Chapter 6
FORMULATION AND COMPARISON OF ALTERNATIVES

6.1 FORMULATION PROCESS

NRCS worked with DMF, CZM, and town officials to identify sites with restricted tidal marshes, poorly functioning fish passages, or stormwater discharges into shellfish beds. NRCS then worked with DMF, CZM, and the towns to screen those sites to a list of preferred sites for each category. NRCS and DMF also identified measures that could be implemented to restore habitat or improve water quality for each type of project, they estimated the costs to implement specific projects, and they estimated the ecological value (habitat units) to be achieved from each project. The goal of the plan formulation process was to maximize National Ecosystem Restoration (NER) benefits (measured as habitat units) at the least cost.

A cost-effectiveness analysis will be done at each site during design for implementation to achieve greatest benefits for the least cost. For planning purposes alternatives were developed for each priority site. Priority sites were not compared across objectives because the proposed action is to restore/improve all the priority sites. The Project addresses existing problems not covered by current laws and regulations, which only address new land use changes.

Salt Marsh

Site Screening

One objective of the Cape Cod Water Resources Restoration Project is to restore tidal flow to restricted salt marshes along the Cape Cod coast. NRCS began the process of selecting the salt marsh sites by consulting with two coastal atlases of tidally restricted salt marshes prepared for the Massachusetts Wetlands Restoration Program: The Cape Cod Atlas of Tidally Restricted Salt Marshes (Cape Cod Commission 2001) and the Atlas of Tidally Restricted Salt Marshes in the Buzzards Bay Watershed (Buzzards Bay Project National Estuary program 2002). Combined with site visits, these atlases provided detailed information on 182 tidally restricted marshes on Cape Cod.

Field data were collected for each site, including information on marsh elevation, culvert inverts, site accessibility, and nearby utilities. In addition, photos were taken of each site. Town officials were contacted to assess their interest in restoring tidal flow to a particular site. A rating matrix was developed to display the following information to rank the sites:

Category	Value
Size of upstream affected area (salt marsh acres/ total affected acres)	less than 5 acres = 3 5 to 10 acres = 5 10 to 25 acres = 7 greater than 25 acres = 10
Is the upstream affected area contiguous to protected open space (ownership)?	yes = 1 no = 0
Does this tidal channel support a shellfish resource area?	yes = 1 no = 0
Is the channel or system part of an anadromous fish pathway?	yes = 1 no = 0
Does the affected area include Priority Habitat of Rare Species or Estimated Habitat of Rare Wildlife?	yes = 1 no = 0

Each site was further screened by assessing the feasibility of restoration. Sites were dropped if they could not feasibly be restored, if local interest was considered low or moderate, if restoring tidal flow would adversely affect nearby septic tanks or private wells, or if the site was already being addressed by another agency.

NRCS conferred again with town officials to verify their interest and support for the remaining sites. The result is a list of 26 salt marsh sites considered high priority for restoration by NRCS and Barnstable County towns. The results of this screening process are shown in Table B-1 in Appendix B.

Figure 6-1 shows the location of the 26 priority salt marsh projects, and Table 6-1 describes the conceptual restoration project proposed for each site.

Conceptual Design and Cost Development

Table 6-1 shows the estimated planning-level cost for each site. NRCS visited 158 restricted salt marsh sites to collect basic information to define the level of restriction, determine site accessibility for construction, identify utilities in the area, and note other site constraints or construction considerations. These site characteristics were recorded on a field data sheet along with photographs. The size of the proposed culvert to provide full tidal flow was based on 3.0 square feet of opening per 1.0 acre of upstream effected area (as identified in the Atlases). NRCS also contacted local town officials to obtain their input on their interest in restoring the site and other pertinent information. Typical construction costs included traffic control, site preparation, dewatering, excavation, removal of existing culvert, new culvert, backfill, and road paving.

Environmental Restoration Benefits

The ecological benefits from the salt marsh projects result from the increased ecological functions of the marsh. The habitat units associated with that benefit were calculated as the acreages of salt marsh

restored to full tidal flushing and, therefore, full ecological function. Table 6-1 shows the estimated habitat unit benefits for each site.

Fish Passage

Site Screening

DMF conducted a survey in 2001 and 2002 to collect information on the present state of fish passage in Massachusetts coastal streams and rivers and help guide future restoration efforts. Statewide, the survey covered 215 coastal streams; 493 lakes, ponds, or reservoirs; and 380 obstructions to migratory fish passage. It also included discussions with regional biologists, harbormasters, and local herring and shellfish wardens. The survey identified 93 existing fish passage structures and approximately 43 active river herring runs in Barnstable County, and it demonstrated that Massachusetts has a large investment in fish passage along the coastal rivers and streams. DMF recommended numerous projects that should be undertaken over the next several years. These projects included the maintenance, repair, and re-design of failing or inefficient existing fishways and the construction of new fishways to provide access to additional spawning grounds (DMF 2004).

The 93 fish passage sites were ranked by DMF using 12 criteria that assessed relative ecological, economic, and social importance as well as the practicality of providing or improving fish passage on Cape Cod. A description of the criteria used to rank the sites and an explanation of the values given for each criterion are shown in Table 6-2. Positive values represent benefits to the overall stream system, and negative values represent impairments. The ranges of values as well as the values themselves were developed by the DMF anadromous fish biologists. The values given for all the criteria were summed to determine a total score for each project site. Sites that ranked high but were given the value “0” for the need criterion were eliminated. The highest ranking 24 remaining sites were selected as priority sites for fish passage restoration. Table B-2 in Appendix B summarizes the evaluation DMF used to rank the original 93 fish passage sites, with the top 24 sites identified by shading. DMF is using the evaluation procedure it developed for this Project to evaluate the remaining statewide fish passage obstructions identified by DMF.

Figure 6-2 shows the location of the 24 fish passage projects, and Table 6-3 describes the conceptual treatment system proposed for each site.

Conceptual Design and Cost Development

NRCS visited each fish passage site to collect information on site conditions and to estimate construction cost for each project. NRCS surveyed the river/stream systems from mouth to headwaters and created a site specific label for each site. At each site, general physical characteristics of the water bodies (spawning areas) and data of specific importance to anadromous fish were noted. All obstructions and fishway characteristics were recorded on a field data sheet and photographed.

Site-specific details were documented for the first impassable obstruction and its impoundment area to assist in the evaluation of future alterations or fish passage possibilities. On some streams, information was gathered on additional impassable obstructions as well. River obstruction type, estimated total and future potential anadromous fish populations, and observed construction issues were recorded. When a fishway was present, the type of design, and needed repairs were recorded along with a brief description of the state of fish passage and the potential for further improvements.

The fish passage obstructions for the Project are manmade. The restrictions fall into the following categories: road culverts, cranberry bog dikes, and dams. The majority of the dams are 6 feet or under in height. Weir pool and notched weir pool fishways were by far the most common designs employed in Cape Cod, followed by the denil ladder, stream baffles, Alaskan Steeppass and combination designs. About half of the existing fishways were judged to be in deteriorated and non-functioning condition.

Construction costs were based on U.S. Fish and Wildlife Service cost for standard denil construction ($25,000 per vertical foot) and NRCS estimates for weir pool construction ($25,000 per vertical foot), Alaskan steep pass construction ($5,600 per 10-foot section), and ditch/channel cleanout/construction ($10,000 per liner foot). Table 6-3 shows the estimated planning-level cost for each site.

Environmental Restoration Benefits

The primary ecological benefit from the fish passage projects is unrestricted access to spawning habitat upstream of the project site (in some cases upstream to the next restriction). The habitat units associated with that benefit were calculated as the acreages of spawning habitat to which full access would be restored. Table 6-3 shows the estimated habitat unit benefits for each site.

Stormwater

Site Screening

Through discussions with town officials and DMF, NRCS identified 160 sites as potential restoration projects for implementation of stormwater best management practices (BMPs). NRCS and DMF used 15 criteria to initially evaluate these sites for stormwater remediation activities (Table 6-4). These criteria ranged from ecological assessments to community-level support to long-term success of a project. The first two criteria were used to screen out sites that (1) were already being addressed by another agency or watershed group or (2) had no feasible solution. For the remaining 13 criteria, numeric values were developed to rank the range of conditions applicable to the criteria (Table 6-4). Through a collaborative process, NRCS and DMF biologists and engineers assigned values for each criterion to each project, summed the values for each project, and ranked the projects by total value. NRCS completed 117 site visits, reviewed topographical and soils maps, delineated drainage areas, developed alternatives, and prepared cost estimates for the recommended BMP alternatives.

Further review and discussion by DMF Area Shellfish Biologists resulted in some re-ordering of the list using subjective criteria, including relationships between areas, the importance and diversity of the shellfishery, and present sanitary classification of the areas. During this process, the highest priority was given to the preservation of open, productive areas where imminent closure was probable. It was decided that these areas present the highest probability for success of mitigation measures and the greatest cost-benefit, as opposed to seeking possible reclassification of areas currently closed. After this process was completed, a final prioritized list of 35 sites was produced. In the process of reviewing these 35 priority sites with town officials for their concurrence, 17 additional sites were identified and had to be re-ranked by DMF. From this final list of 52 sites, the 26 priority were selected for this plan based upon DMF's recommendations on which proposed remediation measures would have a potential impact on classification (high potential = 5, moderate = 3, low = 1). Sites rated as low potential were excluded.

Table B-3 in Appendix B shows the list of 160 sites considered (without ranking values). Table B-4 shows the individual ratings and the rankings of the 52 projects carried through this screening process,

with the top 26 sites identified by shading. Figure 6-3 shows the location of the 26 priority stormwater projects, and Table 6-5 describes the conceptual treatment system proposed for each site.

Conceptual Design and Cost Development

NRCS reviewed several strategies and BMPs that could be used to reduce fecal coliforms in stormwater runoff:

Source reduction:

- Disconnecting roof runoff from the street drainage system, and allowing it to flow to other areas, where it can be recharged into the soil.
- Covering possible sources of contamination, such as animal manure piles, to keep rain water clean.
- Diverting clean water around potential sources of contamination.

Filtration:

- Construction of structures that will capture the first flush of runoff from a storm and treat it by filtering the runoff through sand, or a combination of sand and organic matter. Filtration systems are prone to clogging unless the runoff is pre-treated to remove suspended solids and other fine materials before the runoff enters the filter system. Typically runoff that has been filtered is returned to the existing street drainage system through some sort of outlet. Runoff that exceeds the system's capacity to capture and treat water typically flows through the existing drainage system to receiving waters untreated.

Infiltration:

- Infiltration systems are similar to filtration systems, except that the first flush of runoff is directed into an area where it can infiltrate back into the underlying soils. Otherwise they work the same way. Pre-treatment of runoff to remove suspended solids is vital if the infiltration system is to work for any length of time; in addition, the seasonal high water table must be deep enough below the surface to allow at least a two-foot separation between the bottom of the infiltration system and the water table. In addition, soils need to be permeable enough to allow infiltration of the first flush of stormwater.

Constructed wetlands:

- These only work in areas where the seasonal high water table is high enough to support a wetland, or in areas with relatively impermeable soils (which are very likely to become clogged with fine materials and hold water more or less permanently). They depend on detention of runoff, some settling of sediment (and whatever contaminants are adsorbed onto sediment particles), and biological action by the organisms that grow in the wetland.

Water quality swales:

- Typically these are dry systems, with a dense growth of vegetation, that capture runoff, slow it down, allow sediment to settle, and provide some limited biological treatment.

Other stormwater runoff treatment systems can also be effective, depending on a number of factors. All runoff treatment systems must be tailored to site conditions (soils, slopes, drainage area, amount of

impervious area, depth to seasonal high water table, proximity to receiving waters, type of improvement desired, etc.).

