallest member of the accipiter family. It is 11 inches in length (about the size of a blue jay) with short, broad, rounded wings (20-27 inches), and a long, narrow, square-tipped tail which has three or four bands. Adult birds are blue-grey above with white underparts that are finely barred with reddish-brown. Unlike the adults, immature sharp-shinned hawks are heavily streaked on the breast and belly. Sexes have similar plumage, but like all raptors, females are larger than males. Sharp-shinned hawks have a distinctive flight pattern often characterized as “flap,flap, glide,” with intermittent soaring. The sharp-shinned hawk is similar in plumage to the Cooper's hawk (*Accipiter cooperi*) but can be distinguished from that species by its smaller size (Cooper’s hawks tend to be crow-sized) and by its square tail. This species hunts by perching on a branch and darting after its prey, by gliding close to the ground, or by making short flights from perch to perch. It feeds primarily on small birds caught in mid-air but will also take mice, shrews, bats, frogs, and large insects. Sharp-shinned hawks prefer coniferous or mixed woodlands with clearings, and woodlands bordering open brushy areas. Sharp-shinned hawks are a state-listed Species of Special Concern in Massachusetts.

Sharp-shinned hawks are uncommon winter residents and rare breeders in Massachusetts. They typically begin migrating south in September, and return to breeding grounds in the north by April. Preferred nesting sites are in coniferous woods. Nests are platforms built from sticks and twigs lined with bark, placed in a tree 10-90 feet high. The female lays 4-5 bluish-white or greenish-white eggs, speckled with brown. Incubation is 35 days, with the young fledging in 21 to 35 days. Chicks are fed by both parents.

Sharp-shinned hawks were observed within Reaches 5A and 5B of the PSA from March through December (1998-2000) during field surveys conducted by Woodlot (Woodlot). Sightings (9 total) were within a variety of open habitats, usually in areas immediately adjacent to transitional floodplain forest habitat. Observers generally did not record age or sex of birds (only 1 adult was positively identified), but indicated that the birds were likely transients, and not breeding within the area. NHESP has documented this species breeding within Berkshire County.

Sharp-shinned hawks utilize open forested areas next to clearings (transitional floodplain forest, emergent wetlands), and nest in coniferous forest. Remedial floodplain alternatives (FP 2 through FP 7) will remove vegetation and excavate soil from these habitats in the PSA, so these activities would constitute a take of the sharp-shinned hawks by disrupting its feeding and nesting habitat. Impacts from the removal of large trees which are used for nesting and perching within the canopy will be a significant impact to the habitat suitability of the PSA for this species. Sharp-shinned hawks could also be impacted due to behavioral disturbance caused by construction activities, even by SED 3-8. These behavioral patterns may result in short term adjustments in feeding patterns or potentially long term migration pattern changes. Without more specific information on, and evaluation of, the extent of the habitat likely to support this species in the PSA, even a preliminary determination on whether a take of a significant portion of the local population is not possible. Given the high quality of the existing habitat conditions in the PSA, and the substantial disruption to these habitats that would result from the implementation of most of the remedial alternatives, achieving a net benefit for this species does not appear feasible; specific habitat management measures to enhance conditions for this species are generally untested. Given the high quality of the existing habitat, the potential for establishing a net benefit by way of additional habitat management is remote.

CC-4. Northern Parula (*Parula americana*)

The northern parula is a diminutive (4.5 inches in length) and distinctive wood warbler. Males have blue-gray upperparts with a greenish-yellow patch on the back, yellow throat and breast, and have a black and rufous band across the breast. They have white eye rings and two white wing bars. Females and juveniles are similar in color but paler, with no black breast band. Parulas feed on insects and sometimes spiders. In Massachusetts, this species is found in wet woodlands such as red maple and Atlantic white cedar swamps, river margins and pond shores. Preferred breeding habitat in the northeast are woodlands that contain old man's beard (*Usnea*), a lichen used as nesting material. Northern parulas are a state-listed Threatened Species in Massachusetts.

Parulas nest in late May or early June. The nest is typically a pouch of *Usnea* suspended from the branch of a tree. The nest may be used for several seasons. Parulas lay only one clutch of 4-5 eggs per year. The eggs are white with brown dots. Incubation lasts 12-14 days, the chicks are fledged after another 11-12 days.

Parulas were observed within Reaches 5A and 5B of the PSA in May, 1999 during field surveys conducted by Woodlot. Sightings were limited to 3 males (foraging, vocalizing) in transitional floodplain forest habitat immediately adjacent to the Housatonic River.

