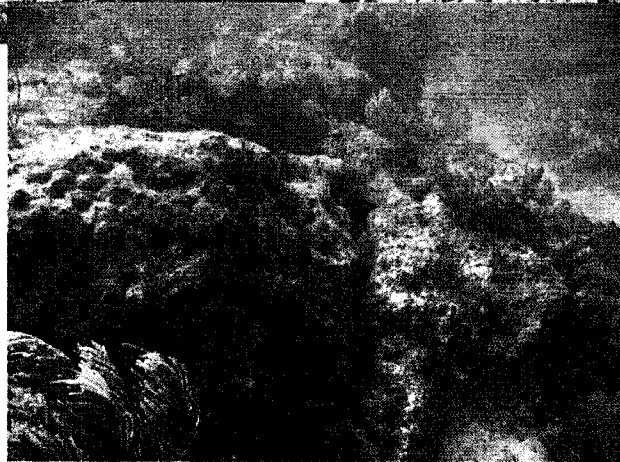




ALLIE B GROUNDING SITE

Administrative Draft Restoration Plan/Environmental Assessment



Prepared for:
The National Park Service
Biscayne National Park

April 2005

ABSTRACT

The Allie B tug, with loaded barge, grounded in Biscayne National Park (BISC) on July 20, 1998. Based on coordinates obtained during the site visit in December 2004 (Tetra Tech, 2005), the Allie B tug came to rest approximately 2,000 feet (ft) (600 meters [m]) west-southwest of the location where the towed barge came to rest. Following the grounding event, the National Park Service (NPS) performed a detailed assessment of the Allie B grounding.

The barge, tug, and tow cable caused the grounding-related injuries. Predominant injuries associated with the tug grounding and subsequent extrication included surficial scraping of the hard bottom substrate and significant displacement of unconsolidated substrate during blowhole formations. Predominant injuries associated with the barge grounding included fractured substrate, displacement of substrate and biota, and hull paint deposition on scarred substrate. A keel scar was also reported on the reef crest at the tug grounding site. Surficial substrate scraping and biotal displacement were caused by the tug/barge cable on Ledbury Reef, north of the barge grounding site.

In September 1998, Hurricane Georges crossed the lower Florida Keys and buffeted BISC with high wind and rough sea conditions for several days. After the passage of Hurricane Georges, the blowhole was found to be partially filled with sediment to a new depth of approximately 3.6 ft (1.5 m). In addition, collateral damage to the adjacent reef occurred from the movement of loose rubble from the berm. In August 1999, time-critical blowhole restoration activities were undertaken at the injury site on behalf of NPS by a contractor, Law Engineering and Environmental Services (LawGibb). This time-critical restoration consisted of covering the bottom of the blowhole with a layer of rubble from the berm.

In its detailed assessment, NPS BISC staff identified injured resources at the tug grounding site as 2,689 square ft. (ft²) (249.82 square meters [m²]) of prop-wash blowholes, 3,229 ft² (300 m²) of prop-wash rubble field, and 269 ft² (25 m²) of keel scar and tug contact points. The barge grounding site injury consisted of truncated and impacted reef spurs at 19 stations totaling 2,089.5 ft² (194.12 m²), and the tow cable injuries consisted of cable scars and coral injuries totaling approximately 269 ft² (25 m²). The Stipulation of Settlement required that the tug defendants pay \$1,000,000 to the United States as compensation for response costs and damages for destruction, loss of, or injuries to park system resources pursuant to the Park System Restoration Protection Act (16 USC 19jj). This settlement included costs for the NPS response to the grounding incident, restoration planning activities, and restoration action implementation.

NPS determined that damages will be applied "toward the restoration, replacement, or rehabilitation of the equivalent of the natural and National Park System resources or resource services which were injured, destroyed or lost as a result of the Allie B grounding."

NPS developed criteria to systematically evaluate applicable restoration actions. The restoration alternatives were then evaluated by NPS using the evaluation criteria. NPS determined that the restoration alternatives for the Allie B grounding site that best comply with BISC coral reef restoration goals and objectives are the following:

(After evaluation of the alternatives by NPS, the selected alternative will be added.)

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ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
BISC	Biscayne National Park
C	Celsius
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DO	Director's Order
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FKNMS	Florida Keys National Marine Sanctuary
FONSI	Finding of No Significant Impact
FS	Florida Statutes
IDT	Interdisciplinary Team
km	kilometer
m	meter
m ²	square meter
MRI	Marine Resources, Inc.
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
PED	Preliminary Estimate of Damages
PSRPA	Park System Restoration Protection Act
RP/EA	Restoration Plan/Environmental Assessment
T&E	Threatened and Endangered
USC	United States Code
USDOJ	United States Department of the Interior
WGS	World Geodetic System

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1. INTRODUCTION

Biscayne National Park (BISC), located in Homestead, Florida, is the largest marine park in the National Park System (NPS)—95 percent of its 173,000 acres are covered by water. Situated south of the city of Miami, in Dade County, Florida, the park is about 35.4 kilometers long; its northern boundary is near Key Biscayne and its southern boundary near Key Largo (Figure 1-1). The park's western boundary is roughly defined by the landward extent of a mature red mangrove forest that forms a narrow band, 100–2,000 feet (ft) (30.5–610 meters (m)) wide, along the western shoreline of Biscayne Bay. The park's eastern boundary follows the 60-ft (18.3-m)-depth contour, for an approximate width of 14 miles (22.5 kilometers). Biscayne's submerged area lies within either the shallow Biscayne Bay or the more turbulent waters of the Hawk Channel and the Florida Straits. The park preserves a unique, sensitive marine environment that is an important component of the south Florida ecosystem and economy (USDOJ-NPS, 2004).

BISC's restoration goals are derived from the NPS Resource Protection Act (PSRPA). The PSRPA states that the goal of restoration is to “replace, restore or acquire equivalent of a damaged park system resource, to speed the recovery of injured reef habitat so that the injured area has aesthetic value and is a functional part of the marine environment, and to obtain compensation for interim lost services.”

Vessel groundings and propeller dredging are common occurrences in BISC because of the shallow waters outside marked channels. The frequency of vessel groundings occurring within BISC is attributed in part to the park's proximity to the city of Miami, where recreational boating is a favorite pastime, and to the Port of Miami, which provides service for many commercial carriers, cruise ships, and barges. Groundings of large marine vessels, such as the Allie B tug and its barge, occur less frequently than those from recreational and small commercial boats, but still account for significant natural resource injuries. Groundings of large marine vessels can be attributed to the park's location adjacent to commercial shipping lanes and major navigational routes used by various types of commercial vessels and to the park's proximity to the major port of Miami and other ports along the eastern coast of Florida.

When injury occurs, damages for grounding cases are sought and obtained under the PSRPA (16 USC 19j). The act specifically allows the Secretary of the Interior “to restore, replace, or acquire the equivalent of resources which were the subject of the action and to monitor and study such resources.” The goal of the Allie B ecological restoration is to create a stable self-sustaining reef of similar topography and surface complexity that existed prior to the injury, which not only meets the objective of restoring the resource, but also provides an enhanced visual experience for park visitors.

1.1 Summary

The Allie B tug, with a loaded barge, grounded in BISC on July 20, 1998. Based on coordinates obtained during the site visit and current conditions assessment in December 2004, the Allie B tug came to rest approximately 600 meters west southwest of the location where the towed barge came to rest (Figure 1-2) (Tetra Tech 2005). The positions of the tug and barge grounding sites are: Allie B barge, 25° 32.496' N/80° 06.097' W, and Allie B tug, 25° 32.255' N/80° 06.238' W.