Biologists from DMF and NRCS consulted with the Charles River Watershed Association to finalize the list of BMPs that, given the constraints of each project site, would allow for optimal removal efficiency for fecal coliforms. Two case studies within Massachusetts have demonstrated the effectiveness of infiltration structures and leaching galleys in reducing fecal coliforms in stormwater and in opening shellfish beds back up for harvesting:

> Broad Marsh River Storm Water Remediation Project (EPA 2006): The town of Wareham implemented infiltration structures to reduce suspended solids and fecal coliform bacteria from storm water runoff. The results of this project included a 99 percent removal of fecal coliform, and local shellfish beds were reopened for harvesting.
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> Lake Tashmoo Storm Water Remediation Project (EPA 2006): The town of Tisbury (Martha's Vineyard) implemented first-flush leaching basins to reduce concentrations of fecal coliform from storm water runoff. Results of this project included a 91 percent decrease in fecal coliforms, and local shellfish beds were reopened for harvesting.

Each site was visited to collect or confirm information on topography, land use, site condition, barriers to successful installation (for example, utilities in street, narrow rights-of-way). Many of the potential BMPs were determined to be infeasible because of the site configuration and space constraints of each project. A BMP was selected for each stormwater project site and a conceptual design was completed in order to develop the cost of each project. Catch basins and infiltration chambers were selected in most areas, because groundwater levels were determined to be too shallow for leaching galleys. Leaching galleys were selected for a few sites where there is adequate depth to groundwater. Other recommended BMPs for only a few projects included the installation of grass swales, constructed wetlands, or other detention facilities.

BMPs were sized for collecting and treating the first inch of runoff. The volume of that runoff was calculated from an estimate of the impervious area (roofs, driveways, pavement, etc.) in the drainage area. To the extent possible, standard designs were used for cost estimates. Table 6-5 shows the estimated planning-level cost for each site.

Environmental Restoration Benefits

The primary ecological benefit from the stormwater management projects is improvement of water quality. The habitat units associated with that benefit were calculated as the acreages of the shellfish beds over which water quality would be improved. For most projects, the habitat units were equal to the total shellfish growing area identified in DMF's shellfish database. In cases where the shellfish area is very large and the area affected by the project is likely to be smaller, DMF scientists estimated the portion of the growing area that is affected by the discharge. Table 6-5 shows the estimated habitat unit benefits for each site.

Table 6-1
Priority salt marsh restoration projects

Site no.	Town	Location	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
BA-SM-6	Barnstable	Maraspin Creek at Commerce Road	Erosion and scour, phragmites invasion. Restricted by 3-foot CMP (3 X 75 ft). A 16-sq ft culvert would be installed.	255,000	5
BA-SM-12	Barnstable	Unnamed channel off Bumps River at Bay Lane	Sedimentation, phragmites invasion. Wetland restricted by 30-inch concrete headwall (2.5 X 36 ft). A 30-sq ft culvert would be installed.	296,000	10
BA-SM-18	Barnstable	Unnamed Creek at Hawes Avenue	Large Scour basin near opening, minor bank erosion. Wetland restricted by two 3-foot MP (2 X 250 ft). A 36-sq ft culvert would be installed.	975,000	12
BA-SM-19	Barnstable	Snows Creek at Ocean Street	Phragmites invasion, scour basin, vegetation die-off. Wetland restricted by 3-foot MP (3 X 30 ft). A 60-sq ft culvert would be installed.	360,000	20
BN-SM-6	Bourne	Mashnee Rd. culvert	Road restriction has caused phragmites invasion. A 9-sq ft culvert would be installed.	104,000	5
BN-SM-16	Bourne	Kenwood Rd. culvert	Wetland restricted by culvert. Road restriction has caused phragmites invasion. A 12-sq ft culvert would be installed.	238,000	4
BN-SM-28	Bourne	Railroad dike culvert near Pocasset River	Marsh diking has limited salt water inflow and caused phragmites invasion. A 6-sq ft culvert would be installed.	110,000	1
BN-SM-32	Bourne	Bridge off Benedict Road	Inadequately sized bridge crossing, phragmites invasion. An 18-sq ft culvert would be installed.	62,000	8
BN-SM-38	Bourne	Service Road culvert on Canal	Scour basin, erosion. Wetland restricted by roadway. A 24-sq ft culvert would be installed.	203,000	8
BN-SM-39	Bourne	Earthen bog dike culvert on L. Buttermilk Bay	Phragmites invasion. Wetland restricted by dike. A 12-sq ft culvert would be installed.	263,000	4
BN-SM-43	Bourne	Earthen dike culvert off Mashnee Road	Phragmites invasion. Wetland restricted by dike. A 27-sq ft culvert would be installed.	631,000	10

Table 6-1 (cont.)
Priority salt marsh restoration projects

Site no.	Town	Location	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
BR-SM-6	Brewster	Unnamed channel off Stony Brook at Route 6A	Large scour basin, erosion around headwall, phragmites invasion. Wetland Restricted by 2.5-foot MP (2.5 X 50 ft). A 96-sq ft culvert would be installed.	322,000	32
CH-SM-4	Chatham	Unnamed channel off Bucks Creek at Cranberry Lane	Scouring and bank erosion, phragmites invasion. Wetland restricted by 18-inch MP (1.5 X 31 ft.). A 16-sq ft culvert would be installed.	151,000	6
DE-SM-5	Dennis	Weir Creek at Lower County Road	Minor scouring and bank erosion, phragmites invasion. Wetland restricted by 2-foot C/MP (2 X 57 ft). An 84-sq ft culvert would be installed.	236,000	42
EA-SM-1	Eastham	Rock Harbor Creek at Dyer Prence Road	Major scouring and erosion, vegetation dieback. Wetland restricted by 30-inch concrete headwall (2.5 X 60 ft). A 36-sq ft box culvert would be installed.	288,000	12
HA-SM-4	Harwich	Tributary to the Herring River at Lothrop Road	Phragmites invasion. Wetland restricted by 20-inch CPP (1.75 X 36 ft). A 42-sq ft box culvert would be installed.	279,000	14
HA-SM-9/ CH-SM-7	Harwich/ Chatham	Muddy River at Route 28	Major scouring, bank erosion, vegetation dieback. Wetland restricted by two 2.6 ft X 3.7 ft CBC. A 54-sq ft culvert would be installed.	752,000	18
SA-SM-9	Sandwich	Long Creek/Cow River at Ploughed Neck Road	Phragmites and purple loosestrife invasion. Wetland restricted by 3-foot concrete pipe (50 ft long). A 160-sq ft box culvert would be installed.	303,000	80
TR-SM-4	Truro	Pamet River at Route 6	Phragmites invasion. Wetland restricted by 4-foot concrete pipe (4 X 375 ft). A 450-sq ft culvert would be constructed.	2,225,000	152
WE-SM-3	Wellfleet	Blackfish Creek at Route 6	Scouring, erosion, vegetation dieback. Wetland Restricted by 2-foot MP (2 X 125 ft). A 51-sq ft culvert would be installed.	660,000	17

Table 6-1 (cont.)
Priority salt marsh restoration projects

Site no.	Town	Location	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
WE-SM-4	Wellfleet	Indian Neck marsh channel at earthen dike	Scouring and erosion, conversion to freshwater wetland. Wetland restricted by 1-foot CMP (1.25 X 30 ft). A 21-sq ft culvert would be installed.	95,000	7
WE-SM-5	Wellfleet	Mayo Creek at Commercial Street	Scouring and erosion, phragmites invasion. Wetland restricted by 30-inch CMP (2.5 X 90 ft). A 57-sq ft culvert would be installed.	369,000	19
WE-SM-6	Wellfleet	Herring River at Chequessett Neck Road	Conversion to upland, acidified water, metal leaching, phragmites invasion. Wetland restricted by one 6-foot and two 7-foot box culverts (44 ft. long). A 3,000-sq ft culvert would be constructed with a bridge opening, which also allows fish passage.	4,795,000	1,000
YA-SM-2	Yarmouth	Hallets Mill Pond at Mill Lane	Scouring and erosion, phragmites invasion. Wetland restricted by 2-foot pipe (2 X 50 ft). An 18-sq ft culvert would be installed.	242,000	6
YA-SM-3	Yarmouth	Short Wharf Creek at Thacher Shore Road	Scour and bank erosion, vegetation dieback. Wetland restricted by 2-foot CP (2 X 50 ft). A 12-sq ft culvert would be installed.	175,000	4
YA-SM-5	Yarmouth	Unnamed channel into salt pond at Bayview Street	Scour, some phragmites invasion. Wetland restricted by 18-inch CP (1.5 X 210 ft). An 8-sq ft culvert would be installed.	153,000	1
			Total	14,542,000	1,497

[1/] Estimated project costs include construction, contingencies (15%), engineering services (8%), administration/ inspection (6% federal; 2.4% local), permits, and land rights. Because salt marsh restoration projects require an additional level analysis for implementation, the estimated costs include an additional project management and engineering cost at 45% of construction costs (based on information from CZM's Wetlands Restoration Program).
[2/] Acres of salt marsh habitat restored.

Notes:
CMP=Corrugated Metal Pipe
MP=Metal Pipe
CPP=Corrugated Plastic Pipe
C/MP=Metal-lined Concrete Pipe
CBC=Concrete Box Culvert
CP=Concrete Pipe

Table 6-2
Criteria used to determine priority fish passage obstruction remediation projects

Criterion	Description of criterion	Description of value	Value
Obstruction number	Stream obstructions (dams, culverts), even if provided with fish passage facilities, can prevent river herring from reaching spawning grounds. The number of obstructions on a stream presents a negative factor in determining potential for development in a system.	Constant	-3 per obstruction
Acreage	Potential population size is loosely related to the amount of habitat available in a system. The total acreage available is important in determining the systems priority for fishway work.	1-5 acres	0
		6-20 acres	3
		21-50 acres	6
		51-100 acres	9
		100 + acres	12
Existing populations[1/]	Most river systems on Cape Cod that have significant habitat currently have populations of river herring. DMF emphasizes that future work should be on preserving existing populations rather than creating new ones. This criterion is important in developing priorities.	Low Population	0
		High Population	15
Stream flow[1/]	Some streams within Cape Cod have chronically low stream flows during fall juvenile migration periods, resulting in occasional loss or partial loss of a year class. The priority for development was reduced for these streams depending on the severity of the problem.	No Stream Flow	-10
		Good Stream Flow	0
Public access[1/]	Some streams are more accessible to the public for recreation than others. Accessible systems were increased in ratings.	Not Accessible	0
		Accessible	5
Water quality issues[1/]	If water quality was considered sufficiently poor to affect productivity of river herring populations, negative values were assigned to the system.	Poor	-5
		Good	0
Conflicting water usage[1/]	Demand on water for agricultural purposes (cranberry bogs) and occasionally public water supplies can have a deleterious effect on river herring populations. Where this situation exists, negative values were given.	Agricultural Demand	-5
		No Agricultural Demand	0

Table 6-2 (cont.)
Criteria used to determine priority fish passage obstruction remediation projects

Criterion	Description of criterion	Description of value	Value
Construction difficulty[1/]	In some situations, the construction of passage facilities is technically difficult or overly expensive. The rating was reduced accordingly.	Difficult	-5
		Not Difficult	0
Environmental benefits[1/]	The provision of fish passage at some locations would provide benefits to other anadromous species, such as American shad and smelt. Additional value was given to these systems.	No Benefit	0
		Benefit	3
Community support[1/]	If a town, city, environmental organization, community group, etc. has expressed support for the project, extra value was given to the system.	No Support	0
		Support	3
Need	Some fish passage structures are currently adequate while others have varying needs of replacement or repair. Where passage was obstructed, restricted, or deteriorating, higher values were given.	None (passage unimpeded)	0
		Preventive (deteriorating)	5
		Necessary (restricted passage)	10
		Critical (obstructed passage)	15

[1/] For this criterion, a range of values was given in evaluating the site; only the low and high values are depicted on the table.