Floodplain (FP 2 through FP 7) and the sediment (SED 3 through SED 8) alternatives would have an impact on this species through the removal of vegetation within forested and riparian habitats that would constitute a take of the northern parula. The northern parula could also be impacted due to behavioral disturbance caused by construction activities. These behavioral patterns may result in short term adjustments in feeding patterns or potentially long term migration pattern changes. Without more specific information on, and evaluation of, the extent of the habitat in the PSA likely to support this species, even a preliminary determination on whether a take of a significant portion of the local population is not possible; any net benefit analysis is similarly not possible under the present understanding of the species' use of the PSA.

CC-5. Blackpoll Warbler (*Dendroica striata*)

The blackpoll warbler is a medium-sized wood warbler (5.5 inches in length) that is chickadee-like in appearance. Breeding males are striped smoky gray with a black cap, white cheeks, and white throat. Females are less streaked and do not have a black cap. Both sexes have two white wing bars. Fall adults and immatures are olive-green above with a greenish breast and throat, and light streaking. Blackpoll warblers feed on insects, spiders, and some seeds and berries. They prefer stunted spruce forests, and its occurrence in Massachusetts is generally limited to areas that resemble this type of habitat, usually in areas containing stunted balsam firs. In northern Berkshire County, breeding blackpoll warblers are found in stands of stunted fir at the summit of Mount Greylock. There are also areas containing various spruces and balsam fir in close proximity to the PSA, found in the higher elevations of October Mountain State Forest and in small stands adjacent to Ashley Lake. Blackpoll warblers are a state-listed Species of Special Concern in Massachusetts.

Blackpoll warblers arrive in Massachusetts in late May. They are long-range migrants (up to 2,500 miles) and are often among the last of the warblers to appear. Courtship begins in June and eggs are not laid until the second or third week of that month. Nests are constructed by the female in the lower parts of young conifers. The female lays 4-5 eggs, which are white with brown dots. Incubation is typically 11 days, and the young are fledged 11-12 days after hatching. There is only one brood per year.

Blackpoll warblers were observed within Reaches 5A, 5B and 5C of the PSA in the month of May (1999 and 2000) during field surveys conducted by Woodlot. Sightings were limited to 5 adult males (foraging, vocalizing) within transitional floodplain forest habitat immediately adjacent to the Housatonic River. At least one sighting was within a stand of "spruce-fir-northern hardwood forest adjacent to backwater areas of Woods Pond."

Remedial work within floodplain areas of the PSA may cause a take of the blackpoll warbler. Although its primary habitat is stunted coniferous forests generally found at higher elevations, this species will, as evidenced by Woodlot, occasionally utilize forested floodplain communities during migration. Without more specific information on, and evaluation of, the extent of the habitat in the PSA likely to support this species, even a preliminary determination on whether a take of a significant portion of the local population is not possible; any net benefit analysis is similarly not possible under the present understanding of the species' use of the PSA.

CC-6. Black Maple (*Acer nigrum*)

The black maple is a medium-to-large-sized deciduous tree reaching heights of 70-110 feet. Bark is smooth and gray on young trees, but narrowly furrowed and almost black on older specimens. Leaves are generally 3 lobed, simple, opposite, dark green above and yellowish-green below. Leaves often have drooping sides. The presence of stipules at the base of the black maple leaves helps distinguish this species from sugar maple (*Acer saccharum*). The flowers of the black maple are similar to those of a sugar maple. Black maples flower from late May through early June. The fruits are paired samaras with wide-spreading papery wings. They ripen in the fall with sugar maples, to which this species is closely related and with which it hybridizes. Heavy seed crops usually occur in 4-year cycles. The black maple is a state-listed Species of Special Concern in Massachusetts.

A single black maple was observed within Reach 5A of the PSA during field surveys conducted by Woodlot. It was found within Massachusetts Audubon's Canoe Meadows property, off the Sacred Way Trail. The observation occurred within transitional floodplain forest habitat adjacent to the Housatonic River. The black maple was growing in association with sugar maple and white ash (*Fraxinus americana*) trees. NHESP has documented this species growing within Berkshire County.

It is not possible to determine whether a take of this species will occur without additional information. The single individual observed by Woodlot was within a transitional floodplain forest area, and this type of habitat is found throughout PSA. A take could occur through the direct removal of any black maple tree during floodplain remediation or significant alteration of the habitat surrounding this species that removes the seeds of this species. Excavation of soils near documented black maple trees will result in a loss of the available seed bank for this species.

