NOAA Restoration Center

Programmatic Environmental Impact Statement

January 2015

DRAFT

Cover Sheet

Draft Programmatic Environmental Impact Statement for habitat restoration activities implemented throughout the coastal United States

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Abstract: This draft Programmatic EIS is prepared pursuant to the National Environmental Policy Act (NEPA) to assess the environmental impacts of NOAA's proposed action to fund or otherwise implement coastal habitat restoration activities through its existing programmatic framework and related procedures. Projects implemented by NOAA vary in terms of their size, complexity, geographic location, and NOAA involvement, and they often benefit a wide range of habitat types and affect a number of different species. Fish passage, hydrologic/tidal reconnection, shellfish restoration, coral recovery, salt marsh and barrier island restoration, erosion prevention, debris removal, and invasive species removal, are among the project types implemented by NOAA through its various programs. Impacts from two alternatives are described. The preferred alternative is a current management, or "no action," alternative. The second alternative consists of providing technical assistance only.

Public comments on this Draft Programmatic EIS are requested by: March 20, 2015

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Table of Contents

Table of Contents ii

Tables vi

Figures vii

Acronyms viii

Executive Summary ix

1.0 Introduction and Purpose and Need 1

1.1.1 Overview of Restoration Activities 4

1.1 Purpose and Need 8

1.2 Scope and Structure of This PEIS 9

1.2.1 Relationship between This Document and Prior NEPA Analyses 10

1.3 Public Involvement 11

2.0 Alternatives 12

2.1 Alternatives Considered but Rejected 15

2.2 Alternative 1 – “Current Management” (Preferred Alternative) 19

2.2.1 Technical Assistance 19

2.2.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting 19

2.2.1.2 Implementation and Effectiveness Monitoring 19

2.2.1.3 Fish and Wildlife Monitoring 21

2.2.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs 21

2.2.2 Riverine and Coastal Habitat Restoration 23

2.2.2.1 Beach and Dune Restoration 23

2.2.2.2 Debris Removal 24

2.2.2.3 Fish Passage 26

2.2.2.3.1 Dam and Culvert Removal, Modification, or Replacement 26

2.2.2.3.2 Technical and Nature-like Fishways 29

2.2.2.4 Fish, Wildlife, and Vegetation Management 31

2.2.2.4.1 Invasive Species Control 31

2.2.2.4.2 Prescribed Burns and Forest Management 32

2.2.2.4.3 Species Enhancement 33

2.2.2.5 Freshwater Stream Restoration 35
2.2.2.5.1 Channel Restoration 35
2.2.2.5.2 Bank Restoration and Erosion Reduction 36
2.2.2.6 Reefs 38
2.2.2.6.1 Coral Reef Restoration 38
2.2.2.6.2 Shellfish Reef Restoration 41
2.2.2.6.3 Artificial Reefs 43
2.2.2.7 Road Upgrading and Decommissioning; Trail Restoration 44
2.2.2.8 Signage and Access Management 46
2.2.2.9 Subtidal Planting 48
2.2.2.9.1 Submerged Aquatic Vegetation 48
2.2.2.9.2 Marine Algae 50
2.2.2.10 Water Conservation and Stream Diversion 51
2.2.2.11 Wetland Restoration 53
2.2.2.11.1 Levee and Culvert Removal, Modification, and Set-Back 53
2.2.2.11.2 Fringing Marsh and Shoreline Stabilization 56
2.2.2.11.3 Sediment Removal 58
2.2.2.11.4 Sediment/Materials Placement 59
2.2.2.11.5 Wetland Planting 60
2.2.3 Land and Water Acquisition and Other Transactions 61
2.2.3.1 Land Acquisition 62
2.2.3.2 Water Transactions 62
2.3 Alternative 2 – “Technical Assistance” 64
3.0 Affected Environment 65
3.1 Coastal Habitats 66
3.1.1 Wetlands 66
3.1.1.1 Tidal Wetlands 67
3.1.1.2 Nontidal Wetlands 68
3.1.2 Ponds/Lakes 69
3.1.3 Stream and River Channels 69
3.1.4 Riparian Habitat 70
3.1.5 Submerged Aquatic Vegetation and Marine Algae 70
3.1.6 Reefs 72

3.1.6.1 Oyster Reefs 72
3.1.6.2 Coral Reefs 72
3.1.6.3 Artificial Reefs 73
3.1.7 Beaches and Dunes 73
3.1.8 Mangroves 74
3.1.9 Mud or Sand Flat and Subtidal Bottom 74
3.2 Geology and Soils 75
3.3 Water Resources 77
3.4 Living Coastal and Marine Resources and Essential Fish Habitat 80
3.5 Threatened and Endangered Species 81
3.6 Cultural and Historical Resources 81
3.7 Land Use and Recreation 81
3.8 Socioeconomics 82
4.0 Environmental Consequences 84
4.1 Type of Potential Impacts 86
4.2 Duration of Potential Impacts 86
4.3 Geographic Extent 86
4.4 Magnitude of Potential Impacts 87
4.5 Environmental Consequences of Preferred Alternative 90
4.5.1 Technical Assistance 108
4.5.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting 108
4.5.1.2 Implementation and Effectiveness Monitoring 108
4.5.1.3 Fish and Wildlife Monitoring 109
4.5.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs 112
4.5.2 Riverine and Coastal Habitat Restoration 114
4.5.2.1 Beach and Dune Restoration 114
4.5.2.2 Debris Removal 115
4.5.2.3 Fish Passage 118
4.5.2.3.1 Dam and Culvert Removal, Modification or Replacement 118
4.5.2.3.2 Technical and Nature-like Fishways 122
4.5.2.4 Fish, Wildlife, and Vegetation Management 125
4.5.2.4.1 Invasive Species Control 125

4.5.2.4.2 Prescribed Burns and Forest Management ... 129
4.5.2.4.3 Species Enhancement ... 130
4.5.2.5 Freshwater Stream Restoration ... 133
4.5.2.5.1 Channel Restoration ... 133
4.5.2.5.2 Bank Restoration and Erosion Reduction ... 135
4.5.2.6 Reefs ... 137
4.5.2.6.1 Coral Reef Restoration ... 137
4.5.2.6.2 Shellfish Reef Restoration ... 140
4.5.2.6.3 Artificial Reef Restoration ... 143
4.5.2.7 Road Upgrading and Decommissioning; Trail Restoration ... 144
4.5.2.8 Signage and Access Management ... 147
4.5.2.9 Subtidal Planting ... 148
4.5.2.9.1 Submerged Aquatic Vegetation ... 148
4.5.2.9.2 Marine Algae ... 151
4.5.2.10 Water Conservation and Stream Diversion ... 152
4.5.2.11 Wetland Restoration ... 155
4.5.2.11.1 Levee and Culvert Removal, Modification, and Set-back ... 155
4.5.2.11.2 Wetland Restoration and Shoreline Stabilization Techniques ... 158
4.5.2.11.3 Wetland Planting ... 160
4.5.3 Land and Water Acquisition and Other Transactions ... 161
4.6 Environmental Consequences of Alternative 2 –"Technical Assistance" ... 162
4.7 Potential Impacts to Threatened and Endangered Species ... 164
4.8 Potential Impacts to Cultural and Historical Resources ... 168
4.9 Cumulative Impacts ... 170
4.9.1 Past, Present, and Reasonably Foreseeable Future Actions ... 179
4.9.2 Climate Change ... 181
4.10 Relationship of Short-Term Uses and Long-Term Productivity ... 182
4.11 Irreversible and Irretrievable Commitments of Resources ... 183
4.12 Compliance with All Applicable Environmental Laws and Regulations ... 183
List of Preparers ... 189
List of Agencies, Organizations, and Persons to Whom Copies of the Statement Were Sent ... 191
Glossary ... 192
References ... 204

Index 224
Appendices 225

Tables

Table 1 – NOAA RC's management objectives and their legislative origins. 8
Table 2 – Criteria for evaluating potential alternatives 14
Table 3 - Commonly planted vegetation species 37
Table 4 – Commonly planted SAV species 49
Table 5 - Fringing marsh and shoreline stabilization activities 57
Table 6 - Habitat types by region 66
Table 7 - Impact Magnitude Definitions 87
Table 8 - Impact Magnitude Definitions by Resource 88
Table 9 – Summary of terms used to describe potential environmental impacts 90
Table 10-Project activities shown in bold have specific considerations which help determine whether the project's activities are fully analyzed in this NEPA document. 92
Table 11 – Summary of environmental consequences of the Proposed Action 94
Table 12 - Summary of impacts to Planning, Feasibility Studies, Design Engineering, and Permitting activities 108
Table 13 - Summary of impacts to Implementation and Effectiveness Monitoring activities 109
Table 14 - Summary of impacts to Fish and Wildlife Monitoring activities 112
Table 15 - Summary of impacts to Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs activities 113
Table 16 - Summary of impacts to Beach and Dune Restoration activities 115
Table 17 - Summary of impacts to Debris Removal activities 118
Table 18 - Summary of impacts to Dam and Culvert Removal, Modification or Replacement activities 122
Table 19 - Summary of impacts to Technical and Nature-like Fishways activities 125
Table 20 - Summary of impacts to Invasive Species Control activities 128
Table 21 - Summary of impacts to Prescribed Burns and Forest Management activities 130
Table 22 - Summary of impacts to Species Enhancement activities 133
Table 23 - Summary of impacts to Channel Restoration activities 135
Table 24 - Summary of impacts to Bank Restoration and Erosion Reduction activities 137
Table 25 - Summary of impacts to Coral Reef Restoration activities 140
Table 26 - Summary of impacts to Shellfish Reef Restoration activities 143
Table 27 - Summary of impacts to Artificial Reef Restoration activities 144
Table 28 - Summary of impacts to Road Upgrading and Decommissioning activities 145
Table 29 - Summary of impacts to Trail Restoration activities 146
Table 30 - Summary of impacts to Signage and Access Management activities 148
Table 31 - Summary of impacts to Submerged Aquatic Vegetation activities 151
Table 32- Summary of impacts to Marine Algae activities 152
Table 33 - Summary of impacts to Water Conservation and Stream Diversion activities 155

Table 34 - Summary of impacts to Levee and Culvert Removal, Modification and Set-back activities 158
Table 35 - Summary of impacts to Wetland Restoration and Shoreline Stabilization Techniques activities 160
Table 36 - Summary of impacts to Wetland Planting activities 161
Table 37 - Summary of impacts to Land and Water Acquisition and Other Transactions activities 162
Table 38 - Potential impacts to Cultural and Historic Resources 169
Table 39 - RC PEIS scoping comments summary B-9

Figures

Figure 1- NOAA Restoration Center Restoration Actions (1992 - 2013) 3
Figure 2 - NOAA RC Habitat Acres Restored (2003-2012) 4
Figure 3 - NOAA RC Stream Miles Opened (2003-2012). 4
Figure 4 - NOAA RC Project Map – Coastal United States 6
Figure 5 - NOAA RC Project Map; HI, AK, PR, VI 7
Figure 6 – NOAA RC Organizational Diagram. 9
Figure 7 - NOAA Restoration Center Funding History for NOAA RC Programs 17
Figure 8 - Debris Removal projects implemented by the NOAA RC. 25
Figure 9 – Dam and Culvert Removal, Modification, or Replacement projects. 29
Figure 10 - Technical and Nature-like Fishways projects 31
Figure 11 - Fish, Wildlife, and Vegetation Management projects. 35
Figure 12 - Freshwater Stream Restoration projects. 38
Figure 13 - Coral Reef Restoration projects 41
Figure 14 - Road Upgrading and Decommissioning; Trail Restoration projects. 46
Figure 15 - Signage and Access Management projects. 48
Figure 16 - Water Conservation and Stream Diversion projects. 53
Figure 17 - Levee and Culvert Removal, Modification and Set-back projects. 56
Figure 18 - Fringing Marsh and Shoreline Stabilization/Sediment Removal and Sediment/Materials Placement projects 60
Figure 19 - Wetland Planting projects. 61
Figure 20 - Land and Water Acquisition and Other Transactions projects. 63
Figure 21 - NOAA Restoration Center Technical Assistance Projects. 64
Figure 22 - Technical Assistance vs. On-the-Ground Restoration Projects 163
Figure 23 - Relative Regional Distribution of Projects 170
Figure 24 - Acres Restored in the Northeast and Great Lakes Regions 173
Figure 25 - Acres Restored in the Southeast, Gulf of Mexico and Caribbean 174
Figure 26 - Acres Restored in the West Coast / Pacific Regions 175
Figure 27 - Stream Miles Opened in the Northeast and Great Lakes Regions 176
Figure 28 - Stream Miles Opened in the Southeast, Gulf of Mexico and Caribbean 177
Figure 29 - Stream Miles Opened in the West Coast / Pacific Regions 178

Acronyms

AKR	Alaska Region
BMP	Best Management Practice
BO	Biological Opinion
CE	Categorical Exclusion
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMP	Coastal Management Program
CRP	Community-based Restoration Program
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CWPPRA	Coastal Wetland Planning, Protection, and Restoration Act
DARRP	Damage Assessment, Remediation and Restoration Program
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERA	Estuary Restoration Act
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FPO	Federal Preservation Officer
FR	Federal Register
FY	Fiscal Year
GLR	Great Lakes Region
HACCP	Hazard Analysis and Critical Control Point
HUC	Hydrologic Unit Code
MDP	Marine Debris Program
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSX	multinucleated sphere unknown (disease)
NANPCA	Aquatic Nuisance Prevention and Control Act
NAO	NOAA Administrative Order
NCTC	National Conservation Training Center
NEPA	National Environmental Policy Act
NER	Northeast Region
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRDA	Natural Resources Damage Assessment
NRHP	National Register of Historic Places
NWR	Northwest Region
OPR	Office of Protected Resources
OPA	Oil Pollution Act
ORI	Open Rivers Initiative
PEA	Programmatic Environmental Assessment
PEIS	Programmatic Environmental Impact Statement
PVC	Polyvinyl chloride
RC	NOAA's Restoration Center
RPM	Responsible Program Manager
SAV	Submerged Aquatic Vegetation
SER	Southeast Region
SFA	Sustainable Fisheries Act
SHPO	State Historic Preservation Officer
SLR	Sea Level Rise
SPEA	Supplemental Programmatic Environmental Assessment
SWR	Southwest Region
THPO	Tribal Historic Preservation Officer
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

NOAA proposes to fund or otherwise implement coastal habitat restoration activities through its existing programmatic framework and related procedures. Multiple NOAA programs carry out habitat restoration projects throughout the coastal United States, which includes the Great Lakes and territories. Many of these programs are housed within the National Marine Fisheries Service (NMFS) Office of Habitat Conservation's Restoration Center (NOAA RC). Projects implemented by NOAA vary in terms of their size, complexity, geographic location, and NOAA involvement, and they often benefit a wide range of habitat types and affect a number of different species. Fish passage, hydrologic/tidal reconnection, shellfish restoration, coral recovery, salt marsh and barrier island restoration, erosion prevention, debris removal, and invasive species removal are among the project types implemented by NOAA through its various programs.

Coastal habitats are continually stressed by human-caused threats such as coastal development, dredging, dams, and coastal engineering and modification (Dahl 2011), and these threats can be exacerbated by natural forces such as storms, climate, and currents/tides. Approximately half of the original wetland acreage in the coastal United States was lost or functionally degraded between the 1780s and 1980s (Dahl 1990). Between 2004 and 2009 coastal wetland habitat continued to decline by more than 80,000 acres per year. This decline is particularly important to NOAA, as the nation's commercial and recreational marine and migratory fishes depend on estuarine, coastal, and riverine habitats for all or part of their life cycles. Because of these threats, there is an urgent need for NOAA to implement habitat restoration and conservation projects that recover threatened and endangered species, rebuild and maintain managed fisheries stocks, restore natural resources injured by releases of oil and hazardous substances, and ensure that valuable natural resources are available to future generations of Americans.

This document analyzes a suite of restoration approaches that NOAA believes will most effectively conserve and restore the coastal and marine resources under NOAA trusteeship. It updates the analysis presented in the Programmatic Environmental Assessment (PEA) and Supplement (SPEA) published in 2002 and 2006, respectively. This PEIS promotes an efficient NEPA compliance process for future NOAA-supported restoration activities, through various programs, by removing the need to consult what are now multiple, out-of-date documents. The analyses in the PEA and SPEA, where relevant, along with NOAA's analyses of individual project impacts, have informed the updated analyses in this PEIS.

This document provides a programmatic-level environmental analysis to support NOAA's proposal to continue habitat restoration activities involving trust resources throughout the coastal United States. The PEIS takes a broad look at issues and programmatic-level alternatives (compared to a document for a specific project or action) and provides guidance for future restoration activities to be carried out by NOAA. In addition to providing a programmatic analysis, NOAA intends to use this document to approve future site-specific actions, including grant actions, so long as the activity being proposed is within the range of alternatives and scope of potential environmental consequences, and does not have significant adverse impacts (see Section 4.5 and Appendix A). Any future site-specific restoration activities proposed by NOAA that are not within the scope of alternatives or environmental consequences considered in this PEIS will require additional analysis under NEPA.

This PEIS contains four chapters.

Chapter 1 – Introduction and Purpose and Need describes the purpose and need for the analysis, as well as background information on NOAA's RC and its programs.

Chapter 2– Alternatives describes the two alternatives considered in this PEIS. The first—Current Management, or "no action" alternative—is a comprehensive restoration approach including activities such as technical assistance, on-the-ground riverine and coastal habitat restoration, and land and water acquisition. A second alternative, Technical Assistance Only, and those alternatives considered but rejected from further analysis, are also described.

Chapter 3– Affected Environment generally describes the physical, biological, and social environments of the United States, with emphasis on coastal, estuarine, and marine habitats. The affected environment associated with the proposed action is substantial, including all coastal, estuarine, and marine habitats in the United States and territories. It also includes inland habitats that influence or affect rivers, streams, and creeks affecting marine or estuarine waters, or that support migratory fish populations.

Chapter 4– Environmental Consequences describes the direct, indirect, and cumulative environmental impacts of the restoration activities that NOAA conducts and supports. NOAA is also required by other statutes to ensure that these actions are analyzed for their impact to the natural and human environment, including, but not limited to, endangered species and their critical habitats and managed fisheries and their Essential Fish Habitat (EFH).

Appendices to the document describe decision-making within the various RC programs, public comments received throughout PEIS development, mitigating measures, and other supplementary information related to individual restoration techniques or policies.

Issues Important to the Public

NOAA received 10 comments during the public scoping period, which began March 5, 2012. The comments ranged from information requests, to questions on the scope and breadth of the document, to comments on suggested areas of focus for the analysis. Public comment received during the scoping period for this PEIS supports the concept that NOAA is an important source of funding for national, regional, and local restoration partners who conduct habitat restoration. Comments were received from non-profit organizations, government agencies (federal and state), and universities. Summarized comments are presented in Appendix B, and have been incorporated into the discussion of analysis where appropriate throughout this document.

Alternatives

The National Environmental Policy Act requires that any federal agency proposing a major action (that is not categorically excluded) consider reasonable alternatives to the proposed action. To warrant detailed evaluation by NOAA, an alternative must be reasonable and meet the purpose and need (see Section 1.1). Screening criteria are used to determine whether an alternative is reasonable (see Section 2.0). After applying the screening criteria to an identified range of considered alternatives, only two of the following alternatives were brought forward for detailed review in the PEIS, as shown in Table ES-1.

Table ES-1 – Criteria for evaluating potential alternatives. Only projects that met all criteria were analyzed in the PEIS.

Alternative	**Criterion 1 -** NOAA has decision-making authority	**Criterion 2 -** Maximizes public benefit	**Criterion 3 -** Is funding-neutral
Alternative 1 – "Current Management"	•	•	•
Alternative 2 – "Technical Assistance"	•	•	•
Alternative 3 – Disbanded/Expanded Program			
Alternative 4 – Limited Geography Focus		•	•
Alternative 5 – Limited Project Type Focus		•	•

"Current Management" (No-Action) – a comprehensive restoration approach that includes activities such as technical assistance; on-the-ground riverine and coastal habitat restoration activities (which includes, but is not limited to, fish passage projects; channel, bank, and floodplain restoration; buffer area and watershed revegetation; saltmarsh restoration; oyster restoration; marine debris removal; submerged aquatic vegetation; invasive species removal; and coral restoration); and land and water acquisition activities. Because this is a programmatic analysis of the NOAA RC's on-going restoration programs (where program activities are being analyzed as opposed to a single specific project action) with no change in management direction, the No Action Alternative is interpreted herein as "no change from current management" (CEQ 1981).

"Technical Assistance" – an alternative restoration approach that includes no on-the-ground restoration, and is limited to technical assistance activities (including project planning, modeling, feasibility studies, engineering and design studies, and permitting activities).

This PEIS presents NOAA's restoration activities and their environmental consequences grouped into three categories of restoration activities: technical assistance, on-the-ground riverine and coastal habitat restoration activities, and land and water acquisition activities. All three of these restoration categories would be undertaken in Alternative 1. Technical assistance activities typically are minimally intrusive, are relatively low-cost, and do not require extensive on-the-ground activities to be implemented. On-the-ground restoration activities include all of the physical riverine and coastal restoration supported by the NOAA RC. Land and water acquisition activities involve transactions of usage rights and access (as opposed to physical on-the-ground work) and have meaningful social or environmental impacts. This alternative is anticipated to have typically long-term beneficial and short-term adverse impacts on the affected environment of various magnitudes and intensities. Section 4.5 – Environmental Consequences of Preferred

Alternative below, and Table 11 – Summary of environmental consequences of the Proposed Action describe these impacts in more detail.

Technical assistance activities are the sole activities included in Alternative 2. This alternative would rely heavily if not exclusively on external sources of funding to conduct on-the-ground implementation and NOAA resources would be directed away from such activities and focused on advisory or technical assistance aspects of the restoration work. The technical assistance activities generally would cause mostly indirect, long-term beneficial impacts, with short-term adverse impacts for more intrusive monitoring and sampling techniques. Again, Section 4.5 – Environmental Consequences of Preferred Alternative below, and Table 11 – Summary of environmental consequences of the Proposed Action describe these impacts in more detail.

1.0 Introduction and Purpose and Need

Coastal habitats are continually stressed by human-caused threats such as coastal development, dredging, dams, coastal engineering and modification (Dahl 2011), and these threats can be exacerbated by natural forces such as storms, climate, and currents/tides. Approximately half of the original wetland acreage in the coastal United States was lost or functionally degraded between the 1780s and 1980s (Dahl 1990). Between 2004 and 2009 coastal wetland habitat continued to decline by more than 80,000 acres per year, a 25 percent higher rate of decrease over the previous 6-year period and a rate 6 times greater than the loss for the entire country over the same period (Dahl 2011). This decline is particularly important to NOAA, as the nation's commercial and recreational marine and migratory fishes depend on estuarine, coastal, and riverine habitats for all or part of their life cycles.

NOAA develops and implements technically sound restoration projects and provides necessary technical expertise and financial assistance throughout the coastal United States (the term "coastal United States" hereafter includes the Great Lakes and territories[1]). Several NOAA programs carry out such projects. These include programs designed to respond to specific environmental injuries and those intended to carry out proactive habitat restoration. NOAA also provides restoration scientific and technical guidance to partners, including data collection and evaluation, assistance with environmental compliance, and project performance monitoring activities.

The NOAA RC began as NOAA's Damage Assessment, Remediation and Restoration Program (DARRP), created after the Exxon Valdez oil spill in 1989. The NOAA RC was formally founded in 1991, and for the first 5 years focused on implementing the DARRP program to restore natural resources injured by releases of hazardous substances and oil, address resource use injuries, and recover lost natural resources and ecological services. The DARRP restores natural resources at hazardous waste sites and after oil spills and other contaminant releases or physical impacts, such as ship groundings on coral reefs. Projects are funded with legal settlements recovered from responsible parties.

NOAA has also been active in the Coastal Wetland Planning, Protection, and Restoration Act (CWPPRA) since its passage in 1990. Through CWPPRA, NOAA works to preserve fish, wildlife, and their habitats in Louisiana by developing and using the latest techniques in restoration to slow the high rate of wetlands loss (estimated at more than 16 mi^2 per year). The program fosters partnerships with federal and state agencies, as well as landowners and industry, and funding is shared between state and federal sources.

In 1996, NOAA created the Community-based Restoration Program (CRP) to encourage local efforts to restore fisheries habitat. The CRP provides financial and technical assistance for habitat restoration projects that benefit natural resources under the jurisdiction of the National Marine Fisheries Service (NMFS), in coastal or marine environments and riverine environments used by

[1] This may include international areas outside the coastal United States and territories if a NOAA trust resource is present in such areas. For the NOAA RC, international projects have been implemented very infrequently.

diadromous species throughout the United States and its territories. In addition to performing on-the-ground restoration, many of these projects have an outreach or education component to promote and enhance natural resource stewardship. NOAA recognizes the significant role communities play in environmental restoration projects and acknowledges the importance of engaging in projects with wide community support—successful projects depend on the involvement of citizens. The CRP was authorized in the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006.

Other efforts have grown out of the CRP as well: the Estuary Habitat Restoration Program (2001), the Open Rivers Initiative (2005), the Community-based Marine Debris Removal Grants program (2006), the Great Lakes Habitat Restoration Program (2008)/Great Lakes Restoration Initiative (2010), and the Coastal and Marine Habitat Restoration Program (under the American Recovery and Reinvestment Act of 2009). Through these various efforts, NOAA has led restoration projects across a wide range of habitat types, restoration techniques, sizes, and levels of complexity.

To date, the NOAA RC has provided funding and technical guidance to more than 3,000 restoration projects, and managed more than $365 million for restoration efforts. Funding for the above programs comes from various sources, including federal appropriations to NOAA and/or partner agencies and funds resulting from individual legal cases settled under the Oil Pollution Act (OPA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and other federal laws (e.g., Clean Water Act). See Figure 1 for the number of projects funded per year, and Figure 2 and Figure 3 for acres and stream miles restored by the NOAA RC. The NOAA RC website contains additional information about current programs (www.restoration.noaa.gov).

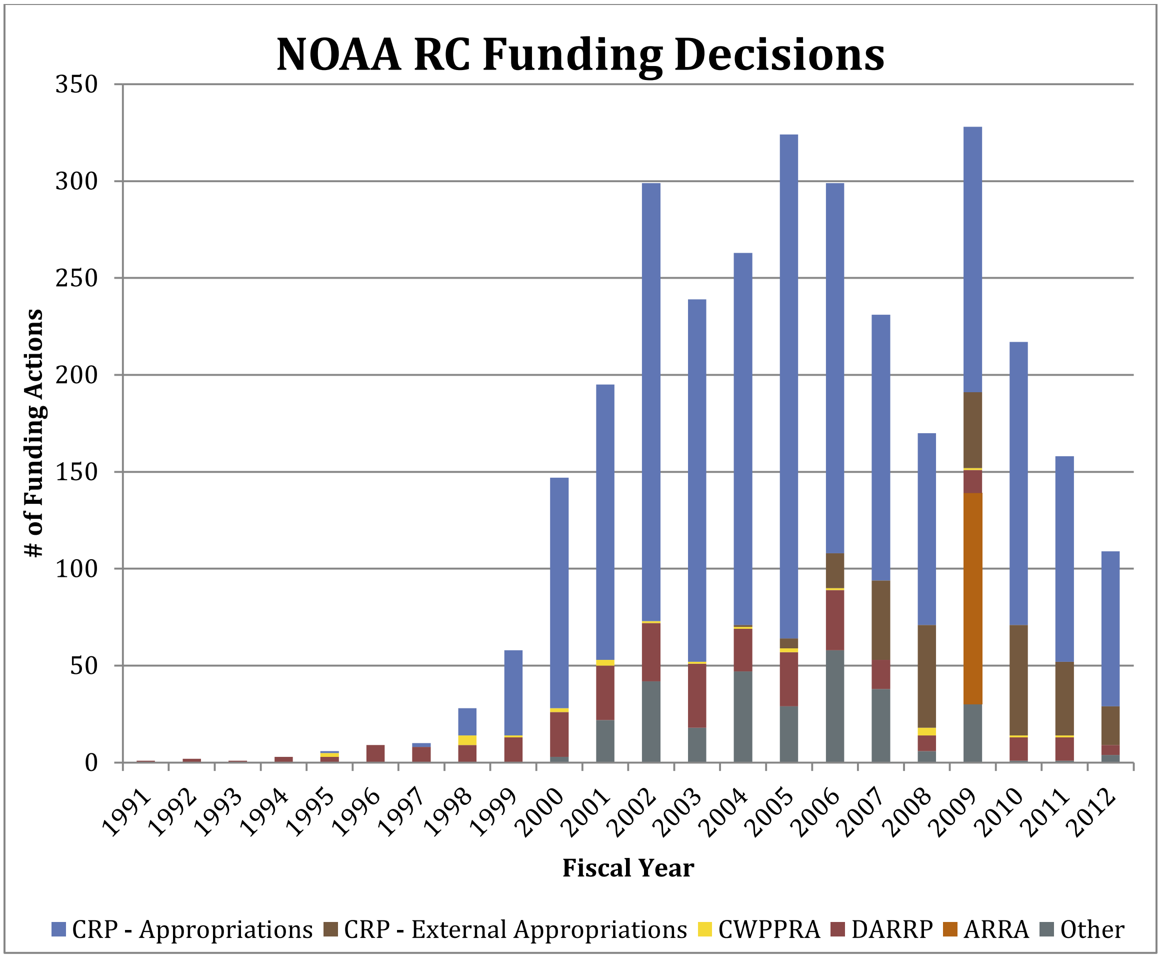

Figure 1- NOAA Restoration Center Restoration Actions (1992–2013). External Appropriations include ERA, GLRI, MDP, ORI. Other includes Atlantic Salmon, Directed Appropriations, and NCBO funds. Data retrieved from NOAA Restoration and Conservation Database.

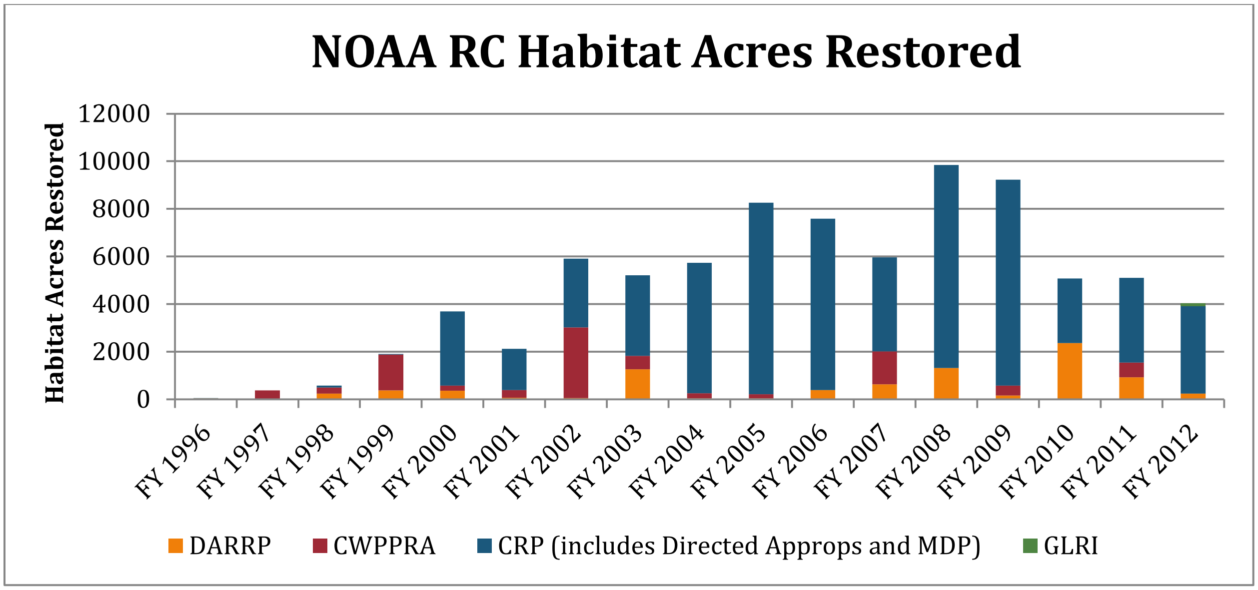

Figure 2 - NOAA RC Habitat Acres Restored (2003–2012 is the period for which the NOAA RC has the most accurate restoration performance data).

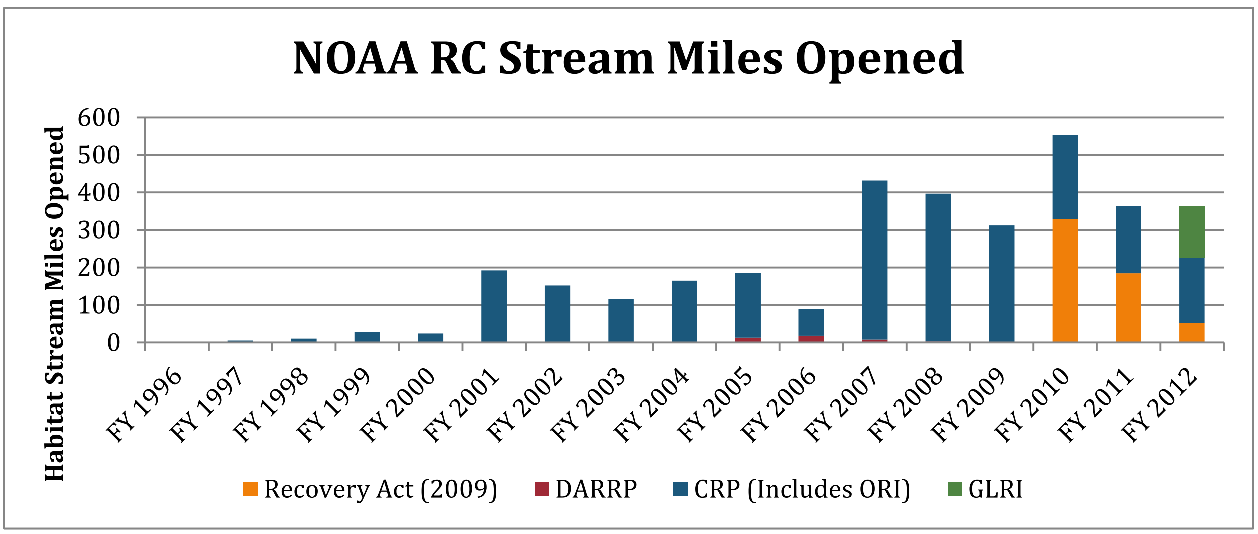

Figure 3 - NOAA RC Stream Miles Opened (2003–2012 is the period for which the NOAA RC has the most accurate restoration performance data).

1.1.1 Overview of Restoration Activities

Typical restoration and conservation activities currently supported by NOAA include, but are not limited to, the activities listed below. Implementation of a restoration project may also include planning or monitoring phases, such as feasibility studies, engineering and design, and evaluation.

- Coral Reef Restoration: reducing or eliminating land-based sources of pollution, reef recovery from disturbance/impacts, promoting recruitment and recovery through enhancement and protection of existing populations and natural systems, or controlling overgrowth of invasive species to enhance recruitment.

- Debris Removal: removing debris (solid, man-made items) from the coastal and marine environment, including removal of derelict fishing gear, and other persistent debris from coastal habitats.
- Beach and Dune Restoration: providing clean sediment for beaches that have been degraded from man-made injuries (oil or hazardous waste spills) or washed away due to natural processes or acute natural events.
- Signage and Access Management: installing signs, fences, or other barriers to prevent or discourage access to recovering habitat.
- Fish Passage: installing fish ladders, bypass channels, nature-like fishways, dam removals, eel passes, and fish-friendly tide gates, and culvert removal and modification or replacement.
- Fish, Wildlife, and Vegetation Management: control/removal of localized populations, re-establishing native species, monitoring for newly established species.
- Levee and Culvert Removal, Modification, and Set-Back: berm breaching; culvert removal/replacement to allow tidal or natural flooding of wetlands; removal of fill, levees, and dikes or other impediments to historic/natural tidal flow or hydrology.
- Shellfish Reef Restoration: creating, restoring, or rehabilitating shellfish populations and shellfish habitats.
- Subtidal Planting: planting submerged aquatic vegetation (SAV) or marine algae.
- Wetland Restoration: adding or removing substrate to achieve the proper elevation for wetland plant growth, or protecting or restoring transition zones such as tidal shorelines through shoreline stabilization methods.
- Freshwater Stream Restoration: placing habitat structures such as woody debris; reconnecting floodplains to stream channels; stabilizing, protecting, or restoring stream banks; or creating/restoring off-channel habitats.
- Land and Water Acquisition and Other Transactions: conserving land through acquisition (fee-simple purchase, permanent easements, and temporary easements) and/or water transactions (water rights acquisition or transfers, water easements, temporary forbearance agreements).

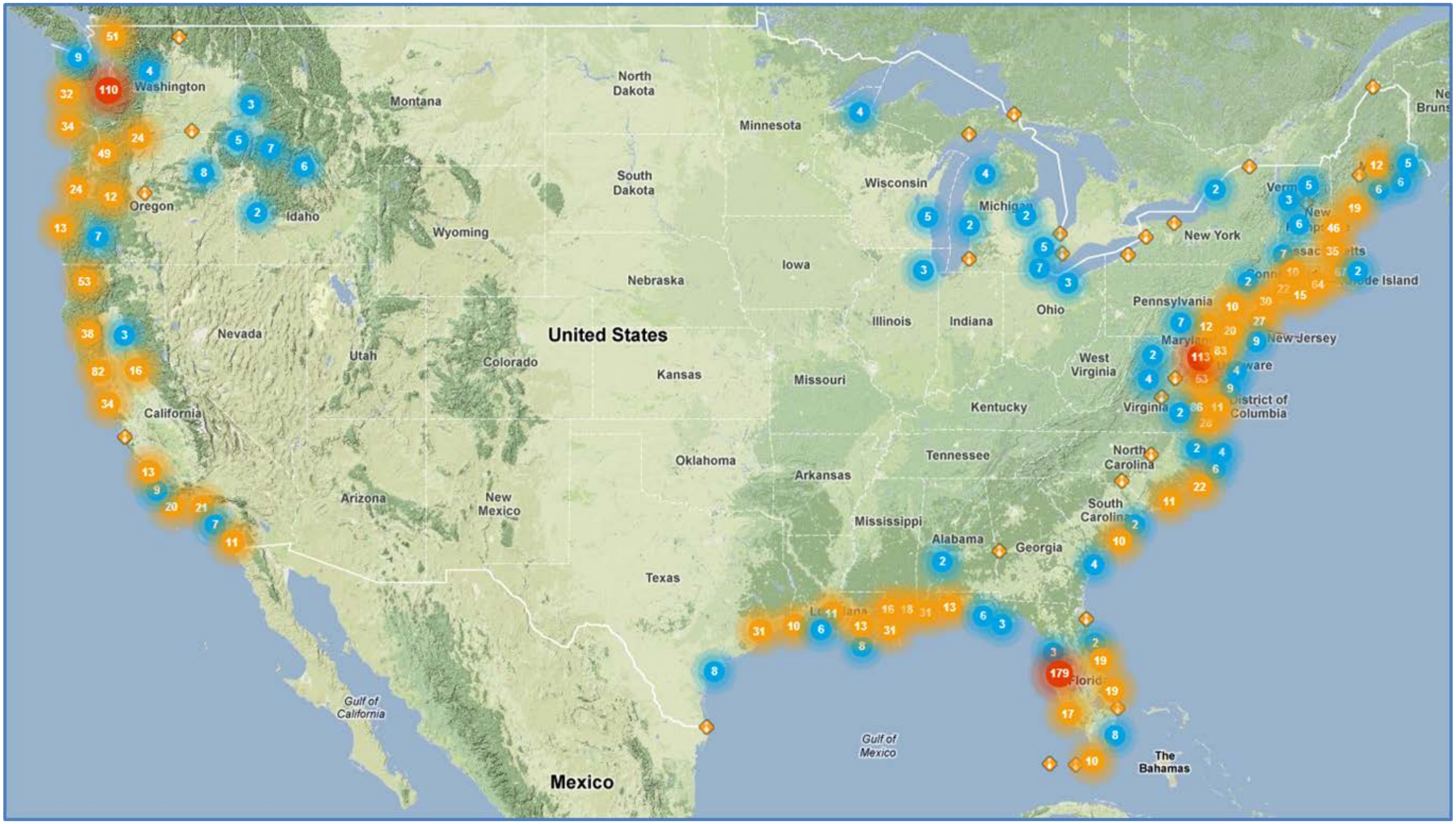

Figure 4 - NOAA RC Project Map – Coastal United States

***NOAA RC Project Map** - Coastal United States*

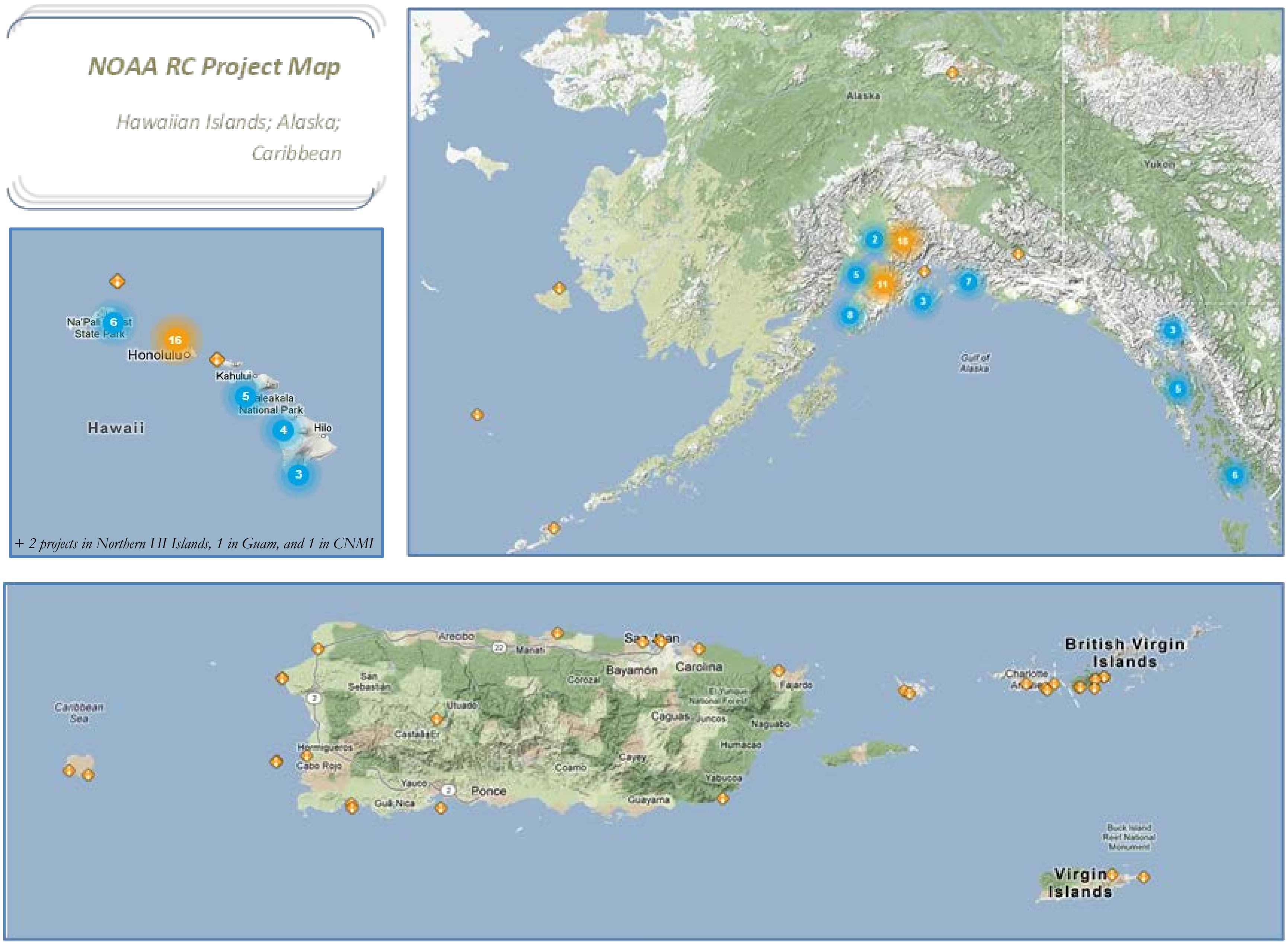

Figure 5 - NOAA RC Project Map; HI, AK, PR, VI

1.1 Purpose and Need

Proposed Action: NOAA proposes to fund or otherwise implement habitat restoration activities through its existing programmatic framework and related procedures. The NOAA RC programs, which are authorized to conserve and manage coastal and marine resources, will support, fund or otherwise implement habitat restoration activities throughout the coastal United States through the year 2025.

NOAA identifies in this document a suite of appropriate restoration approaches that NOAA believes will most effectively conserve and restore the coastal and marine resources, and the ecosystem services they provide, under NOAA trusteeship. This PEIS evaluates the potential impacts to the human and natural environment of implementing these approaches and sets the stage so that future decisions by NOAA at the project-specific level can be documented as included under, or effectively tiered from, this programmatic analysis.

Purpose: The purpose of the proposed action is summarized in one of the four pillars of NOAA's mission[2]: to conserve and manage coastal and marine ecosystems and resources. NOAA carries out this mission by addressing the historical trend of habitat loss and the specific, acute injuries to NOAA trust resources that result from damage or degradation, oil or hazardous waste spills, or other chronic threats to the function and sustainability of the nation's coastal and marine resources. A number of management objectives relevant to the NOAA RC in particular are tied to NOAA's mission and authorities, outlined in Table 1.

Need: Because of the widespread acute and chronic threats to coastal and marine habitat, there is an urgent need for NOAA to evaluate and implement habitat restoration and conservation projects that will recover threatened and endangered species, rebuild and maintain managed fisheries stocks, restore natural resources injured by releases of oil and hazardous substances, and ensure that valuable natural resources are available to future generations of Americans.

Table 1 – NOAA RC's management objectives and their legislative origins.

Objectives	MSA	ESA	OPA	CERCLA	CWPPRA	FWCA
Restore fishery and coastal habitats	•		•	•	•	
Restore natural resources injured by releases of oil and hazardous substances			•	•		
Identify and construct projects to prevent loss of coastal Louisiana wetland					•	
Rebuild fishery stocks	•					
Recover threatened and endangered species		•				
Ensure natural resources are protected for future generations of Americans		•		•		
Build public-private partnerships	•					•
Implement community-supported projects that promote stewardship of NOAA trust resources	•					

[2] The other three pillars are: science, service, and stewardship; to understand and predict changes in climate, weather, oceans, and coasts; and to share that knowledge and information with others.

1.2 Scope and Structure of This PEIS

As the lead federal agency and in accordance with the regulations of the Council on Environmental Quality (CEQ), the National Oceanic and Atmospheric Administration (NOAA) Restoration Center (RC) prepared this Programmatic Environmental Impact Statement (PEIS) in compliance with the National Environmental Policy Act (NEPA; 42 U.S.C. § 4321 et seq.).

The scope of this PEIS consists of the range of restoration and conservation activities supported, funded or otherwise implemented by the NOAA RC for conservation of recreationally and commercially important species, threatened and endangered species, and their habitats. As the only office within NOAA solely devoted to restoring the nation's coastal, marine, and migratory fish habitat, this document focuses primarily on those activities conducted and supported by the NOAA RC, however, other offices within NOAA may use this PEIS where appropriate.

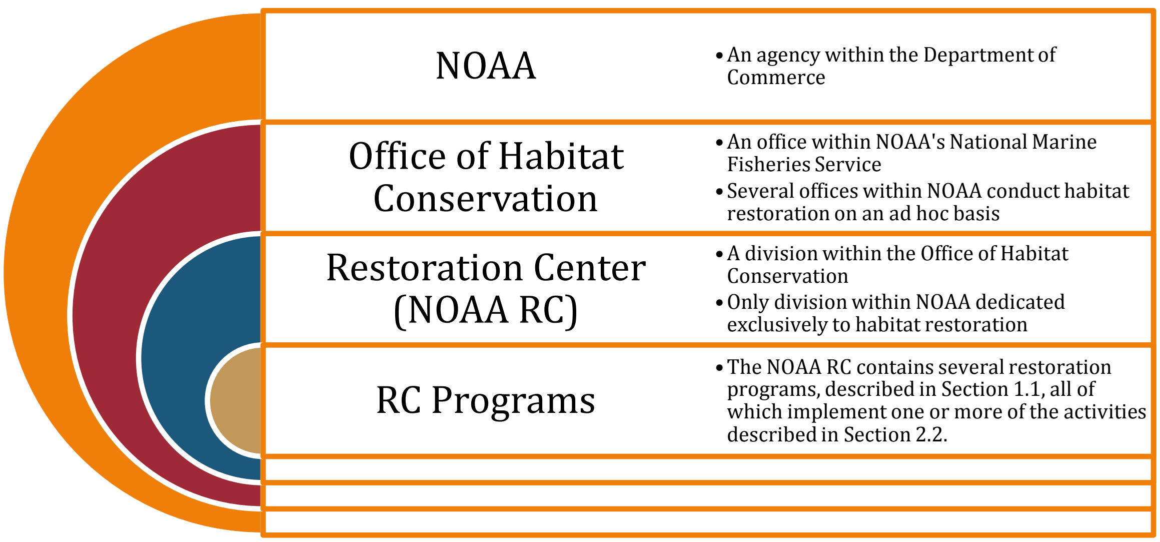

Figure 6 – NOAA RC Organizational Diagram. The restoration activities in the analysis are conducted primarily by the NOAA RC, but may also be implemented by other programs within NOAA.

NEPA requires documented, formal consideration of the environmental impacts of major federal actions, as well as analyses of the potential impacts associated with alternatives to the action, before a federal agency implements policies, programs, plans, and projects. Because the allocation of federal funds for NOAA-sponsored activities described in Section 2.0 is a major federal action, NOAA must comply with requirements set forth under several statutory and regulatory authorities related to NEPA. The National Environmental Policy Act of 1969 itself, in accordance with the regulations of the CEQ for implementation of NEPA (40 CFR 1500 through 1508 (CEQ 1992)), provides the overarching framework for the NEPA compliance process for federal actions. The CEQ is responsible for the development and oversight of regulations and procedures implementing NEPA. NOAA has prepared environmental review procedures for implementing NEPA in NOAA Administrative Order 216-6 (NAO 216-6). Section 5.04 of NAO 216-6 (NOAA 1999) lays out the general requirements for drafting an Environmental Impact Statement and more specifically describes NOAA's policies, requirements, and procedures for complying with NEPA and the CEQ implementing regulations.

The vast majority of NEPA documents typically focus on site-specific projects and impacts. However, by conducting a comprehensive review of restoration activities conducted by NOAA (as is done in this PEIS), we can more widely assess potential impacts stemming from overall policies, programs, and plans. This can also improve efficiency in fulfilling NEPA compliance. These "programmatic documents"—as defined by CEQ (National Environmental Policy Task Force 2003)—are inherently broader in scope due to a wider geographic area of potential effect, and therefore the potential to affect a larger portion of the U.S. population (Plater et al. 1992).

Programmatic NEPA analyses and tiering can reduce or eliminate redundant and duplicative analyses and effectively address cumulative effects. Tiering refers to the practice of analyzing only certain general issues of a federal action in a broad NEPA document (e.g. a programmatic document such as this one), and incorporating that general analysis by reference in any subsequent project or site-specific statements or environmental impacts analyses. This allows for the NEPA practitioner to focus on the critical issues specific to the subsequent action (CEQ Regulations 1508.28).

This PEIS provides a programmatic-level environmental analysis to support NOAA's proposal to continue habitat restoration activities involving trust resources throughout the coastal United States. The PEIS takes a broad look at issues and programmatic-level alternatives (compared to a document for a specific project or action) and provides guidance for future restoration activities to be carried out by NOAA. In addition to providing a programmatic analysis, NOAA intends to use this document to approve future site-specific actions, including grant actions, so long as the activity being proposed does not have significant adverse impacts (see Section 4.5 and 4.12Appendix A).

NOAA makes determinations regarding the level of NEPA analysis in accordance with processes described in NAO 216-6, NMFS policy, and the Office of Habitat Conservation Quality Assurance Plan (QAP). Appendix A contains the description of this process. When a project is excluded from the analysis in this document, the usual reasons for exceeding the level of impacts analyzed include causing public health and safety risks, dramatically altering physical characteristics of a site, carrying unknown risks leading to scientific controversy, introducing invasive species, or impacting particularly sensitive cultural resources. See Section 4.4 for a summary of which project activities are most likely to be excluded from this analysis.

1.2.1 Relationship between This Document and Prior NEPA Analyses

NOAA has historically conducted NEPA analyses at a variety of scales across its various programs. Ensuring compliance with NEPA processes and regulations is an important part of the NOAA RC's work. Due to the growing size and complexity of NOAA-implemented projects and the growing interrelatedness of the human and natural environment, that compliance is increasingly important. In 2002 the NOAA RC completed a programmatic environmental assessment (PEA) and associated Finding of No Significant Impact (FONSI) for the CRP's restoration activities as a whole, in accordance with NEPA and in consultation with other federal agencies. The PEA addressed NEPA compliance at the national program level, rather than at the specific project level. Because the types, scopes, and overall number of restoration projects supported by the NOAA RC have evolved to include larger and more numerous projects, in 2006 the NOAA RC developed a supplemental programmatic environmental assessment (SPEA) to update the PEA of 2002 and ensure continued compliance with NEPA and other applicable laws and regulations, as well as to further facilitate environmental impact review and the NEPA documentation process. As NOAA's restoration activities continue to change, the PEA and SPEA documents are being replaced by this analysis of NOAA's restoration programs, activities, and impacts. This PEIS will further promote an efficient NEPA compliance process for future NOAA-supported restoration activities, through various programs, by removing the need to consult what are now multiple, out-of-date documents. The analyses in the PEA and SPEA, where relevant, along with NOAA's analyses of individual project impacts, have informed the updated analyses in this PEIS. All previous NEPA documents are kept on file as part of the NOAA RC Program Record.

1.3 Public Involvement

The NOAA RC filed a Notice of Intent (NOI) on March 2, 2012, that was published in the *Federal Register* on March 5, 2012 (77 FR 13095). The notice provided the public all information relevant to the public scoping process as required by NEPA—background information on NOAA's restoration programs, a summary of the Proposed Action, relevant dates related to the public scoping period and draft timeline, and addresses for contacting NOAA via mail, phone, and email.

The NOAA RC was also proactive in further notifying and soliciting feedback from the public by providing e-newsletter announcements and social media posts on two separate instances during the public scoping period. The NOAA RC received 10 comments during the public scoping period. The comments ranged from information requests, to questions on the scope and breadth of the document, to comments on suggested areas of focus for the analysis. Comments were received from non-profit organizations, government agencies (federal and state), and universities. Summarized comments received can be found in Appendix B, and have been incorporated into the discussion of analysis where appropriate throughout this document.

All NOAA RC projects involve ample opportunity throughout the planning, permitting, and construction phases for public input on the project. See Appendix A for more information on this process.

2.0 Alternatives

2.0 Alternatives ... 12

2.1 Alternatives Considered but Rejected ... 15

2.2 Alternative 1 – "Current Management" (Preferred Alternative) ... 19

2.2.1 Technical Assistance ... 19

2.2.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting ... 19

2.2.1.2 Implementation and Effectiveness Monitoring ... 19

2.2.1.3 Fish and Wildlife Monitoring ... 21

2.2.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs ... 21

2.2.2 Riverine and Coastal Habitat Restoration ... 23

2.2.2.1 Beach and Dune Restoration ... 23

2.2.2.2 Debris Removal ... 24

2.2.2.3 Fish Passage ... 26

2.2.2.3.1 Dam and Culvert Removal, Modification, or Replacement ... 26

2.2.2.3.2 Technical and Nature-like Fishways ... 29

2.2.2.4 Fish, Wildlife, and Vegetation Management ... 31

2.2.2.4.1 Invasive Species Control ... 31

2.2.2.4.2 Prescribed Burns and Forest Management ... 32

2.2.2.4.3 Species Enhancement ... 33

2.2.2.5 Freshwater Stream Restoration ... 35

2.2.2.5.1 Channel Restoration ... 35

2.2.2.5.2 Bank Restoration and Erosion Reduction ... 36

2.2.2.6 Reefs ... 38

2.2.2.6.1 Coral Reef Restoration ... 38

2.2.2.6.2 Shellfish Reef Restoration ... 41

2.2.2.6.3 Artificial Reefs ... 43

2.2.2.7 Road Upgrading and Decommissioning; Trail Restoration ... 44

2.2.2.8 Signage and Access Management ... 46

2.2.2.9 Subtidal Planting ... 48

2.2.2.9.1 Submerged Aquatic Vegetation ... 48

2.2.2.9.2 Marine Algae 50
2.2.2.10 Water Conservation and Stream Diversion 51
2.2.2.11 Wetland Restoration 53
2.2.2.11.1 Levee and Culvert Removal, Modification, and Set-Back 53
2.2.2.11.2 Fringing Marsh and Shoreline Stabilization 56
2.2.2.11.3 Sediment Removal 58
2.2.2.11.4 Sediment/Materials Placement 59
2.2.2.11.5 Wetland Planting 60
2.2.3 Land and Water Acquisition and Other Transactions 61
2.2.3.1 Land Acquisition 62
2.2.3.2 Water Transactions 62
2.3 Alternative 2 – "Technical Assistance" 64

To warrant analysis in this document, an alternative must be reasonable and meet the purpose and need described in Section 1.1.1. If an alternative was considered but deemed to be 1) not realistic or reasonable or 2) not in line with the purpose and need, it was not evaluated in detail in this document. Section 2.1 describes alternatives that were considered but rejected. Sections 2.2 and 2.3 provide a detailed description of the alternatives considered in this PEIS and how those alternatives were developed.

Three criteria were developed to determine whether an alternative was realistic or reasonable and was therefore analyzed in the document:

1. "Decision-making Authority." Are NOAA leadership and program managers allowed to exercise decision-making authority on how funds and resources are allocated? NOAA's leadership and program managers must operate within their statutory authority. If an alternative represented a situation that included a decision that NOAA has no authority to make, it was excluded from further analysis.
2. "Maximize the Public Benefit." Does the alternative ensure that the proposed action maximizes the public benefit? As a national agency, NOAA must allocate funding and other resources to ensure the maximum amount of NOAA trust resources benefit from the proposed action. If an alternative represented a situation that excluded geographic regions over whose resources NOAA has regulatory or other stewardship duties, or targeted specific individual resources to the exclusion of other resources, it was excluded from further analysis.
3. "Funding-Neutral." Can the proposed action be implemented irrespective of the amount of funding the given program has at its disposal? If an alternative was based on the level of effort that would occur at a specific level of funding, it was excluded from further analysis. Future funding levels within federal programs are unknown, as they are determined each

year through legislative appropriations, DARRP settlements, and external program contributions. Although NOAA could have selected an unlimited number of funding-based alternatives, none of these would have had a higher likelihood of occurrence, making the analysis time-consuming and of little value for understanding potential impacts. Figure 7 below demonstrates that program funding has both increased and decreased since 2009.

An alternative was not evaluated in detail in this document if it did not meet all of the above established criteria. Table 2 below shows how each alternative did or did not meet each criterion; alternatives were fully analyzed if they met all three.

Table 2 – Criteria for evaluating potential alternatives

Alternative	**Criterion 1 -** NOAA has decision-making authority	**Criterion 2 -** Maximizes public benefit	**Criterion 3 -** Is funding-neutral
Alternative 1 – "Current Management"	•	•	•
Alternative 2 – "Technical Assistance"	•	•	•
Alternative 3 – Disbanded/Expanded Program			
Alternative 4 – Limited Geography Focus		•	•
Alternative 5 – Limited Project Type Focus		•	•

The full range of alternatives included the following:

Alternative 1 – "Current Management" (Preferred Alternative) is the preferred alternative of this PEIS and takes the most comprehensive approach to achieving NOAA's mission by continuing the implementation of a wide range of restoration activities. NOAA (specifically the NOAA RC) has historically supported a number of different types of restoration projects to carry out NOAA's mission. Depending on the conservation or management goals of the specific program and the amount of funding available to implement restoration activities, a project may conduct multiple activities or have a number of diverse impacts that require analysis during a NEPA review.

The NEPA regulations require that the alternatives presented in an Environmental Impact Statement include the "alternative of no action" (1502.14(d)). For programmatic analyses of ongoing programs, where program activities are being analyzed as opposed to a single specific project action, the No Action alternative can be interpreted as "no change from current management" (CEQ 1981). For the purposes of this analysis, NOAA adopts this CEQ interpretation of "no action" for the preferred alternative. This alternative includes a diverse range of ongoing program activities that are typically implemented through NOAA RC programs, and each is described in the following sections. As a result, this alternative enables NOAA to carry out its mission, due to the high level of efficiency and flexibility provided by a comprehensive restoration approach. Efficiency and flexibility are especially important to achieving the proposed action and fulfilling NOAA's mission, given the varying economic and budget conditions to which NOAA as a federal agency must adapt each year and to which restoration project managers must adjust.

The activities included under this alternative are:

- Technical assistance (described in Section 2.2.1).
- Riverine and coastal habitat restoration activities (described in Section 2.2.2).
- Land and water acquisitions and other transactions (described in Section 2.2.2.11).

Alternative 2 – "Technical Assistance" represents a scenario of minimal to no on-the-ground restoration, but has a heavy focus on an advisory role, such as planning, permitting, monitoring, research, and outreach/education activities.

The comparison of the environmental impacts of each alternative and the extent to which each achieves the purpose and need, previously described in Section 1.1, serves as the foundation of this PEIS and will ultimately inform the Responsible Program Manager (RPM) in drafting the Record of Decision (ROD).

2.1 Alternatives Considered but Rejected

Alternative 3 – "Disbanded/Expanded Program"

This potential alternative represents a theoretical scenario defined by increased or decreased (i.e., zero) levels of funding. It was rejected because it did not meet any of the three criteria.

NOAA leadership and management do not have the decision-making authority to abnegate responsibilities under a number of authorities. The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 authorizes the NOAA RC's Community-based Restoration Program to implement and support the restoration of fishery and coastal habitats by providing federal financial and technical assistance for local restoration and to promote stewardship and conservation values for NOAA trust resources. If NOAA received federally appropriated funds to implement habitat restoration, but did not do so because of disbanded restoration programs, the agency would be disregarding congressional intent. Secondly, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act (OPA) authorize the President to act on behalf of the public as trustee for natural resources regarding the release or threatened release of hazardous substances in the environment or for the discharge or threatened discharge of oil into navigable waters or adjoining shorelines, respectively. In both cases, NOAA has been delegated trustee authority with respect to natural resources for which the agency has management or protective responsibilities. As such, these Acts *require* NOAA to seek damages on behalf of the public to restore natural resources within the scope of its trusteeship that are injured by the release of hazardous materials or discharge of oil.

If NOAA were to receive appropriated or settlement funds to implement habitat restoration, but had disbanded its restoration programs and therefore did not do so, no public benefit would result; therefore, this alternative does not meet Criterion #2.[3]

This alternative does not meet Criterion #3, as it is dependent on selecting a level of funding—either $0 or some amount larger than the historic range of funding described in Section 1.0 and shown in Figure 7 below.

Alternative 4 – Limited Geography Focus and **Alternative 5 – Limited Project Type Focus**

For similar reasons, both of these alternatives were rejected from further analysis in this document. These alternatives represent scenarios where NOAA implements restoration exclusively in one or more specific, limited locations or chooses to implement a limited suite of restoration activities. Alternatives such as these, with a particular intensity in a specific geographic area or a particular restoration activity, are not reasonable because they fail to meet Criterion #1.

Although NOAA managers do have the authority to limit participation in implementing restoration activities, when they receive federally appropriated funding with broad authorities, NOAA has historically received congressional appropriations with limited intent or geography. Two such examples are the Great Lakes Habitat Program/Great Lakes Restoration Initiative with a specific geographic focus, and the Open Rivers Initiative with limited restoration activity intent. Figure 7 shows these funding sources with special direction outside NOAA's management control that emerged or disappeared during the past 4 years. For this reason, this alternative did not meet Criterion #1.

[3] NOAA RC does analyze in this document an alternative of minimal on-the-ground restoration (Alternative 2 – "Technical Assistance" Section 2.3). This alternative essentially excludes all on-the-ground restoration in favor of technical assistance, planning, permitting, monitoring, research, and outreach or education activities. That scenario approximates the physical impacts of the disbanded program alternative.