Table 6-3
Priority fish passage obstruction remediation projects

NRCS site number	Town	Waterbody	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
BA-FP-LE-1	Barnstable	Red Lilly Pond	Outlet to Lake Elizabeth and Red Lily Pond. Install concrete abutments with provisions for flash boards. Replace fishway.	36,000	10
BA-FP-MMR-2	Barnstable	Marston Mills River	Location of the Mill Pond Dam and fish ladder. Replace existing concrete notched weir fishway.	478,000	6
BA-FP-MMR-5 [3/]	Barnstable	Marston Mills River	Install 2 channel retention structures at pond outlet for a distance of approx. 20 feet into pond. Extension would be a concrete wall.	170,000	250
BA-FP-SanR-1 and	Barnstable	Santuit River	Bog sluice. Replace fishway.	170,000	166
MA-FP-SR-2 [4/]	Mashpee	Santuit River	Outlet to Santuit Pond. Install three sections of Alaskan steep pass along with resting and connector sections.	118,000	
BA-FP-WL-1	Barnstable	Wequaquet Lake	Outlet of Wequaquet Lake. Remove sand and install two channel retention structures at the outlet of Wequaquet Lake. Also, remove sand and retain channel below Long Pond.	225,000	702
BO-FP-MR-2 and	Bourne	Monument River	Benoits Pond Dam. Concrete Work - Hole in floor of sluice and sections needing gunite treatment. Remove sections of loose and cracked concrete, repair and replace as needed.	67,000	501
BO-FP-MR-3 [4/]			Concrete deflector barrier dam with stop logs is needed.	118,000	
BO-FP-RB-1 and	Bourne	Red Brook	Two Alaskan steep pass sections along with resting and connector sections.	181,000	17
BO-FP-RB-2 [4/]			Repair a leaking notched weir pool.	56,000	
BR-FP-SB-3	Brewster	Stoney Brook	600 linear feet of channel retention needed.	139,000	386

Table 6-3 (cont.)
Priority fish passage obstruction remediation projects

NRCS site number	Town	Waterbody	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
CH-FP-LL-1	Chatham	Lovers Lake	Upstream of culvert, replace current fishway with one section of Alaskan steep pass along with resting and connector section.	36,000	16
and					
CH-FP-LL-1A			Current culvert has collapsed and restricting passage of fish. Culvert needs to be replaced.	555,000	
and					
CH-FP-LL-2 [4/]			Replace current fishway with one section of Alaskan steep pass along with resting and connector section.	36,000	
CH-FP-LL-4 [5/]	Chatham	Lovers Lake	Replace current fishway with one section of Alaskan steep pass along with resting and connector section.	36,000	36
DE-FP-SC-1	Dennis	Sesuit Creek	Scargo Lake Outlet. Sand deposition blocks outlet. Extend existing channel retention structure for approx. 20 feet into Long Pond. Extension would be concrete wall. Two 20-foot walls are needed. Replace culvert under an un-paved connector, and clean culvert between the pond outlet and culvert under Doctor Lord's Road S.	994,000	53
EA-FP-HR-1	Eastham	Herring River	Sand deposition blocks outlet. Extend existing channel retention structure for approx. 20 feet into pond. Extension would be concrete wall (2 walls are needed).	118,000	42
FA-FP-ChR-2	Falmouth	Childs River	Install self cleaning screened barrier for downstream migrating juveniles.	26,000	317
FA-FP-CL-1	Falmouth	Cedar Lake Ditch	Road construction issues.	170,000	21
HA-FP-HR-3	Harwich	Herring River	Outlet to Long Pond. Sand deposition blocks outlet to Long Pond. Extend existing channel retention structure approx. 30 feet into Long Pond. Extension would be concrete wall.	181,000	1,119

Table 6-3 (cont.)
Priority fish passage obstruction remediation projects

NRCS site number	Town	Waterbody	Description of project	Estimated project costs ($)[1/]	Habitat units[2/]
MA-FP-QR-7	Mashpee	Quashnet River	Sand deposition blocks outlet. Extend existing channel concrete retention structure for approx. 30 feet into the pond. Two 30-foot walls needed.	118,000	317
OR-FP-PL-1	Orleans	Pilgrim Lake	A complete replacement is needed. Replacement includes a 415-foot-long series of notched weir pools.	1,104,000	39
WE-FP-HR-1	Wellfleet	Herring River	Removal of obstruction and construction of bridge.	— [6/]	157
YA-FP-WB-1	Yarmouth	Whites Brook	Work on Fish Passage. 10-foot Alaskan Steep Pass section to be attached to pond level concrete control structure. Install resting section and connector section. Open section from the control structure to the pond.	118,000	36
			Total Cost	5,250,000	4,191

[1/] Estimated project costs include construction, contingencies (15%), engineering services (12%), administration/ inspection (6% federal; 2.4% local), permits, and land rights. The estimated costs include an additional project management and engineering cost at 43% of construction costs based on information provided by the Massachusetts Division of Marine Fisheries to plan, design and implement site specific projects.
[2/] Acres of spawning habitat to which access has been fully restored.
[3/] Completion of BA-FP-MMR-2 is required for anadromous fish to have access to BA-FP-MMR-5.
[4/] The following sites are grouped together because all improvements are needed to provide access to the same spawning areas:
BA-FP-SanR-1 and MA-FP-SR-2; Total spawning area = 166 acres
BO-FP-MR-2 and BO-FP-MR-3; Total spawning area = 501 acres
BO-FP-RB-1 and BO-FP-RB-2; Total spawning area = 17 acres
CH-FP-LL-1, CH-FP-LL-1A, and CH-FP-LL-2; Total spawning area = 16 acres
[5/] Completion of CH-FP-LL-1, CH-FP-LL-1A, and CH-FP-LL-2 is required for anadromous fish to have access to CH-FP-LL-4.
[6/] Fish passage will be accomplished with construction of the bridge under the salt marsh restoration objective (see site no. WE-SM-6 in Table 6-1). There are no additional costs for fish passage.

Table 6-4
Criteria used to determine priority stormwater remediation projects

No.	Criterion	Description	Value
1	Is someone else addressing this site? Yes/No If there are other agencies or watershed groups conducting restoration, then site is removed from the list.		0
2	Is there a feasible solution? Yes/No If feasible, continue with ranking; otherwise stop the site ranking		0
3	Distance from discharge site to target shellfish beds	less than 50 ft 50 ft - 500 ft greater than 500 ft.	5 3 1
4	Other land uses may impact shellfish beds	None Other stormwater discharges Many uncontrollable sources	5 3 1
5	Community support	Support Neutral Oppose	5 3 1
6	Land rights	Public land 1 private landowner More than 1 private landowner	5 3 1
7	Additional beneficial impacts (beaches, sediment reduction for fish runs, flooding)	More than 1 One None	5 3 1
8	Negative environmental impacts?	No Yes	5 1
9	Discharges to salt marsh	Marsh immediately downstream Marsh immediately upstream No salt marsh	5 3 1

Table 6-4 (cont.)
Criteria used to determine priority stormwater remediation projects

No.	Criterion	Description	Value
10	Potential for future development in the watershed	Little	5
		Some	3
		Major	1
11	Monitoring data to support closures available?	Yes	5
		No	1
12	Animal impacts	None	5
		Some	3
		Major	1
13	Productivity of shellfish beds	High	5
		Moderate	3
		Low	1
14	Aquaculture present?	Yes	5
		No	1
15	Outfall within Area of Critical Environmental Concern?	Yes	5
		No	1

Table 6-5
Priority stormwater remediation projects

Site no.	Town	Location	Description of the project[1/]	Estimated project costs ($)[2/]	Habitat units[3/]
BA-SW-1	Barnstable	Cotuit Town Pier at Oyster Place Road	Install 12 infiltration systems to treat runoff from Main St and Oyster Rd. enter Cotuit Bay	227,000	536
BA-SW-2	Barnstable	Cotuit Old Shore Rd from Main St. to Boat Landing	Install 4 infiltration systems to treat runoff from Main St. and all runoff from Old Shore Rd discharge into Cotuit Bay	71,000	536
BA-SW-9	Barnstable	East Bay Boat Ramp	Install 4 infiltration systems to treat runoff from East Bay Rd. enters East Bay	78,000	157
BA-SW-13	Barnstable	Bay Shore Rd	Install 52 infiltration systems to treat runoff from several subdivision roads enters Lewis Bay	976,000	46
BA-SW-18	Barnstable	Scudder Lane Boat Ramp	Install 6 infiltration systems to treat runoff from Scudder Lane enters Barnstable Harbor.	105,000	2,092
BO-SW-4	Bourne	Cohasset Narrows	Install 50 infiltration systems to treat runoff from Rt. 6, cross streets and adjacent developed property flows into Buttermilk Bay; traffic, access, and safety are issues; tourist economy and other concerns must be addressed.	1,183,000	221
BO-SW-7	Bourne	Queen Sewell Cove	Install 14 infiltration systems to treat runoff from Lewis Point Rd enters Queen Sewell Cove	255,000	98
DE-SW-4	Dennis	Fisherman's Landing	Install 2 infiltration systems to treat surface runoff from boat ramp and Fishermans Landing Rd. discharge into Kelley's Bay; alternative BMP would be to repave plot with unit pavers designed to infiltrate runoff.	44,000	298
DE-SW-5	Dennis	Leif Ericson	Install 3 infiltration systems to treat runoff from residential streets are collected by catch basin and discharge to Kelley's Bay	71,000	298
DE-SW-11	Dennis	Wrinkle Point	Install 5 infiltration systems to treat surface runoff from road discharges into Bass River	69,000	204

Table 6-5 (cont.)
Priority stormwater remediation projects

Site no.	Town	Location	Description of the project[1/]	Estimated project costs ($)[2/]	Habitat units[3/]
EA-SW-1	Eastham	Salt Pond	Install 2 infiltration systems to treat runoff is delivered through storm system to Salt Pond; alternative BMP would be to construct wetland - swale	297,000	22
EA-SW-4	Eastham	Fort Hill	Install 7 infiltration systems to treat runoff is delivered through road cuts to the marsh affecting WQ and shellfish areas in Town Cove	153,000	416
FA-SW-2	Falmouth	Curley Blvd	Install 28 infiltration systems to treat runoff from Curley Blvd and Quaker Rd discharges into Dam Pond through drainage system and overland flow- then into Wild Harbor River and Buzzards Bay; alternative BMP would be to repave plot with unit pavers designed to infiltrate runoff.	480,000	17
HAR-SW-1	Harwich	Hulse Pt	Install 1infiltration systems to treat surface runoff from road discharge into Doanes Creek	41,000	19
HAR-SW-2	Harwich	Lower County Rd.	Install 8 infiltration systems to treat surface runoff from road and marina discharge into Allens Harbor	266,000	19
MA-SW-2	Mashpee	Shoestring Bay	Install 6 infiltration systems to treat runoff from Mashpee Neck Rd. discharges to Shoestring Bay; alternative BMP would be to repave plot with unit pavers designed to infiltrate runoff.	99,000	102
ORL-SW-3	Orleans	High Tide Ln. Marina	Install 4 infiltration systems to treat surface runoff from road and marina discharge into Meeting House Pond	110,000	314
PR-SW-1	Provincetown	Provincetown Inn	Install 8 infiltration systems, based on Town's consultant's recommendations for Phase I outfall modifications	485,000	131
WE-SW-5	Wellfleet	Holbrook Ave	Install 7 infiltration systems to treat surface runoff from Holbrook Rd discharges into Mayo Creek	111,000	247

Table 6-5 (cont.)
Priority stormwater remediation projects

Site no.	Town	Location	Description of the project[1/]	Estimated project costs ($)[2/]	Habitat units[3/]
WE-SW-6	Wellfleet	Commercial St.1	Install 16 infiltration systems to treat surface runoff from Commercial St., E. Commercial St., and Railroad Ave. including sidewalks, lots, and roofs discharge into Duck Creek	448,000	247
YA-SW-5	Yarmouth	Mill Creek @ 28	Install 116 infiltration systems to treat runoff from Rt. 28 discharges into Mill Creek via storm drain system	1,918,000	26
YA-SW-7	Yarmouth	Mill Creek @ Bogs	Install 12 infiltration systems to treat runoff from Rt. 28 discharge to Mill Creek via storm drain system	265,000	26
YA-SW-32	Yarmouth	Susan Rd.	Install 6 infiltration systems to treat runoff from Susan Rd discharges to Follins Pond via road cuts and storm drain system	94,000	298
YA-SW-33	Yarmouth	Aunt Dorahs	Install 8 infiltration systems to treat runoff from Aunt Dorah's Ln discharge to Follins Pond via pocket wetland	126,000	298
YA-SW-35	Yarmouth	Longview	Install 10 infiltration systems to treat runoff from Longview Rd discharges to Follins Pond via storm drain system and overland flow	153,000	298
YA-SW-45	Yarmouth	Merchant Ave 2	Install 4 infiltration systems to treat runoff from Merchant Rd discharges to Folins Pond via storm drain system and overland flow	67,000	298
			Total	8,192,000	7,264

[1/] This description is of an alternative that appears feasible and capable of improving water quality for the shellfish area. The most cost efficient and best practices (described on page 6-5) will be determined on a site by site basis during the implementation phase of the project.
[2/] Estimated project costs include construction, contingencies (10-15%), engineering services (24 %), administration/inspection (6% federal; 2.4% local), permits, and land rights.
[3/] Acres of shellfish bed over which water quality would be improved by the stormwater remediation project.