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Attachment 1 – Invasive Species

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Attachment 1 to Appendix B
Housatonic River Restoration

Invasive Species Control Summary

The Massachusetts Invasive Plant Advisory Group (MIPAG) defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts" and naturalized plants as "non-indigenous taxa that occur without the aid and benefits of cultivation in Massachusetts." These plants can cause environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to native plant communities and ecosystems. The Natural Resources Conservation Service's Wetland Science Institute (1999) found that invasive species threaten the success of wetland restoration and creation by replacing native vegetation, reducing biodiversity, reducing wildlife habitat and food, changing ecosystem processes, and increasing hybridization. Invasive species are a particular concern where the preservation of rare species is an issue due to the high potential for invasives to outcompete and eliminate rare species. Invasive non-native organisms have contributed to the decline of 42% of federally listed threatened and endangered species (The Nature Conservancy 2009). A study by the New England Division of the Army Corps of Engineers on the success of wetland mitigation sites found that invasive species was a common problem at a majority of the sites they reviewed (Minkin and Ladd 2003). It has been estimated that 725 (32%) of the 2,263 species documented in the Commonwealth are naturalized newcomers (NEWFS, 2006), and the MIPAG has developed a list of 62 species considered to be especially aggressive or problematic in minimally managed habitats in the Commonwealth (8.5% of the 725 naturalized species), plus four other species not yet found in the Commonwealth but deemed "Potentially Invasive" because of their documented invasiveness in nearby states.

Many of the plant species in the PSA are naturalized, and at least 15 plants species observed in the PSA are included on the *Invasive, Likely Invasive, and Potentially Invasive Plants in Massachusetts* (MIPAG, 2005). These plants occupy the aquatic, herb, shrub, and vine layers of the plant community, and an additional species which occupies the tree stratum (Northern Catalpa) is a "watch list" plant on the Massachusetts list. Invasive species tend to spread in areas where disturbance to the plant community or surface soils occurs. Since these are the types of activities that will occur under most of the FP and SED alternatives, this makes the PSA vulnerable to invasive species proliferation. Since invasive species proliferation results in a displacement of native plant species, it has the result of not only eliminating rare plant species, but also the native plants upon which animal species depend (including rare animal species).

Table 1 provides a summary of invasive plant species observed in the PSA, and which are therefore of immediate concern in terms of potential proliferation under remedial measures, along with the potential control strategies (mechanical, chemical, physical, biological) that have been used for these species. The listing of control measures demonstrates the complexity and challenges of trying to control multiple species occupying a large, sensitive ecosystem. In each case preliminary recommendations have been made as to the likely option for control in the PSA. Even the control options warrant concern for protecting rare species due to the long term requirement for human intervention in monitoring and management of the floodplain communities.

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Table 1. Summary of Potential Invasive Plant Species Control Strategies.

Species Name	Scientific Name	Indicator Status*	Control Methods
Common Buckthorn	*Rhamnus cathartica*	NL	Fire: controlled burns in mid march to late may for 5-6 years has shown a positive results
			Physical + Mechanical: pulling small diameter stems and seedlings is effective for small plants but soil disturbance may release new seed.
			Chemical: cutting and treating the stumps with an herbicide treatment during the growing season has been shown to be very effective.
			Biological: No biological control organisms are available for this plant.
			Recommendation: cutting + chemical treatment (May 1 to Oct 1)
Common Reed	*Phragmites australis*	FACW	Fire: prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, may be effective. Burning after herbicide treatment also reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Plants should not be burned in the spring or summer before flowering as this may stimulate growth.
			Physical + Mechanical: This type of control (e.g., repeated mowing) may be effective at slowing the spread of established stands but is unlikely to kill the plant. Excavation of sediments may also be effective at control but if small fragments of root are left in the soil, they may lead to reestablishment.
			Chemical: Glyphosate-based herbicides (e.g., Rodeo®) are the most effective control method for established populations. Herbicides are best applied in late summer/early fall after the plant has flowered either as a cut stump treatment or as a foliar spray. It is often necessary to do repeated treatments for several years to prevent any surviving rhizomes from resprouting.
			Biological: No biological control organisms are available for this plant.
			Recommendation: Combination of cutting and chemically treating the stems