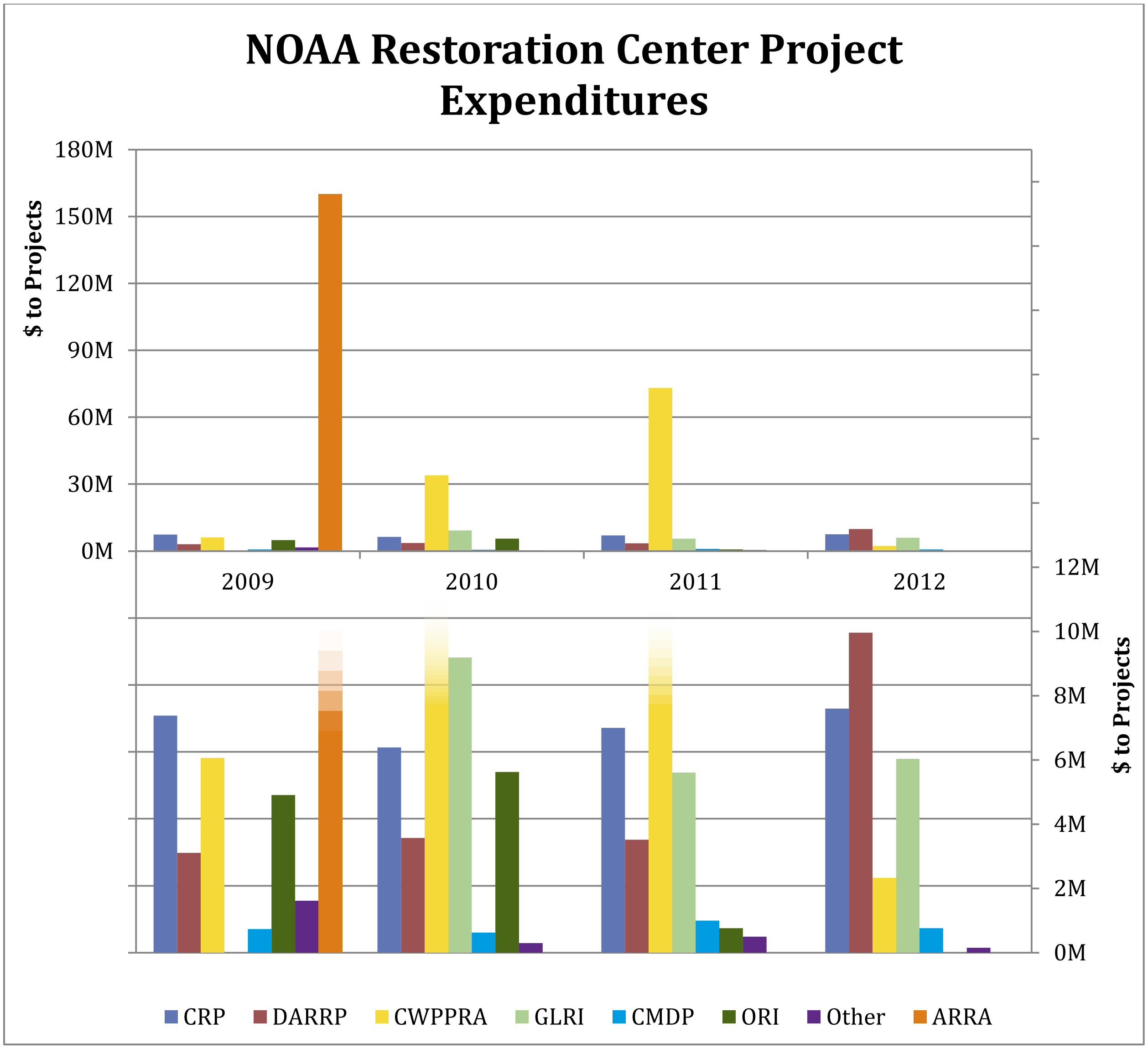

Figure 7 - NOAA Restoration Center Funding History for NOAA RC Programs (Open Rivers Initiative funding started in FY 2007 and was eliminated in FY 2011; Great Lakes Restoration Program funding started in FY 2009 and was eliminated in FY 2011).

The NOI published during the scoping process for this PEIS laid out three alternatives to be evaluated for their potential environmental impacts due to the implementation of the proposed action. Alternative 1 in the NOI called for the implementation of a comprehensive range of restoration activities (analogous to this document's Alternative 1, which is described in Section 2.2). Alternative 2 in the NOI called for the implementation of that same range of physical restoration activities, but it excluded Land and Water Acquisition activities. Alternative 3 in the NOI called for the implementation of a smaller range of activities limited to Technical Assistance (analogous to Alternative 2 in this document, as outlined in Sections 2.2.1 and 2.3). When alternatives are referenced in the public scoping comments in Appendix B, those comments are referring to the original organization of the alternatives as laid out in the NOI.

Throughout the scoping process and as a result of internal discussions, this document was modified to analyze only the two alternatives that met all three criteria for being realistic and reasonable alternatives: a comprehensive restoration approach (Alternative 1) and a scaled back technical assistance approach (Alternative 2). NOAA determined that Alternative 2 from the NOI was similar to the rejected Alternatives 4 and 5 described above. The separate analysis of Technical Assistance–only activities remained as a reasonable way to demonstrate the loss of certain impacts when only desk activities or field studies are conducted.

2.2 Alternative 1 – "Current Management" (Preferred Alternative)

The following sections describe the restoration activities that fall under the preferred alternative for the proposed action. Each section defines the activities under the restoration type, addresses the threats or injury that the activity typically restores, the conditions or functions that each activity is meant to restore, where geographically each activity is typically used, and limitations (if any) to the scope or extent of the environmental impacts covered under this analysis.

2.2.1 Technical Assistance

2.2.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting

Project planning, feasibility studies, engineering and design studies, and permitting activities are conducted before implementing restoration projects to characterize the environment, determine the best restoration approach from an engineering standpoint, and predict and compare results and conditions with the project and without it. Such activities are a mixture of research into historic conditions, modeling of hydrologic response to the project, and creating maps and scale drawings of the project site. This may also include minimally intrusive field activities such as drilling into the soil or sediment with a soil auger, vibra-core, or hand probe to remove core samples for grain size or chemical analysis; determining existing and predicted groundwater levels and elevations; and performing geotechnical evaluation. These activities may also include archaeological studies at and around the project site, which often involve digging test pits, and collecting and documenting historic features. Feasibility studies typically analyze a project's environmental impacts under multiple alternatives, while the development of engineered designs typically addresses only the chosen project alternative. All of the information described above may also be required to complete permit applications. Some data collection may also require permits, for example when collecting data related to threatened and endangered species.

2.2.1.2 Implementation and Effectiveness Monitoring

Monitoring activities evaluate implementation quality and the effectiveness of completed or in-progress habitat restoration projects, sometimes involving volunteers as citizen scientists. This monitoring is consistent with recommendations under the Estuaries and Clean Waters Act of 2000 (Estuary Restoration Act; ERA).[4] The term "adaptive management" has been used since the late 1970s to describe particular approaches to natural resource management, including ecosystem management. The CEQ first addressed the potential for using adaptive management in the NEPA process in its report, *The National Environmental Policy Act: A Study of its Effectiveness after Twenty-five Years* (1997b). In that report, the CEQ recognized that environmental protection afforded by the traditional environmental management model ("predict, mitigate, and implement") did not account for unanticipated changes in environmental conditions, inaccurate predictions, or subsequent information that might affect the original environmental protections (CEQ 1997b). The adaptive management model adds the ideas of "monitor and adapt" to the model, thus increasing

[4] One of the purposes of the ERA is to "to promote the restoration of estuary habitat by implementing a coordinated Federal approach to estuary habitat restoration activities, including the use of common monitoring standards and a common system for tracking restoration acreage."

the flexibility of impact analyses under NEPA. Adaptive management involves four iterative, continual types of actions: monitoring and gathering of information, evaluating (lessons learned), planning and setting directions, and acting. Critical to the use of adaptive management techniques is the need to establish measurable objectives (measurable desired future conditions, or targets to be achieved or maintained), indications, and monitoring protocols to determine whether the management actions undertaken have in fact achieved the desired results.

While important for the NEPA process and understanding restoration activity impacts, adaptive management and strategic monitoring are also critical to NOAA's restoration decision-making process to ensure restoration decisions are made with the best data and in the most informed way, and are implemented in NOAA's programs where feasible. Because of this importance, the NOAA RC has developed and adopted a Monitoring, Evaluation, Reporting, and Feedback Framework (Framework) for the restoration projects supported through its various programs. The Framework establishes a consistent and cost-effective approach to the monitoring and evaluation of habitat restoration projects so that the extent to which the projects have produced the intended benefits to habitat can be documented. To do this, the NOAA RC established a tiered approach to monitoring that distinguishes between implementation and effectiveness monitoring.

Tier I (implementation) monitoring is defined by the NOAA RC as systematic data collection to assess whether a directed restoration action was carried out as designed and, as appropriate, to determine whether the restoration action is providing a basic level of effectiveness. Examples of Tier I parameters may include as-built topography/bathymetry (e.g., width, depth, slope, height, elevation, etc.), other ecosystem structure components (e.g., survival of planted species, water stage, etc.), and/or presence/absence of target fish species.

Tier II (effectiveness) monitoring is defined by the NOAA RC as systematic data collection to assess the effectiveness of restoration actions and to assess progress toward the desired goals and outcomes of a given project. It typically addresses the development, enhancement, or testing of coastal habitat restoration techniques; improves the understanding of trophic relationships within coastal habitats; and improves habitat restoration monitoring and evaluation methods. Tier II monitoring and evaluation address ecological and/or technique effectiveness questions and thus advances the understanding of the efficacy of habitat restoration actions. Tier II monitoring data analyses and dissemination of results inform future priorities, project selection, and implementation activities and improve RC programs and advance restoration practice. The activities described below in Section 2.2.1.3 - Fish and Wildlife Monitoring are similar to those conducted as part of a project's Tier II monitoring plan.

The Framework described above also provides guidelines for data management and reporting and describes a process for using what is learned from monitoring to influence program priorities, project selection, implementation actions, and external communications. The goal for implementing this Framework is to improve the NOAA RC's planning, decision-making, information sharing, and overall effectiveness at achieving the NOAA RC's desired outcomes. The degree to which NOAA and its partners implement Tier I and Tier II monitoring depends largely on the amount of funding available to their programs.

2.2.1.3 Fish and Wildlife Monitoring

Fish and wildlife monitoring, often implemented during DARRP cases, involve trained individuals gathering observational data on the plant or animal species that use or occupy specific habitats. Such data can be used to develop baseline measurements of the species composition, diversity, and richness of a targeted habitat, which can then be used to identify changes in the ecosystem and track the progress of a restoration project. Fish and wildlife monitoring programs are currently in place in wetlands, marshes, rivers, and other coastal areas throughout the United States. Many of these programs have been established to gather data on fish, birds, amphibians, reptiles (including sea turtles), macroinvertebrates, and mammals in an area at a certain time, with particular emphasis on monitoring species that may be more sensitive to changes in their habitat or that may be unique to an area or specific habitat conditions. The monitoring programs typically involve collecting information on fish and wildlife population abundance and diversity using a variety of methods including, but not limited to, transect surveys, traps (or other capture activities), calls, tagging, telemetry, or electrofishing. For coral projects, such activities may occur either in nurseries or on existing reefs. These activities include, but are not limited to, tissue sample collection using syringes, shears, or pliers; marking or measuring coral colonies using plastic tags, flagging, or measuring tape, or calipers; conducting transect based surveys; and the placement or exclusion of other native species to either promote herbivory or reduce coral grazing as needed.

Electrofishing is a common monitoring (and removal) restoration technique used in freshwater environments with limited conductivity (i.e., salt content) with different impacts than the monitoring and research techniques mentioned above in Section 2.2.1.2; hence they are analyzed separately in this section. Electrofishing activities are commonly used to determine species presence/absence, assess population abundance, or eliminate non-native invasive species. Electrofishing units are typically powered by batteries or gas generators, and may be mounted on a backpack, or configured to operate on a boat or raft. The unit induces an electric current into the water, causing a temporary involuntary muscle contraction in organisms present in close proximity in the water, and attracts the organisms toward the source of the electricity. Technicians then use nets to collect the stunned individuals and place them in a live well for processing. Specimens are generally returned into the environment alive. Because of the attenuation of the electric field, electrofishing is most effective in shallow freshwater and is therefore most commonly used in rivers and streams with limited conductivity, shallow-water lakes and ponds, or shoreline areas of deeper bodies of freshwater (USFWS and CDFG 2010).

Some states may require state-issued collecting permits for this work, and the U.S. Fish and Wildlife Service (USFWS) or NMFS may also require a permit if federally protected species are involved.

2.2.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs

The public outreach project type includes implementation of projects to enhance and further public knowledge about the local environmental resources, the ecological importance of restoration activities, and the value of the environment to local communities. Project types may include various youth group activities that promote environmental stewardship and educate youth about living coastal and marine resources and the coastal environment, training programs, formal school partnerships, monitoring programs, and development of educational materials, as described below.

Environmental education activities may include development and delivery of educational programs explaining the ecological importance to local communities of living coastal and marine resources, environmental problems and solutions, wildlife resources in the local community, sensitive ecosystems, and environmental stewardship. In addition, some NOAA funds are eligible for use in building environmental education facilities (e.g., education centers, observation blinds or decks, boardwalks, and information kiosks) focused on educating the public about local community resources.

NOAA may develop relationships with local organizations focused on environmental stewardship of marine, estuarine, and riverine resources. Such partnerships can help schools develop environmental curricula; learn about environmental issues; and arrange field trips to environmentally sensitive areas, education centers, aquariums, and museums. These partnerships can also develop educational materials to assist in teaching the public about environmental issues and the benefits of environmental stewardship, conservation, water resources and wetlands, and living coastal and marine resources in the local community and beyond. Examples of educational materials include pamphlets, flyers, posters, and books on environmental topics related to the ocean and other aquatic resources. Lastly, these partnerships may develop programs designed to train volunteers to conduct restoration work and outreach, and provide technical expertise to support on-the-ground implementation of fishery habitat restoration projects that involve significant community support. Such training programs would help ensure that volunteers become knowledgeable about environmental restoration, processes and procedures to conduct the various types of projects, and considerations regarding health and safety precautions.

2.2.2 Riverine and Coastal Habitat Restoration

The following restoration activities are listed in alphabetical order.

2.2.2.1 Beach and Dune Restoration

Beach re-nourishment or replenishment is the placement of suitable material from sources outside the natural sources of sediment for the eroding beach. The goal of this restoration technique is to provide clean sediment for beaches that have been degraded from human-caused injuries (oil or hazardous waste spills) or washed away due to natural processes or acute natural events such as storms or hurricanes.

Shorelines are directly benefited through sediment addition to restore suitable substrate for habitat and through revegetation of beaches, dunes, dune lakes and swales, and back barrier marshes. The restoration of the original physical and biological habitat is vital to the maintenance of shoreline fauna. Additionally, shoreline habitats landward of the beach (e.g., wetlands) often rely on beach and dune habitat, as these areas provide protection from storm surge and erosion. Sea turtles, migratory and resident birds, terrestrial species, and human use activities could indirectly benefit from restoration of beach and barrier island habitat. Birds use these areas as essential stopovers during migration to rest and feed. Terrestrial species would benefit from increased habitat for shelter and foraging. Restored beach, dune, dune lake, and barrier marsh habitat would increase habitat and aesthetic value and increase human use of the area for recreational activities.

Sediment should be chosen from a borrow site where the physical and chemical characteristics of the sediment closely match those at the restoration site. Identification of suitable borrow material is crucial, including consideration of sediment color, grain size, and other characteristics. This is important because introducing different sediment characteristics could negatively impact aesthetics, ability of turtles to nest, and general use by shoreline fauna. This document assumes that projects maintain such characteristics or ensure compatibility at the restoration site. Borrow material could come from sandy shoals in inlets or navigation channels, from nearshore/offshore ocean waters, or from upland areas with suitable substrate material. Once mined and transported—either by pumping directly from the source, barging, or trucking—the borrow material is placed on the beach. Various methods could be used for placing sediment on the beach, including placement of the material as an unvegetated foredune behind an active beach, using it to build a wider and higher berm or dune system (backshore beach) above the mean high water mark, distributing it over the entire beach, or placing sand in an offshore sand bar. For onshore sand placement, rakes, bulldozers, or natural processes are some of the techniques that can be used to distribute the sand. The volume of material needed for the site should be considered during construction planning. Once placed onshore, the distributed sand would be reworked by wind action to establish equilibrium beach slope profiles. Offshore sand placement would be distributed by wave action. Sediment dynamics at the restoration site would be studied prior to implementation of this technique to determine the sediment “budget” (i.e., gains and losses of sediment) on the beach. Replenishment of sediment would be completed in accordance with all applicable laws and regulations.

2.2.2.2 Debris Removal

The purpose of debris removal is to eliminate immediate physical, biological, or even chemical threats to the survival of living coastal and marine resources and their habitats. Abandoned, lost, and discarded debris can be found throughout aquatic and terrestrial ecosystems. Many types of debris are composed of synthetic, slowly degrading, or contaminated materials and may remain in the environment for years or even decades. Debris may include derelict or illegal fishing gear (e.g., abandoned or lost nets, lobster and crab traps, float lines), derelict or illegal structures, general solid waste (e.g., used tires, appliances, plastic materials), abandoned vessels, and pilings. There may be some circumstances where the removal of natural debris (e.g., logs or other woody debris deposited by storm events) is warranted to restore ecosystem function. This analysis does not include the removal of industrial debris with high levels of contaminants, or debris associated with environmental remediation projects. Many forms of debris can negatively impact riverine, riparian, associated upland, coastal, intertidal, or subtidal habitat and compromise the ecosystem by limiting access to habitat, degrading the quality of habitat, or directly harming a living marine resource. Derelict fishing gear can entangle and kill fish, birds, sea turtles, and marine mammals—including endangered or threatened species—and can snag on or drag across sensitive subtidal habitats such as coral reefs. Solid waste, abandoned vessels, and pilings may leach chemicals that impair water quality or directly obstruct habitat or access to habitat.

Debris removal projects typically involve, but are not limited to:

- Identifying, assessing, and removing unwanted or illegally placed debris from riverine, riparian, associated upland, intertidal, subtidal, or other coastal environments.
- The entry of personnel and/or heavy equipment into marine, estuarine, riverine, riparian, or associated upland environments.
- The use of machinery, trucks, or boats to access and remove the debris (depending on size and location of debris), or the installation of screening or debris trapping devices.
- Identification and removal of debris from underwater environments by appropriately trained divers or special equipment (such as remotely operated vehicles or side scan sonar).
- Manual removal by volunteers or professionals, depending on the debris type, size, and location.
- Treatment and disposal of biofouled debris containing non-native, potentially invasive, organisms.

In coastal and intertidal environments, debris removal may occur in estuarine, nearshore, marsh, beach, and other coastal habitat types where debris removal could potentially benefit NOAA trust resources. Such activities primarily benefit managed or protected species in in-shore waters where fishing gear or land-based trash is likely to accumulate. Typically, debris is removed by hand from salt marsh, SAV, coral, or beach habitat. In some instances, debris submerged in deeper water may be removed by a diver using lift bags or by mechanical methods from the surface (i.e., using a crane or grapple hook). Any debris that is entangled in the habitat structure (such as reefs) is carefully cut away so as to not disturb the habitat unnecessarily. Larger debris is removed with heavy equipment. All debris is disposed of through beneficial re-use, or at appropriate locations (such as landfills or recycling centers).

Debris removal activities in the subtidal or offshore environment would likely require the use of boats and/or divers to access and remove the debris. Appropriately trained divers or special equipment (such as remotely operated vehicles or side scan sonar) may be used to identify and remove the debris from subtidal environments. Manual removal by appropriately trained volunteers or professionals may also be used to recover floating debris, depending on the debris type, size, and location.

Nationwide, the NOAA RC has implemented more than 220 projects with debris removal as a restoration component, and it is reasonable to expect that the need for small- and large-scale debris removal activities would continue due to the concern over potential landfall of debris generated by domestic and international sources, in addition to the mitigation of ongoing injury to animals and habitat from accumulated marine debris. These projects have taken place in all regions of the NOAA RC, but predominantly in the southeast, northeast, and northwest (including Alaska) regions.

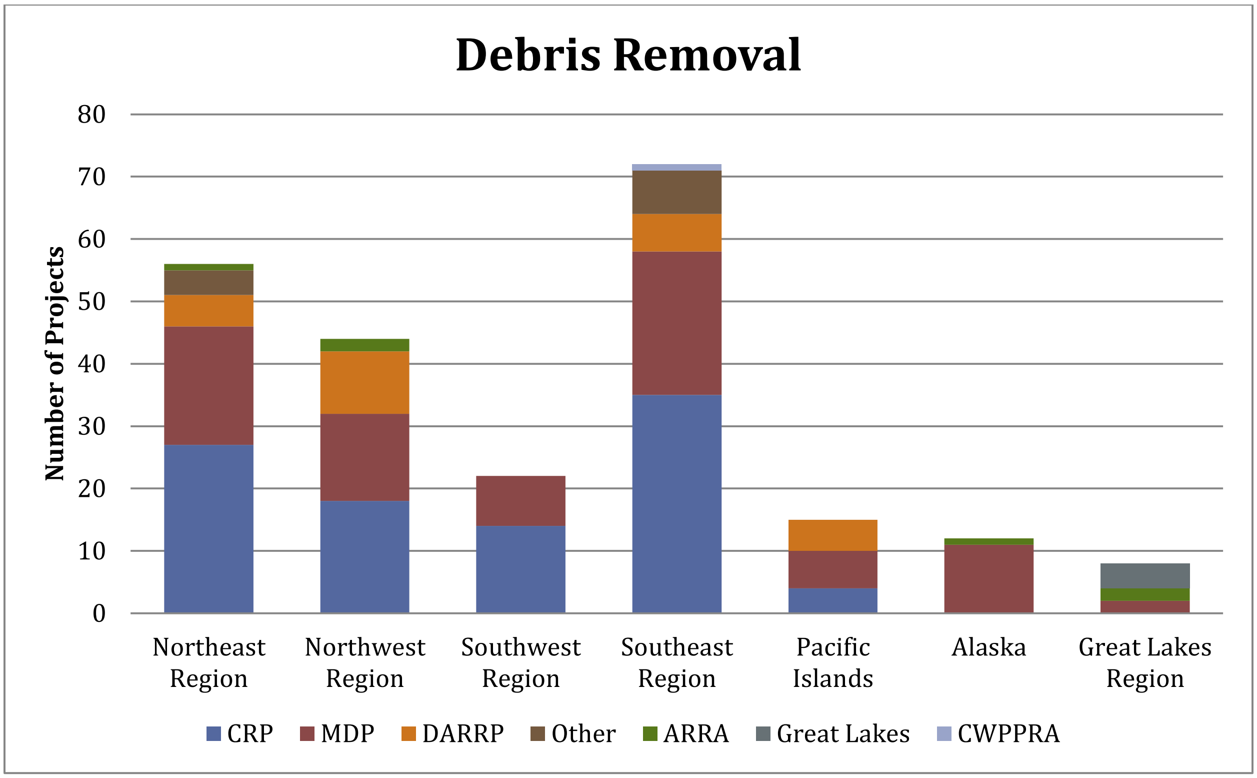

Figure 8 - Debris Removal projects implemented by the NOAA RC. Data retrieved from NOAA Restoration and Conservation Database October 2013.

2.2.2.3 Fish Passage

2.2.2.3.1 Dam and Culvert Removal, Modification, or Replacement

This section addresses the removal, modification, or replacement of dams, culverts, and similar infrastructure (e.g., weirs, concrete trapezoidal channels, seasonal push-up dams, failed step/pool structures) for the purposes of enhancing fish passage and habitat function in riverine systems. The majority of the coastal rivers in the United States are blocked with dams and culverts at one or more locations. In the northeastern United States, there are on average seven dams and 106 road crossings (culverts) per 100 river miles (Anderson and Olivero Sheldon 2011; Martin and Apse 2011). If not designed and maintained to provide effective fish passage, these barriers can prevent migratory fish from reaching historic spawning and rearing areas (due to limitations in fishes' ability to jump); alter natural flow patterns and velocities (fish have limited swimming speed); inhibit natural downstream movement of beneficial sediment, organic matter, and nutrients; create harmful temperatures or oxygen levels; and impact surrounding riparian habitat through flooding, drying, or both. Fish passage barrier removal is a high priority in many aquatic ecosystems and in many regional recovery plans for anadromous species (e.g., NMFS 2012). Roni et al. (2002) suggested that, prior to conducting in-stream or riparian habitat restoration work, practitioners should focus on restoring habitat connectivity by removing fish passage barriers. Barrier removal activities address the potential adverse impacts of dams, culverts, and similar infrastructure by physically removing or modifying them. Alternatively, sometimes barriers are modified through partial removal, or through installing fish passage structures (See Section 2.1.2.5.2 - Technical and Nature-like Fishways).

Barrier removal projects consist of one or more of the following activities:

- Physical removal and disposal of the barrier materials themselves, using heavy equipment or explosives.
- Placement of temporary fill into the river and surrounding areas for equipment access, isolating the work area, and dewatering the stream channel.
- Diverting water flows through constructed side channels or installed pipes.
- Removal and disposal of sediment collected behind the structure, using heavy equipment or passive sediment management.
- Implementation of best management practices (BMPs), such as erosion control practices or others, such as the examples described in Section 4.5.2.3.1 (Dam and Culvert Removal impacts) or Appendix C.
- Restoration of surrounding habitat on both sides of the barrier, including planting of native wetland plants and seeding of vegetation cover to stabilize banks and monitoring and removing growth of invasive species when needed (See Sections 2.2.2.4.1 - Invasive Species Control, 2.2.2.11 - Wetland Restoration, and 2.2.2.5.2 - Bank Restoration and Erosion Reduction).
- Reconstruction of the channel to match the existing channel upstream and downstream of the former barrier site.

- Installation of dry hydrant systems, new water management structures, piping or water diversions for fire safety, agricultural and other uses, to meet the needs provided by the original barrier (see Section 2.2.2.10 - Water Conservation and Stream Diversion).
- Rerouting infrastructure such as water and sewer lines and other public utilities.
- Installing large woody debris (see Section 2.2.2.5 - Freshwater Stream Restoration), riffles, and weirs for the purposes of grade control or habitat enhancement.
- Securing water rights for long-term protection (see Section 2.2.3.2 - Water Transactions).
- Constructing and installing a new and improved structure such as a bridge or larger culvert that allows for fish passage, sediment transport, and other needs (such as a road crossing).
- Installing public educational signage to address cultural or safety issues associated with a dam or areas in the vicinity (see Sections 2.2.2.8 - Signage and Access Management and 3.6 - Cultural and Historical Resources).

Dams are constructed for many purposes, including irrigation, electricity generation, flood control or storm water management, navigation, water supply, recreation, fire protection, fish and wildlife benefits, debris control, mine waste tailings, and others (National Inventory of Dams 2014). Dams can prevent safe downstream movement of fish by forcing them into hydroelectric turbines or over spillways, sometimes killing fish by large pressure changes or supersaturation induced by the water turbulence. The Heinz Center estimates the existing impediments to fish passage from dams alone include approximately 76,000 blockages greater than 6 feet in structure height, and possibly as many as 2 million dams in total (2002). Dams are built for a variety of purposes. About 50 percent of dams in the northeast, Great Lakes, and southeastern/Gulf of Mexico regions have a primary purpose of recreation; about 40 percent of dams in the southwest, northwest, and Alaska regions are used primarily for irrigation (National Inventory of Dams 2014; See Appendix D - National Inventory of Dams – Dam Purpose by Region for more information). In general, there are two types of dams—storage dams and run-of-river dams. Run-of-river dams have minimal water storage capacity and thus do little to alter downstream flow timing. Dam structures are highly variable in design and construction, but many may consist of designs incorporating crib, earth fill, dry cut stone, rock fill, concrete gravity, concrete arch, and concrete buttress dams (Heinz Center 2002). The greatest body of knowledge regarding removal exists for small dams (Heinz Center 2002), but more removals of moderate to large dams are being completed each year. The NOAA RC has found the impacts of dam removals, both beneficial and adverse, are not directly tied to the size of the structure or the impoundment behind it.

Culverts are typically constructed to allow water to flow under roads, transportation corridors, trails, or other infrastructure. Culverts can prevent safe fish passage if they are too small, causing water to pass through them at too high a speed for fish to overcome; or they can be too long and dark for fish to be willing to enter. Sometimes culverts on a steeply sloped stream are installed with the downstream end being too high for some fish to jump. Culverts can be made of steel or concrete in a variety of cross section shapes, sizes, and lengths. Maintaining water flow through fixed culverts in dynamic stream environments is challenging, as stream channels migrate vertically and horizontally under shifting flow, sediment, and wood influences, often resulting in culverts that reduce or block fish passage (Bates et al. 2003; Gubernick et al. 2003; Price et al. 2010). For example, the U.S. Forest Service and Bureau of Land Management recently found that more than 10,000 culverts exist on fish-bearing streams on federal lands in Washington and Oregon and that at least half of those may be fish passage barriers (GAO 2001).

The activities analyzed in this document include not just removal but the feasibility studies and engineering and design plans that may be prepared for barrier removal projects. These studies determine baseline conditions, model hydrologic changes that may occur after removal, analyze alternatives, and educate the public before dam removal (see Section 2.2.1.1 - Planning, Feasibility Studies, Design Engineering, and Permitting). Feasibility studies include a review of historic information about the barrier, assessment of the plant communities and animal assemblages upstream and downstream, base mapping of the barrier and surrounding topography and bathymetry, assessment of the volume and chemical quality of sediments impounded behind the barrier, or other pertinent information.

Projects covered under this document include removal and modification of dams, culverts, and other structures as mentioned above. As with all project types, only those barrier removals that have potential impacts described in this document will be included in this PEIS.

Since 1992, the NOAA RC has implemented approximately 500 projects nationwide with culvert and dam removal or modification activities as components of the work. It is reasonable to expect that the need for culvert and dam removal activities would continue due to the concerns over continued blockages of spawning runs for migratory threatened and endangered species, as well as recreationally and commercially important fish and macroinvertebrate species. The majority of projects in this category implemented by the NOAA RC have taken place in the northeast and on the west coast. Dam removal activities are particularly common in the northeast due to a high prevalence of obsolete Industrial Revolution–era dams, whereas culvert removal and replacement activities tend to be more common activities on the west coast.

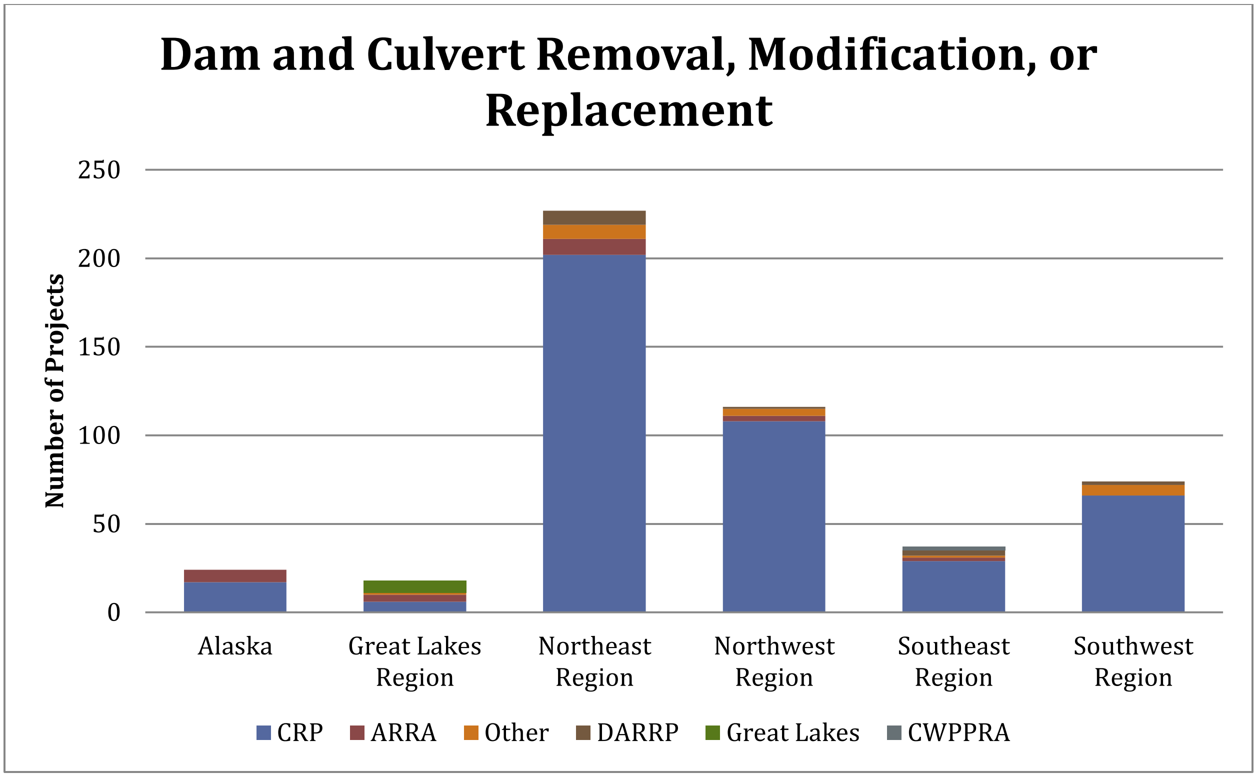

Figure 9 – Dam and Culvert Removal, Modification, or Replacement projects implemented by the NOAA RC (includes dam modification (including replacement), dam removal, culvert modification (including replacement), culvert removal, and daylighting activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.3.2 Technical and Nature-like Fishways

Fishways are pathways designed specifically to allow the upstream passage of target fish species and life histories past a particular migratory obstruction. Species and the life histories for which fishways are designed may include, but are not limited to, adult and juvenile fish, lamprey, and eels. Generally, projects that completely remove migration barriers are the preferred restoration activity undertaken by NOAA to restore or improve natural riverine functions, migratory passage, and water quality. However, sometimes barriers (such as dams) are modified to only enhance migratory passage when complete barrier removal is not possible. A technical fishway is typically constructed of concrete or metal. Types of technical fishways include vertical slot, Denil, Alaskan Steeppass, and pool-weir fishways. Nature-like fishways are constructed stream channels that mimic specific morphology and roughness of natural channels and include pool-riffle, step-pool, cascade-pool, and cascade channels. They are constructed with rock and other natural materials and may be constructed to span the natural channel or as a bypass channel around the barrier, proximate to the stream channel. Nature-like fishways are also regionally identified as rock ramps, rock weirs, roughened channels, geomorphic based channels, and threshold channels. Lamprey and eel passage can be facilitated through (1) modification of traditional technical and nature-like fishway designs, (2) specific structures within a technical or nature-like fishway, or (3) as a standalone structure adjacent to a technical or nature-like fishway. Lamprey and eel passage systems may also incorporate metal, plastic, and/or netting. When using a single fishway to provide passage for more than one species, design tradeoffs must often be made, which enhance the passage of one species over another.

Fishway effectiveness for any species and life history hinges greatly on the operation and maintenance of the fishway, regardless of its type (even nature-like fishways). Every effort should be made to establish an operational and maintenance plan that covers the realm of foreseeable adverse passage issues that may arise at a project. These issues may include, but are not limited to, debris accumulation, scour, deposition, evulsion, low-water operation, movement of large rock, and frequency and method of maintenance.

Construction activities for the installation of structural and nature-like fishways are similar to those described above in Section 2.2.2.3.1 - Dam and Culvert Removal, Modification, or Replacement; however, these activities often can be completed with less disturbance to a barrier and its surrounding habitats, because the barrier is often only modified and not removed entirely from the site.

Fishways may target individuals migrating up or downstream at various life stages (Katopodis 1992). The design of the fishway will be highly site-dependent and will vary based on a number of factors, including swimming performance and behavior of the targeted species of fish (Katopodis 1992). Effective fishways attract fish readily and allow them to enter, pass through, and exit safely with minimal cost to the fish in time and energy (Katopodis 1992). They are designed to operate at most water levels, and at peak efficiency during fish migration periods. Trapping and trucking of fish around a barrier may also be used in place of a fishway, only if other options are exhausted.

Since 1992, the NOAA RC has implemented approximately 120 structural and nature-like fishway projects nationwide. It is reasonable to expect that the need for these activities would continue due to the concerns over continued blockages of spawning runs for migratory threatened and endangered fish species, as well as recreationally and commercially important species, especially in circumstances where dam removal is not feasible. The majority of projects in this category implemented by the NOAA RC have taken place in the northeast region.

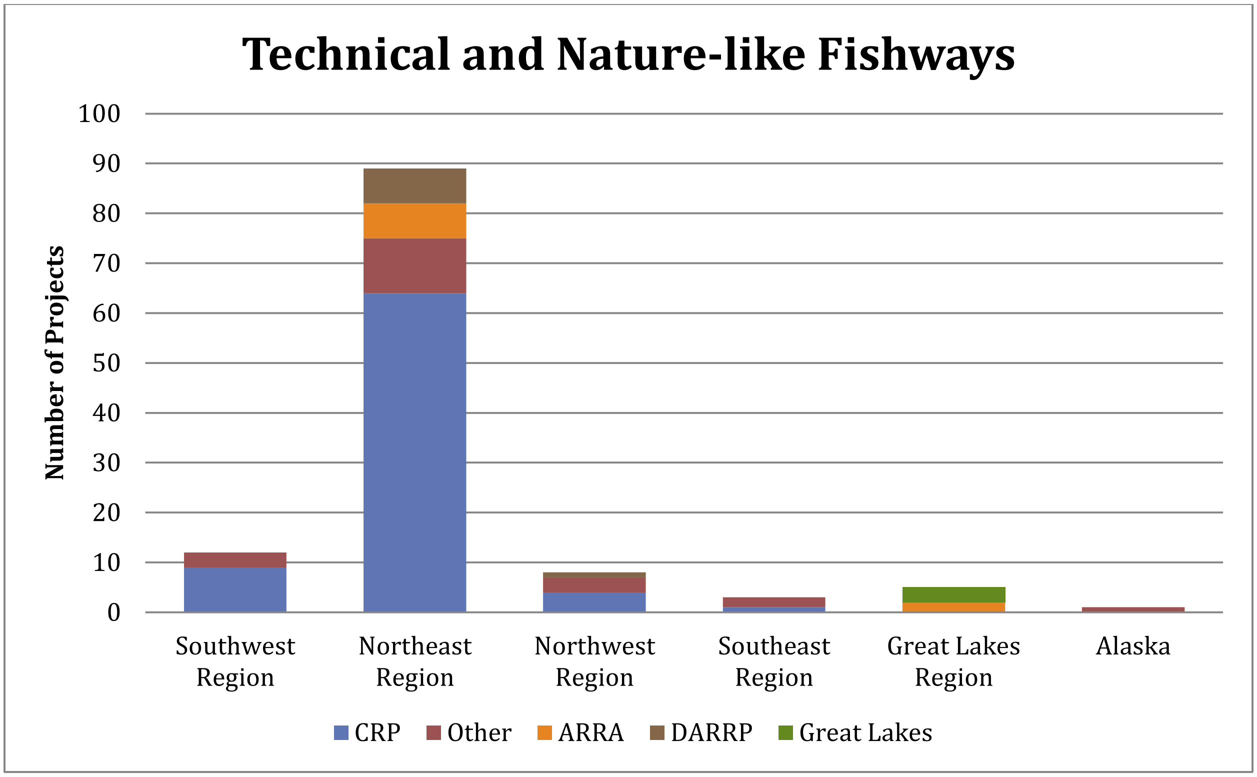

Figure 10 - Technical and Nature-like Fishways projects implemented by the NOAA RC. Data retrieved from NOAA Restoration and Conservation Database

2.2.2.4 Fish, Wildlife, and Vegetation Management

2.2.2.4.1 Invasive Species Control

Invasive species are any non-indigenous species or viable biological material (including seeds, eggs, and spores) that are transported into an ecosystem and cause economic or environmental harm or harm to human health when they colonize a new area. These species impact the habitats they colonize by reducing the abundance or diversity of native species and altering ecosystem processes. They can impact native species through predation, competition for food and space, and hybridization, as well as the introduction of pathogens and parasites. Normal functioning of the ecosystem—including hydrology, nutrient cycling, or productivity—may also be altered by biological invasion.

Invasive species control measures eradicate or suppress a population within an area to limit spread and reduce impacts to natural resources. Methods for control are often multifaceted and may include a combination of physical (i.e., manual or mechanical), biological, educational (i.e., behavioral change), and chemical techniques. These include:

- Physical removal – Plants may be removed by digging, pulling, mowing, or cutting the plant and then burying or disposing of it offsite. This is often done by hand, but some herbaceous and woody plants may require mechanical removal with chainsaws, mowers, or other machinery to be used; for marine algae, underwater vacuums (e.g., "Super Suckers") may be used. This may be done in addition or as an alternative to herbicide use. Both aquatic and terrestrial animals may also be physically removed by manual or mechanical means such as fishing, hunting, trapping, or poisoning.

- Biological control – This technique relies on predation, parasitism, herbivory, or other natural mechanisms through the release of native natural enemies, known as biocontrol agents. Biocontrol is often used to gradually suppress widespread infestations in remote areas where other methods are not economically feasible.
- Herbicide use – Herbicide use is restricted to activities conducted in accordance with approved application methods and BMPs (see Section 4.5.2.4.1) designed to prevent exposure to non-target areas and organisms. Typical methods include backpack spraying, cut stump, and hack-and-squirt; however, other methods may be used as the site or target species dictates, with the goal of reducing the risk of herbicide drift. Furthermore, methods that do not require surfactants should be used when possible. In situations where surfactants are necessary, products used should be limited to those determined to be the least toxic to aquatic and marine/estuarine organisms. Spray pattern indicators (i.e., dyes) are often used in conjunction with herbicides to track application.
- Electrofishing – This technique may be used as a restoration technique in the removal of non-native fish species. See Section 2.2.1.3 - Fish and Wildlife Monitoring for more information on this activity.
- Prescribed burns – Whether used alone or in combination with other mechanisms, controlled or prescribed burning of landscapes is an effective method of controlling various invasive plant species or other non-native plant species while simultaneously stimulating the growth of native plants and encouraging the development of a broader diversity of organisms that adapted to fire regimes (see Section 2.2.2.4.2 - Prescribed Burns and Forest Management below).

2.2.2.4.2 Prescribed Burns and Forest Management

Controlled or prescribed burning of landscapes is an effective method of controlling various invasive plant species or other non-native plant species while simultaneously stimulating the growth of native plants and encouraging the development of a broader diversity of organisms that previously occurred there. Typically, prescribed burns have been used to maintain and restore native grasslands but have also been used in forested areas. Often, prescribed burns are used in conjunction with herbicides and mechanical methods to control particularly aggressive invasive plants. As a management tool, prescribed burning recycles nutrients tied up in old plant growth, eliminates many woody plants and undesirable herbaceous weeds, improves poor-quality forage, increases plant growth, reduces the risk of large wildfires, and improves certain wildlife habitat. Wetlands, particularly marshes, are being increasingly burned to remove built-up dead plant matter in order to promote growth and diversity of native wetland vegetation, as well as to control woody and invasive plant species.

A burn plan is prepared to avoid impacts to non-target resources, including threatened and endangered species, area residences, and adjacent structures. The burn plan should describe the size and specific location(s) to be burned and the individuals with the experience and training who will conduct the burn. The plan should also include the state and local fire jurisdiction, a list of those to be contacted before initiating the burn, and any other relevant site-specific information that would affect the safety or control of the burn. Necessary state and/or local burn permits are typically required prior to burning.

Other methods of forest management may be used as elements of a NOAA RC restoration project. Trees may be removed to improve the ecological condition of the site. For instance, in the Pacific Northwest some western juniper trees are expanding into neighboring plant communities to the detriment of native riparian vegetation, soils, or streamflow. Those trees may be thinned or completely removed by uprooting smaller trees, cutting larger trees with a chainsaw, or a combination of both techniques. Chain-sawed trees may be left in place, lower limbs may be cut and scattered. All or part of the trees may be used for stream bank or wetland restoration (see Sections 2.2.2.5 - Freshwater Stream Restoration and Section 2.2.2.8 - Signage and Access Management).

2.2.2.4.3 Species Enhancement

Species enhancement includes all efforts that involve placing native plants or animals into the environment, and the process of growing them to release/outplanting size (hereafter referred to as stocking). Planting vegetation is described under Sections 2.2.2.11 - Wetland Restoration and 2.2.2.9 - Subtidal Planting. In additional to vegetation and related materials, coral and shellfish are also commonly relocated and placed into a new environment during habitat restoration activities. For a description of Coral Reef Restoration see Section 2.2.2.6.1, and for shellfish restoration see Section 2.2.2.6.1 - Coral Reef Restoration. Restoration efforts may also include the release of mobile organisms including, but not limited to, scallops, echinoderms, crustaceans, and finfish; and may also include the release of non-reef-forming shellfish such as abalone and clams. Such organisms are typically released, or stocked, to help recover at-risk populations, or to restore natural resources that have been injured by releases of hazardous substances or oil, or as a form of biocontrol. When used, NOAA or project partners source these animals from facilities abiding by all local, state, and federal permitting requirements, and only release them where they naturally occur, although some biocontrol programs may be an exception to this condition. Stocking efforts fall into several categories, based on their purpose:

- Stock enhancement – increasing population abundance to offset exploitation or habitat degradation (Lorenzen et al. 2010).
- Re-stocking – rebuilding depleted stocks more quickly than would occur naturally (Lorenzen et al. 2010).
- Supplementation – reducing extinction risk and conserving genetic diversity (Hedrick et al. 2000; Hildebrand 2002; from Lorenzen et al. 2010).
- Re-introduction – re-establishing a locally extinct population (Reisenbichler et al. 2003; from Lorenzen et al 2010).
- Organisms may also be stocked for biomanipulation purposes (e.g., addition of sea urchins to reduce macroalgal growth).

Various species may be released, and species/sub-species selection will depend on the population targeted for stock enhancement or recovery. Released individuals should be genetically representative of the wild population at the specific location targeted for release, and, if re-establishment of a viable population is desired, should encompass sufficient diversity of genotypes and life history phenotypes (Miller and Kapucinski 2003; from Lorenzen et al. 2010).

Rearing of individuals for release occurs in land-based or nearshore aquaculture facilities. Aquaculture facilities are used to spawn and/or rear individuals and to make sure stocks are disease-free before being placed in their new environment. This programmatic analysis covers the use of existing, pre-permitted aquaculture facilities. The analysis does not discuss the environmental consequences of the construction and operation of new facilities. Alternatively, individuals may be captured live in the wild and released at the site targeted for restoration (i.e., species translocation).

Once raised in an aquaculture facility or captured live, individuals are released at the site targeted for restoration. Individuals may be released at varying life stages. Timing, site location, and life stage for release will depend on local conditions and should follow the BMPs described in the Species Enhancement environmental consequences section (Section 4.5.2.4.3). Organisms may be released from boats, trucks, or, in some situations, carried to the site by restoration practitioners or volunteers.

Nationwide, the NOAA RC has implemented more than 620 projects using Fish and Wildlife Management techniques. It is reasonable to expect that the need for such restoration activities would continue for two reasons: the growing concern over the persistence and mobility of invasive species impacting important riverine, coastal, and subtidal habitat; and the importance of maintaining healthy habitats such as oyster reefs. This activity is implemented in all regions of the NOAA RC, but most commonly in the northeast region.

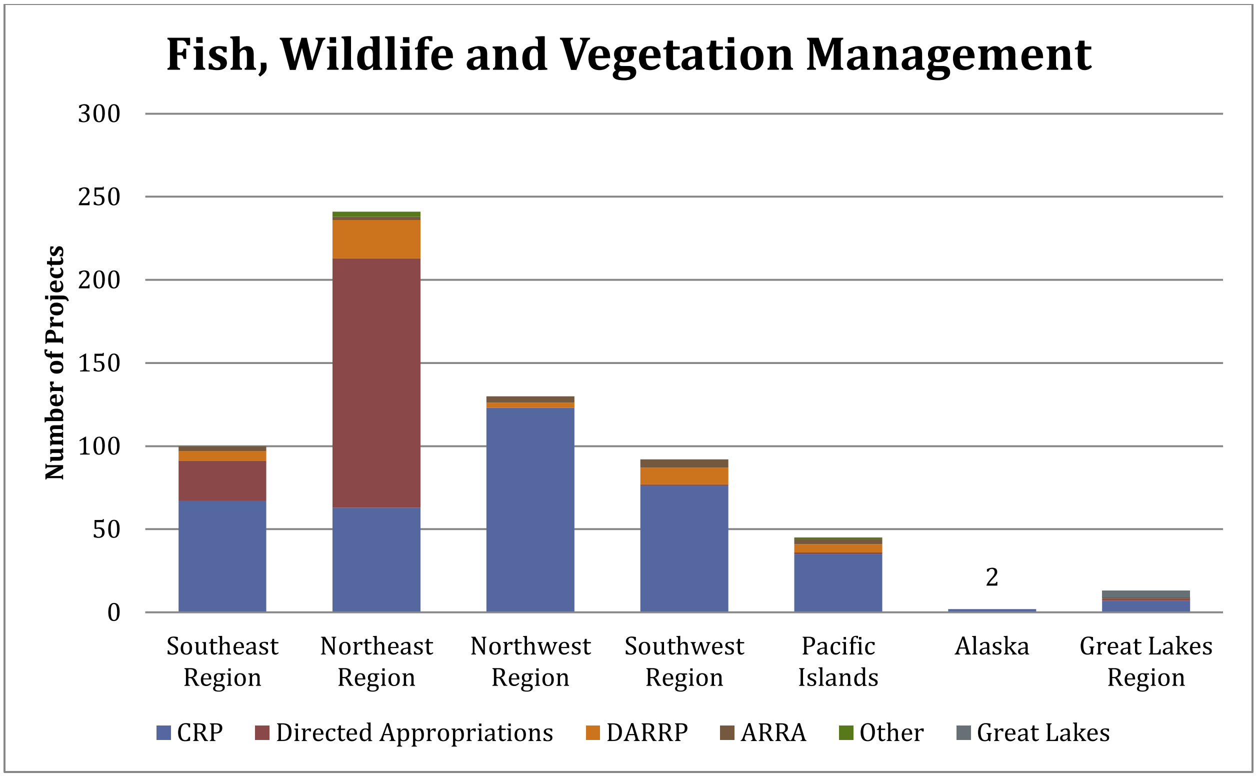

Figure 11 - Fish, Wildlife, and Vegetation Management projects implemented by the NOAA RC (includes invasives removal: vegetation, prescribed burn, species enhancement, and species reintroduction (non-plant)). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.5 Freshwater Stream Restoration

2.2.2.5.1 Channel Restoration

Complex in-stream and side channel (also known as "off-channel") habitat is a major limiting factor in the survival and reproduction of many fish species. In-stream channel complexity and the availability of side channel habitat have declined significantly in many areas due to human activity. Restoration activities are implemented within riverine environments in urban, rural, agricultural, and forested settings. In-stream and side channel restoration is used throughout the affected environment where diverse fish habitat is limited. Off-channel features such as side channels, ponds, and oxbows provide fish with refuge from high-velocity winter flows, provide ample and diverse food resources for accelerated growth, and capture fine sediments that can cause excess turbidity. Habitat quality is increased when wood, brush, and boulders are placed in these off-channel habitats. Off-channel habitat can also provide floodplain water storage capacity, thus reducing damages to human environments from flooding.

Side channel and in-stream restoration activities aim to restore habitat complexity and sediment sorting processes that are critical for all life stages of fish and many other aquatic organisms. Restoration activities may also take place within a stream's associated flood plain.

These activities address lack of structure, cover, and available refuge habitat in the system and involve:

- Excavating new channels or reconnecting historic channels and other off-channel habitat to enhance sinuosity, channel length, and habitat complexity.
- Using heavy equipment for excavation, wood and boulder placement, channel shaping, and deploying woody debris. This may be done by hand in some cases for smaller projects.
- Temporarily diverting stream flows from work areas to prevent excess turbidity.
- Installing boulders, gravel, and large woody debris. These features are placed to induce local scour, create deeper pools, and initiate substrate sorting, which improves spawning and rearing conditions, increases dissolved oxygen availability for aquatic organisms, and provides cover from predators and high flows.
- Obtaining living or scavenged woody debris, brush, and boulders from within the project area or from off-site.

2.2.2.5.2 Bank Restoration and Erosion Reduction

Bank restoration and erosion reduction refers to activities that take place in the area adjacent to the stream or river that are intended to improve the quality and/or quantity of riparian vegetation or other habitat features and improve the water quality of the adjacent stream. Many of these activities focus on improving the health of the riparian zone, which is important because it performs a range of beneficial functions. These include trapping sediment from runoff, stabilizing stream banks, reducing or enhancing channel scour, moderating water temperatures, and providing shelter for fish—all of which improve the ecological benefits provided by the adjacent stream or river. The width and other characteristics of the riparian zone vary greatly between regions and locally between river and watershed size and stream order. Examples of bank restoration and erosion reduction activities that could be implemented include the following:

- Installing wildlife habitat structures (e.g., conifer/hardwood snags, brush piles, bat roosting/breeding structures, avian nest boxes and platforms, and turtle basking logs).
- Installing woody debris (e.g., root wads, engineered log jams, logs, tree limbs).
- Implementing willow bioengineering techniques: willow mattresses, bundles, stakes, and walls.
- Shoring banks with biodegradable materials, such as coconut fiber "bio-logs" or geotextile mesh that biodegrade over time and allow the establishment of vegetation.
- Stormwater management (e.g., constructing bioretention cells or bioswales (rain gardens), baffle boxes, culverts, filtered curb or grate inlet baskets, grass swales, stormwater ponds or sediment basins, constructed wetlands, or removing man-made impervious surfaces and replacing them with pervious surfaces).
- Erosion and sediment control practices (e.g., geotextile mats, hydroseeding, silt fencing, check dams, waterbars).
- Planting of native vegetation using manual methods or heavy equipment.

Planting the appropriate vegetation may slow erosion. In riverine areas, native plants are generally planted using hand tools. See Table 3 - Commonly planted vegetation species below for some examples. Along stream banks, small native trees and shrubs are planted, usually above the tidal range. Preferably non-native species are removed during this process, and only native regionally genotypic and certified weed-free materials are used for planting and revegetation efforts. A description of those activities and potential impacts related to invasive species are covered in Sections 2.2.2.4.1, 4.5.2.4.1, and 4.8.

Many of the techniques used in this restoration activity are typically implemented manually, but sometimes machines are required for bank grading and for delivering supplies or lifting them into place.

Table 3 - Commonly planted vegetation species

Common Name	Scientific Name	Restoration Region
Smooth cordgrass	*Spartina alterniflora*	NER, SER
saltmeadow cordgrass	*Spartina patens*	NER, SER
spike grass	*Distichlis spicata*	NER
salmonberry	*Rubus spectabilis*	NWR
Indian plum, osoberry	*Oemleria cerasiformis*	NWR
red osier dogwood	*Cornus sericea*	NWR
western red cedar	*Thuja plicata*	NWR
red alder	*Alnus rubra*	NWR, SWR
Sitka willow	*Salix sitchensis*	NWR
Pacific willow	*Salix lucida*	NWR
slough sedge	*Carex obnupta*	NWR
western sword fern	*Polystichum munitum*	NWR
wapato	*Sagittaria latifolia*	NWR
redwood	*Sequioa sempervirens*	SWR
Arroyo willow	*Salix lasiolepis*	SWR
'Brazoria' seashore paspalum	*Paspalum vaginatum*	SER

Nationwide, the NOAA RC has implemented more than 320 projects with freshwater stream restoration activities as components to the work, whether as an activity associated with dam removal (in-stream and side channel restoration can occur prior to, and after dams are removed to trap sediments and restore natural channel function), to reconnect off-channel and side channel habitat using engineered log jams, or to create stream complexity in areas that were simplified due to past logging practices. The majority of these projects have taken place in the northwest and southwest regions of the NOAA RC; however, it is a common restoration activity in all regions of the NOAA RC. It is reasonable to expect that the need for freshwater stream restoration activities would continue in these regions in particular, but also nationwide, where lack of structure, cover, and refuge habitat for resident and anadromous fish within important river and estuarine systems requires restoration to more suitable conditions.

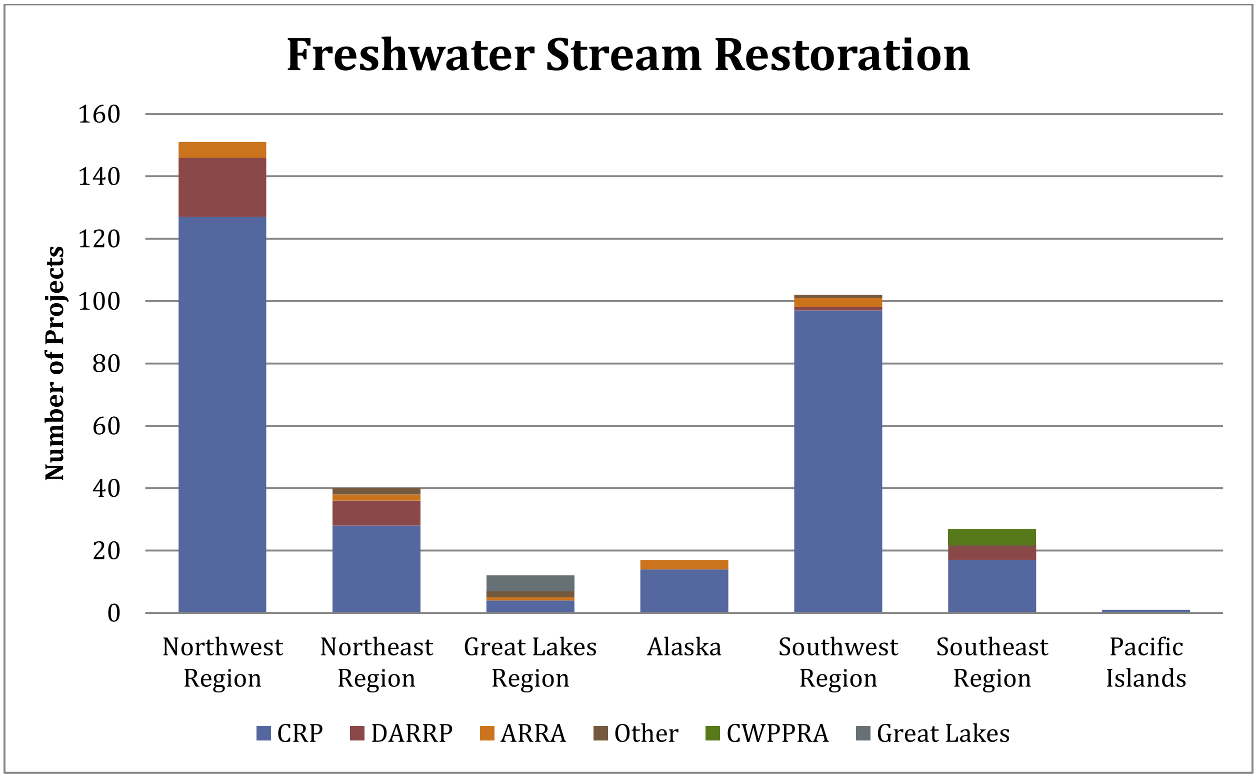

Figure 12 - Freshwater Stream Restoration projects implemented by the NOAA RC (includes large woody debris/structure placement, weir construction, weir removal, stream channel reconnection/creation, substrate modification and stream pool construction activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.6 Reefs

2.2.2.6.1 Coral Reef Restoration

Coral reef restoration techniques include physical and biological restoration actions to restore shallow benthic coral communities—specifically coral communities characterized by consolidated hard substrates. Restoration is typically implemented using, but not limited to, the following range of techniques:

- Propagating a genetically and species-rich collection of coral fragments in nurseries, with an emphasis on threatened and endangered species (see Section 3.5 - Threatened and Endangered Species).
- Transplanting (outplanting) coral fragments from nursery or an impacted location (see below) to appropriate targeted locations.

- Implementing erosion control techniques to stabilize sediment (see Section 2.2.2.5.2 - Bank Restoration and Erosion Reduction for more information.
- Managing invasive species (invasive fish and algae) through removal and appropriate maintenance techniques (e.g., release of natural predators (urchins) or continued removal). See Section 2.2.2.4.1 - Invasive Species Control.
- Re-attaching or moving broken corals or stabilizing rubble substrates in areas impacted by events such as vessel groundings or storms, sometimes in conjunction with proactively relocating corals to more appropriate locations, which may include a coral nursery.
- Improving infrastructure such as aids to navigation or mooring buoys, or enhancements to piloting or salvor operational capabilities.

Stressors to shallow-water coral communities include human-induced and natural stressors. Natural stressors may include hurricanes, coral diseases, and changes to water temperature, salinity, and water quality. Human-induced stressors include invasive species, dredging, anchoring, overfishing, and ocean acidification. Human activities such as recreational overuse and coastal development can alter coral reef habitat quality through physical damage and the introduction of pollutants, sediment, and excess nutrients and freshwater flow to reef systems. Localized disturbances to corals (e.g., changes in temperature, salinity, or light; sedimentation; aerial exposure; and pollutants) can cause bleaching events. Coral reef bleaching is the whitening of corals that results from the coral expelling the symbiotic zooxanthellae. Once the stress subsides, corals can often recover their previous levels of zooxanthellae, but this recovery depends on the intensity and duration of the stress (Hoegh-Guldberg 1999). Other stressors to corals, besides the global warming of waters related to climate change, include ocean acidification and greater frequency of mechanical damage to corals from greater severity and frequency of tropical storms and hurricanes (Janetos et al. 2008), and shipping/boating activities.

Coral reef restoration activities include creating or re-creating reef relief or structure through transplant and re-attachment of coral fragments, reef rubble, or coral reef substrate. These activities restore the structure and favorable conditions that allow recruitment, growth, and survival of corals, sponges, live rock, and other reef organisms. Restoring coral reef structure may also involve creating and deploying limestone and cement modules to provide attachment sites for corals and other reef organisms via natural recruitment. Re-attachment or transplanting of coral fragments is a common technique for restoring coral reef habitat. Preferably, fragments are not harvested from intact corals, but rather from fragments broken off by natural or other processes ("corals of opportunity"; Johnson et al. 2011). Other sources of fragments could be propagated nursery corals, corals that need to be moved prior to a development project or salvage operation, or those which have colonized an improperly permitted artificial reef or derelict structures that are failing or are likely to come apart in the near future. Coral fragments can also be harvested from live, intact colonies with minimal impact on the survivorship of the donor colony using simple hand tools with appropriate techniques. Coral fragments are collected by hand and either re-attached to non-mobile structures through use of marine-safe cements or epoxies, or used to stock coral nurseries for grow-out and later transplant. For substrate placement and rubble stabilization, barges with cranes may be used for lifting heavy materials into place. For in-water restoration activities, teams of divers must use appropriate safety and operating protocols. Furthermore, coral restoration can also be implemented using "flypaper" techniques or settlement tents that attract coral larvae to suitable, restored substrate, thereby enhancing natural recruitment to the restoration site.

Corals are propagated in underwater nurseries with the goal of transplanting nursery-reared corals back onto reefs to improve existing coral colonies and to increase the likelihood of genetic and species diversity within the coral colonies. Transplanted corals should be near enough to each other for successful cross-fertilization during sexual reproduction. Transplantation sites for nursery-grown corals or fragments collected from damaged sites should be chosen where the integrity of the reef structure can be stabilized or has not been severely compromised. This increases the likelihood that coral fragments would successfully attach to the substrate and that attachment failures would not damage adjacent areas on the reef. Coral nursery designs are typically limited to two general types: coral fragments attached to hard structure (e.g., cement, limestone, wire, rebar substrate) or coral fragments suspended on lines in the water column. Specific configurations and deployments are site-specific, dependent on a variety of local conditions as well as the grow-out strategy being pursued by the nursery operators. Nursery stock may be further divided or out-planted using the methods described above.

Coral restoration activities may also include a wide variety of land-based activities to reduce sedimentation and pollution to coral reefs, which are described in different sections of this document. These are activities such as upland revegetation (Section 2.2.2.11.1), wetland creation and the installation of sediment traps or treatment wetlands (Section 2.2.2.11), and road grading and other stabilization techniques (Section 2.2.2.6).

Nationwide, the NOAA RC has implemented more than 85 coral restoration projects and it is reasonable to expect that the need for such restoration activities would continue due to concerns over continued degradation of important coral habitat from the aforementioned stressors acting upon them. These projects have taken place in the southeast (i.e., Caribbean) and Pacific Islands regions.