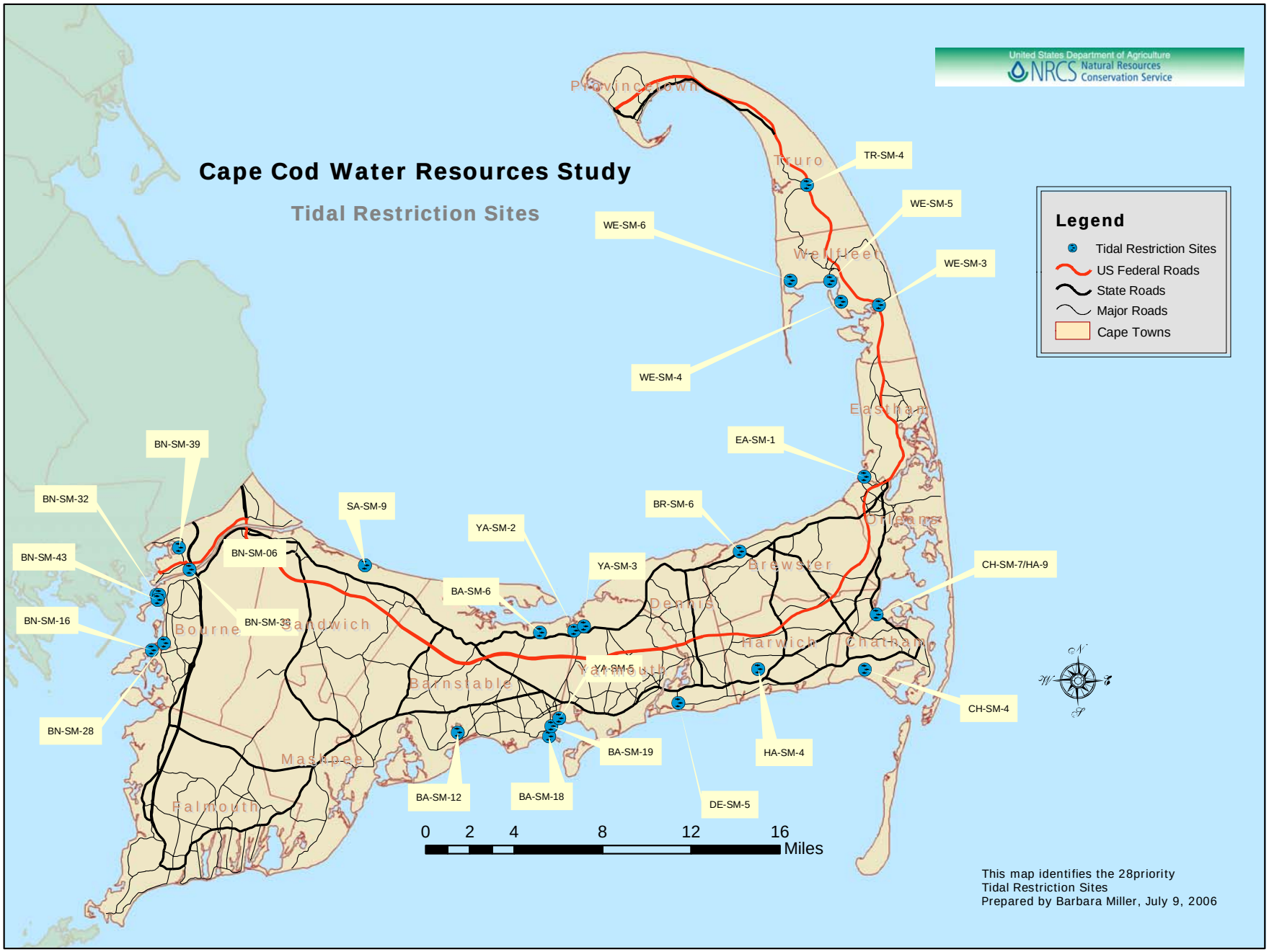

Fig. 6-1 Priority salt marsh sites

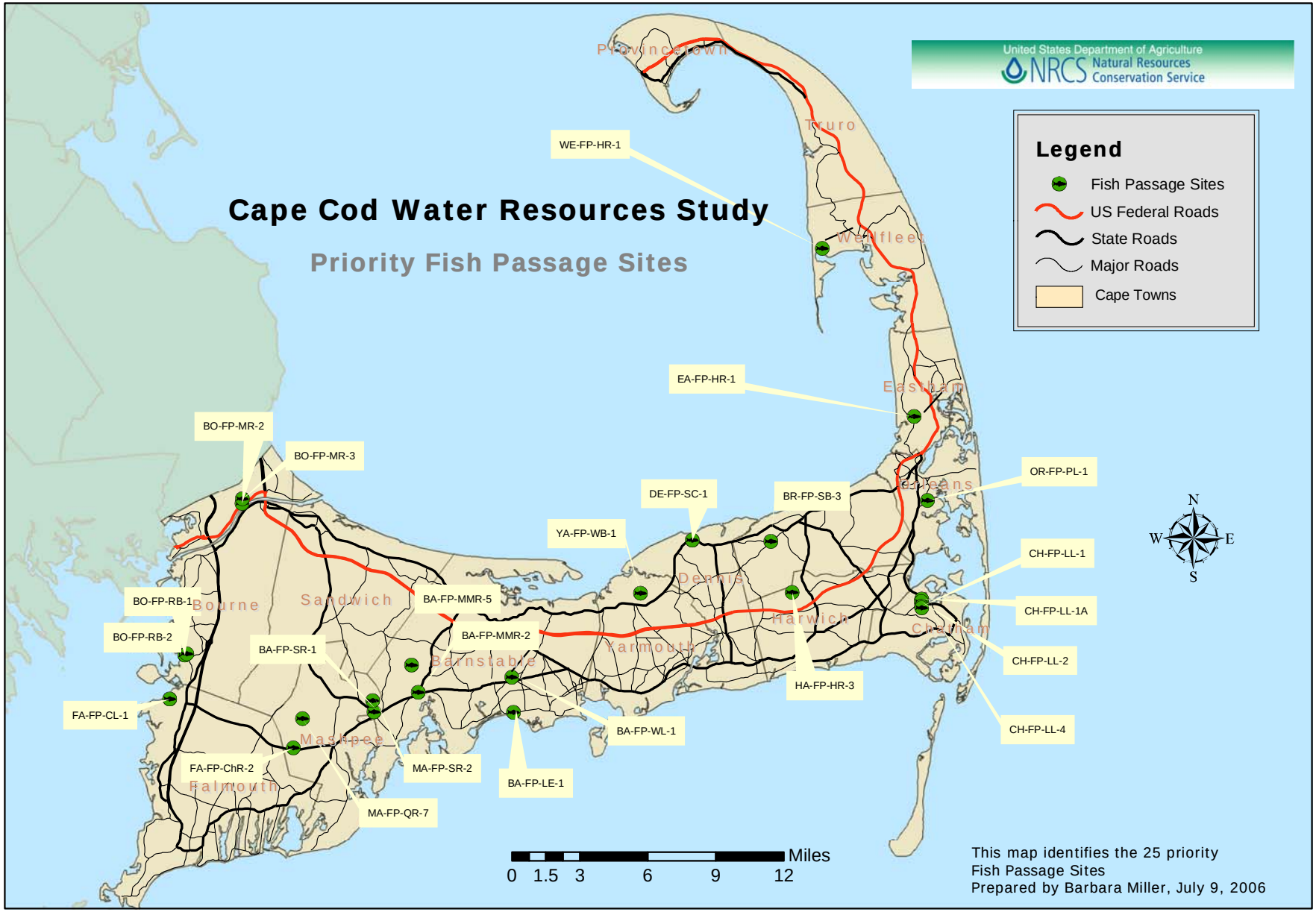

Fig. 6-2 Priority fish passage sites

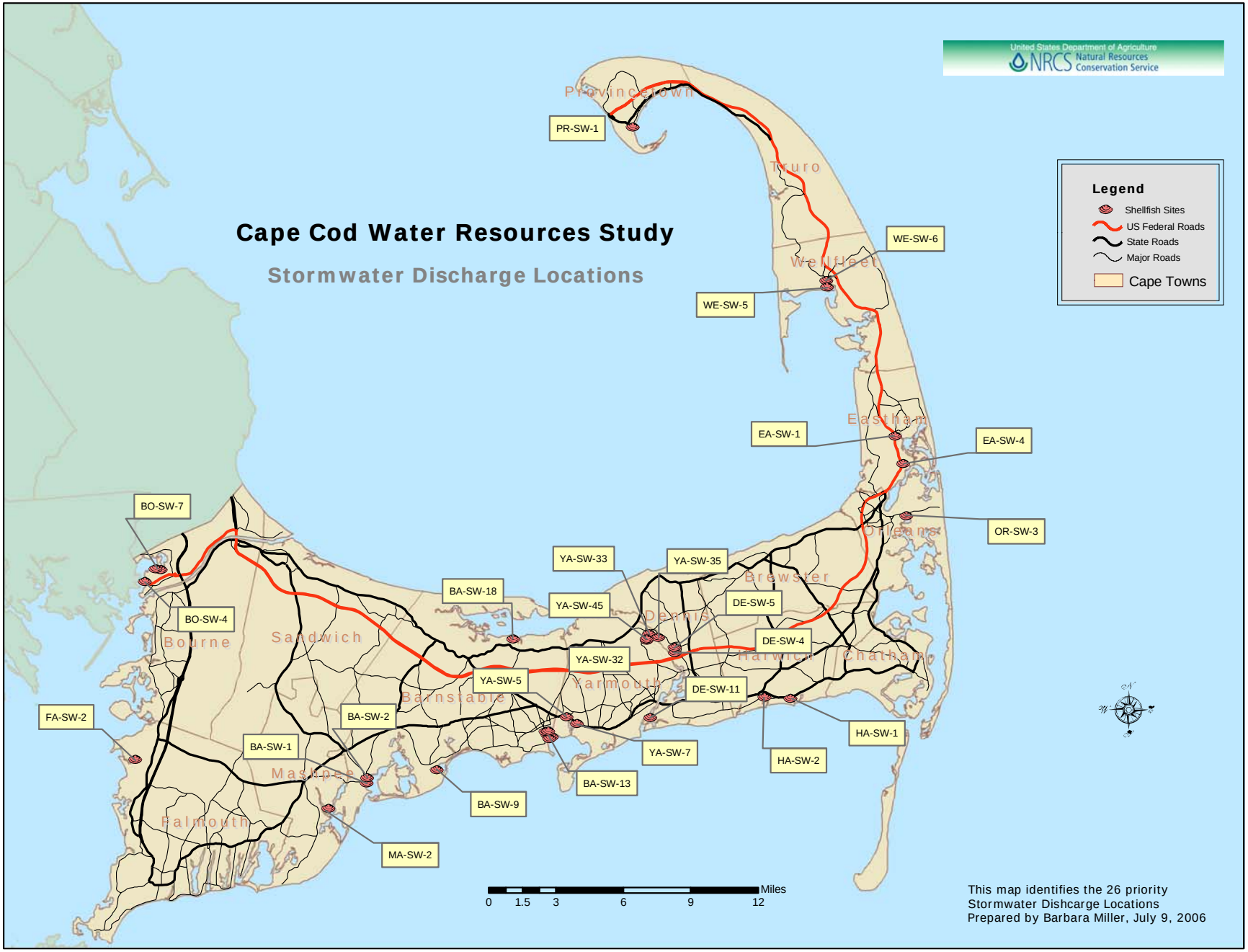

Fig. 6-3 Priority stormwater sites

6.2 DESCRIPTION OF ALTERNATIVE PLANS

Proposed Action—Cape Cod Water Resources Restoration Project

The proposed action is for NRCS to provide funding and technical assistance for projects to (1) restore degraded salt marshes by improving tidal flushing in salt marshes where road culverts and other restrictions have significantly reduced tidal flushing, (2) restore anadromous fish passages by restoring fish ladders and other fishways that have deteriorated, and (3) improve water quality for shellfishing areas by treating stormwater runoff.