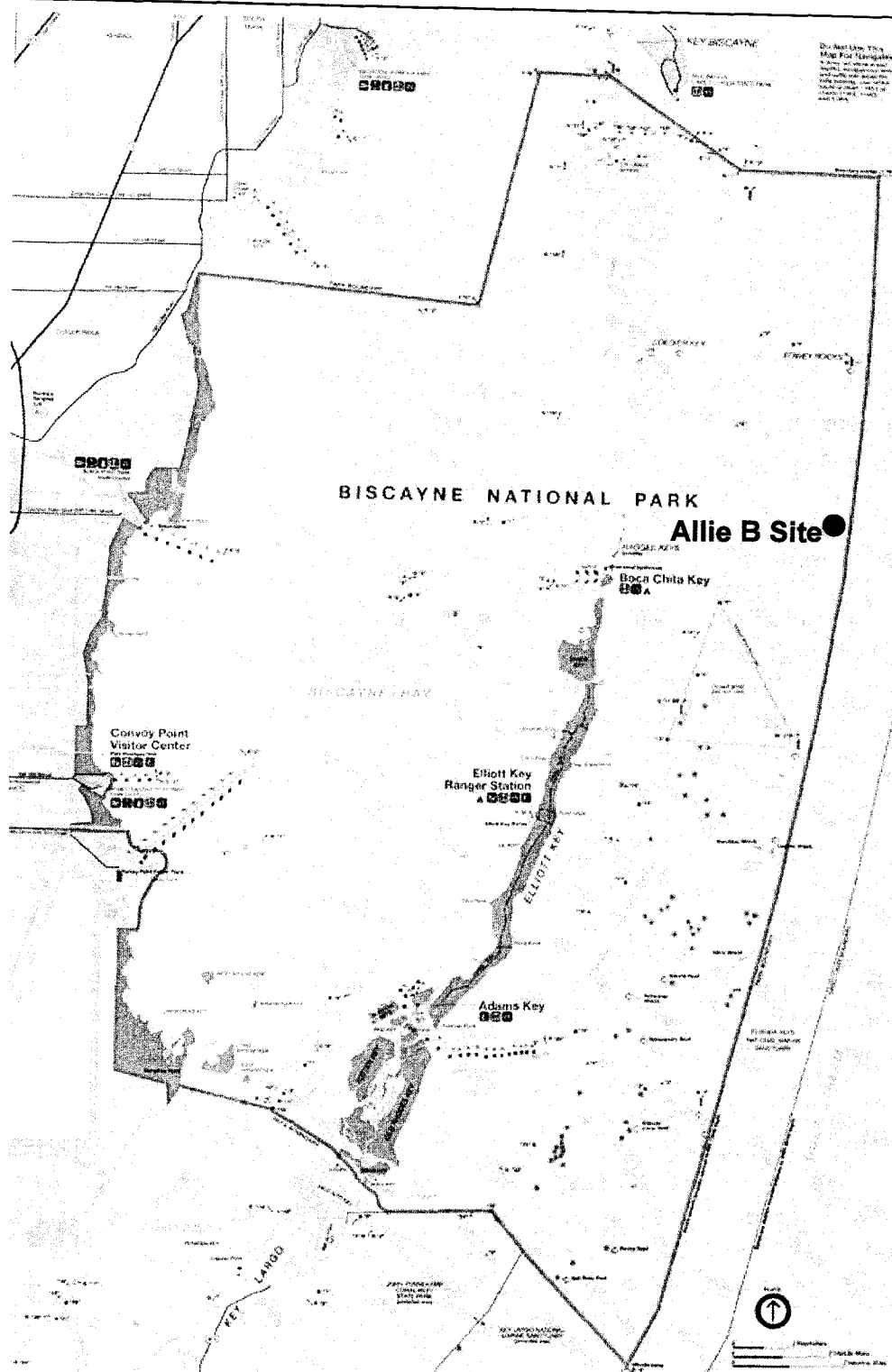


Figure 1-1. Biscayne National Park and Site Location Map

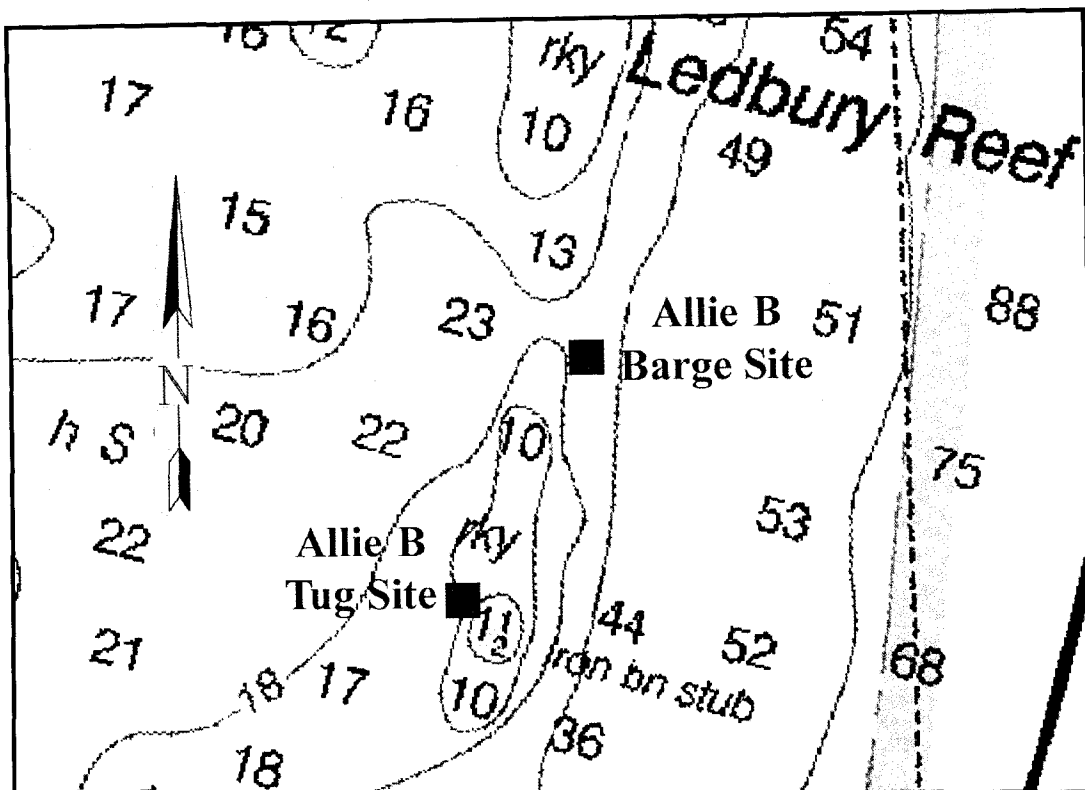


Figure 1-2. Locations of the Allie B Tug and Barge Grounding Sites within Biscayne National Park

The navigational coordinates (World Geodetic System (WGS) 84) obtained during the most recent site visit in December 2004 agree with those obtained during a site survey and assessment conducted in January 2003 (MRI, 2003). The overall spatial extent of the injury and corresponding navigational coordinates for site-specific injury locations are given in the Allie B damage assessment report by Law Engineering and Environmental Services, Inc. (LawGibb, 1998).

Following the grounding event, LawGibb conducted a detailed assessment of the Allie B grounding for NPS. The assessment began on July 25 and continued through August 1998. The assessment included performing coral reef triage to salvage and reattach broken and displaced corals, mapping and measuring the physical area of injury from the two sites, determining the pre-injury conditions of the biological community, collecting substrate rugosity measurements, quantifying epibiotal loss in the injury areas, and determining primary restoration options. The detailed assessment was documented in two reports (LawGibb, 1998; LawGibb, 2001).

Grounding-related injuries were caused by the barge, tug, and tow cable. Predominant injuries associated with the tug grounding and subsequent extrication included surficial scraping of the hard bottom substrate and significant blowhole formations—displacement of unconsolidated substrate that occurred when the tug attempted to power off. Predominant injuries associated with the barge grounding included fractured substrate, displacement of substrate and biota, and hull paint deposition on scarred substrate. LawGibb (1998) reported a keel scar on the reef crest located at the

tug grounding site and the tug/barge cable injuries comprised of surficial substrate scraping and biotal displacement on Ledbury Reef north of the barge grounding site (see Figure 1-2).

In September 1998, Hurricane Georges crossed the lower Florida Keys and buffeted BISC with high wind and rough seas for several days. After the passage of Hurricane Georges, a visit to both injury sites were conducted and additional measurements for the blowholes and berms were completed (November 11, 1998). The blowhole was found to be partially filled with sediment as a result of the hurricane; the new depth of the blowhole was approximately 3.8 ft. (1.5 meters). In addition, collateral damage to the adjacent reef occurred from the movement of current-driven loose rubble from the berm. In August 1999, LawGibb undertook time-critical blowhole restoration activities at the injury site on behalf of NPS. This time-critical restoration consisted of covering the bottom of the blowhole with a layer of rubble from the berm (LawGibb 1999).