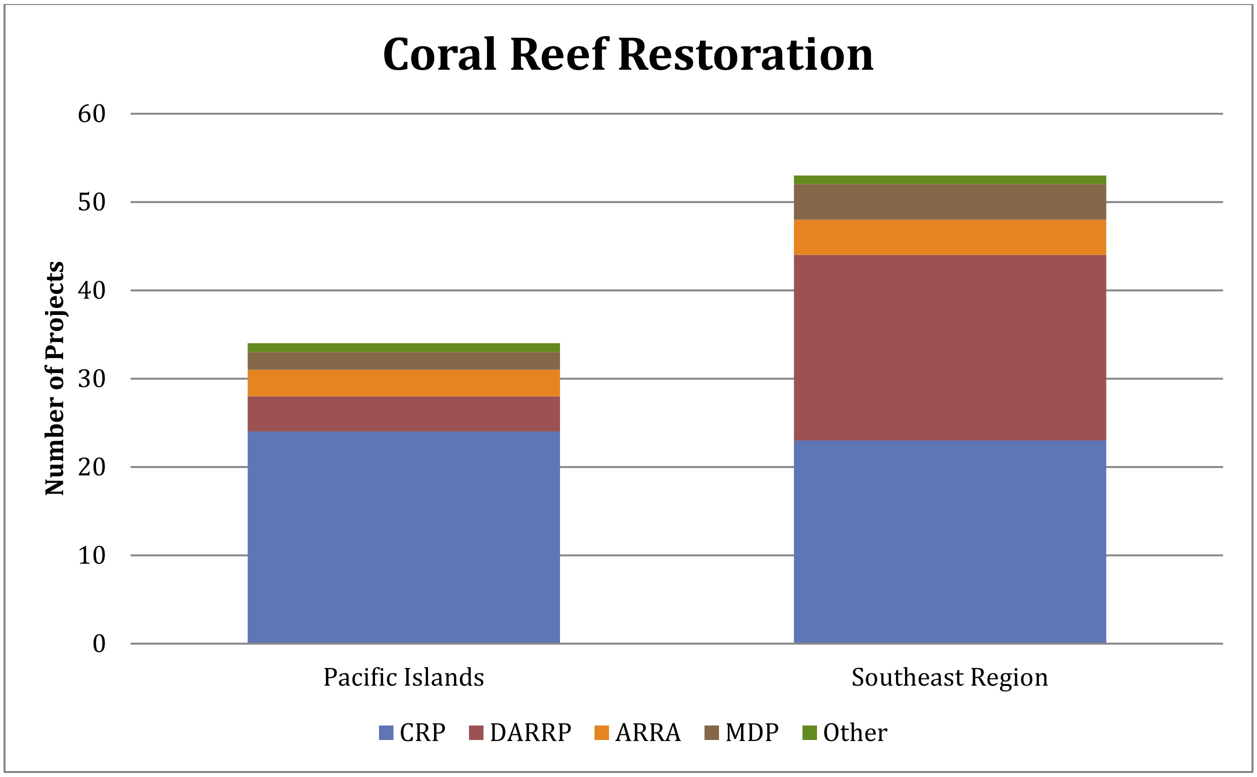

Figure 13 - Coral Reef Restoration projects implemented by the NOAA RC (includes coral nursery, coral reattachment, coral reef construction, rubble stabilization, invasives removal, erosion control, and vegetation planting activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.6.2 Shellfish Reef Restoration

Both natural and artificial oyster reefs play an important role in aquatic ecosystems. Oyster reefs can be enhanced or created as components of living shoreline projects as natural shoreline protective structures to dissipate wave energy, decrease coastal erosion, increase habitat for fish and invertebrate species, improve water quality, and provide protection for newly planted marsh grasses and SAV. In fact NOAA supports many kinds of bivalve shellfish restoration activities. These activities primarily benefit native oysters (e.g., *Crassostrea virginica*, *Ostrea lurida, Ostrea conchaphila*), but may also restore other shellfish species (e.g., hard clams, abalone, mussels, or scallops) or finfish species that use reef structures for forage or shelter through their various life stages; Section 2.2.2.4.3 - Species Enhancement above describes stocking activities related to such non-reef-forming shellfish species. Techniques can be grouped into two types: placement or modification of substrate and re-introduction of shellfish seed stock. One or the other of these types may be used, or both together at the same restoration site, depending on the species or the needs of the locality.

Substrate may be used to encourage recruitment of fish or oyster larvae recruitment in both intertidal and subtidal environments. Mollusks are ecosystem engineers and their shells form complex and heterogeneous habitats in benthic environments that affect processes on population, community, and ecosystem levels (Lenhert and Allen 2002; Gutierrez et al. 2003). Natural substrate (e.g., oyster or clam shells, rock) has been used more widely for restoration, but supply is limited and demand is high from the restoration and aquaculture sectors. Although shell is preferred because oyster larvae have an affinity for it, it is not always available. Shells can be deployed loose or in plastic mesh bags or similar containment materials. Artificial substrate such as limestone marl, granite, or crushed concrete (sometimes in combination with shells) may also be used when there is not enough shell substrate available, or in high-energy areas where substrate would otherwise be unstable and may require a more stable or higher reef structure. Other commonly used artificial substrates for shellfish reef restoration include wire mesh cages, racks, steel rebar structures (e.g., ReefBLK), or weighted plastic mats containing natural or artificial substrate. Such solutions are effective, but naturally occurring materials are often preferred for restoration.

Most substrate is deployed from a boat or barge when the restoration site is far from shore. At nearshore, shallow-water project sites, restoration practitioners and community volunteers may carry substrate to the reef location (when manageable, such as oyster shell bags). Large volumes of loose shells can be sprayed off barges with high-pressure hoses, or placed with large equipment such as a backhoe or with specialized hopper-conveyer belt systems built into the deployment vessel. Heavy substrates such as concrete or limestone are typically placed using heavy equipment located either onshore or loaded onto a barge.

Oyster reefs are typically constructed or replenished immediately prior to times of high spat set (larval settling).

In addition to reef/substrate construction, shellfish restoration efforts also include placing native shellfish in the restoration area if the local population is not large enough to produce viable larvae or has been fully extirpated from the area. Shellfish for restoration purposes may be obtained from natural beds (e.g., "wild stock"), purchased from commercial harvesters, or reared in land-based or nearshore aquaculture facilities (i.e., hatcheries). Non-reef-forming bivalves such as scallops, abalone, or clams may be deposited as single individuals. Similarly, because reef-forming oysters attach to hard substrates and each other, they may be distributed as individuals, or as multiple juveniles already attached to substrate (i.e., as spat on shell). Shellfish may also be placed in cages in spawner sanctuaries to reduce predation or poaching and to facilitate research efforts.

The preliminary step in planting live shellfish may include construction or use of a shellfish rearing facility, which is occasionally an aspect of shellfish restoration. These facilities usually consist of land-based tanks or floating cages. Typically, several large-capacity tanks are installed onshore or on existing dock/pier space, and water is pumped from the adjoining water body into the hatchery and discharged into the bay after use. Even when wild stocks of bivalves are used, hatcheries may be used to augment the bivalve supply and to ensure that stocks are disease-free before being placed in their new environment. This programmatic analysis covers use of existing pre-permitted shellfish rearing facilities, and the creation of small-scale, land-based facilities.

Nationwide, the NOAA RC has implemented almost 520 projects with shellfish restoration as a component to the project's work, and it is reasonable to expect that the need for such restoration activities would continue due to the widespread decline of oyster and shellfish populations in many areas across the coastal United States. The majority of these projects have taken place in the southeast and northeast regions of the NOAA RC.

2.2.2.6.3 Artificial Reefs

Artificial reefs are submerged structures that are constructed or placed on the existing substrate in coastal or marine waters to influence biological or physical processes in those environments. Such structures take many forms, including, but not limited to, natural materials (e.g., stone) or artificial materials (e.g., concrete) or structures (e.g., sunken vessels, engineered reef blocks). Finfish use natural reef structures for forage or shelter through their various life stages, but uncertainties related to design, siting, and management of artificial reef structures call into question their effectiveness as appropriate substitutes for degraded or lost natural reef habitat. In cases where it is possible to resolve these uncertainties related to design, siting, construction, and management, artificial reef construction or placement may be an appropriate habitat restoration activity. Given the uncertainties identified above, the NOAA RC has historically supported such activities, for the most part, in instances where restoration of lost or diminished human uses (e.g., recreational fishing) are the primary goal of a given restoration project.

In subtidal, intertidal, or other coastal areas where natural substrates such as rock and stone have previously been removed, NOAA may place substrate material to encourage recruitment of fish and to restore the functional attributes of the lost habitat. For example, in the Great Lakes, suitable rock substrate may be used to construct fish spawning beds for native Great Lakes lithophilic (rock-dwelling) fish species such as lake sturgeon, walleye, and whitefish.

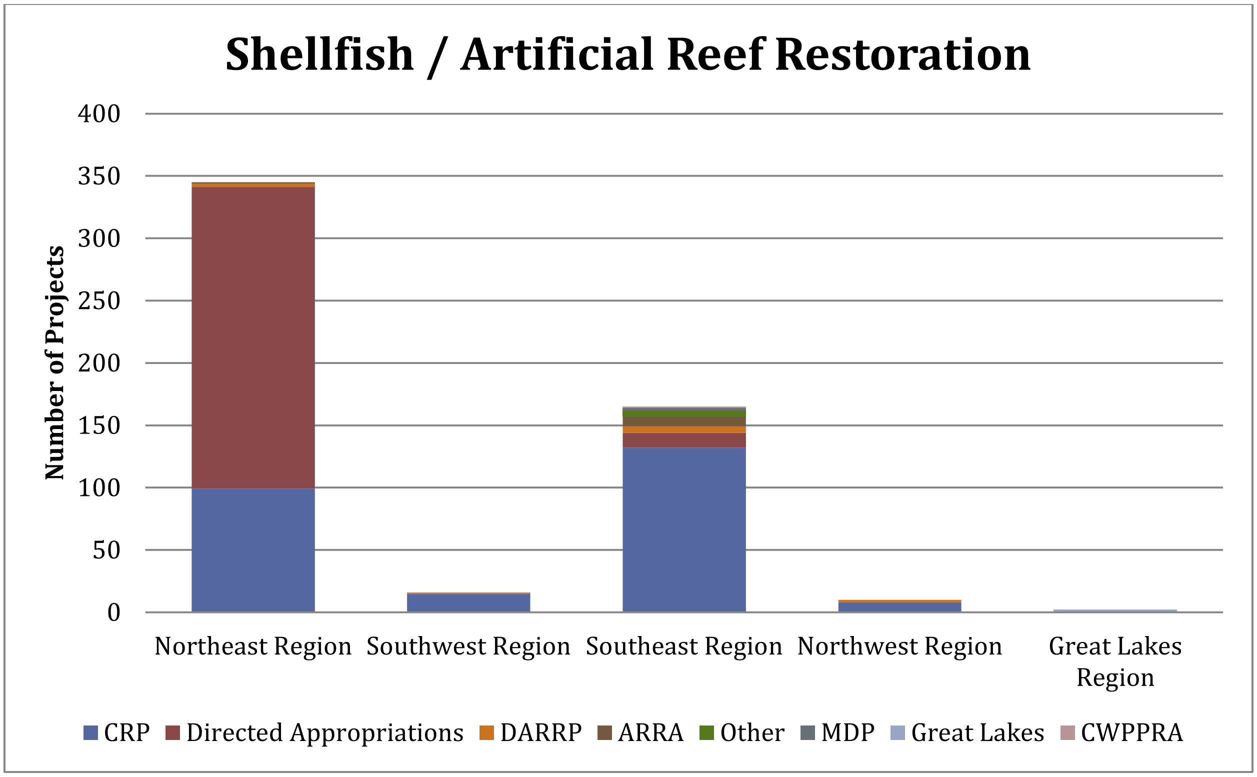

Figure 17 - Shellfish Reef Restoration and Artificial Reefs projects implemented by the NOAA RC (includes artificial fish habitat reef construction, oyster gardening and oyster reef construction activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.7 Road Upgrading and Decommissioning; Trail Restoration

Roads that are upgraded or decommissioned through NOAA RC programs usually pass through or near sensitive habitats such as wetlands or streams, or have been determined to adversely impact these habitats. The upgrading or decommissioning of roads in these situations reduces erosion and sediment loading into adjacent water bodies and spawning habitats. Decommissioning helps discourage or prevent vehicle access through the areas, reduces road maintenance costs, restores vegetated buffers, reduces potential for fish passage blockages (after removal of roadbed, culvert, or bridge over stream crossings), and places land back into productive natural use. Typically, support for decommissioning projects has been for roads that were deemed unnecessary by the owner and land use managers.

Roads, both improved and unimproved, can increase the frequency of landslides, debris flows, and other large inputs of sediment into streams, lakes, and wetlands. Additionally, when roads are damaged or impassible, natural areas adjacent to roads may be impacted by increased traffic. When appropriate, road restoration activities are implemented to restore impacted natural resources as part of road maintenance projects. With placement of appropriate physical barriers, these projects may also discourage future off-road vehicle entry into the impacted sensitive areas.

Trail restoration projects are implemented with the joint purpose of restoring trails to reduce erosion and enhancing low-impact recreational uses. Some trail restoration projects also provide better public access to natural areas, such as estuaries and other wetlands, and discourage the public from entering non-trail areas that could be damaged by erosion or foot traffic.

Restoration or decommissioning of roads and trails typically includes one or more of the following actions:

- Re-vegetating fill or cut slopes.
- Stabilizing eroding hillsides or banks.
- Installing or upgrading drainage features.
- Removing invasive species.
- Grading or resurfacing, sometimes with permeable materials, or complete removal of the roadbed and road-stream crossings to match the original slope.
- Fixing damaged or creating new trails.
- Building, repairing, or removing footbridges and replacing or repairing raised or permanent walkways (e.g., boardwalks) designed to control access to sensitive areas.

Road upgrading and trail restoration work is likely to require entry of personnel and heavy equipment to excavate or rearrange soils. During construction, this is likely to temporarily affect a small area and damage upland vegetation and soils. To minimize impacts from this action, erosion and pollution control measures would be implemented and areas of disturbed vegetation would be replanted.

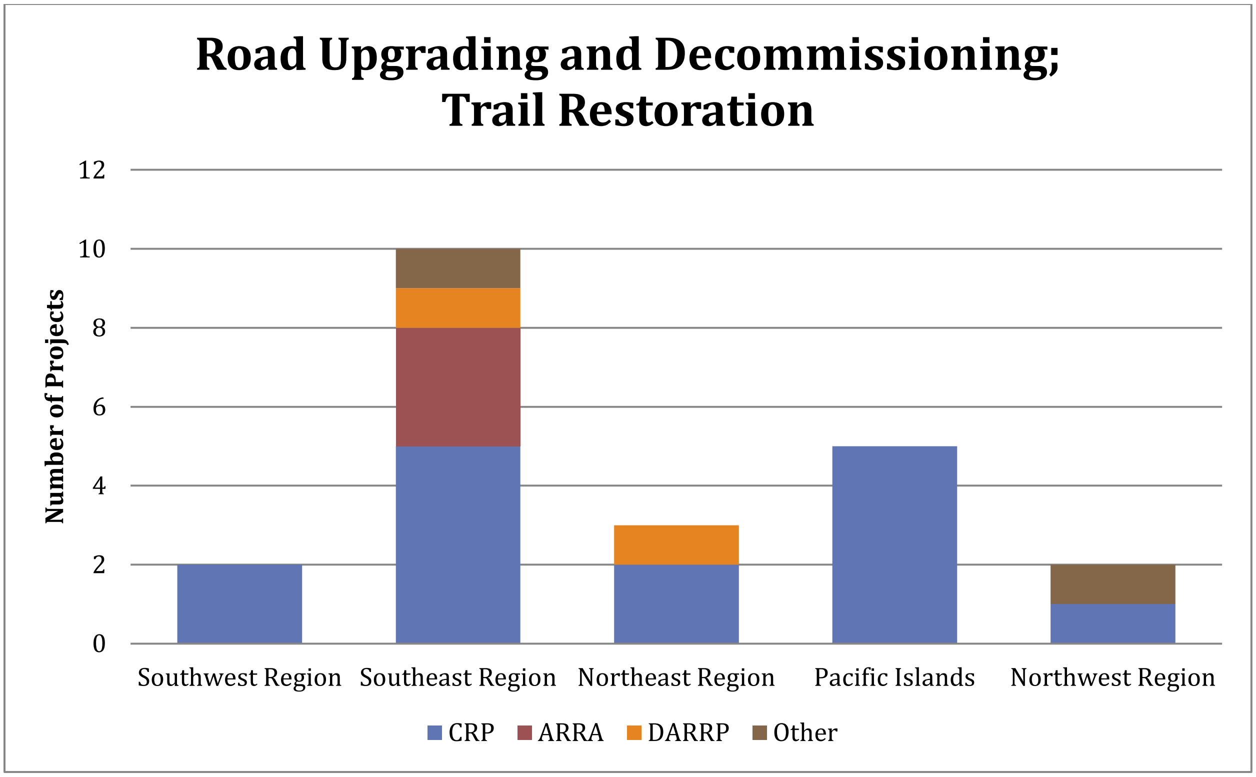

Figure 14 - Road Upgrading and Decommissioning; Trail Restoration projects implemented by the NOAA RC (includes storm water/runoff control activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.8 Signage and Access Management

This section describes temporary or permanent fencing, signage, or netting placed around sensitive environmental resources (e.g., highly erosive areas, sea turtle nesting areas, streams, and SAV restoration sites, among others). These activities reduce erosion and/or prevent the resources from being damaged or disturbed by people, animals (e.g., livestock), or vehicles. Grazing, human disturbance, or off-road vehicle use results in bank trampling and collapse of undercut banks, and erosion from overused trail crossings and overgrazed riparian areas. Exclusionary fencing, signage, or netting may be needed directly after another type of restoration action has been implemented to allow a site's vegetation to rebound after disturbance or to allow site vegetation to rebound.

Exclusionary fencing, signage, or netting may be constructed in riverine, riparian, associated upland, coastal, intertidal, and even subtidal or sub-marine environments. Livestock exclusion fencing may be found more frequently in rangelands and areas of high agricultural use. It also provides controlled access for walkways that livestock use to transit through riparian areas and stream channels and avoid sensitive riparian habitat. Exclusion netting may be deployed to prevent or discourage predation. Bollards, boulders, or other heavy objects may be used as a form of fencing to prevent vehicular or foot access to sensitive habitat areas. Access to these areas may also be inhibited by removing footbridges or other access pathways. Signage may be used to discourage harvest or other anthropogenic disturbances. Fencing may be temporary and can be removed after vegetation is well-established. Signage is more commonly used in highly populated areas where human use or attempted access to a site is expected.

The construction of exclusionary fencing, signage, or netting is likely to require:

- Use of personnel and heavy equipment to excavate post holes or install access management structures or signs.
- Individual fence or sign posts pounded or dug using hand tools or augers on backhoes or similar equipment.
- Removal of native or non-native vegetation along the proposed fence line.

The construction of temporary or permanent fencing, signage, or netting is likely to require entry of personnel and heavy equipment into sensitive habitats to excavate post holes. During construction, this is likely to affect a small area and alter riparian, wetland, or upland vegetation and soils. BMPs for general construction (described in Appendix C) would be followed. Individual fence or sign posts would be pounded or dug using hand tools or augers on backhoes or similar equipment. Fence posts would be set in the holes and backfilled, and fence wire would be strung or wooden rails placed. Installation may involve the removal of native or non-native vegetation along the proposed fence line. Occasionally rustic wood X-shaped fence that does not require setting posts would be used.

When fences are used to exclude animals from a riparian area, NOAA encourages upland management to ensure restoration of ecological links between the upland and aquatic areas; otherwise, riparian recovery would be minimal. The use of corridor fencing to separate a heavily grazed pasture from a narrow riparian zone is more effective when upland grazing practices are simultaneously redesigned to reverse upland degradation, which NOAA also encourages when such projects are implemented. Often this type of activity is used alongside others aimed at reducing livestock attraction to riparian areas and stream channels by providing upslope water facilities to help distribute livestock away from sensitive areas. See Section 2.2.2.10- Water Conservation and Stream Diversion for more information on this approach. Maintenance activities, which are frequently needed to maintain effectiveness, include repairing or re-installing access management structures when needed.

Nationwide, the NOAA RC has implemented more than 130 projects with exclusionary fencing, signage, or netting installation as a restoration component, and it is reasonable to expect that the need for such activities would continue. Fencing and signage are valuable tools in preventing injured or restored resources from being further damaged or disturbed by people, animals, or vehicles. These projects have taken place in all regions of the NOAA RC, but most commonly in the northwest, southwest, and southeast regions.

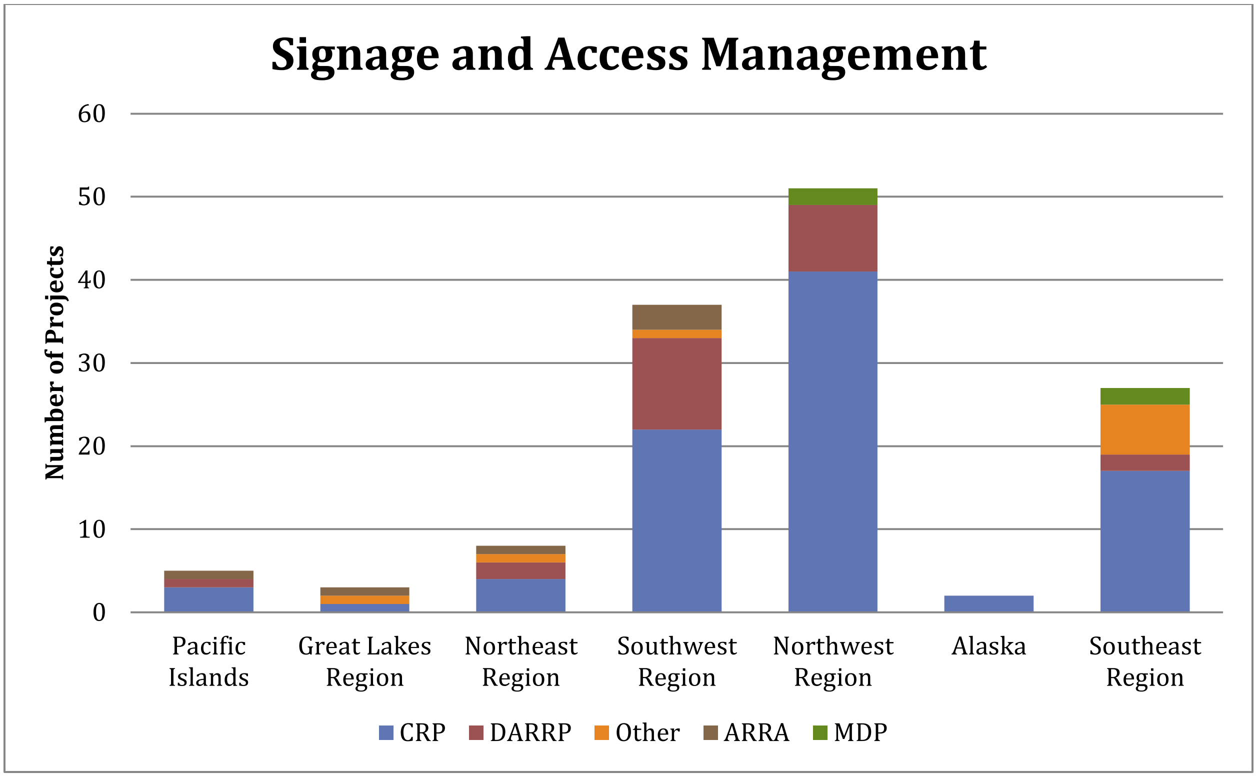

Figure 15 - Signage and Access Management projects implemented by the NOAA RC (includes fencing/netting and signage activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.9 Subtidal Planting

2.2.2.9.1 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) restoration involves transplanting or seeding nearshore or subtidal habitats in bays and estuaries with native SAV, installing bird perches as a source of nutrients to SAV beds in areas where waters are nutrient deficient, or installing signage at a restoration site. Seagrass beds dampen wave energy, stabilize sediments, improve water quality, and provide food and shelter for marine organisms. When used in conjunction with other restoration activities such as marsh restoration, a natural shoreline buffer is created that reduces coastal erosion and stabilizes sediments via root growth. This restoration activity may benefit estuarine/inshore species or those that live in fully marine salinities (see Table 4 below for examples of common SAV species). SAV provides nursery and feeding habitat for a variety of aquatic fish and other organisms. In addition, SAV provides fish and other marine species hiding places from predation and competition. SAV beds help stabilize sediments, making it easier for additional SAV or other stable substrate–dependent organisms, such as oysters, to establish.

SAV in bays and estuaries is important habitat for estuarine species, and has declined dramatically due to accelerated sedimentation, disturbance, and increased water turbidity. In some areas, SAV beds are still fairly intact, while in other areas these beds have been extirpated. For example, Texas and Florida have reported losses of 30 to 90 percent (Fonseca et al. 1998) of their original coverage in some areas. SAV habitat is frequently impacted by recreational boaters in shallow water when propellers create "prop scars" or "blowholes" in the seagrass bed. Larger vessels that run aground on shallow flats can also cause damage to SAV beds. A small injury to an SAV bed may be enlarged by a storm event that increases the instability caused by the original damage. Also, SAV beds die off due to poor water quality and high turbidity.

Table 4 – Commonly planted SAV species

Common Name	Scientific Name	Habitat Type	Restoration Region
widgeongrass	*Ruppia maritima*	Marine, Brackish	SER, SWR
shoalgrass	*Halodule wrightii*	Marine	SER
turtlegrass	*Thalassia testudinum*	Marine	SER
manatee grass	*Syringodium filiforme*	Marine	SER
eelgrass	*Zostera marina*	Marine	SWR, NWR, AKR, NER
redhead grass	*Potamogeton perfoliatus*	Brackish, Fresh	NER, GLR
sago pondweed	*Stuckenia pectinata*	Brackish, Fresh	NER, GLR
water stargrass	*Heteranthera dubia*	Brackish, Fresh	NER, GLR
wild celery	*Vallisneria Americana*	Brackish, Fresh	NER, GLR
common waterweed	*Elodea Canadensis*	Fresh	GLR

In general, SAV restoration activities convert open water to seagrass beds and enhance poorly-vegetated or unvegetated open bottom. In most locations the natural rate of seagrass colonization is prone to disturbance, and settlement or natural recolonization is therefore unreliable (Fonseca et al. 1998). Therefore, NOAA often provides technical and financial support to restoration projects for the purpose of creating or re-establishing SAV where it does not exist.

Restoration is accomplished by direct planting of live plants in bare root, plug, or mat form, either by hand or with mechanical methods. In some cases, seeds are distributed via seed buoys.[5] Many SAV species do not readily grow from seed, and so need to be reestablished after water quality improves. SAV plants or seeds are usually collected from existing SAV beds, which can cause minor disturbances to the beds and their substrate, and temporarily reduce the number of individuals or seeds in the existing population. The planting area is often enhanced with appropriately sized sediment to provide nutrients and proper sediment elevations for the transplants (e.g., within prop scars). Stakes are often used to keep the new transplants upright, and wave attenuation devices

[5] Seed buoys house mature reproductive seagrass shoots in nets that are deployed and anchored to a given in-water restoration area. The idea is that the seeds will ripen in due time and naturally release and recruit to the immediate or surrounding area. Buoys eliminate the need to store and ripen shoots in holding tanks on shore, and eliminate the duplicative step of having to transport immature shoots to an onshore holding tank, and then redeploying tank-ripened seeds to the in-water restoration site.

that reduce erosion and suspended sediments may be installed to increase water quality. Often, bird perches are installed within the planting area to encourage nutrient input from bird feces into the planting area. Each of these techniques may be implemented separately or in combination, depending on site conditions and extent of the injury or degradation of SAV.

NOAA has been conducting seagrass planting and seeding in all geographic regions of the coastal United States. Eelgrass is a commonly planted SAV on the west coast; the most frequently used in restoration in the Gulf of Mexico and Florida are shoalgrass, manatee grass, and turtlegrass. In North Carolina, eelgrass, widgeongrass, and shoalgrass have been used in restoration. Shoalgrass and widgeongrass are frequently used as pioneering species that quickly establish cover and stabilize sediments (Fonseca 1994).

2.2.2.9.2 Marine Algae

Marine algae (kelp forests and seaweeds) are important structural components of the near-shore marine environment that provide nursery and feeding grounds for thousands of marine species. They are also instrumental in the carbon sequestration process, which is important to maintaining healthy CO_2 levels in the environment. In addition, marine algae are used for a variety of foods, medical products, and cosmetics. Pollution and sedimentation runoff from nearby land-based human activities have harmed marine algae. Additionally, large areas of marine algae that once existed have been drastically reduced or eliminated due to food web shifts and resulting increases in sea urchin predation. Marine algae restoration (communicated in biomass per square meter, or density of holdfasts per square meter) aims to restore the plant communities' structural and functional attributes. Restoration involves transplanting and securing of lab-grown or drifting algae into the marine environment, usually by divers. Restoration may also involve moving the algae, attached to boulders, from one productive site (donor bed) to the injured location (recipient bed). Yet another method involves cutting the receptacles (reproductive structures) from donor beds and placing them in mesh bags and allowing them to release their gametes (reproductive material) onto the rocks, as they would if adult plants were present. As such, marine algae restoration occurs in subtidal environments with hard substrate for holdfast attachment. Each restoration method should include initial genetic work to ensure genetic integrity of the population at the restoration site. In some projects that use this restoration activity, sea urchins—one of marine algae's primary predators—are removed from planted or already established areas to increase survival and growth of the plant community.

Marine algae restoration occurs in many areas of California, Oregon, and Alaska, and occasionally in the northern latitudes of the U.S. east coast; it is implemented most in Southern California waters, where kelp forests have been reduced by 80 percent over the past century. Techniques of planting and predator removal tend to be similar in all areas where marine algae restoration is done. Species of marine algae planted can vary between different geographic regions, and may have different starting conditions and depth requirements. Marine algae restoration occurs in many areas of California, Oregon, and Alaska, and occasionally in the northern latitudes of the U.S. east coast.

2.2.2.10 Water Conservation and Stream Diversion

This section contains a description of all actions that divert water from a stream for the purpose of maintaining access to water for humans while providing habitat conservation benefits. This includes, but is not limited to, providing levels of in-stream flow necessary for survival, spawning, and rearing of fish and other aquatic organisms; providing off-channel watering systems for livestock to maintain in-stream water quality; and maintaining the availability of water for fire suppression, such as with dry hydrant systems.

Examples of water conservation and stream diversion activities that could be implemented include the following:

- Installing pumps or unpressurized piping (dry hydrants) to remove water from the stream.
- Constructing and installing water storage tanks or ponds.
- Installing new wells.
- Installing livestock watering stations.
- Installing piping and/or ditches to transport diverted water.
- Installing fish screens on the water diversion.

Domestic, agricultural, and industrial water diversions may reduce the quantity of surface flow in streams and rivers, thus reducing available habitat for fish and disrupting ecosystem processes. Water quality is directly related to water quantity, and good water quality is not only important to the species that inhabit these streams, but is also essential to human communities. Stream connectivity and flow allow nutrient and food transport, help ensure adequate dissolved oxygen, and allow migration of fish and other aquatic organisms within their habitat. Reduced flow can result in disconnected sections of stream or off-channel habitat, which impedes fish migration and feeding and reduces dissolved oxygen in the water. In many cases, water withdrawals result in complete drying of stream reaches. In addition, adequate stream flow is essential to maintaining water temperatures appropriate for the survival and growth of desired fish species (e.g., salmonids). By providing water storage tanks for rainwater catchment or seasonal storage, NOAA can reduce water diversion from streams during periods of limited flow. In addition, improving water transport infrastructure (e.g., moving or consolidating a river or stream's diversion point(s) to a more beneficial location, replacing ditches with pipes, and replacing worn equipment) can reduce the amount of water diversion needed for human use.

Alternately, habitat restoration, such as dam removal (see Section 2.2.2.3.1) or access management (see Section 2.2.2.8), may prevent access to water for domestic, agricultural, or industrial use, and as part of the project, that access must be maintained. Dry hydrants provide access to water sources for fire suppression while livestock management practices such as providing off-channel watering systems allow landowners to continue their land use activities, while increasing water quality in the stream.

Fish screen projects are implemented at sites where surface water is diverted for human consumption, agricultural, or industrial use. Without fish screening in such locations, fish are diverted from their habitat in the river into fields, ditches, dam turbines, and industrial plants where survival is unlikely. Fish screen projects conducted by NOAA involve installing exclusionary structures at water diversion points on rivers and streams used by resident and anadromous fish. Projects range from small individual landowner diversions for domestic water use, to large-scale agricultural diversions for farmland irrigation. There are also many existing fish screen structures that are in need of maintenance to bring them up to current standards. NOAA has implemented fish screen projects in stream and river channels and in pond and lake habitats, primarily on the west coast. Fish screens are designed to minimize impacts to natural stream flow and stream currents, and do not interfere with sediment and debris transport. Fish screens are designed to prevent the injury or death of migrating fish and eggs, and to reduce the impediment to passage posed by the intake structures or other associated construction on the river. Fish screen projects typically involve installing or modifying an existing diversion structure with a screened intake constructed of any number of materials and configurations dependent upon the expected size and behavior of the target fish. Depending on the project size, these structures can be installed with manual labor, small construction tools, or heavy equipment. Screens are used on both gravity flow and pump diversion systems. Normally, a flow measuring device and head gate are also required for monitoring and controlling diversion flows. Other structures with similar functions may be designed and used to control the spread of invasive species.

There are many types of fish screen designs with different levels of complexity. NOAA follows all current state and federal fish screen design standards (related to openings sizes, debris cleaning capabilities, bypass routes, etc.) when implementing fish screen projects. Almost all designs are determined by the specific site conditions, fish species targeted, particular life stage of those fish species, and technology or materials available for use at the site. For instance, projects in California, Oregon, Washington, and Alaska are designed to prevent injury, entrainment, or impingement of multiple species, and typically reflect pre-established regional NMFS design criteria, which are specific to the species present at the project locations.

These water conservation and stream diversion measures occur throughout the coastal United States, but typically are focused in Washington, Oregon, California, Idaho, and Hawaii. There is a need for them in many other coastal states, and it is reasonable to expect that projects in those areas will develop. Water conservation measures tend to vary geographically with type of land use, type of diversions, local standards, state water laws, climate, and topography. These projects may be implemented in coordination with dedication of water and water rights to in-stream benefits through agreements that limit water removal during all or part of the year (see Section 2.2.2.11 - Wetland Restoration).

Nationwide, the NOAA RC has implemented almost 40 projects that divert water from a stream for the purpose of maintaining access to water for humans while providing habitat conservation benefits. It is reasonable to expect that the need for these activities will continue and perhaps grow nationwide, particularly on the west coast, due to the continued competition for scarce water resources for use by humans, migratory threatened and endangered species, and recreationally and commercially important species in those areas. The majority of NOAA RC–led projects to date have taken place in the southwest region.

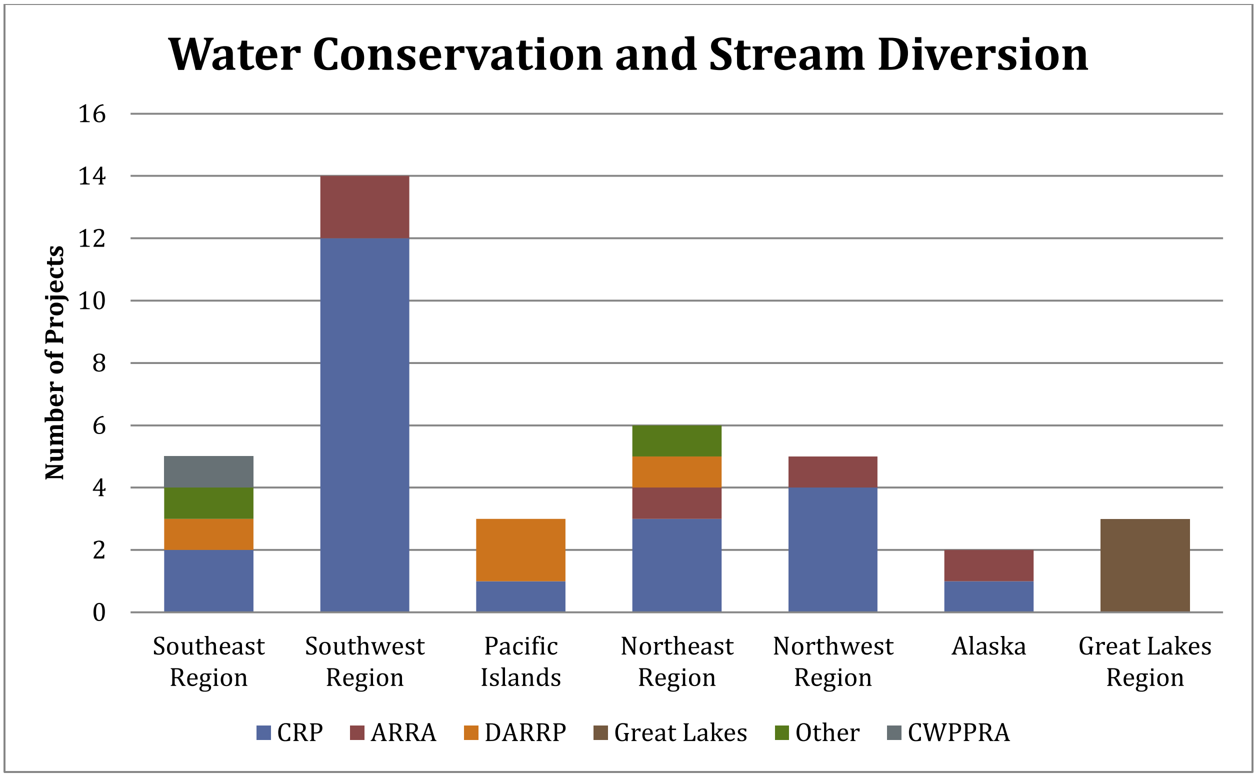

Figure 16 - Water Conservation and Stream Diversion projects implemented by the NOAA RC (includes stream flow modification and fish screen activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.11 Wetland Restoration

NOAA implements many kinds of wetland restoration. These restoration activities include the removal or addition of substrate to create the desired elevation and hydrology for wetland vegetation and fish habitat. Techniques include removing sediment and possibly vegetation to achieve intertidal elevations, introducing sediments such as dredged material or other clean fill to achieve the required elevation and hydrology, and planting native vegetation. Structures that help stabilize the leading edge of the marsh may also be employed. Most often, the goal is to achieve targeted elevations that are tied to groundwater, surface water, or intertidal elevations to create or restore a mosaic of wetland and associated upland habitats.

2.2.2.11.1 Levee and Culvert Removal, Modification, and Set-Back

This section addresses the removal and/or modification of levees, dikes, culverts, and similar infrastructure for the purposes of enhancing or restoring hydrologic connections in tidal or riverine systems. Throughout U.S. history, people have changed hydrology by constructing levees and berms along streams, tidal marshes, and rivers to drain land for crop production, to provide flood control, and for a number of other purposes. Such activities have drastically altered these areas through impacts to water quality, turbidity, erosion, simplification of habitat, and the diversion of vast amounts of surface water and groundwater from their natural course. Levees also capture flows, thereby reducing downstream habitat quality (through altered sedimentation patterns and increased scour) and posing the risk of entraining juvenile spawning fish. NOAA removes and modifies levees, dikes, and berms (including the removal or modification of culverts) to return surface water flows, either riverine or tidal, to a more natural regime, thereby increasing available habitat to fish and other coastal resources, and improving wetland function. Such activities primarily benefit rivers and their floodplains, salt marshes, freshwater tidal marshes, and mangroves, and may enhance connections between estuaries and their watersheds.

NOAA implements levee and berm modification, set-back, and removal activities to restore the natural flow and hydrology to affected areas and reconnect additional fish habitat that has been blocked, such as floodplains. These projects typically involve several components, including but not limited to the following:

- Physical removal of the levee, berm, or plug materials themselves, which are typically earthen or concrete, using heavy equipment.
- Construction of replacement levees built farther from the stream channel ("set-back levees") to expand the fish habitat available while protecting nearby infrastructure.
- Culvert removal or replacement.
- Removal, modification, or installation of tide gates and flood gates.
- Use of heavy equipment to breach the levee.
- Filling of ditches and canals behind levees.
- Channel reconstruction (see Section 2.2.2.5 - Freshwater Stream Restoration).

Levees are removed typically from impounded areas where foot or vehicle passage is not required around the site. This is especially appropriate in locations where an earthen impoundment was created using borrowed materials from the site's interior, and refilling those interior borrow areas with the degraded levee wall, which assists in achieving elevation targets in the restored interior. On the west coast, many levee removal projects occur in deltaic floodplains that have historically been used for agriculture. Projects conducted in the southeastern United States may install culverts or remove berms in order to restore tidal flow to formerly impounded areas. In all cases, potential rates of sea level rise are considered in design.

Where removal is not appropriate (e.g., for impounded areas where foot or vehicle passage is not required across the impoundment edge, but might be required in some locations around the site), multiple breaches may be placed strategically around the impoundment and aligned with tidal channels to restore tidal flow. Bridges may be installed in locations along the impoundment edge where passage over the flow point is still required. Tidal channels may be created to facilitate water flow to different points throughout a tidal wetland. The size of the channel created would depend on the overall size of the site, the amount of water conveyed, and the tidal range at the location, but should be comparable to similar natural systems.

Ditch filling or plugging is used to improve and/or enhance wetland hydrology in areas that have been channelized to facilitate drainage (typically for agriculture and mosquito control).

Grading may be required in sites where excess sediments have been deposited, leaving the site at elevations inappropriate for wetland function. In impounded areas, it might actually be necessary to supply additional sediments because compaction of the sediment over time often results in lower elevation than required to support wetland vegetation.

Water control structures (i.e., tide gates and weirs) are appropriate for project sites where strict management of water levels is required (i.e., mosquito management, flood control, and migratory fowl habitat) or seasonal impacts require the complete control of water regimes for salinity, water level, timing (seasonal objectives), or biological controls. Broad-crested earthen weir (i.e., flat crested or overflow dam, earthen and vegetated) are typically incorporated into tidal hydrology restoration projects that seek to increase the residence time of freshwater in low-salinity marsh environments, while simultaneously providing a point of overflow.

Culverts are installed in areas where water flow has been restricted but passage over the flow point is still required (e.g., roads and walking paths). Multiple culverts can be strategically placed around the site or grouped together. For shallow-water sites with the goal of re-establishing sheet flow, multiple smaller pipes are sometimes installed because they more effectively mimic sheet flow characteristics. Culverts are replaced or repaired typically in situations where the older culverts have failed due to breakage or inadequate size. Also reference Section 2.2.2.3.1 - Dam and Culvert Removal, Modification, or Replacement for more information on how culverts are used in restoration in riverine habitats, where similarities may exist.[6]

Nationwide, the NOAA RC has implemented more than 110 projects with levee removal or modification activities as components to the work, and it is reasonable to expect that the need for levee removal activities would continue nationwide due to the importance of re-establishing hydrologic flows that are disjointed or interrupted by levee systems. The northwest region has implemented twice as many projects as all other regions combined.

[6] Adapted from NOAA Restoration Center and NOAA Coastal Services Center for a summary of commonly used techniques. Returning the Tide: Tidal Hydrology Restoration Guidance Manual. 2010

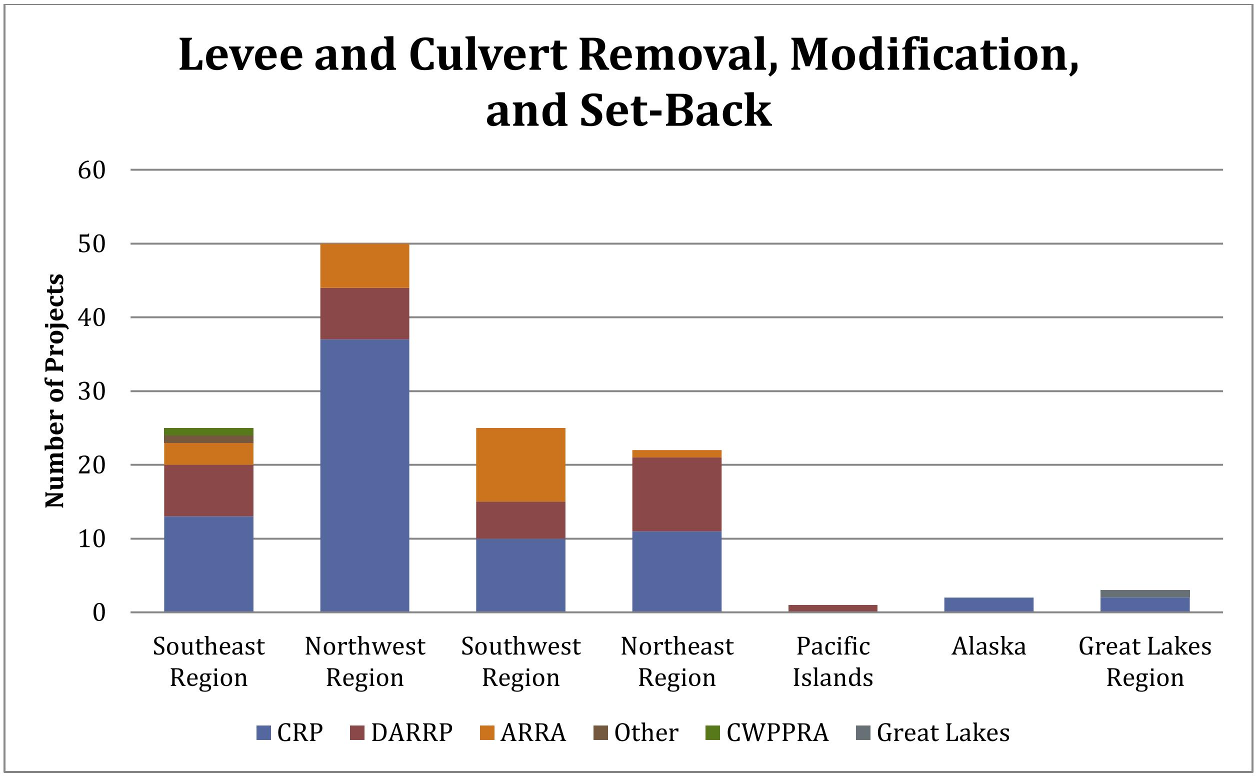

Figure 17 - Levee and Culvert Removal, Modification, and Set-Back projects implemented by the NOAA RC (includes berm/dike modification (including replacement) and berm/dike removal activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.11.2 Fringing Marsh and Shoreline Stabilization

Fringing marsh restoration and shoreline stabilization activities are employed along all shoreline types, including salt marshes, tidal and nontidal freshwater marshes, and sandy or gravel sheltered shorelines. Appropriate techniques are highly variable, based on regional ecosystems. These techniques restore natural habitats and reduce erosion, often employing stabilizing structures in a configuration sometimes referred to as a "living shoreline," "green armoring," or "bioengineering." In areas of low wave energy, non-structural techniques may be used, such as grading, planting, and stabilizing with biodegradable materials. Areas of higher wave energy often require hybrid techniques that use non-structural practices in combination with sills, toes, or breakwaters consisting of rock, shell, or other artificial reef materials. The specific combination of methods used to restore a fringing marsh or shoreline depend on the desired level of erosion reduction at each project site and other site-specific conditions.

Examples of fringing marsh restoration and shoreline stabilization include the following (NOAA et al. 2004):

- Using heavy equipment to remove bulkheads and other shoreline armoring, and then re-grading the bank to a stable slope.
- Shoring banks with biodegradable materials, such as coconut fiber "bio-logs" or geotextile mesh that biodegrade over time and allow the establishment of vegetation.

- Planting banks with native vegetative cover, such as native marsh grass.
- Reducing erosion and stabilizing banks through harder structures such as rock breakwaters, sills and groins, logs, or oyster reefs (see Oyster restoration section).
- Adjacent upland stormwater management (e.g., creating or improving bio-swales, removing man-made impervious surfaces and replacing them with pervious surfaces).

Planting the appropriate vegetation may slow erosion and provides habitat for estuarine organisms. Native plants, such as smooth cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*) on the east coast, are generally planted using hand tools. Landward of the marsh, small native trees and shrubs may be hand planted or mechanically planted above the tidal range as part of an upland buffer. Non-native species are preferably removed during this process, and only native, regionally genotypic and certified weed-free materials are used for planting and revegetation efforts. A description of those activities and potential impacts related to invasive species are covered in Sections 2.2.2.4.1, 4.5.2.4.1, and 4.8.

Hybrid shoreline stabilization techniques that involve erosion reduction structures are installed using heavy equipment, deployed from the bank or a barge. A typical project is constructed by first placing or regrading sediment at marsh elevations using construction equipment. In most cases, any existing vertical bulkheads or other structures are removed. Then, breakwater structures, sills, or stone toes ranging from subtidal oyster reefs to intertidal rock breakwaters are installed. In all cases, the breakwater structure provides regionally appropriate ingress and egress routes for fish. Smaller structures may be installed by hand (see Section 2.2.2.6.2 - Shellfish Reef Restoration) but are more typically placed using heavy machinery. Finally, salt marsh or upland buffer vegetation is planted to initiate the formation of the marsh.

Table 5 describes various restoration techniques and materials that may be used in implementing this restoration technique.

Table 5 - Fringing marsh and shoreline stabilization activities

Design Strategy	Application
Sand fill and clean dredge material placement	Typically used to create a gentle bank slope that dissipates wave energy and provides a surface on which to plant vegetation. Sites without a bulkhead can be regraded, filled, and replanted with native vegetation. Bulkheads can be removed and the shoreline then regraded, filled, and replanted.
Tree and grass planting	Stabilize the riparian zone above high tide by holding on to the soil, which minimizes bank erosion while filtering upland runoff and providing wildlife habitat. Common riparian vegetation used at each site differs depending on the species native to that area, but typically includes a combination of native woody trees, shrubs, and grasses.
Marsh grass planting	Dissipate wave energy, filter upland runoff, and improve habitat for fish and wildlife. Native grasses are planted in the littoral zone. Marsh grasses may be more successful if they are planted in the spring in areas where there is evidence of existing marsh and minimal fetch.
Mangrove restoration	Mangrove restoration typically involves the restoration of degraded physical or hydrological conditions at a given site such that regeneration of mangrove communities occurs naturally over time. This can be coupled by the manual planting of mangrove propagules. These plant communities typically grow in the Caribbean, southern Florida, and portions of south Louisiana. See Section 2.2.2.11.5 - Wetland Planting for a description of the restoration activity.

Design Strategy	Application
Natural fiber logs (or bio-logs) placement	Made of biodegradable coconut fiber and netting, bio-logs are commonly used to stabilize slopes and minimize bank erosion. Logs are placed along bank slopes or in the water at specified elevations, molded to fit the bank line, and then anchored in place. They provide protection to newly planted marsh grasses so they can establish a healthy below-ground root system.
Natural fiber matting placement	Made of coir fiber, wood, straw, jute, or a combination of organic, biodegradable materials. The matting is laid over eroding steep slopes or coastal areas to minimize the loss of sediment from the land and trap wave-transported sediment. Organic matting can also be planted with marsh grasses or riparian vegetation to enhance shore stabilization.
Rock footer installation	Rock or boulder material used to anchor and support bio-logs and stabilize the restored shoreline. The rock footer supports the structural integrity of the vegetative root mass and prevents it from sloughing off into deeper waters of the bank slope.
Rock sill, groin, or breakwater installation	Freestanding rock structures placed in the water parallel or perpendicular to shore to dissipate wave energy and protect eroding marshes and shorelines. Structures are generally segmented, which allows wildlife access to the shoreline. Some structures are designed to be seeded with oyster spat and/or provide appropriate substrate to catch natural spat set (e.g., reef balls) to improve water quality and provide habitat while reducing wave energy.
Sediment-filled geotextile material tubes placement	Placed parallel to shore to dissipate waves in high-energy environments. The tubes, which measure approximately 12 feet in diameter, create new avenues for dredge material disposal, and produce a hard surface on which the eastern oyster can construct reefs.
Filter fabric placement	A porous layer of geotextile material placed beneath rock sills and breakwaters to prevent sand movement into or through the rock or concrete structure at hybrid living shoreline sites.
Native reef-building	Techniques can be grouped into two types: placement of substrate and introduction of shellfish. One or the other of these types may be used, or both together at the same restoration site, depending on the species or the needs of the locality. See Section 2.2.2.6.1 - Coral Reef Restoration for a description of the restoration activity.

2.2.2.11.3 Sediment Removal

Sediment accumulation in wetland, estuarine, and marine systems from either natural or anthropogenic processes (e.g., erosion or dredging operations) can alter normal flow patterns, bury or suffocate living coastal and marine resources such as shellfish and SAV, entrap or immobilize fish, cause flooding, block migratory fish from reaching spawning areas or completing out-migration, and otherwise adversely affect the aquatic environment. Sediment removal projects are undertaken to alleviate these situations and restore natural flow regimes.

A characteristic restoration project including removal of substrate would involve using heavy machinery to remove the unwanted sediment. Historically, existing marsh was often converted to upland through the placement of sediment onto the marsh. Sometimes this activity was for the purpose of creating buildable upland areas, but dredge spoil from waterways was frequently discharged in a marsh for disposal purposes. To remove unwanted sediment, restoration activities often involve:

- Removing unwanted upland vegetation in the area with hand tools such as chain saws, or with heavy machinery (e.g., front-end loaders and dump trucks). Heavy machinery is often used to both remove and dispose of the removed vegetation and sediment; or
- Excavating to an elevation determined by project designers based on the overall goals of the project. The area may be gently sloped to create a gradient from subtidal to high marsh elevations, or additional excavation may be needed to create tidal creeks or channels.

Sometimes projects excavate sediment from one portion of a project site, and place it in the littoral zone or upland areas within the same project site.

2.2.2.11.4 Sediment/Materials Placement

In cases where the wetland has subsided and the native marsh vegetation has drowned, or where new wetland is needed, various techniques may be used to raise the level of the marsh. Loss of sediment and land subsidence can lead to the disappearance of tidal wetlands at alarming rates. For example, sediment historically supplied by the Mississippi River no longer reaches Louisiana's coast due to man-made channelizing of the river's flow for flood control and navigation maintenance. Although other factors (such as erosion from wave action in the channels cut throughout the bayous for oil and gas exploitation and exploration activities) contribute further to the loss, the main problem is the loss of sediment and subsequent degradation of marsh habitat. Sediment placement activities, including the beneficial use of dredge material, can be used to create or restore wetlands, stabilize eroding natural wetland shorelines, nourish subsiding wetlands, or construct erosion barriers that aid in restoring a degraded wetland. Depending on the project, the equipment used in such cases may include dredges and/or heavy construction equipment to distribute dewatered sediment to the appropriate elevation.

Sediment/materials placement activities often involve:

- Deploying sediments, either dredged materials or clean sand fill, into areas fully converted to open water (as in the case of marsh restoration), or onto eroded or degraded coastal shorelines (as in the case of beach restoration). This technique may involve creating mounds designed to provide a variety of elevations and slow water velocities, further trapping sediment to build elevation naturally; or
- Spraying a thin layer of dredge sediments over an existing wetland. This technique is used when the wetland is failing to keep pace with sea level rise and/or subsidence but has not yet been fully converted to open water.

Nationwide, the NOAA RC has implemented more than 1,090 projects with shoreline stabilization activities as components of the project and it is reasonable to expect that the need for shoreline stabilization activities will continue nationwide due to the need to address concerns over continued degradation of important coastal and subtidal habitat for migratory threatened and endangered species, as well as recreationally and commercially important species. The majority of these projects have taken place in the southeast, northeast, southwest, and northwest regions, but this is a critical restoration activity in all parts of the country where NOAA works.

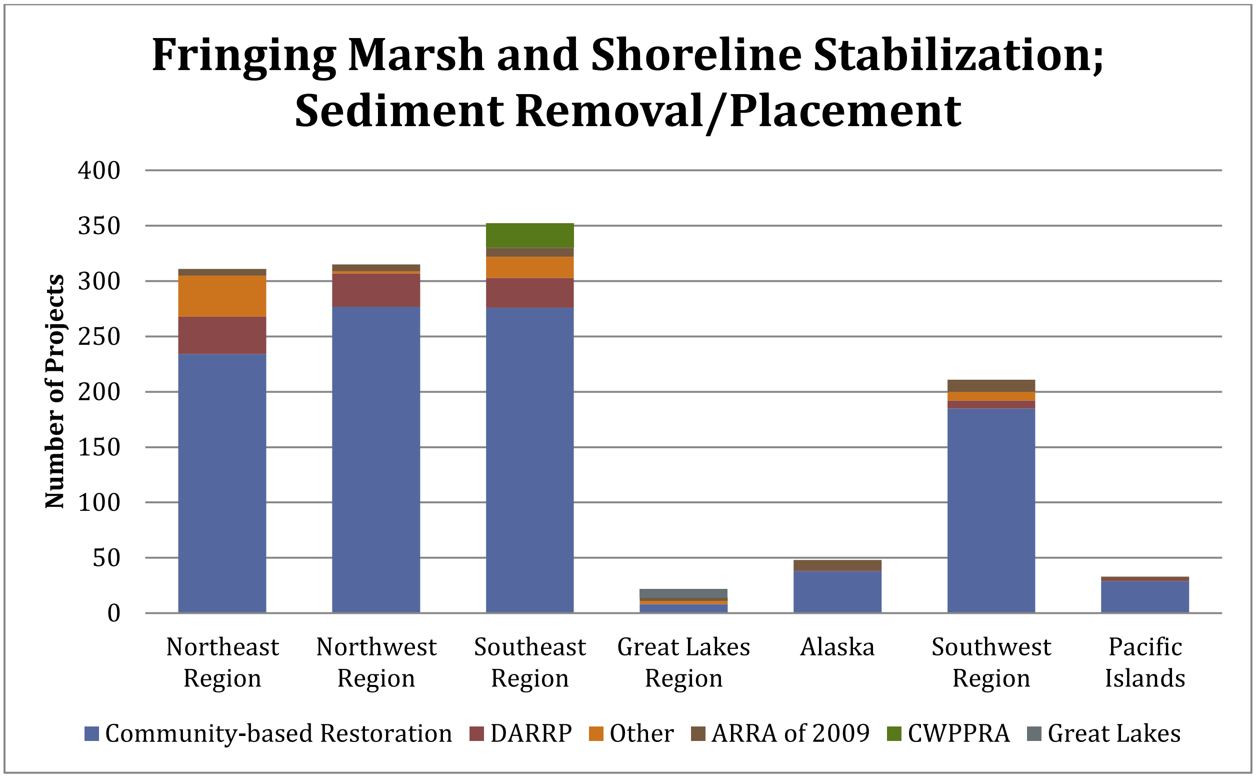

Figure 18 - Fringing Marsh and Shoreline Stabilization/Sediment Removal and Sediment/Materials Placement projects implemented by the NOAA RC (includes terracing, culvert modification (including replacement), culvert removal, native plant nursery construction, planting, tide gate installation, tide gate modification (including replacement), tide gate removal, fill removal, placement of dredge material and bird habitat enhancement activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.2.11.5 Wetland Planting

Native vegetation may be planted in combination with other restoration techniques, or as a separate effort. Planting is required either because a local native vegetation source is not available or is insufficiently abundant to spread to new habitat, or because project managers wish to jump-start vegetation growth (depending on site conditions and available seed source) and potentially involve volunteers in planting efforts. Such activities are conducted in order to stabilize bare or erodible substrate. Commonly planted species are shown in Table 3Table 3 - Commonly planted vegetation species above.

Native plants may be sourced from local nurseries, or from healthy donor marshes. Some organizations involved in restoration construct and manage plant nurseries. These range from a series of wading pools in a school playground, to large wetland areas created as donor sites, to greenhouses. Shrubs or trees planted in high marsh, floodplains, and other frequently flooded areas may require digging a hole approximately twice the diameter of the root ball; many herbaceous wetland plant plugs are planted with a dibbler that creates only a small indentation, which is filled by patting soil back into place by hand. Slow-release fertilizer may be added to the planting hole.

Nationwide, the NOAA RC has implemented more than 1,290 projects with marsh restoration activities as components to the project's work, and it is reasonable to expect that the need for such restoration activities would continue nationwide due to the importance of marsh habitat to migratory threatened and endangered species, as well as recreationally and commercially important species.

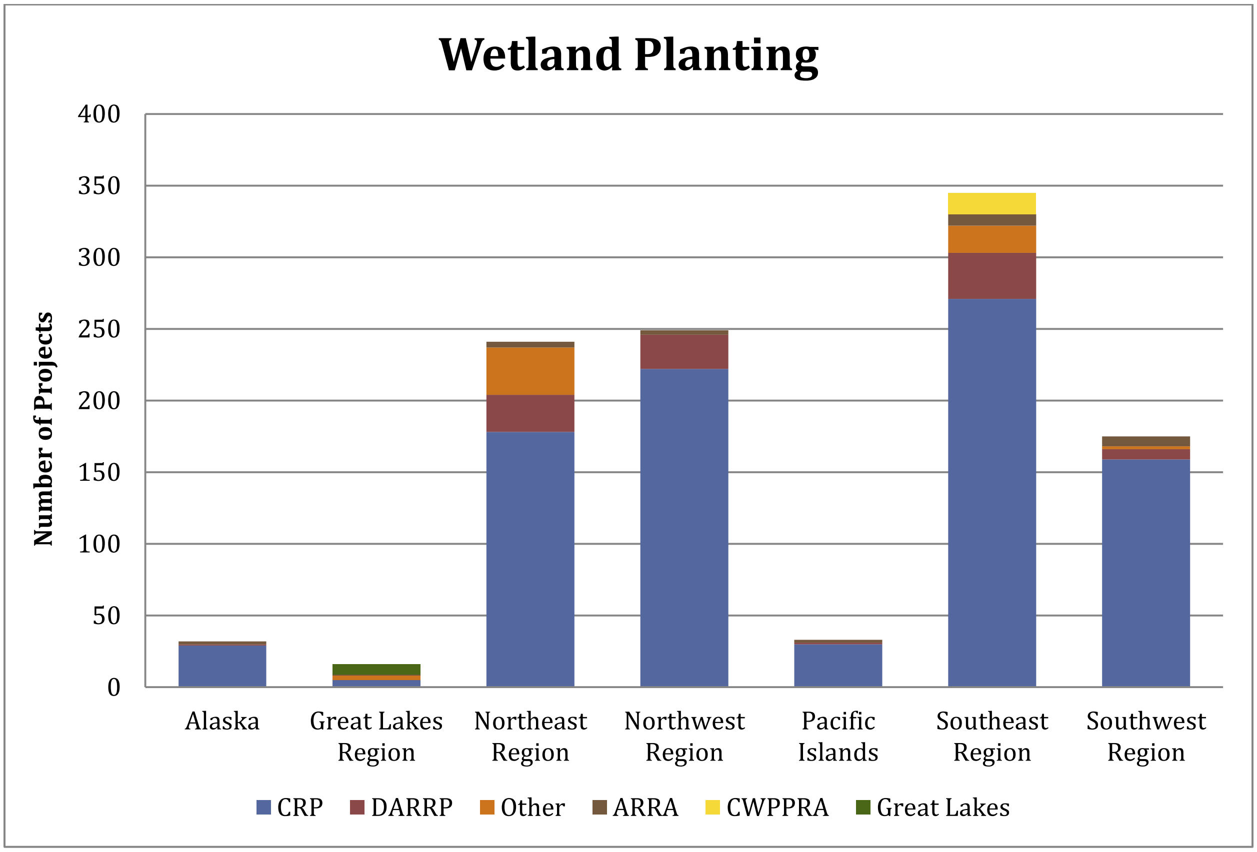

Figure 19 - Wetland Planting projects implemented by the NOAA RC (includes erosion control, bulkhead removal, planting, native plant nursery construction, and bird habitat enhancement activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.2.3 Land and Water Acquisition and Other Transactions

The acquisition, and related transactions, of land and water can be used strategically to conserve, protect, and restore our nation's fisheries resources. These transactions can take many forms, including land acquisition (fee-simple purchase, permanent easements, and temporary easements) and water transactions (water rights acquisition or transfers, water easements, and temporary forbearance agreements). As a general rule, NOAA would provide funds to acquire the minimum possible interest or rights in lands and waters while still meeting the defined resource objectives. The title or easement would not be held by NOAA but rather by a private or public entity for conservation purposes. Furthermore, these actions would be limited to those that have willing landowner participation. These actions can be used in combination with other conservation tools, such as active restoration of injured or at-risk resources, to protect subtidal, shoreline, and riverine habitats.

2.2.3.1 Land Acquisition

Financial instruments such as land acquisitions (i.e., fee-simple purchases or easements) are increasingly being used as a mechanism for conserving subtidal, shoreline, upland, and riverine habitats for fisheries. Land-use planning often couples acquisition with active restoration to protect and restore suitable habitats for injured or at-risk resources.

Land acquisition projects include implementation of projects involving land purchases (fee-simple transactions) or securing conservation easements (temporary or permanent) for the purposes of conservation and restoration. Land acquisition may include improvements to public access to resources. Acquisition of existing structures, such as boathouses or docks, is also considered a land acquisition activity. Acquisition is an effective passive restoration and conservation approach by itself or as a component to a larger restoration effort. Acquisitions would be from willing landowners only. All land acquisition projects would be implemented in accordance with state laws and statutes pertaining to the acquisition of lands, waters, or other interests and in full cooperation with the appropriate state, county, and local governing bodies of the area in question as required by relevant statutes and laws. Land uses after acquisition would be limited to those less destructive to the environment than before purchase—namely for the purpose of restoration, protection, or other conservation activities—and in accordance with state and local laws.