Through the ranking process described in Section 6.1, NRCS has developed lists of priority sites for each of these three categories of projects. These projects are summarized in Table 6-1 (26 salt marsh sites), Table 6-3 (24 fish passage sites), and Table 6-5 (26 stormwater sites). More details on each project (site photographs, descriptions, cost estimates) are available through the NRCS office in Amherst, Massachusetts (see page i for contact information). The total cost for category of project is:

Salt marsh sites	$ 14.5 million
Fish passage sites	$ 5.3 million
Stormwater sites	$ 8.2 million
Total	$ 28.0 million

NRCS estimates that these funds will be expended over a 10-year period after the Cape Cod Project funding is appropriated by Congress.

The projects listed in Section 6.1 may not be the final list of projects that eventually get implemented under the Cape Cod Project. Selection of final projects will depend (1) on which projects are brought forward for final assistance by the towns, the County, and/or EOEA, and (2) on the results of a final, detailed evaluation of each site, including costs and environmental impacts and benefits. New sites may be proposed by the local organizations. A new site would be evaluated first by NRCS through the screening/ranking process described in Section 6.1, and if it ranks within the range of the sites currently on the priority list, it would be added to the list and become eligible for assistance.

No Action Alternative

Under the No Action Alternative, NRCS would not provide funding or technical assistance to projects for treating stormwater on Cape Cod. NRCS would continue to provide funding and technical assistance for restoring tidal marshes and restoring fish passages under the Farm Bill's Wildlife Habitat Incentives Program (WHIP) and/or the Wetlands Restoration Program (WRP) if funding is available. The County, towns, or EOEA may choose to implement some of these projects through state, local, or other sources of federal funding, but the number of projects to be implemented would be substantially less. NRCS estimates that the current level of restoration/remediation work on the Cape is one or two salt marsh restoration projects, one or two fish passage replacements, and one to three stormwater remediation projects each year. Some federal funding for these projects is declining, though, and the number of projects is expected to decline in the future. NRCS estimates that it would take the Sponsors twenty years to achieve their objectives for restoring the proposed sites without the Project action.

6.3 EFFECTS OF ALTERNATIVE PLANS

In this section, the effects of the Proposed Action and No Action Alternatives on the natural and human environment are described. Resources that are not affected by either alternative (for example, geology, climate) are not included in this section.

Under either alternative a certain number of environmental restoration projects may be conducted each year by the County, the towns, and EOEA using funding sources other than NRCS. It is not possible to project into the future how many such projects will occur, and given declining federal funding from other sources, the current level of projects may not be sustained in the future. The impacts from these projects will occur under either alternative, so they are not factors in deciding between the two alternatives. Therefore, these non-NRCS projects are not discussed as components of either the Proposed Action or No Action Alternatives.

In addition to the impacts described in this section, construction of projects funded under the proposed Cape Cod Water Resources Restoration Project would have short-term, minor effects on vegetation, animals, noise, traffic, the local economy (jobs), and people in the immediate vicinity of the construction. In general, though, these projects would be small in scope with the entire construction period typically being one or two weeks up to one or two months, and best management practices would be used to minimize environmental impacts. These impacts, therefore, are not discussed in detail.

6.3.1 AIR QUALITY

Proposed Action Alternative

Barnstable County is currently designated as a moderate nonattainment area for 8-hour ozone, which means that the applicability of the Clean Air Act General Conformity rule must be assessed. The rule applies if the total of direct and indirect emissions from a proposed federal action in a nonattainment area exceed the threshold levels specified in EPA's air quality regulations (40 CFR 93.153(b)(1)). For areas of moderate ozone nonattainment, these thresholds are 100 tons/year of nitrogen oxides (NO_X) and 50 tons/year of volatile organic compounds (VOCs), which are the pollutants most responsible for the formation of ground-level ozone.

Each of the components of the restoration Project (salt marsh, stormwater, and fish passages improvements) would result in emissions of air pollutants from construction equipment. In order to evaluate the applicability of this Clean Air Act requirement, annual air emissions were calculated for each of the three mitigation tasks. Air emissions were estimated from equipment types, engine sizes, and estimated hours of operation for a typical project and from emission factors for diesel engines in EPA's AP-42 emission factor document (EPA 1995). This screening-level calculation was a conservative approach, designed to overestimate actual emissions. The emission calculations and assumptions are provided in Appendix C-1.

The emission analysis focused on NO_X, because VOC emissions by comparison are negligible for such construction activities. Assuming four stormwater projects, four salt marsh projects, and three fish passage projects per year, NO_X emissions would be approximately 9 tons/year. This level of emissions would be well below the 100 tons/year threshold, so the General Conformity Rule would not apply to the

Cape Cod Project and no further air quality analysis is required. In fact, the number of annual projects could increase ten-fold, and the Project would still remain under the NO_X significance threshold.

No Action Alternative

None of the proposed construction projects would occur under the No Action Alternative; there would be no construction-related air emissions and no change in air quality.

6.3.2 SOILS

Proposed Action Alternative

Each of the proposed projects, regardless of which type of project it is, would result in short-term, minor disturbance of soils in the construction area. Erosion and sediment control measures would be employed for each project, and the soils would be restabilized by vegetation after construction is completed. An erosion and sediment control plan would be prepared before construction could begin on any project. None of the projects would affect prime or important farmland soils.

The salt marsh projects would have long-term, moderate impacts on the soils within and immediately adjacent to each salt marsh restoration site. The influx of salt water to a higher elevation would increase flooding of those soils, which, in turn, would increase periods of low dissolved oxygen in the soil, increase salt content, and alter chemical properties. The reintroduction of tidal water would promote the growth of salt marsh vegetation that is tolerant of these conditions.

The proposed fish passage projects would have no long-term effect on soils.

The proposed stormwater projects are designed to capture the first inch of runoff and route it through the soil to filter out bacteria and other pollutants. These projects, therefore, would have long-term, minor effects on soils by increasing the loading of pollutants. The effects are considered minor because the area affected at each project site is small, the sites are all in developed areas (mostly roadways or adjacent to roadways), and the practice of using soils for runoff treatment has become well established and accepted.

No Action Alternative

Construction would not occur under the No Action Alternative; therefore, no effects to soils would occur.

Salt marshes that are currently experiencing changes in vegetation and marsh substrate erosion would continue to deteriorate. Soils would be expected to continue decomposing, resulting in increased erosion and subsidence and in persistent open water areas. A lack of sediment accretion would decrease the ability of salt marshes to keep pace with rising sea levels.

6.3.3 GROUNDWATER

Proposed Action Alternative

The proposed salt marsh projects may affect local groundwater resources. Removing tidal restrictions would increase the amount of water entering the salt marsh, potentially elevating the water table in adjacent freshwater wetlands and surrounding uplands, particularly during the higher monthly (spring) tides. Elevated groundwater levels have the potential to affect nearby septic systems, water wells, and even buildings on properties around the marsh. Although each potential restoration site was selected because septic systems or private wells are not thought to be located near the marsh, site-specific Environmental Evaluations tiered to this EIS would re-evaluate this potential problem for each marsh project to ensure there would be no problems. A topographic survey would be performed to aid in determining the effects on surrounding properties.

The proposed fish passage projects would not affect groundwater.

The proposed stormwater projects are designed to capture the first inch of runoff and route it through the ground to filter out bacteria and other pollutants. These structures only work if there is an adequate depth of soil above the existing water table to provide this filtering function. Furthermore, all projects are located within 200 feet of tidal waters (and mostly within 50 feet), so the water routed to the soil would move toward those surface waters. These projects, therefore, are not expected to adversely affect groundwater, and they would have no effect on Cape Cod's sole source aquifer.

No Action Alternative

Groundwater would not be affected under the No Action Alternative; existing conditions would continue.

6.3.4 SURFACE WATERS

<u>Hydrology</u>

Proposed Action Alternative

The proposed salt marsh projects would enhance the hydrology within each restored marsh to as close to its pre-restriction condition as possible without causing other negative impacts, and they would restore tidal influence to a larger area of the Cape. The replacement of inadequately sized, damaged, or blocked culverts would allow greater tidal exchange between the marsh and the outside bay or estuary. Increasing the size of the undersized culverts or bridges would also allow increased outflow of upland runoff, reducing or eliminating any backwater effects the restrictions may now have on storm flows. The reintroduction of tidal flushing would also affect freshwater wetlands, ponds, or streams that become inundated by tidal water, converting these areas to salt marsh or other forms of intertidal habitat. These impacts would be addressed in site-specific Environmental Evaluations.

The salt marsh projects have the potential to affect the use of adjacent properties because of increased water levels. In the time since the marsh inlets became restricted, the towns or the property owners around the marshes may have constructed roads or buildings or other structures that could be adversely affected by higher water levels. NRCS screened out sites where impacts to such structures could be

determined in advance. Each specific project proposed for funding, however, would be evaluated in more detail in the site-specific Environmental Evaluation to ensure that adjacent structures would not be affected. This evaluation could include field surveys and hydrologic modeling, which would include the analysis of storm surges and possible flooding events.

The proposed fish passage projects would only have local, minor effects on hydrology. The improved passages may remove local blockages and divert some flow, for example, from a spillway to the fishway, but there would be no effect on stream hydrology above or below the project site.

The proposed stormwater projects would also have local, minor effects on hydrology because the first inch of runoff would be routed from the surface drainage way to the ground. This effect is minor because the project sites are located within 200 feet of the receiving water at the most downstream ends of the local watersheds and the areas affected are small.

All salt marsh and fish passage projects and possibly some of the stormwater projects would require construction activities in the floodplain. There would be no above-ground permanent structures placed in the floodplain and no permanent changes to the functioning of the floodplain from any projects.

No Action Alternative

There would be changes to existing hydrology on Cape Cod from the No Action Alternative. The restrictions on tidal marsh inlets would continue to reduce tidal flow into the marshes and possibly reduce flood flows out of the marshes. Over time, some restrictions could close further from additional siltation or blockage, thereby restricting tidal flushing even more.

Water Quality

Proposed Action Alternative

The proposed salt marsh and fish passage projects would cause short-term, minor, increases in turbidity in the surface water at the construction site and for some distance downstream. Some construction in the waters themselves would be required for many projects, although the projects are generally small enough that equipment would not have to enter the waters directly. In-water construction activity for the proposed salt marsh and fish passage projects is estimated to take a few days up to a few weeks. Some projects may require the temporary construction of a cofferdam to conduct work in dry conditions and minimize potential effects on water quality. Silt curtains may also be used to minimize migration of turbidity offsite from instream construction. Banks that may be disturbed during construction activities would be restored and stabilized, so there would be no long-term negative effects to water quality.

As discussed above for soils, to minimize movement of soils into the adjacent receiving water, erosion and sediment control measures would be employed for all projects that would disturb the land, and the soils would be restabilized by vegetation after construction is completed. An erosion and sediment control plan would be prepared before construction could begin. If the disturbed area exceeds one acre, a general NPDES permit for construction activities would be required from EPA before construction could begin.

The proposed salt marsh projects would have several long-term effects on water quality in Cape Cod's salt marshes and adjacent estuaries. Increased tidal flushing would reduce the retention times of organic,

oxygen-demanding substances and increase the flow of well-oxygenated water, thereby improving dissolved oxygen concentrations in the marsh. Increased flushing would also increase the abilities of the marshes to function in trapping nutrients, which could improve water quality in adjacent bays and estuaries, and in exporting detritus, which would increase food supply to organisms in the bays and estuaries. Increased flushing may also dilute and reduce concentrations of fecal coliform bacteria upstream of the obstruction.