Species Name	Scientific Name	Indicator Status*	Control Methods
Garlic Mustard	*Alliaria petiolata*	FACU-	Fire: Fire has been used to control garlic mustard in some large natural settings but, because burning opens the understory, it can encourage germination of stored seeds and promote growth of emerging garlic mustard seedlings. For this reason, burns must be conducted for three to five consecutive years.
			Physical + Mechanical: Hand removal of plants is possible for light infestations and when desirable native species co-occur. Care must be taken to remove the plant with its entire root system because new plants can sprout from root fragments. For larger infestations of garlic mustard, or when hand-pulling is not practical, flowering stems can be cut at ground level or within several inches of the ground, to prevent seed production. If stems are cut too high, the plant may produce additional flowers at leaf axils. Once seedpods are present, but before the seeds have matured or scattered, the stalks can be clipped, bagged and removed from the site to help prevent continued buildup of seed stores. This can be done through much of the summer.
			Chemical: For heavy infestations, where the risk to desirable plant species is minimal, application of the systemic herbicide glyphosate (e.g., Roundup®) is effective.
			Biological: Research is currently being performed on biological controls for this species. No releases of agents have yet been made against garlic mustard.
			Recommendation: A combination of physical and mechanical removal and use of herbicide for very heavy infestations. Regardless of the control method employed, annual monitoring is necessary for a period of at least five years to ensure that seed stores of garlic mustard have been exhausted.
Honeysuckle (bush)	*Lonicera sp.*	NI	Fire: Prescribed burning has shown some promise for exotic bush honeysuckles growing in open habitats. In all instances, control should be initiated prior to the seed dispersal period (late summer to early autumn) to minimize reinvasion of treated habitats.
			Physical + Mechanical: Grubbing activities can be used but soil disturbance may release new seed. Repeated mowing for several years may result in high mortality but if mowing is not continued for several years it may actually thicken the stand.
			Chemical: Well established stands of exotic bush honeysuckles are probably best managed by cutting the stems to ground level and painting or spraying the stumps with a slightly higher rate of glyphosate (2-3%).
			Biological: No biological control organisms are available for this plant.
			Recommendation: Cutting and chemical treatment

Species Name	Scientific Name	Indicator Status*	Control Methods
Japanese Barberry	*Berberis thunbergii*	FACU	Fire: Not an effective management option
			Physical + Mechanical: Small plants can be pulled by hand, using thick gloves to avoid injury from the spines. The root system is shallow making it easy to pull plants from the ground, and it is important to get the entire root system. Equipment can be used to clear large areas with the roots. Work should be done in late summer prior to seed production.
			Chemical: Treatments using the systemic herbicides glyphosate (e.g., Roundup®) and triclopyr (e.g., Garlon®) have been effective in managing Japanese barberry infestations that are too large for hand pulling. For whole plant treatment, apply a 2% solution of glyphosate mixed with water and a surfactant.
			Biological: No biological control organisms are available for this plant.
			Recommendation: Mechanical removal of plants, roots in late summer. Hand pulling of new seedlings.
Japanese Knotweed	*Polyganum cuspidatum*	FACU-	Fire: Not an effective management option
			Physical + Mechanical: Grubbing is effective for small initial populations or environmentally sensitive areas where herbicides cannot be used. Remove the entire plant including all roots and runners. Juvenile plants can be hand pulled depending on soil conditions and root development. Any portions of the root system not removed will potentially resprout. All plant parts (including mature fruit) should be bagged and disposed of in a trash dumpster to prevent reestablishment.
			Chemical: <u>Cut stem application</u> Use this method in areas where plants are established within or around non-target plants or where vines have grown into the canopy. Cut the stem about 2 inches above ground level. Immediately apply a 25% solution of glyphosate (e.g., Roundup®, or use Rodeo® if applying in or near wetland areas) or triclopyr (e.g., Garlon®) and water to the cross-section of the stem. A subsequent foliarapplication of glyphosate may be require to control new seedlings and resprouts <u>Foliar application</u> Use this method to control large populations. Apply a 2% solution of glyphosate or triclopyr and water to thoroughly wet all foliage. Do not apply so heavily that herbicide will drip off leaves. A 0.5% non-ionic surfactant is recommended in order to penetrate the leaf cuticle, and ambient air temperature should be above 65 ºF.
			Biological: No biological control organisms are available for this plant.
			Recommendation: Manual grubbing followed by foliar application if needed

Species Name	Scientific Name	Indicator Status*	Control Methods
Moneywort	*Lysimachia nummularia*	FACW-	Fire: Not an effective management option
			Physical + Mechanical: The plant can be hand pulled where practical. All stems and stem fragments should be removed from the area to prevent the stems from rooting again in the soil. Prolonged submergence will kill moneywort. At restoration sites, moneywort can be controlled by establishing native grasses to shade it out. Mowing is not effective since moneywort adheres closely to the ground due to its many rooting nodes
			Chemical: Several herbicides are effective in controlling moneywort. Because moneywort usually grows in or near wetlands, be sure that the herbicide is approved for use in wetlands (such as Rodeo).
			Biological: No biological controls were found during research.
			Recommendation: Physical and mechanical controls should be put in place to properly remove the plant and reseed with native grasses which may out compete this species.