2.2.3.2 Water Transactions

Complementing efforts to acquire, protect, and restore land are activities to protect and enhance stream flows. NOAA's water transaction activities seek to preserve or increase water quantity within rivers to conserve freshwater biodiversity while maintaining the water needs of human society. Water transactions may include water rights acquisition and transfers, long-term and permanent water easements, temporary forbearance agreements, or other financial incentives to improve in-stream flows (e.g., short-term and split-season leasing, source switching, point of diversion changes, and rotational pooling agreements).

All water transaction agreements would provide temporal and quantitative assurances that water withdrawal activities would result in reduced water withdrawal during low flow or environmentally sensitive periods (typically the summer on the West Coast). The parameters for in-stream flow and withdrawal allowances (i.e., change of water use practice, low flow threshold, season of storage, etc.) would be specified in the transaction agreement. Furthermore, all forbearance agreements would designate the period of agreement (e.g., 10 years) for which the agreement would be in place. All water transaction activities supported by NOAA would require diverters to verify compliance with water rights laws and, as needed, provide evidence of small domestic use or livestock stockpond registration, appropriative water right, or a statement of riparian water use registered with the cognizant state agency.

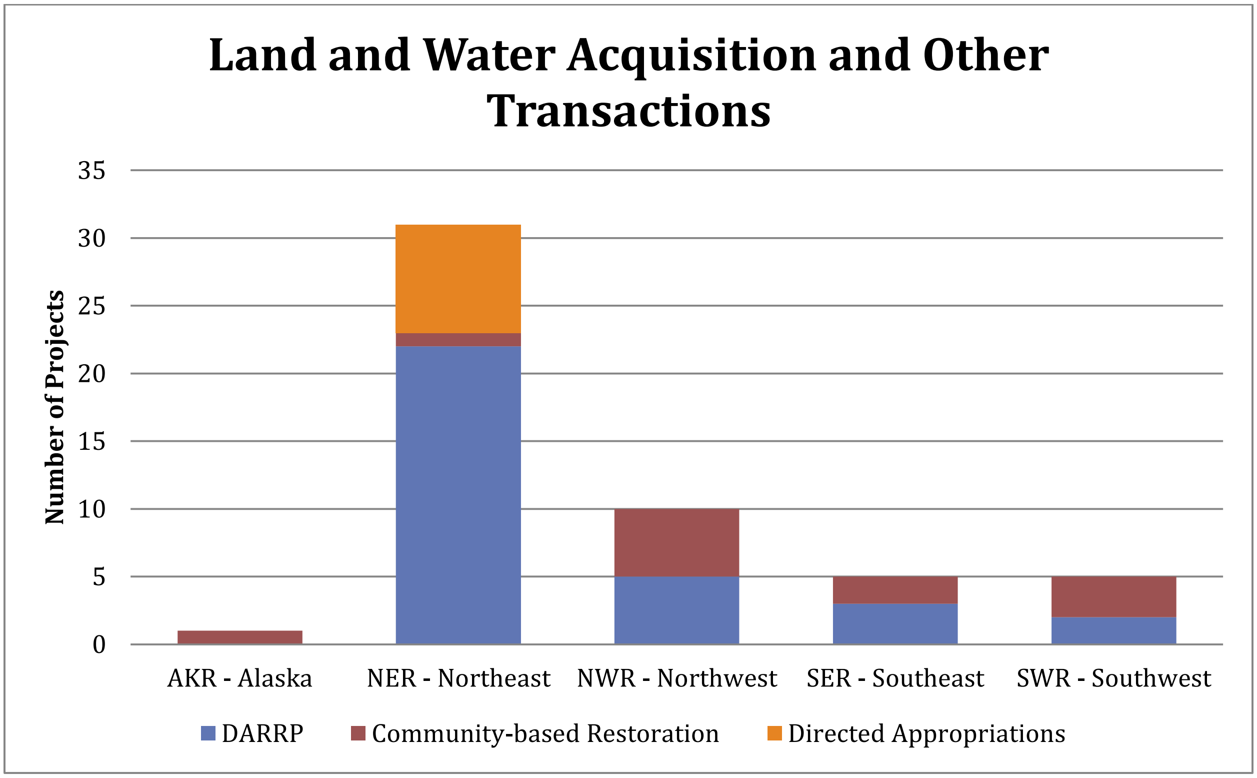

Figure 20 - Land and Water Acquisition and Other Transactions projects implemented by the NOAA RC (includes water rights and land acquisition activities). Data retrieved from NOAA Restoration and Conservation Database December 2013.

2.3 Alternative 2 – "Technical Assistance"

The technical assistance alternative describes NOAA's actions in the restoration process as being advisory in nature, which includes supporting only planning, permitting, monitoring, research, and outreach or education activities. Section 2.2.1 describes the activities proposed under this alternative, and while these activities would also be conducted under the preferred alternative, they would not be paired with the physical restoration activities that the preferred alternative would implement as described in Sections 2.2.2 and 2.2.3. Technical assistance activities are important to the overall restoration process, however they do not normally achieve immediate tangible habitat restoration benefits as they exclude the on-the-ground activities. Therefore, under this alternative, the benefits resulting from on-the-ground restoration activities would not be a result of direct involvement by NOAA, and efforts toward achieving NOAA's mission as outlined in the Purpose and Need (Section 1.1.1) would be greatly reduced.

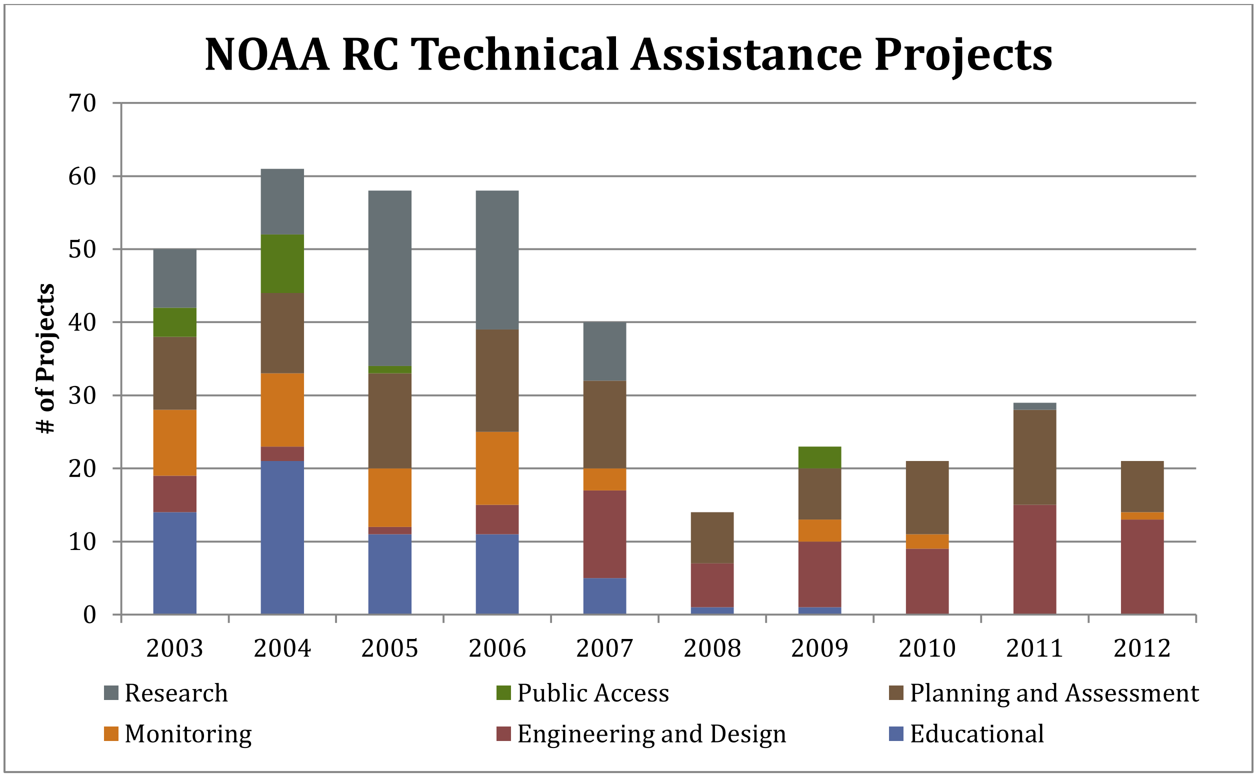

Figure 21 - NOAA Restoration Center Technical Assistance Projects (since 2003).

3.0 Affected Environment

3.0 Affected Environment ... 65
3.1 Coastal Habitats ... 66
3.1.1 Wetlands ... 66
3.1.1.1 Tidal Wetlands ... 67
3.1.1.2 Nontidal Wetlands ... 68
3.1.2 Ponds/Lakes ... 69
3.1.3 Stream and River Channels ... 69
3.1.4 Riparian Habitat ... 70
3.1.5 Submerged Aquatic Vegetation and Marine Algae ... 70
3.1.6 Reefs ... 72
3.1.6.1 Oyster Reefs ... 72
3.1.6.2 Coral Reefs ... 72
3.1.6.3 Artificial Reefs ... 73
3.1.7 Beaches and Dunes ... 73
3.1.8 Mangroves ... 74
3.1.9 Mud or Sand Flat and Subtidal Bottom ... 74
3.2 Geology and Soils ... 75
3.3 Water Resources ... 77
3.4 Living Coastal and Marine Resources and Essential Fish Habitat ... 80
3.5 Threatened and Endangered Species ... 81
3.6 Cultural and Historical Resources ... 81
3.7 Land Use and Recreation ... 81
3.8 Socioeconomics ... 82

The affected environment associated with the proposed action is substantial, including all coastal, estuarine, and marine habitats in the United States and territories. It also includes inland habitats that influence or affect rivers, streams, and creeks affecting marine or estuarine waters, or that support migratory fish populations. It may also include adjacent or continuous habitats in Canada or Mexico that support living coastal and marine resources under NOAA trusteeship.

The following sections generally describe the physical, biological, and social environments of the United States, with emphasis on the coastal, estuarine, and marine habitats. The descriptions use an ecosystem approach to segment each region into specific types of habitat, for which baseline information is presented in the PEIS (CEQ 1993; Bailey 1995). Table 6 presents the applicable habitat types and the NOAA RC regions containing the specific habitat types.

Table 6 - Habitat types by region

Affected Environment	Alaska	Great Lakes	North-east	North-west	Pacific Islands	South-east	South-west
Corals					•	•	
Wetlands	•	•	•	•	•	•	•
Mud or Sand Flat and Subtidal Bottom			•	•	•	•	•
Stream and River Channels	•	•	•	•		•	•
Marine Algae (kelp and seaweeds)			•	•			•
Mangroves					•	•	
Oyster Reefs and Shellfish Habitat	•		•	•		•	•
Ponds/Lakes	•	•	•	•		•	•
Riparian Habitat	•	•	•	•	•	•	•
Shorelines	•	•	•	•	•	•	•
Submerged Aquatic Vegetation	•	•	•	•		•	•
Water Resources	•	•	•	•	•	•	•

The following resources also are generally described: geology and soils, water resources, living coastal and marine resources and EFH, threatened and endangered species, cultural and historic resources, land uses, and demographics. For resources that differ greatly between regions, efforts are made to highlight the resource on a regional basis. For the sake of brevity, resources for which impacts are not possible or likely are not carried forward for further evaluation.

3.1 Coastal Habitats

3.1.1 Wetlands

Wetlands provide numerous beneficial ecological functions, including protection of shorelines from waves and storm surges, erosion control and buffering, carbon sequestration and storage, water storage, maintenance of water quality, removal of sediments, groundwater recharge, nutrient and pollution filtering, spawning and nursing areas for many fish species, and food and habitat for numerous species of aquatic and terrestrial plants and animals. Wetlands are among the most productive ecosystems in the world, supporting thousands of species of plants, animals, shellfish, finfish, birds, invertebrates, and microbes (NMFS 2004b). Wetlands also provide important recreational and economic benefits for humans, such as opportunities for boating, fishing, hiking, waterfowl hunting, nature observation, and photography, among many others.

Since the 1700s, millions of acres of wetland resources in the United States have been directly and indirectly degraded or significantly altered by humans through processes such as ditching, draining, filling, invasion of invasive species (e.g., common reed (Phragmites sp), purple loosestrife, among others), impounding, sea level rise, pollution, and diversion or impacting by storm water (Long

Island Sound Habitat Restoration Initiative 2003). Between the 1950s and the late 1990s, the contiguous United States lost an estimated 385,000 acres of estuarine vegetated wetlands (salt marshes, shrub wetlands, and mangroves) (Dahl 2000; Mitsch and Gosselink 2000). And between 1922 and 1954, approximately 642,200 acres of coastal wetlands were lost (Mitsch and Gosselink 2000). These figures amount to an average rate of estuarine and coastal wetland loss of 13,696 acres per year between 1922 and the late 1990s (the total loss was roughly 1,027,200 acres for the entire period). These figures do not include losses for other wetland habitat types critical to maintaining fish stocks, such as stream and riverine habitat losses. In addition, the degradation and loss of tidal wetland habitats can result in these strong natural carbon sinks becoming large sources of carbon (Pendleton et al. 2012).

Section 404 of the Clean Water Act (CWA) (33 USC 1344) provides a statutory definition of wetlands and assigns jurisdiction over protection of wetlands to the U.S. Army Corps of Engineers (USACE). For regulatory purposes under the CWA, wetlands are defined as "… those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (40 CFR 230.3(t)). An area is a jurisdictional wetland only if it exhibits the following three characteristics: evidence of hydric soils, dominance of hydrophytic vegetation, and wetland hydrology. Under Section 404 of the CWA, the USACE requires that an interested party obtain a permit before filling, constructing on, or altering a jurisdictional wetland. Further, mitigations for such activities are required but vary from state to state, and may include purchasing wetlands from an existing wetland bank, or enhancing, restoring, or creating wetlands that may be either onsite or offsite. In some states, the state has assumed jurisdiction over certain wetlands from the USACE under Section 404.

Wetland resources are found throughout the area potentially affected by NOAA RC–supported projects, including all regions and many areas along coastlines, rivers, streams, estuaries, and other water bodies or receiving areas. A wide variety of wetlands occur in the potentially affected area covered by this PEIS, including tidal and nontidal wetlands. These categories of wetlands are described below.

3.1.1.1 Tidal Wetlands

Tidal wetlands include salt, brackish, and fresh tidal marshes that are transitional habitats between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water tidally or seasonally (Thayer et al. 2003). Marshes occur on all coasts of the United States, in every region under NOAA jurisdiction. Most marine fish depend on the resources of tidal wetlands during some part of the life cycle. Marsh ecosystems, like all wetlands, are a function of hydrology, soil, and biota. Salt marshes exist on the transition zone between the land and the sea in protected low-energy areas such as estuaries, lagoons, bays, and river mouths (Copeland 1998). Tidal cycles allow salty and brackish water to inundate and drain the salt marsh, circulating organic and inorganic nutrients throughout the marsh. The marshes are strongly influenced by tidal flushing and stream flow, which affect the inundation and salinity regimes of salt marsh soils. In areas with enough freshwater input, salt marshes transition into brackish and freshwater marshes (Copeland 1998). Sand and mudflats occur throughout the tidal spectrum, whereas salt marsh vegetation develops where the soils are more exposed to the air than inundated by tides, usually above mean sea level. Salt marshes are of paramount ecological importance because they 1) export vital nutrients to adjacent waters, 2) improve water quality through the removal and recycling of inorganic nutrients, 3) absorb wave energy from storms and act as a water reservoir to reduce damage further inland, and 4) serve an important role in nitrogen and sulfur cycling (Mitsch and Gosselink 1993) and in carbon sequestration and storage (McLeod et al. 2011). Salt marshes provide important habitat for invertebrates (such as crabs and bivalves) and fishes. Vital nutrient exchange takes place in salt marshes, as the detritus and algae in the marshes are consumed and nutrients excreted by birds, fish, and shellfish are recycled by the flora (Zedler 1992). Salt marshes, along with mangroves and seagrasses, are very productive ecosystems that also store and sequester substantial amounts of carbon belowground in soils at very high rates, commonly known as "blue carbon" (Duarte et al. 2010; Donato et al. 2011; McLeod et al. 2011; Fourqurean et al. 2012). This ability to sequester and store carbon at high rates makes these ecosystems approximately equivalent to terrestrial forests in their ability to serve as carbon sinks, despite having a much smaller geographic footprint (McLeod et al. 2011).

Influenced by local geology and climate, estuaries also vary in character in and along different coastlines and are generally classified as drowned river valleys, fjords, bar-built, and tectonic in origin (Pritchard 1967; Russell 1967). These estuarine types differ dramatically from one another in habitat structure: from broad, deltaic flats with monotypic stands of emergent marsh or expansive, unvegetated flats to mainstem channels cutting through bedrock beach terraces. Additionally, many restoration projects in such areas take place along very urbanized coastline, and some of these urbanized estuaries have lost a large portion of their littoral wetland habitats.

Brackish marshes are found in embayments and tidally influenced rivers where marine water is diluted with freshwater. Brackish water typically has a salinity of 0.5 to 35 parts per thousand; the salt content of soil in brackish marshes ranges from 0.5 to 18 parts per thousand (Long Island Sound Habitat Restoration Initiative 2003). Species composition changes with salinity and water content. Fresh tidal marshes are found in areas where the tide rises and falls but the waters have no detectable salt content. Fresh tidal marshes feature the greatest diversity of tidal wetlands and support a larger number of plants than salt and brackish marshes.

3.1.1.2 Nontidal Wetlands

Nontidal wetlands include a wide variety of wetland habitat types, including certain palustrine, riverine, and lacustrine forested, scrub-shrub, emergent wetlands, and also bogs, fens, and vernal pools. Freshwater wetlands are found in every state and region. Some freshwater wetlands provide spawning and rearing habitat for migratory fish species and are hydrologically connected with coastal areas.

Cowardin et al. (1979) developed a system for classification of freshwater wetlands in the United States that includes the following types:

- Palustrine refers to nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens. This also includes non-vegetated wetlands that are shallow (i.e., less than 6 feet deep) with no wave-formed or exposed bedrock shoreline features, and that are less than 20 acres in size.

- Lacustrine refers to deep-water habitats (see Section 3.1.2 - Ponds/Lakes below) and wetlands situated in a topographical depression or dammed river channel. Lacustrine wetlands lack trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens with greater than 30 percent aerial coverage, and are more than 20 acres in size.

- Riverine refers to wetlands and deep-water habitats contained within a channel, except those dominated by persistent emergent vegetation, trees, or shrubs (palustrine), or with greater than 0.5 parts per thousand ocean-derived salinity (estuarine, marine).

3.1.2 Ponds/Lakes

Ponds and lakes are freshwater habitats located in topographic depressions where water is naturally or artificially impounded and stored for extended periods of time. Ponds and lakes are located throughout the United States, occurring in every state and region. Ponds and lakes are critical ecological resources with respect to the proposed action; similar to the freshwater wetlands with which they are often intricately associated, ponds and lakes provide habitat for species such as waterfowl that also use coastal resources. In addition, many lakes and ponds are hydrologically connected with coastal or marine resources through processes such as surface water flow. They provide nutrients, sediment and pollution filtration, and water storage, among many other functions.

The U.S. Environmental Protection Agency (EPA) defines a lake as "a large body of water, typically freshwater, which can be formed by glaciers, river drainage, surface water runoff, or ground water seepage. Lakes provide an area for recreational activity (e.g., boating, water skiing, and fishing) and a habitat for wildlife. They are particularly important to migrating wildlife." Lake ecosystems support complex and important food web interactions and provide habitat needed to support numerous threatened and endangered species (U.S. EPA Office of Water 2004). EPA defines a pond as "a body of water usually smaller than a lake, encircled by vegetation, and generally shallow enough for sunlight to reach the bottom. Rooted plants can grow in any spot within the pond creating a habitat for various forms of animal life" (U.S. EPA 2004b).

3.1.3 Stream and River Channels

Tidal and nontidal stream and river systems are located in every region of the NOAA RC. Many rivers and streams along the coast are tidal, with the effects of ocean tides extending upstream. The channel of a stream or river is the portion of the cross section that is usually submerged and totally aquatic (U.S. EPA Office of Water 2004). Channel substrates may be composed of various materials, including cobbles, boulders, sand, clay, and silt. Portions of a river channel often contain biological elements such as oyster reefs or SAV beds that help shape or define the channel.

Stream and river channels are critical to the viability of living coastal and marine resources. In addition to providing freshwater, rivers and streams transport nutrients and provide habitat for thousands of aquatic and terrestrial species, including birds, shellfish, finfish, amphibians, reptiles, mammals, plants, and invertebrates. Vegetation that grows along the banks of rivers and streams stabilizes the banks, shades the water, and provides cover and food for animals and nutrients for the ecosystem (e.g., from fallen leaves).

The integrity of stream and river channels is important to the viability of not only the streams and rivers themselves, but also to the estuaries, oceans, marshes, and wetlands connected to them. Processes such as accelerated channel erosion, pollution, diking, damming, channel alteration, scouring, and dumping can drastically affect the rivers and streams and their receiving waters by causing accelerated sedimentation, and alteration of temperature and water quality, among other factors.

3.1.4 Riparian Habitat

Riparian zones are defined as the land immediately adjacent to a stream or a river. Riparian areas are commonly characterized by bottomland hardwood and floodplain forests in the East and as bosque (dense growth of trees and underbrush) or streambank vegetation in the West (Mitsch and Gosselink 1993). Riparian environments are maintained by high water tables and experience seasonal or periodic flooding. Riparian zones contain or adjoin riverine wetlands and share many functions, including water storage, sediment retention, and nutrient and contaminant removal, as well as habitat functions.

The riparian zone is a characteristic association of substrate, flora, and fauna within the floodplain of a stream or, if a floodplain is absent, a zone hydrologically influenced by a stream or river (Hunt 1988). Riparian environments are maintained by high water tables and experience seasonal or periodic flooding. The width and other characteristics of the riparian zone vary greatly between regions and locally between river and watershed size and stream order. They may also contain or adjoin riverine wetlands and share with them many functions, including surface and subsurface water storage, sediment retention, nutrient and contaminant removal, and maintenance of habitat for plants and animals. They often share some of the characteristics of wetlands but cannot be defined as wetlands because they are saturated at much lower frequencies. Riparian ecosystems have distinctive vegetation and soils, and are characterized by the combination of species diversity, density, and productivity. Continuous interactions occur between riparian, aquatic, and upland ecosystems through exchanges of energy, nutrients, and species (National Research Council 1995).

3.1.5 Submerged Aquatic Vegetation and Marine Algae

Submerged aquatic vegetation (SAV; submerged grasses or seagrasses) differ from most other wetland plants in that they are almost exclusively subtidal, reside mainly in marine salinities, and use the water column for support. Seagrasses occur across a wide depth range, from rocky intertidal habitats to depths of 40 meters, and, for some species, across broad latitudinal ranges. Distribution patterns are influenced by physical (waves, currents, tides), geological (sediment grain size) and geochemical factors. (Koch 2001). Seagrasses supply many habitat functions, including: (1) support of large numbers of epiphytic organisms; (2) damping of waves and slowing of currents, which enhances sediment stability and increases the accumulation of organic and inorganic material; (3) binding by roots of sediments, thus reducing erosion and preserving sediment microflora; and (4) roots and leaves provide horizontal and vertical complexity to habitat, which, together with abundant and varied food sources, support densities of fauna generally exceeding those in un-vegetated habitats (Wood et al. 1969; Thayer et. al. 1984). As with salt marshes, seagrasses (and mangroves – see Section 3.1.8 below) are very productive ecosystems that also store and sequester substantial amounts of carbon belowground in soils at very high rates, commonly known as 'blue carbon' (Duarte et al. 2010; Donato et al. 2011; McLeod et al. 2011; Fourqurean et al. 2012). This ability to sequester and store carbon at high rates makes these ecosystems approximately equivalent to terrestrial forests in their ability to serve as carbon sinks, despite having a much smaller geographic footprint (McLeod et al. 2011).

Several types of marine algae are targeted for restoration. Kelp "forests" are subtidal marine communities dominated by large brown algae (kelps) that form floating canopies on the surface of the sea. Kelp forest communities are found from sea level to as deep as 60 meters, depending on light penetration (Foster and Schiel 1985). The combination of nutrients, warm temperatures and other macrophytes determine the distribution of kelp forest at low latitudes, while kelp forest distribution is dependent on light at high latitudes (Graham et al 2002). The major species that form floating surface canopies along the West Coast are *Macrocystis pyrifera* and *Nereocystis luetkeana*, off California, and *Alaria fistulos*a in Alaska (Druehl 1970). A kelp canopy can reduce bottom light to less than 3% but usually less than 1% of surface influx, thus affecting species composition and growth rates in the understory (Reed and Foster 1984). Severe water motion can modify kelp communities by removing the kelp plants (Cowen et al. 1982; Dayton and Tegner 1984), but in milder conditions the floating canopy can act as an offshore damper that reduces wave forces (Schiel and Foster 1992). Kelps with floating canopies do not occur along the East Coast, although plants can obtain heights of over 6 meters above the bottom. Kelp forests are highly productive and also create a three-dimensional aspect to the nearshore environment, providing habitat and food for hundreds of other species of plants (algae) and animals. Kelp forests on hard reef areas can harbor lush understory layers of red and brown algae, as well as mobile and encrusting invertebrates. Throughout the kelp forest there are hundreds of species of fish, and there are vertical layers of vegetation that vary with depth (Schiel and Foster 1992). Food is exported from kelp forests to associated communities such as sandy beaches and the deep sea.

Seaweeds (e.g., rockweeds) are brown macroalgae such as *Ascophyllum spp.* and *Fucus spp.* Like kelps, they are primary producers converting inorganic nutrients into organic biomass by using the energy of the sun. They lack true roots, stems, and leaves and because they lack a vascular system, absorbing dissolved nutrients directly through the blades. The holdfast is used to attach the algae to intertidal rocks. Without attachment to hard substrates, algae will die. Unlike kelp, rockweeds have a higher light requirement, a higher water temperature tolerance (0–28° C), a higher tolerance to low salinity waters, and, to some degree, can resist desiccation, ultraviolet radiation and overheating. Rockweeds can grow vegetatively or sexually. For *Fucus spp.* sexual reproduction can occur year-round, whereas *Ascophyllum nodosum* reproduces in the late spring and early summer. In Maine, the life span of rockweeds ranges from approximately 3 years for *Fucus vesiculosus* to 16 years for *Ascophyllum nodosum* (Wippelhauser 1996). Rockweed reproduction is restricted to local adult plants; if all adults are gone, an area can be devoid of rockweeds for years.

3.1.6 Reefs

3.1.6.1 Oyster Reefs

The terms "oyster reefs" and "oyster beds" are often used interchangeably, although some make the distinction of oyster reefs being subtidal, dense, high relief structures, whereas oyster beds are low relief, loose collections of oyster communities in the intertidal zone. For this document, we will refer to oyster reefs in general, and reference oyster beds where the distinction is appropriate. Oyster reefs may be found in intertidal and subtidal areas, where suitable substrate and adequate larval supply exist, along with appropriate (brackish to estuarine) salinity levels and water circulation. Oyster reefs historically were common throughout the coastal United States (from Alaska to California; from the Gulf Coast to Maine), but have been greatly reduced in occurrence as a result of anthropogenic impacts in the past 200 years (Kennedy and Sanford 1999). In many areas, oyster reefs have experienced dramatic declines in both population numbers and functional capacity (Beck et al. 2011). Oyster reefs are naturally built by the cementing together of oyster shells, with additional hard substrate provided by associates such as other bivalves, barnacles, and calcareous tube builders such as some polychaetes (Kennedy and Sanford 1999). Larvae of these invertebrates settle seasonally on this substrate. Eventually, a mound forms and grows vertically and laterally as oysters accumulate and shell is scattered in the bed's vicinity (Bahr and Lanier 1981). Oyster reefs can vary in morphology, influenced by local effects (Kennedy and Sanford 1999). Oyster reefs provide shoreline protection (hard substrate) from wave action; filter and clarify water; provide habitat for other invertebrates; and serve as an important food source for humans.

3.1.6.2 Coral Reefs

Coral reefs are among the most productive of marine ecosystems and are critically important for the ecosystem services they provide. They are complex and diverse ecosystems with a high level of biodiversity and productivity. Coral reefs are found throughout the Southeast Atlantic, Gulf of Mexico, and Pacific regions of the coastal United States. The United States has jurisdiction over an estimated 19,700 km^2 of coral reefs, not including the Freely Associated States (Turgeon et al. 2002). Twenty-two threatened coral species from the Caribbean and Indo-Pacific regions are listed under the ESA.[7]

Coral reefs provide habitat for thousands of species of fish and shellfish and hundreds of species of corals, algae, sponges, echinoderms, mollusks, bryzoans, crustaceans, and many other groups of organisms. Therefore, the health of coral reefs has profound implications on these species and on the marine ecosystem as a whole. Shallow-water reef-building corals are composed of tiny coral polyps that cluster together to form larger coral colonies. A typical coral reef is composed of complexes of coral colonies and other organisms that construct a calcium carbonate (limestone) structure. Reef-building corals maintain symbiotic relationships with algae (zooxanthellae) that live in the coral polyps, which give the corals most of their color; provide the corals with food,

[7] As of October 2014. See the NOAA Protected Resources website for current listing of species. www.nmfs.noaa.gov/pr

oxygen, and byproducts to build the calcium carbonate necessary to build their skeletons; and take up nutrients excreted by the corals (NOAA 2011). In return, the algae gain protection from predators and strong wave activity. Corals also provide a source of nitrogen fixation in low-nutrient environments. Coral-dependent cyanobacteria and other algae use elemental nitrogen and release excess to the surrounding water column (Sorokin 1993). This release stimulates both benthic and pelagic biological productivity. Generally, shallow-water corals require fully marine waters, warm water, ample sunlight, and the presence of suitable substratum.

While most of the reef environment is depositional, the seaward growing portion of the reef is essential for the survival and maintenance of the rest of the reef system (Hoegh-Guldberg 1999). Coral reefs predominate in many tropical benthic environments because of their ability to grow or maintain structures in the face of heavy or prevailing wave action. Also, coral reefs grow in oceanic waters that may be low in nutrients. Coral may dominate a habitat (coral reefs), be a component of a habitat (hardbottom), or exist as individuals within a community characterized by other fauna (solitary corals) (GMFMC 1998, NOAA 2011). Hardbottoms constitute a group of communities characterized by a thin veneer of live corals and other biota overlying associated sediment types. They are usually of low relief and occur on the continental shelf and may be associated with relict reefs. Coral reefs are also linked to mangroves and seagrasses where these systems occur in close proximity to one another (Nagelkerken et al 2002, Mumby et al 2004).

In addition to their exceptionally important ecological role, coral reefs provide numerous human use values. These include, but are not limited to: shoreline protection (through dissipation of wave energy); habitat for reef and pelagic fish species (re: human food/subsistence); diving, snorkeling, and other recreational opportunities and associated economic benefits; and potential medicinal uses.

3.1.6.3 Artificial Reefs

When properly planned, designed, implemented, and managed, artificial reefs can enhance fishery habitat by replacing degraded habitat and ecosystem functions (SAFMC 1998). They can be used in almost every possible coastal and marine environment, from shallow-water estuarine creeks to offshore sites up to several hundred feet in depth. They can provide new primary hard substrate similar in function to newly exposed hard bottom. They can also increase habitat complexity, which provides shelter and foraging habitat for numerous species.

3.1.7 Beaches and Dunes

Sandy beaches, characterized by sand, coarse sand, and cobbles and having few fine-grained silts and clays, are formed by waves and tides sufficient to winnow away the finer particles. The sand also typically “migrates” offshore and onshore seasonally. Such environments may exhibit low species diversity, but high population densities of those species that can tolerate the high-energy conditions, like some invertebrate species, for example. Sand dunes form when wind and waves push sand above the usual water level and it is trapped by gravel, vegetation, etc. Dunes mature through plant succession and small, salt-tolerant pioneer species may eventually be overtaken by woodier species to form maritime forests. Dunes often provide habitat for seabirds and sea turtles, including various species of endangered sea turtles that rely on beaches for nesting habitat.

3.1.8 Mangroves

Mangroves are woody plant communities that develop in sheltered tropical and subtropical coastal estuarine environments. Mangroves are adapted to survive in very saline, waterlogged, reduced soils that are often poorly consolidated and subject to rapid change. Four species comprise the major elements of mangrove communities within the affected environment of this PEIS—red (*Rhizophora mangle*), black (*Avicennia germinans*), white (*Laguncularia racemosa*), and button (*Conocarpus erectus*) mangroves. Red mangroves usually are found in fringe or riverine environments characterized by active water flow and a high degree of flushing. The other species tend to dominate in stagnant environments where water flows are reduced and often seasonal (Cintron-Molero 1992).

Mangrove communities, like salt marshes, facilitate much nutrient cycling, trapping nutrient-rich sediments and maintaining high rates of organic matter fixation (Cintron-Molero 1992). Mangroves also provide important shelter for larval fish and crustaceans, and contribute detritus and dissolved organic carbon to estuarine food webs (Mumby et al 2004, Nagelkerken et al 2008). In addition, mangroves store and sequester substantial amounts of carbon, both in aboveground biomass and belowground in soils at very high rates. This carbon is commonly known as “blue carbon” (Donato et al. 2011; McLeod et al. 2011). Mangrove ecosystems are often coupled to other systems such as seagrass beds and coral reefs, supporting migratory species of fish, shrimp, and birds. Mangrove communities may also support large resident and migratory populations of mammals, reptiles, and other animals (Alongi 2002). Mangroves are highly productive structures. A substantial amount of the net production is incorporated into leaves and fruits, allowing more energy to be incorporated into the food web. This results in an abundance of shellfish and finfish in mangrove areas, as well as a diversity and abundance of other associated fauna.

3.1.9 Mud or Sand Flat and Subtidal Bottom

Mud flats are un-vegetated, level areas along shorelines or around islands that are covered with shallow water, are composed of fine-grained sediments, and occur episodically at low-water tidal areas where exposure to the air is temporary. They provide burrowing habitat for invertebrates and feeding grounds for birds and fish (Mitsch and Gosselink 2000). Mud flats are often backed by sandy beaches or marshes and occur in areas where general circulation results in sediment deposition (Thayer et al. 2003). An emerging component of mudflats and a new area of study are biofilms. These are communities of microorganisms, including bacteria and algae, embedded in a matrix of polymeric compounds. Mudflat biofilm is dominated by photosynthetic microalgae, diatoms for the most part (collectively called microphytobenthos), and they are being recognized as a major food source for snails and other invertebrates, a few species of fish, and shorebirds. Oil spills can have a major impact on these microscopic communities and impact the mudflat ecosystem as a whole. Mud flats occur in every NOAA RC region.

Subtidal bottoms can be hard or soft surfaces on the substrate that occurs below the low tide line. They are composed of loose, unconsolidated substrate characterized by fine- to coarse-grained sediment. These habitats are usually located adjacent to beaches or other sediment sources (Thayer et al. 2003), and can support a great diversity of fauna, depending on the type of substrate (i.e., sand or mud), the content of organic matter, and depth. Many subtidal bottoms are dominated by infaunal invertebrates, including polychaete worms, crustaceans, echinoderms, and mollusks. Fish that often occupy subtidal bottoms include species of flatfish, croaker, sculpin, combfish, and lizardfish. Soft bottom subtidal habitats represent valuable recreational and ecological resources, as they are major sources of secondary and tertiary production. They also serve as recycling areas for detritus and other excess biomass, which is used by many infaunal and epifaunal species through deposit feeding activities. Deposit feeders, in turn, provide key food sources for fish and invertebrate predators. Infauna provide food for larger predators, such as fish, shrimp, and crabs, which have substantial value as commercial fisheries (Ricketts et al. 1985).

Subtidal bottom ecology is sensitive to pollution, such as wastewater discharges that alter the amount of organic and small particulate material. The physical distinction between sand and mud habitats is often vague, which creates a high degree of overlap in species distributions. The species assemblages of the subtidal soft bottom are divided into the ecotypes offshore eelgrass bed, subtidal mud, and subtidal sand (Ricketts et al. 1985).

3.2 Geology and Soils

Geology and soil resources potentially impacted by NOAA RC–supported restoration projects vary greatly between and within the regions, and include sandy beach, barrier island, rocky coastline, mud bottom, and many other types of substrate and source material. Geologic features and soils generally depend on location, local physical geography, climate, geologic activity level, and a number of other attributes. It would be of little value to attempt to list or describe all of the specific types and features of geology and soil present in coastal as well as tidally and nontidally influenced riverine areas in the United States. However, it is possible to describe, in very general terms, the types of materials, substrates, and features in areas where NOAA RC–supported projects could occur.

The following are general descriptions of the characteristics, materials, unique features, and areas of concern for soils and geologic formations that underlie or comprise some key habitat types that could be affected by NOAA RC restoration activities:

- Sandy beaches – the interface between land and ocean, these areas are naturally unstable due to constant action of waves, currents, and winds. Include sandy bluffs, embayments, barrier islands, and dunes. Materials are fine to coarse (diameters from 0.5mm to 2mm) and may contain substantial amounts of shell fragments.

- Rocky coastlines and intertidal zones – Areas composed of rock with low to high energy depending on slope, tidal range, currents, waves, etc. Include solid rock formations as well as gravel, cobble, or boulders that are often consolidated but can be moved.

- Mud flats – Low-energy areas influenced by flooding or tides that consist primarily of unconsolidated silts and clays.

- Sand flats – Low-energy areas influenced by flooding or tides that consist mostly of unconsolidated sands.

- Shell flats – Low-energy intertidal habitats that consist predominantly of unconsolidated shell fragments.
- Peatlands – Submerged or former tidal marsh plains that are predominated by peat.
- Other soils and materials present in nontidal areas, which can be hydric (either occasionally, frequently, or permanently wet in wetland areas), or dry upland materials, which can be highly variable in the organic and inorganic composition.

In addition, NOAA restoration activities could potentially affect the following sediment and rock types:

- Clay-silts – Often found in estuaries, marshes, slow-moving rivers and streams, pools, and deltas.
- Limestone – Calcium carbonate substrate; commonly associated with coral reefs. Occurs along coasts of Florida and the Gulf of Mexico.
- Volcanic materials – Habitat consisting mainly of relatively recent volcanic material. Occurs in Hawaii and Alaska, areas of high volcanic activity.

Coastal land loss is a major concern associated with sandy beaches in the United States and elsewhere. The rates of erosion and loss of sandy materials vary greatly within and between regions, and are highly dependent on climate, level of beach nourishment, and wave energy. For example, erosion rates in the Gulf of Mexico region are generally highest in Louisiana along the shores of barrier islands and headlands associated with the Mississippi Delta, whereas the most stable Gulf beaches are along the west coast of Florida where low wave energy and frequent beach nourishment minimize erosion (USGS 2004).

The physical factors having the greatest influence on coastal land loss are reductions in sediment supply, relative sea level rise, and high-energy storm events, whereas the most important human activities are sediment excavation, river modification, and coastal construction. As a result of these agents and activities, coastal land loss is most commonly manifested as beach or bluff erosion and coastal submergence (USGS 2004). Longshore drift associated with breakwaters, jetties, and other artificial structures also often results in net loss of materials from sandy beaches.

Lithologic composition and hardness determine the land loss potential of the coast. For example, loose sand is more easily eroded than compacted, stiff mud. Because hard crystalline rocks resist erosion, some rocky coastlines in New England and along the Pacific coast have not changed appreciably in recorded history. Some limestones (e.g., coral reefs of the Florida Keys) also resist erosion, but other limestones may be dissolved by underground springs that cause the land to collapse and form drowned sinkholes. Some land loss (e.g., along the west Florida coast) is caused by near-surface dissolution of limestone, or karst terrain (USGS 2004).

Land loss may also depend partly on smoothness or consistency of the coast and continental shelf. Because wave energy generally increases at promontories and decreases in embayments, headlands of highly irregular coasts are attacked more vigorously by waves than are long stretches of smooth sandy beaches. Wave fetch, nearshore water depths, and shoreline orientation are components of shoreline morphology that also control the wave energy reaching the coast. The greatest coastal land loss normally occurs where there are long fetches of open water, the offshore profile is steep (relatively deep water near shore), and the waves approach the coast at a high angle (USGS 2004).

The density and type of vegetative cover also influence land loss by (1) dissipating the wave energy reaching sheltered shores, (2) encouraging the accumulation of organic and inorganic sediment, and (3) acting as a sediment binder that resists erosion. Some common coastal vegetation habitats are maritime forests, scrub thickets, grassy upland prairies, freshwater swamps, freshwater marshes, mangrove swamps, saltwater marshes, and grassy or forested dunes (USGS 2004).

Each type of coastal vegetation has its own unique features that can retard land loss. For example, dense stands of salt marsh and mangroves trap sediment or offer resistance to waves and currents so that land loss is prevented or mitigated. Dune grasses also help stabilize blowing sand and can assist in dune enlargement. However, the roots of grasses and trees are generally too shallow to reduce erosion from large storm waves that lower the back beach and undercut the dunes or uplands (USGS 2004).

3.3 Water Resources

Water resources in the areas that could be affected by NOAA RC–supported projects are diverse and dynamic, including surface water of many varieties and groundwater. Surface-water resources consist of marine water (oceanic), tidally influenced water bodies such as estuaries, and nontidal freshwater resources, including some inland rivers and streams, lakes, and ponds. Coastal waters support estuaries, coastal wetlands, coral reefs, mangrove forests, and upwelling areas. Critical coastal habitats provide spawning grounds, nurseries, shelter, and food for finfish, shellfish, birds, and other wildlife. Coastal resources also provide nesting, resting, feeding, and breeding habitat for 85 percent of waterfowl and other migratory birds (EPA 2004). Water resources also are affected by or associated with floodplains, storm water runoff (point and non-point releases), and water quality. Surface-water resources are described in the following sections in descending order of salinity (i.e., marine, estuary, fresh), followed by groundwater.

Marine Waters

The surrounding oceans of the United States (Atlantic, Pacific, Arctic, and Gulf of Mexico), are composed of marine (salt) water. Marine water is the primary medium for living coastal and marine resources and comprises the bulk of essential fish habitat (See Section 3.4 - Living Coastal and Marine Resources and Essential Fish Habitat below). Marine water is threatened in the United States and elsewhere by changes in water quality. Contamination of the marine environment from point and non-point source pollution and climate change has caused alteration or loss of habitat; reductions in numbers of species and individuals that live in these waters; reductions in seawater pH levels (ocean acidification); increases in floating trash and debris, and advisories concerning fish consumption and swimming; and the loss of recreational and commercial opportunities (EPA Office of Water 2004). Restoration activities supported by NOAA to benefit marine water include reef restoration and creation, oyster and shellfish habitat restoration, planting or restoring SAV and kelp, and nearshore erosion reduction and prevention.

Estuaries

An estuary is a partially enclosed body of water where saltwater from the ocean mixes with freshwater from rivers, streams, and creeks. These areas of transition between the land and the sea are tidally driven, but, like rivers, they are sheltered from the full force of ocean wind and waves. Estuaries are generally enclosed in part by the coastline, marshes, and wetlands; the seaward border may be barrier islands, reefs, and sand flats or mud flats. Estuaries are biologically productive and directly support thousands of species of plants, animals, birds, and fish as well as sequestering and storing substantial amounts of carbon from the atmosphere, particularly in their vegetated coastal wetlands. Bodies of water that may be estuaries include sloughs, bays, harbors, sounds, inlets, and bayous. Some familiar examples of estuaries are Chesapeake Bay, San Francisco Bay, Boston Harbor, Tampa Bay, and Puget Sound (NOAA 2004). Restoration activities supported by NOAA to benefit estuaries include restoration of coastal resources such as wetlands, shellfish, SAV etc., and projects that benefit habitats for example erosion reduction projects and tidal hydrologic reconnection projects.

Nontidal (Freshwater) Resources

Nontidal waters that could be impacted by NOAA RC–supported projects includes waters such as lakes, ponds, rivers and streams that support migratory fish or are hydrologically connected to coastal, marine, or estuarine resources or wetlands. This includes the Great Lakes region, which is largely considered to be nontidal. Restoration activities supported by NOAA to benefit nontidal resources include riparian restoration, wetland and marsh restoration and creation, installation or restoration of in-stream structures, dam and culvert removal, and levee modification or removal.

Groundwater Resources

Groundwater is water beneath the land surface. It interfaces with surface waters and supplies streamflow during periods between rain events. Because groundwater discharge is a large source of input to many tidal and nontidal water resources (including rivers, streams, and estuaries), the quality of groundwater greatly influences the overall water quality in these areas. Groundwater quality can be compromised in many ways, including spills and seepage from buried disposal areas (e.g., landfills). Restoration activities supported by NOAA that can benefit groundwater resources include contaminated sediment removal, debris removal, and wetland restoration if it results in enhanced stormwater runoff retention and infiltration.

Floodplains

Floodplains are the valley floors adjacent to a stream channel that may be inundated during periods of high water (Linsley et al. 1982). Floodplains are associated with most rivers and streams that could be affected by NOAA RC–supported projects, including all regions. Floodplains are composed of sediments deposited by the stream. Floodplains include a floodway (the width of the river that must be reserved to discharge the 100-year flood without increasing the water surface by more than 1 foot) and a floodfringe (the area of the floodplain outside the floodway that is susceptible to flooding). A 100-year flood is the flood elevation with a 1 percent chance of being equaled or exceeded in any one year (Federal Emergency Management Agency 2004).

Development and agricultural activities within floodplains cause problems in many areas of the United States. During a flood, sediment, pollution, nutrients, scour, and debris from the floodplain can be uplifted and transported to coastal areas, which can decrease water quality, increase turbulence, and block rivers, streams, estuaries, freshwater wetlands, and other water bodies. Additionally, human life and property is risked by such development as well. Restoration activities supported by NOAA to benefit floodplains include debris removal, dam removal, and levee modification and removal.

Wetlands

Wetlands are an important resource that directly and indirectly affects water resources as a whole. Some types of wetlands, such as tidal marshes, occupy the interface between the aquatic and terrestrial components of estuarine and riparian systems. Many other types of wetlands are entirely freshwater systems that may be associated with groundwater, lakes, streams, or rivers. Wetland habitats are critical to the life cycles of fish, shellfish, migratory birds, and other wildlife, and they help improve surface-water quality by filtering residential, agricultural, and industrial wastes. Wetlands also buffer coastal areas against storm and wave damage, and can sequester and store large amounts of carbon if left undisturbed. Because of their close interface with terrestrial systems, wetlands are vulnerable to land-based sources of pollutant discharges and other human activities (EPA 2004). Wetland resources are discussed in greater detail in Section 3.1.1. Restoration activities supported by NOAA to benefit wetlands include wetland and marsh restoration and creation, planting of tree and shrub buffers, debris removal, dam removal, and all erosion reduction projects.

Storm Water Management Facilities

Storm water refers to water flows from heavy precipitation when the amount of it or rate that it falls exceeds the ground's ability to absorb it, and the excess flows downslope. In many locations across the United States, storm water has been diverted into marine, estuary, and freshwater bodies. The results are an overall loss of ecological value due to declining water quality associated with constituents in the runoff, as well as dilution of estuaries to a degree that enables salt-intolerant invasive plants such as Phragmites to replace native vegetation (Copeland 1998). In addition, the contamination of water bodies and sediments by chemicals (including metals and organic substances from urban, agricultural, and industrial sources) has resulted in declining water quality in marine, estuarine, and freshwater resources (EPA 2004). Restoration activities supported by NOAA to enhance storm water management facilities include culvert and tide gate installation, modification, or removal; dam removal; and levee modification or removal.

<u>Water Quality</u>

Water quality is a generic term used to represent the general "cleanliness" of the water of a certain resource. It is based on the relationship between the concentrations of various chemical and physical contaminants or pollutants and the ability of the water resource to support its ecosystem adequately. Although water quality is a function of many factors, five primary indicators are often used to assess the quality of surface water in an estuary or freshwater body—nitrogen, phosphorous, chlorophyll a, dissolved oxygen (DO) content, and water clarity.

Light penetration into estuarine waters is important for SAV, which serves as food and habitat for the resident biota. Some nutrient inputs to coastal waters (e.g., nitrogen and phosphorous) are necessary for a healthy, functioning estuarine ecosystem. But when nutrients from various sources, such as sewage and fertilizers, are introduced into an estuary, the concentration of available nutrients can increase beyond natural background levels, resulting in eutrophication. Excess nutrients can lead to excess plant production and thus to increased chlorophyll, which can decrease water clarity and lower concentrations of dissolved oxygen (EPA 2004).

Several regulatory statutes protect beaches, coasts, and the marine environment from pollution and development. Permitting requirements of Section 404 of the CWA are discussed in Section 4.12 - Compliance with All Applicable Environmental Laws and Regulations, and many other regulations have been established by agencies such as EPA, NOAA, U.S. Fish and Wildlife Service (USFWS), and USACE for the protection of water resources. For example, in 2000 EPA was ordered under Executive Order 13158 to "expeditiously propose new science-based regulations, as necessary, to ensure appropriate levels of protection for the marine environment. Such regulations may include the identification of areas that warrant additional pollution protections and the enhancement of marine water quality standards." Restoration activities supported by NOAA to benefit water quality include all erosion reduction projects, tidal hydrology reconnections, dam removals (and other projects that reduce the residence time of water in an impoundment), sediment removal and placement, debris removal, and others.

3.4 Living Coastal and Marine Resources and Essential Fish Habitat

A primary mission of NOAA is the stewardship of living coastal and marine resources through science-based conservation and management, and the promotion of healthy ecosystems. Living marine resources refer to the organisms that use or otherwise rely on marine, estuarine, and riverine (tidal and nontidal) resources during all or part of their life cycles. The passage of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in 1976 and its subsequent amendments, and the Sustainable Fisheries Act of 1996 (SFA) authorized three important management responsibilities to NMFS:

1. To manage fisheries within the 200-mile wide exclusive economic zone (EEZ) along the coasts of the United States.
2. To address human impacts on coastal and marine environments.
3. To prioritize identification and management of EFH.

EFH is defined in the MSA as "... those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (P.L. 109-479; Sec.2). As discussed in Section 4.12 - Compliance with All Applicable Environmental Laws and Regulations, each action or project covered under this PEIS will receive consideration by the RC regarding its potential to affect designated EFH, and the RC will determine whether preparation of an EFH assessment is necessary or initiation of a consultation is required. Under the auspices of the MSA and the SFA, each NMFS region is required to prepare and implement Fisheries Management Plans in which species to be managed (Management Unit Species) are identified within sub-regional units partly determined by the geographic coverage of a particular fishery.

3.5 Threatened and Endangered Species

The ESA provides for the conservation of species in danger of extinction throughout all or a significant portion of their range, as well as designation of critical habitat for these species. Listed and candidate species under ESA that may benefit from NOAA RC restoration activities are primarily aquatic species inhabiting marine, coastal, and riparian habitats that may reside or temporarily migrate through a restoration project area. The official records for the most current ESA listings can be found in 50 CFR Parts 17, 222, and 224. The NMFS Office of Protected Resources (OPR) and USFWS webpages also contain up-to-date listings (http://www.nmfs.noaa.gov/pr/species/ and http://endangered.fws.gov, respectively).

3.6 Cultural and Historical Resources

NOAA considers impacts to both cultural and historic resources under NEPA. Cultural resources include historic properties, as defined in the National Historic Preservation Act (NHPA), sacred sites, and archaeological sites. The scope of cultural resources considered under NEPA is broader than that considered under the NHPA (CEQ 2013). Although a complete inventory of potentially impacted cultural and historic resources is not possible, given the national scope of this analysis, NOAA recognizes that habitat restoration projects located close to streams and coasts often have an inherent nexus with both pre-Columbian and European settlement in the United States. Examples of potentially impacted resources include dams, bridges, water control structures, project sites with tribal or archaeological importance, and project site structures that are eligible or potentially eligible for listing in the National Register of Historic Places (NRHP).

3.7 Land Use and Recreation

The majority of NOAA's restoration efforts are located in or directly adjacent to coasts, estuaries, marshes, rivers, streams, and other aquatic features. As coastal areas are the most heavily developed areas in the United States, a significant portion of project sites are in urban and suburban areas, where land uses range from residential (single- and multi-family) to recreational (e.g., beaches, estuaries, wetland preserves, rivers, and trails) to industrial (ports and aquaculture). Other sites are located in rural and agricultural areas. Although not exhaustive, the following coastal land uses are the most likely to be impacted by NOAA's habitat restoration efforts.

Tourism and recreational opportunities are an important use of coastal lands, and are dependent on a clean, healthy coastal environment. These activities include bird watching, hunting, fishing, beach-going, and boating. For instance, approximately 8 million individuals have participated in coastal recreational fishing along the Atlantic and Gulf of Mexico coasts each year since 2009 (NMFS 2014).

Agriculture is an important component of coastal, estuary, and freshwater land use. Because water is important for successful agricultural production this land use is often located near estuaries, streams, rivers, and other water bodies. Agriculture has significantly altered the natural landscape and reduced the availability of high-quality fish habitat by building levees and reducing the quantity and quality of water in adjacent water bodies.

Marine transportation is an important component of coastal land use. Port development and operations, including expansion, have resulted in substantial alteration and damage to the natural environment. Port property often includes brownfields—abandoned industrial facilities where environmental contamination discourages development. Ongoing impacts include reductions in air and water quality and the importation of invasive aquatic species (Urban Harbors Institute 2000). Although ports are often located in environmentally compromised areas, Port Authorities are also involved in environmental remediation and clean-up efforts (Urban Harbors Institute 2000). Maintaining or improving coastal and marine navigation systems continues to require dredging sediment from waterways. More than 300 million cubic yards of material are removed from navigation channels each year (AAPA 2014) and 5 to 10 percent of those sediments may be contaminated (Urban Harbors Institute 2000).

Saltwater aquaculture is also an important coastal land use. In 2005, more than 1,000 farms containing 327,487 acres were in saltwater aquaculture production across 25 coastal states.

3.8 Socioeconomics

In 2010, coastal regions were home to more than 163 million people (approximately 52 percent of the U.S. population), and this number is expected to increase to 178 million by the year 2020 (NOAA, 2013). People enjoy coastal areas for their beauty and depend on them for recreational and commercial uses. Over 75 percent of commercial fisheries and 80 to 90 percent of recreational marine and migratory fishes depend on estuarine, coastal, and riverine habitats for all or part of their life cycles (National Safety Council 1998; NOAA 2002). The most recent NOAA data show that the commercial fishing industry employs around 1 million people (about 1,029,000 in 2009) and contributes $116 billion to the nation's economy. Recreational fishing industries supported about 327,000 full- and part-time jobs, contributing $50 billion to the nation's economy (NMFS 2010). However, human activities and development have caused the destruction of more than half (roughly 55 million acres) of the wetlands in our coastal states (NOAA 2002).

NOAA RC–supported projects provide benefits that can be enjoyed by coastal communities within or near a project site. Such benefits may include increased flood protection (or reduced risk of flood damage), aesthetic and spiritual benefits, improved commercial and recreational fishery resources, reduced financial maintenance costs in areas where natural ecological processes are being restored, increased local economic activity supporting restoration activities, improved goodwill between communities and restoration practitioners, and others. NOAA RC–supported projects generally tend to increase public access and environmental quality wherever implemented. In rural and urban areas, projects frequently involve minority and low-income populations as volunteers or paid labor, which may provide economic benefits, or increased human capital in developing skills for future employment.

4.0 Environmental Consequences

4.0 Environmental Consequences 84
4.1 Type of Potential Impacts 86
4.2 Duration of Potential Impacts 86
4.3 Geographic Extent 86
4.4 Magnitude of Potential Impacts 87
4.5 Environmental Consequences of Preferred Alternative 90
4.5.1 Technical Assistance 108
4.5.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting 108
4.5.1.2 Implementation and Effectiveness Monitoring 108
4.5.1.3 Fish and Wildlife Monitoring 109
4.5.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs 112
4.5.2 Riverine and Coastal Habitat Restoration 114
4.5.2.1 Beach and Dune Restoration 114
4.5.2.2 Debris Removal 115
4.5.2.3 Fish Passage 118
4.5.2.3.1 Dam and Culvert Removal, Modification or Replacement 118
4.5.2.3.2 Technical and Nature-like Fishways 122
4.5.2.4 Fish, Wildlife, and Vegetation Management 125
4.5.2.4.1 Invasive Species Control 125
4.5.2.4.2 Prescribed Burns and Forest Management 129
4.5.2.4.3 Species Enhancement 130
4.5.2.5 Freshwater Stream Restoration 133
4.5.2.5.1 Channel Restoration 133
4.5.2.5.2 Bank Restoration and Erosion Reduction 135
4.5.2.6 Reefs 137
4.5.2.6.1 Coral Reef Restoration 137
4.5.2.6.2 Shellfish Reef Restoration 140
4.5.2.6.3 Artificial Reef Restoration 143
4.5.2.7 Road Upgrading and Decommissioning; Trail Restoration 144

4.5.2.8 Signage and Access Management ... 147
4.5.2.9 Subtidal Planting ... 148
4.5.2.9.1 Submerged Aquatic Vegetation ... 148
4.5.2.9.2 Marine Algae ... 151
4.5.2.10 Water Conservation and Stream Diversion ... 152
4.5.2.11 Wetland Restoration ... 155
4.5.2.11.1 Levee and Culvert Removal, Modification, and Set-back ... 155
4.5.2.11.2 Wetland Restoration and Shoreline Stabilization Techniques ... 158
4.5.2.11.3 Wetland Planting ... 160
4.5.3 Land and Water Acquisition and Other Transactions ... 161
4.6 Environmental Consequences of Alternative 2 –"Technical Assistance" ... 162
4.7 Potential Impacts to Threatened and Endangered Species ... 164
4.8 Potential Impacts to Cultural and Historical Resources ... 168
4.9 Cumulative Impacts ... 170
4.9.1 Past, Present, and Reasonably Foreseeable Future Actions ... 179
4.9.2 Climate Change ... 181
4.10 Relationship of Short-Term Uses and Long-Term Productivity ... 182
4.11 Irreversible and Irretrievable Commitments of Resources ... 183
4.12 Compliance with All Applicable Environmental Laws and Regulations ... 183

This section evaluates the anticipated environmental impacts resulting from implementation of each of the restoration activities presented in Section 2.0 - Alternatives. Due to the programmatic nature of this document, general characteristic impacts are described for each such restoration activity. The potential impacts would be applicable to the affected environment described in Section 3.0 - Affected Environment, with slight variations due to local project-level site conditions and resources. Also discussed are potential cumulative impacts; adaptive management and project-level mitigation monitoring and evaluation; unavoidable adverse impacts; the relationship between short-term uses and long-term productivity; and the irreversible and irretrievable commitment of resources.

The potential impacts have been described by their characteristics—type (direct, indirect, or cumulative), duration (short- or long-term), geographic extent (localized or beyond project site), and significance. Each of these characteristics is described in the following sections (4.1 - 4.4), and summarized in Table 11 – Summary of environmental consequences of the Proposed Action. Project-specific potential impacts would be documented in the manner described in Appendix A.

4.1 Type of Potential Impacts

Direct, indirect, and cumulative impacts are defined at 40 CFR 1508.7 and 1508.8, and these definitions are presented below. These categories are used to describe the timing and proximity of potential impacts on the affected area only. They have no bearing on the significance of the potential impacts, as described below, and are used only to describe or characterize the nature of the potential impacts. Cumulative impacts are defined below, and are discussed in Section 4.7.

- **Direct Impact**: A known or potential impact caused by the proposed action or project that occurs at the time and place of the action.
- **Indirect Impact**: A known or potential impact caused or induced by the proposed action or project that occurs later than the action or is removed in distance from it, but is still reasonably expected to occur.
- **Cumulative Impact**: A known or potential impact resulting from the incremental effect of the proposed action added to other past, present, or reasonably foreseeable future actions.

4.2 Duration of Potential Impacts

The duration of the potential impact can be defined as either short-term or long-term and indicates the period of time during which the environmental resource would be impacted. Duration takes into account the permanence of an impact or the potential for natural attenuation of an impact. In general, the impacts of construction and other activities undertaken to implement a proposed project would be short-term, and the impacts of the project results would be long-term. The duration of each potential impact is defined as follows:

- **Short-Term Impact**: A known or potential impact of limited duration, relative to the proposed project and the environmental resource. For the purposes of this analysis, these impacts may be instantaneous or may last minutes, hours, days, or years.

- **Long-Term Impact**: A known or potential impact of extended duration, relative to the proposed project and the environmental resource. For the purposes of this analysis, these improvements or disruptions to a given resource would last longer than 5 years.

- **Permanent Impact**: A known or potential impact that is likely to remain unchanged indefinitely.

4.3 Geographic Extent

Restoration activities can cause impacts at a variety of geographic scales. For the purposes of this analysis, impacts are assessed in two ways:

- **Localized:** Site-specific and generally limited to the immediate surroundings of a project site.
- **Beyond the Project Site:** Unconfined or unrestricted to the project site. These impacts may extend throughout a watershed or beyond.

4.4 Magnitude of Potential Impacts

To determine the proposed action's magnitude or intensity, NOAA qualitatively assessed the degree to which the alternatives would impact a particular resource. The magnitude or intensity of a known or potential impact is defined on a spectrum ranging from no impacts to major impacts. The potential impacts could be either beneficial or adverse for a particular resource. The PEIS considers the relative magnitude or intensity of both adverse and beneficial impacts, because the intent of NOAA RC's proposed action is to provide beneficial impacts to habitat. The qualitative assessment is based on a review of the available and relevant reference material, and is based on professional judgment using standards that include consideration of the permanence of an impact or the potential for natural attenuation of an impact; the uniqueness or irreplaceability of the resource; the abundance or scarcity of the resource; the geographic, ecological, or other context of the impact; and the potential that mitigation measures can offset the anticipated impact. Impact magnitude definitions are described in Table 7 and below as follows.

Table 7 - Impact Magnitude Definitions

Resource	Minor	Moderate	Major
Geology and Soils **Water** **Living Coastal and Marine Resources and EFH** **Threatened and Endangered Species**	This relative term is used to describe impacts to the structure or function of a resource that might be perceptible but are typically not amenable to measurement. These are typically localized to the project site but may in certain circumstances extend to beyond a project site.	This relative term is used to describe impacts to the structure or function of a resource that are more perceptible and, typically, more amenable to quantification or measurement. These can be both localized, or may extend beyond a project site.	This relative term is used to describe impacts that are typically obvious, amenable to quantification or measurement, and result in substantial structural or functional changes to the resource. These can be both localized, or may extend beyond a project site. Generally, major impacts are those that, in their context and due to their severity, have the potential to meet the considerations of 'significance' set forth in CEQ regulations (40 CFR 1508.27).
Cultural and Historic Resources **Land Use and Recreation** **Socioeconomics**	This relative term is generally used to describe impacts that might be perceptible but, in their context, are not amenable to measurement and do not alter the overall, fundamental condition of the resource from status quo. Such impacts generally would be isolated to that resource alone and would not have any meaningful influence on other resource categories.	This relative term is used to describe impacts that are more perceptible and, typically, more amenable to quantification or measurement and would likely alter the overall, fundamental condition of the resource from status quo. These may be so impactful as to meaningfully alter or affect another resource category in the project area.	This relative term is used to describe impacts that are obvious, amenable to quantification or measurement, and result in substantial changes to the fundamental condition of the resource from status quo. Such impacts may be so severe or profound as to substantially alter or affect more than one other resource category in the project area. Generally, major impacts are those that, in their context and due to their severity, have the potential to meet the considerations of 'significance' set forth in CEQ regulations (40 CFR 1508.27).

Table 8 - Impact Magnitude Definitions by Resource

Resource	Minor	Moderate	Major
Geology and Soils	Changes or disturbances to geologic features (such as small amounts of erosion or soil compaction) have little to no impact on the overall function of geologic and soil physical characteristics.	Changes or other disturbances to geologic features are sufficient so as to potentially alter geologic and soil physical characteristics and function.	Changes or other disturbances to geologic features are of sufficient severity so as to dramatically alter the geologic and soil physical characteristics and function.
Water Resources	Changes to water quality are minimal and ephemeral. Such changes, when adverse, do not exceed regulatory standards or minimum thresholds. These include small, inconsequential changes to hydraulics and/or groundwater flows.	Changes to water quality are noticeable and may be long lasting. Such changes, when adverse, are not likely to exceed regulatory standards or minimum thresholds. These include changes to hydraulics and/or groundwater flows.	Changes to water quality are obvious and easily detected. Such changes, when adverse, are likely in excess of regulatory standards. These include changes to hydraulics, groundwater flows, or hydrology.
Living Coastal and Marine Resources and EFH **Threatened and Endangered Species**	The action would have only a small impact on living marine resources and protected species. That impact, when adverse, may disturb a few individuals and alter their behavior temporarily, however it is not likely to "adversely affect" those individuals (per ESA definition). Population-level impacts (for example to migration, feeding and reproductive behavior) would not occur at a meaningful level. Changes to living marine resources' and protected species' habitats (EFH and critical habitat) are minimal and do not appreciably differ from previous or natural conditions. Changes to habitat function are small and inconsequential.	The action has a more noticeable impact on living marine resources and protected species. That impact, when adverse, may widely and frequently disturb individuals, and the action may have the potential to "adversely affect" those individuals (per ESA definition). Population level impacts (for example to migration, feeding and reproductive behavior) may occur. Changes to living marine resources' and protected species' habitats (EFH and critical habitat) would be apparent when compared to previous or natural conditions. Changes to habitat function are measurable.	The action has an obvious impact on living marine resources and protected species. That impact, when adverse, may result in harassment of individuals at sub-lethal or lethal levels, and the action may have the potential to "jeopardize" those populations and "adversely modify" critical habitat (per ESA definitions). Population level impacts (for example to migration, feeding and reproductive behavior) are likely to occur. Changes to living marine resources' and protected species' habitats (EFH and critical habitat) would be obvious when compared to previous or natural conditions. Changes to habitat function are obvious.