The proposed fish passage projects would provide long-term, minor water quality benefits in the immediate vicinity of the project and downstream because dissolved oxygen concentrations would be increased by greater aeration of the water passing down the steps of the fishway.

As demonstrated in the two Massachusetts projects cited in Section 6.1, the proposed stormwater projects would result in long-term improvements in water quality from the reductions of fecal coliform bacteria and other contaminants associated with storm water runoff. These effects would occur primarily through the infiltration of runoff through layers of natural media (e.g. pea gravel, clean stone, and grass) or soil, and removal of fines and fecal coliform bacteria. These improvements would complement the state's and towns' efforts to reduce fecal coliform bacteria in these waters through the TMDL being prepared by the state. They will contribute toward the goal of having these waters meet the state standard for bacteria, and removing these waters from the state's list of impaired waters. Priority stormwater remediation projects (Table 6-5) would benefit the following waterbodies listed by the State as needing a TMDL (Category 5 waters) for pathogens or nutrients:

Project Site No.	Waterbody Improved	TMDL Pollutant	TMDL Reference
BA-SW-13	Hyannis Harbor	pathogens	DEP (2005a)
WE-SW-6	Duck Creek	pathogens	DEP (2005a)
BA-SW-2	Cotuit Bay	pathogens	DEP (2005a)
PR-SW-1	Provincetown Harbor	pathogens	DEP (2005a)
BO-SW-4	Buttermilk Bay	pathogens	DEP (2005a)
DE-SW-11	Bass River	pathogens	DEP (2005a)
YA-SW-5	Mill Creek	nutrients pathogens	DEP (2004b) DEP (2005a)
MA-SW-2	Shoestring Bay	pathogens	DEP (2005a)
YA-SW-7	Mill Creek Lewis Creek	nutrients pathogens	DEP (2004b) DEP (2005a)

Additional long-term benefits of the proposed alternative would be the reduction of floatable materials (e.g. plastic, aluminum cans, paper, etc) that often carry oil and grease. These materials would be trapped by pre-treatment measures and prevented from entering local waterbodies.

No Action Alternative

The No Action Alternative would result in the continued gradual decline of the waters on Cape Cod. Tidal restrictions would remain in place, limiting tidal flushing and reducing oxygen concentrations in the

marsh waters. Concentrations of fecal coliform bacteria and other pollutants would continue to increase as the watershed continues to develop.

6.3.5 AQUATIC LIFE

Proposed Action Alternative

Construction of the proposed salt marsh and fish passage projects would temporarily disrupt aquatic life in the vicinity of the projects due to turbidity and physical activity in the water. Soil disturbances and in-water construction activities are estimated to take a few days up to a few weeks. Projects would be constructed in periods where critical life stages would not be present. Time-of-year restrictions in the permits required for instream construction, for example, would prohibit construction during the spring migration, spawning, and nursery period for river herring.

The proposed salt marsh projects would have a long-term, major beneficial effect on aquatic organisms in the restored tidal marshes. The increased sizes of the marsh inlets would physically allow more movement in and out of the marshes by fish and some invertebrates. The increased volume of water and improved water quality in the marshes would increase the availability and quality of habitat for all trophic levels of aquatic organisms. These improvements would benefit fish that spend all or most of their life in salt marshes, such as mummichog and Atlantic silverside, and fish that use the marshes for primary spawning and nursery areas, such as alewife and blueback herring. Larger numbers of smaller, resident foraging fish in the marshes would provide an increased food source for the larger predatory fish that would also be able to move more easily into and out of the marshes because of the larger passageways. Aquatic organisms in the bays and estuaries outside of the marshes would also benefit by the export of detritus, which serves as food for the lower trophic levels of the food web. Fish that prefer the existing fresh or low-salinity fringe marshes would lose habitat as salinity increases after the restriction is removed. Some of this displaced habitat may move upstream as the salt water floods a larger area.

The proposed fish passage projects would have long-term, major benefits toward reversing the general decline of anadromous fish on Cape Cod over the last century. The restoration of full function to fish passage structures would allow river herring, in particular, to access new and former spawning and nursery habitats. In many cases, a partially functioning fishway now supports a small population of river herring in a stream. Improving access upstream would allow more fish to return to the spawning grounds each spring and promote growth of that stream's natural population. In other cases where a natural run does not exist now, several years of stocking by DMF would be employed to develop a new population imprinted on that stream. Other anadromous and catadromous fish, such as sea run trout and eels, would also benefit from improved stream passage. Large predator fish (for example, striped bass, bluefish, and Atlantic cod) in the downstream bays and estuaries would benefit from this increase in river herring, an important prey species. The increased number of eggs and juvenile fish in the spawning and nursery areas would also serve as increased food supply for locally resident fish, birds, mammals, and other predators.

The proposed stormwater projects would have only minor effects on aquatic organisms. Construction would not directly affect receiving water biota in the short term because the projects would occur away from the shoreline, and runoff of sediment from the disturbed areas would be minimized by erosion and sediment controls. In the long-term, the primary benefit of the stormwater projects—removing fecal coliform bacteria—would be increased use of the shellfish beds for recreational and commercial fishing.

Improved water quality would allow increased harvesting of the beds, which would result in reduction of shellfish populations. The coincidental removal of other pollutants (sediment and metals adsorbed to sediments) would have a long-term, minor benefit to the shellfish growing in the beds where these storm systems discharge.

In compliance with the Magnuson Stevens Fisheries Conservation and Management Act, NRCS has submitted to the National Marine Fisheries Service an assessment of the potential effects of the Project on essential fish habitat (Appendix C-4). The salt marsh restoration projects could have an effect on non-mobile life stages (eggs, plankton) of managed fish species that would be present in the area during construction, although these effects would be negligible because the projects are small in size, limited in duration (less than one or two weeks of actual in-water construction per project), and widely separated in time (two or three per year) and location (all of Cape Cod). Improvements to tidal salt marshes would result in increased marsh habitat, increased populations of prey species, and increased production of organic materials entering the food web. The proposed fish passage and stormwater projects would not directly affect designated essential fish habitat. Improvements to fish passages would make more spawning and nursery habitat available to anadromous fish that are food sources for some of the fish covered by federal management plans and, therefore, indirectly contribute to improved populations of those fish. Fish passage sites would be located in nontidal waters and not within the designated essential habitat. Stormwater projects would be located in upland areas and, with appropriate best management practices for erosion and sediment control, would not affect tidal waters.

No Action Alternative

Under the No Action Alternative, the aquatic communities would continue with declining trends in several important cases. Tidally restricted salt marshes would continue to lose function as spawning areas, nurseries, and refuges for marsh-dependent species. Herring runs would decline as the functionality of existing fishways continued to decline, further restricting fish from returning to their spawning areas. NRCS would undertake no restoration project under this program, so there would be no need for consultation with the National Marine Fisheries Service about essential fish habitat.

6.3.6 WETLANDS

Proposed Action Alternative

The proposed salt marsh projects would restore tidal flow to the selected marshes and have long-term, major benefits for the marshes' ecology. (For the purpose of this EIS, the term salt marsh includes the entire area flooded by tidal water on a daily basis, which encompasses a variety of habitats found within the intertidal zone, such as mud flats, tidal pools, channels, and hummocks.) Restoring tidal flow would increase the tidal range within each marsh, converting marsh that has become dominated by the invasive species phragmites to native salt marsh vegetation. These increases in salt marsh area would result in corresponding decreases in fringe brackish or freshwater wetlands and upland, terrestrial areas. These changes would lead to shifts in the wildlife communities in the region as amphibians, reptiles, birds, and mammals that use salt marsh habitat displace the animals that use the existing freshwater and upland habitats. This change is considered an overall ecological benefit because of the greater functional values of adequately flushed tidal marshes over poorly flushed brackish marshes and adjacent uplands.

Mosquito populations may be affected by the changing hydrologic conditions in the marshes. Populations are likely to decrease if increases in tidal flow improve flushing in the marshes and disrupt standing pools of water, and if high marsh areas are adequately drained during ebb and low-tide cycles. If pools of water are left standing in the high marsh between flushing events, however, they could become mosquito breeding grounds. The Massachusetts Department of Agricultural Resources State Reclamation and Mosquito Board implements an integrated mosquito management program on Cape Cod that includes (1) selected ditch maintenance to improve drainage and flushing of tidal marshes and (2) use of larvicides to control mosquitoes before they emerge into the adult form. NRCS would work with the Department of Agricultural Resources on follow-up observations in restored marshes to determine if implementation of the Department's management program would be necessary.

The proposed salt marsh projects also would create a long-term benefit by restoring stands of submerged aquatic vegetation, such as eelgrass (*Zostera marina*). Eelgrass beds are an important habitat in Buzzard's Bay and in coastal ponds on Cape Cod. They serve as breeding, nurseries, and feeding grounds for a variety of fish species. Eelgrass beds are sensitive to water quality, and improving tidal flow into salt marsh systems is likely to improve water quality, potentially increasing eelgrass beds in open water portions of salt marshes.

The proposed fish passage projects would have no long-term effects on wetlands. Water levels at the impoundments in the vicinity of the project would be maintained at their existing elevations, which would maintain existing freshwater wetlands around those ponds.

The proposed stormwater projects would not affect wetlands.

No Action Alternative

Restrictions to tidal flow would remain and perhaps become more restrictive from further siltation or blockage, resulting in continued marsh degradation. In many cases, marshes would continue to experience a decrease in ecological value as phragmites continues to expand into the marsh, displacing native salt marsh vegetation. Existing non-tidal freshwater wetlands adjacent to marshes would remain intact and possibly expand as the salt marshes contract.

6.3.7 THREATENED AND ENDANGERED SPECIES

Proposed Action Alternative

In compliance with the federal and state Endangered Species Acts, NRCS sent letters to the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and the Massachusetts Division of Fisheries and Wildlife advising them of the Cape Cod Water Resources Restoration Project and of its intent to consult with the agencies in the future on each specific project. Responses were received from each agency (Appendix A).

The U.S. Fish and Wildlife Service (June 21, 2006) stated that no federally listed threatened or endangered species or critical habitat under its jurisdiction was known to occur in the project areas, and no further consultation under Section 7 is required for this Plan-EIS.

The National Oceanic and Atmospheric Administration (April 20, 2006) identified nine threatened or endangered whale and turtle species known to occur seasonally in waters off the coast of Massachusetts (see Appendix C-5). NRCS determined that the proposed projects of the Cape Cod Water Resources Restoration Project would not affect any of these marine species and submitted a letter to NOAA (July 6, 2006) seeking their concurrence. NOAA concurred with that determination (July 21, 2006) and stated that no further consultation under Section 7 is required.

The Massachusetts Division of Fisheries and Wildlife (May 19, 2006) identified five fish passage project sites and six salt marsh project sites that fall within the state's designated areas for "priority habitat" or "estimated habitat" (the state letter includes one other site ("BN-33") that has been screened from the list of priority sites). Projects within these designated habitat areas require a filing for Project Review by the Division of Fisheries and Wildlife. If a specific project were to require a "take" of a state-protected species, an application for a conservation and management permit would have to be submitted to the Division of Fisheries and Wildlife. When granted, conservation and management permits often include a Conservation Restriction to offset the proposed take.

The potential for effects of the proposed projects on threatened and endangered species would vary from site to site, and site-specific assessments have not been conducted at this time. Each site would be evaluated specifically for potential effects in the Environmental Evaluation that would be prepared before NRCS would provide funding and technical assistance for that project. This evaluation would include the consultations with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, as required under Section 7 of the federal Endangered Species Act, and consultation with the Massachusetts Division of Fisheries and Wildlife under the state Endangered Species Act.

In general, there are no areawide constraints on the Cape Cod Project from threatened or endangered species. Similar restoration projects have been undertaken previously by the towns and the state. Time-of-year restrictions on construction work may be required to protect threatened or endangered species during critical life stages (for example, spawning or nesting), but this would not affect the Project because the short construction time for any single project would allow it to be scheduled around any such restrictions.