1.2 Purpose and Need

This Restoration Plan/Environmental Assessment (RP/EA) presents information to the public regarding the affected environment, the determination of natural resource injuries, and possible restoration actions to restore injured coral reef resources and to compensate for lost natural resource services caused by the Allie B vessel grounding on Ledbury reef and an unnamed reef within BISC.

1.2.1 Purpose

According to the park's legislation, the purpose of BISC is "to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty." This RP/EA is intended to assist BISC in meeting its purpose of preserving and protecting the coral reef resources located within the park by guiding the determination of the restoration action appropriate for the Allie B grounding site.

This document is intended to comply with the National Environmental Policy Act of 1969 (NEPA) and its implementing regulations, as well as with NPS guidelines for compliance with NEPA.

1.2.2 Need

BISC, the largest marine park in the National Park System, was set aside in 1968. There are three major environments found within BISC: coral reefs, the bay environment (Biscayne Bay), and terrestrial. These three environments comprise a variety of smaller communities such as seagrass meadows, hard bottom areas, mangrove forests, and hardwood hammocks.

Coral reefs are the most biologically diverse ecosystems in the world. The coral reefs of BISC are part of a 150-mile (240 kilometer [km])-long chain of coral reefs extending down through the lower Florida Keys and the Caribbean. The coral reef system of the Florida Keys is North America's only living coral barrier reef and the third longest coral barrier reef in the world. The reefs provide habitat for fish, stony and soft corals, sponges, jellyfish, anemones, snails, crabs, lobsters, rays, moray eels, sea turtles, dolphins, sea birds, and other animals. They are home to more than 150 species of tropical fish and 50 species of coral, representing 80 percent of the coral species in the tropical western Atlantic (USDOI-NPS, 2005a).

Because recreational and light commercial boating occur within the park boundaries, grounding incidents are common. Approximately 200 vessel groundings are reported per year in BISC; however, it is estimated that this represents only a small portion of all groundings that occur. While groundings occur throughout the park, several grounding hotspots have been identified at shoals, tidal creeks, and navigation channels. Though seagrass beds are injured by groundings more often than coral reefs at BISC, when groundings do occur on coral reefs, injuries are usually significant. Development of this RP/EA will determine the restoration actions that are appropriate for implementation at the Allie B injury site to stabilize and restore the injured natural resources and compensate the public for lost recreational services from the time of injury until full recovery.

1.2.3 Goal

The National Park Service's "Organic Act" of August 25, 1916, states that "the Service thus established shall promote and regulate the use of Federal areas known as national parks, monuments and reservations ... by such means and measures as conform to the fundamental purpose of the said parks, monuments and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The goal of the Allie B restoration actions is to create a stable, self-sustaining spur and groove and transitional reef of similar topography and surface complexity to that existing prior to injury, to the extent practicable, such that natural recovery processes, enhanced through mitigation if needed, will lead to a fully functioning community with near natural complexity, structure and make-up of organisms. This RP/EA has been prepared as part of the decisionmaking process to assist BISC in determining what type of restoration actions are appropriate for the Allie B grounding site.

1.3 Coordination with Responsible Parties

There are three stages when BISC staff may coordinate with the responsible parties for coral injuries: grounding response activities, damages assessment, and settlement. Response activities involve collaboration among towboat companies, dispatch, rangers, and biologists. Typically, grounded vessels contact towboat companies, which obtain the coordinates, stake the site, then a fax a documentation sheet to the park. Park staff may or may not respond immediately to reported groundings, depending on the apparent severity of the incident, the natural or cultural resources involved, and availability of staff. Park staff may also encounter groundings while performing other duties on the water. Grounded vessels may be removed by self-extrication, use of lift bags, or tugboats. Professional salvage is a trigger for Resource Management response and oversight.

Damage assessment involves documenting injured resources, quantifying the aerial extent and degree of the injury, and describing adjacent unaffected reference areas. The damage assessment is used to develop a claim settlement report, which includes the following components and their associated costs: response and assessments, prescribed restoration (primary and compensatory), primary and compensatory monitoring, and administrative/legal costs.

Once a claim is settled, coordination with the responsible party is concluded. The site is re-assessed, and restoration planning by NPS begins. The preferred course of action may be "natural recovery," depending on the time since the incident and severity of the injury. Monitoring should be performed

during natural recovery and following restoration. Restoration planning, implementation, and monitoring may be accomplished in-house, by contractors, or by both.

1.4 Settlement of Natural Resource Claims

The NPS BISC staff identified injured resources at the Allie B tug grounding site as 249.82 square meters (m^2) of prop-wash blowholes, 300 m^2 of prop-wash rubble field, and 25 m^2 of keel scar and tug contact points. The barge grounding site injury consisted of truncated and impacted reef spurs at 19 stations totaling 194.12 m^2 , and the tow cable injuries consisted of cable scars and coral injuries totaling approximately 25 m^2 (USDOJ-NPS, 1999).

The Stipulation of Settlement required that the tug owners (defendants) pay \$1,000,000 to the United States as compensation for response costs and damages for destruction, loss of, or injuries to the park's resources pursuant to the PSRPA. This settlement included costs for NPS's response to the grounding incident, restoration planning activities, and restoration action implementation.

1.5 Public Participation

NEPA was enacted by Congress to ensure that federal agencies consider the potential environmental impacts of their proposed actions and alternatives before deciding on a course of action. Public involvement is an important part of the NEPA process. The NRDA regulations require the Trustees of injured resources, in this case NPS, to solicit public comments on a Draft RP/EA and to consider the comments during the preparation of a Final RP/EA (15 CFR 990.55[c]). In addition, public review of an RP/EA is consistent with NEPA as amended (42 USC 4321 et seq.) and its implementing regulations (40 CFR Parts 1500–1508). The public is invited to comment on the proposed restoration action or suggest alternative actions.

The document will be presented at a public meeting to be held on October 27, 2005, in Homestead, Florida. During this meeting, NPS staff will be available to answer questions and discuss the document with the public. Public review of the Draft RP/EA is scheduled from October 28, 2005, to November 26, 2005 (30 days). All comments made by interested parties during this meeting and during the public review period will be considered during the development of the Final RP/EA. A Responsiveness Summary will be presented as Appendix A of the Final RP/EA.

NPS will send out a notice issuing the Draft RP/EA in the Federal Register and a local newspaper. Methods for submission of comments on the scope of a Draft RP/EA include fax, e-mail, and U.S. mail. Comments received are considered in the preparation of the Final RP/EA.

1.6 Restoration Plan Implementation

Once the RP/EA is finalized, two possible outcomes, as outlined in NEPA, may occur. The first outcome is that a Finding of No Significant Impact (FONSI) will be issued and the selected restoration actions will be implemented. This will occur if the results of the environmental assessment indicate that the restoration actions will not make a significant environmental impact. NPS would then issue a request for funds and restoration action implementation would begin.

However, if the environmental assessment determines that the proposed projects would cause significant environmental impacts, an Environmental Impact Statement (EIS) must be developed. Through the EIS process, NPS would carefully evaluate which proposed alternatives would be

selected and what measures would be implemented to mitigate the potentially significant environmental impacts. A Record of Decision would then be issued to implement the selected alternative(s).

1.7 Administrative Record

The Freedom of Information Act requests, and litigation requires, a complete record for response, so the Natural Resource Trustees, NPS for incidents at BISC, must maintain a publicly available Administrative Record to document the bases for decisions pertaining to restoration actions. Depending on the nature and extent of the incident and assessment, the Administrative Record would include documents relied upon during the assessment, such as:

- Any notices of draft of final restoration plans
- Meeting notes
- Public comment letters
- Documentation of public involvement
- Comments from other agencies or government entities
- Copies of documents disseminated for review, including comments
- Issues resolution

Furthermore, NEPA Section 103 (42 USC 4333) directs federal trustees to maintain the Administrative Record in a manner consistent with the Administrative Procedure Act, 5 USC 551–59, 701–06. NPS has established an Administrative Record that contains documents relied upon by NPS in identifying, evaluating, selecting, and implementing restoration actions.