Resource	Minor	Moderate	Major
Land Use and Recreation	Changes to recreational opportunities or land uses are slight, inconsequential, and only affect a small number of people or are limited to few user groups. Changes to the viewscape or soundscape are slight and difficult to notice and do not change the aesthetic experience.	Changes to recreational opportunities or land uses may be noticeable and consequential when compared to previous uses and would likely alter the way the resource is used. These changes may affect a large number of people or multiple user groups. Changes to the viewscape or soundscape are apparent but do not change the overall aesthetic experience.	Changes to recreational opportunities or land uses would be dramatically different when compared to previous uses and would fundamentally alter the way the resource is used. These changes would likely affect a large number of people or user groups. Changes to the viewscape or soundscape are obvious, and may change the overall aesthetic experience.
Cultural and Historic Resources	The effect is measurable or perceptible, but it is slight and affects a limited area of a site, structure or group of sites or structures. Slight alteration(s) to any of the characteristics that qualify the site(s) for inclusion in the National Register may diminish the integrity of the site(s). For purposes of Section 106, the determination of effect would be adverse effect. *	The effect is measurable and perceptible. The effect changes one or more of the characteristics that qualify the site(s) or structure(s) for inclusion in the National Register and diminishes the integrity of the site(s), but does not jeopardize the National Register eligibility of the site(s) or structure(s). For purposes of Section 106, the determination of effect would be adverse effect.*	The effect on the site or structure, or group of sites or structures, is substantial, noticeable, and permanent. The action severely changes one or more characteristics that qualify the site(s) for inclusion in the National Register, diminishing the integrity of the site(s) or structure(s) to such an extent that it is no longer eligible for listing in the National Register. For purposes of Section 106, the determination of effect would be adverse effect. *
Socioeconomics	Few to no individuals, groups, businesses or other institutions would experience a change in economic or social conditions as a result of an action.	Some individuals, groups, businesses or other institutions would experience a change in economic or social conditions, and these are likely the result of the action.	A large proportion of individuals, groups, businesses or other institutions would experience a change in economic or social conditions as an obvious result of an action.

* Per 36 CFR 800.5, such adverse impacts may include but are not limited to physical changes, alterations (including restoration, rehabilitation, repair, maintenance, stabilization), removal of the property from its historic location, change of the character of the resource, changes to the integrity of the historical nature of the property, or transfer, lease or sale of the resource.

4.5 Environmental Consequences of Preferred Alternative

The following section describes the environmental consequences of the preferred alternative. For all restoration projects conducted, NOAA staff will conduct site-specific analyses to ensure that the level of impacts expected from a given project are in line with those described in the relevant sections below.

Table 9 displays the terms used to describe potential impacts in this PEIS. The type of impact is defined; the duration, geographic extent, and magnitude/intensity are identified; and an adverse or beneficial qualifier is applied. Potential impacts are often reduced through mitigating measures. CEQ regulations (40 CFR 1508.20) define mitigation measures as:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

Appendix C - Mitigating Measures includes many typical measures to mitigate impacts associated with restoration activities, such as using heavy equipment, working in sensitive habitats, and reducing erosion of bare soil. In addition to the specific mitigation measures that may be outlined in the sections below, NOAA and partner organizations would use adaptive management techniques at the project level where possible, and would conduct monitoring activities to inform that process, as described in Section 4.5.1.2 - Implementation and Effectiveness Monitoring.

Table 9 – Summary of terms used to describe potential environmental impacts

Type of Impact	Duration of Impact	Geographic Extent	Magnitude/Intensity	Qualifier
No Effect Direct Indirect Cumulative	Short-term Long-term Permanent	Localized Beyond Project Site	Minor Moderate Major	Adverse Beneficial

However, not all negative impacts can be mitigated below the levels analyzed in this document. The environmental activities described in Section 2.2 and their associated levels of impacts described in Section 4.5 are the maximum level of adverse impact for projects that will receive NEPA compliance through this analysis. Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. For 16 restoration activities, projects with impacts equal to or less than the characteristics (duration, extent, and magnitude) described in Section 4.5 (and summarized in Table 11) will not reach a level of significant adverse impacts. For ten of the 26 restoration activities described in this analysis there are specific considerations that must be reviewed prior to determining whether the project falls under this analysis. This review confirms that the project's impacts are equal to or less than the characteristics (duration, extent, and magnitude) described, and also will not have significant adverse impacts. Table 10 summarizes which restoration activities include specific considerations to help NOAA staff determine whether a project's impacts are included in this analysis. The review process is described in Appendix A.

Table 10-Project activities are excluded from this analysis when their impacts are greater than described in Section 4.5. Project activities shown in bold have specific considerations which help determine whether the project's impacts may be significant.

Section	Restoration Activity	Criteria for Exclusion in Analysis
2.2.1	**Technical Assistance**	
2.2.1.1	Planning, Feasibility Studies, Design Engineering, and Permitting	Impacts are above those described
2.2.1.2	Implementation and Effectiveness Monitoring	Impacts are above those described
2.2.1.3	Fish and Wildlife Monitoring	Impacts are above those described
2.2.1.4	Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs	Impacts are above those described
2.2.2	**Riverine and Coastal Habitat Restoration**	
2.2.2.1	**Beach and Dune Restoration**	Volume of sediment; length of beach/dune; impacts of and to proposed borrow location
2.2.2.2	**Debris Removal**	Contaminants/industrial waste
2.2.2.3.1	**Dam and Culvert Removal, Modification, or Replacement**	Reservoir sediment volume compared to stream sediment loads; river channel location; method of handling contaminated sediment; changes in flood zone
2.2.2.3.2	**Technical and Nature-like Fishways**	No technical fishways are likely to exceed the impacts described; Considerations for nature-like fishways are the same as dams
2.2.2.4.1	Invasive Species Control	Impacts are above those described
2.2.2.4.2	**Prescribed Burns and Forest Management**	Size; historic fire regime
2.2.2.4.3	**Species Enhancement**	Release of disease or invasive species
2.2.2.5	Freshwater Stream Restoration	Impacts are above those described
2.2.2.6.1	Coral Reef Restoration	Impacts are above those described
2.2.2.6.2	Shellfish Reef Restoration	Impacts are above those described
2.2.2.6.3	**Artificial Reefs**	Left in place artificial reefs require additional analysis
2.2.2.7	Road Upgrading and Decommissioning; Trail Restoration	Impacts are above those described
2.2.2.8	Signage and Access Management	Impacts are above those described
2.2.2.9	Subtidal Planting	Impacts are above those described
2.2.2.10	Water Conservation and Stream Diversion	Impacts are above those described
2.2.2.11.1	**Levee and Culvert Removal, Modification, and Set-Back**	Extent and height of new levees to be built
2.2.2.11.2	Fringing Marsh and Shoreline Stabilization	Impacts are above those described
2.2.2.11.3	Sediment Removal	Impacts are above those described
2.2.2.11.4	Sediment/Materials Placement	Impacts are above those described
2.2.2.11.5	Wetland Planting	Impacts are above those described
2.2.3	**Land and Water Acquisition and Other Transactions**	
2.2.3.1	**Land Acquisition**	Eminent domain requires additional analysis
2.2.3.2	**Water Transactions**	Eminent domain requires additional analysis

The following sections discuss the potential impacts resulting from the various project types, and the potential mitigation of such impacts. Table 11 presents a summary of the environmental consequences of the proposed action.

Table 11 – Summary of environmental consequences of the Proposed Action

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Technical Assistance						
Planning, Modeling, Permitting Feasibility Studies *(Section 4.5.1.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor	Adverse
	Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor	Adverse
	Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Socioeconomics	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Implementation and Effectiveness Monitoring *(Section 4.5.1.2)*	*Geology and Soils*	Indirect	Long-term	Beyond Project Site	Major	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Major	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Socioeconomics	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Technical Assistance						
Fish and Wildlife Monitoring *(Section 4.5.1.3)*	*Geology and Soils*	Indirect	Long-term	Beyond Project Site	Major	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Major	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	Indirect	Short-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Minor	Adverse & Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Socioeconomics	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Environmental Education / Partnerships; Training Programs *(Section 4.5.1.4)*	*Geology and Soils*	Direct	Long-term	Beyond Project Site	Minor	Beneficial
	Water	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Socioeconomics	Direct	Long-term	Beyond Project Site	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Beach and Dune Restoration *(Section 4.5.2.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Moderate	Beneficial
	Water	Direct	Short-term	Localized	Minor	Adverse
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	Direct & Indirect	Long-term	Localized	Minor	Adverse & Beneficial
	Land Use and Recreation	Indirect	Short-term	Localized	Minor	Beneficial
	Socioeconomics	Direct & Indirect	Long-term	Localized	Moderate	Beneficial
Debris Removal *(Section 4.5.2.2)*	*Geology and Soils*	Direct	Long-term	Localized	Minor	Beneficial
	Water	Direct	Long-term	Localized	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Long-term	Localized	Minor	Beneficial
	Socioeconomics	Direct	Short-term & Long-term	Localized	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Dam and Culvert Removal, Modification, or Replacement *(Section 4.5.2.3.1)*	*Geology and Soils*	Direct & Indirect	Short-term & Long-term	Localized	Minor & Moderate	Adverse
		Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Water	Direct	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	Direct	Long-term	Localized	Moderate and Major	Adverse
		Direct	Permanent	Localized	Major	Beneficial
	Land Use and Recreation	Direct	Long-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Moderate	Beneficial
Technical and Nature-like Fishways *(Section 4.5.2.3.2)*	*Geology and Soils*	Direct	Short-term	Localized	Minor & Moderate	Adverse
	Water	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Direct & Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Direct & Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	Direct	Long-term	Localized	Moderate & Major	Adverse
		Direct	Permanent	Localized	Major	Beneficial
	Land Use and Recreation	Direct	Short-term & Long-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Invasive Species Control *(Section 4.5.2.4.1)*	*Geology and Soils*	Direct	Short-term	Localized	Moderate	Adverse
		Direct	Long-term	Localized	Moderate	Beneficial
	Water	Direct	Short-term	Beyond Project Site	Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	No Effect				
	Land Use and Recreation	Direct	Short-term	Localized	Moderate	Adverse
	Socioeconomics	No Effect				
Prescribed Burns *(Section 4.5.2.4.2)*	*Geology and Soils*	Direct	Short-term	Localized	Moderate	Adverse
		Direct	Long-term	Localized	Moderate	Beneficial
	Water	Direct & Indirect	Short-term	Localized	Moderate	Adverse
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
		Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct	Short-term	Localized	Minor	Adverse
		Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Short-term	Beyond Project Site	Moderate	Adverse
	Socioeconomics	Direct	Short-term	Localized	Minor	Adverse

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Species Enhancement (stocking) *(Section 4.5.2.4.3)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	No Effect				
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate & Major	Adverse
		Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate & Major	Adverse
		Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	No Effect				
	Land Use and Recreation	Indirect	Long-term	Localized	Minor	Beneficial
	Socioeconomics	Indirect	Short-term & Long-term	Localized	Minor	Beneficial
Channel Restoration *(Section 4.5.2.5.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short Term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct & Indirect	Short-term & Long-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Short Term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Short term & Long-term	Localized	Minor & Moderate	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Bank Restoration and Erosion Reduction *(Section 4.5.2.5.2)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short Term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct & Indirect	Short-term & Long-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Short Term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Short term & Long-term	Localized	Minor & Moderate	Beneficial
Coral Reef Restoration *(Section 4.5.2.6.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Moderate & Major	Beneficial
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	No Effect				
	Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Shellfish Reef Restoration *(Section 4.5.2.6.2)*	*Geology and Soils*	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate & Major	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Land Use and Recreation	Direct	Short-term	Beyond Project Site	Minor	Adverse & Beneficial
	Socioeconomics	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Artificial Reef Restoration *(Section 4.5.2.6.3)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
	Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Threatened and Endangered Species	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
		Direct	Short-term	Localized	Minor	Adverse
	Cultural and Historic Resources	No effect				
	Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Socioeconomics	Indirect	Short-term & Long-term	Beyond Project Site	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Road Decommissioning and Upgrading *(Section 4.5.2.7)*	*Geology and Soils*	Direct	Short-term	Localized	Moderate	Adverse
		Direct	Long-term	Localized	Moderate and Major	Beneficial
	Water	Direct	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate and Major	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct	Long-term	Localized	Minor	Beneficial
	Land Use and Recreation	Indirect	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Minor	Adverse & Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Adverse & Beneficial
Trail Restoration *(Section 4.5.2.7)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Moderate and Major	Beneficial
	Water	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate and Major	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Direct	Long-term	Localized	Minor	Beneficial
	Land Use and Recreation	Indirect	Short-term	Localized	Minor	Adverse
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Signage and Access Management *(Section 4.5.2.8)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Moderate	Beneficial
	Water	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Localized	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	No Effect				
	Land Use and Recreation	Direct	Long-term	Localized	Minor	Adverse
	Socioeconomics	No Effect				
Submerged Aquatic Vegetation *(Section 4.5.2.9.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Localized	Minor	Beneficial
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Localized	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
	Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
	Cultural and Historic Resources	Direct	Long term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Long-term	Localized	Minor & Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Marine Algae Restoration *(Section 4.5.2.9.2)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Localized	Minor	Beneficial
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Localized	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
	Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
	Cultural and Historic Resources	Direct	Long term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Long-term	Localized	Minor & Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial
Water Conservation and Stream Diversion *(Section 4.5.2.10)*	*Geology and Soils*	Indirect	Long-term	Localized	Minor	Beneficial
	Water	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
		Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Beneficial
	Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial & Adverse

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Fish Screens and Pumps *(Section 4.5.2.10)*	*Geology and Soils*	No Effect				
	Water	Direct	Short-term	Localized	Minor	Adverse
	Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Cultural and Historic Resources	No Effect				
	Land Use and Recreation	No Effect				
	Socioeconomics	No Effect				
Levee and Culvert Removal, Modification, and Set-Back *(Section 4.5.2.11.1)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Major	Beneficial
	Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
	Land Use and Recreation	Indirect	Long-term	Localized	Minor	Adverse
	Socioeconomics	No Effect				

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
On-the-Ground Riverine and Coastal Restoration						
Wetland Restoration and Shoreline Stabilization *(Section 4.5.2.11.2)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
		Direct	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
	Land Use and Recreation	Indirect	Short-term	Beyond Project Site	Minor	Beneficial
		Indirect	Long-term	Localized	Minor	Adverse
	Socioeconomics	Indirect	Short-term	Beyond Project Site	Minor	Beneficial
Wetland Planting *(Section 4.5.2.11.3)*	*Geology and Soils*	Direct	Short-term	Localized	Minor	Adverse
	Water	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Threatened and Endangered Species	Direct	Short-term	Localized	Minor	Adverse
		Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
	Land Use and Recreation	Direct	Short-term	Localized	Minor	Adverse
		Indirect	Permanent	Beyond Project Site	Minor	Beneficial
	Socioeconomics	Indirect	Short-term	Beyond Project Site	Minor	Beneficial

Restoration Activity	Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Land and Water Acquisition and Other Transactions						
Land Acquisitions and Water Transactions *(Section 4.5.3)*	*Geology and Soils*	Indirect	Long-term	Localized	Minor	Beneficial
	Water	Direct & Indirect	Long-term	Localized	Moderate	Beneficial
	Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
		Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Beneficial
	Land Use and Recreation	Direct & Indirect	Long-term	Localized	Moderate	Beneficial
	Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial & Adverse

4.5.1 Technical Assistance

4.5.1.1 Planning, Feasibility Studies, Design Engineering, and Permitting

The completion of project planning, feasibility studies, design engineering studies, and permitting activities would cause indirect, long-term, beneficial impacts to the affected environment. These activities would support the continued implementation of the most successful projects and therefore result in effective and efficient habitat restoration. Some feasibility studies would cause direct, short-term, minor impacts through associated fieldwork, including drilling into **soil** or sediment with an augur, drill rig, or other tools to remove surface, subsurface, or core samples. These impacts would be very minor and localized to the project site given how small such areas are in relation to an overall project area. Similar short-term impacts to **living coastal and marine resources and EFH, and threatened and endangered species** may include effects from handling, noise, and displacement (see Section 4.7 for more details).

All projects of this type fall within the scope of the analysis of this PEIS, as all projects will have adverse impacts equal to or lesser than those analyzed here and there will be no associated impacts from restoration actions. While information gathered may inform future projects, the outcome of the study does not commit NOAA to a future action that could have impacts on the environment.

Table 12 - Summary of impacts to Planning, Feasibility Studies, Design Engineering, and Permitting activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor	Adverse
Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor	Adverse
Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Socioeconomics	Indirect	Long-term	Beyond Project Site	Minor	Beneficial

4.5.1.2 Implementation and Effectiveness Monitoring

The environmental consequences of the initial implementation of restoration monitoring could cause direct and indirect, short-term, minor, localized, adverse impacts. Impacts to **threatened and endangered species** may include effects from handling, noise, turbidity, displacement and mortality (see Section 4.7 for more details). These impacts would result from activities associated with in-water or on-site observation or experimentation, such as the use of equipment for sampling or monitoring of organisms (see also Section 4.5.1.3 - Fish and Wildlife Monitoring below). Although these adverse impacts may occur, the monitoring products would result in indirect, long-term, minor to major beneficial impacts that extend beyond the project site. The benefits would allow future restoration proposals to be planned with better information and implemented more effectively by using the most successful methods, materials, or equipment for achieving the goal of restoration.

All projects of this type fall within the scope of the analysis of this PEIS, as all projects will have adverse impacts equal to or lesser than those analyzed here and there will be no associated impacts from restoration actions. While information gathered may inform future projects, the outcome of the study does not commit NOAA to a future action that could have impacts on the environment.

Table 13 - Summary of impacts to Implementation and Effectiveness Monitoring activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Major	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Socioeconomics	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial

4.5.1.3 Fish and Wildlife Monitoring

Fish and wildlife monitoring activities are related to monitoring the performance and progress of restoration projects relative to their established project goals. Because monitoring can allow for smarter decision-making, projects using this technique could cause indirect, long-term, minor to major beneficial impacts to **geology and soils, water resources, living coastal and marine resources, and threatened and endangered species** that may be localized or extend beyond the project site. The data gathered by trained individuals would be used to establish baseline information on species abundance and diversity and then to evaluate changes in these metrics through time. These data would be used as a basis for future aquatic habitat management decisions to benefit various species. NOAA would also use the data to report on the success of individual projects over time, thus possibly indirectly and positively affecting future funding of NOAA's various programs. The observational data gathered by trained individuals would be used to develop baseline and ongoing measurements on species composition, diversity, and richness of habitat. These data would then be used as a basis for future habitat management decisions and restoration actions to substantially benefit various wildlife species. NOAA RC would also use the data to report on the success of individual projects over time, thus possibly indirectly and positively affecting future funding of NOAA's various programs.

In addition, indirect and direct, short-term, localized, minor to moderate adverse impacts **to living coastal and marine resources and EFH, and threatened and endangered species** may include effects from handling, noise, turbidity, displacement, and mortality (see Section 4.7 for more details). **Cultural and historic resources** may be impacted if disturbed during monitoring activities. Projects with successful monitoring programs would likely be more successful than those without such programs because monitoring would allow problems and flaws to be identified early in the process and corrected. Newly established invasive species also would be identified quickly, contained, and eradicated before they become widely established. Monitoring programs would have direct and indirect, long-term, minor beneficial impacts on **land use and socioeconomics** that extend beyond any project site, because the information gathered and any involvement of local citizens in environmental projects would promote environmental stewardship, an understanding of living coastal and marine resources and environmental issues, and a sense of community pride.

Despite the beneficial impacts expected from this activity, monitoring could cause adverse impacts. Direct, short-term, localized, minor adverse impacts are expected to **geology and soils** from the human presence and movement around the project site (i.e., from soil compaction). Direct, short-term, localized, minor adverse impacts are also expected to air quality and noise at the project site due to the presence of crew members (and in the case of electrofishing, the operation of gas- or battery-powered electrofishing equipment). Direct, short-term, localized, minor adverse impacts may occur to **water quality** because, depending on the water body's substrate, turbidity may increase from the movement of crew members throughout the project site. Direct, short-term, localized, minor, adverse impacts would occur to **land use and recreation** because anglers or other individuals recreating at the project site may need to vacate or avoid the site in order to avoid interacting with monitoring activities.

Adverse population level effects are not expected from monitoring activities (e.g., electrofishing) because the activity typically takes place over a relatively small area compared with the overall distribution of the population being monitored. Regardless of the level of mortality observed from a monitoring event, it is reasonable to expect that areas that may observe mortality would be rapidly recolonized by individuals from surrounding, connected waters (e.g., Berra and Gunning 1970; Smock 2006).

Projects may specifically use electrofishing to remove unwanted individuals of a certain species (e.g., non-native species) from the aquatic environment. Removing these individuals would increase the fitness of desirable individuals (e.g., native species) at the project site. This would result in indirect, short- and long-term, localized, moderate beneficial impacts to **living coastal and marine resources and threatened and endangered species**. Impacts would be short- or long-term, depending on whether or not, and how quickly, undesirable species are able to reestablish at the project site (e.g., depending on isolation of the project site, human interference). No impacts are expected to **cultural and historic resources, land use and recreation, or socioeconomics** as a result of electrofishing activity save for potential adverse impacts as mentioned above for monitoring in general.

Electrofishing may result in direct and indirect, short- and long-term, localized, minor adverse impacts to **living coastal and marine resources and threatened and endangered species**, such as some fish and invertebrate species. The potential adverse effects of electrofishing on individual fish include cardiac or respiratory failure, injury (e.g., spinal damage or internal hemorrhaging), stress, fatigue, and mortality (Snyder 2003). Most fish mortality from electrofishing will be immediate or occur shortly after capture (e.g., Dwyer and White 1995), though some evidence suggests that delayed mortality from injury or severe stress can occur (Snyder 2003). Though results have not been consistent, some studies have found that negative impacts on reproductive success or growth may also occur (e.g., Dwyer and White 1995; Roach 1996; Tipping and Gilhuly 1996; Ruppert and Muth 1997), particularly if an individual is repeatedly exposed to electrofishing (Snyder 2003). Several factors may influence the likelihood of these adverse effects occurring, including electrical-field variability such as the current and voltage used, duration of exposure, number of passes conducted, and orientation of fish relative to lines of current and biological factors including species, size, and physical condition (Snyder 2003). Macroinvertebrates may also be affected by electrofishing activities. Though the electric field used for electrofishing rarely results in mortality of macroinvertebrates (e.g., Mesick and Tash 1980), individuals may drift in the water column once the electric current causes them to move from their substrate habitat (e.g., Kruzic et al. 2005). Electrofishing may also lead to trampling of bottom sediments, disturbing macroinvertebrate habitat. The overall effect of electrofishing on macroinvertebrates depends on several factors, including the voltage and current used, duration of exposure, number of passes conducted, and biological factors including species, life stage, and physical condition (USFWS and CDFG 2010).

NOAA projects make use of the following mitigating measures:

- Destructive sampling techniques (e.g., biomass sampling, benthic cores, and fish capture) would only be used as part of an experimental design, tailored to require the fewest number of samples to achieve the desired purpose. All researchers would obtain biological sampling permits as required for their locality.
- Electrofishing crew supervisors and crew members must have appropriate training and experience with electrofishing techniques (e.g., USFWS – NCTC Principles and Techniques of Electrofishing).
    - Training should include equipment usage and maintenance, safety training, and proper techniques to avoid/minimize fish injury.
- Electrofishing activities should be coordinated with other agencies/parties to avoid duplication of effort and unnecessary stress on fish.
- Each electrofishing session should begin with all settings (i.e., voltage, pulse width, and pulse rate) set to the minimums needed to capture fish.
- Electrofishing should be performed in a manner that minimizes harm to the fish.
    - Sample reaches systematically
    - Fish should not make contact with the anode
    - Do not allow fish to remain in the electric field longer than necessary
    - Fish should be processed as soon as possible following capture

  - o Use of an approved anesthetic may be required to reduce fish stress
- Crews should observe the condition of fish throughout sampling, and change or terminate activities if experiencing problems with fish recovery time, banding, injury, mortality, or other indications of fish stress.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. . Although information gathered may inform future projects, the outcome of the study does not commit NOAA to a future action that could have impacts on the environment.

Table 14 - Summary of impacts to Fish and Wildlife Monitoring activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Major	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Major	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	Indirect	Short-term	Localized	Minor	Adverse
Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Socioeconomics	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial

4.5.1.4 Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs

Projects that provide environmental education classes, programs, and centers; encourage and maintain partnerships with local school systems; and fund the development of education materials would have direct and indirect, long-term, minor beneficial impacts on **geology and soils, water resources, living coastal and marine resources and EFH, threatened and endangered species, land use, and socioeconomics**. The beneficial impacts would result because education of local citizens and youth about environmental issues in the community and beyond, habitat restoration, and conservation would promote environmental stewardship, an understanding of living coastal and marine resources and environmental issues, and a sense of community pride. Educational materials developed would encourage conservation and environmental stewardship, and educate the public on the benefits of habitat restoration projects.

Projects that provide education programs on wildlife would have indirect, long-term, minor beneficial impacts on **water resources, living coastal and marine resources and EFH, and threatened and endangered species**, because they would encourage conservation, understanding, and environmental stewardship with respect to wildlife. Wildlife education programs would have no impacts on **geology and soils, cultural and historical resources, land use, or socioeconomics**. Projects are not likely to adversely impact **threatened and endangered species**.

Projects that encourage and enlist the participation of youth groups in restoration projects and provide outreach and education to youth groups would have direct, long-term, minor beneficial impacts on **geology and soils, water resources, living coastal and marine resources and EFH, threatened and endangered species, and socioeconomics**. Projects conducted by youth groups would generally benefit the community both through their results and by promoting community cohesion. These projects would have indirect, long-term, minor beneficial impacts on land use, because education and involvement of youth in environmental projects would promote environmental stewardship, an understanding of living coastal and marine resources and environmental issues, and a sense of community pride. Projects are not likely to adversely impact threatened and endangered species.

Projects that train volunteers to participate in restoration projects and provide outreach and education to the community would have indirect, long-term, minor beneficial impacts on **all resources** because training and involvement of local citizens in environmental projects would promote environmental stewardship, an understanding of living coastal and marine resources and environmental issues, and a sense of community pride. Projects are not likely to adversely impact **threatened and endangered species**.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. No projects with adverse impacts will be funded.

Table 15 - Summary of impacts to Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Long-term	Beyond Project Site	Minor	Beneficial
Water	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Threatened and Endangered Species	Direct & Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Socioeconomics	Direct	Long-term	Beyond Project Site	Minor	Beneficial

4.5.2 Riverine and Coastal Habitat Restoration

The following sections are in alphabetical order, corresponding to Section 2.2.2.

4.5.2.1 Beach and Dune Restoration

Beach and dune restoration activities may provide a number of direct and indirect benefits to a diverse range of species. Sea turtles may use restored beach habitat for nesting. Migratory and resident birds, as well as terrestrial species, may similarly use such habitat for shelter, forage, and nesting. Human recreational uses and aesthetic values also benefit from such activities.

Beach nourishment and sediment placement are likely to have direct, short-term, minor adverse impacts at the sediment borrow and restoration sites on **geology and soils, water resources, living coastal and marine resources and EFH**, and on **threatened and endangered species** at the restoration site in the form of loud, heavy machinery, disturbed habitat, and increased human presence. Both direct and indirect impacts to **cultural and historic resources** resulting from the implementation of this restoration activity are dependent on the extent to which cultural and historic resources are present at a specific site. Impacts may be adverse or beneficial. Adverse impacts may be realized if such resources are uncovered during construction activities. However, cultural resources may also benefit from restoration activities near a site. Indirect, short-term, minor beneficial impacts are anticipated on **recreation and land use** due to recreational and fisheries benefits of habitat restoration that extend beyond the project site. Such projects would have direct and indirect, long-term moderate beneficial impacts to **socioeconomic resources** from restoration of beach habitat and profile through increased tourism. The **geology** of the area would be directly benefited, as beach sand placed along the shoreline would provide additional stabilization to the eroding shoreline. No indirect impacts on **water resources** would be anticipated from sediment placement activities. Long-term major beneficial impacts on **living coastal and marine resources and EFH**, and on **threatened and endangered species,** such as resident and migratory species that use beach habitat, would be expected, as this activity could increase the habitat area for use as foraging ground for terrestrial species and birds, and as nesting sites for sea turtles.

There will be instances where a beach and dune restoration project supported by the NOAA RC is expected to produce adverse impacts beyond the nature of those described in this PEIS. In such cases, an environmental assessment or EIS (tiered from the analysis in this document) will be prepared, as needed. NOAA RC staff will consider the magnitude of impacts to the resources described in this PEIS (especially impacts to cultural resources or to protected species, or as a result of cumulative impacts from past actions), but will also consider whether the volume of sediment or the length of the restored area are of a size that requires additional analysis beyond that described below. The NOAA RC will also consider whether the impacts to borrow sites, the method of borrow, site hydrology (of both borrow and placement area), nutrient fluxes, biota, social aspects, and the implemented best practices warrant such additional analysis. Policies and regulations of the local jurisdiction are other factors that would be considered prior to implementation of this technique (Hopfensperger 2011).

Table 16 - Summary of impacts to Beach and Dune Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Moderate	Beneficial
Water	Direct	Short-term	Localized	Minor	Adverse
Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	Direct & Indirect	Long-term	Localized	Minor	Adverse & Beneficial
Land Use and Recreation	Indirect	Short-term	Localized	Minor	Beneficial
Socioeconomics	Direct & Indirect	Long-term	Localized	Moderate	Beneficial

4.5.2.2 Debris Removal

Most debris removal activities would have both adverse and beneficial impacts on the affected environment in the project area, but would ultimately restore habitat for marine species and reduce the hazards of debris to NOAA trust resources. Generally, debris removal projects would cause direct, short- and long-term, localized, minor to moderate beneficial impacts. By identifying, locating, and removing unwanted debris from the affected environments, beneficial impacts to **geology, soils,** and **land use and recreation** would occur simply because areas are cleaner. In some cases (e.g., general solid waste and unwanted natural debris), debris would re-accumulate to the project area and benefits would be short-lived. In other cases (e.g., derelict fishing gear, abandoned vessels, and pilings), pollution would no longer occur and benefits would be local and long-term or even permanent in some cases. Whether short- or long-term, there would be direct, moderate beneficial impacts to **water quality** when debris is removed and the debris or associated leachate is no longer present in the coastal environment. Implementation of debris removal projects would also result in indirect, long-term, moderate beneficial impacts on **living coastal and marine resources and EFH**, and on **threatened and endangered species** because habitats would be cleared of potentially injurious debris—these impacts would likely extend beyond the project site. In the riverine environment, debris may exist within the stream channel, in shallow-water or off-channel habitats, in riparian and floodplain areas, or in associated upland areas where debris removal could potentially benefit NOAA trust resources. In the open-water environments, debris removal may occur on the surface, within the water column from shallow to deep water, or from benthic habitats where debris removal could potentially benefit NOAA trust resources.

The effectiveness of a given removal technique should be considered alongside short- and long-term beneficial and adverse environmental impacts when choosing whether to remove marine debris. Despite long-term beneficial impacts, debris removal activities may cause minor adverse impacts to **living coastal and marine resources** and their habitat, such as trampling, increases in turbidity, releases of contaminants, and other effects. It is also likely that marine debris may be colonized by biofouling organisms, and some of these animals and plants may have the potential to become invasive species elsewhere if care is not taken to inspect the marine debris for non-native species and to take precautions accordingly during disposal to prevent spread. Simultaneously, derelict fishing gear may be used as habitat by marine plants and animals, and attempting to remove the gear can result in harm to those organisms. In such cases, leaving the debris in place and/or partially removing the targeted debris may be the best course of action. Migration corridors and rearing and feeding areas for NOAA trust resources are often found throughout the affected environment. Debris is also often entangled in rocks and woody debris, or may be partially buried in sand or gravel—all of which may be used by species as habitat. Direct interaction with these (and other) species during debris removal activities may result in displacement or altered behavior. In certain cases (e.g., in-water debris removals) there is the potential for interaction with large marine mammals such as whales, and special care would be taken to time debris removal activities and employ BMPs so as to avoid interactions with these animals.

Disturbance at a debris removal restoration site typically only lasts as long as the removal process, generally several minutes to a few hours, but potentially longer (e.g., a vessel removal may take multiple days if the vessel must be removed in pieces). Human and equipment access to a site for debris removal may cause minor damage to habitat and species through trampling, noise, displacement, and unintentional introduction of invasive species; construction impacts are described further in Section 4.5.2.11 - Wetland Restoration. When heavy equipment or motor vehicles are used for debris removal, BMPs for vehicle staging, fuel storage, erosion and pollutions control, and species decontamination should be used to prevent construction-related impacts to the extent possible. Temporary turbidity and displacement of individual fish may occur as a result of submerged debris removal, although the intensity and duration of this disturbance is unlikely to increase total suspended solids, or otherwise impair aquatic habitats or essential fish behavior. Temporary turbidity is the primary potential adverse effect from this activity with respect to listed salmonids. **Water resources** can also be impacted by the removal, remobilization, and transport of debris, which may cause temporary adverse impacts to water quality. Creosote from pilings, fuel from abandoned vessels, chemicals from appliances, and other solid waste may be released or spread into the aquatic environment through removal activities. In the case of piling removal, steps would be taken to minimize creosote release, sediment disturbance, and total suspended solids and BMPs would be followed accordingly. Contaminated debris is removed to landfills qualified to handle the contaminating chemical.

There is potential for impacts to **cultural and historic resources** during debris removal activities, such as in the case of shipwrecks or other properties in submerged, coastal, or inland waterways. Care would be taken to ensure such properties are avoided during removal, especially in known historically or culturally sensitive areas. Any of the following potential measures may also be carried out during a project as ways to prevent unwanted impacts to cultural and historic resources: coordination with the State Historic Preservation Officer (SHPO) as appropriate; use of a marine archaeologist to identify known sites; carry out staff training on potentially injurious project activities or techniques; project planning (e.g., to account for unanticipated discoveries or to establish buffer zones around sensitive areas); and remotely sensing the area to identify submerged resources (Barnea et al. 2009). Conversely, however, in some cases it is the historical structure or artifact itself that is being removed, and would involve local SHPO or Tribal Historic Preservation Officer (THPO) staff as appropriate.

NOAA projects make use of the following mitigating measures:

- If debris is being removed, NOAA would consider the most experienced personnel and type of equipment appropriate to use to reduce impacts to the environment during debris removal activities. Volunteers may be appropriate for beach clean-up efforts, while professional contractors may be most appropriate for large-scale or technically difficult vessel removals.
- Debris removal on beaches would be scheduled to coordinate with the tidal cycle at the clean-up sites to avoid unnecessary water quality impacts and considerations for worker safety.
- Direct interactions with threatened or endangered species would be avoided as much as possible (see Section 4.7).
- All removed debris would be handled and disposed of in a responsible manner, and recycled when possible.
- Potential impacts caused by equipment staging, vehicle or foot traffic, and other construction-related activities would be avoided and minimized by applying BMPs related to construction activities.
- To avoid disturbance, displacement, or direct mortality of animals and plants that are using the debris as habitat, attempts would be made to remove entangled live animals and vegetation before debris removal. Any removed organisms that are native to the restored habitat would be left in place where the debris was encountered. Non-native species, if properly identified as such, would be removed and disposed of properly.
- For in-water removals less than 100 feet deep, divers should hand-remove nets and lines from the seabed by cutting away encrusted or severely entangled lines or netting to minimize entanglement of fish or invertebrates.
- Vehicles or equipment used to manage invasive plants should be cleaned of all debris before removing them from the treatment site to prevent the unintended spread of seeds, rhizomes, or plant fragments to other areas. Biofouled debris bearing non-native species should be appropriately treated before moving to reduce the likelihood of introducing or spreading invasive species.
- Complete removal of piles should be considered and protocols followed for removal or cutting, barge operations, capture of floating surface debris, minimizing in-water equipment presence, and filling the holes left by removed piles with clean, native sediment. In the case of creosote pilings, many state agencies have BMPs associated with such removals, and those BMPs or others should be followed during removal operations.

All projects of this type fall within the scope of the analysis of this PEIS, with the exception of those that exceed the duration, extent or intensity of impacts, those that include the removal of industrial debris with high levels of contaminants, or those that remove debris associated with environmental remediation projects. As described in Section 2.2.2.2, debris removal projects included in this analysis restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the mitigating measures included in this section and in Appendix C, which lists the general precautions taken when planning restoration projects in order to avoid adverse impacts greater than those described here.

Table 17 - Summary of impacts to Debris Removal activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Long-term	Localized	Minor	Beneficial
Water	Direct	Long-term	Localized	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Long-term	Localized	Minor	Beneficial
Socioeconomics	Direct	Short-term & Long-term	Localized	Minor	Beneficial

4.5.2.3 Fish Passage

4.5.2.3.1 Dam and Culvert Removal, Modification or Replacement

In general, dam and culvert removal, modification, or replacement projects typically implemented by the NOAA RC produce short-term adverse ecological impacts and considerations, but the long-term ecological benefits—improved water quality, sediment transport, and native resident and migratory species recovery—demonstrate that removal of these barriers could be an effective long-term and beneficial river restoration tool (Bednarek 2001).

Barrier removals may include indirect and direct, short-term, minor, moderate, or major adverse impacts on **geology and soils, water resources, and living coastal and marine resources** and EFH, both localized to the project site and beyond the project site. They may also have direct, long-term, impacts to **land use and recreation**. Indirect and direct, short-term, minor, and moderate adverse impacts to **threatened and endangered species** may include effects from handling, noise, turbidity, contaminants, changes to hydraulics and local hydrology, additional habitat quality/quantity, and displacement (see Section 4.7 - Potential Impacts to Threatened and Endangered Species and below for more details). However, indirect and direct, long-term, moderate, and major benefits to threatened and endangered species, as well as to other resources, may result as well. The detailed analysis used to describe impacts of small dam removals completed for NOAA's 2006 programmatic NEPA review is incorporated by reference and can be accessed upon request from the CRP Program record (CRP 2006). This document reviewed the existing literature on dam removals and the results of 30 dam removals partially or fully funded by the NOAA RC. Case studies included four successful projects that had no significant impact, one project that was not completed due to potential adverse impacts identified during feasibility analysis, and two projects that were anticipated to receive NEPA review outside the existing programmatic EA in use at the time.

Adverse impacts to **geology and soils during project construction** are direct and indirect, short-term, and of minor to moderate effect, and may be localized to the project site or realized beyond the project site. These impacts stem from the use of heavy machinery and construction equipment and include soil compaction, temporary grading, minor bedrock removal, short-term downstream sediment deposition, and increased soil erosion and runoff in the immediate area of construction operations. The scale and duration of impacts may depend on the size of the dam or culvert to be removed, but more often will depend on the magnitude of the overall project footprint and include many factors such as the construction of haul roads, stockpile areas, cofferdams, or the size of area to be cleared for equipment storage. Post-construction scouring of the channel bed caused by a release of water and sediments that accumulated in the impounded area may occur, depending on the size and spatial configuration of the quantity of impounded sediment, the grain size of impounded sediments, flow competence, and other factors (Collins et al. 2007). Downstream migration of impounded sediments can increase downstream flood elevations. Changes to any flood elevations would only occur after appropriate regulatory consultations.

During and after the construction phase, there are impacts to **water resources** that extend beyond the project site as a result of stream flow. The change in obstruction (e.g., fully or partially removed barrier) increases the connection between upstream and downstream areas and therefore produces direct and indirect, short- and long-term impacts, generally resulting from altered hydraulics and stream geomorphology. In general, smaller dams and culverts store less water and sediment, and have fewer impacts during removal, and the removal of a run-of-river dam is unlikely to alter downstream hydrology (Heinz Center 2002). Short-term impacts to water resources may include downstream turbidity and sedimentation. This impact may also be affected by a potential increase in site-specific (local) erosion and changes in channel geomorphology, and minor changes to stream hydraulics. However, areas exposed by the drawdown of the impoundment often revegetate quickly, reducing the extent of the turbidity impacts (Aspen Institute 2002).

Long-term, post-construction impacts from the removal of dams and culverts result in direct and indirect, long-term, moderate, and major impacts to **water resources.** Temperature may increase or decrease, depending on whether water was previously released from the top or bottom of the dam, and therefore may affect cold- or warm-water fish populations, respectively. Such removals may also reintroduce nutrients downstream through sediment transport. The magnitude of these changes is often, but not always, based on the size of the dam and impoundment. For instance, small run-of-river dams and culverts are unlikely to substantially alter thermal regimes (Poff and Hart 2002) and water quality is unlikely to change noticeably if the impoundment had a short residence time and infrequent stratification (Bushaw-Newton et al. 2002). However, the removal of even small run-of-river dams have shown in some cases to improve water quality to such a point that the river reach was removed from state impaired water lists. Within the former impoundment area, the stream channel may have higher dissolved oxygen levels than existed prior to removal. Minor changes may also occur in groundwater supplies at the impounded area after drawdown, which depends on impoundment stages and alluvial aquifer characteristics.

Adverse impacts to **living coastal and marine resources** such as vegetation and wildlife are direct and indirect, short-term, and of minor to moderate effect. They occur most often during the construction phase, and can extend beyond the project site. Impacts to vegetation around the site from the construction process include removal of the vegetation for equipment access or trampling. The scale of the impacts varies based on the overall footprint of the project site, similar to the impacts to geology and soils described earlier in this section. Wildlife species near the project site, including endangered or threatened species, may be temporarily displaced or harassed during construction activities due to reverberations, noise, air quality impacts, and artificial lighting. Habitat may be lost by the filling or cutting off of side channels from sediment deposits following dam removal, or when vegetation is uprooted by migrating stream channels. These types of habitat loss impacts are anticipated to be temporary until a large flood event or groundwater sources carve new channels in such areas. Human activities may also be temporarily affected.

Eroded sediments can impact downstream floodplain and aquatic habitat and spawning grounds, as well as water and food quality. Sediment releases may also increase bed elevations, which can cause short-term increases in flood stages and potentially impact bridges, floodplain land uses (including low-lying structures), and recreational uses. Sediments can be quickly flushed out following a dam removal (Heinz Center 2002; Stanley and Doyle 2003), or may be released in pulses over time (Pearson et al. 2011). Sediment deposition downstream does not always cause measurable changes in algal or invertebrate communities (Stanley and Doyle 2003), and, if they do show decreases, they may be short-term and can realize a relatively quick recovery (Orr et al. 2008). In other cases, there is evidence of shifts in downstream riverine and estuarine food webs following dam removal that show animals with invertebrate diets shifting increasingly to terrestrial-based invertebrates for their food source (NWIFC 2013). One study showed that some fish were impacted by sediment accumulation downstream, but effects appeared short-term (Bushaw-Newton et al. 2002).

Additional short-term, direct impacts may include supersaturation of gases, from too rapid a drawdown of the dam reservoir, which could lead to gas-bubble disease and fish mortality. Bednarek (2001) noted that supersaturation results from one study were short-term and did not affect overall populations. Contaminants could be released through resuspension of sediments behind barriers that are removed, but sediments with sorbed contaminants at concentrations high enough to impact biota are properly removed from NOAA RC implemented projects sites when necessary, and not allowed to be released downstream. Site-specific analyses are conducted prior to any barrier removal implementation phase in order to assess the likely presence or quantity of contaminants. Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as lumber or paper mills, industrial sites, or intensive agricultural production, because chlorinated pesticides historically were legal to purchase and use.

Post-construction impacts to **living resources** also occur. A reduction in species preferring reservoir habitats may occur, as conditions change to favor more lotic than lentic species. Without obstruction, migratory fish can reach historic spawning areas (Baish et al. 2002). Additional impacts are triggered by the shifts in temperature and nutrient gradients described in the impacts to water resources earlier in this section, which lead to changes such as fish assemblages and behavior; re-establishment of natural flow regimes; sediment, nutrient, and organic material being available to downstream habitats; and possible reductions in flood elevations in the former impoundment upstream. Dam removal may increase the abundance and diversity of aquatic insects, fish, and other organisms (Heinz Center 2002), and may even decrease invasive and undesirable species (Bednarek 2001). When the fish species in question is an endangered species, increased access to their spawning habitat can have long-term, major beneficial impacts. For example, Cederholm et al. (2000) reported that up to 82 species of animals use salmon carcasses as a food resource in Oregon and Washington. These resources would not be available if migratory individuals are not able to reach this habitat. Additionally, reintroducing migratory fish to habitats upstream of a barrier through the construction of a fishway may result in a more native fish assemblage. Further, overall ecosystem productivity could increase as a result of the presence and spawning activity of migratory species. Helfield and Nairman (2001) found that trees and shrubs near salmon spawning streams derive 22 to 24 percent of their foliar nitrogen from spawning salmon. However, the removal of barriers may open pathways for invasive species into new habitats.

A dam and culvert removal, modification, or replacement project that results in a reduced impoundment frequently causes changes in **land use and recreation**, along with the composition of localized ecosystems. They may have direct, long-term, minor adverse impacts to land use that extend beyond the project site, as well as direct, long-term, moderate beneficial impacts. This includes direct impacts such as the conversion of wetland areas to uplands around the former reservoir margins, as well as the potential colonization of invasive vegetation on newly exposed soils. Barrier removal can impact some recreational users, as well as aesthetic conditions for those who prefer flat water created by an impoundment. Beneficial impacts may also result. Although wetlands may decrease at the former impounded area edge, they could redevelop both above and below the dam site. The downstream channel may also improve its connection to the floodplain, enhancing existing riparian wetlands. In addition, these projects can create new recreational opportunities and waterfront revitalization, provide sediment to replenish beaches, and decrease safety and liability concerns. Lastly, despite barrier removal costs and the value of lost services (if applicable), removal may save financial resources otherwise required for operating costs and rehabilitation of the dam for safety or ecological reasons.

Many dam and culvert removal, modification, or replacement projects result in a long-term change to **cultural and historic resources**. In some cases, cultural and historic sites are made accessible after a barrier removal where they were once submerged by reservoirs. Such activities may be considered to have direct, long-term or potentially permanent, major beneficial impacts to such cultural/historic resources. However, if the barrier (usually a dam) meets criteria for eligibility in the NRHP, removal will have major impacts to historic resources. In such cases NOAA will enter into agreement with the relevant agency (through a memorandum of agreement or other formal or informal means) that will determine the specific steps needed to mitigate adverse impacts to cultural and historic resources. Historic and cultural resources will only be adversely affected under this PEIS once National Historic Preservation Act consultation requirements are complete.

There are generally direct and indirect, long-term **socioeconomic** impacts related to changes in aesthetics at a removal site, increased access for recreation and indirectly, and increased business opportunities for the local recreation sector, which are largely beneficial. Changes in property values, land-use, and recreational opportunities (e.g., shifts from flat-water recreation to white-water recreation) adjacent to a removal site may be beneficial or adverse depending on the perspective of the user group.

There will be instances where a dam removal project supported by the NOAA RC is expected to produce adverse impacts beyond the nature of those described in this PEIS. In such cases, an environmental assessment or EIS (tiered from the analysis in this document) will be prepared, as needed. NOAA RC staff will consider the magnitude of impacts to the resources described in this PEIS (especially impacts to cultural resources or to protected species, or as a result of cumulative impacts from past actions), but will also consider whether such factors as reservoir sediment volume compared to stream sediment loads, level of sediment contamination, changes to stream channel characteristics or pathway, or flood zone changes warrant such additional analysis.

Table 18 - Summary of impacts to Dam and Culvert Removal, Modification or Replacement activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct & Indirect	Short-term & Long-term	Localized	Minor & Moderate	Adverse
	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Water	Direct	Short-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	Direct	Long-term	Localized	Moderate	Adverse
	Direct	Permanent	Localized	Major	Beneficial
Land Use and Recreation	Direct	Long-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Moderate	Beneficial

4.5.2.3.2 *Technical and Nature-like Fishways*

Fishway projects result in some adverse impacts, but the long-term ecological benefits to native resident and migratory species make this an effective habitat restoration tool. During construction direct, short-term, localized, minor to moderate, adverse impacts to **geology and soils** may result, including soil compaction, temporary grading, and increased erosion. These impacts would occur due to the use of heavy machinery, construction equipment, and the movement of restoration practitioners throughout the project site during construction of access roads, staging areas, and/or the fishway itself. **Water resources** may also be affected during construction with direct, short-term, minor to moderate, adverse impacts expected to water quality. Due to the introduction of fine sediment to the water column during construction, water turbidity would increase at the project site, and may extend beyond the project site, depending on the degree of attenuation. Also, as is the case during any construction activity, an accidental contaminant spill (e.g., fuel, oil, grease, hydraulic fluid) may have short-term, direct adverse impacts on water quality.

During construction, fishway projects could result in direct and indirect, short- to long-term, minor to moderate adverse impacts to **living coastal and marine resources,** and **threatened and endangered species**, which are localized or extend beyond the project site. Most directly, these projects may temporarily displace aquatic organisms from the immediate project area because construction may require the use of a coffer dam or other method used to exclude aquatic organisms. Additionally, fishway projects could delay upstream or downstream migration of aquatic organisms during construction. However, this delay would only be temporary. Increased sedimentation and turbidity during construction could also negatively impact aquatic organisms with increased mortality, reduced physiological function, and decreases in available or apparent food resources possible (Henley et al. 2000). These impacts could be localized or extend beyond the project site, depending on the degree of attenuation. Riparian vegetation may also be removed or crushed during construction in order to build staging areas, increase access to the project site, or to make room for the fishway itself. This reduction in riparian vegetation could indirectly affect aquatic organisms by altering water temperatures at the project site, or decreasing the amount of large woody debris available for input into the water body.

Fishway projects result in direct and indirect, long-term, minor to major benefits to **living coastal and marine resources** and **threatened and endangered species** that extend beyond the project site. Fishways are generally constructed and/or modified in order to increase fish escapement rates. Therefore, it is expected that fishway projects will increase the amount of habitat available to desirable aquatic organisms for growth, survival, and reproduction, while decreasing the likelihood that migratory individuals will deplete their energy reserves prior to reaching their preferred habitat. Fishway construction can contribute to increases in fish productivity (e.g., Mullins et al. 2007). Fishway construction will directly benefit the species targeted for passage, and the beneficial impacts will be long-term. In addition, indirect, long-term ecosystem benefits may result in the watershed above the project site. For example, Cederholm et al. (2000) reported that up to 82 species of animals use salmon carcasses as a food resource in Oregon and Washington. These resources would not be available if migratory individuals are not able to reach this habitat. Additionally, reintroducing migratory fish to habitats upstream of a barrier through the construction of a fishway may result in a more native fish assemblage. Further, overall ecosystem productivity could increase as a result of the presence and spawning activity of migratory species. Helfield and Nairman (2001) found that trees and shrubs near salmon spawning streams derive 22 to 24 percent of their foliar nitrogen from spawning salmon.

However, these projects could also have adverse impacts through an increase in the escapement and availability of habitat for invasive species. For example, in the Great Lakes region, some agencies advocate for the maintenance or construction of barriers to inhibit the passage of invasive sea lamprey (*Petromyzon marinus*; Lavis et al. 2003). If necessary, fishways are constructed or modified to be species-selective, allowing the passage of desirable species while inhibiting the passage of undesirable species, such as sea lamprey in the Great Lakes region.

Fishway projects could also result in direct, long-term, localized, minor to major adverse impacts to **cultural and historic** resources. A fishway project site may meet criteria for eligibility in the National Register of Historic Places (NRHP) and, consequently, altering these sites may have impacts to historic resources. Construction would begin at these sites under this PEIS only after a consultation that meets the requirements of the National Historic Preservation Act has been completed.

Land use and recreation may be temporarily disturbed, as people not associated with the project will be unable to access the project site during construction. Increases in noise from the operation of heavy machinery and construction equipment could also result in short-term adverse impacts to land use and recreational activities in the area surrounding the project site. Conversely, fishway projects may increase recreational and commercial opportunities at the project site due to increases in fish productivity, or if an effort is made to make the fishway site a publically accessible site for education and outreach.

Fishway projects may also result in direct and indirect, short- and long-term, minor beneficial impacts to **socioeconomic resources,** as we would expect a varying number of jobs to be created and a beneficial impact on the local economy to result from the funding spent on project construction.

Fishways as a fish passage restoration tool come in a variety of forms, as described in Section 2.2.2.3.2. NOAA RC staff will generally consider similar site characteristics as those described in Section 4.5.2.3.1 - Dam and Culvert Removal, Modification or Replacement above when analyzing a project and its inclusion in the scope of this PEIS analysis.

Table 19 - Summary of impacts to Technical and Nature-like Fishways activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor & Moderate	Adverse
Water	Direct	Short-term	Beyond Project Site	Minor & moderate	Adverse
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Direct & Indirect	Long-term	Beyond Project Site	Major	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Direct & Indirect	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	Direct	Long-term	Localized	Moderate & Major	Adverse
	Direct	Permanent	Localized	Major	Beneficial
Land Use and Recreation	Direct	Short-term & Long-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

4.5.2.4 Fish, Wildlife, and Vegetation Management

4.5.2.4.1 Invasive Species Control

The impacts of invasive species removal ultimately benefit the immediate ecosystem by allowing native species the chance to re-establish. In the United States, approximately 49 percent of the species on the threatened or endangered species lists are at risk primarily because of predation or competition with invasive species (Wilcove et al. 1998). In fact, impacts from non-native species are second only to habitat destruction as a cause of global biodiversity loss (Lawler et al. 2006). Generally, invasive species removal activities may cause direct, short-term, localized, minor adverse impacts to the affected area from mechanical or human activities. For terrestrial and aquatic invasive plant removal, direct adverse impacts to **geology and soils** may include compaction, whereas impacts to in-water substrate and **water resources** may include ephemeral sedimentation, turbidity, or other water quality impacts. However, long-term moderate to major beneficial impacts to **geology and soils, water resources, coastal and marine resources, and EFH** and **threatened and endangered species** would result as non-native species are replaced by diverse native plant and animal communities.

Herbicide use for removal of invasive plant species could cause direct, short-term, moderate, adverse impacts to **geology and soils, water, living coastal and marine resources and EFH, threatened and endangered species,** and **land use and recreation**. These impacts would result from the potential for lethal effects on soil biota and the short-term loss of shading and habitat for prey species provided by the invasive plant. The potential impacts to birds, aquatic organisms, and terrestrial organisms will be mitigated by the use of the least toxic herbicides, surfactants, and spray pattern indicators available, but sub-lethal impacts are possible. These include impacts to reproduction, survival to adulthood, and disrupted food webs (NMFS 2005). Potential impacts to non-target plant species are reduced when proper application methods are prescribed, but rainfall and wind may cause herbicides to leach into the surrounding soil or be transported to non-invasive plants, causing unintentional damage. Appropriate herbicide application methods should reduce the risk of such herbicide drift. Suggested methods include backpack spraying, cut stump, and hack-and-squirt; however, other methods may be used as the site or target species dictates. These methods also greatly reduce the chance of exposing surface waters and their ecological communities to these chemicals due to the high level of applicator control. Methods that do not require surfactants would be used when possible. If necessary, surfactants would be limited to products determined to be the least toxic to the terrestrial, aquatic, and marine/estuarine organisms found in the immediate area. Herbicide tracers (i.e., spray pattern indicators) should be used whenever possible to track herbicide application progress. The use of herbicide tracers will reduce the possibility of over-application, and thus would result in direct, short-term beneficial impacts to the affected area; adverse effects are the same as would be expected from herbicide application, as described above. A project area may be treated several times per year, often for multiple years, to control regrowth of the invasive plant. Where feasible, the area will be regularly monitored for regrowth of the target or new invasive species. Generally, use of herbicides in project areas would be conducted according to established protocols for the locality, as determined by a licensed herbicide applicator. Such protocols would include information and guidelines for appropriate chemical to be used, timing, amounts, application methods, and safety procedures relevant to the herbicide application.

The removal of invasive fish species requires selective removal that is typically done by spearfishing, pole fishing, hand line, troll, trap, seining, or electrofishing (see Section 4.5.1.3 for a description of impacts from electrofishing activities). The environmental consequences of spear, pole, hand line, troll, and trap fishing for invasive species are limited due to the selective nature of the removal method. Care would be taken to ensure non-target organisms are not impacted directly through bycatch or increased human traffic, but the possibility of this impact does exist to varying degrees depending on the removal technique being used. In most situations, the removal of an invasive species would have overall beneficial effects. The ecosystem-wide impacts at the scales at which these activities are carried out would likely be minor. However, biological invasion often results in the loss of biodiversity as well as an alteration of trophic relationships and ecosystem processes, signifying that restoring native communities is often not as simple as removing the invader. In some situations, native species may have come to depend on particular invasive species as a prey item or habitat. In other cases, invaders may have rendered the habitat unsuitable for native species to repopulate. Given the numerous and complex interactions among species and their environment, it is difficult in general to predict the outcome of invasive species removal. This justifies careful evaluation of the functional roles of invasive species within ecosystems prior to initiating any removal effort.

Once the target species has been appreciably diminished or extirpated from the management area, habitat restoration and long-term monitoring are critical to mitigate further harm to native species.

Whether or not an area can recover naturally (i.e., by allowing desirable populations to recover without taking further action) depends upon a number of ecological and site-specific factors. However, restoration is often necessary to avoid the replacement of one invasive species with another or to prevent soil erosion or other problems associated with the absence of biological materials through such activities as emergency soil stabilization, replanting, and monitoring. In support of Executive Order 13112, NOAA supports a "place-based" approach to restoration, which emphasizes the importance of using plant and animal materials that are native to the particular area in any revegetation activities.

NOAA projects make use of the following mitigating measures:

- Care should be taken when selecting control measures, as some may disturb the soil, resulting in rapid expansion of the target species. The effectiveness of treatments will be dependent on the life history characteristics of the target species as well as the size of infestation. Control options should be carefully evaluated to determine the control measure(s) that are both appropriate and cost-effective.

- Vehicles or equipment used to manage invasive plants should be cleaned of all debris before removing them from the treatment site to prevent the unintended spread of seeds, rhizomes, or plant fragments to other areas. Biofouled debris bearing non-native species should be appropriately treated before moving to reduce the likelihood of introducing or spreading invasive species.

- If physical removal/mechanical measures are used, plant materials should be buried on site or bagged and incinerated or disposed of in a sanitary landfill. This will prevent seed spread and allow sunlight to reach the soil surface to promote germination of native plants. Any invasive fish or animal collected by this method should not be re-released into the environment; the organisms should be properly contained and/or humanely euthanized to ensure further spread does not occur.

- Composting is not advised because not all seeds may have been destroyed in the composting process, permitting regrowth to occur. In the case of algae composting, algae should be kept within the same watershed as it was collected to minimize the chance of spread.

- Any herbicide must be registered for use in that state and used in a manner consistent with its application by a licensed applicator under all necessary state and local permits.

- Implementation of prevention measures, such as application of Hazard Analysis and Critical Control Point (HACCP) planning, is important to identify and minimize the risks of introducing non-native organisms during restoration activities.

- An inventory should be completed of existing invasive species including invasive populations using field reconnaissance and mapping. Knowing where invasive species live is essential to control efforts; the species will continue to spread until removed.

- During removal activities, ingress and egress routes should be planned to minimize the area impacted. Prior to project implementation, workers and any volunteers should receive proper training on sound removal methods to avoid invasive species spread or unintentional damage to native species.

- Prevention strategies should be implemented to avoid many of the long-term economic, environmental, and social costs associated with invasive species. For example, inspection and decontamination of vehicles, equipment, and clothing for should be conducted upon entrance and exit from the worksite to minimize the risk of unintentionally moving invaders.

- Soil disturbance should be minimized or soil disturbance areas sequenced to allow for rapid establishment of a healthy native plant cover. When working in relatively closed canopies, retain shade to the extent possible to suppress weeds and prevent growth.

- All materials and native species used for restoration should be inspected and, when possible, certified that they are not acting as vectors for invasive species.

- New invaders can show up at any time and are easiest to control when they first arise in an area; thus regular monitoring of the site and updating of the species inventory is important.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.4.1, invasive species control projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the mitigating measures included in this section and in Appendix C, which lists the general precautions taken when planning restoration projects in order to avoid adverse impacts greater than those described here.

Table 20 - Summary of impacts to Invasive Species Control activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Moderate	Adverse
	Direct	Long-term	Localized	Moderate	Beneficial
Water	Direct	Short-term	Beyond Project Site	Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Cultural and Historic Resources	No Effect				
Land Use and Recreation	Direct	Short-term	Localized	Moderate	Adverse
Socioeconomics	No Effect				

4.5.2.4.2 Prescribed Burns and Forest Management

Prescribed burning could cause direct and indirect, short-term, localized, minor, and moderate impacts on **geology and soils, water, living coastal and marine resources,** and **threatened and endangered species** at the time of the burn. Impacts to living coastal and riverine resources and EFH and threatened and endangered species may include disturbance or displacement of species from high temperatures and burning, elimination of cover and material used for insulation, elimination of moisture, and the retention of heat due to burning (see Section 4.7) and may extend beyond the project site. Typically, prescribed burns have been used to maintain and restore native grasslands but have also been used in forested areas or freshwater marsh systems. Often, prescribed burns are used in conjunction with herbicides and mechanical methods to control invasive plants. As a management tool, prescribed burning recycles nutrients tied up in old plant growth, eliminates many woody plants and herbaceous weeds, improves poor-quality forage, increases plant growth, reduces the risk of large wildfires, and improves certain wildlife habitat. Mitigation for potential impacts would focus on the timing of the burn to take place when listed species are the least vulnerable (e.g., in Great Lakes habitats in the winter when amphibians and reptiles are underground or under water). Prescribed burning would cause direct and indirect, long-term, beneficial impacts to wetland vegetation and the wildlife that use this habitat by increasing seed production and the viability of native plant species, stimulating new native species to germinate, returning plant nutrients to the soil, and eliminating invasive plant species and woody species overall, creating additional habitat quality and quantity. **Cultural and historic resources** would be protected from long-term impacts by excluding them from burn areas. These resources may experience direct, minor, short-term impacts resulting from smoke. **Land use** (agricultural, recreational) may be directly impacted in the short-term at the burn site and adjacent areas. This may have corresponding socioeconomic impacts if tourism is affected, but, in general, the **socioeconomic** impacts would likely be negligible.

Because prescribed burns present unique challenges as a restoration tool, a burn plan must be prepared to minimize or avoid impacts to water and air resources, impacts to non-target resources (including threatened and endangered species), area residents, and adjacent structures. The burn plan typically describes the size and specific location(s) to be burned, a list of those to be contacted before initiating the burn, any relevant site-specific information that would affect the safety or control of burn (e.g., proximity to residential, agricultural, or other developed areas), and the individuals with the experience and training who will conduct the burn. NOAA RC staff consider all of these characteristics and the natural fire regime of the ecosystem in determining whether a prescribed burn falls under the analysis in this PEIS. If not, an environmental assessment or environmental impact statement, tiered from this analysis, would be created.

Prescribed burn projects invariably involve the state and local fire jurisdiction. Necessary state and/or local burn permits must also be obtained prior to burning.

Table 21 - Summary of impacts to Prescribed Burns and Forest Management activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Moderate	Adverse
	Direct	Long-term	Localized	Moderate	Beneficial
Water	Direct & Indirect	Short-term	Localized	Moderate	Adverse
Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct	Short-term	Localized	Minor	Adverse
	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct	Short-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Short-term	Beyond Project Site	Moderate	Adverse
Socioeconomics	Direct	Short-term	Localized	Minor	Adverse

4.5.2.4.3 Species Enhancement

The impacts of placing native vegetation, corals, and bivalves in the environment are described in the relevant sections of Wetland Restoration (4.5.2.11), Subtidal Planting (4.5.2.9), Coral Reef Restoration (4.5.2.6.1), and Shellfish Reef Restoration (4.5.2.6.2), respectively. This section addresses the environmental impacts of releasing mobile animals such as crustaceans, echinoderms, and finfish that are native to the ecosystem under consideration. The use of non-native organisms species enhancement is strongly discouraged, as these species may become invasive and result in adverse, long-term economic, environmental, and social costs. The release of mobile, native animals into the environment will hereafter be referred to as "stocking."