No Action Alternative

Under the No Action Alternative, NRCS would not fund any restoration projects under this program, so there would be no effect from NRCS actions on threatened or endangered species on Cape Cod.

6.3.8 COASTAL ZONE

Projects that may be undertaken by other federal agencies under either alternative would have to comply with the Act and demonstrate compliance with the state's Coastal Zone Management Plan.

Proposed Action Alternative

Under the Coastal Zone Management Act, NRCS is required to demonstrate that the proposed Project is consistent with the Massachusetts Coastal Zone Management Plan to the maximum extent practical. The Massachusetts Office of Coastal Zone Management, as an agency within the Massachusetts Executive Office of Environmental Affairs, is a sponsor and fully supportive of the Cape Cod Project (see letter of

September 15, 2006, in Appendix A). The Cape Cod Project would be entirely consistent with the Plan and would comply with the following specific policies that are directly related to the Project's objectives:

Policy	Effect
Water Quality Policy #1: Ensure that point-source discharges in or affecting the coastal zone are consistent with federally approved state effluent limitations and water quality standards.	Stormwater remediation projects would contribute toward meeting the goals of the fecal coliform TMDL for Cape Cod tidal waters and meeting future goals for stormwater control to be implemented under town NPDES permits.
Habitat Policy #1: Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and freshwater wetlands for their important role as natural habitats.	The Cape Cod Project would restore currently degraded resource areas—salt marshes, tidal waters, and anadromous fish runs.
Habitat Policy #2: Restore degraded or former wetland resources in coastal areas and ensure that activities in coastal areas do not further wetland degradation but instead take advantage of opportunities to engage in wetland restoration.	Salt marsh restoration projects would restore tidal flooding to marshes where it is currently restricted, thereby restoring former salt marsh habitat.
Protected Areas #3: Ensure that proposed developments in or near designated or registered historic districts or sites respect the preservation intent of the designation and that potential adverse effects are minimized.	No effects on designated or registered historic districts or sites would be expected. Each individual project site would be evaluated further in a site-specific Environmental Evaluation to ensure there are no adverse effects from that project.
Coastal Hazard Policy #2: Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Approve permits for flood or erosion control projects only when it has been determined that there will be no significant adverse effects on the project site or adjacent or downcoast areas.	There would be no interference with water circulation or sediment transport from the Cape Cod Project. Salt marsh restoration projects would restore tidal flooding to marshes where it is currently restricted, thereby restoring former salt marsh habitat.

No Action Alternative

NRCS would not be required to comply with the Coastal Zone Management Act under the No Action Alternative, because there would be no federal action.

6.3.9 ECONOMY

Proposed Action Alternative

The proposed salt marsh and fish passage projects would create long-term, minor, indirect benefits for the local economy by increasing components of the food web (organic matter, prey fish) that sustain populations of larger commercial prey fish. Increased herring runs, for example, that would be expected from the fish passage projects would help sustain or expand the populations of striped bass, bluefish, and cod. Demand for river herring for bait for game fish has been increasing, and increased runs would bring anglers to the area and increased revenue from herring permit sales.

The proposed stormwater projects would have long-term, major benefits for the commercial shellfishing industry by improving water quality (reduction of fecal coliforms), thereby reducing or eliminating the number of days that the shellfish beds affected by these discharges would be closed to fishing. Currently, the total number of harvest days for commercial shellfishing is reduced when beds are closed because of excessive fecal coliform concentrations. Many of the proposed projects are located in areas where shellfish beds currently fluctuate between being closed and open because existing water quality is affected for short periods by polluted stormwater runoff. These projects were highly rated in the screening process because of the high potential for stormwater treatment to reduce the pollution and thereby reduce, if not eliminate, the number of days those beds would be closed or potentially closed if remedial measures are not installed. Increased numbers of fishing days and fishing areas would result in increased commercial shellfish landings. One of the goals of the proposed projects would be to prevent the downgrade of shellfish beds that are currently classified as “approved” and “conditionally approved” to “restricted” or “prohibited”. If all priority projects would be implemented, up to 3,700 acres of “approved” beds would be maintained at their current classified status, 3,200 acres of “conditionally approved” shellfish beds would either be maintained at their current status or potentially upgraded to “approved” status, and 320 acres of “prohibited” and “restricted” beds would be potentially upgraded so that limited fishing would be allowed in these areas.

No Action Alternative

The No Action Alternative would have a long-term, minor adverse impact on the local economy owing to continued declines in commercial shellfishing as continued development of the Cape leads to increased contamination of local shellfish waters and increased closures of shellfish beds. Specifically, those beds that are targeted under the Cape Cod Project because they fluctuate between being closed and open would be closed for increasing number of days. A portion of the 6,900 acres of shellfish beds currently classified as “approved” and “conditionally approved” would likely be downgraded in classification because of increasingly high fecal coliform concentrations. The economic value of the shellfish industry would decline because of reduced harvesting.

6.3.10 RECREATION

Proposed Action Alternative

The proposed salt marsh projects would have long-term, minor, indirect effects on sport fishing through the food web effects discussed previously.

The proposed fish passage projects would have long-term, major benefits for recreational fish populations. Increased river herring populations would serve as increased food sources for sport fish such as largemouth bass and pickerel, and success of these projects could ultimately contribute toward removal of current recreational fishing restrictions for river herring.

The proposed stormwater projects would have long-term, major benefits for recreational shellfishing by reducing fecal coliform bacteria in stormwater runoff and increasing the number of recreational harvesting days by elevating bed classifications to "approved" in areas where they currently fluctuate between open and closed. The projects may also benefit nearby beaches by reducing fecal coliform bacteria in the water and reducing the number of days the beaches are closed.

No Action Alternative

The no action alternative would have a long-term, minor adverse impact on recreation owing to continued declines in herring runs, increased contamination of local shellfish waters and increased closures of shellfish beds. Specifically, those beds that are targeted under the Cape Cod Project because they fluctuate between being closed and open could be closed for increasing number of days.

6.3.11 NATURAL AREAS

Proposed Action Alternative

One of the priority salt marsh projects—Herring River, Wellfleet (WE-6)—would be constructed on land adjacent to the Cape Cod National Seashore, but the salt marsh that would be benefited by the project lies within the seashore. The National Seashore is fully supportive of the project (see letters of June 8 and October 10, 2006, in Appendix A). No other projects on the priority lists would affect designated natural areas.

No Action Alternative

The No Action Alternative would have no effect on natural areas.

6.3.12 CULTURAL RESOURCES

Proposed Action Alternative

The potential exists for effects upon archaeological and historic resources from construction of any of the proposed projects. To determine these effects, federal agencies are required to follow the Section 106 process, named for Section 106 of the National Historic Preservation Act 1966 as amended. This process requires the federal agency to take into account the effect of the federally assisted undertaking on any site, district, or object that is included in or eligible for listing on the National Register of Historic Places. The process also requires consultation with federally recognized tribes—in this case the Wampanoag Tribe of Gay Head (Aquinnah) (WTGHA)—and the State Historic Preservation Officer (SHPO).

The potential for each project to affect cultural resources would be evaluated in more detail in an Environmental Evaluation tiered to this EIS. This evaluation would be based on whether (1) the proposed construction would disturb the ground in areas which contain or are likely to contain resources which

were previously undisturbed, (2) there are historic or archaeological resources within the area that would be disturbed, and (3) the site is a Traditional Cultural Place to which a recognized tribal entity, in this case the WTGHA, attaches a particular cultural significance.

Salt Marsh Sites

Restoring tidal flow, in most cases, would involve the upgrading of a previously installed culvert or other roadway-related structure that is restricting tidal flow to a salt marsh. These projects would generally involve removal and replacement of structures in previously disturbed or artificial fill and, thus, are not likely to affect cultural resources negatively.

NRCS would evaluate all of the structures to be replaced for the project's potential to affect archaeological or historic resources. Concurrence letters would be sent to the SHPO and the WTGHA would be consulted as per Section 106. This process would be undertaken during planning the individual projects. NRCS may choose to seek Memoranda of Understanding with the SHPO and the Wampanoag Tribe of Gay Head (Aquinnah) to facilitate the 106 process.

Fish Passage Sites

Native peoples heavily utilized the fish resources available to them. They gathered the anadromous species by spearing and netting. Some streams were shallow enough that catching by hand would have been relatively easy. All of the fish passage locations can be assumed to be archaeologically sensitive because of this extensive native fishery. Whether or not previous construction of the existing ladders disturbed any pre-existing sites is unknown at this time. It can also be assumed, though, that if these sites were present when the ladders were built, they were damaged and can be considered disturbed.

The first step would be to perform sufficient file and documentary research to determine if known archaeological and/or historic sites exist in the area. A literature report would be prepared by an archaeological consultant, followed by a field investigation to determine if the project area contains unknown archaeological sites.

The next step would be to determine what effect the proposed projects might have on this group of sensitive and known sites. This step would be carried out in the field, in conjunction with those individuals who are planning the layout of the project. It is important that this assessment take place early in the planning process to avoid costly and unnecessary delays. The proposed design would be assessed for its potential to disturb the ground in areas which were not previously disturbed by earlier construction of the existing fish ladder or adjacent areas. This assessment would include potential access roads, staging areas, and borrow pits. If the area has not been previously disturbed and/or if construction of the replacement ladder would not exceed the footprint of the existing ladder for any reason, then the proposed project would have no effect on buried cultural resources, and no further archaeological investigation would be required.

If, however, the project would disturb sensitive areas which are previously undisturbed, then a Phase 1 investigation would be conducted. This Phase 1 investigation would consist of a number of shovel test pits and screening of the soil horizons to look for evidence of human occupation. This evidence might include artifacts related to tool production, such as spear points, or evidence of habitation and byproducts of cooking, such as charcoal, animal bones, or shell middens (waste shell piles). It may also reveal evidence of colonial occupation or habitation like buttons, metal ware, nails, etc.

The proposed design would also be assessed for its possible impact on historic properties in the area; for example, where an existing fish ladder was constructed on a property that is listed or eligible for listing on the National Register of Historic Places and possesses characteristics which contribute to the historic property.

The third assessment would be to determine by consultation with the WTGHA whether they attach traditional significance to the area. These properties are referred to as Traditional Cultural Places. A ladder may have been constructed in an area which their ancestors once harvested fish. In this case, the WTGHA as a sovereign Nation becomes a consulting party on the proposed construction. The Tribe would be consulted for their input on each project.

When the site investigation is made, standing historic resources would be evaluated with respect to project effects. Visual examination would be made to verify that any historic properties identified by file research would not be adversely affected by the installation of the new fish passage structure.

The results of these assessments would determine the nature of Section 106 consultation with the SHPO and the WTGHA. If the area of potential effect is found to be either previously disturbed or, if upon Phase 1 investigation, is found not to contain archaeological or historic resources, a letter would be sent to the SHPO requesting their concurrence with the NRCS determination of no effect on cultural resources.

If archaeological materials are discovered during the phase 1 investigation, the site would be evaluated for significance and a determination of effect would be made by NRCS based on an archaeologist's recommendation. Should NRCS make the determination that the site is not significant, and if the SHPO concurs in that determination and the WTGHA is consulted, then the project may go forward after receipt of the SHPO concurrence letter. If either the determination by NRCS or the SHPO finds the site to be a significant resource, then modifications to the project would be explored to avoid disturbing these resources.

If concurrence cannot be reached among the consulting parties and NRCS, documentation may be submitted to the Advisory Council for Historic Preservation for their participation in negotiating a Memorandum of Agreement to which all parties agree. If for some reason sufficient changes cannot be made to avoid damaging the resources, NRCS can elect to either withdraw assistance for that particular fish passage project or enter into a recovery phase where a percentage of the site would be recovered prior to construction. It has been NRCS's experience that the great majority of significant resources can be avoided through design modifications, thereby negating the need for recovery activities.