Comments based on review of the Draft RP/EA, Final RP/EA, and other restoration planning process documents are part of the Administrative Record. The Administrative Record can be viewed at the BISC Visitor Center located in Homestead, Florida. Amanda Bourque should be contacted at the addresses below to view copies of the documents contained in the Administrative Record:

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Biscayne National Park
9700 SW 328th Street
Homestead, FL 33033
305-230-1144, ext. 3013
Amanda_Bourque@nps.gov

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2. AFFECTED ENVIRONMENT

Biscayne National Monument was established in 1968. It was expanded in 1974 and again in 1980, when it was redesignated Biscayne National Park. BISC encompasses an area of 173,000 acres. It extends approximately 22 miles (35.4 km) from north to south and averages 14 miles (22.5 km) from east to west. Prominent natural features of BISC include most of southern Biscayne Bay, a subtropical marine lagoon, and the offshore northern fringe of the Florida reef tract. Approximately 171,925 acres of BISC is submerged and nearly equally divided in area between the reef tract and estuarine environments (USDOI-NPS, 2004). The Allie B tug/barge grounded on shallow reef formations between Star and Ledbury reefs in BISC.

This section describes the physical environment and biological resources that could be affected at the Allie B grounding sites. The descriptions focus on the natural resources that are relevant to the discussion of injuries and restoration alternatives presented in the document.

2.1 Physical Environment

The hard bottom injured during the grounding of the Allie B tug and barge is part of the Florida reef tract that is underlain by Pleistocene coralline limestone (Shinn et al., 1989). The hard bottom is part of the outer bank reef system, which is an elongated feature whose long axis is oriented parallel to the shelf edge (north-south). The water depth of the hard bottom injured during the grounding ranges from 2 to 9 m. Underwater visibility at the sites ranges from 2 to 30 m.

The hard bottom formations within BISC injured during the grounding include a portion of a bank reef with a seaward spur and groove feature (Allie B barge site) and a transitional reef (Jaap, 1984) that lacks well-defined spurs and grooves (Allie B tug site). Both hard bottom formations are best described as moderately developed reefs lacking a fringing elkhorn coral (*Acropora palmata*) zone. Although this reef formation may have supported large stands of *A. palmata* in the recent geological past, it is now a series of limestone ridges with minimal Holocene deposition (Shinn, 1988). The hard bottom is composed of a substrate matrix of encrusted and lithified limestone-secreting organisms, primarily corals, algae, and bryozoans, that has developed on pre-existing bedrock facies. The bank reef topography is quite variable within the reef matrix as a result of disproportional erosional processes occurring over a geological time scale. Maximum vertical relief of the affected hard bottom is approximately 2 m and is defined by the substrate topography and associated biological community.

Hydrographic conditions at the grounding sites are related to their position between the seaward Florida Current and the landward low-lying keys. The northerly Florida Current moderates winter temperatures and eddies, which are often associated with larval transport and nutrient enhancement to coastal systems. Tides, which influence outer bank reef circulation greatly, are semi-diurnal—having two low and high tides per lunar day. The mean tidal range for 2004 at Fowey Rocks, approximately 2 statute miles from the grounding sites, was 0.7 m (NOAA, 2005a). Ten-day means of water temperatures for Fowey Rocks ranged from 21°C to 31°C (Vaughn 1918); the National Oceanic and Atmospheric Administration (NOAA) Fowey Rocks data buoy recorded a similar mean water temperature variation of 22°C to 31°C for the 10-year period between 1991 and 2001 (NOAA, 2005c).

The climate of BISC is subtropical. Mean air temperatures recorded at Fowey Rocks NOAA data buoy for the 10-year period between 1991 and 2001 ranged from 17°C to 30°C (NOAA, 2005c). Prevailing winds are from the southeast and east-southeast for most of the year and have a mean yearly velocity near 15 kilometers per hour (Jaap, 1984). Cold fronts and associated winds with a northerly component are common during the winter months.

2.2 Biological Environment

The Allie B vessel grounding impacted a number of components of the biological environment. These components include the reef biological community, hard corals, other invertebrates, ichthyofauna, floral species, and threatened and endangered species and are described below.

2.2.1 Reef Biological Community Structure

Hard bottom formations from both the tug and barge sites support a biological community visually dominated by soft corals, sponges, and hard corals. The most conspicuous epibiota on the reef are the soft corals. Some of the most common species of soft coral include the sea fans (*Gorgonia* spp.), encrusting corky sea finger (*Erythropodium caribaeorum*), sea plumes (*Pseudopterogorgia* sp.), and sea rods (Plexauridae). Common sponges included the boring sponge (*Cliona* sp.), the giant barrel sponge (*Xestospongia muta*), and various cavity-dwelling species (e.g., *Agelas* spp., *Clathra* sp., and *Chondrosia* sp.). The giant barrel sponge can be as wide and high as 1 m and provides habitat for numerous sponge inquilines that include brittle stars and snapping shrimp. Another commonly observed sponge is the relatively large branching vase sponge (*Callyspongia vaginalis*), which provides habitat for surficial zoanthids (*Parazoanthus* sp.) and other invertebrates. Some of the most common species of hard coral found on the reef include the maze coral (*Meandrina meandrites*), star corals (*Montastraea* spp.), elliptical star coral (*Dichocoenia stokesii*), mustard hill coral (*Porites astreoides*), and brain corals (*Diploria* spp.). Fire coral (*Millepora* spp.) is also a commonly observed component of the reef biological community. For further information regarding vertebrate species present, see the list of invertebrates observed during an assessment operation at the Allie B grounding sites prepared by Brandenburg (2001).

2.2.2 Hard Corals

Hard corals, the slowest growing components of the biological community, are critical for providing structural framework for the reef system. Typical methods for determining the abundance and relative importance of hard corals within the community structure include estimating percent cover and density (colonies/unit area). Coral reef community dynamics can be described based on temporal changes in the aforementioned community structure parameters (Porter and Meier, 1992). LawGibb (2001) estimated the coverage of hard corals at the Allie B grounding sites to be less than 1 percent. Quantitative sampling at four BISC bank reefs in water depths similar to the grounding sites showed coral coverage to be quite variable—ranging from 1.3 to 5.9 percent (Burns 1985). Based on more recent data from BISC bank reefs, it has been estimated that coral coverage ranges from 1.9 to 12.7 percent; these coverages corroborate the high degree of variability (Miller and Szmant, 2000). Coral cover at Ajax Reef, approximately 9 statute miles south of the grounding sites, was reported to be slightly less than 10 percent (Murdoch and Aronson, 1999). Hard coral density at Elkhorn Reef, dominated by mustard hill coral (*P. astreoides*) and staghorn coral (*Acropora cervicornis*) and approximately 13 statute miles south of the grounding sites, was estimated to have less than 6 colonies/m² (Jaap 1984). Miller and Szmant (2000) estimated the hard coral density for Elkhorn

Reef to be greater than 10 colonies/m². The relatively large disparity between the two data sets may be a result of differences in sampling technique and more intense sampling of juveniles by Miller and Szmant (2000).

The marine epibiota of BISC belongs to the Caribbean-Western Atlantic biogeographic province. The hard bottom reef formations within BISC support a relatively diverse hard coral community. Burns (1985) observed a total of 36 hermatypic hard coral species during sampling of BISC bank reefs; the number of species ranged from 8 to 18 between individual sampling sites. Miller and Szmant (2000) recorded species diversities for BISC reefs ranging from 23 to 43. The BISC hard coral fauna represents over two-thirds of the total species recorded in the province (Laydoo, 1990).

2.2.3 Other Invertebrates

The commercially important spiny lobster (*Panulirus argus*) inhabits the coastal and shallow continental shelf waters from North Carolina to Brazil (Marx and Herrnkind, 1986) and is found throughout BISC. The spiny lobster is a decapod crustacean that is named for its spine-studded carapace and prominent rostral horns. The spiny lobster has been commercially fished in Florida for more than 100 years and in 1999 exceeded the pink shrimp as Florida's most valuable fishery (Muller et al., 2000). The ontogeny of the spiny lobster includes multiple developmental and behavioral phases and consequently makes use of a broad range of marine habitats during its lifetime. Adults inhabit reef crevices, ledges, and other hard bottom discontinuities.