Potential impacts from stocking will depend on the techniques used. In general, stocking would cause direct and indirect, short- and long-term, beneficial impacts to **living coastal and marine resources** and/or **threatened and endangered species**. Benefits would be realized at the project site, but could extend to all areas hydrologically connected to the project site. This technique would have direct, short-term beneficial impacts because **living coastal and marine resources** and/or **threatened and endangered species** are added directly to the project site, increasing the abundance of the stocked species, at least temporarily. Indirect, long-term benefits may result if the stocked individuals reproduce and increase the population abundance of the desirable, native species. Increases in abundance may also lead to desirable species assemblage shifts, as changes in species abundance can have cascading effects throughout the food web (e.g., Pace et al. 1999)—an indirect, long-term benefit. Indirect, short- and long-term benefits may also result if organisms are stocked for biocontrol purposes. For example, black sea urchins (*Diadema antillarum*) may be stocked into the environment to control invasive and/or overabundant macroalgae.

Stocking would result in direct, short-term, minor **socioeconomic** benefits due to the economic activity generated from the stocking activity itself. Additionally, stocking may also result in long-term, indirect, minor beneficial **socioeconomic** impacts if stocking leads to local population level increases of species that are targeted for recreational or commercial harvest.

No impacts to the **geology and soils** are expected beyond the direct, short-term, minor impacts from the compaction of soils at the project site during stocking. Additionally, no impacts are expected to **water resources** unless there is an unanticipated hazardous waste leak at the project site from a vehicle used to transport the organisms to be stocked. No impacts are expected to **cultural and historic resources** as a result of this activity.

Despite the short- and long-term beneficial impacts that are expected to occur from this activity, species enhancement may cause adverse impacts. Short-term minor adverse impacts on air quality and noise may occur during stocking due to the presence of boats and restoration practitioners at the project site. In addition, direct and indirect, short- and long-term, moderate and major adverse impacts to **living coastal and marine resources,** as well as **threatened and endangered species**, may result from stocking. However, these impacts can be minimized and/or avoided with the use of BMPs, examples of which are outlined at the end of this section.

Stocking may lead to increases in recreational or commercial fishing pressure on both the stocked individuals and individuals that were already present in the ecosystem, a short-term minor adverse impact to living coastal and marine resources, as well as threatened and endangered species, at the project site. If project activities resulted in population-level increases to stocked species, increased fishing pressure would continue in the long term, though this impact is assumed to be minor.

Many of the potential adverse impacts on **living coastal and marine resources,** as well as **threatened and endangered species**, result because of the potential interaction among stocked individuals (for this analysis, stocked individuals are native species) and individuals that were previously present in the ecosystem. These individuals could be of the same species or be different species with similar ecological requirements. Following stocking, natural-origin individuals must compete with the newly introduced individuals for the limited resources present at the project site. This includes, but is not limited to, competition for food and space, important resources that often limit species production and abundance (Bradford et al. 1997; Grenouillet et al. 2002). Therefore, stocking can reduce resource availability for natural-origin individuals, resulting in short- and long-term, indirect, moderate impacts. Predation from stocked individuals can also impact natural-origin populations, a potentially direct, short- and long-term, moderate impact. For example, studies have indicated that coho salmon (*Oncorhynchus kisutch*) smolts may readily consume smaller pink (*Oncorhynchus gorbuscha*) and chum (*Oncorhynchus keta*) salmon (e.g., Hargreaves and LeBrasseur 1985, 1986). The release of large numbers of coho salmon in the presence of wild chum or pink salmon could result in significant mortality (Naish et al. 2008).

Stocking and the resulting increases in fish abundance and associated competition can also have cascading effects down the food web (Department of Primary Industries 2011). Sometimes these alterations are beneficial, as mentioned above, but these alterations can also lead to long-term, indirect, moderate, adverse impacts. For example, the stocking of many game fish species in the freshwater systems of North America and Europe has resulted in more homogenous fish assemblages with increased species richness of top predators (Eby et al. 2006). Additionally, it has been shown that increased predation pressure, potentially resulting from stocking, may lead to changes in lower trophic level production (Christensen and Pauly 1998).

Stocking can also inadvertently result in the introduction of non-native organisms, including diseases and parasites into the environment—an indirect, long-term, major, adverse impact. Such species may be relocated with the target organisms, either attached or living inside, as well as with the water or packing materials used for transport. For example, hatchery-based fish stocking programs have been a primary vector for the unintentional release of several non-native species, including fish, mussels, and parasites, as well as disease. Preventative measures, such as those outlined by the Hazard Analysis and Critical Control Point (HACCP) process, should be used to identify and manage the risks of moving non-native species during the stocking activities.

Genetic concerns could arise if individuals raised in an aquaculture facility interbreed with wild populations (hereafter referred to as hybridization), potentially resulting in indirect, long-term, major impacts. Hybrid offspring may be infertile or poorly adapted to the local environment, or may contribute to a loss of genetic diversity in the wild population (CDFG 2010). For example, hybridization among wild and hatchery origin fish species has been recognized as a factor contributing to the decline of many California native fish populations (CDFG 2010).

NOAA projects make use of the following mitigating measures:

- To avoid the negative effects of hybridization, organisms used in stocking efforts should either be genetically integrated with the natural-origin population, or maintained in segregated conditions in time and space from the natural-origin population.
- To minimize adverse ecological interactions, stocking efforts should include gathering data on the size and age of the organisms, as well as the time and location of release.
- If stocked individuals are sourced from facilities, the facility should have a management practice that minimizes the risk of spreading disease or non-native species. Such practices may include, but are not limited to, the following: provide suitable water supplies, have low rearing densities, use appropriate feeds and feeding protocols, use careful sanitary procedures, screen for and limit the use of broodstock with high levels of pathogens, use antibiotics when necessary, monitor for presence of non-native species, and implement control measures when such incidences occur.
- All aspects of the stocking efforts must be conducted in compliance with all local, state, and federal environmental laws and regulations.
- To identify and respond to negative impacts to native populations, stocking efforts should include protocols for a comprehensive monitoring and evaluation program

There will be instances where a species enhancement project supported by the NOAA RC is expected to produce adverse impacts beyond the nature of those described in this PEIS. In such cases, an environmental assessment or EIS (tiered from the analysis in this document) will be prepared, as needed. NOAA RC staff will consider the magnitude of impacts to the resources described in this PEIS (especially impacts to to protected species, or as a result of cumulative impacts from past actions), but will also consider whether such factors as potential for release of disease or invasive species warrant such additional analysis.

Table 22 - Summary of impacts to Species Enhancement activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	No Effect				
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate & Major	Adverse
	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate & Major	Adverse
	Direct & Indirect	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	No Effect				
Land Use and Recreation	Indirect	Long-term	Localized	Minor	Beneficial
Socioeconomics	Indirect	Short-term & Long-term	Localized	Minor	Beneficial

4.5.2.5 Freshwater Stream Restoration

4.5.2.5.1 Channel Restoration

Construction activities related to restoration of in-stream channel and off-channel habitat can cause direct and indirect, short- and long-term, minor and moderate, localized, beneficial and adverse impacts. **Geology and soils** and **water resources** would receive direct, short-term, minor adverse impacts due to a temporary increase in turbidity and exposure of bare stream banks as a result of the restoration activity. Channel and in-stream restoration can involve the use of heavy equipment, which could disturb soil and the channel beds. Exposure of bare soil can cause erosion, and channel bed disturbances can cause stream turbidity.

Reconnection of side channels and installation of habitat features can redirect water flows within the stream corridor, which can lead to bank erosion or channel evulsion, or expansion of invasive species populations. Woody debris structures could mobilize and deposit in undesirable places downstream. While these adverse impacts are possible, they are unlikely to occur or unlikely to last at a restoration site because in-stream habitat features would likely be anchored in areas without any human infrastructure, such as bridges, and habitat features would be installed by specialists with the goal of reducing adjacent bank erosion and resulting turbidity. Direct, long-term, moderate beneficial impacts (including increased bank stability, water oxygenation and in-stream wood retention, diverse winter rearing habitat, and increased pool depth for aquatic resources) would likely be the predominant result from this restoration activity.

In-stream and off-channel restoration would cause direct and indirect, short- and long-term, minor and moderate, beneficial and adverse impacts to **living coastal and marine resources and EFH** and **threatened and endangered species**. More in-stream complexity promotes higher benthic organism productivity throughout the system, increased feeding opportunities, lowered predation rates on juvenile fish, more suitable spawning substrate, and deeper rearing habitat—conditions that are beneficial to living coastal and marine resources and EFH, and threatened and endangered species. In-stream restoration construction activities could cause temporary alteration of EFH and disruption or mortality of living coastal marine resources and threatened and endangered species. Due to this potential, in-stream and channel restoration projects would only occur in work windows when low flow conditions are present at the project site, and when the least number of ESA species are present in the project area.

In-stream channel restoration could have direct, minor, short- and long-term adverse impacts on **cultural and historic resources** if unknown sites are disturbed during construction. These impacts will be avoided by conducting surveys and historic analysis of sites likely to have historic and cultural resources, avoiding known historic or cultural sites, and stopping project activities when previously unknown sites are uncovered (see Section 4.5.2.3.1 - Dam and Culvert Removal above for further description of similar impacts to cultural and historic resources).

This restoration activity will also have direct, short- and long-term, minor and moderate adverse and beneficial impacts to **land use and recreation** because increases in recreational opportunity will likely occur in the project area and beyond in the larger river system in the long term; however, short-term use may be curtailed during construction activities. Increased fishing pressure may occur in the short and long term. Channel restoration activities are widely implemented through the use of volunteers and conservation corps groups, and are a source of local employment and job training in many rural areas. As such, in-stream restoration activities can result in indirect short- and long-term, minor and moderate beneficial impacts to **socioeconomics**.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.5.1, channel restoration projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 23 - Summary of impacts to Channel Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct & Indirect	Short-term & Long-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Short term & Long-term	Localized	Minor & Moderate	Beneficial

4.5.2.5.2 Bank Restoration and Erosion Reduction

Bank restoration and erosion reduction activities would cause direct and indirect, short-term, minor adverse impacts on **geology and soils, water, living coastal and marine resources and EFH,** and **threatened and endangered species** during the on-the-ground implementation phase. Impacts to threatened and endangered species may include effects from handling, noise, turbidity, contaminant exposure, altered hydrology, additional habitat quality/quantity, displacement, and mortality (see Section 4.7 for more details). These impacts would result from installation of natural features or geotextile materials, stabilization of slopes, removal of bulkheads or other artificial shoreline armoring, or introduction of new vegetation (planting). Depending on the nature of each project, the installation of materials and stabilization of slopes could require small or large earth-moving machines, which would cause minor amounts of localized soil compaction, may introduce non-native species if not properly decontaminated, and other impacts as described above. The duration of impacts typically range from weeks to months, depending on the length of the shoreline or stream bank. Wildlife would also potentially be displaced temporarily during construction activities. By protecting erodible or unstable soils, bank restoration and erosion reduction would result in indirect, long-term, minor and moderate beneficial impacts to **water** quality and benthic habitat in wetlands, water bodies, and other sensitive riparian or coastal habitats where erosion is a problem beyond the project site. Natural processes (beginning after planting) would help stabilize banks and shorelines. Installation of bio-logs or geotextile materials also would stabilize areas of high erosion.

Bank restoration and erosion reduction activities could cause indirect, long-term, minor impacts on **cultural and historic resources** and **land use** either localized to or beyond the project site. The land use would change from its presently managed or otherwise cultural/ historic condition to a vegetated, more natural condition at each proposed project site. Any cultural and historic resources nearby could be impacted by ground disturbance during construction or from the change in land use. These impacts would be mitigated through the consultation process described in Section 3.6. However, many projects of this type are in areas that historically functioned as wetlands but were altered or eroded away to their present condition, thereby previously eroding any historic or cultural resources that might exist at the site.

Habitat restoration practices that are most likely to take place on stream banks, riparian habitat, and coastal or intertidal areas usually involve revegetation, placement of woody debris, stabilization of banks, removal of bulkheads or other artificial shoreline armor, and stormwater management practices. Revegetation usually results in minor disturbance of the surrounding habitat, which is quickly remedied by the revegetation of the area itself. However, the placement of woody debris and other wildlife habitat features, stabilization of banks, removal of bulkheads or other artificial shoreline armor, and stormwater management practices may require the use of heavy machinery. The use of heavy machinery can often cause damage to the surrounding riparian area such as clearing of existing vegetation, compaction, and disruption of the soil. This, in turn, may cause sedimentation in the adjacent stream, with turbidity plumes typically being short-term and quickly dispersed by the river current.

In instances where native vegetation remains on the site, restoration activities may cause some incidental damage to the vegetation by trampling it. Recovery times of such incidental damage depend on the growth habit of native vegetation; a long growing season would therefore cause minimal impact. In the case of projects using heavy machinery to conduct the restoration work, potential impacts are related to compaction of the soils, leaking of petroleum products, and increased turbidity at the restoration site. All of these impacts would be ameliorated through the use of BMPs. Although soil compaction has the potential for long-term impacts, BMPs would reduce the compaction so that plant roots and benthic infauna can inhabit the soil and create further improvements.

This restoration activity will also have direct, short- and long-term, minor and moderate, adverse and beneficial impacts to **land use and recreation** because increases in recreational opportunity will likely occur in the project area and beyond in the larger river system in the long term; however, short-term use may be curtailed during construction activities. Increased fishing pressure may occur in the short and long term. Channel restoration activities are widely implemented through the use of volunteers and conservation corps groups, and are a source of local employment and job training in many rural areas. As such, in-stream restoration activities can result in indirect short- and long-term, minor and moderate beneficial impacts to **socioeconomics**.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.5.2, bank restoration projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 24 - Summary of impacts to Bank Restoration and Erosion Reduction activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short Term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct & Indirect	Short-term & Long-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Short Term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Short term & Long-term	Localized	Minor & Moderate	Beneficial

4.5.2.6 Reefs

4.5.2.6.1 Coral Reef Restoration

Coral communities are directly benefited through coral reef restoration activities that enhance larval recruitment to the reef, because natural recruitment restores the original biological community and increases overall percent coral cover and habitat value. This is vital to the maintenance of the existing coral population on the restored reef. Substrate and coral stabilization and transplantation of new coral colonies to injured reefs increase the overall percent coral cover and increase habitat value. Transplantation of native coral fragments could also increase the diversity on the reef or improve the chances of successful cross-fertilization during reproduction.

Disturbances at a coral reef restoration project site last from a few weeks to months, depending on the project type. Projects repairing damaged sites and/or creating new reef structure would likely last a few weeks to months. Coral nursery operations occur over a time span of months to years, but the ongoing site impacts are minimal from operational activities. However, the harvesting of coral fragments may have direct adverse impacts to the **substrate** and **water** column, which may include ephemeral sedimentation, turbidity, or other water quality impacts associated with the immediate effects of construction activities. There may also be direct, short-term, adverse, localized impacts to **marine animals** as a result of human disturbance in the collection area. Direct benefits of this activity include reduced mortality to injured or threatened corals, reduction or elimination of adverse impacts to adjacent areas caused by loose rubble or sediment as it is moved by the action of waves or currents, and creation of suitable stable substrate for colonizing reef species. The greatest source of short-term impacts is the potential for doing additional damage to the site during the restoration process. This might include accidental contact with the already-damaged corals or unimpacted areas by divers, equipment, and anchoring boats. Because divers may be required to undertake activities such as proactively removing corals to prevent damage, or drilling cores/taking fragments from existing corals to be transferred to the restoration site or nursery, there is also the potential to damage healthy, intact colonies. Divers and boat operators should possess the appropriate knowledge, training, and experience to conduct the restoration safely and effectively and follow all relevant BMPs. Long-term moderate to major beneficial effects on **geology and substrate** are anticipated from this technique. Stabilizing loose rubble or sediments and transplantation of coral fragments would enhance consolidation of the reef framework and improve the substrate quality for corals and other organisms. Enhancing recruitment of corals to the reef would increase coral cover, thereby enhancing consolidation of the reef framework.

Short-term minor adverse effects on surface **water resources** would be anticipated to result from coral reef restoration activities. Some minor adverse effects may result from the dispersion of adhesives used to plug the clipped coral or transplant the injured corals onto the reef into the water column; however, the specific adhesives used in coral restoration are designed to have minimal dispersion and impact to the area. Short-term, localized increases in turbidity may also result. Indirect, long-term moderate beneficial effects on the biological resources being directly restored at the site are anticipated from coral reef restoration due to a healthier coral ecosystem being in place.

Short-term **noise** impacts may occur during restoration implementation due to the presence of boats and equipment at the restoration site. Impacts on cultural resources from the implementation of coral reef restoration are dependent on site-specific conditions associated with a project proposed for implementation. No direct effects on **socioeconomics** are anticipated from this technique beyond the beneficial economic activity associated with the restoration activity itself, as such activities may draw high numbers of restoration participants (e.g., volunteers or restoration project staff). There may be indirect, long-term impacts to local communities as a result of improved tourism in the area.

Coral reef restoration—stabilizing substrate and transplanting injured or nursery-reared corals back onto damaged coral reefs—provides indirect, long-term moderate benefits to **water column and invertebrates, marine resources and EFH,** including marine mammals, sea turtles, and birds, all of which are dependent on a healthy reef for food, shelter, or reproduction. Invertebrates also inhabit the crevices in coral reefs, which are enhanced from transplanting efforts, for shelter from predators. Restoration would enhance coral cover and production on the reef, which would benefit plankton and other organisms. Pelagic birds would benefit, as healthy coral communities harbor healthy fish populations, which seabirds use as a primary food source. Enhancing natural recruitment of coral larvae by increasing available hard substrate, or using "flypaper" techniques or settlement tents, would potentially lead to increased coral cover and habitat area for living coastal and marine resources. Coral communities would be beneficially impacted by enhanced recruitment, as this would provide a healthier reef system for the existing coral community. The increase in density of settlers at the restoration site would increase the coral cover and would be vital to the maintenance of existing coral populations. Coral reef restoration also provides an indirect benefit to human use activities by making the area more attractive for recreation diving, snorkeling, and fishing.

Short-term minor indirect adverse impacts on **geology and substrate** would be anticipated due to construction and work activities at the nursery or coral reef restoration sites. Potential indirect effects to cultural resources are dependent on site-specific conditions associated with a project proposed for implementation. Coral reef restoration would be expected to have long-term, moderate, indirect beneficial effects on **socioeconomics** of local communities. Restoring the natural appearance of the reef would potentially increase revenue from diving and other recreational activities as well as improve fishing opportunities. As corals provide physical shoreline protection from wave action, coral restoration could lead to a decreased risk of localized land loss due to erosion.

NOAA projects make use of the following mitigating measures:

- When barges and other boats must moor on site to accomplish restoration work, mooring locations would be chosen to minimize damage to existing healthy reef or adjacent SAV beds.
- All coral tissue samples would be less than 1 cm^2.
- When establishing coral nurseries, brood stock would be collected in the following order:
    1. Fragments of opportunity that have been broken off by storms, groundings, etc.
    2. Harvest of at-risk reefs threatened by development.
    3. Collection of healthy wild stock.
- Only qualified, trained staff would handle coral fragments to reduce potential for damage to live corals.
- Projects involving the sampling of portions of coral colonies through the removal of one or more cores should fill the core hole with clay, cement, or epoxy unless permits do now allow for filling of cores.
- Projects involving the transplantation of corals from a healthy site to a degraded area should minimize the amount of coral removed, based on best practices that have been recommended by the international community (e.g., no more than 20 percent of a colony is removed; colonies are removed from competitive interactions where they are likely to die or be overgrown instead of the removal of isolated colonies and collection follows other guidelines summarized in Bruckner, 2003).
- When collecting samples from coral with diseased tissue, consideration needs to be given to personal safety and potential spread of coral disease. Coral projects will need to take steps to avoid transmission of possible disease agents, disposable gloves should be used, and disinfection with a commercial disinfectant or an appropriate bleach solution (prepared within 12 hours of use and kept out of direct sunlight) should be used to decontaminate collection tools, work areas, and dive gear before moving to new sites (following the field manual by Woodley et al. 2008).
- Restoration projects involving transplantation of corals or other organisms include: 1) only transplantation of those species that are native to the area to be transplanted; 2) outplants/transplants must be from a “genetically connected: population; and 3)

outplants/transplants are from the localized area and appear healthy to avoid potential introduction of pathogens or parasites (e.g., corals are not transplanted from Puerto Rico to Florida).

- Chemicals used must ensure minimal impact on the target species, associated species, or habitat and are permitted for use.
- Projects that involve the use of vessels must comply with all local and federal laws. Small-boat operators should have completed safety and operational trainings.
- Projects involving the use of traps, nets, trawls, or other types of fishing gear used to sample fish populations must include measures to ensure that these gear types are not placed or used in locations where they will damage habitats and are in accordance with local and federal regulations for the area.
- Projects involving laboratory studies will follow the laboratory's environmental compliance guidelines and ensure that chemicals are disposed of in proper manner, comply with the ethical treatment of animals, and take steps to ensure that invasive species are not introduced or spread as a result of the work.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.6.1, coral restoration projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the mitigating measures included in this section and in Appendix C, which lists the general precautions taken when planning restoration projects in order to avoid adverse impacts greater than those described here.

Table 25 - Summary of impacts to Coral Reef Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Moderate & Major	Beneficial
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	No Effect				
Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial

4.5.2.6.2 Shellfish Reef Restoration

Shellfish reef restoration activities may have direct, short-term, minor adverse impacts as well as indirect, long-term, moderate beneficial impacts.

Impacts to **geology and soils** may include short-term adverse impacts such as compaction to underlying soils where reef material is placed**.** Long-term beneficial impacts may occur through reductions in wave energy, thereby reducing erosion along adjacent shorelines.

Direct, short-term, minor adverse impacts and indirect, long-term, minor beneficial impacts to **water resources** could result from reef restoration. The direct impacts include increased turbidity during project construction and the indirect impacts may include improvements to water quality in the immediate project area as a result of increased oyster filtering capacity over the long term. Turbidity related to construction activities can be reduced through use of BMPs. Few, if any, adverse effects are expected from building and operating small-scale aquaculture facilities to assist in shellfish restoration. No long-term impacts to the aquatic environment or marine species from the water discharge are anticipated; unlike some forms of aquaculture, shellfish culture does not create high nutrient discharge because shellfish often feed on phytoplankton in seawater, rather than needing nutrient-rich feed (Mugg et al. 2000). As shellfish filter phytoplankton from the water, much of the nitrogen removed from the water column is transferred to sediments through their excreted psuedofeces (Pietros et al. 2003). Ammonia produced by shellfish is taken up by phytoplankton (Clark and Wikfors 1998). These ecological interactions lead to low impacts on the surrounding area, provided that native species are grown in historically documented concentrations.

Direct, long-term, moderate to major beneficial impacts are likely to affect **living coastal and marine resources and EFH** as a result of increased fish productivity within species that use the improved oyster habitat, as well as the productivity of the oysters themselves (Wong et al. 2011). Direct, short-term, minor adverse impacts to these resources are also possible as a result of construction activities. Several of the most common shellfish restoration techniques have potential impacts related to placing non-natural materials such as plastic bags or metal cages into the estuarine environment. In the case of bagged shell, the plastic mesh bags remain immobile in the environment until the oyster reefs grow over and encapsulate the plastic (this occurs with plastic mats as well).

When shells are imported from other locations, they may carry other organisms or diseases such as *Perkinsus marinus* (Dermo) and *Haplosporidium nelson* (MSX, Multinucleated Sphere unknown). Several states have recognized the risk in transporting shells from one area to another and have instituted requirements or recommendations for shells transplanted into state waters. Research and biosanitary protocols are used to prevent the spread of invasive species and diseases through the relocation of bivalve shells (Cohen and Zabin 2009). Although deployment of shell shellfish does have the potential to spread shellfish diseases or non-native organisms, restoration will use BMPs and follow state regulations that require that shellfish be certified as disease-free and that shell has been weathered and aged (Bushek et al. 2004). As Dermo has spread from the Gulf of Mexico to Maine, and MSX is prevalent from Maine to Florida and reported on the west coast in California and Washington (Bower 2007; Bower 2011), the potential for NOAA-implemented restoration projects to spread these diseases to new areas is low.

Reef restoration projects have the potential to convert one habitat type into another. This conversion frequently involves re-establishing a reef in a formerly degraded shellfish area. In general, shellfish restoration projects convert shallow, open water habitats to subtidal or intertidal reefs or beds (the latter in the case of *Ostrea lurida* and some Atlantic state estuaries). While open water habitats are valuable, the historical loss of shellfish habitat within the coastal United States has been significant. For example, in the United States there has been an estimated 88 percent decline in oyster biomass and an estimated 63 percent decline in the spatial extent of oyster habitat over the past 100 years (zu Ermgassen et al. 2012), making this conversion a minor impact in most locations.

Coral reefs, artificial reef, and live/hard bottom—all in the marine environment—are not impacted due to their location relative to typical oyster restoration sites. Oyster reefs or beds may promote the development (or re-establishment) of SAV beds or marsh habitat in their landward or intertidal areas through increased shoreline stabilization. In either configuration, oysters serve as habitat, providing food and refuge for recreationally and commercially important fish and crustaceans (e.g., crabs and shrimp) and their prey. In addition, these habitats can help protect marsh habitat by reducing the erosion caused by wave action.

All restoration actions occurring in/near shallow or intertidal habitat may displace **living coastal and marine resources** through the increased activity and noise associated with restoration project construction. Vegetation may be disturbed if shellfish restoration site is accessed from land instead of by boat. These impacts are expected to be temporary. In most cases, fish return to restoration sites almost immediately after construction.

Threatened and endangered species may generally experience indirect, long-term, minor beneficial impacts as a result of the improved habitat and shoreline protection values oyster reefs provide. For example, Atlantic sturgeon (*Acipenser oxyrinchus*) use oyster reefs as forage and refuge habitat.

Cultural and historic resources located in coastal areas may benefit from the increased stability to shorelines from wave energy provided by shellfish reefs.

Both water- and land-based **recreation and land use** activities near a shellfish restoration site may be adversely impacted in short-term, minor ways by changing boat traffic or other resource use patterns, or beneficially impacted by improved recreational fishing near successfully restored oyster reefs. Generally, oyster reef restoration projects are supported by NOAA on the condition that they are not harvested.[8] In building and operating small-scale aquaculture facilities to assist in shellfish restoration, little to no impact is expected. Facilities are frequently located in areas of existing marine industry.

The **socioeconomic** benefits of conducting reef restoration projects may result insofar as such projects create viable habitat that support a diverse array of commercial and recreational fish

[8] NOAA's programs to support commercial fishing and/or aquaculture may support shellfish harvest, but these would not be considered habitat restoration projects analyzed within this document.

species, and therefore communities that benefit from these resources may realize benefits related to increased ecological productivity.

NOAA projects make use of the following mitigating measures:

- Shell or other substance used for substrate enhancement would be procured from clean sources that do not deplete the existing supply of shell bottom. Shells should be left on dry land for a minimum of six months (up to a year or more) before placement in the aquatic environment. Shells from the local area would be used whenever possible.
- To prevent spread of disease, any shell or shellfish transported across state lines would be certified disease free and inspected for non-native organisms. Molluscan shellfish would be species native to the project area.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.6.2, shellfish reef restoration projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the mitigating measures included in this section and in Appendix C, which lists the general precautions taken when planning restoration projects in order to avoid adverse impacts greater than those described here.

Table 26 - Summary of impacts to Shellfish Reef Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate & Major	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Cultural and Historic Resources	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Land Use and Recreation	Direct	Short-term	Beyond Project Site	Minor	Adverse & Beneficial
Socioeconomics	Indirect	Long-term	Beyond Project Site	Minor	Beneficial

4.5.2.6.3 Artificial Reef Restoration

Restoration activities such as artificial reef deployment include minor, short-term impacts to the **geology and soils** associated with the conversion of relatively small areas of similar sandy habitat to areas with hard substrate. No long-term adverse impacts to **water** resources are anticipated either outside of short-term, minor (temporary) turbidity impacts. BMPs or other measures required by state and federal regulatory agencies would be employed to minimize any other water quality impacts.

Construction impacts (related to noise and air pollution) would be minor, short-term, and localized to the project site. Impacts to **living coastal and marine resources and EFH and threatened and endangered species** (e.g., harassment) may occur during deployment of reefs. Compared to long-term, moderate benefits, such impacts would be short-lived because these activities are intended to increase available reef habitat for species that inhabit reef ecosystems for some part of their life history.

Direct, short- and long-term, minor **socioeconomic** benefits across the project implementation area may be realized through local job creation and support from construction. Long-term, indirect, minor benefits could result from increasing **recreational** opportunities and/or target species populations in the project area. Minor adverse impacts to tourism during construction, but long-term benefits, would be realized.

The analysis for artificial reefs is limited only to those artificial reefs where materials are deployed for the strict purpose of creating fish habitat. Left-in-place structures (e.g., vessels, oil rigs) are not covered in this analysis. Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant.

Table 27 - Summary of impacts to Artificial Reef Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Threatened and Endangered Species	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
	Direct	Short-term	Localized	Minor	Adverse
Cultural and Historic Resources	No effect				
Land Use and Recreation	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Socioeconomics	Indirect	Short-term & Long-term	Beyond Project Site	Minor	Beneficial

4.5.2.7 Road Upgrading and Decommissioning; Trail Restoration

Road upgrading and decommissioning, and trail restoration activities would cause direct and indirect, short-term, minor and moderate adverse impacts, typically in riparian and upland affected environments, resulting from temporary construction activities in the project area. Aside from construction impacts, however, most of the impacts resulting from these activities would be direct and indirect, moderate to major beneficial impacts, as they are designed to control access to sensitive areas, limit the use of sensitive areas as routes for vehicular transportation, and reduce a road's propensity for erosion. As mentioned in Section 2.2.2.7, roads that are targeted by NOAA are those that pass through or near sensitive habitats such as wetlands or streams, or have been determined to injure living resources or habitat areas through erosion or human traffic. Beneficial impacts would also be both short- and long-term in duration, depending on whether the road or trail is maintained (short-term) or upgraded, restored, or decommissioned (long-term).

Activities involving the decommissioning or upgrading of roads that travel through or adjacent to, or are located within watersheds that feed into, sensitive habitat areas would have direct and indirect, short-term, minor and moderate adverse impacts on **geology and soils, water resources, living coastal and marine resources and EFH, threatened and endangered species, and land use**. Impacts to **threatened and endangered** species may include effects from handling, noise, turbidity, contaminant exposure, altered hydrology, additional habitat quality/quantity, displacement, and mortality (see Section 4.7 for more details). These impacts would result from temporary construction activities in the project area. Road decommissioning would cause direct, long-term, minor, moderate, and major beneficial impacts on **geology and soils, water, living coastal and marine resources and EFH, threatened and endangered species, and cultural and historic resources** because removal of roads would protect living resources and habitat from disturbance, erosion, and species introductions caused by human and vehicle traffic. The decommissioning of roads would have direct, long-term, minor impacts on **land use** because such actions would limit access to the areas once served by the roads, which could be both an adverse or beneficial impact depending on what that use was (i.e., reduced recreational access or reduced human disturbance). Lastly, as long as the roads decommissioned do not prevent people from accessing work, home, or other necessary destinations, projects involving the decommissioning of roads would have minor beneficial impacts on **socioeconomics**.

Table 28 - Summary of impacts to Road Upgrading and Decommissioning activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Moderate	Adverse
	Direct	Long-term	Localized	Moderate and Major	Beneficial
Water	Direct	Short-term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate and Major	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct	Long-term	Localized	Minor	Beneficial
Land Use and Recreation	Indirect	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Minor	Adverse & Beneficial

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Socioeconomics	Indirect	Long-term	Localized	Minor	Adverse & Beneficial

Trail restoration projects would take place in all types of habitat areas; however, they have historically occurred most frequently in riparian and upland affected environments. These activities would cause direct, short-term, minor, adverse impacts on **geology, soils, and water**, and would cause direct and indirect, short-term, minor, adverse impacts on **living coastal and marine resources and EFH, and threatened and endangered species**, resulting from temporary construction activities, as previously described. There may be direct, long-term minor to moderate adverse impacts that result from increased shading over previously exposed habitat that depends on photosynthetic processes. Areas that experience such impacts are relatively small, and may be reduced with BMPs (e.g., increased spacing of boardwalk boards). Trail restoration projects would cause indirect, short-term, minor impacts on land use, resulting from construction activities required to restore the trail (e.g., temporarily blocking trails with machinery). Impacts to **threatened and endangered species** may include effects from handling, noise, turbidity, contaminant exposure, altered hydrology, additional habitat quality/quantity, displacement, and mortality (see Section 4.7 for more details).

Trail restoration projects would also cause direct and indirect, long-term, minor to major beneficial impacts on **geology and soils, water, living coastal and marine resources and EFH, threatened and endangered species, cultural and historic resources, and socioeconomics**. The beneficial impacts would result from reduced erosion potential and rates after projects were implemented and from both allowing and controlling access to sensitive areas.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.7, road upgrading and decommissioning projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 29 - Summary of impacts to Trail Restoration activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Moderate and Major	Beneficial
Water	Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate and Major	Beneficial
Living Coastal and Marine	Indirect	Short-term	Beyond Project Site	Minor	Adverse

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Resources and EFH	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Direct	Long-term	Localized	Minor	Beneficial
Land Use and Recreation	Indirect	Short-term	Localized	Minor	Adverse
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

4.5.2.8 Signage and Access Management

Temporary or permanent fencing, signage, or netting is intended to eliminate or reduce degradation of streams, streambanks, lakeshores, riparian/wetland vegetation, and unstable upland slopes. The effects of livestock grazing, human access, and vehicle traffic on riparian and in-stream habitats can be detrimental to habitat quality. Such impacts include the compacting of stream substrates, destabilization of streambanks, localized reduction or removal of herbaceous and woody vegetation along streambanks and within riparian areas, increased stream width-to-depth ratios, reduced pool frequency, promotion of incised channels, increased sedimentation and turbidity, and lowered water tables. Increased water temperatures can also result from the removal of streambank vegetation that provides shade, and from shallow, slow-moving reduced water flows through open stream areas.

The installation of temporary or permanent fencing, signage, or netting would have direct, long-term (fencing would likely have a long-term impact, but not netting), moderate beneficial impacts on the **geology and soils** of the project site, and on **water resources**, **living coastal and marine resources and EFH**, and **threatened and endangered species** beyond the project site. The benefits of these actions are reduced disturbance by humans, animals, and vehicles. Similarly, invasive species spread could be reduced by consolidating or restricting access to sensitive habitats. These benefits may be enhanced by implementing this restoration in concert with other activities such as vegetation planting, creation of riparian buffers, and reduction of livestock attraction to riparian areas and stream channels by providing upslope water facilities to help distribute livestock away from sensitive areas.

The construction of temporary or permanent fencing, signage, or netting could also have the following potential adverse effects to **living resources and listed species** and their habitats: minor removal and trampling of vegetation, negligible erosion and sedimentation, possible use of heavy equipment and associated noise, pollution, invasive species, and erosion control issues, and the potential for displacement of species that are sensitive to these short-term impacts. BMPs for general construction (see Appendix C - Mitigating Measures) would be followed.

The placement of exclusionary fencing or signage would have direct, long-term, localized, minor adverse impacts on **land use**, because exclusionary fencing would limit public access and recreational activities to areas outside the fence. Fencing or access restrictions designed to limit human or vehicle access to a site, for safety reasons, must take into account what alternative routes would be available.

No substantial effect is anticipated on **cultural and historic** or **socioeconomic resources.**

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.8, signage and access management projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 30 - Summary of impacts to Signage and Access Management activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Moderate	Beneficial
Water	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Localized	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	No Effect				
Land Use and Recreation	Direct	Long-term	Localized	Minor	Adverse
Socioeconomics	No Effect				

4.5.2.9 Subtidal Planting

The impact of submerged aquatic vegetation restoration activities when compared to the total population of managed fish in the affected area is unlikely to have long-term impacts of any magnitude likely to harm those populations. Most projects are expected to result in long-term increases in the quality or quantity of habitat, resulting in a net benefit from restoration activities.

4.5.2.9.1 Submerged Aquatic Vegetation

SAV restoration activities take place in nearshore, intertidal, and subtidal project locations. Potential impacts from SAV restoration are dependent on the techniques used. Adverse impacts to **geology and soils** and **water** resources would result from temporary turbidity and substrate disturbance during planting, but would ultimately lead to long-term soil stabilization, sediment retention, and improved water quality. Turbidity related to habitat restoration would be reduced by use of BMPs. Similarly, during the harvesting of plants from donor sites, the potential to trample existing vegetation exists. Short-term damage to stands of healthy SAV may occur as plugs are harvested from the donor site. Studies have shown that the species of SAV most frequently used in restoration for their quick colonization habits also regrow quickly in the donor beds. Nursery stock grown to be adapted to specific site conditions (e.g., salinity) may be used if available or desirable.

Two techniques—bird stakes and filling scars with sediment encasement tubes—introduce foreign materials into the estuarine/marine environment, but there is no long-term, adverse impact with either of those techniques. Bird stakes are removed when no longer being used, and the sediment encasement materials are biodegradable starting within a few months after deployment and are completely degraded within a couple years (Kenworthy et al. 2006).

Collection of plant and seed material from existing beds can create localized turbidity and reduce propagule abundance and density of the source bed. Planting and sediment augmentation activities can cause turbidity disturbance or eliminate the existing benthic habitat or temporarily displace marine organisms, resulting in direct, short-term, minor and moderate adverse impacts to **living coastal and marine resources and EFH and threatened and endangered species** in the area. All restoration actions occurring in/near shallow or intertidal habitat may displace managed or threatened and endangered species through the increased activity and noise associated with restoration. These impacts are expected to be temporary and may have the beneficial side effect of removing fish from harm's way during construction. In most cases, fish return to restoration sites almost immediately after construction. Damage to nearby natural SAV habitat through activities such as anchoring work vessels or unintentional introduction of non-native species would be reduced through BMPs. SAV plantings provide immediate structural complexity in the nearshore and subtidal environments, and disturbances to the site typically from implementation only last days or weeks, as restoration sites tend to be small due to the hands-on, time-intensive nature of SAV restoration. SAV restoration activities provide nursery areas for breeding fish and other marine animals. SAV restoration will provide short- and long-term minor and moderate beneficial impacts to **living coastal and marine resources, EFH and threatened and endangered species**. Selection and transport of SAV seeds and plants can alter or compromise species genetic differences based on geography. However, established SAV beds provide important structural cover that encourages marine species diversity. SAV restoration provides important nursery and feeding habitats for a many marine species. SAV beds help stabilize bottom substrate, reducing estuarine turbidity.

Direct and indirect, long-term, minor and moderate beneficial impacts can occur to **land use** and **recreation** from of SAV restoration. Planting results in addition of structural habitat components that immediately increase colonization and utilization by marine resources, resulting in an immediate and long-term increase in diving, snorkeling, and fishing opportunities. Increased fishing opportunities and marine organism populations will cause indirect, long-term, minor beneficial impacts to **socioeconomics**. Increased fishing pressure may occur in the short and long term.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.9.1, submerged aquatic vegetation planting projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 31 - Summary of impacts to Submerged Aquatic Vegetation activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Localized	Minor	Beneficial
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Localized	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
Cultural and Historic Resources	Direct	Long term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Long-term	Localized	Minor & Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

4.5.2.9.2 Marine Algae

Marine algae (kelp and seaweed) restoration activities have similar impacts to those described in 4.5.2.9.1 - Submerged Aquatic Vegetation and Table 31 above. There are direct, short-term, minor adverse impacts that are largely related to project implementation activities and limited to the project site, and long-term beneficial impacts that result once the marine algae restoration has had a chance to develop. These restoration activities use divers and are almost exclusively conducted in subtidal environments.

Marine algae starts (i.e., those plants that are first propagated and grown in classrooms and marine laboratory tanks) are outplanted into subtidal areas. Divers working on such projects should follow diving BMPs when outplanting these algae and conducting predator removal to minimize disturbance to the sea floor and the risk of introducing non-native species. However, some level of diver disturbance of marine fish and organisms at the planting site, as well as alterations to the physical environment, can occur. These restoration activities can cause minor impacts to the **water** column (through increased turbidity) and **living coastal and marine resources, EFH and threatened and endangered species** (through disturbance from restoration activities). The establishment of marine algae forests can change the local habitat of the planted area once they have grown dense and large in size. This could displace organisms that thrived in the area before kelp stands developed. However, marine algae generally grow slowly. Therefore, the recovery period for damaged or uprooted marine algae can be long-term, decades in some cases.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.9.2, marine algae planting projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 32- Summary of impacts to Marine Algae activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Localized	Minor	Beneficial
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Localized	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
Threatened and Endangered Species	Direct	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Minor & Moderate	Beneficial
Cultural and Historic Resources	Direct	Long term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Long-term	Localized	Minor & Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial

4.5.2.10 Water Conservation and Stream Diversion

In-stream flows in many streams have declined by 30 to 50 percent of baseline conditions due to human use. In some areas, stream flows during dry months are nonexistent where they were once plentiful. Climate change and reduced snow pack are exacerbating the flow issue. Water conservation and stream diversion projects would cause indirect, long-term, minor to major beneficial impacts to **geology and soils, water, living coastal and marine resources and EFH, threatened and endangered species, cultural and historic resources, and socioeconomics**. Projects may have short-term and minor adverse impacts to coastal and marine resources or threatened and endangered species, but long-term benefits. The projects analyzed by NOAA in this analysis only divert water from a stream for the purpose of maintaining access to water for humans while providing habitat conservation benefits. Consequently, projects do not dewater streams or reduce levels of in-stream flow lower than necessary for survival, spawning, and rearing of fish and other aquatic organisms.

During construction, impacts to **geology and soils** include minor soil disturbance or compaction through grading and trenching activities, and would likely be limited to the project site. Generally, fish screen and pump installation activities consist of minor alterations to the streambed to ensure the screening structure is placed properly in the stream. In addition, temporary coffer dams or berms are sometimes needed to isolate the work site, and construction of these may disturb stream gravels. In some cases, the streambed and streambanks are configured to best fit the screening structure. This disturbance can alter the gravel composition of the streambed and expose streambanks to erosion.

Construction impacts to **water resources** are closely tied to impacts to **living coastal and marine resources and EFH and threatened and endangered species**. These projects also could cause direct and indirect, short-term, adverse minor impacts on living coastal or marine resources and threatened and endangered species that extend beyond the project site. In-stream pump and piping modifications can cause temporary water turbidity that can interfere with feeding and movement of aquatic organisms. Tank and pond construction, well installation, and piping activities typically involve soil disturbance by heavy equipment, which can cause erosion. Vehicles and equipment used for construction may introduce non-native species if not decontaminated prior to entering the project area. Minor adverse impacts to soil and water resources may result from heavy equipment oil/fluid leaks. Temporary diversion of streamflow around the work area can cause minor turbidity, but would be conducted according to BMPs and would not be sufficient to alter downstream habitat or degrade water quality downstream. Generally, fish and amphibians are excluded from the project construction area prior to project implementation so aquatic species mortality associated with project activities is minimized. Other impacts to threatened and endangered species may include effects from handling, noise, turbidity, altered hydrology, and displacement (see Section 4.7). These minor impacts would result from disturbance during fish relocation activities, due to the requirement for dewatering. Captured fish are sometimes relocated in areas with lower habitat quality, potentially altering essential behavior and increasing predation risk in the short term (NMFS 2004d).

BMPs associated with equipment refueling and maintenance would be followed to ensure no toxic leakage into the aquatic environment. Preventative measures would be taken to ensure invasive species are not spread when water is diverted to new locations. Erosion control measures would be implemented during and after work is completed to prevent erosion at the work sites.

Over the long term, increased in-stream flow as a result of these water conservation projects results in minor to major beneficial impacts to **water, living coastal and marine resources and EFH, and threatened and endangered species**. Increased flows generate higher dissolved oxygen levels, increased nutrient exchange between habitats, unimpeded fish migration and feeding, and cooler water temperatures. In some situations the increased flows are used to prevent fish eggs from being desiccated due to dropping water levels. These are all long-term, minor to major, beneficial impacts that extend beyond the project site, which result from implementing water conservation measures.

Water conservation projects can potentially result in a higher water table, and thus minor changes in streamside vegetation. Increased water flow may inundate streamside habitats that were not previously wet during dry periods. These changes will be beneficial, as they will help to create diversified riparian habitat and increased access to aquatic habitat.

When river diversions are reduced, or upgraded with fish screens, there is reduced potential for fish entrainment, impingement, and mortality associated with pumping activities, so there is an overall beneficial effect to the aquatic environment, and to threatened and endangered species associated with these projects. Such ecosystem benefits from prevention of fish and amphibian entrainment would occur upstream and downstream of the project area, and would contribute to threatened and endangered species recovery, increased species distribution, and decreased predation associated with injury and avoidance of the pumping facility.

There are no long-term impacts to **land use** anticipated, as these projects maintain current land use. Water diversions will be limited to only those that are less destructive to the environment than baseline conditions.

NOAA projects make use of the following mitigating measure:

- Relevant hydrologic information would be identified that would ensure regional fish screen criteria are met, as well as criteria for types of materials to be used and long-term maintenance procedures associated with the screening facility.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.10, water conservation and stream diversion projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the mitigating measures included in this section and in Appendix C, which lists the general precautions taken when planning restoration projects in order to avoid adverse impacts greater than those described here.

Table 33 - Summary of impacts to Water Conservation and Stream Diversion activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Indirect	Long-term	Localized	Minor	Beneficial
Water	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Indirect	Short-term	Beyond Project Site	Minor	Adverse
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Beneficial
Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial & Adverse

Table 34 - Summary of impacts to Fish Screens and Pump installation activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Indirect	Long-term	Localized	Minor	Beneficial
Water	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Indirect	Short-term	Beyond Project Site	Minor	Adverse
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Beneficial
Land Use and Recreation	Direct & Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial & Adverse

4.5.2.11 Wetland Restoration

NOAA implements many kinds of wetland restoration. These restoration activities create the desired elevation and hydrology for wetland vegetation and fish habitat. Potential impacts from restoration activities vary from very low impacts for planting, to much more substantial impacts from the use of heavy equipment. While wetland restoration techniques are distinct and were described separately in Section 2.2.2.11, three techniques—fringing marsh and shoreline restoration, sediment removal, and sediment/materials placement—generally consist of the more acute impacts caused by the use of heavy equipment on site, followed by lasting benefits. Consequently, these techniques are grouped together into Section 4.5.2.11.2 for the analysis of impacts.

4.5.2.11.1 Levee and Culvert Removal, Modification, and Set-back

The removal and/or modification of levees, dikes, culverts, and similar infrastructure would cause direct and indirect, short-term, localized, minor adverse impacts on **geology and soils, water, living coastal and marine resources and EFH, and threatened and endangered species** during the construction phase of the project. These impacts also apply to the construction of new or replacement levees (set-back levees) as part of the overall project. The use of heavy machinery and construction equipment is the primary cause of the direct, adverse impacts associated with this activity, which may include soil compaction, temporary grading, removal or crushing of understory vegetation, increased soil erosion in the immediate area of construction operations, and unintentional introduction of non-native, potentially invasive, species.

To minimize the impacts from this activity, unless it is being used to fill man-made features such as ditches or canals, non-native fill material originating from outside the floodplain would be removed to an upland site. Fill material may contain cultural resources and Section 4.8 describes the process that the NOAA RC follows in such cases. Construction activities are managed to minimize fish entrapment, typically by breaching the levee or berm at the downstream end of the project site or at the lowest elevation of the floodplain. Mitigation for potential impacts would focus on implementation of BMPs. Impacts to threatened and endangered species may include effects from handling, noise, turbidity, contaminants, hydrology, additional habitat quality/quantity, and displacement (see Section 4.7). Removal of barriers may also open pathways for invasive species.

These restoration activities would provide direct and indirect benefits to **geology and soils, water, living coastal and marine resources and EFH, and threatened and endangered species.** These projects result in benefits to riparian, stream and river channel habitats, and shoreline habitats such as wetlands, mangrove swamps, beaches, and mudflat areas. Restoration of natural hydrology would aid in the development of vegetated communities that provide vital rearing, feeding, and refuge habitat for fish and benthic communities and wildlife species. This technique is beneficial for anadromous fish that need connected coastal waterways and rivers with unaltered hydrology for passage during migration events, as well as for estuarine fish species that benefit from increased habitat area. Long-term major beneficial effects to the quality of surface water resources at the project site and beyond are expected due to restoration of tidal flow and water movement. Restoration of these areas to natural states would enhance water quality and salinity, reduce turbidity and soil erosion, increase carbon sequestration and storage capacity (providing climate change mitigation), and enhance habitat quality, although some increases in turbidity in the water column could result due to increased water movement**.** In areas where berms and levees bounded ponded areas restored to wetland, indirect, long-term minor beneficial effects would be expected by uptake and transformation of nutrients resulting from enhanced vegetative growth in the restoration area.

Cultural and historic resources and land use could experience indirect, long-term, minor adverse impacts resulting from levee modification or removal. The land use in the floodplain, including any potential culturally sensitive areas, would change as the water resources in the floodplain changed. Because land use would stabilize in the floodplain over time, the impact would be minor.

There will be instances where a levee and culvert project supported by the NOAA RC is expected to produce adverse impacts beyond the nature of those described in this PEIS. In such cases, an environmental assessment or EIS (tiered from the analysis in this document) will be prepared, as needed. NOAA RC staff will consider the magnitude of impacts to the resources described in this PEIS (especially impacts to cultural resources or to protected species, or as a result of cumulative impacts from past actions), but will also consider whether the extent, height, or location of the levee warrants additional analysis.

Table 35 - Summary of impacts to Levee and Culvert Removal, Modification, and Set-Back activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Major	Beneficial
Living Coastal and Marine Resources and EFH	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Moderate	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
Land Use and Recreation	Indirect	Long-term	Localized	Minor	Adverse
Socioeconomics	No Effect				

4.5.2.11.2 Wetland Restoration and Shoreline Stabilization Techniques

Potential impacts from wetland restoration activities described in Section 2.2.2.11—fringing marsh and shoreline restoration, sediment removal, and sediment/materials placement—generally consist of the more acute impacts caused by the use of heavy equipment on site followed by lasting benefits. Consequently, these techniques are grouped together in the analysis of impacts.

Construction impacts from sediment removal, materials placement, and shoreline stabilization activities are similar, and would cause direct and indirect, short-term, localized, minor adverse impacts on **geology and soils, water, living coastal and marine resources and EFH, and threatened and endangered species** during the implementation phase of the projects.

Impacts to **living coastal and marine resources, EFH, and threatened and endangered species** may include effects from handling, noise, turbidity, contaminants, changes to hydrology, and displacement (see Section 4.7 for more details). In the case of any activities using heavy machinery to conduct restoration work for marsh restoration activities, potential impacts are related to compaction of the soils, leaking petroleum products, and increased turbidity at the restoration site. Techniques such as the thin-layer deployment of dredged materials will have fewer impacts than traditional deployment, as there is less material to cause soil compaction or vegetation smothering. Many of these impacts would be ameliorated through the use of BMPs. Although soil compaction has the potential for long-term impacts, BMPs would reduce the compaction so that plant roots and infauna can inhabit the soil and create further improvements. Several shoreline stabilization techniques have potential impacts related to placing plastic or metal into the environment. In the case of bagged shell, the plastic mesh bags remain immobile in the environment until oysters grow over and encapsulate the plastic. All rock or shell breakwaters would be designed with appropriate ingress and egress for fish, in consultation with regulatory agencies.

These restoration activities may impact vegetation on the project site or nearby. Impacts to vegetation should be minimal, as the most frequently removed mature plants would not be native to the site or would be invasive species. For instance, shrub and tree species would be removed if the end goal is a habitat dominated by wetland obligate species. The removed plant species may not provide the same quality of habitat for fish as the goal habitat and consequently the overall impact of this removal is low. In instances where sediment and vegetation are not removed from the site, those working on the site may potentially trample existing vegetation or unintentionally introduce non-native species, but this would be kept to a minimum through the use of BMPs.

Increased water turbidity and temporary decreases in water quality may result from sediment removal, materials placement, and shoreline stabilization activities, which may in turn impact living resources in the area. Behavior of species that use wetlands impacted by this restoration activity may be temporarily modified. Mitigation for potential impacts would focus on implementation of BMPs. All restoration actions occurring within or near shallow or intertidal habitat may displace managed or protected species through the increased activity and noise associated with restoration. These impacts are expected to be temporary and may have the side effect of removing fish from harm's way during construction. In most cases, fish return to restoration sites almost immediately or within a short time after construction (Bilkovik and Mitchell 2013). Direct, short-term, localized moderate impacts would be expected on benthic fauna and infauna smothered by sediment placement. Materials with contaminant concentrations consistent with published sediment quality guidelines and background levels rarely impact biota, and will be considered non-significant.

After construction, these projects would result in direct and indirect long-term or permanent, moderate to major beneficial impacts **to geology and soils, water, living coastal and marine resources and EFH, and threatened and endangered species**, and minor beneficial impacts related to socioeconomic resources as a result of increased tourism opportunities that could result from an improved resource.

Sediment removal, materials placement, and shoreline stabilization activities would result in beneficial impacts by restoring or creating wetland and/or shallow-water habitats that provide areas for feeding and shelter for fish, as well as nutrient cycling and carbon sequestration and storage capacity. Changes in **land use** would be permanent if uplands were converted to wetlands. In general, increases in wetlands are beneficial impacts, due to the historic loss of wetland habitat.

Minor adverse impacts to **cultural and historic resources** may occur during wetland restoration, when historic structures are present within a project site (e.g., staddles).

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.11, wetland restoration projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 36 - Summary of impacts to Wetland Restoration and Shoreline Stabilization Techniques activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Short-term	Beyond Project Site	Minor & Moderate	Adverse
	Direct	Short-term & Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct & Indirect	Short-term	Beyond Project Site	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
Land Use and Recreation	Indirect	Permanent	Beyond Project Site	Minor	Beneficial
	Indirect	Long-term	Localized	Minor	Adverse
Socioeconomics	Indirect	Short-term	Beyond Project Site	Minor	Beneficial

4.5.2.11.3 Wetland Planting

Wetland planting may occur as a separate restoration activity or in combination with other restoration types described in this document. Planting may cause short-term, direct adverse impacts to **living coastal and marine resources** when existing vegetation is trampled during the donor harvest or planting process. Planting is generally short-term in duration, lasting days to weeks, but the length of time between the restoration efforts that prepare a site for planting and when planting is begun may be several months, as planting cannot be completed outside the local growing season. For this reason, active wetland restoration activities may last over a year, even at smaller sites. Short-term damage to stands of healthy wetland vegetation may occur where native species are harvested from donor sites using species-appropriate techniques. The growth habit and length of the growing season determines how rapidly a donor site would recover. Generally, the benefits of using a local, native plant source outweigh the damage to the donor site, which is temporary. For restoration activities that involve building native plant nurseries, although the nursery use may be long-term, the impacts are low because the sites are generally constructed in areas that do not have existing habitat value (e.g., a school playground, a disturbed upland area, or former sewage treatment plant or aquaculture pond). Minor adverse impacts to **cultural and historic resources** may occur during wetland restoration, when historic structures are present within a project site.

Long-term, moderate beneficial impacts to **water resources, living coastal and marine resources and threatened and endangered species** would occur due to the erosion reduction and increased shelter provided by wetland plants. Woody and herbaceous plant communities play an important role in stabilizing the shoreline. Mangroves are especially beneficial, as their extensive root systems trap sediment and nutrients (improving water quality) and dissipate wave energy, thereby decreasing coastal erosion and providing shoreline stabilization and protection

(Lewis and Streever 2000). Wetland planting activities would result in beneficial impacts by restoring or creating wetland and/or shallow-water habitats that provide areas for feeding and shelter for fish, as well as nutrient cycling and carbon sequestration and storage capacity. Changes in **land use** would be similar to those described above in Section 4.5.2.11.2. Minor beneficial impacts related to socioeconomic resources may result from increased tourism opportunities that could develop around an improved resource.

Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant. As described in Section 2.2.2.11.5, wetland planting projects included in this analysis are designed to restore and maintain ecological function and are planned and designed with those principles in mind. Examples include the BMPs described in Appendix C, which list the minimum precautions taken when planning restoration projects of this type in order to avoid adverse impacts greater than those described here.

Table 37 - Summary of impacts to Wetland Planting activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Direct	Short-term	Localized	Minor	Adverse
Water	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Long-term	Beyond Project Site	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Threatened and Endangered Species	Direct	Short-term	Localized	Minor	Adverse
	Direct	Long-term	Beyond Project Site	Moderate	Beneficial
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Adverse
Land Use and Recreation	Direct	Short-term	Localized	Minor	Adverse
	Indirect	Permanent	Beyond Project Site	Minor	Beneficial
Socioeconomics	Indirect	Short-term	Beyond Project Site	Minor	Beneficial

4.5.3 Land and Water Acquisition and Other Transactions

Land acquisition and water transaction projects would cause indirect, long-term, moderate to major beneficial impacts to geology and soils, water, living coastal and marine resources and EFH, threatened and endangered species, cultural and historic resources, and socioeconomics.

These impacts would result from new management of land and water resources and would prevent development or other degrading activities from taking place on the project site; acquisition and water rights projects would be limited to those that would improve the environment and/or enhance human use values (e.g., recreation) following completion. Beneficial impacts to **geology and soils, water resources, living coastal and marine resources and EFH and threatened and endangered species** may occur from such restoration activities due to improved access to coastal areas and habitats, the creation of buffer zones between sensitive resources, altered or managed timing of water withdrawals, and other factors that could impact such resources. Depending on the nature of the land acquisition or water transaction, **land use** overall could be directly and moderately benefitted over the long term, as fewer adverse environmental impacts occur at the project site. **Recreational** opportunities and **land use** practices would largely be improved as natural areas and ecosystems are preserved (e.g., through fee simple purchase of tracts of land or of water flows in rivers). **Cultural and historic resources**, if located on a protected parcel, would benefit from not being disturbed by development or other degrading activities that might otherwise occur.

Project-level impacts would be evaluated on an individual basis and would depend on the specific acquisition proposal. Acquisition projects through eminent domain are not covered under this analysis and, in such cases, an environmental assessment or EIS (tiered from the analysis in this document) will be prepared, as needed. Additional NEPA analysis will be completed if the proposed project has adverse effects that are beyond the scope of those analyzed here, including adverse effects that are significant.

Table 38 - Summary of impacts to Land and Water Acquisition and Other Transactions activities

Resource	Type of Impact	Duration of Impact	Geographic Extent	Magnitude / Intensity	Quality
Geology and Soils	Indirect	Long-term	Localized	Minor	Beneficial
Water	Direct & Indirect	Long-term	Localized	Moderate	Beneficial
Living Coastal and Marine Resources and EFH	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
Threatened and Endangered Species	Indirect	Long-term	Beyond Project Site	Minor	Beneficial
	Indirect	Short-term	Beyond Project Site	Minor	Adverse
Cultural and Historic Resources	Indirect	Long-term	Localized	Minor	Beneficial
Land Use and Recreation	Direct & Indirect	Long-term	Localized	Moderate	Beneficial
Socioeconomics	Indirect	Long-term	Localized	Minor	Beneficial & Adverse

4.6 Environmental Consequences of Alternative 2 –"Technical Assistance"

Overall, Alternative 2 has direct and indirect, short- and long-term, minor impacts that result from technical assistance restoration activities. Section 4.5.1 discusses the environmental consequences of each technical assistance restoration activity separately.

This alternative would rely heavily if not exclusively on external sources of funding to conduct on-the-ground implementation and NOAA resources would be directed away from such activities and focused on advisory or technical assistance aspects of the restoration work. Public comment received during the scoping period for this PEIS supports the concept that NOAA is an important source of funding for national, regional, and local restoration partners who conduct habitat restoration. The technical assistance activities would generally cause direct and indirect minor beneficial impacts, with some adverse impacts for more intrusive monitoring and sampling techniques. It is clear that NOAA's technical expertise is very important to a successful restoration approach, but were the program's focus to shift to a solely advisory role, NOAA would miss a very large opportunity to achieve positive environmental results. A substantial benefit would be lost within the affected environments that are not allocated funds for on-the-ground restoration activities. This point is particularly clear when considering how quickly beneficial results can be seen soon after on-the-ground restoration is conducted and habitat is restored. At certain restoration sites in the northeast region, herring populations have dramatically increased only a few years after the deconstruction of dams or the removal of blocked culverts. Oyster reef restoration not only repopulates oysters and improves water quality, but benefits other recreationally and commercially important species as well; the reef structure and subsequent shelter and feeding grounds these organisms create have shown similarly dramatic population results in local recreationally and commercially important fish species. Seagrass restoration and off-channel riverine pond creation projects have shown an increase in the size and number of species using these habitats. These are all benefits that are not readily or immediately achieved with a strictly advisory approach to restoration—they may not be realized to a large degree due to a shortage of funding sources, or they may be realized but later than they otherwise would have with NOAA RC funding.

Technical assistance is an important component for NOAA's restoration approach. On average, about 20 percent of projects supported year after year fall under this category of technical assistance projects. Figure 22 shows the relative balance of technical assistance projects supported by the NOAA RC against on-the-ground restoration projects since 2003.

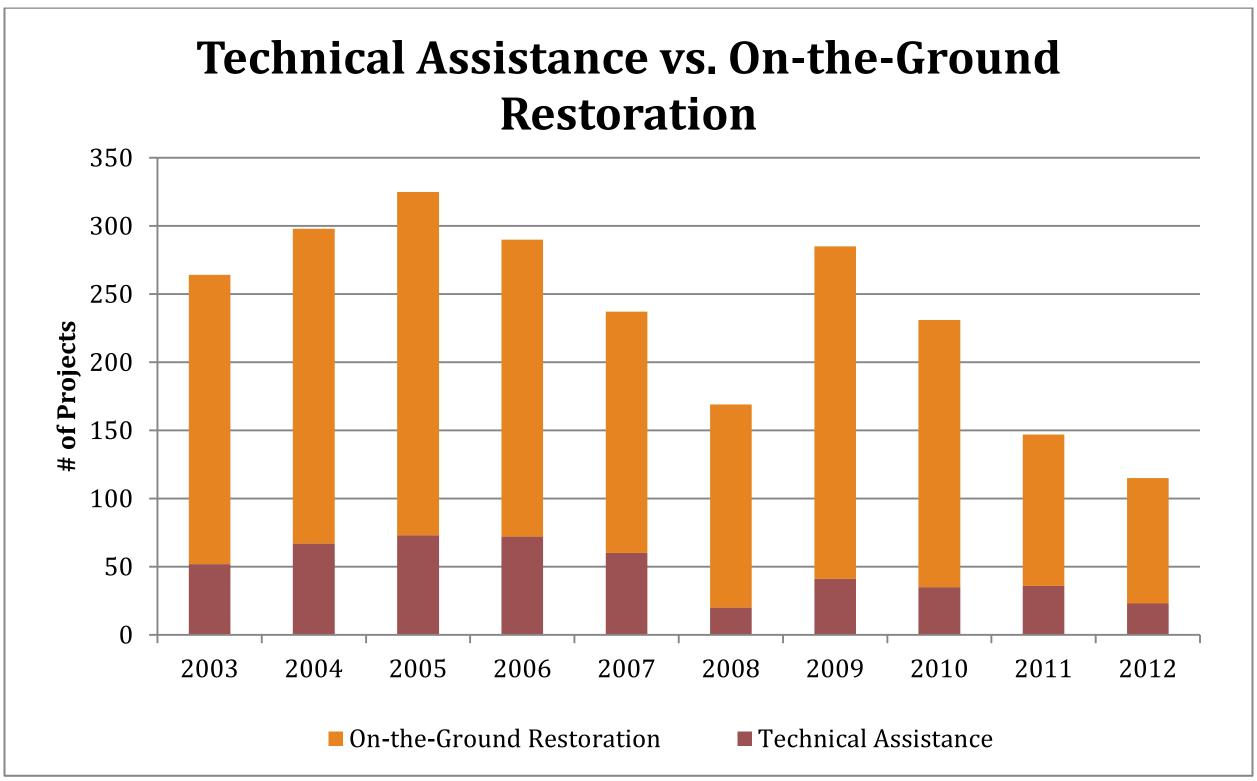

Figure 22 - Technical Assistance vs. On-the-Ground Restoration Projects (since 2003). Data is inclusive of Technical Assistance projects that have subsequently moved to on-the-ground restoration.

Of all technical assistance projects supported by the NOAA RC that eventually reached construction, 90 percent were subsequently supported in their on-the-ground restoration phase by NOAA.

Figure 21 above shows the breakdown of technical assistance projects supported per year by the NOAA RC since 2003. Over the past 5 years the NOAA RC has noticeably shifted away from funding projects that are strictly research, public access, and educational in nature, focusing more specifically on engineering and design, and planning projects.

4.7 Potential Impacts to Threatened and Endangered Species

The following section describes the potential impacts to threatened and endangered species (often called "listed species" because they are listed under the Endangered Species Act (ESA)) that may occur due to implementation of the preferred alternative. Because the majority of NOAA restoration activities have the potential to impact threatened and endangered species, those impacts are described below and referenced as appropriate throughout Section 4.5 - Environmental Consequences of Preferred Alternative, above.