Stormwater Sites

Infiltration of stormwater in most cases would involve excavation beneath existing streets and highways to install catch basins or similar structures. In other situations, existing stormwater systems may be modified to accommodate deeper or additional dry wells or similar structures. These structures would be located beneath streets and highways where previous construction has disturbed the original subsurface. There are some instances, though, where previously undisturbed areas would be utilized for the stormwater structure installation. In these areas, the normal field investigation would be followed by a phase 1 archaeological survey.

NRCS would evaluate each of the structures to be installed to assess its potential to affect archaeological or historic resources. Letters of NRCS findings would be sent to the SHPO, and the WTGHA would be

consulted as required by Section 106. This process would be undertaken during planning of the individual projects.

No Action Alternative

Under the No Action Alternative the proposed construction projects would not occur, and there would be no effects on cultural resources.

6.3.13 HUMAN HEALTH AND SAFETY

Proposed Action Alternative

Under the Proposed Action, NRCS would fund an estimated five to ten construction projects each year for approximately ten years. All construction projects involve increased risks to human health and safety, both to project workers and to the public that may be near to the projects. Contractors would be required to follow federal and state regulations for protecting workers and the public to minimize those risks. For projects affecting public roads (salt marsh and stormwater projects), traffic control would be instituted where necessary to ensure safe travel through the project area, to protect both the public and the construction workers.

No Action Alternative

NRCS would undertake no projects under the No Action Alternative, so there would be no effects on human health and safety.

6.3.14 CUMULATIVE IMPACTS

Proposed Action Alternative

NEPA requires the federal agency preparing an EIS to evaluate the cumulative impacts of its proposed action and the impacts of other known past, present, and future actions in the affected area. The adverse impacts from the Cape Cod Project would be associated with construction activities and would be short-term in duration and minor in magnitude. The construction of any single project would only take a few weeks up to a few months, and it would disturb only a small area in the immediate vicinity of the project. The total number of projects is expected to be five to ten per year, and they would be widely scattered around the Cape. These projects, therefore, would make negligible additional adverse impacts on resources on the Cape compared to other large-scale road and development projects occurring during the Project lifetime. There would be no long-term adverse impacts from the Project after construction is completed. The incremental cumulative adverse impacts of the Project, therefore, are minor when added to other past, present, and foreseeable future actions.

The long-term positive benefits of the Cape Cod Project—improved salt marsh flushing and ecology, improved fish passages and herring runs, improved water quality and shellfishing—would mitigate historical adverse effects on the resources from human activity and development on Cape Cod. The Project would complement other marsh, fish passage, and water quality restoration and remediation projects that are being undertaken or planned by the towns and state and federal agencies. There are no

known conflicts between the projects proposed under the Cape Cod Project and other projects proposed by other agencies.

No Action Alternative

There would be no cumulative impacts from construction activities under the No Action Alternative. Although other agencies would implement planned restoration and remediation projects, the cumulative long-term benefits in ecological values would be less because areas that would be benefited by the Cape Cod Project would not be improved. Salt marshes would continue to decline in ecological value as inlets were silted in, tidal flushing decreased, water quality degraded, and invasive species expanded. Fish passages that are currently partially restricted would probably become less effective in the future, and herring runs would continue their declines. Water quality would continue to be affected by bacterial contamination from stormwater runoff, and shellfish beds would continue to be closed.

6.3.15 LONG-TERM PRODUCTIVITY AND COMMITMENT OF RESOURCES

NEPA requires the federal agency to determine if the proposed action, in combination with other actions, would sacrifice the enhancement of significant long-term productivity as a tradeoff for short-term uses. The Cape Cod Project would enhance long-term ecological and economic productivity through improved salt marshes, fish passages, and water quality.

NEPA also requires the federal agency to determine if the proposed action would irreversibly and irretrievably commit the use of resources such as important farmlands, wetlands, and fish and wildlife habitat. The Cape Cod Project would not result in the long-term use or loss of any natural resources.

6.3.16 CONSISTENCY WITH LOCAL AND REGIONAL PLANS

The Cape Cod Water Resources Restoration Project has been thoroughly coordinated with and has the support of Barnstable County, the 15 towns of Barnstable County, the Cape Cod Commission, key state environmental agencies (Executive Office of Environmental Affairs, Division of Marine Fisheries, and Office of Coastal Zone Management), and the National Park Service. Letters of support received from some of these agencies are included in Appendix A. The projects of the CCWRRP are consistent with key environmental planning documents for the Cape, including the Massachusetts Bay Program's Comprehensive Conservation and Management Plan, the Cape Cod Commission's Regional Policy Plan for Barnstable County, and the Cape Cod Watershed Assessment and Action Plan.

6.4 COMPARISON OF ALTERNATIVE PLANS

Table 6-6 summarizes the major environmental and socioeconomic benefits of the two alternatives: No Action (without project) and Proposed Action—the Cape Cod Water Resources Restoration Project (with project). The comparison focuses on the Environmental Quality account, which is the basis for selection of the National Ecosystem Restoration plan.

Table 6-6
Summary and comparison of alternative plans[1/]

Effects	Without project	With project[2/]
Measures	None	26 salt marsh restoration projects 24 fish passage obstruction remediation projects 26 stormwater remediation projects
Project investment	$0	$29,950,000
Environmental Quality Account—Ecology—Water		
Tidal water hydrology	0 acres of salt marsh with enhanced tidal flushing (continued restricted tidal flushing may result in a further loss of salt marsh owing to vegetation dieback and soil subsidence)	1,500 acres of salt marsh with enhanced tidal flushing
Tidal water quality	0 acres of salt marsh with improved water quality and continued restriction of tidal flushing	1,500 acres of salt marsh with improved water quality resulting from increased tidal flushing
	0 acres of tidal water over shellfish beds with decreased fecal coliform concentrations because of no additional stormwater treatment	7,300 acres of tidal water over shellfish beds with decreased fecal coliform concentrations, thereby supporting the TMDL for pathogen and nutrient reductions on Cape Cod and possible delisting of affected waters from the state list of impaired water; and with reductions in other pollutants (sediment, trash, nutrients, toxic substances) removed by stormwater treatment
Environmental Quality Account—Ecology—Plants		
Salt marshes	0 acres of salt marsh vegetation restored; large stands of invasive phragmites continue to expand	1,500 acres of salt marsh vegetation restored; areas of invasive phragmites reduced

Table 6-6 (cont.)
Summary and comparison of alternative plans[1/]

Effects	Without project	With project[2/]
Environmental Quality Account—Ecology—Animals		
Salt marshes	0 acres of habitat restored for salt marsh animals (continued use by intertidal, freshwater, and upland wildlife)	1,500 acres of habitat restored for animals using salt marshes for all or part of their life cycle
Anadromous fish	0 acres of spawning habitat restored to full access for anadromous fish	4,200 acres of spawning habitat restored to full access for anadromous fish Improved river herring runs Increased biological productivity of streams
Other Socio-Economic Account—Commercial and Recreational Shellfishing		
Shellfish beds	0 acres of water quality improvement (water quality would continue to decline, and the number of acres of closed beds would likely increase as a result)	3,200 acres of "conditionally approved" shellfish beds maintained at current classification and potentially upgraded to "approved" classification 3,700 acres of "approved" shellfish beds maintained at current classification 320 acres of "prohibited" or "restricted" shellfish beds potentially upgraded to "conditionally approved" classification

[1/] Current remediation work by NRCS and other agencies would continue with or without the Cape Cod Project; this ongoing work is not included in the evaluation for either alternative.

[2/] With project effects include the use of adaptive management for salt measure and stormwater measures to maximize project benefits.

6.5 RISK AND UNCERTAINTY

Risk and uncertainty is expected and inherent in a watershed plan. Each project has a certain level of risk and uncertainty associated with it, which may change the overall costs or benefits of the project. Ecosystem restoration is not an exact science; stormwater remediation measures and salt marsh restoration measures, in particular, have risks and uncertainties associated with their final outcomes. Adaptive management is commonly used for such ecosystem restoration projects because of these risks and uncertainties. A list of probable risks and uncertainties is identified for each category of project:

Salt marsh restoration projects

- Presence of improvements (e.g., wells, septic tanks) around marshes could make implementation of specific projects impossible or more expensive than estimated
- Local opposition from adjacent property owners could prevent implementation of specific projects.
- More detailed modeling and field surveys may be required to define project effects on adjacent properties accurately.
- Construction costs may increase because of site-specific factors unknown at this time.
- Adaptive management may show that enhancing or restoring tidal flow has not restored the salt marsh habitat as expected, and some additional work may be necessary such as additional interior channels.

Fish passage obstruction remediation projects

- Following improvement of fishways, DMF intends to implement a fish restocking program to reintroduce river herring species in the project area. Reintroduced fish may not survive or return to the project area.
- DMF funding for the restocking program could decrease and sufficient base populations imprinted on the stream may not develop.
- Construction costs may increase because of site-specific factors unknown at this time.

Stormwater remediation projects

- Future growth and development of Cape Cod will likely result in increased impervious surfaces and consequently increasing stormwater runoff into tidal waters. Current state law requires new developments to treat the first flush of runoff; however, the overall effectiveness of the proposed BMP treatments could be reduced if other pollutant sources are not controlled or reduced.
- Adaptive management may show that proposed facilities are less effective than thought, the proposed number of treatment facilities may not provide the expected efficiency removals for existing fecal coliform loads, or other toxic compounds (e.g. metals, PCBs, pesticides) may be causing impairment to shellfish beds and more expensive treatment methods are required.
- Reduction of fecal coliform bacteria may not improve the health of targeted shellfish beds and extend the number of days that the shellfish beds are open.
- The implementation of proposed BMPs may not provide adequate water quality benefits to support upgrading shellfish beds that are currently classified as “restricted” to “conditionally approved” or “approved” status.
- Tourism may be affected if construction activities are conducted during peak tourism months.
- Construction costs may increase because of site-specific factors unknown at this time, e.g., underground utilities requiring relocation.

6.6 RATIONALE FOR PLAN SELECTION

The recommended plan is the Proposed Action (Cape Cod Water Resources Restoration Project) because it maximizes ecological benefits and is the National Ecosystem Restoration (NER) Plan. The Recommended Plan achieves the desired level of improvement for the least cost. For each project type (shellfish, fish passage, and saltmarsh), as summarized in Table 6-6, the Restoration Project would provide a greater number of habitat units and greater other environmental benefits than the No Action Alternative:

Salt marsh restoration: The total acreage of salt marsh habitat will increase by 1,500 acres.

Additional benefits of the proposed salt marsh restoration projects would be (1) regrowth of salt marsh vegetation, which in turn would provide support for the marsh substrate and prevent erosion, (2) enhanced habitat for a variety of wildlife (3) improved water quality within the tidal creek network and within adjacent estuaries, (4) improved hydrology within each restored marsh, (5) increased breeding grounds and nursery habitat for fish species, (6) increased fish movement into the marshes because of wider inlet passages, and (7) increased inputs of organic material and prey fish into the bay and estuarine food webs.

Fish Passage Obstruction Remediation: Full access will be provided to 4,200 acres of spawning habitat for anadromous fish species; river herring is the primary target.

Additional benefits of the proposed fish passages projects would be (1) restoration of anadromous fish populations, (2) increased biological productivity in the streams associated with re-establishment of anadromous fish to historic habitat, (3) increased populations of out-migrating juveniles that will provide forage for marine and estuarine fish, (4) additional recreational fishing opportunities, and (5) increased commercial fish landings and quotas.

Stormwater Remediation: Water quality would be improved over 7,200 acres of shellfish beds to help maintain or improve the classification of those beds.

Additional benefits of the proposed stormwater remediation projects would be (1) improved water quality in tidal waters on the state's impaired waters list (303(d)) by reducing fecal coliform bacteria, which is the primary pollutant causing the impairment, (2) increased commercial and recreational shellfish activities by reducing the number of shellfish beds that are partially or completely closed due to bacteria, (3) increased total number of days that shellfish harvesting can occur in a specific bed, (4) increased economic value of the shellfish industry located in the Cape Cod Watershed, and (5) increased number of landings for commercial shellfish.

The No-Action Alternative for shellfish, fish passage, and saltmarsh restoration would provide none of these ecological benefits.

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