Sponges are an important epibenthic component on Florida's reefs. Sponges are major competitors with other reef epibiota for space and other resources and have the greatest overgrowth capability of other reef encrusting organisms (Jaap, 1984). Prominent ecological roles of sponges include providing shelter and food as well as contributing to both erosional and depositional processes. Sponge-mediated consolidation of rubble may increase rates of reef growth and enhance reef recovery after damage (Wulff, 1984).

2.2.4 Ichthyofauna

Hard bottom formations from both the tug and barge sites supports an abundance of fishes represented by several species, and more than 200 species of fish are reported to inhabit the BISC reefs (USDOI-NPS, 2005b). The parrotfish (Scaridae) and damselfish (Pomacentridae) are the most abundant fish, contributing the most individuals, observed at BISC (Tilmant et al., 1979). A general characteristic of the reef fish assemblages is established residency, i.e., once settled, most fish become sedentary. Most of the larger predatory species, including snappers and grouper, rarely travel far from their resident reef except for spawning (Chiappone and Sluka, 1996). Many of the smaller fish, such as gobies (Gobiidae), blennies (Blenniidae), and damselfish (Pomacentridae) are strongly territorial and defend their small sections of reef. The number and abundance of reef fish species is known to be directly related to substrate and habitat complexity in the form of vertical relief and number of interstices (Luckhurst and Luckhurst, 1978; Dennis and Bright, 1988). Substrate and epibiotal complexity are important to reef fishes because they provide shelter from predation as wells as spawning sites, and foraging areas. Soft corals, hard corals, and sponges, the dominant epibiotal components of the hard bottom formations, are not the primary food source for most reef fish, but they provide valuable habitat for numerous invertebrates that are fed on by fish.

A fish stock assessment for the Florida Keys indicated that many commercially important fishes, including grouper (*Epinephelinae*), snappers (*Lutjanidae*), hogfish (*Labridae*), and grunts, (*Haemulidae*) have been “overfished,” and that some stocks, particularly the largest, most desirable and vulnerable species, have been chronically overfished since the late 1970s (Ault et al., 1998). Population changes as a result of overfishing can contribute to changes in overall community structure and dynamics.

2.2.5 Floral Species

Turtle grass (*Thalassia testudinum*), one of the three dominant seagrasses found in BISC, is found along the shoreward edge of the Allie B tug grounding site. Turtle grass, the most widespread of the seagrasses, forms many of the large, lush seagrass beds found throughout BISC. Turtle grass typically has three broad strap-like leaves with rounded tips. The leaves emerge from the sediment at the top of a stem that rarely protrudes above the sediment surface. The individual shoots originate from thick, fibrous rhizomes that may extend 20 cm (7.9 in) or more into the sediment. These beds provide a variety of benefits to the marine environment: they enhance sediment stability, decrease wave energy, improve water clarity, and create habitat and substrate diversity. They also provide feeding grounds for many commercially and economically important fish and invertebrates, numerous species of wading and diving birds, and endangered species such as the West Indian manatee (*Trichechus manatus*) and the green sea turtle (*Chelonia mydas*) (Porter and Porter, 2002). The queen conch, *Strombus gigas*, may also be found in seagrass habitats.

The most distinctive benthic algae found on reef formations include a number of species of calcareous green algae (most notable is *Halimeda* spp.) and red algae (*Corallinaceae*); both are present at the grounding sites. These algae constitute a major source of calcium carbonate and marine sediment. *Halimeda* spp. typically grows in loosely interlocking series of connected plates that coalesce to form compact clumps and large cushion-like mats. Crustose coralline red algae accrete calcium carbonate onto the reef to help build and maintain the structure and have been linked to chemical stimuli that allow coral to recognize suitable substrate for settlement and metamorphosis (Negri et al., 2001). A variety of types of benthic macroalgae are found near the grounding sites, where they enhance primary productivity and serve as a food source for many species. Jaap (1984) provides a synoptic overview of algae associated with south Florida reef systems.

2.2.6 Threatened and Endangered Species

The federal Endangered Species Act (ESA) of 1973, the state of Florida Rules 39-27.004 and 39-27.005, and Florida Administrative Code (FAC) Chapter 68A-27 (animals) and Chapter 5B-40 FAC (plants) direct federal and state agencies to protect and conserve listed threatened and endangered (T&E) animals and plants. Habitats of T&E species are of particular importance because they require careful management.

Federally listed and candidate T&E species that occur within the area of the Allie B grounding sites are presented in Table 2-1. The list includes six mammals, one fish, five turtles (reptiles), and three coral species. The West Indian manatee (*Trichechus manatus*) is the only listed T&E species (Table 1) that permanently resides in BISC. The manatee is most closely associated with Biscayne Bay and seagrass habitat, but it occasionally occurs in the areas of the grounding sites. The other listed marine mammals include five species of endangered whales that may seasonally (predominantly in the winter) occur in the offshore vicinity of the grounding sites. The status of the smalltooth sawfish

(*Pristis pectinata*) population within BISC is uncertain. The current range of the smalltooth sawfish is peninsular Florida and is relatively common only in the Everglades region at the southern tip of the state (NOAA, 2005b). The sawfish inhabits shallow coastal waters and may occasionally be found in the areas of the grounding sites. There are five T&E species of sea turtles, three endangered and two threatened species, which occur in the areas of the grounding sites. The predominant months for sea turtle occurrence in the Florida Keys are April through October (Lott, 1996). Elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), and fused staghorn (*Acropora prolifera*), which occur within BISC, are candidates for possible addition to the list of T&E species protected under the ESA. Fused staghorn (*A. prolifera*) is a first generation hybrid of elkhorn and staghorn corals (Vollmer and Palumbi, 2002). Designation as candidate species by the U. S. National Marine Fisheries Service is planned to promote conservation efforts to protect the existing *Acropora* populations. Colonies of *Acropora* have not been sighted at or close to the Allie B grounding sites.

Table 2-1. Federally Listed and Candidate Threatened and Endangered Species Associated with the Allie B Grounding Sites

Common name	Scientific Name	Group	Status
Finback whale	<i>Balaenoptera physalus</i>	mammal	Endangered
Humpback whale	<i>Magaptera novaeangliae</i>	mammal	Endangered
Right whale	<i>Eubalaena glacialis</i>	mammal	Endangered
Sei whale	<i>Balaenoptera borealis</i>	mammal	Endangered
Sperm whale	<i>Physeter macrocephalus</i>	mammal	Endangered
West Indian manatee	<i>Trichechus manatus</i>	mammal	Endangered
Smalltooth sawfish	<i>Pristis pectinata</i>	fish	Endangered
Elkhorn coral	<i>Acropora palmata</i>	coral	Candidate
Fused staghorn	<i>Acropora prolifera</i>	coral	Candidate
Staghorn coral	<i>Acropora cervicornis</i>	coral	Candidate
Common green sea turtle	<i>Chelonia mydas</i>	reptile	Threatened
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	reptile	Endangered
Kemps Ridley sea turtle	<i>Lepidochelys kempii</i>	reptile	Endangered
Leatherback sea turtle	<i>Dermochelys coriacea</i>	reptile	Endangered
Loggerhead sea turtle	<i>Caretta caretta</i>	reptile	Threatened

2.3 Cultural Resources

Human populations are known to have inhabited Florida as early as 12,000 years ago. When people first came to Biscayne Bay, South Florida was a freshwater marsh or lake that extended from the rocky hills of the present-day keys to the ridge that forms the current Florida coast. As melting glaciers caused a gradual rise in global sea level, the basin became inundated by seawater. The modern-day configuration of the Florida coastline was established about 4,000 years ago (Milanich 1994), so some of the areas in BISC that are currently inundated and near submerged keys may contain prehistoric Native American archeological sites. Based on general knowledge of Florida prehistory, sites expected would be remnants from small nomadic bands supported by a hunting, fishing, and gathering economy. One prehistoric period site has been recorded within the upland

area of BISC, and it is anticipated that additional sites may be present on the outer reefs and on the bottom of Biscayne Bay (Leynes and Cullison, 1998). Sites that may be expected within the inundated areas of BISC would possibly be represented by discrete scatters of stone tools and, if inundated prior to degradation of organic materials, possibly remnants of materials such as woven basketry, cloth, and items made of wood.