In addition to the minimization efforts noted below for particular impacts, all restoration projects will attempt to time or locate activities to eliminate or avoid interaction with listed species, especially during critical activity periods such as migration, breeding, and nesting. If listed species are encountered at a project's construction site, construction activities would stop to ensure that they do not harass or otherwise interfere with the encountered animal(s). When feasible, some species can be safely and effectively discouraged from using the project area to minimize impacts to them prior to and during project activities, reducing the need for capture and release (see Displacement below). No major or severe adverse impacts to federally listed species are expected due to the temporary nature of the restoration activities typically implemented. The direct and indirect impacts described below note how listed fish, terrestrial and marine mammals, birds, amphibians, reptiles, sessile invertebrates, mobile invertebrates, and plants are most likely to be affected.

The impacts to listed species or critical habitat that are discussed below and covered by this PEIS are those that NOAA has determined will not have significant, adverse effects. In addition, these impacts will not cause jeopardy to or adverse modification of critical habitat for the species in question, unless the application of reasonable and prudent measures can reduce those impacts below the level of significance. Some project types may require a project-specific consultation with NOAA or USFWS, and adherence to any terms and conditions of an approval as required by the agencies.

<u>Handling and Direct Contact</u>

Handling of listed species will be avoided whenever possible. Protected species may be stressed, injured, or killed by either physical or chemical effects. Physical impacts may be indirect or direct, including strike impacts (from boats, vehicles, or equipment); entrapment; burial (including eggs); or incidental effects to food sources, cover/shelter, or exposure to temperature or moisture changes. Chemical factors are mostly relevant to aquatic species, and may contribute to stress, injury, or mortality from changes in dissolved oxygen, carbon dioxide, salinity, and other soluble minerals and metals. Trauma that can occur will vary with the duration of capture or handling; physical extent of an injury; extent of overcrowding or debris buildup in traps; and exposure to predation, harmful chemistry, or bacteria.

Fish are the most likely species type to require handling; however, it is possible that mammals, amphibians, reptiles, sessile and mobile invertebrates, birds, and plants may also need to be handled during restoration activities. Capturing and handling can stress fish in particular (see Section 4.5.1.3 for a description of typical fish monitoring impacts). However, these effects are generally short-lived, as fish typically recover fairly rapidly from approved handling techniques (NMFS 2003a, 2004d). Passive or active fish gear may pose some risk to the fish, including stress, disease transmission, injury, or death (Hayes 1983; Hubert 1983; NMFS 2003b). However, through the use of appropriate relocation techniques and protocols, unintentional mortality of listed fish species can be kept to a minimum, and a skilled operator can further reduce that risk.

Mammals, amphibians, reptiles, sessile invertebrates, and plants may also experience similar impacts from handling as those to fish, including stress and injury. Handling is only likely to be needed with relatively few individuals. Handling effects will be minimized by following proper procedures and conservation measures (e.g., minimizing handling time). In addition, the handling of any listed species will be conducted or supervised by a trained biologist experienced with work area isolation and competent to ensure the safe handling of listed species.

<u>Displacement</u>
All types of mobile listed species covered by this document may be temporarily displaced due to altered environmental conditions, such as human presence, noise, reverberations, contaminants, increased turbidity, or modifications in flow. Immobile species (such as corals) may be transplanted to other areas by project staff. Salmonids are generally able to avoid the adverse conditions created from restoration activities if the disturbances are small relative to the total habitat area, and if recovery can occur before the next disturbance (NMFS 2004d). Most other types of mobile species should be able to avoid these areas of disturbance as well. This displacement may cause species to occupy areas with lower habitat quality, potentially altering essential behavior and increasing predation risk in the short term (NMFS 2004d). Additional impacts may include increased interspecific and intraspecific competition, stress due to different thermal regimes, or altered feeding and movement patterns of listed species due to the temporary displacement of other fauna. In general, the short duration associated with displacement caused by restoration activities will minimize impacts on listed species.

<u>Noise and Reverberations</u>
Noise and reverberation generated during restoration activities have the potential to affect all listed species (fish, terrestrial mammals, marine mammals, birds, amphibians, reptiles, sessile invertebrates, and mobile invertebrates) except plants. Wildlife species may be temporarily impacted by reverberations caused by the operation of equipment, blasting, and/or noise caused by equipment or the presence of people (e.g., volunteers, work crews). The effects of noise disturbances on fish and wildlife are not well understood (U.S. Environmental Protection Agency 1971; Fletcher and Busnel 1978; Fraser et al. 1985; White and Thurow 1985; Andersen et al. 1989; Henson and Grant 1991; Reijnen et al. 1995; USFWS 1997). Noise from construction and other

activities may cause stress to aquatic organisms, and although the extent of the impact is difficult to determine, it can be related to the degree of species habituation to various levels and types of noise. Noise disturbances to fish and wildlife species may also result in, but are not limited to, reduced reproductive success; interference with foraging, resting, roosting, or species communication; decreased species or prey densities; and the attraction of predators to project sites. Noise is most likely to lead to avoidance and displacement (see Displacement above).

Projects will minimize impacts from noise and reverberations (e.g., cofferdams can isolate the work area from the stream and minimize impacts affecting the water column). In general, however, impacts would be temporary and generally occur at a small spatial scale relative to the species' typical home range.

<u>Turbidity</u>
Restoration activities may cause limited erosion, temporarily increasing sediment input and turbidity. Impacts on fish are first described and were gathered from biological opinions related to restoration activities' impacts on Pacific and Atlantic salmonids (NMFS 2001, 2004c, 2004d; USFWS 2005). Beneficial impacts of increased turbidity to fish include enhanced cover conditions, reduction in fish/bird predation rates, and improved survival. Detrimental impacts include physiological stress, reduced growth, and adverse effects on survival. High turbidity concentrations can reduce feeding efficiency, decrease food availability, reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and also cause fish mortality (Berg and Northcote 1985; Gregory and Northcote 1993; Velagic 1995; Waters 1995). Additional sub-lethal effects could include impairment of swimming activity and predator avoidance. Turbidity may lead to the deposition of fine sediments, which may adversely affect primary and secondary productivity (Spence et al. 1996), as well as reduce incubation success (Bell 1991) and cover for juvenile salmonids (Bjornn and Reiser 1991). Newly emerged juvenile salmonids may be especially sensitive to even moderate amounts of turbidity (Bjornn and Reiser 1991), and smolts may be vulnerable to stress-induced mortality during migration to the ocean. Large amounts of sediment may also disrupt olfactory senses of adult salmon, impairing migratory behavior.

The occurrence and magnitude of many of the physical and behavioral effects noted above are greatly determined by the frequency and the duration of the exposure, in addition to the amount of sediment input. Because restoration activities should only affect turbidity for short durations, it is unlikely that the degree of impact will be significant. This is especially true if the background levels of turbidity are high. In addition, it is anticipated that the turbidity levels resulting from restoration activities will be much lower than those levels focused on by the research noted above. Also, high concentrations of suspended sediments associated with storm and snowmelt runoff episodes do not appear to have much effect on adult and larger juvenile salmonids (Bjorn and Reiser 1991). In addition, recent studies reported in northern California, which compared control streams to those with moderate turbidity levels and short-term high turbidity levels, showed little to no difference in measurements of salmonid growth and abundance (Rogers 2000; U.S. Forest Service 2004). However, although turbidity may lead to the impacts described above, this generally only occurs when species cannot leave the area. Therefore, the most likely effect of suspended sediments on salmonids is behavioral avoidance of turbid waters (DeVore et al. 1980; Birtwell et al. 1984; Scannell 1988) (see Displacement above). In order to avoid turbid plumes, researchers have found that salmonids may move laterally and downstream (McLeay et al. 1984, 1987; Sigler et al. 1984; Lloyd 1987; Scannell 1988; Servizi and Martens 1991).

In addition to the information on fish noted above, elevated turbidity levels could similarly impact aquatic listed species such as marine mammals, reptiles, amphibians, and sessile invertebrates. However, turbidity can have physical and behavioral effects on these species through altering food sources (e.g., effects on aquatic macroinvertebrates and algae), as well as by causing stress, injury, mortality, and displacement. Amphibians and reptiles may be especially sensitive to turbidity impacts, and sediment may smother eggs. Immobile invertebrate listed species (e.g., mollusks) may be the most impacted by turbidity because they are unable to avoid sediment plumes. Terrestrial mammals, birds, mobile invertebrates, and plants are less likely to be affected. However, as referred to above, elevated turbidity may decrease fish/bird predation rates, affecting feeding opportunities of listed bird species.

These short-term turbidity increases are unlikely to cause major impacts to listed species. Species can avoid areas of increased sediment as noted above, and can be temporarily or permanently moved (see Displacement above). Restoration activities will include BMPs to decrease the amount of sediment entering the stream and potential impacts on listed species.

<u>Contaminants</u>

Contaminants may be released during project construction. The following information on contaminants was gathered from several biological opinions related to the impacts of restoration activities (NMFS 2001, 2004c, 2004d). Soils mobilized during project work may act as a delivery mechanism for chemical pollutants. In general, chemical exposure can alter fecundity, increase disease, shift biotic communities, and reduce the overall health of listed species. The use of heavy equipment can result in accidental spills of fuel, oil, lubricants, and hydraulic fluids, injuring or killing organisms. Petroleum-based materials contain polycyclic aromatic hydrocarbons (PAHs), which at high levels of exposure can cause acute toxicity to salmonids, and also cause chronic lethal as well as acute and chronic sub-lethal effects to aquatic organisms (Neff 1985). However, the consequences of many project types will also lead to a long-term, beneficial reduction in contaminants, through reduction in sediment delivery, increased filtering capacity at the project site, and removal of debris.

Herbicides may also be used in restoration activities involving the control of invasive species. Exposure to herbicides can have lethal and sub-lethal effects on salmonids, aquatic invertebrates, aquatic vegetation, and target and non-target riparian vegetation (Spence et al. 1996).

Sub-lethal effects may be uncertain, but changes in physiological or behavioral functions can adversely affect the survival, reproductive success, or migratory behavior of individual fish. Indirect effects on salmonids may also occur at lesser thresholds, due to the greater sensitivities of aquatic plants and macroinvertebrates to the acutely toxic effects of herbicides. NOAA ensures application is done by qualified individuals and designed to reduce impact to non-target species and surface waters. In addition, long-term major beneficial impacts to threatened and endangered species will result as non-native species are replaced by diverse native plant communities.

Exposure from contaminants during restoration activities may impact all listed species covered by this document, especially aquatic species. Terrestrial mammals, birds, mobile invertebrates, and plants are less likely to be affected. In all cases, project proponents will obtain necessary permits and consultations before proceeding with a project involving herbicides or contaminated sediments. Investigations on the distribution of contamination may be required if that information is not available. All appropriate BMPs will be used to minimize any such releases and environmental impacts. If listed species are present in the project area, assessment of impacts under NEPA will rely heavily on ESA consultations.

Hydrology and Hydraulics

Restoration activities typically alter the hydraulics of the stream area around the project site. Some projects that include flow restoration or augmentation can change stream hydrology. Large-scale restoration efforts may increase peak flow elevations, scour, and sediment transport (see Turbidity above), as well as change groundwater storage and stream flow. High flows can injure and displace eggs, juveniles, and smaller adult species. Low flows can result in desiccation, decreased oxygen, and silt deposition affecting spawning areas. In addition, hydraulic changes can result in shifts in the aquatic community, altering the prey base and trophic dynamics related to listed species.

Some restoration construction activities may also change local hydraulics. This may involve dewatering and diversion activities, which can lead to stranding, desiccation, or displacement. Dewatering may temporarily impact macroinvertebrates, crucial to riverine food chains, in the disturbed area. However, impacts would likely be negligible for salmonids because rapid recolonization of macroinvertebrates is typical following rewatering (Cushman 1985; Thomas 1985; Harvey 1986; NMFS 2004c). Water diversions are also likely to maintain the flow of these food sources from upstream areas. In addition, changes in flow due to dewatering are expected to be small, gradual, and short-term. Soil compaction from heavy equipment use and road upgrades can reduce soil permeability and infiltration, and increase runoff.

Hydraulic and local hydrologic changes are most likely to affect listed aquatic species, but may indirectly affect terrestrial listed species that rely on aquatic prey and riparian habitat. Fish, reptiles, amphibians, and sessile invertebrates may be affected, whereas marine mammals, terrestrial mammals, birds, mobile invertebrates, and plants are less likely to be affected. However, due to the short duration of construction activities, the impacts are expected to be minimal. Impacts to riparian areas from changes in hydrology and hydraulics will typically be minimized due to the presence of saturated soils, high water tables, and runoff processes dominated by direct precipitation and overland flow (Dunne and Leopold 1978; NMFS 2004d).

4.8 Potential Impacts to Cultural and Historical Resources

Restoration activities could have direct, permanent, minor to moderate adverse impacts to historic and cultural resources during construction or other on-the-ground activities. NOAA acknowledges the projects under this PEIS are undertakings as defined in the NHPA. Adverse effects under the

NHPA include physical destruction, damage, or alteration, including moving the property or cultural resource from its historic location; isolation from, or alteration of, the setting; and introduction of intrusive elements.

In this analysis, the intensity of adverse impact is described as (adapted from NPS 2008):

- Minor: the effect is measurable or perceptible, but it is slight and affects a limited area of a site, structure, or group of sites or structures. Slight alteration(s) to any of the characteristics that qualify the site(s) for inclusion in the National Register may diminish the integrity of the site(s). For purposes of section 106, the determination of effect would be adverse effect.
- Moderate: the effect is measurable and perceptible. The effect changes one or more of the characteristics that qualify the site(s) or structure(s) for inclusion in the National Register and diminishes the integrity of the site(s), but does not jeopardize the National Register eligibility of the site(s) or structure(s). For purposes of section 106, the determination of effect would be adverse effect.
- Major: the effect on the site or structure, or group of sites or structures, is substantial, noticeable, and permanent. The action severely changes one or more characteristics that qualify the site(s) for inclusion in the National Register, diminishing the integrity of the site(s) or structure(s) to such an extent that it is no longer eligible for listing in the National Register. For purposes of section 106, the determination of effect would be adverse effect.

Some actions may have beneficial impacts, such as providing increased protection for historic buildings and structures, reduced erosion of soils covering archaeological sites, or increased use of the site for culturally important practices, such as subsistence harvest. Given the nature of cultural and historic resources, adverse impacts are generally considered permanent, except for when impacts are restricted to restoration activities that temporarily prevent the use of a site for culturally important practices or impair a viewshed.

Although all grant activities are considered undertakings under the NHPA, not all restoration activities have the potential to cause effects on historic properties, assuming such historic properties were present, as not all activities involve ground disturbance. Table 39 - Potential impacts to Cultural and Historic Resources below describes whether impacts to historic or cultural resources may occur with the restoration activities analyzed here, and the intensity of the impact.

Table 39 - Potential impacts to Cultural and Historic Resources

Action	Type	Intensity	Qualifier
Technical Assistance			
Planning, Feasibility Studies, Design Engineering, and Permitting	Direct and Indirect	Minor	Adverse
Implementation and Effectiveness Monitoring	No Effect		
Fish and Wildlife Monitoring	No Effect		
Environmental Education Classes, Programs, Centers, Partnerships, and Materials; Training Programs	No Effect		
Riverine and Coastal Habitat Restoration			

Coral Reef Restoration	No Effect		
Debris Removal	Direct	Minor	Adverse
Access Management and Signage	Direct	Minor	Adverse
Fish Passage	Direct	Minor to Major	Adverse
Fish, Wildlife and Vegetation Management	Direct	Minor	Adverse
Wetland Restoration	Direct and Indirect	Minor to Major	Adverse
Freshwater Channel, Stream, and Bank Restoration	Direct	Minor to Moderate	Adverse
Road Upgrading and Decommissioning; Trail Restoration	Direct	Minor	Beneficial and Adverse
Shellfish Restoration	Indirect	Minor	Beneficial
Subtidal Planting	Direct	Minor	Adverse
Water Conservation and Stream Diversion	Indirect	Minor	Beneficial and Adverse
Land and Water Acquisition			
Land Acquisition	Indirect	Minor	Beneficial
Water Transactions	Indirect	Minor	Beneficial

When there is a potential for impact to archeological or historical resources, NOAA consults with the appropriate state and local officials and Indian tribes, and considers their views and concerns regarding the potentially affected cultural resources prior to making a final project implementation decision. This frequently results in a letter from the State Historic Preservation Officer (SHPO) with a determination of "no historic properties affected." In some cases where SHPO determines that historic properties will likely be affected, NOAA works with the SHPO and affected tribes to develop a memorandum of agreement, with stipulations to reduce the adverse impacts such as:

- Archival quality photographs of structures prior to removal and documentation on appropriate state-designated forms.
- Immediate notification of State Historic Preservation Offices if previously undocumented historic properties or sites are discovered during the project.
- Interpretive signage.
- Development and implementation of unanticipated discovery plans.
- Installation or remediation of structures in accordance with the Secretary of the Interior's Standards for Rehabilitation.
- Monitoring of excavations and site disturbance by a historian or archaeologist who meets the Secretary of the Interior's Professional Qualification Standards.

4.9 Cumulative Impacts

The CEQ regulations (40 CFR 1500) for implementing the provisions of NEPA define cumulative impacts as "the impact on the environment which results from the

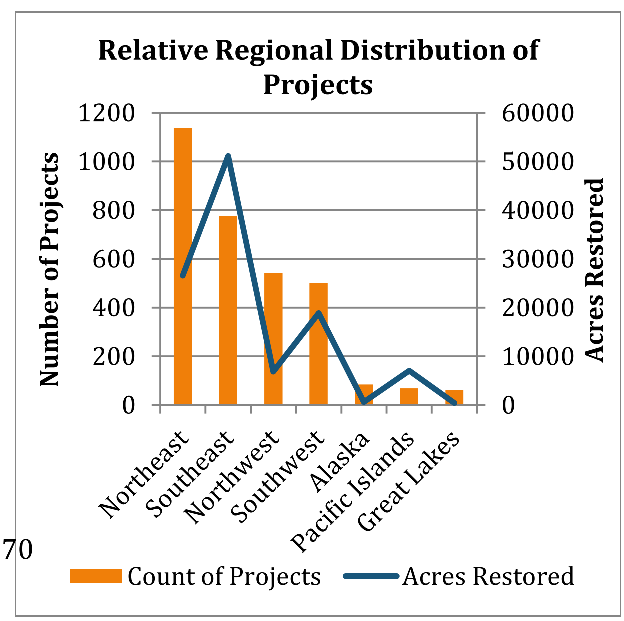

Figure 23 - Relative Regional Distribution of Projects

incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (CEQ 1997a). The regulations further define cumulative impacts as those that can result from individually minor but collectively significant actions that take place over a period of time. This is an important consideration in complying with NEPA requirements for program-wide analyses because of the potential for additive effects from small projects that could potentially result in a cumulative effect to a resource within the project area. At the same time, analyzing site-specific cumulative effects in a programmatic document is challenging, primarily because of the large geographic extent of NOAA's various programs, the long temporal boundaries that are considered in such analyses, and the relative unknowns of future program decisions.

Under the preferred alternative, NOAA would implement restoration activities across a large geographic extent. To date, the area of influence has included 43 states, territories, or international areas, primarily focused within four geographic regions. Although geographic equity is a major consideration when distributing grant funds across a national program, each region of the NOAA RC has not implemented the same number of projects. Figure 23 shows the regional distribution of past and ongoing projects supported by the NOAA RC. Almost 400 more projects have been implemented in the northeast region than in the southeast region (the next highest), followed by the northwest, southwest, and Great Lakes regions.[9]

Geographic equity in funding distribution does not equate to arbitrary project selection, however. NOAA RC funding programs follow agency, office, and regional priorities in making funding decisions (see Appendix A). Projects are very often conducted in high-priority, biologically important areas and, as a result, multiple projects are often implemented concurrently or sequentially within a watershed for a more comprehensive beneficial impact. Arguably, areas with more individual projects have a higher potential for cumulative impacts resulting from those projects, although both negative and beneficial impacts may result.

The duration of project implementation and useful project life, which can vary significantly depending on the specific details for each project, also contribute to an assessment of cumulative impacts. Over 75 percent of NOAA RC projects supported since 1992 were short-term in duration; i.e., they took less than 5 years to complete, from design through construction. Of those, many had an active construction window of only weeks or one to two seasons. Most adverse impacts from restoration occur during the construction window. There are instances where NOAA has supported parts of longer-term, larger-scale projects that have taken longer than 5 years to design and implement, or has continually supported the same restoration work in a given area for more than 5 years. In such cases, these projects may have a higher likelihood of experiencing a cumulative impact from construction activities happening at the same time or near each other. In the same vein, the lingering effects of one project may exist during the implementation of another project, leading to a cumulative effect. This is usually, but not always, likely to occur in watersheds where the NOAA RC has restored a large number of acres. Figure 24 through Figure 29 below show acres

[9] Great Lakes projects have only received project funding since 2009, with the authorization of the Great Lakes Restoration Initiative.

restored and stream miles opened summed within hydrologic units (HUC 8). Again, this does not necessarily represent geographic areas where cumulative impacts are realized, but rather areas of restoration intensity and benefits resulting from NOAA RC restoration activities.

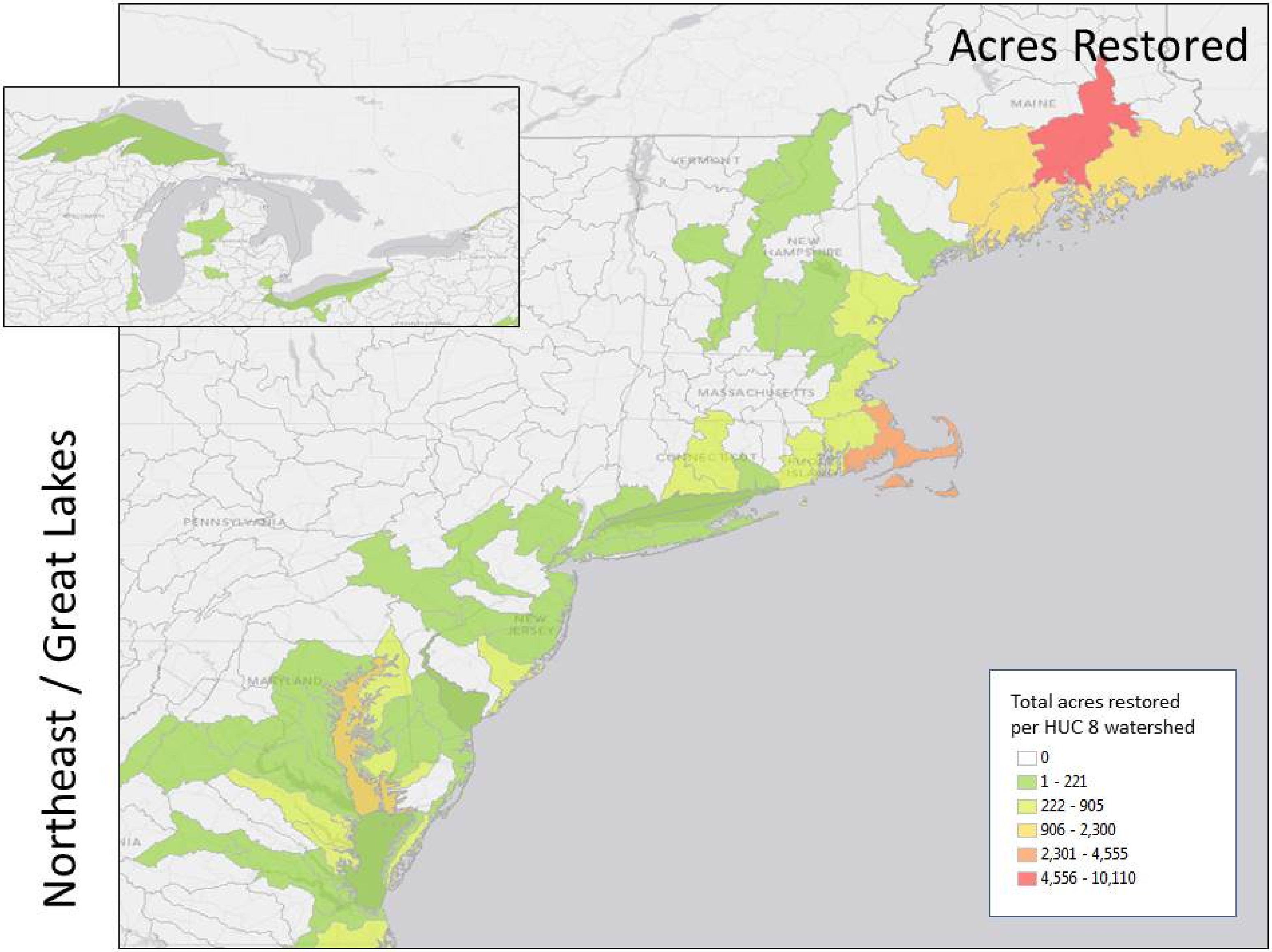

Figure 24 - Acres Restored in the Northeast and Great Lakes Regions, by HUC-8 Watershed

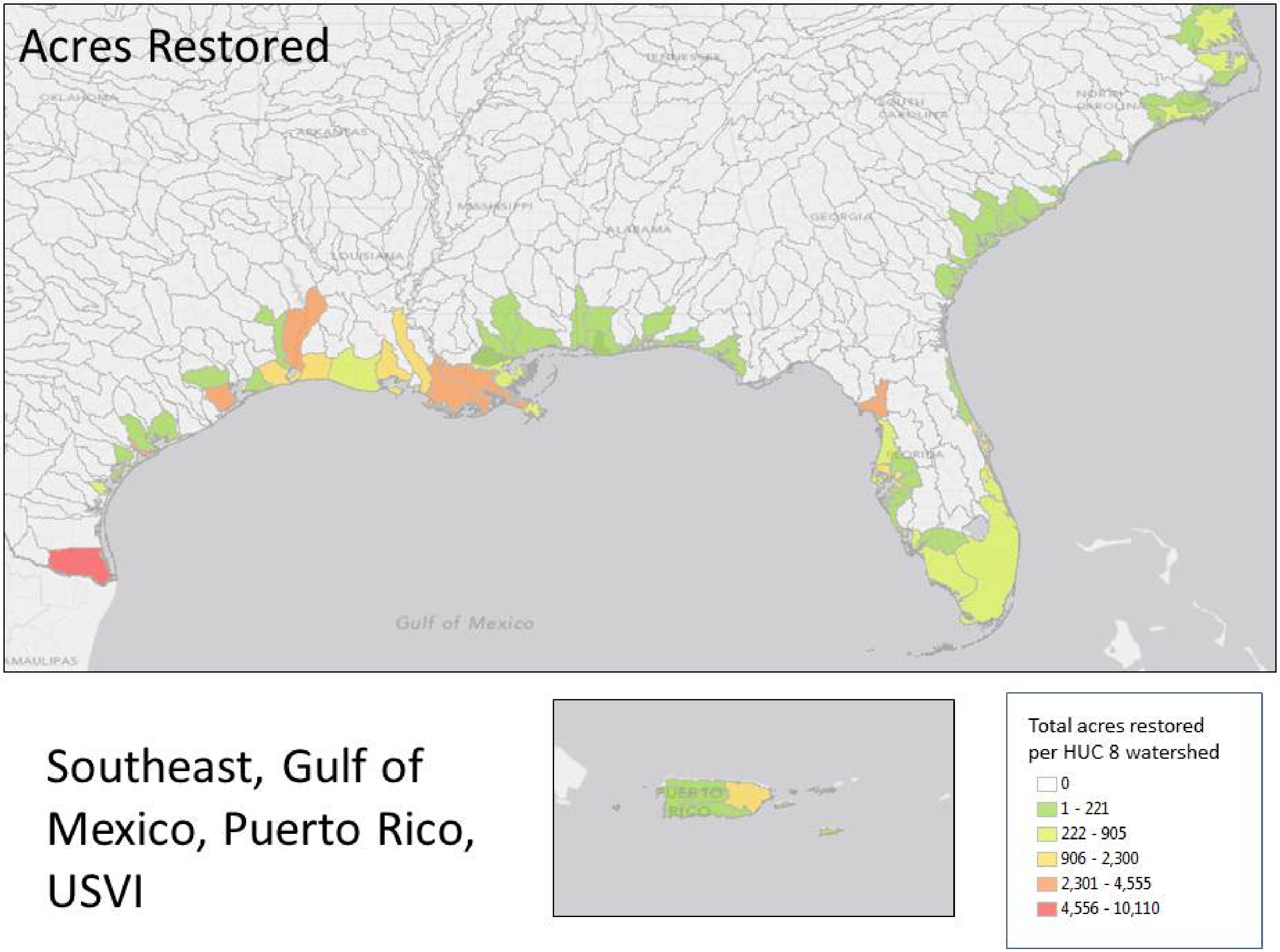

Figure 25 - Acres Restored in the Southeast, Gulf of Mexico and Caribbean, by HUC-8 Watershed

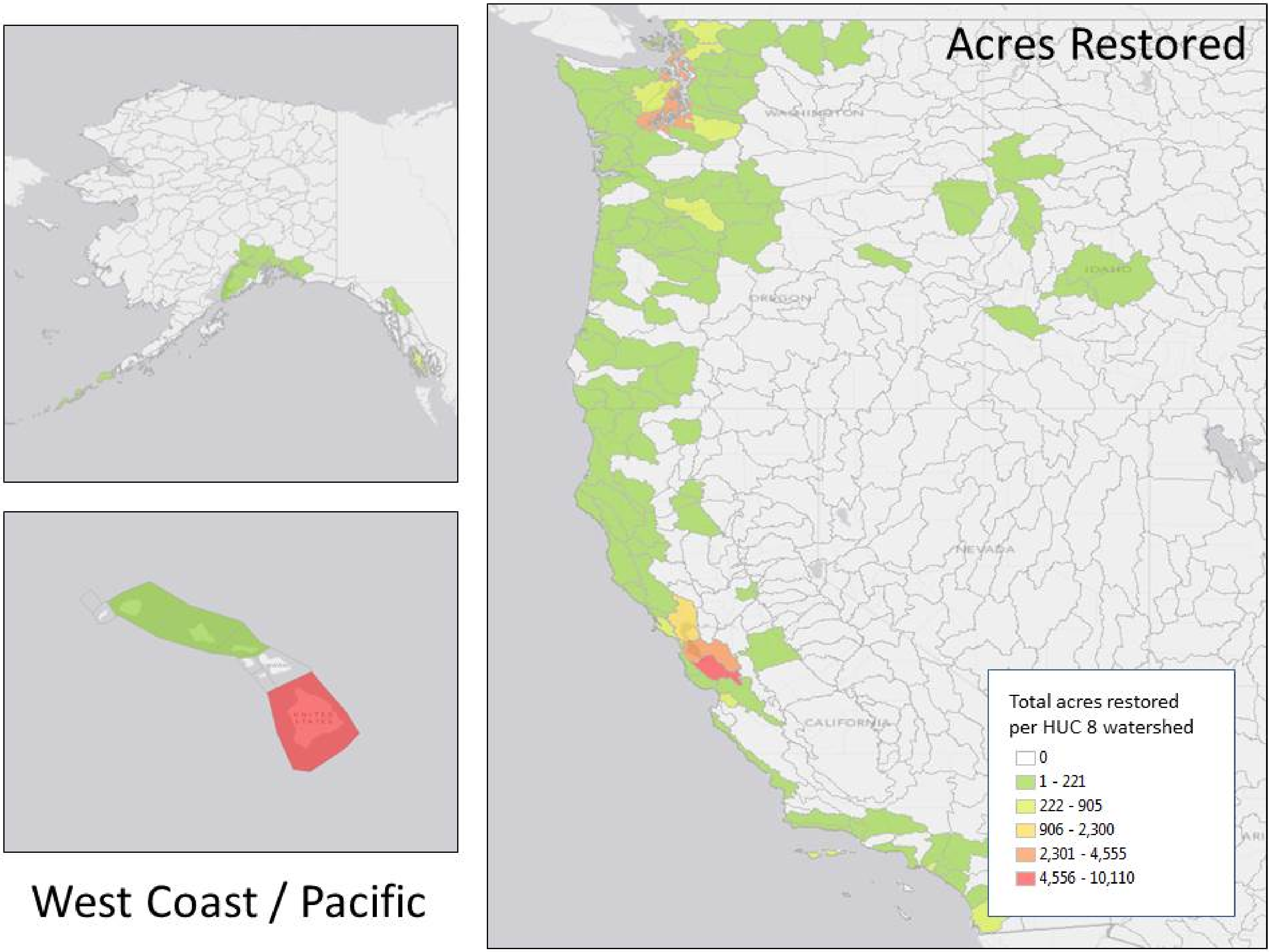

Figure 26 - Acres Restored in the West Coast / Pacific Regions, by HUC-8 Watershed

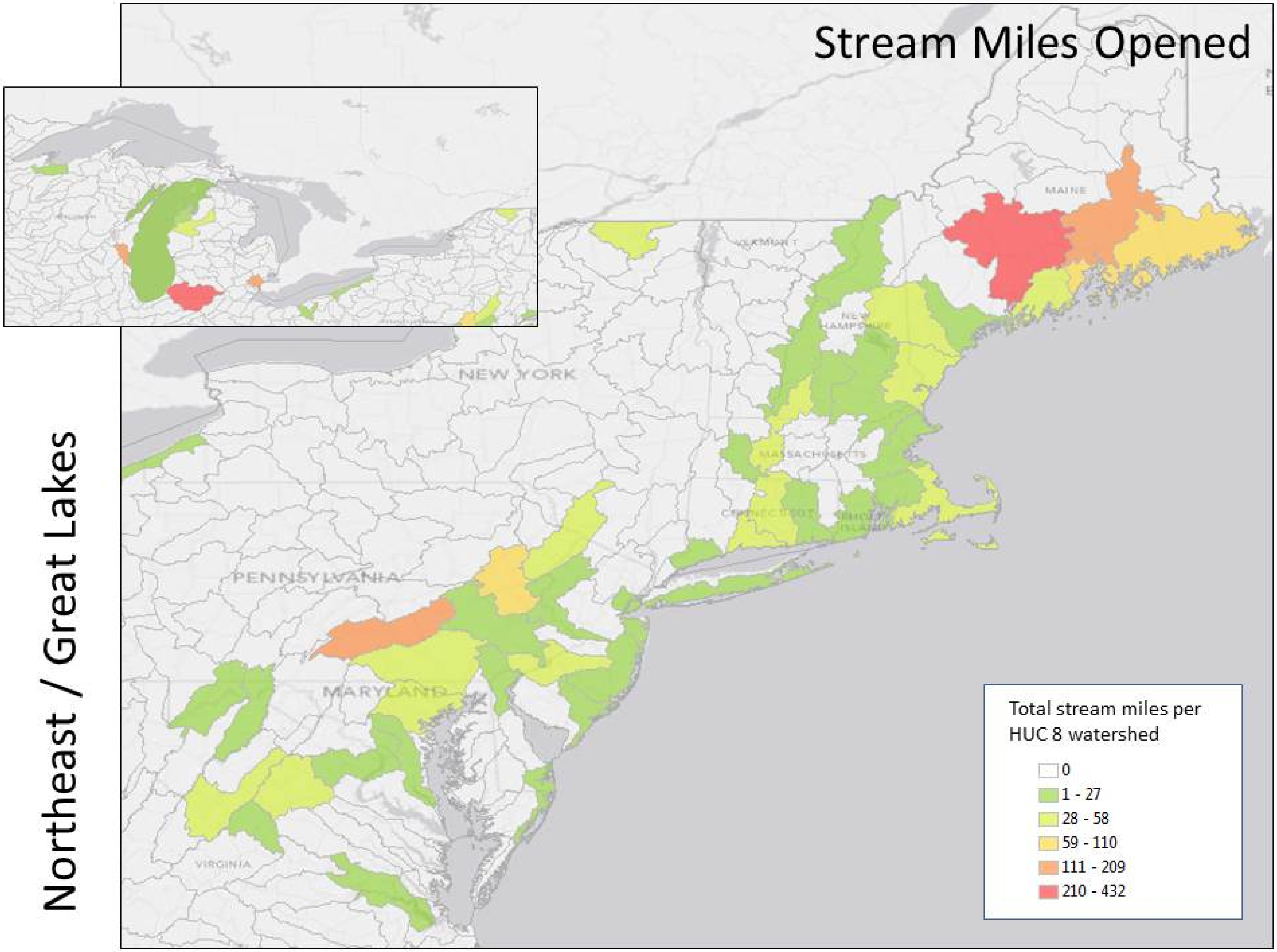

Figure 27 - Stream Miles Opened in the Northeast and Great Lakes Regions, by HUC-8 Watershed

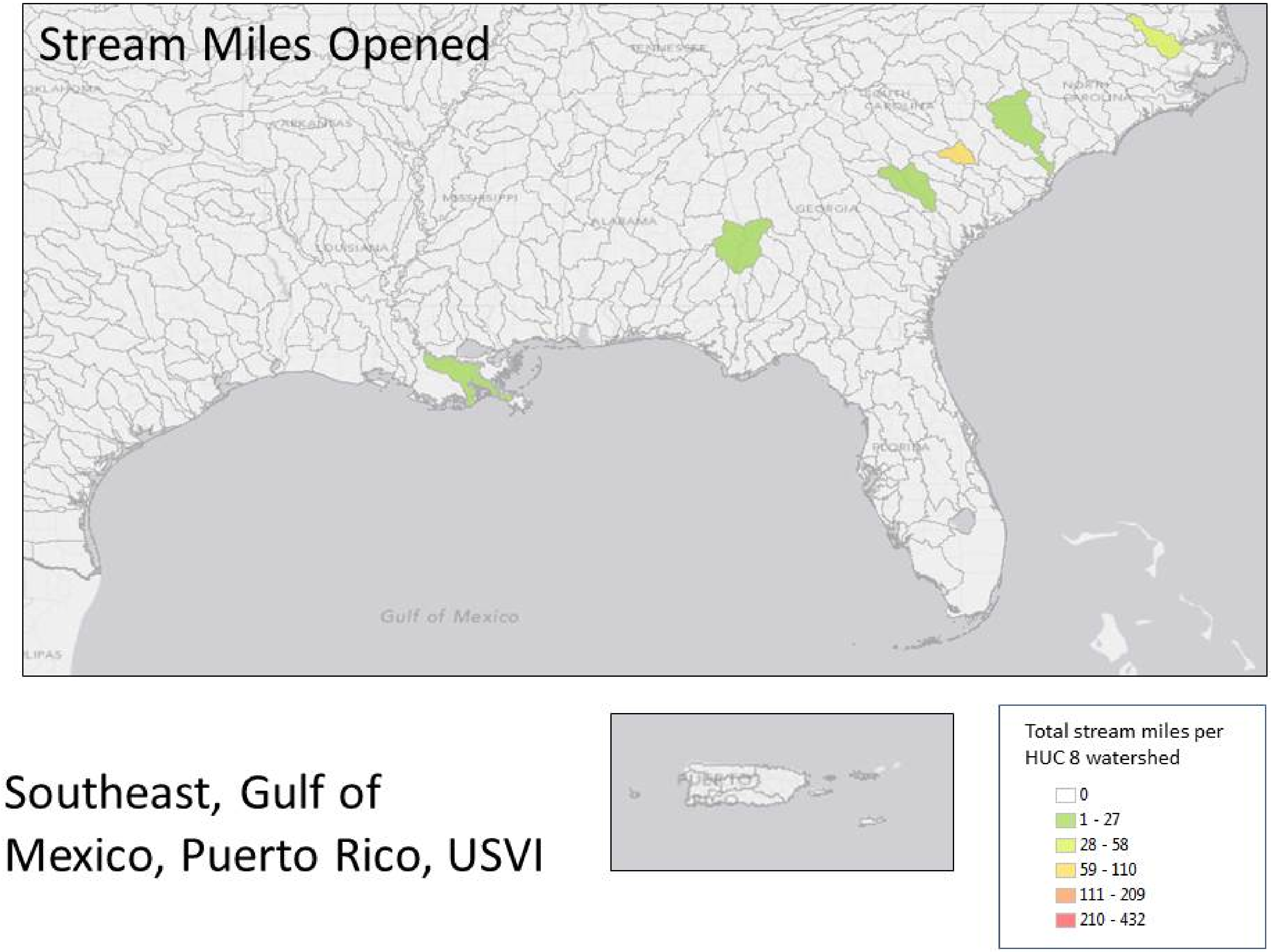

Figure 28 - Stream Miles Opened in the Southeast, Gulf of Mexico and Caribbean, by HUC-8 Watershed

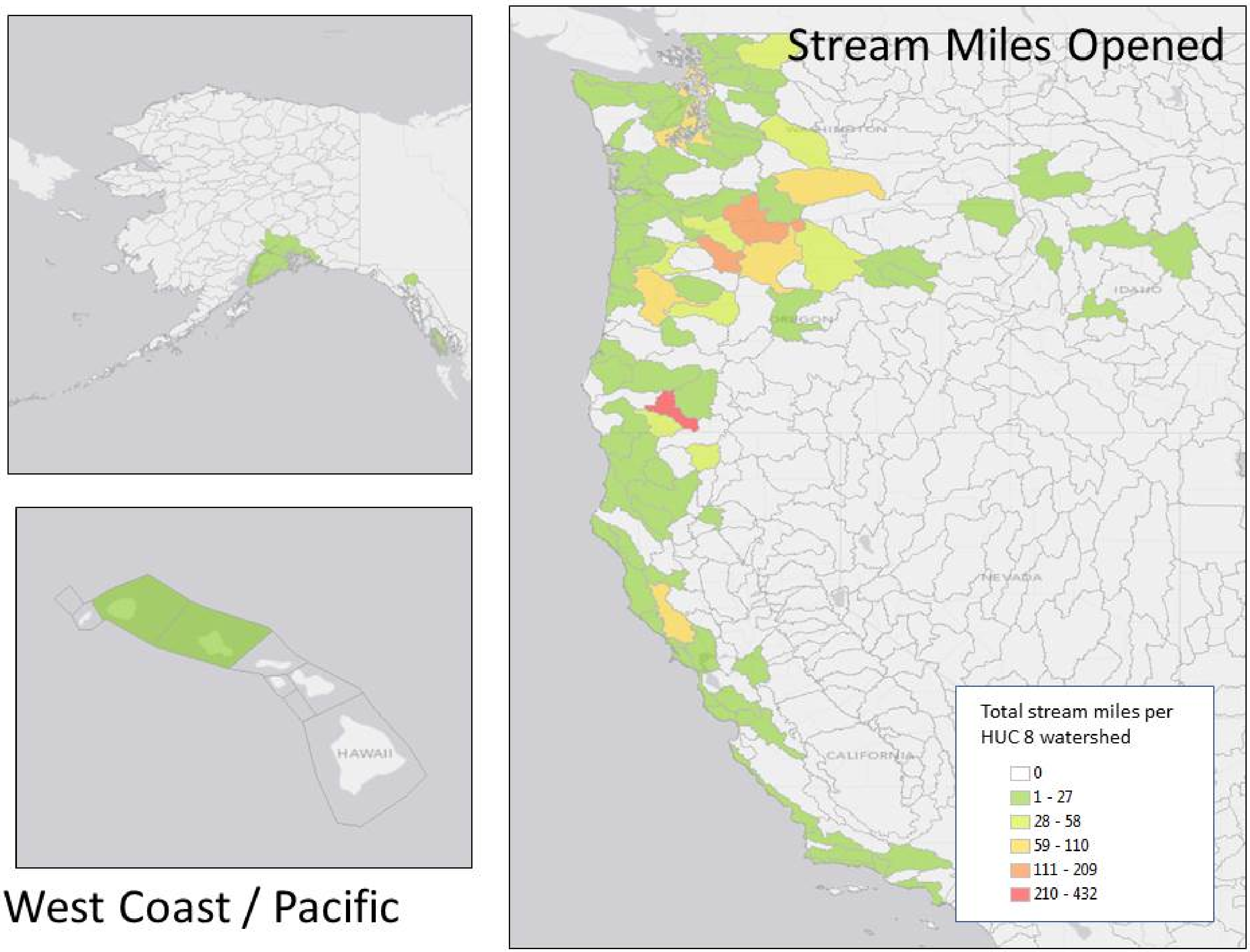

Figure 29 - Stream Miles Opened in the West Coast / Pacific Regions, by HUC-8 Watershed

Overall, the adverse impacts from project construction are likely to be short-term and only minor to moderate when they do occur. As most project sites are isolated from each other, cumulative short-term construction impacts (from both NOAA RC and other restoration projects) are unlikely. On the other hand, because projects are restoring natural habitat structure and function, any successful restoration project should lead to longer-term minor, moderate, or major beneficial impacts on the community, living coastal and marine resources and endangered species, and ecosystems of the coastal United States that have been identified in Section 3.0. Projects that do not perform as planned are modified through adaptive management (see Section 2.2.1.3 - Fish and Wildlife Monitoring) where possible to ensure a successful restoration outcome or to reduce or prevent adverse impacts. Because project implementation periods (and the associated adverse effects from construction activities) are short-term, and the beneficial impacts from a project are long-term, generally, the cumulative impact of the proposed action program-wide is estimated to have a net beneficial impact to the identified resources from Section 3.0, because the long-term benefits essentially reflect increased sustainability and quality of coastal habitat, restored ecosystem services, and improved fishery production.

Despite the various priorities that guide the NOAA RC's decision-making and the subsequent geographic distribution of projects, the NOAA RC's programs implement projects through a variety of mechanisms (described further in Appendix A). As a result, there are inherent uncertainties about site-specific locations and timing of restoration activities that cannot always be analyzed ahead of time in a reasonable way. To address this, before a given restoration project is awarded, a more detailed, site-specific analysis shall be conducted in order to determine the overall environmental impact to the project site. Included in these analyses is an assessment of cumulative impacts—essentially a determination as to whether the project is one of a series of past, ongoing, or reasonably foreseeable future actions (conducted by both NOAA and others) that together would cause a meaningful impact to a project area's resources. This analysis also informs NOAA of any special award conditions or BMPs that must be adhered to in order to implement the project in a way that avoids as much adverse impact as possible, further reducing the potential for adverse cumulative impacts. See Appendix A for further detail on this process.

Under Alternative 2, which is characterized by fewer on-the-ground activities and more desk-based activities, the potential for cumulative impacts to the affected environment are not as likely to be immediately realized. For example, approximately 67 percent of projects funded by the NOAA RC resulted in more than 109,000 acres of restored habitat (the other 37 percent did not or, as of this publication, have not yet reported final restored acres). Conversely, if considering only Alternative 2 projects funded by the NOAA RC, approximately 8 percent of projects resulted in restored acreage (1,318 acres). Without NOAA RC funds for the restoration phase, as is proposed in Alternative 2, more than 100,000 acres of restoration would not have occurred. Therefore, if Alternative 2 is implemented, the beneficial and adverse impacts resulting from project implementation would not occur, or would be substantially delayed until other funding sources could be found.

4.9.1 Past, Present, and Reasonably Foreseeable Future Actions

Since 2003, the NOAA RC has restored anywhere from 3,900 to 9,800 habitat acres per year, and has opened anywhere from 90 to 430 stream miles per year (see Figure 2 and Figure 3 above). In total, the NOAA RC has restored almost 200,000 acres of habitat, and opened more than 5,500 stream miles. Using the average of achieved results to date, the NOAA RC expects to restore about 6,600 acres per year, and open more than 240 miles of stream habitat each year. At the local or regional level where these restoration activities would take place, coastal ecosystems would experience greater biological diversity and coastal communities would benefit from improved ecological functions in restored areas. However, it is important to note for context that since European settlement, nationwide, roughly more than 110 million acres of wetlands are estimated to have been lost from conversion to agriculture, logging, transportation, flood protection, and development uses (Fretwell et al. 1996; Dahl 2010).

To date, the NOAA RC has completed an average of about 200 projects per year through direct grants, sub-awards, and contracts. The number of projects supported per year will fluctuate depending on priorities determining the structure of funding competitions and the number and size of Natural Resources Damage Assessment (NRDA) settlements. For example, historically for the NOAA RC's grant programs, the NOAA RC has used grants to non-profits and state and local agencies to make sub-awards to implement the activities described in the preferred alternative, which generally meant that NOAA was contributing fewer dollars to more projects. The number of projects supported by the NOAA RC will likely be reduced as the office shifts toward larger-scale projects. The NOAA RC anticipates restored acres will not decrease, because the overall scope of such projects would likely be greater, provided that annual appropriations are not substantially decreased. A case in point demonstrates this. With $10.8 million of FY 2013 funds, the NOAA RC's CRP supported restoration projects at 37 project sites. These projects (when fully funded) are anticipated to restore approximately 15,000 acres through 2016. In FY 2010, $7 million supported 115 projects, which resulted in just over 3,600 acres restored by 2013.

By definition, cumulative impacts analyses for NEPA documents must also include a consideration of the reasonably foreseeable future activities and impacts from NOAA and non-NOAA groups alike within the affected environment. Various impacts from other physical activities may occur at or near project sites, which could potentially have an additive effect on those that occur during a restoration action implementing the preferred alternative. Attempting to analyze such specific actions for every potential project site or location within the affected environment at a programmatic level would be neither realistic nor informative in determining actual cumulative impacts, especially when project site-specific impact analyses are conducted for each restoration project supported by the NOAA RC during the award or NRDA settlement process. Below is a list of reasonably foreseeable future actions that may contribute negatively or positively to a cumulative effect to the natural or human environment within or surrounding a project site:

- Other ongoing habitat restoration projects conducted by other agencies or groups. For example, an upstream dam removal project could impact a downstream restoration site during construction, thus causing a cumulative impact to be realized. Such a removal could also improve the long-term viability of downstream habitat and the beneficial impact of downstream projects.
- Coastal development in the United States has increased steadily since the 1960s. There are only 254 counties (out of 3,142 total nationwide) situated on the coast, yet these counties

contain almost a third of the U.S. population (U.S. Census Bureau 2010) and are home to intense concentrations of economic and social activity. Degradation or development of existing natural areas, or disruption of natural processes through increased human activity, all have the potential to impact the affected area and specifically project sites and resources during implementation of the preferred alternative or after restoration has been completed.

- Natural disasters and climate-related impacts could cause major devastation to coastal communities and natural resources. Hurricanes Katrina (2005) and Sandy (2012) are recent examples of not only the large-scale physical damage to the natural and human environment that can result, but of how government agencies (federal, state, and local) and citizens mobilize resources and shift priorities to address impacted areas. A shift in priorities, as well as the physical degradation or damage to natural resources, could have a meaningful impact on how the preferred alternative is implemented. Similarly, changes in weather patterns or other meteorological shifts may impact project sites and ultimately change where and when the preferred alternative is implemented. For example, extended drought may nullify the efforts of watershed revegetation and in-stream habitat construction projects, and changes in ocean conditions may modify migratory fish behavior.
- There are inherent uncertainties about restoration project locations and timing within the DARRP. It is not possible to know in advance where a release of oil or hazardous substances will occur that results in natural resource injuries that will require restoration. The timing of reaching settlements or recovering damages in litigation is also not predictable, as it varies case by case.
- Natural resource management regimes may shift to include greater or fewer species being proposed or listed under the Endangered Species Act (and subsequently their critical habitat designations) or within fishery management plans (and subsequently their essential fish habitat designations).
- Public and private funding availability that is normally used to implement restoration may expand or contract. Depending on how such changes come to pass could impact the areas in which the preferred alternative is implemented.
- State environmental conservation programs that regularly conduct on-the-ground projects within the affected environments of the proposed action could contribute to a cumulative effect. Fish stocking, invasive species removal, land acquisition, and stormwater management actions performed by state programs may enhance the benefits of a restoration project. Conversely, state programs may choose their area of activity based on NOAA restoration activities. For example, several New England states stock river herring in watersheds where NOAA has conducted dam removals.

4.9.2 Climate Change

The restoration activities analyzed in this document are particularly relevant to the discussion of carbon emissions and climate change science and its practical application in environmental restoration and conservation. The release of carbon and other greenhouse gasses into the atmosphere is due to a number of causes, most notably the combustion of fossil fuels and the destruction of ecological "carbon sinks"—ecosystems that absorb or contain more carbon than they emit. In the context of habitat restoration, a carbon sink could be coastal and freshwater wetlands, salt marshes, mangroves and SAV beds, the associated biomass for these habitats, or even the ocean itself—all environments that NOAA RC activities work to restore, enhance, rehabilitate, reestablish, or protect. Sequestered carbon is an important concept in assessing the impacts of habitat restoration, because many of the habitats described in Section 3.1 - Coastal Habitats as part of the affected environment of this analysis do serve as carbon sinks and therefore their restoration or protection from damage, degradation, or outright conversion/development either prevents greenhouse gas emissions, or conversely increases the capacity of the habitat to further sequester carbon. Ultimately the goal of these activities is to improve the functionality of ecosystems to where their carbon sequestration potential is enhanced, or protected.

In addition to carbon sequestration, the restoration activities described in Section 2.2 also enhance the physical resiliency of coastal ecosystems to withstand the effects of climate change and sea level rise. There is general agreement within the scientific community that sea levels have been rising over the past century, and at an increasing rate (Merrifield et al. 2012). The two main causes of sea level rise—meltwater from glaciers and ice sheets, and volumetric expansion (due to rising water temperatures)—both observed since the introduction of satellite-based global sea level observations, can have a direct impact on the affected environments outlined in this document and in which the NOAA RC will implement the proposed action. In fact, the U.S. Geological Survey's Coastal Vulnerability Index (which takes into account erosion rates, coastal geomorphology, historic sea level rise rates, regional coastal slope, and tide range and wave height of a given coastal area) indicates that more than 11,200 miles (roughly 50 percent) of coastline in the United States has a high or very high sea level rise vulnerability index ranking (USGS 2011). Coastal environments by their very nature experience the most direct and immediate impacts of rising sea levels. Those impacts can fundamentally change ecosystem functionality by inundating habitat; altering tidal flow patterns, sediment transport, and vertical accretion rates; eroding shorelines; changing tidal amplitudes; and disrupting plant and animal composition and use (Cahoon et al. 2009). Similarly, changes in precipitation and global meteorological patterns can impact project sites and affect where NOAA implements the preferred alternative. Although predicting exactly how sea level rise and other climate-related impacts will translate at the local and regional level is difficult, global trends do suggest that this impact merits serious consideration in coastal management decisions and, more specifically, project planning and design and program prioritization (NMFS 2011).

4.10 Relationship of Short-Term Uses and Long-Term Productivity

The proposed action described in Section 1.1 and the preferred alternative described in Section 2.2 would, in general, affect short-term impacts to many resources because of short-term construction and implementation activities. However, the short-term impacts and uses would lead to a higher level of long-term resource productivity. The long-term productivity would result from proposed habitat restoration activities, proposed land use changes, and proposed cleanup and remediation, and indirectly from public education programs and other technical assistance activities.

4.11 Irreversible and Irretrievable Commitments of Resources

Although the proposed action described in Section 1.1.1 and the preferred alternative described in Section 2.2 would commit specific sites to a long-term conversion of land use (through habitat restoration, land and easement acquisition, and changes to public access), only some of the activities or their impacts would be irreversible and irretrievable. Habitat restoration would involve the removal of specific types of vegetation (mostly invasive species) in favor of natural vegetation. Land and easement acquisition and enhancement of public access would change the long-term land use for some parcels of land. This land use could be changed again in the future if necessary, and is therefore not irreversible. The potential destruction of cultural resources during restoration implementation could occur and would therefore be irreversible; however, appropriate coordination with state or tribal agencies would take place on a project-by-project basis to avoid this scenario.

The restoration activities outlined in the preferred alternative generally would require the commitment of time, money, human effort, and the use of fossil fuels. Such activities would be irreversible and irretrievable.

4.12 Compliance with All Applicable Environmental Laws and Regulations

The following is a list of general, federal environmental regulations that are likely to apply to proposed projects, as well as a description of compliance by NOAA with applicable regulations. Other federal- or state-level regulations may apply on a project-specific basis, and NOAA and its partners consider and comply with all other applicable regulations for specific projects as well. Some project types are not likely to be selected for funding if they trigger other regulatory considerations.

Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990, reauthorized by the National Invasive Species Act (NISA) in 1996: Establishes the Aquatic Nuisance Species Task Force (ANSTF), which is an intergovernmental organization dedicated to preventing and controlling aquatic invasive species and coordinating government efforts in this regard with those of the private sector and other North American interests. The Undersecretary of Commerce for Oceans and Atmosphere and the Director of the Fish and Wildlife Service are the ANSTF Chairpersons.

Clean Water Act (CWA): The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's water. Many restoration activities supported by NOAA require a permit under Section 404 of the CWA. Under a 1989 memorandum of agreement on federal enforcement of Section 404 of the CWA between the U.S. Army and EPA, a permit is required for the removal of less than one-third acre of wetlands and that mitigation measures may be required for removal or disturbance of more than one-third acre of wetlands. NOAA staff examine each project for compliance with the CWA and incorporate the information into environmental compliance documentation and decision-making.

Coastal Zone Management Act (CZMA): The CZMA provides for protection of resources found in the coastal zone, proactive land management practices, and preservation of unique coastal resources.

Restoration activities supported by NOAA would be consistent with the enforceable policies of approved state coastal management programs (CMP). The regions consider compliance with the CZMA on a project-level basis.

Endangered Species Act (ESA): The ESA requires all federal agencies, in consultation with the Departments of the Interior (USFWS) and Commerce (NMFS), to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of such species.

Most habitat restoration projects are located in coastal or riparian areas. Project implementation windows and BMPs are used to avoid potential impacts to federally protected listed and candidate species managed under the ESA. For any project with a potential for impacts to federally protected species, NOAA evaluates the potential impacts and, if needed, prepares a biological assessment to determine the significance. For any project with a potential to impact federally protected species or critical habitat, NOAA will first determine whether (1) the project type and affected species or habitat are included in an existing programmatic Biological Opinion and (2) the project can be implemented according to the requirements of that Opinion. If both of these conditions are met, a new ESA consultation will not be initiated. If the above conditions cannot be met, depending on the potential impacts NOAA will initiate either formal or informal ESA consultation.

NOAA must consult with the USFWS or NMFS and consider their response(s) prior to making a final decision on project implementation. If either the USFWS or NMFS issues a Biological Opinion, and recommends any reasonable and prudent measure or terms and condition for protecting species or specific critical habitat, NOAA must ensure that the effects are appropriately avoided, minimized, or mitigated with the use of special award conditions. All ESA consultations are included in the Project Record. If the proposed project plans cannot fully incorporate all impact avoidance measures or if new information becomes available that affects the basis for the determination of "not likely to affect," then supplemental consultation will be undertaken prior to project implementation.

Potential impacts to threatened and endangered species are described in Section 4.7. Impacts are generally considered according to the following species types: fish, terrestrial mammals, marine mammals, birds, amphibians, reptiles, sessile invertebrates, mobile invertebrates, and plants.

Estuary Protection Act: The Estuary Protection Act ensures conservation of sensitive estuary ecosystems and habitats through sound management of estuary resources.

By intent, activities supported by NOAA have no long-term adverse impacts on any estuary, and are conducted specifically to result in long-term or permanent beneficial impacts, by funding projects that help to restore and improve habitats within estuaries. Consequently, the NOAA RC restoration activities fundamentally support the stated purposes of this act to protect, conserve and restore these areas.

Executive Order 11990, Protection of Wetlands: The intent of Executive Order 11990 is to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support for new construction in wetlands whenever there is a practicable alternative.

Generally, restoration activities supported by NOAA do not have an adverse impact on any wetlands, and usually result in beneficial impacts, as individual projects would help to restore and improve some habitats within wetlands. NOAA regional staff considers any impacts to wetlands on a project-level basis, as described above for the CWA.

Executive Order 11988, Floodplain Management: Executive Order 11988 requires each agency (including military departments) to "avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative."

Generally, restoration activities supported by NOAA have no adverse impacts on floodplains and, when conducted within floodplains, they intentionally result in long-term or permanent beneficial impacts withal projects that help to restore and improve habitats within floodplains. However, review for compliance with this legislation follows the guidance set forth in NOAA implementing procedures (DOC 2012).

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations: Executive Order 12898 directs that the programs of federal agencies identify and address disproportionately high and adverse effects on human health and the environment of minority or low-income populations.

Restoration activities supported by NOAA help to ensure the enhancement of environmental quality for all populations in the United States. Generally, activities under this program do not have an adverse impact on any minority or low-income population, and result in long-term or permanent beneficial impacts by funding projects that restore and improve coastal or marine habitats, which provides employment opportunities and results in improved ecosystem services to coastal inhabitants.

Executive Order 13089, Coral Reef Protection: Requires that all federal agencies whose actions may affect U.S. coral reef ecosystems in federal, state, territorial, or commonwealth waters shall: subject to the availability of appropriations, provide for implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. To the extent not inconsistent with statutory responsibilities and procedures, these measures shall be developed in cooperation with the U.S. Coral Reef Task Force and fishery management councils and in consultation with affected states, territorial, commonwealth, tribal, and local government agencies, nongovernmental organizations, the scientific community, and commercial interests.

Executive Order 13112, Invasive Species: Directs federal agencies to take actions to enhance prevention and control of invasive species. Specifically the Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them. Finally, E.O. 13112 states that federal agencies have an affirmative duty to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species.

Executive Order 13186, Migratory Birds: On January 10, 2001, President Clinton signed Eexecutive Order (EO) 13186, ''Responsibilities of Federal Agencies to Protect Migratory Birds''. One of the requirements of E.O. 13186 is that each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement a MOU with the FWS that shall promote the conservation of migratory bird populations (E.O. 13186 Section 3(a)). On July 17, 2012, NMFS and FWS finalized this MOU to conserve migratory bird populations as prescribed by E.O. 13186. This MOU went into effect on the date it was signed.

This NMFS–USFWS MOU encompasses all relevant seabird-related NMFS activities and identifies specific areas of collaboration and cooperation with USFWS, including seabird bycatch reduction, information sharing and coordination, international policy and diplomacy, and habitat conservation. The MOU also provides for strengthening migratory bird conservation by identifying strategies that promote conservation and reduce adverse impacts on migratory birds through enhanced collaboration between NMFS and the USFWS. In addition, this MOU identifies specific activities where cooperation between NMFS and the USFWS, will contribute to the conservation of migratory birds and their habitat. These activities are intended to complement and support existing efforts and to facilitate new collaborative conservation efforts for migratory birds. The NOAA RC will consider impacts to seabirds, as it does with all protected species impacts.

Fish and Wildlife Coordination Act, as amended in 1964: Requires that all federal agencies consult with NMFS, U.S. Fish and Wildlife Service, and state wildlife agencies when proposed actions might result in modification of a natural stream or body of water. Federal agencies must consider effects that these projects would have on fish and wildlife development and provide for improvement of these resources. The Fish and Wildlife Coordination Act allows NMFS to provide comments to the U.S. Army Corps of Engineers during review of projects under §404 of the Clean Water Act (concerning the discharge of dredged materials into navigable waters) and §10 of the Rivers and Harbors Act of 1899 (obstructions in navigable waterways). NMFS comments provided under the Fish and Wildlife Coordination Act are intended to reduce environmental impacts to migratory, estuarine, and marine fisheries and their habitats.

Magnuson-Stevens Fishery Conservation and Management Act (MSA), Reauthorized by the Sustainable Fisheries Act of 1996: Congress enacted the Magnuson-Stevens Act to provide the Secretary of Commerce, by and through NMFS, authority to regulate domestic marine fisheries in need of conservation and management. Federal fisheries management is accomplished through

Fishery Management Plans (FMPs) developed and prepared by regional Fishery Management Councils (or the Secretary through NMFS where appropriate) and approved, implemented, and enforced by NMFS. Each FMP must identify essential fish habitat (EFH) for the fishery and minimizing adverse fishing impacts to the extent practicable. In addition, Federal agencies must consult with NMFS on any action that may adversely impact EFH. Activities implemented by the NOAA RC would support the goals of this legislation by restoring and protecting EFH and contributing to the conservation and management of these species.

Each region conducts programmatic EFH consultations or combined regional Biological Opinion and EFH consultation to achieve compliance with applicable EFH regulations. The programmatic EFH consultations are kept as part of NOAA Program Records.

Marine Mammal Protection Act of 1972 (MMPA): In passing the MMPA, Congress provided for their protection and encouraged the development of sound resource management policies that maintain the health and stability of the marine ecosystem. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States.

As with projects with the potential to impact endangered species (see above), NOAA works closely with NMFS on coastal and marine projects to ensure there is no risk of take, harassment, or other interaction with marine mammals.

National Historic Preservation Act of 1966 (NHPA): The NHPA, amended in 1992, requires that responsible agencies taking action that potentially affects any property with historic, architectural, archeological, or cultural value that is listed on or eligible for listing on the National Register of Historic Places comply with the procedures for consultation and comment issued by the Advisory Council on Historic Preservation. The responsible agency also must identify properties affected by the action that are listed on or potentially eligible for listing on the NRHP, usually through consultation with the State Historic Preservation Officer (SHPO).

Section 106 of the NHPA defines requirements and policy for the preservation, restoration, and maintenance of the historic and cultural environment of the United States. NOAA complies with Section 106 of NHPA by conducting project-by-project consultations. It is NOAA or its designee's process to consult with SHPOs and/or Tribal Historic Preservation Officers (THPOs) on project types that may impact cultural or historic resources.