Species Name	Scientific Name	Indicator Status*	Control Methods
Oriental Bittersweet	*Celasrtrus orbiculatus*	NL	Fire: Not an effective management option
			Physical + Mechanical: Small infestations can be hand-pulled but the entire plant should be removed including all the root portions. If fruits are present, the vines should be bagged in plastic trash bags and disposed of in a landfill. For climbing vines, first cut the vines near the ground at a comfortable height to kill upper portions and relieve the tree canopy. Rooted portions will remain alive and should be pulled, repeatedly cut to the ground or treated with herbicide. Cutting without herbicide treatment will require vigilance and repeated cutting because plants will resprout from the base.
			Chemical: <u>Basal bark application</u> - Use a string trimmer or hand saw to remove some of the foliage in a band a few feet from the ground at comfortable height. To the exposed stems, apply a 20% solution of triclopyr ester (Garlon® 4) (2.5 quarts per 3-gallon mix) in commercially available basal oil with a penetrant (check with herbicide distributor) to vine stems. This can be done year-round although efficacy may vary seasonally; temperatures should be above 50 degrees F for several days. <u>Cut stem application</u> - Use this method in areas where vines are established within or around non-target plants or where vines have grown into the canopy. Cut each vine stem close to the ground (about 2 in. above ground) and immediately apply a 25% solution of glyphosate (e.g., Accord®) or triclopyr (e.g., Garlon® 3A) mixed with water to the cut surface of the stem.. A subsequent foliar application may be necessary to control new seedlings. <u>Foliar application</u> - Use this method to control extensive patches of solid bittersweet. It may be necessary to precede foliar applications with stump treatments to reduce the risk of damaging non-target species. During foliar applications some of the herbicide is also absorbed through the stem for additional (basal bark) effect. Apply a 2% solution (8 oz per 3 gal. mix) triclopyr ester (Garlon® 4) or triclopyr amine (Garlon® 3A) mixed in water with a non-ionic surfactant to the leaves. For dense, low patches of bittersweet another alternative is to cut the entire patch to the ground early in the growing season. About one month later, apply 1-2% solution of triclopyr ester (Garlon® 4) or triclopyr salt (Garlon® 3A) in water to the previously cut patch using a backpack sprayer. This method has resulted in complete rootkill of the bittersweet and no off-target damage or root uptake by adjacent plants.
			Biological: No biological control organisms are available for this plant.
			Recommendation: Cut the vines at ground level and use the chemical cut stem application

Species Name	Scientific Name	Indicator Status*	Control Methods
Purple Loosetrife	*Lythrum salicaria*	FACW+	Fire: Not an effective management option
			Physical + Mechanical: Small infestations of young purple loosestrife plants may be pulled by hand, preferably before seed set. Grubbing activities can be used but soil disturbance may release new seed.
			Chemical: For older plants, spot treating with a glyphosatetype herbicide (e.g., Rodeo® for wetlands, Roundup® for uplands) is recommended. These herbicides may be most effective when applied late in the season when plants are preparing for dormancy. However, it may be best to do a mid-summer and a late season treatment, to reduce the amount of seed produced.
			Biological: biological control is seen as the most likely candidate for effective long term control of large infestations of purple loosestrife. As of 1997, three insect species from Europe have been approved by the U.S. Department of Agriculture for use as biological control agents. These plant eating insects include a root-mining weevil (*Hylobius transversovittatus*), and two leaf-feeding beetles (*Galerucella calmariensis* and *Galerucella pusilla*). Two flower-feeding beetles (*Nanophyes*) that feed on various parts of purple loosestrife plants are still under investigation. Galerucella and Hylobius have been released experimentally in natural areas in 16 northern states, from Oregon to New York. Although these beetles have been observed occasionally feeding on native plant species, their potential impact to non-target species is considered to be low.
			Recommendation: Combination of physical removal and chemical treatment.
Reed canary Grass	*Phalaris arundinacea*	FACW+	Fire: Not an effective management option
			Physical + Mechanical: excavation to remove grass, seed and soil is most effective if all materials are removed from the site. Mowing and harvesting, grazing, mulching or covering in plastic, and hydrology control are also management options
			Chemical: Foliar application of large stands with a glyphosatetype or grass- specific (i.e. sethoxydim or fluazifop) has been shown to be effective but may cause the loss of native plants
			Biological: No biological control organisms are available for this plant.
			Recommendation: Excavation followed by solarization (black plastic covering) and herbicide treatment if necessary.