Spanish explorers who came to the area during the 16th century encountered local populations whom they called Tequesta. Tequesta populations may have occupied a wide range of areas in eastern Florida. Within the park, four Tequesta sites have been recorded. These sites, which include ceramics, worked shell, and middens, suggest the presence of intermittent intensive seasonal settlements that may date from about 1000 AD (if not earlier) to about 1650 AD. These identified sites may represent remnants of sites related to the Tequesta and indicate that other related sites may be found. Such local populations, in addition to exploiting shell resources, may have hunted in the water using watercraft of unknown design. Remnants of such watercraft could be among the cultural resources buried within Biscayne Bay.

After its discovery by Spanish explorers, the area that includes BISC became a preferred route for ships returning to Spain from the New World. However, the numerous submerged keys proved repeatedly to be a hazard to navigation. The Straits of Florida was the fastest route to Europe, but was also dangerously narrow. Consequently, numerous archeological remains, some of which are listed in the National Register of Historic Places (NRHP), are located on submerged bottomlands of BISC. These remains include an array of shipwrecks, other representations of maritime casualties, and submerged historic non-shipwreck sites (e.g., docks, ballast piles, navigation aids, etc.). Among the earliest known wrecks are a Spanish treasure galleon, *Nuestra Senora de Populo*, which sank in 1733, and the HMS *Fowey*, a British warship, which sank in 1748. The Offshore Reefs Archaeological District is the only existing NRHP underwater shipwreck district in an NPS unit. It is considered significant for the information that it yields regarding more than 200 years of maritime commerce and transportation. Forty-three known shipwreck sites representing more than 500 years of maritime heritage are located within the current park boundary. Twenty-eight of these are located within the boundary of the Offshore Reefs Archaeological District. In addition, 7 of the park's 16 submerged historic non-shipwreck sites are located within the boundaries of the Offshore Reefs Archaeological District.

3. INJURY ASSESSMENT

In support of NPS Reef Restoration Program in BISC, Tetra Tech and Marine Resources, Inc. (MRI) conducted onsite dive surveys at the Allie B grounding sites. Surveys were conducted in January 2003 (MRI, 2003), approximately 4.5 years after the grounding incident, and in December 2004 (Tetra Tech, 2005), approximately 5.5 years after the grounding. The objective of the surveys was to gather site-specific information that would provide guidance in determining feasible restoration options.

3.1 Physical Environment

The Allie B's barge was a relatively heavy ship that injured the reef's geological structural integrity. Structural injury to the reef matrix is often characterized by major alteration in the topographic relief (Hudson and Diaz, 1988; Graham and Schroeder, 1996; Banks et al., 1998; Tilmant et al., 2003). Destabilization of the reef structural matrix increases the vulnerability to ongoing erosional processes. Studies have indicated that once destabilization occurs, recovery is not likely without mitigative actions to stabilize the site (Miller et al., 1993; Jaap, 2000; Hudson and Goodwin, 2001). Lack of management intervention following the incident will often result in a continued degradation and enlargement of the impacted site over time (Tilmant et al., 2003).

3.1.1 Fractures of Reef Substrate

Fractures to the reef substrate are an injury type reported for both the Allie B tug and barge grounding sites (LawGibb, 1998; LawGibb, 2001). This injury type is defined as a break, rupture, or crack in the reef structural matrix. This injury is caused when sufficient external force is applied to a hard reef substrate. Fracturing of the reef matrix produces variously sized fissures or fragments. The amount of injury caused by the fractures depends upon their size and the physical stability of any loose fragments after the injury. Large accumulations of unstable substrate rubble have the potential to cause further damage due to movement and impacts with other reef features.

Fracturing of reef substrate at the Allie B sites was difficult to conclusively identify as grounding-related due to post-injury biological and erosional masking. The most prominent fracturing was observed in association with the graded topographic features of the barge site. Some of the smaller impact features identified during the post-grounding injury assessments by LawGibb (1998) could not be located during the recent site surveys. Fractures and subsequent lateral separation of the substrate appeared relatively stable at most of the graded (i.e., leveled or planed off) impact features at the barge site (Figure 3-1). The assessment of fracture stability was based on observations made over a short period; large fractures observed at the barge site have substantially increased the surface area of the exposed substrate. Based on this trend, which is likely to persist, it is expected that substrate degradation will not stabilize and may accelerate as erosional processes continue. Some of the graded impact features, originally tagged during assessment operations and located again during the recent site surveys, were characterized by fissures and localized loose substrate fragments. One impact feature was severely degraded and was distinguished from other locations by the high degree of substrate fragmentation (Tetra Tech, 2005).

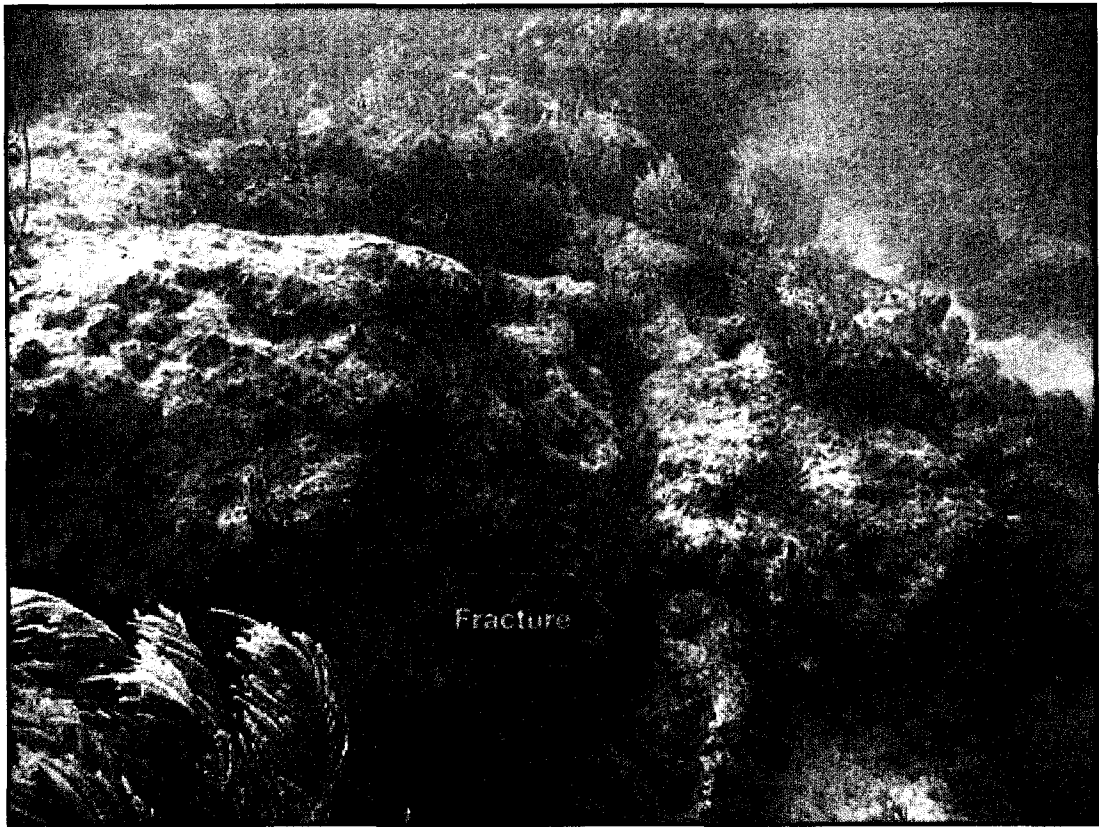


Figure 3-1. Lateral Separation of Substrate along Fracture at One of the Barge Site Graded Impact Features

3.1.2 Altered Topography

The Allie B grounding altered the topography of the exposed hard bottom formations and unconsolidated substrate (LawGibb, 1998; LawGibb, 2001). An estimated 373 m² of hard bottom reef substrate was altered at the barge grounding site (LawGibb, 2001) and was characterized as leveled topography relatively devoid of epibiota. At the tug grounding site, approximately 18 m² of hard bottom reef substrate was altered, including scrapes of variable sizes and depths and substrate displacement. The most prominent topographic alteration at the tug grounding site was the alteration of unconsolidated substrates that resulted in the creation of 190 m² of blowhole depressions and a corresponding 302 m² of elevated berms (LawGibb 2001).