National Marine Sanctuaries Act (NMSA): Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries.

Restoration activities supported by NOAA involving proposed actions in marine sanctuaries regulated under this act maintain full compliance with the applicable statutory and regulatory guidelines. The NOAA RC consults with the Office of National Marine Sanctuaries whenever a restoration project is to occur within such boundaries to ensure that no restoration action would destroy, cause the loss of, or injure a sanctuary resource.

Rivers and Harbors Act of 1899: The Rivers and Harbors Act of 1899 regulates the following: (1) construction of bridges, causeways, dams, or dikes; (2) obstruction of excavations and filling of navigable waters (generally, construction of wharves, piers, and similar structures); (3) establishment of harbor lines and conditions related to grants for the extension of piers; and (4) penalties related to the regulated actions, and to the removal of existing structures.

Restoration activities supported by NOAA involving proposed actions regulated under this act maintain full compliance with the applicable statutory and regulatory guidelines. Dam removal projects are of specific importance to the NOAA RC. In addition to the specific regulatory concerns under this act, many states also have regulatory standards related to the removal of dams. The NOAA RC examines these considerations on a project-level basis.

List of Preparers

The core Interdisciplinary Team for this analysis consists of the NOAA RC's Environmental Compliance team, which is made up of technical experts and restoration practitioners from all regions of the NOAA RC. Roles, contributions, and expertise are summarized for the team below. This team provided the majority of brainstorming, drafting of analysis, and technical review. However, the team greatly appreciates the input provided by other individuals from within the NOAA RC and from other offices, who participated in the review and development of this document.

Name	Role	Professional Discipline/Contribution	Degrees	Years of Experience
Barry, Tom	Interdisciplinary Team Member – CRP	Draft PEIS document preparation, editing and coordination; technical review; marine debris issues	M.A., Marine Affairs, University of Miami B.A., International Affairs, University of Colorado	5
Benson, Kristopher	Interdisciplinary Team Member – Southeast Region	Draft PEIS document preparation, editing and coordination with SE NOAA RC staff; technical review; southeast region habitat types and issues	M. Marine Resource Management, Texas A&M University B.S., Marine Biology, Texas A&M University	11
Gange, Melanie	Interdisciplinary Team Member - CRP	Draft PEIS document preparation, editing and coordination; technical review; wetland restoration issues	M. Environmental Management, Coastal Environmental Management, Duke University B.S., Biology/Ecology, Florida Institute of Technology	12
Hilgart, Megan	Interdisciplinary Team Member – Northwest Region	Draft PEIS document preparation, editing and coordination with NW NOAA RC staff; technical review; focus on fish passage and hydrologic reconnection projects	B.S., Oceanography, University of Washington	15
Hutchins, Eric	Interdisciplinary Team Member – Northeast Region	Draft PEIS document preparation, editing and coordination with GARFO staff; technical review; permit review and restoration project management	M.A., Marine Affairs, University of Rhode Island B.S., Fisheries and Wildlife Biology, University of Massachusetts	20

Landsman, David	Interdisciplinary Team Member – DARRP	Project management, program oversight; marine and coastal conservation	M.S., Natural Resource Management, University of Washington B.S., Biology, Duke University	13
MacMillan, Eric	Interdisciplinary Team Member - CRP	Draft PEIS document preparation, and editing; technical review; fish passage, stock enhancement	M.S., Fisheries and Wildlife, Michigan State University B.A., Biology, Willamette University	3
Mahan, Leah	Interdisciplinary Team Member – Southwest Region	Draft PEIS document preparation, editing and coordination with SW NOAA RC staff; technical review; water conservation and in-stream restoration issues (Botanical surveys, riparian restoration, fish passage restoration)	M.S., Botany, California State University, Chico B.S., Biology/Ecology, California State University, Chico	18
Shenot, Jeff	Interdisciplinary Team Member - CRP	Draft PEIS document preparation, editing and coordination; technical review; oversight	M.S., Marine, Estuarine, and Environmental Sciences, University of Maryland B.S., Wildlife and Fisheries Management (dual major), Frostburg State University	21
Schnabolk, Howard	Interdisciplinary Team Member – Southeast Region	Coordination of technical review of Southeast habitats and techniques; fish passage and hydrologic restoration	M.P.A, Earth Systems Sciences, Columbia University B.S., Natural Resources Planning, Humboldt State University	10
Sims, Julie	Interdisciplinary Team Member – Great Lakes Region	Draft PEIS document preparation, editing and coordination; technical review; Great Lakes issues	M.S., Natural Resource Management B.S., Environmental Biology and Zoology, Michigan State University	10

List of Agencies, Organizations, and Persons to Whom Copies of the Statement Were Sent

The following list of Agencies, Organizations, and Persons received a copy of the Draft PEIS and were given the opportunity to comment. The NOAA RC received comments from some of the listed agencies, and those comments are reflected in Appendix B below.

Section 1.3 - Public Involvement above describes the scoping process and solicitation of public comments for this document.

- National Marine Fisheries Service, Headquarters – Office of Habitat Conservation, Habitat Protection Division
- National Marine Fisheries Service, Headquarters – Office of Protected Resources
- National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office – Office of Protected Resources
- NOAA Office of General Counsel - Natural Resources Section
- National Ocean Service – Coral Reef Conservation Program
- National Ocean Service – Office of Response and Restoration
- National Ocean Service – Office of Ocean and Coastal Resource Management
- National Ocean Service – Office of National Marine Sanctuaries

Glossary

100-Year Floodplain – A regulatory designation of lands within the boundaries of a flood that statistically has a 1% chance of occurring in a given year.

Adaptive Management – A type of management in which, as an ongoing process, the monitoring of results of management decisions, in relation to sustaining ecosystem characteristics and changes in societal goals, is used to modify management approaches.

Affected Environment – The baseline environment of the relative resource components.

Algae – Non-vascular plants that are very small; algae are the main producers of food and oxygen in aquatic environments.

Alluvial Plain – The floodplain of a river, where the soils are deposited by the overflowing river.

Alluvium – Any sediment deposited by flowing water, as in a riverbed, floodplain, or delta.

Analysis Area – The geographical boundary of the area to be analyzed.

Aquatic – Pertaining to standing and running water in streams, rivers, lakes, and ponds; living or growing in or on water.

Attainment Areas – Geographic areas where air pollution levels remain consistently below the National Ambient Air Quality Standards (see *National Ambient Air Quality Standards*).

Backwater – A body of water in which the flow is slowed or turned back by an obstruction such as a bridge or dam, an opposing current, of the movement of the tide.

Benthic – On the bottom or near the bottom of streams, lakes, or oceans.

Best Management Practices (BMP) – A practice or combination of practices that is determined by a state (or designated wide-area planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biodiversity – The diversity of life in an area, including the diversity of genes, species, plant and animal communities, ecosystems, and the interaction of these elements.

Biofouling – The attached and associated free-living organisms found on aquatic structures.

Biological Diversity – The variety and abundance of life forms, processes, functions, and structures, including the relative complexity of species, communities, gene pools, and ecosystems at spatial scales that range from local through global.

Biological Opinion (BiOp) – An official report by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service issued in response to a formal request for consultation or conference. It states whether an action is likely to result in jeopardy to a species or adverse modification of its critical habitat.

Brackish – Water with a salinity intermediate between seawater and freshwater, often referred to as oligohaline (salinity 0.5 to 5.0 ppt). Interlacing or tangled network of several small branching and reuniting shallow channels are also often present.

Brackish Marsh – Marsh areas containing a mixture of saltwater and freshwater; however, the salinity level is less than seawater.

Calcareous – Sediment or soil formed of calcium carbonate or magnesium carbonate due to biological deposition or inorganic precipitation.

Carbon Monoxide (CO) – A poisonous gas that, when introduced into the bloodstream, inhibits the delivery of oxygen to body tissue. Exposure creates a severe health risk to individuals with cardiovascular disease. The largest manmade source of CO is motor vehicle emissions. This pollutant is a health concern in areas of high traffic density or near industrial sources.

Catchment – The land area drained by a river or stream; also known as "watershed" or "drainage basin"; the area is determined by topography that divides drainage between watersheds.

Coastal Habitat Restoration – The process of reestablishing a self-sustaining habitat in coastal areas that in time can come to closely resemble a natural condition in terms of structure and function.

Coastal Habitat Restoration Monitoring – The systematic collection and analysis of data that provides information useful for measuring coastal habitat restoration project performance.

Coastal United States – geographic regions of the United States and territories that encompass oceans and coasts, bays, estuaries, rivers and the Great Lakes.

Code of Federal Regulations (CFR) – A codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the Federal Government. The Code is divided into 50 titles that represent broad areas subject to federal regulations. Each title is divided into chapters, which usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas.

Community – All the groups of organisms living together in the same area, usually interacting or depending on each other for existence; all the living organisms present in an ecosystem.

Connected Actions other free-moving organisms.

Cooperative Agreement – An award of financial assistance that is used to enter into the same kind of relationship as a grant; and is distinguished from a grant in that it provides for substantial involvement between the federal agency and the recipient in carrying out the activity contemplated by the award.

Coral Reefs – Highly diverse ecosystems, found in warm, clear, shallow waters of tropical oceans worldwide. They are composed of marine polyps that secrete a hard calcium carbonate skeleton, which serves as a base or substrate for the colony.

Cultural Resources (Heritage Resources) – The tangible and intangible aspects or cultural systems, living or dead, that are valued by a given culture or which contain information about the culture. Cultural resources include but are not limited to sites, structures, buildings, districts, and objects associated with or representative of people, cultures, and human activities and events. Cultural resources are commonly discussed as prehistoric and historic values, but each period represents a part of the full continuum of culture values from the earliest to the most recent.

Cumulative Impacts – The impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant action taking place over a period of time (40 CFR 1508.7).

Demersal – Bottom-feeding or bottom-dwelling fish, crustaceans, and other free moving organisms.

Diatoms – Any of a class (Bacillariophyceae) of minute planktonic unicellular or colonial algae with silica-based skeletons. – Management practices or actions that (1) automatically trigger other actions that may require environmental impact statements, (2) cannot or would not proceed unless other actions are taken previously or simultaneously, or (3) are interdependent parts of a larger action and depend on the larger action for their justification.

Downwelling – The process of build-up and sinking of warm surface waters along coastlines.

EA – See *environmental assessment*.

Ebb – A period of fading away; low tide.

Ecosystem – A conceptual unit comprising organisms interacting with each other and their environment having the major attributes of structure, function, complexity, interaction and interdependency, temporal change, and no inherent definition of spatial dimension.

EIS – See *environmental impact statement*.

Emergent Plants – Aquatic plants with roots and part of the stem below water level, but with the rest of the plant above water (examples: cattails and bulrushes).

Endangered Species – Any species that is in danger of extinction throughout all or a significant part of its range. Endangered species must be designated in the *Federal Register* (see *threatened species*).

Environmental Assessment (EA) – A concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or to return a finding of no significant impact, aids an agency's compliance with NEPA when no Environmental Impact Statement is necessary, or facilitates preparation of a statement when one is necessary (see *environmental impact statement*).

Environmental Consequences (Effects or Impacts) – The physical, biological, social, and economic results (positive or negative) of implementing a given alternative.

Environmental Impact Statement (EIS) – A formal document to be filed with the Environmental Protection Agency that considers significant environmental impacts expected from implementation of a major federal action (see *environmental assessment*).

Erosion – The wearing away of the land surface by running water, wind, ice, and other geological agents. The detachment and removal of soil from the land surface by wind, water, or gravity.

Essential Fish Habitat – defined in the Magnuson-Stevens Act as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The rules promulgated by the NMFS in 1997 and 2002 further clarify EFH with the following definitions:

- *waters* - aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate;
- *substrate* - sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem;
- *and spawning, breeding, feeding, or growth to maturity* - stages representing a species' full life cycle.

Estuary – A part of a river, stream, or other body of water that has at least a seasonal connection with the open sea or Great Lakes and where the seawater or Great Lakes mixes with the surface or subsurface water flow, regardless of the presence of manmade structures or obstructions.

Eulittoral – Refers to that part of the shoreline situated between the highest and lowest seasonal water levels.

Exotic Species – Plants or animals not native to the area.

Fauna – The animal community in a given region or period.

Federal Register – A daily federal publication that publishes regulations and legal notices that have been issued by federal agencies.

Fetch – The distance along open water or land over which the wind blows.

Flora – The plant community in a given region or period.

Fluvial – Of, relating to, or living in a stream or river.

Fronds – Leaf-like structures of kelp plants.

Function – Refers to how wetlands and riparian areas work—the physical, chemical, and biological processes that occur in these settings, which are a result of their physical and biological structure regardless of any human benefit.

Gastropods – Any of a large class (Gastropoda) of mollusks (e.g., snails and slugs) usually with a single shell or no shell and a distinct head bearing sensory organs.

Grant – An award of financial assistance, the principal purpose of which is to transfer a thing of value from a federal agency to a recipient to carry out a public purpose of support or stimulation authorized by a law of the United States (see 31 U.S.C. 6101(3)). A grant is distinguished from a contract, which is used to acquire property or services for the federal government's direct benefit or use.

Habitat – The natural environment of a plant or animal. An animal's habitat includes the total environmental conditions for food, cover, and water within its home range.

Habitat Capability – The ability of the vegetative community to provide food, cover, and water for wildlife.

Heritage Resources – See *cultural resources*.

Historic properties - any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places.

Holdfast – kelp's rootlike structure that wraps around substrate to anchor the growing alga

Hydric Soils – A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. Field indicators of hydric soils can include a thick layer of decomposing plant material on the surface; the odor of rotten eggs (sulfur); and colors of bluish-gray, gray, or black, with occasional contrasting brighter spots of color.

Indicator Species – A species whose presence in a certain location or situation at a given population level indicates a particular environmental condition or management endpoint. Populations of indicator species are typically monitored to indicate effects of management activities on a number of other species or water quality.

Infauna – Plants that live in the sediment.

Infiltration – The process by which water passes through the soil surface.

Interdisciplinary (ID) Team – A group of two or more individuals with different training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to solve the problem. The members of the team proceed to solution with frequent interaction so that each discipline may provide insights to any stage of the problem and disciplines may combine to provide new solutions.

Intermittent Stream – A stream that flows seasonally (10 to 90 percent of the time) in response to a fluctuating water table, with a scoured channel that is at least 3 feet wide.

Interpretive Site – A developed recreation site where natural and/or cultural history is described for the enjoyment and education of the public.

Intertidal – An area that is alternately flooded and exposed by tides.

Intralittoral – A sub-area of the sublittoral zone where upward-facing rocks are dominated by algae (mainly kelp).

Invasive Species – A species that does not naturally occur in a specific area and whose introduction is likely to cause economic or environmental harm.

Issue – A subject or question of widespread interest identified through public participation and that relates to the management of natural resources. A matter of controversy or dispute over resource management activities or land use that is well-defined or topically discrete. Usually the causal relationship between the activity or use and the undesirable results are well-defined or able to be documented. Statement of the planning issues orients the management planning process.

Lacustrine – Pertaining to, produced by, or formed in a lake.

Lagoons – A shallow stretch of seawater (or lake water) near or open to the sea (or lake) and partly or completely separated from it by a low, narrow, elongate strip of land.

Land Condition – The state of a given area in terms of the quality of its physical and biological character and use. Land conditions can be existing, future, or desired.

Land Management – An intentional process of planning, organizing, programming, coordinating, directing, and controlling land use action.

Land Use – The occupation or reservation of land or water area for any human activity or any defined purpose.

Landscape – A viewed area of land generally of large size and commonly a mosaic of landforms and plant communities irrespective of ownership or other artificial boundaries.

Littoral – Refers to the shallow water zone (less than 2 meters deep) at the end of a water body, commonly seen in lakes or ponds.

Macroalgae – Relatively shallow (less than 50 meters deep) subtidal algal communities dominated by very large brown algae. Kelp and other macroalgae grow on hard or consolidated substrates forming extensive three-dimensional structures that support a diversity of other plants and animals.

Management Direction – A statement of multiple-use and other goals and objectives, the management prescriptions, associated standards and guidelines, and action plans for attaining them.

Management Indicator Species – See *indicator species*.

Management Practice – A specific action or treatment.

Mangroves – Swamps dominated by shrubs that live between the sea and the land in areas inundated by tides. Mangroves thrive along protected shores with fine-grained sediments where the mean temperature during the coldest month is greater than 20 degrees Celsius, limiting their northern distributions.

Marine Polyps – The small living units of a coral, responsible for secreting calcium carbonate maintaining coral reef shape.

Marshes (Marine and Freshwater) – Transitional habitats between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water tidally or seasonally. Freshwater species are adapted to the short- and long-term water level fluctuations typical of freshwater ecosystems.

Mitigate – To make less severe through specific actions; to moderate in force or intensity.

Mitigation Measure – An action taken to lessen adverse impacts or enhance beneficial effects.

Mottling – Contrasting spots of bright colors in a soil; an indication of some oxidation or groundwater level fluctuation.

Mudflat – Bare, flat bottoms of lakes, rivers and ponds, or coastal waters, largely filled with organic deposits, freshly exposed by a lowering of the water level; a broad expanse of muddy substrate commonly occurring in estuaries and bays.

National Environmental Policy Act (NEPA) – Establishes a national policy to encourage productive and enjoyable harmony between humankind and the environment, to promote efforts that would prevent or eliminate damage to the environment and stimulate the health and welfare of humans, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality.

Native Species – Any species of flora or fauna that naturally occurs in the United States and that was not introduced by humans.

Nearshore – Nearshore waters beginning at the shoreline or the lakeward edge of the coastal wetlands and extending offshore to the deepest lakebed contour where the thermocline typically intersects with the lakebed in late summer or early fall.

NEPA Process – All measures necessary for compliance with the requirements of Section 2 and Title I of NEPA (40 CFR 1508.21).

NOAA Trust Resources – Commercial and recreational fishery resources, diadromous species (fish, like salmon, that spawn in fresh water and then migrate to the sea, or species like the American eel, that spawn in sea water and then migrate to fresh water), marine mammals, endangered and threatened marine species, the habitats of the aforementioned species (such as marshes, mangroves, seagrass beds, coral reefs, and other coastal habitats), and resources associated with National Marine Sanctuaries and National Estuarine Research Reserves.

Oligotrophic – A water body that is poor in nutrients; refers mainly to lakes, ponds, and some wetlands.

Oxbow – A U-shaped bend in a river.

Oyster Beds – Dense, highly structured communities of individual oysters growing on the shells of dead oysters.

Palustrine – Nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.

Pelagic – Pertaining to, or living in open water column.

Perennial Stream – A stream that flows year-round (more than 90 percent of the time) with a scoured channel that is always below the water line.

pH – A scale for measuring the amount of free hydrogen ions in a substance to determine acidity and alkalinity.

Phytoplankton – Microscopic floating plants, mainly algae that are suspended in the water column and are transported by wave currents.

Plankton – Plants and animals, generally microscopic, that float or drift in freshwater or saltwater.

Program Record – The Program Record contains the selection package for a funding solicitation, as well as any memos to the file created when selecting projects, or running NOAA's various programs. This is located typically in the NOAA headquarters office.

Project – An organized effort to achieve an objective identified by location, activities, outputs, effects, and time period and responsibilities for execution.

Project Record – The Project Record contains project-specific information such as proposals, progress reports, regulatory compliance information, etc. This is located with NOAA staff person who is primarily responsible for the project.

Rare Species – Any plant or animal that, although not presently threatened with extinction, is in such small numbers through its range that it may be endangered if its environment worsens; the "rare" category is a state, not federal, category.

Receiving Water Bodies – Lakes, estuaries, or other surface waters that have flowing water delivered to them.

Record of Decision (ROD) – The decision documentation for an EIS, including the date and a statement of reasons for the decision.

Resource – Anything that is useful for something, be it animal, vegetable, or mineral; a location; a labor force; or other commodity. Resources, in the context of land use planning, vary from commodities such as timber and minerals to amenities such as scenery or scenic viewing points.

Restoration – The process of reestablishing a self-sustaining habitat that in time may come to closely resemble a natural condition in terms of structure and function.

Restoration Monitoring – The systematic collection and analysis of data that provides information useful for measuring restoration project performance at a variety of scales (locally, regionally, and nationally).

Riparian – A form of wetland transition composed of multiple habitats and located between permanently saturated wetland and upland habitats. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence.

Riparian Areas – Geographically delineated areas with distinctive resource values and characteristics that are composed of the aquatic and riparian ecosystems, flood plains, and wetlands. They include all areas within a horizontal distance of 100 feet from the edge of perennial streams or other water bodies.

Riparian Ecosystem – A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem, which is identified by soil characteristics and distinctive vegetation communities that require free or unbound water.

Riverine – Associated with rivers.

Riverine Forests – Forests found along sluggish streams, drainage depressions, and in large alluvial floodplains.

Rock Bottom – All wetlands and deep-water habitats with substrates having a cover of stones, boulders, or bedrock 75 percent or greater, and vegetative cover of less than 30 percent.

Rocky Shoreline – Extensive littoral habitats on wave-exposed coasts; the substrate is composed of boulders, rocks, or cobble.

Runoff – That part of precipitation, as well as any other flow contributions, that appears in surface streams, either perennially or intermittently.

Salinity – The concentration of dissolved salts in a body of water, commonly expressed as parts per thousand.

Salt Pan – An undrained natural depression in which water gathers and leaves a deposit of salt upon evaporation.

Scoping – The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping is an integral part of environmental analysis. Scoping includes eliciting public comments on the proposal, evaluating concerns, and developing alternatives for consideration. Depending on the complexity and nature of the action, scoping varies from a brief consideration of a few pertinent factors in a proposed action that may be categorically excluded to full compliance with the Council of Environmental Quality direction for a proposed action that must be documented in an environmental impact statement.

Sediment – Organic matter or soil that settles to the bottom of a liquid.

Sensitive Species – Those plant and animal species for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Soft Bottom – Loose, unconsolidated substrate characterized by fine- to coarse-grained sediment.

Soft Shoreline – Sand beaches and muddy shores; stretches of land covered by loose material, exposed to and shaped by waves or wind.

Species – A fundamental category of plant or animal classification.

Standard – A principle requiring a specific level of attainment; a rule to measure against.

Strand – A diffuse freshwater stream flowing through a shallow vegetated depression on a gentle slope.

Stream – A channel with defined bed and a bank that carries enough water flow at some time during the year to flush out leaves.

Submerged Aquatic Vegetation (SAV; Marine, Brackish, and Freshwater) – Flowering plants that grow on soft sediments in sheltered shallow waters of estuaries, bays, lagoons, and lakes. Freshwater species are adapted to the short- and long-term water level fluctuations typical of freshwater ecosystems.

Subtidal – Continuously submerged areas affected by ocean tides.

Supersaturation – When a solution (e.g. water in a river) has an abnormally high concentration of dissolved gasses than otherwise would occur under normal conditions.

Supralittoral Region – An area above the high tide mark receiving splashing from waves.

Surface Water – Rivers, lakes, ponds, streams, and so forth that are located above ground.

Thermocline – A horizontal region in a thermally stratified body of water that separates warmer oxygen-rich surface water from cold oxygen-poor deep water.

Threatened Species – Any species which is likely to become endangered within the foreseeable future and which has been designated in the *Federal Register* as threatened species (see *endangered species*).

Tide – The rhythmic, alternate rise and fall of the surface (or water level) of the ocean, and connected bodies of water, occurring twice a day over most of the Earth, resulting from the gravitational attraction of the moon, and to a lesser degree, the sun.

Tiering – The coverage of general matters in a broader environmental impact statement (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basin-wide program statements or, ultimately, site-specific statements), incorporating by reference the general discussions and concentrating solely on the issues specific to the subsequent statements or analyses as follows: (1) from a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site-specific statement or analysis; or (2) from an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues that are ripe for decision and exclude from consideration issues already decided on or not yet ripe (40 CFR 1508.28).

Unconsolidated – Loosely arranged.

Undertaking – a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval.

Water Column – A conceptual volume of water extending from the water surface down to, but not including, the substrate; found in marine, estuarine, river, and lacustrine systems.

Water Table – The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Watershed – An area of land with a single drainage network.

Wetlands – Those areas that are inundated by surface water or groundwater often enough to support plants and other aquatic life that requires saturated or seasonally saturated soils for growth and reproduction. Wetlands generally include swamps, marshes, and bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wildlife Habitat – The sum total of environmental conditions of a specific place occupied by a wildlife species or a population of such species.

Wildlife Structure – A site-specific improvement of a wildlife or fish habitat (e.g., spring development or a dugout to provide water, log placement in a stream for fish cover and pool creation, or nest box installation for birds).

Woody Debris –trees (or portions thereof – limbs, branches, rootwads) that fall naturally or are strategically placed within a river channel to enhance habitat availability to fish

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Index

American Recovery and Reinvestment Act of 2009, 2
Aquatic Nuisance Prevention and Control Act of 1990, 183
CERCLA. *See* Comprehensive Environmental Response, Compensation, and Liability Act
Clean Water Act, 67, 183
climate change
  affected environment, 77
    sea level rise, 66, 76
  corals, 39
  cumulative impacts, 181
  sea level rise, 59, 182
coastal development, ix, 39, 180
Coastal Wetland Planning, Protection, and Restoration Act, 1
Coastal Zone Management Act, 184
Community-based Restoration Program, 1, 15
  performance measures, 181
Comprehensive Environmental Response, Compensation, and Liability Act, 15
consultation, A-2
  cultural and historic resources, 187
  endangered species, 184
  Essential Fish Habitat, 187
CRP. *See* Community-based Restoration Program
CWA. *See* Clean Water Act
CWPPRA. *See* Coastal Wetland Planning, Protection, and Restoration Act
CZMA. *See* Coastal Zone Management Act
Damage Assessment, Remediation and Restoration Program, 1, 21
DARRP. *See* Damage Assessment, Remediation and Restoration Program
Endangered Species Act, 81, 164, 184
environmental justice
  Executive Order 12898, 185
ERA. *See* Estuary Restoration Act
ESA. *See* Endangered Species Act
Estuaries and Clean Waters Act of 2000. *See* Estuary Restoration Act
Estuary Protection Act, 184
Estuary Restoration Act, 19
flood control, 27, 53–55, 59
  Executive Order 11988, 185
impacts
  cumulative impacts, 170–82
  definition and types of, 86
  summary table, 94
international areas, 1, 171
invasive species
  Executive Order 13112, 185
  Hazard Analysis and Critical Control Point, 127, 132, C-2
  monitoring, 110, 126
laws. *See* regulations
monitoring
  activity description, 19
  electrofishing, 21, 32
  environmental consequences, xii, 109, 162
  evaluation and adaptive management, 19, 108
NANPCA. *See* Aquatic Nuisance Prevention and Control Act
National Historic Preservation Act of 1966, 187
NHPA, 187
Oil Pollution Act, 15
OPA. *See* Oil Pollution Act
regulations, 183–88
Rivers and Harbors Act of 1899, 188
scoping
  process, 11
  public comment summary, B-6
species enhancement, 33, 130
stocking. See species enhancement
wetlands
  Clean Water Act, 183
  climate change, 181
  Executive Order 11990, 185
  loss, ix, 82, 180
  restoration, 26, 53–61

Appendices

Appendix A - NOAA RC Project Award and Environmental Compliance Analysis Process

Appendix B - RC PEIS Scoping Comments

Table 40 - RC PEIS scoping comments summary

Appendix C - Mitigating Measures

Appendix D - National Inventory of Dams – Dam Purpose by Region

Appendix A. NOAA RC Project Award and Environmental Compliance Analysis Process

1. NOAA CRP and Related Grants Award Process

The NOAA RC has a number of ways to implement the restoration activities outlined in the alternatives presented in this PEIS. NOAA staff is available and can provide technical assistance to prospective project applicants, existing restoration partners, or other government agencies. On-the-ground coastal and riparian restoration activities can be implemented via competitive or non-competitive grants and cooperative agreements, competitive or non-competitive contracts, or strategic partnerships with external organizations. The majority of the NOAA RC's current and historic project portfolio has been implemented via cooperative agreements, sub-awards under cooperative agreements with funded partners, and less often, through grants and contracts.

Funding decisions of individual restoration actions are made primarily, as mentioned above, through competitive cooperative agreement, grant and contracting processes and public solicitations. During this process reviewers assess each application using published evaluation criteria specific to the given competition. The criteria may vary between competitions but are based on restoration priorities and strategies determined by the agency (NOAA) and the NOAA RC. Priorities may be as general as agency-wide planning focus areas (such as those provided in Annual Guidance Memoranda[10]), line office-level prioritization, or other restoration priorities.

Project information including information needed to complete NEPA review is generally gathered through a proposal process. For cooperative agreements awarded by NOAA, the process is as follows:

- The NOAA RC announces a Federal Funding Opportunity, which includes requirements for information pertaining to NEPA compliance[11].
- Applicant organizations prepare and submit proposal applications.
- Once the NOAA RC receives all applications and the deadline for submission of applications has expired, the NOAA RC evaluates each application based on the standard criteria for NOAA competitive grant programs. Standard criteria may evolve over time depending on the priorities of a given solicitation; however, the general categories (including importance and applicability of the proposal, technical and scientific merit, overall qualifications of the applicants, project costs, and community involvement considerations) typically remain intact. The technical and scientific merit section specifically references the adequacy of the information submitted to ensure NEPA compliance.
- The NOAA RC decides on a suite of projects to recommend for funding, based on the scores from the proposal evaluation.

[10] Annual Guidance Memoranda aim to focus agency attention on near-term execution challenges and a balanced implementation of NOAA's strategy across mission areas given our mandates, stakeholder priorities, and the fiscal outlook.

[11] Federal Funding Opportunities are published on Grants.gov and prior examples are on file with the CRP.

- The local NOAA RC staff document site-specific project information and impacts and determine the mechanism to ensure NEPA compliance for each recommended project, including whether a projects has adverse effects beyond the scope of those analyzed here, including significant adverse impacts, and will require an individual NEPA document. The process is described in Section 3 of this appendix, below.
- A final funding decision is made by the NOAA Grants Management Division after the review process described here is complete.
- In accordance with the Department of Commerce Standard Terms and Conditions, the Grants Officer may apply special award conditions that withhold funds from the award recipient until NEPA review is complete. In these instances, NOAA RC staff first document NEPA compliance for the action of awarding the funds and any initial activities the grantee needs to do to obtain further environmental data, and then completes a second "phase" of review to determine the potential significance of on the ground activities, once data is in hand. The NOAA RC documents and ensures compliance with permits or consultation as needed with special award conditions and a description included in the decision document prepared for the Administrative Record.

Some NOAA RC projects are funded through the federal acquisition process, under a contract. In those instances, formal Notices to Proceed on work are not issued until NOAA staff confirm that NEPA review and any necessary consultations with NMFS or USFWS have been completed, and all permits are in hand.

2. DARRP Process

The NOAA RC intends to follow a similar NEPA process as described above to address DARRP projects that fit within the descriptions of restoration actions and related impacts analyzed in this PEIS. The DARRP restores natural resources at hazardous waste sites and after oil spills and other contaminant releases or physical impacts, such as ship groundings on coral reefs. After damage occurs, the Restoration Center engages in restoration planning and restoration implementation. Projects, which are funded with legal settlements recovered from responsible parties, must be described in a Restoration Plan, and the NEPA process is required to be completed before projects can be implemented. This PEIS can be applied to DARRP projects, including:

- When NEPA analysis is required for any part of the planning process itself, this PEIS can be tiered to during the planning process.
- When a draft Restoration Plan is completed, the proposed projects can be evaluated against this PEIS. If the project activities and impacts are described within the PEIS, than the final Restoration Plan will tier to this PEIS, and no additional NEPA analysis is needed.
- When a final Restoration Plan is completed, there are instances in which some proposed actions are lacking detail required to complete NEPA analysis and/or the analysis of impacts changes prior to implementation. The Restoration Plan will clarify the individual actions that will not be implemented until details are developed and NEPA analysis is

completed. In these instances, this PEIS could be tiered to complete the NEPA analysis, or, as needed, additional NEPA analysis (outside of this PEIS) may be required.

3. Process for Determining Required Level of NEPA Analysis

A process to analyze project-specific impacts and create an administrative record for projects included under the PEIS analysis will be implemented by the NOAA RC. In order to avoid duplication of effort, when other offices, divisions, and programs outside the NOAA RC fund projects of similar scale and type as those described in the PEIS, they may choose to use the PEIS as the basis for their NEPA review, as appropriate, in accordance with the policies and procedures applicable to that office.

Documentation

Projects determined to meet the project and impact descriptions in this PEIS, and which need no further NEPA analysis, will be documented in the RC Program Record. The Program Record will include a checklist, a memorandum, and/or other electronic files for each project, approved by the RPM or designee. Program Record documents will:

- Help determine whether the activities of a project and its actual impacts do or do not exceed those that are described in this PEIS, including any additional considerations for those complex project types that are most likely to fall outside the PEIS analysis, identified in Table 10.
- For projects that are not fully described, including those which will result in significant adverse impacts, the document informs the tiering process by bringing to the forefront those activities and impacts not covered by this programmatic EIS.
- Record the total number of actions covered by this programmatic EIS, which can be used to monitor the validity and currency of the analysis, ensuring an appropriate lifespan for the document.

The final format of the Program Record may be paper or electronic, and may contain checklists, memoranda, and/or spreadsheets and databases, but will include the following content.

I. Identifying Project Information
II. Other Federal Partners and their Level of NEPA Review
III. Description of Project and Scope of Activities for Analysis
   a. Project activity and site description
   b. Is the full project being analyzed, or does the current analysis only cover the impact of planning and design, so that information can be gathered for a later full analysis?
IV. Project Impact Analysis
   a. Core Questions- To be addressed for all restoration activities
      i. Are the activities to be carried out under this project fully described in Section 2.2 of the NOAA RC PEIS? [A “No” response indicates a project falls outside the PEIS analysis.]
      ii. Are the impacts that are likely to result from this project fully described in Section 4.5.2 of the NOAA RC PEIS?

- Will the project have significant impacts? [A "Yes" response indicates a project falls outside the PEIS analysis.]
- Does the level of adverse impact from the restoration activity exceed that described in Table 11 of the NOAA RC PEIS? [A "Yes" response indicates a project falls outside the PEIS analysis.]

iii. Describe the project impacts to resources (including beneficial impacts) and any mitigating measures being implemented.

iv. Describe any potential cumulative impacts that may result from past, present or reasonably foreseeable future actions (beneficial or negative).

v. Describe the opportunities for public outreach and/or comment that have taken place to this point. Are any future opportunities for public input anticipated?

vi. Have any public comments raised issues of scientific controversy? Please describe.

vii. Describe the most common positive and negative public comments on issues other than scientific controversy described above.

b. Supplemental Questions- To be addressed based on project type

i. Beach and Dune Restoration

- Describe the volume of sediment being moved and the length of the beach/dune being restored. How is it appropriate to the level of analysis presented in the NOAA RC PEIS in Sections 2.2 and 4.5.2?
- Describe the impacts to the borrow location and any impacts caused by the borrow material. How is it appropriate to the level of analysis presented in the NOAA RC PEIS in Sections 2.2 and 4.5.2?

ii. Debris Removal

- Are contaminants or other hazardous materials being removed from the environment? If so, how are they being disposed of?

iii. Dam and Culvert Removal, Modification, or Replacement

- Describe the amount and type of sediment in the reservoir behind the dam. Compare it to the stream's usual sediment load.
- Will the restored river channel be in the same location as the original channel? Please describe any changes.
- Are there contaminated sediments behind the dam? Describe the disposal method (i.e., will these be released downstream or taken off-site)?
- Describe the anticipated changes to the flood zone.

iv. Technical and Nature-like Fishways

- Describe the amount and type of sediment in the reservoir behind the dam. Compare it to the stream's usual sediment load.
- Will the restored river channel be in the same location as the original channel? Please describe any changes.
- Are there contaminated sediments behind the dam? Describe the disposal method (i.e., will these be released downstream or taken off-site)?
- Describe the anticipated changes to the flood zone.

v. Prescribed Burns and Forest Management
- Describe the size of the burn to be conducted. How is it appropriate to the level of analysis presented in the NOAA RC PEIS in Sections 2.2 and 4.5.2?
- Describe the natural fire regime of the ecosystem and how the planned burn matches that regime.

vi. Species Enhancement
- Describe the precautions taken to prevent the release of disease or invasive species.

vii. Artificial Reef Restoration
- Describe the artificial reef materials being deployed. How is it consistent with the types and impacts of the artificial reefs presented in the NOAA RC PEIS in Sections 2.2 and 4.5.2?

viii. Levee and Culvert Removal, Modification and Set-back
- Describe the extent and the height of the levee/culvert targeted in the restoration project. How is it appropriate to the level of analysis presented in the NOAA RC PEIS in Sections 2.2 and 4.5.2?

ix. Land and Water Acquisition and other Transactions
- Is the land or water right acquisition being implemented as a result of eminent domain or some other court-ordered expropriation?
- Describe the anticipated owner and funds being used to purchase the land or water transaction.

V. NEPA Recommendations to RPM or Designee

a. The action is completely covered by the impact analysis within the NOAA RC PEIS.

b. At this time funding will be limited to those portions of the action and impacts analyzed in the NOAA RC PEIS. [For funding feasibility and design.]

c. The action or its impacts are not covered by the analysis within the PEIS.

i. The project action or impacts are not described but are not significant. A tiered EA will be written.

ii. The project impacts are significant, and an EIS will be written.

The administrative record for projects that fall under recommendation V.c. will follow NAO 216-6 and the Office of Habitat Conservation Quality Assurance Plan (QAP).

Agency Review and Public Notification

As described in the National Marine Fisheries Service Policy Directive 30-131: Delegation of Authority for Completing NEPA Documents, the NOAA RC will consult with the NMFS NEPA Coordinator regarding the level of NEPA analysis for any major federal action. This includes all projects determined by the NOAA RC to fall under the analysis within this PEIS. When offices outside NMFS use this PEIS as the basis of their analysis, they will follow relevant policies for NEPA consultation and concurrence, and are requested to notify the NOAA RC so that the RC may track the total number and types of actions covered under the PEIS in the RC Program Record. The public will be notified of the projects that the NOAA RC determines to be included under the PEIS analysis on the NOAA RC website.

Projects where the action or impacts are not described, or that have significant adverse impacts , will result in an individual NEPA document and the agency review and public involvement procedures for those documents will follow NAO 216-6 and the Office of Habitat Conservation Quality Assurance Plan (QAP).

Appendix B. RC PEIS Scoping Comments

The NOAA RC received 10 comments during the public scoping period. The comments ranged from information requests, to questions on the scope and breadth of the document, to comments on suggested areas of focus for the analysis. Comments were received from non-profit organizations, government agencies (federal and state), and universities. Summarized comments received are below.

1. *RC Programmatic / Process Issues*

- It is not clear if all 5 current funding programs listed in Alternative 1 and 2 would have separate funding or if they would be competing competitively against each other for one funding source. If funding would still be granted under specific programs such as CRP, DARRP, CWPPRA, GLHRP, etc., we believe that Alternative 1 is preferable to address a variety of habitat restoration efforts and land purchases. In conjunction with each other, restoration and land purchase provides the greatest benefit to future generations.
- While it is well known that NOAA's technical assistance efforts toward the restoration of our coastal resources is excellent, funding is the limiting factor in efforts to restore coastal resources. If, under Alternative 3, technical assistance is the only program offered by NOAA, regional and statewide restoration efforts will be significantly reduced, especially as funding in all government sectors is being reduced.
- The demand for federal funding to support habitat restoration has, to date, outstripped current levels of support. Nonetheless, NOAA's restoration programs have provided an important avenue for building capacity at various levels (tribes, states, municipalities and the private sector). As a result, we feel it is important that NOAA continue to support a comprehensive range of restoration activities through a variety of project types. Alternative 1, and NOAA's current set of priority habitat types, is appropriate but will have greater impact both ecologically and economically if the level of support were expanded to better meet this demand.
- Alternative 1 presents the only comprehensive range of restoration activities undertaken by NOAA. Providing less than this comprehensive range of activities would be inefficient and an undue burden on NOAA partners by requiring individual NEPA compliance that would result in fewer restoration projects and less habitat restored.
- Supporting restoration through competitive public/private partnerships provides efficiencies and secures investment of non-federal dollars that leverage federal resources. Given the demand for expanding restoration it is appropriate to ensure that federal funds are leveraged and, conversely, partnerships provide incentives and leverage in return for raising private, state, local or other non-federal funds for restoration.

- Maintaining a focus on community-based restoration is an effective mechanism for spurring innovation in restoration methods. NOAA's capacity for technical support and outreach through community-based programs ensures that new ideas are harnessed and rapidly transferred within the field of restoration.
- There is a need to continue to support restoration at a number of scales. Small "pilot-scale" projects have often revealed techniques that can be implemented at large scales, harnessing economies-of-scale benefits. Economic analyses of some recent mid-scale projects are showing that there are significant returns on investment from both near-term implementation activities and longer-term ecosystem services.
- In NOAA's "Science-Based Restoration Monitoring of Coastal Habitats" guidelines for developing a monitoring plan (Thayer et al. 2003), explicit recognition is given to the need to develop testable hypotheses to "determine progress toward restoration goals," yet the examples given of post-implementation monitoring are large structural criteria, and no functional criteria are proposed above the level of Tier II, EFH; i.e., density and composition of organisms. A cursory review of Progress Reports submitted under the NOAA Restoration Center's Community-based Restoration Program (CRP), Progress Report Narrative Formats includes only biological inventories (restricted at or below EFH, Tier II) and/or topographical/structural parameters. We can and must do better.

2. *Regulatory Issues*

- The State of FL cannot convey any natural resource management authority to federal entities, pursuant to Chapter 379.23, F.S. and Chapter 379.244, F.S. If land purchase is added to this program, further clarification of land management options in conjunction with land purchasing objectives is necessary.
- Description of Authorities – The description of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act is inadequate and does not capture the true mandate or authorization provided to NOAA for community-based habitat restoration. Suggested language regarding authorization for restoration:
  - "The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 directs the Secretary of Commerce to establish a community-based fishery and coastal habitat restoration program to implement and support the restoration of fishery and coastal habitats. The Act further authorizes NOAA to provide federal financial and technical assistance for local restoration, promote stewardship and conservation values for NOAA trust resources, develop public-private participation in fishery and coastal habitat restoration."

3. *Riverine / Riparian Restoration / Associated Uplands Restoration Issues*

- The Restoration Center should not fund, or stop funding fish ladder projects, even though many local communities feel good about them. Full passage of all fish is usually not achieved, causing congestion points of fish below the dams.
- Invasive species. Oregon recognizes "A" weeds (economically-important weeds that occur in small enough infestations to make eradication or containment possible) and "B" weeds (economically important which are generally regionally abundant). Perhaps the restoration

center could consider some similar protocols that favor projects aimed at eradication or control of infesting weeds rather than of species so established or widespread that eradication or control is not feasible. Could a similar protocol be used for aquatic nuisance species?

- Fish passage projects are a high priority for recovery of Atlantic and shortnose sturgeon, alewife, blueback herring, and American shad.

4. *Coastal / Intertidal Restoration Issues*

- NOAA's habitat restoration program should address and clearly define the role that artificial reefs play in habitat restoration efforts relative to securing ecological benefits to trust species. Where artificial reefs are used as a tool to effect restoration of aquatic habitat functions as their main goal rather than fish enhancement, they should be considered as part of the CRP and eligible for program funding.
- Think twice about how to approach and fund living shoreline projects. Shoreline hardening is actually increasing in areas treated by these projects. Are living shorelines becoming proxies for almost any type of bulkheading, shoreline hardening, berm construction, etc…?
- Do habitat adaptation projects (protecting or restoring habitat in transition zones to provide room for habitat migration with sea level rise) arbitrarily select one habitat type as having greater intrinsic value over another?
- Beach restoration projects should not include or serve as proxy for "beach nourishment" or shoreline berm construction to protect private property or preserve views.

5. *Land and Water Acquisition Issues*

- If land purchase is a new activity that will be added to this program without additional funding, it may compromise restoration efforts due to the significant costs for land purchase and management. Land purchase and management programs should be funded separately from restoration programs.

Table 40 - RC PEIS scoping comments summary

Date Received	Affiliation	Request Type	Reply Sent Date	Request Details	Relevant Section
3/5/2012	Northwestern University	Information Request	3/6/2012	Requested information on the NOAA RC NEPA process and any scoping materials, as well as the 2002 "NOAA Fisheries' Implementation Plan for the Community-based Restoration Program" and the 2006 NOAA Restoration Center Supplemental Programmatic Environmental Assessment (SPEA).	Requested information provided to Commentor
3/6/2012	Environmental Protection Agency	Information Request	3/6/2012	Requested information on the geographic area to which the PEIS announced on the Federal Register pertains.	Requested information provided to Commentor
5/10/2012	Trout Unlimited	Comment	N/A	Comment via telephone on the importance of prioritizing river systems in So. CA, and integrating threats analysis into prioritization documents	Section 2.2 and Appendix A.1
5/10/2012	Montclair State University	Information Request	5/15/2012	Requested information on RC's latest thoughts on success criteria for funded projects. Reply was provided to give general background on Tier 1/2 monitoring metric development.	Sections 2.2.1.2 and 2.2.1.3
5/10/2012	South Slough NERR	Comments	5/15/2012	1. Beach restoration projects should not include or serve as proxy for "beach nourishment" or shoreline berm construction to protect private property or preserve views. 2. Think twice about how to approach and fund living shoreline projects. Shoreline hardening is actually increasing in areas treated by these projects. Are living shorelines becoming proxies for almost any type of bulkheading, shoreline hardening, berm construction, etc…? 3. Do habitat adaptation projects (protecting or restoring habitat in transition zones to provide room for habitat migration with sea level rise) arbitrarily select one habitat type as having greater intrinsic value over another? 4. The Restoration Center should not fund, or stop funding fish ladder projects, even though many local communities feel good about them. Full passage of all fish is usually not achieved, causing congestion points of fish below the dams. 5. Invasive species. Oregon recognizes "A" weeds (economically-important weeds that occur in small enough infestations to make eradication or containment possible) and "B" weeds (economically important which are generally regionally abundant). Perhaps the restoration center could consider some similar protocols that favor projects aimed at eradication or control of infesting weeds rather than of species so established or widespread that eradication or control is not feasible. Could a similar protocol be used for aquatic nuisance species?	Comments addressed in the following sections: 1. Section 2.2.2.11.4 2. Section 2.2.2.11.1 3. Section 4.9 4. Section 2.2.2.3.1 5. Sections 2.2.2.4 and 4.8
5/16/2012	Guana Tolomato Matanzas NERR	Comments	6/11/2012	Comments sea level rise is not prominently mentioned, and should be, and regional coordination of restoration planning and implementation should be strong, and mention the Regional Ocean Alliance.	Sections 2.2.2.11, 3.1.1, and 4.9.2
5/30/2012	Restore America's Estuaries	Comments	6/11/2012	Comment in support of the preferred alternative (comprehensive approach), and provided suggested language for authorization section.	Section 2.1

Date Received	Affiliation	Request Type	Reply Sent Date	Request Details	Relevant Section
5/31/2012	The Nature Conservancy	Comments	6/11/2012	Comment on the need for comprehensive restoration capabilities, partnership building, maintaining a focus on community-based restoration at small and large scales.	Sections 1.0 and 4.5
6/1/2012	NC DMF	Comments	6/11/2012	Comment on the importance of shellfish and fish passage restoration projects for NC fisheries and ESA species.	Sections 2.2.2.3.1, 2.2.2.6.1, 3.1.4, 3.1.6.1, 4.5.2.3.1, and 4.5.2.6.1
5/23/2012	FL FWCC	Comments	6/11/2012	• It was unclear where funding would be coming from, and whether the restoration activities would be competing with each other for funding (as opposed to there being separate funding sources for each). • Land/acquisition projects while important may take resources away from other restoration due to high costs associate with such projects • If land purchase takes place, need to outline management options due to FL having management authority • Technical assistance only would seriously reduce other restoration efforts and have consequences • Document should describe the role of artificial reefs especially when reefs restore aquatic habitat function and not fish enhancement.	Comments addressed in the following sections: 1. Section 1.0 2. Section 4.5 3. Section 2.2.3.1 4. Section 4.6 5. Section 2.2.2.6.1
6/16/2014	NOAA OCRM Coastal Services Center	Comments	6/17/2014	1. Various editorial / clarification comments 2. Develop the types of trail restoration NOAA RC supports, and consider impacts from shading that may occur from certain trail restoration projects. 3. Consider clarifying in this discussion that the impacts of beach nourishment and sediment placement listed assume that the sediment added to the nearshore system is compatible in composition and grain size with the existing sand. 4. Consider including a more in-depth discussion of the climate change impacts of projects funded by the Restoration Center. 5. Clarify that restoration activities supported by NOAA are consistent with the enforceable policies of each state's coastal zone management program. 6. Consider referencing in these discussions the requirements of the NOAA Guidance on Compliance with the Implementing Procedures for Executive Orders 11988 and 11990. 7. Consider including the Fish and Wildlife Coordination Act, Marine Mammal Protection Act, the National Marine Sanctuaries Act, Executive Order 13158 (Marine Protected Areas), and Executive Order 13089 (Coral Reef Ecosystems).	Comments addressed in the following sections: 1. Various 2. Section 4.5.2.7 3. Section 2.2.2.1 4. Sections 3.1 and 4.9.2 5. Section 4.12 6. Section 4.12 7. Section 4.12

Date Received	Affiliation	Request Type	Reply Sent Date	Request Details	Relevant Section
7/24/2014	NMFS GARFO	Letter of Support		NMFS GARFO provided an informational letter indicating the need for consultation on impacts to protected species prior to restoration actions taking place, and support for the NOAA RC in developing this PEIS.	N/A

Appendix C. Mitigating Measures

The following practices are used as mitigating measures to minimize the impact of restoration projects. These practices don't reflect an exhaustive list of best practices used in NOAA programs, but are practices considered in the analysis of impacts. This appendix includes practices used across multiple restoration activities. Practices specific to only one type of restoration were included in Section 4.

Activities that minimize impacts from construction equipment

On-site Pollution Controls -

- Properly confine, remove, and dispose of construction waste, including every type of debris, discharge water, concrete, cement, grout, washout facility, welding slag, petroleum product, or other hazardous materials generated, used, or stored on-site.
- All vehicles and other heavy equipment would be (a) operated in a safe manner; (b) stored, fueled, and maintained in a vehicle staging area set back from any natural waterbody or wetland; (c) inspected daily for fluid leaks before leaving the vehicle staging area.
- Generators, cranes, and any other stationary equipment operated within 150 feet of any natural or wetland would be maintained as necessary to prevent leaks and spills from entering the water.
- Use procedures to contain and control a spill of any hazardous material generated, used or stored on-site, including notification of proper authorities.
- Heavy equipment can also leak oil and fluids. Equipment is always refueled away from stream corridors, and operators are required to have a spill response plan in place in case of a leak
- Mooring locations and buoy installation - When barges and other boats must moor on site to accomplish restoration work, mooring locations would be chosen to minimize damage to existing healthy reefs or adjacent SAV beds.

Off-site Sediment and Dredge Spoil Use –

- Sediments used in placement activities would closely match the general makeup of the existing sediment in terms of grain size, color and mineral content.
- Siting and design techniques may be used that maximize potential benefit sea turtles or birds, such as constructing beaches intended to benefit ground nesting birds in areas closed to vehicular traffic to avoid damage to nests, or constructing beaches intended to benefit sea turtles in areas with minimal artificial ambient light that could disrupt hatchlings.
- Practices to place sediment in a manner to minimize impacts to any existing vegetation would be implemented to the maximum extent practicable, for example by following all

applicable laws and regulations at the site of project implementation, local management authorities would be involved in project planning.

- All available information on sediment transport in the project area would be considered prior to contemplating restoration of barrier island and beach habitat.
- Before dredged material is deposited, sediments must be tested for contaminants and analyzed for physical characteristics such as grain size and water content to ensure vegetation will successfully re-colonize the area.

Invasive Species Spread Prevention-

- Vehicles or equipment used to manage invasive plants should be cleaned of all debris before removing it from the treatment site to prevent the unintended spread of seeds, rhizomes or plant fragments to other areas. Biofouled debris bearing non-native species should be appropriately treated before moving to reduce the likelihood of introducing or spreading or invasive species.
- Implementation of prevention measures, such as application of Hazard Analysis and Critical Control Point (HACCP) planning, can be used to identify and minimize the risks introducing non-native organisms during restoration activities.

Activities that reduce disturbance to vegetation and soils

Erosion Control -

- Temporary erosion controls would be in place before any significant alteration of the action site and would be monitored during construction to ensure proper function. Any number of erosion control structures or approaches may be used: turbidity curtains, hay bales, and erosion mats may be used where appropriate. When possible, stream flow would be diverted from work areas to prevent excess turbidity.
- Confine vegetation and soil disturbance to the minimum area, and minimum length of time, as necessary to complete the action, and otherwise prevent or minimize erosion associated with the action.
- Anticipate erosion and head cuts through grade control structures or bank recontouring;
- Cease work under high flows or seasonal conditions that threaten to disturb turbidity reduction measures, except for efforts to avoid or minimize resource damage.
- Exposed areas would be mulched and seeded after ground-disturbing activities are complete.
- Site restoration - Any woody debris, mature native vegetation, topsoil, and native channel material displaced by construction would be stockpiled for use during site restoration. When construction is finished, all streambanks, soils, and vegetation would be cleaned up

and restored as necessary to renew ecosystem processes that form and maintain productive fish habitats.

Methods to Reduce Soil Compaction -

- Existing access ways would be used whenever possible. Temporary access roads would not be built on slopes greater than 50%, where grade, soil, or other features suggest a likelihood of excessive erosion or failure. Soil disturbance and compaction would be minimized within 150 feet of a natural waterbody or wetland. All temporary access roads would be obliterated when the action is completed, the soil would be stabilized, and the site would be revegetated. Temporary roads in wet or flooded areas would be restored shortly after the work period is complete.

- Heavy equipment would be selected and operated in a manner that minimizes adverse effects to the environment (e.g., minimally-sized, low pressure tires, minimal hard turn paths for tracked vehicles, temporary mats or plates within wet areas or sensitive soils).

- To the extent feasible, heavy equipment would work from the top of the bank, unless work from another location would result in less habitat disturbance.

Planting or installing vegetation –

- NOAA RC would ensure the use of an appropriate assemblage of species native to the action area or region, including trees, shrubs, and herbaceous species. Often implemented to prevent erosion at restoration sites.

- For all geographic areas, no more than 5 percent of the below ground biomass of an existing donor bed would be harvested for transplanting purposes. Plants harvested would be taken in a manner to thin an existing bed without leaving any noticeable bare areas. Harvesting of flowering shoots would occur only from widely separated plants.

- Adequate Training of Volunteers - Training should be provided to ensure minimal impact to the restoration site by volunteers. Volunteers shall be trained in the use of low-impact techniques for planting, equipment handling, and moving around the restoration site to avoid unnecessary impacts on native flora and fauna.

Activities that Protect Human Safety

Diver safety and protocols -

- To minimize disturbances, divers would typically adhere to low-impact restoration techniques which include having no more than four divers per group, the use of appropriate dive equipment and tools, expert boat anchoring, job-specific diver training, and diver awareness.

- SCUBA divers that will be involved in in-water research and monitoring should have proper training in diving, and are capable of exhibiting responsible dive practices (e.g., proper buoyancy) such that they minimize injure organisms or cause unnecessary habitat impacts. It is the responsibility of NOAA or a recipient organization to ensure that divers are trained to a level commensurate with the type and conditions of the diving activity being undertaken. The organization must have the capacity (appropriate insurance, safety policies, etc.) to oversee all proposed diving activities.

Activities that Avoid Disturbing Sensitive Areas and Species

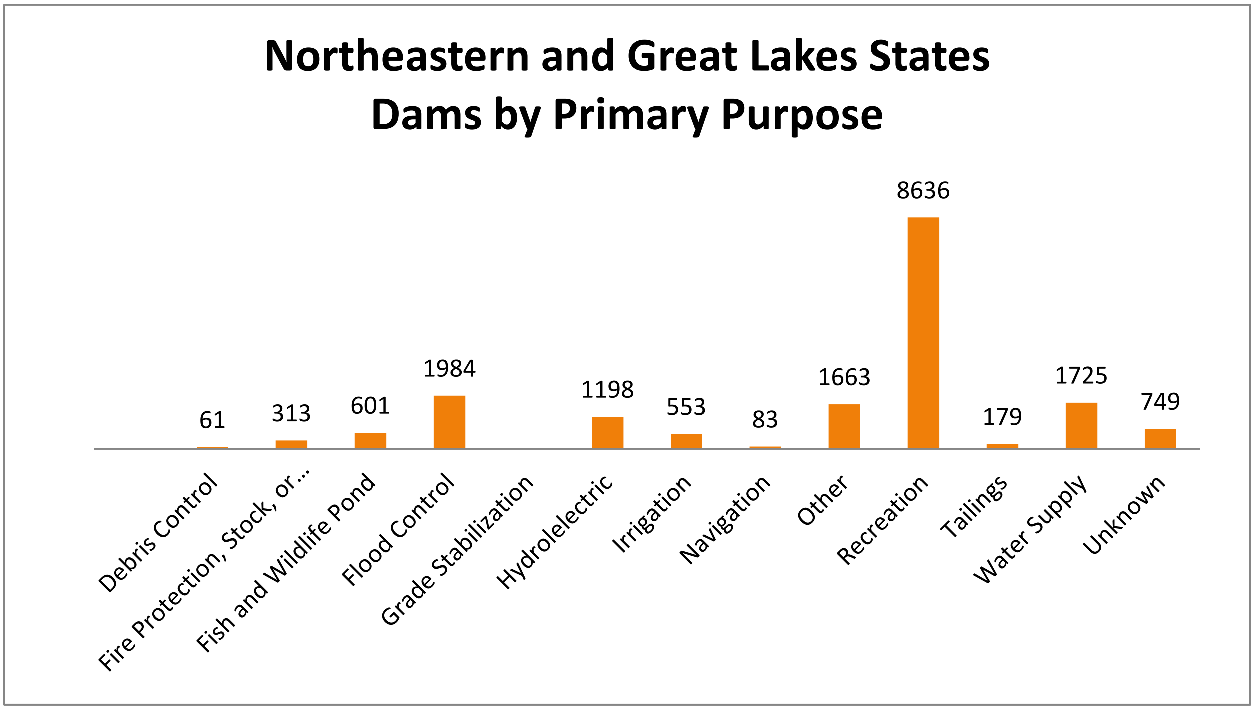
Flagging sensitive areas - Sensitive resource areas adjacent to the action area, such as buffers, archeological sites, and wetlands would be flagged to avoid accidental impacts.

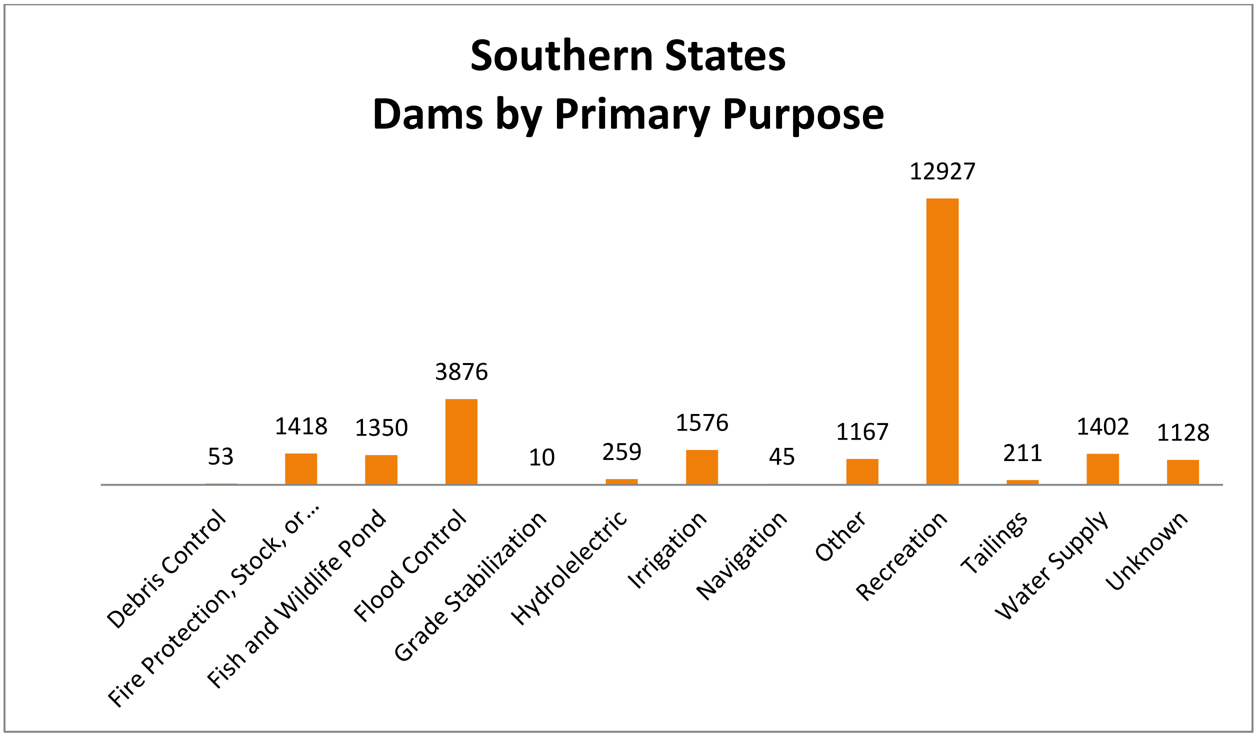
Seasonal Work Periods - All applicable work windows for diadromous fish or species listed under the Endangered Species Act would be followed. Hydraulic and topographic measurements as part of a restoration action may be completed at any time, provided that the affected area is not occupied by adult fish congregating for spawning.

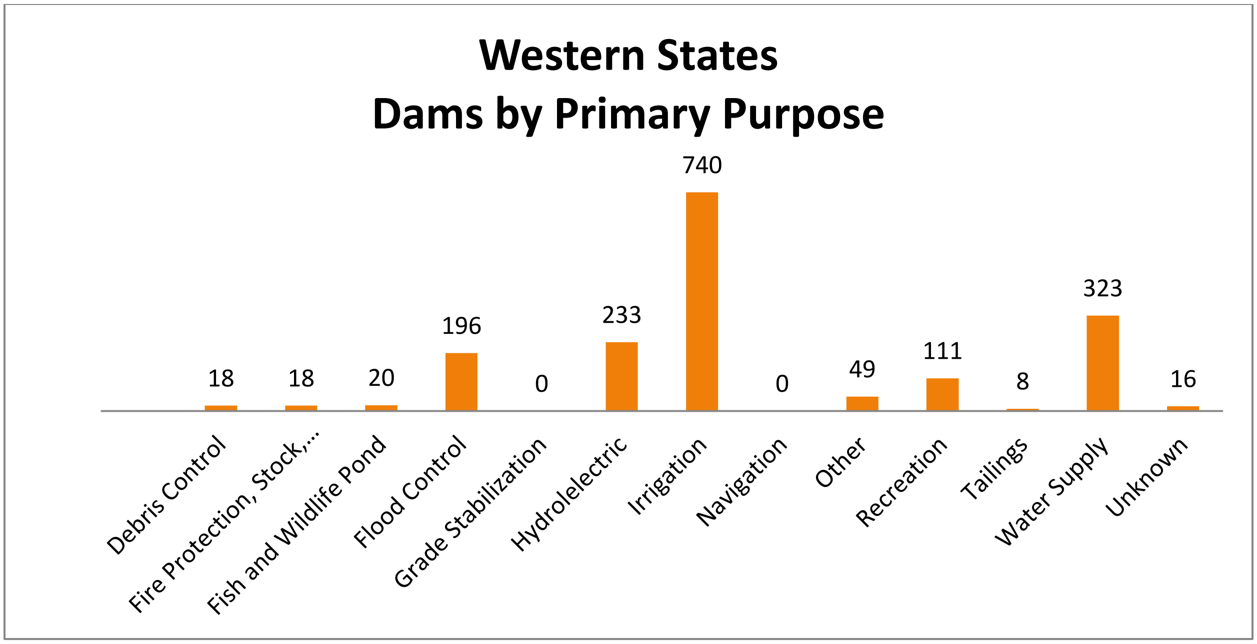
Adequate Training of Volunteers - Training should be provided to ensure minimal impact to the restoration site by volunteers. Volunteers shall be trained in the use of low-impact techniques for planting, equipment handling, and moving around the restoration site to avoid unnecessary impacts on native flora and fauna.

Appendix D. National Inventory of Dams – Dam Purpose by Region

Data accessed January 2014 from http://nid.usace.army.mil







Western States
Dams by Primary Purpose
18
18
20
196
0
233
740
0
49
111
8
323
16
Debris Control
Fire Protection, Stock,...
Fish and Wildlife Pond
Flood Control
Grade Stabilization
Hydrolelectric
Irrigation
Navigation
Other
Recreation
Tailings
Water Supply
Unknown