Species Name	Scientific Name	Indicator Status*	Control Methods
Spotted Knapweed	*Centaurea stoebe*	NI	Prevention: Plant can easily be spread through the use of hay bales and vehicle traffic.
			Fire: Not an effective management option
			Physical + Mechanical: Small areas can be removed through excavation of plants and soils, however hand pulling is difficult as the plant will regrow if roots are not removed entirely.
			Chemical: Control of spotted knapweed infestations using three chemical herbicides (2,4-D, clopyralid, and picloram) has been reported but is problematic. Existing plants can be killed with 2,4-D but it needs to be reapplied yearly to control new plants germinating from seed stored in the soil. Picloram is a more persistent herbicide and has controlled knapweed for three to five years when applied at 0.25 lb/acre at any stage of plant growth; or with clopyralid (0.24 lb/acre) or clopyralid (0.2 lb/acre) plus 2,4-D (1 lb./acre) applied during bolt or bud growth stage. In the absence of desirable native grasses, longevity of control may be increased by revegetating with competitive grasses and forbs. Picloram may pose a risk of groundwater contamination where soils are permeable, particularly where the water table is shallow.
			Biological: Two seedhead flies, 3 moths and a weevil have all been shown to reduce seed production. Long-term grazing by sheep and goats has been found to control spotted knapweed.
			Recommendation: Combination of prevention and mechanical management. Use hay bales only where necessary and try to locate a vendor with weed free hay. Proper disposal of biomass and soil containing seed bank and replacement with clean fill.
Yellow Iris	*Iris pseudacorus*	OBL	Fire: Burning is not recommended. Seeds germinate and grow well after late summer burning, and plants have a strong tendency to resprout from rhizomes after burning
			Physical + Mechanical: Manual control is feasible for individual plants/small stands. Grubbing is affective if you can dig out mature plants, taking care to remove the entire rhizome. Repeated mowing/cutting may keep plants contained and can potentially kill it by depleting the energy in the rhizomes after several years of intensive mowing
			Chemical: For control of large infestations, herbicide use may be necessary. Infested areas should not be mowed until after the herbicide application, which may take several weeks depending on the herbicide used. Due to dense growth, re-application a few weeks after initial treatment will likely be needed for complete coverage. For several years following treatment, monitor areas for new plants germinating from the seed bank or from rhizome fragments. In some cases several years of treatment may be necessary.
			Biological: No biological control organisms are available for this plant.
			Recommendation: Mechanical removal of individual plants and all rhizome material.

Species Name	Scientific Name	Control Methods
	Aquatic Plants	
Eurasian Water Milfoil	*Myriophyllum spicatum*	Physical + Mechanical: sediment removal, manual removal (including root crown), benthic barriers (sheeting or sediment covers), drawdown (not realistic in this case).
		Chemical: systemic herbicides (fluridone or triclopyr based, probably not feasible in flowing water)
		Biological: milfoil weevil
		Recommendation: Removal by dredging where planned for remediation, benthic barriers on new growths in small patches.
Curly-Leaf Pondweed	*Potamogeton crispus*	Physical + Mechanical: sediment removal, harvesting (manual or mechanical, but before winter buds dropped in early summer), benthic barriers (sheeting or sediment covers),
		Chemical: herbicides (fluridone based early in season is best, probably not workable with flow).
		Biological: No insect biological control agents are available for curly leaf pondweed control.
		Recommendation: Removal by dredging where planned for remediation, early harvesting (before winter buds drop in May/June) for new growths.
Water Chestnut	*Trapa natans*	Physical + Mechanical: sediment removal, harvesting (manual or mechanical, but before seeds dropped in mid-summer), benthic barriers (sheeting or sediment covers).
		Chemical: herbicides (diquat based preferable, early in summer, should work in Woods Pond)
		Biological: Research is currently being performed on biological controls for this species. No host specificity testing has yet been done.
		Recommendation: Removal by dredging where planned for remediation, early harvesting (before seeds dropped in August) for new growths.
*USFWS National Wetland Inventory Wetland Occurrence Rating		