The altered topography at the Allie B grounding sites has not recovered. That fact was apparent during the Tetra Tech/MRI site survey performed in December 2004 (MRI, 2003; Tetra Tech, 2005). The graded topography at the barge site shows only limited biotal recruitment, and was easily identifiable even 5.5 years after the grounding. The degree of topographic alteration at the barge site can be extrapolated by the amount of (1) loose substrate fragments directly adjacent to graded impact features and (2) the inverted biotal orientation on large substrate pieces displaced during the grounding. Identifiable features of altered topography at the tug site include the blowholes outlined by surficial sand substrate and what appear to be small remnant piles of substrate rubble (Figure 3-2).

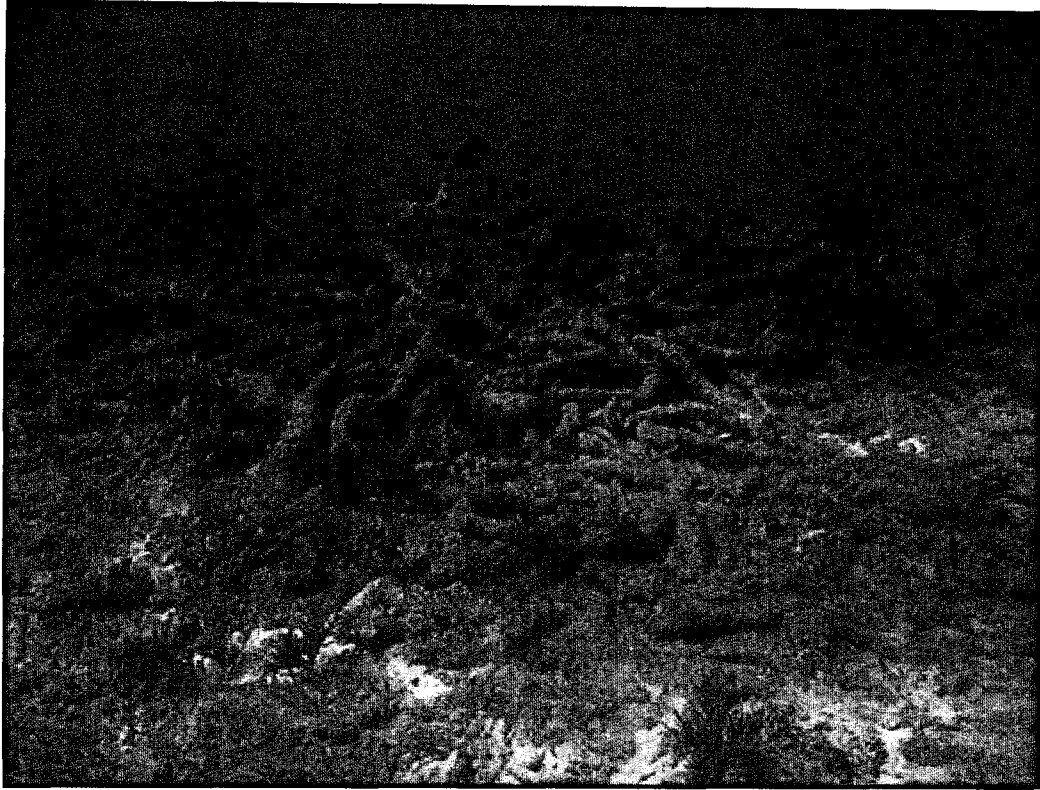


Figure 3-2. Small Pile of Substrate Rubble Located at the Allie B Tug Grounding Site

3.1.3 Rubble

Rubble is produced when the substrate is destabilized and removed from its original place or position or substrate features are fragmented or detached and accumulate in depressions or piles. The severity or degree of rubble production is based primarily on its spatial extent and the volume of displaced substrate. In addition, rubble is evaluated on its potential to cause further injury. For example, loose rubble (e.g., displaced substrate) can be very detrimental or injurious to reef habitat because it can severely alter the substrate topography by reducing habitat stability and complexity. Another harmful consequence of loose rubble or substrate displacement is collateral biological damage from the burial or mechanical abrasion of associated epibiota.

Rubble was produced at both Allie B grounding sites and was extremely severe at the tug site (LawGibb, 2001). Rubble ranging in diameter from 0.25 to 3 m was reported from the barge site (LawGibb, 2001). Large piles (i.e., berms) of displaced substrate composed primarily of hard coral fragments, abraded calcium carbonate rubble, and sand were created by the prop wash during the extrication of the grounded tug (Figure 3-3). The mechanical disruption of the prop in conjunction with its forceful movement of seawater (i.e., prop wash) rapidly eroded the semi-consolidated reef matrix that supported the grounded vessel. The extrication of the Allie B tug demonstrated that uncontrolled efforts to remove grounded vessels can be more detrimental to the habitat than the grounding itself. Prop wash greatly increases the spatial extent of an impact due to displacement/burial and creation of a fine sediment plume.



**Figure 3-3. Berms of Displaced Substrate Created by Prop Wash
at the Allie B Tug Grounding Site**

Rubble, a consequence of the grounding and extrication events that originally altered the topography, was observed to remain at the Allie B grounding sites during the December 2004 site survey (Tetra Tech, 2005). An estimated 20 pieces of large substrate rubble (>0.5 m long) were observed to be loose and adjacent to graded impact features at the barge grounding site. Most of the rubble near the graded impact features site was relatively stable due to the degree of burial in soft sediments, their size, and to a lesser extent, their orientation. Rubble at the tug grounding site included both large reef substrate and piles of smaller semi-consolidated substrate (see Figures 3-2 and 3-3). Larger pieces of substrate with associated attached biota were observed along the shoreward edge of the reef crest and directly adjacent to the primary blowhole formation. These large substrate pieces were relatively isolated and were prone to scouring along the base (Figure 3-4). Two semi-consolidated rubble piles were observed along the shoreward edge of the blowhole formations. The apparently remnant accumulations of rubble associated with blowhole formations appeared to be relatively stable (Tetra Tech, 2005) (see Figure 3-2).

3.1.4 Increased Turbidity

Increased turbidity existed during, and probably for a short time after, the grounding events. Grounding-associated turbidity was directly observed at the Allie B tug grounding site and was video-documented by BISC in 1998. The sediment plume whose presence was captured on video was relatively extensive and oriented approximately north-northwest, away from the grounding site. Although a sediment plume was observed in the video, injuries attributable to the increased turbidity during and after the grounding were not documented during assessment operations. A



Figure 3-4. Larger Pieces of Substrate with Attached Biota

determination of turbidity-related injury at the tug site was probably not feasible due to the ephemeral nature of the condition and the higher priority placed on assessing the severe injuries associated with direct impacts of substrate displacement. Rogers (1990) reviewed the responses of reef habitat and organisms to sedimentation and determined that species and habitat-specific sedimentation thresholds are a primary data gap for predicting consequences of sedimentation.

3.1.5 Presence of Foreign Material

LawGibb (1998) reported anti-fouling paint on some of the barge site injury areas characterized by graded topography. No anti-fouling paint was observed during the December 2004 visit to the Allie B barge grounding site (Tetra Tech, 2005).

3.2 Biological Environment

3.2.1 Loss of Biota

Epibiotical loss at the Allie B grounding sites was based on percent-cover estimates (LawGibb, 2001). Loss of epibiota for the tug and barge sites were estimated to be 85.45 m² and 373 m², respectively. Loss of biota at the tug site includes soft and hard corals, zoanthids, hydroids, and sponges; estimates for loss of biota at the barge site included only the soft and hard corals (LawGibb, 2001).

Biotical loss at the Allie B grounding sites was a result primarily of displacement and burial. Displacement is caused by the exertion of sufficient force to overcome the resistance provided by the organism's substrate attachment. Sufficient force may be the result of direct contact or other physical forces (e.g., pressure differential), such as the force a rapidly moving vessel might produce

in shallow water. Displacement may be a temporary condition for some biota, because many organisms exhibit relatively rapid tissue growth and subsequent reestablishment of a primary holdfast. However, displacement is a relatively severe condition for both soft and hard corals. One loose colony of maze corals (*M. meandrites*) observed at the barge grounding site during the December 2004 site survey (Tetra Tech 2005) appeared to have been recently displaced from its attachment point.

Burial is best defined as movement of substrate or biota that inundates other substrate or biota. The displacement/burial injury type is a consequence of other habitat injuries (i.e., displaced organisms, fractured substrate, and displaced substrate). There are various degrees of burial, the most extreme being complete coverage. Severity of injury to most reef biota is more directly related to the duration and not the degree of displacement/burial; burial conditions at the tug site persisted for months after the grounding event (Mulcahy, 2005).

3.2.2 Surficial Injury to Epibiota

Surficial injuries are injuries to the outer or topmost portion of organisms that produce a visible lesion (i.e., sign of damage). This type of injury is caused by abrading the surface with considerable pressure. Surficial scarring of soft tissue organisms lacking a calcium carbonate skeleton may be observable only for a short period due to tissue regeneration (Hoppe, 1988; Duckworth, 2003). This type of injury was described for impacts associated with the tow cable of the Allie B grounding. Surficial injuries, which are readily masked, were not observed during the December 2004 site survey (Tetra Tech, 2005). The ability of epibiota, especially hard corals, to recover from surficial injuries depends on the size and morphology of the lesion, location of injury, size of colony, and species (Meesters et al., 1996; Meesters et al., 1997).

3.2.3 Tissue Toxicity

There was no indication of ongoing tissue toxicity during December 2004 surveys at the Allie B grounding sites (Tetra Tech, 2005). The embedded anti-fouling paint observed during assessment operations has dispersed, and the localized toxic effect of antifouling paint observed at other grounding sites is not apparent at the Allie B barge site.

3.3 Emergency Actions Performed

Post-grounding restoration actions were conducted at both the Allie B tug and barge grounding sites (Mulcahy, 2005). Emergency restoration actions at the tug site included backfilling the blowhole formations with displaced rubble and reattaching the displaced hard corals. The amount of rubble placed in the blowhole formations was insufficient to bring the blowhole depression back to grade with the adjacent substrate. Natural sand movement within the habitat after the grounding resulted in deposition within the blowhole depression and has substantially elevated the grade of the bottom of the blowhole formation. Approximately 200 hard coral colonies were reattached on the hard bottom substrate along the reef crest; these corals were buried by sand and were not relocated following Hurricane Georges (LawGibb, 2001). Emergency restoration action at the barge site included reattaching displaced hard corals and movement of substrate pieces. Approximately 25 hard coral colonies were reattached onto the graded topographic features; the reattached corals have since eroded. Some large substrate pieces that were considered relatively unstable after the grounding were repositioned in a more stable orientation within natural depressions of the reef formation.

3.4 Threatened and Endangered Species

No injuries to federally listed and candidate T&E species (see Table 2-1) were documented from the Allie B grounding.

3.5 Cultural Resources

After the grounding incident, BISC performed a preliminary investigation for cultural resources at the Allie B grounding site. The preliminary interpretation of the observations at the injury site was that submerged cultural resources do exist and that these resources may be an archeological site representing some form of historical maritime casualty. At the barge site, one brick was observed that was similar to the type found on the brick wreck. The brick wreck, which lies within the park boundaries is suspected to have been a vessel that was carrying bricks for the construction of Fort Jefferson during the 19th century. At the tug site, several pieces of metal were observed to the south and east of the blowhole, and two barrel hoops, several metal bars, unidentified sheet metal and beams, and a scattering of coal were observed. The association of materials and artifacts found is similar to a pattern seen on other reefs and submerged archeological sites of maritime casualty found within the park (Adams, 1998).Lost Recreational Use Services

The Allie B grounding adversely affected visitor use of BISC. Lost visitor uses included recreational boating and lobster fishing. Recreational boating was lost because a 2-square-mile buffer was imposed around the injury site from July 27, 1998, to May 10, 1999, or approximately 10 months. The closure occurred 2 days prior to the 2-day spiny lobster sport season, and an estimated 100 lobster fishers were excluded from the area. Based on the duration of the area closure and the time of closure, the preliminary estimate of the value of the lost boating was \$60,000, and the lost use during lobster sport season was estimated at \$10,500, for a total estimated value for lost recreational use services of \$70,500.

3.6 Issues Eliminated from Further Consideration

Other resources issues that were not relevant to the proposed actions or any of the alternatives considered in this RP/EA are indicated and briefly discussed below. NEPA and the Council on Environmental Quality (CEQ) regulations direct agencies to "avoid useless bulk... and concentrate effort and attention on important issues" (40 CFR 1502.15). The rationales for eliminating these issues from further consideration are also addressed below.

3.6.1 Other Aquatic Habitats

Restoration efforts will emphasize the offshore shallow reef formations injured at the Allie B tug and barge grounding sites, specifically, the reef formations between Star and Ledbury reefs in BISC. Other aquatic habitats within the park are not anticipated to be affected by restoration efforts and therefore not included for further consideration.

3.6.2 Socioeconomics

NEPA requires an analysis of impacts to the "human environment," that is the economic, social, and demographic elements in the affected area. Because Miami-Dade County residents often use BISC for recreational and commercial purposes, they will directly benefit from the restoration of offshore reef formations to baseline conditions. However, because the dollar value of the restoration actions themselves is low, the actions will not create a significant number of jobs for Miami-Dade

County residents. The socioeconomics issue, therefore, was not included for further analysis in this RP/EA.

3.6.3 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental impacts of their programs and policies on minorities and low-income populations and communities. Environmental justice considerations were not included for further analysis in this RP/EA because the proposed restoration actions are not expected to have a direct or indirect impact on minority or low-income populations or communities.

3.6.4 Air Quality

The Federal 1970 Clean Air Act stipulates that federal agencies have an affirmative responsibility to protect a park's air quality from adverse air pollution impacts. The air quality issue was eliminated from further consideration because restoration activities would not significantly impact air quality.

4. RESTORATION ALTERNATIVES

This section presents the alternatives for reef restoration that will be considered prior to the selection of the preferred site-specific reef restoration alternatives. Preliminary restoration actions (i.e., alternatives) were presented in the NPS Preliminary Estimate of Damages (PED), dated January 19, 1999, for the Allie B grounding. Restoration actions outlined in the PED included filling tug blowhole formations using natural materials, rebuilding lost reef structure using quarried limestone boulders, and allowing natural recovery. PED restoration actions were for scaling purposes to develop a reasonable claim for grounding-associated damages.

To develop the range of alternatives presented in this RP/EA, NPS assembled an interdisciplinary team (IDT) that includes decisionmakers, specialists from BISC and other NPS offices, as well as NEPA and technical experts. This IDT developed a comprehensive list of restoration actions appropriate for coral reef injury sites. The IDT then classified the specific injury types present at the Allie B site and selected the most suitable restoration actions for the those injury types from the comprehensive list. These suitable actions are presented below. The No Action alternative is also considered, as required by NEPA. The injuries at the Allie B grounding site have been categorized by two types: Reef Contact sites (where vessel, either the tug or barge, had direct contact with the reef) and Blowhole sites (where a blowhole was left in the substrate bottom). The injuries have been categorized because restoration alternatives differ for the two types. Restoration alternatives for all injury classifications are divided into two general categories, Geological and Biological. The alternatives presented below only include field-tested methods for restoring coral reef habitats. Depending on the injury type and site conditions, a combination of these alternatives may be more effective.

4.1 Applicable Restoration Methods—Reef Contact Sites

4.1.1 Geological

Restoration alternatives for reef contact sites under the Geological Category are further subdivided into three types of injuries: fracture of reef substrate, altered topography, and rubble. Geological restoration methods entail actions taken to stabilize, restore, or rebuild the reef structure following any one, or combination, of the three injury types.

4.1.1.1 Fracture of Reef Substrate

No Action Alternative

Under a No Action alternative, structural habitat restoration would be based on natural recovery. The No Action alternative serves as a benchmark for evaluating other considered alternatives. No action would leave the grounding sites in their current condition and rely on natural processes to restore pre-injury reef structure. The No Action alternative can have two general outcomes: (1) natural recovery taking longer than active restoration alternatives, or (2) further deterioration of the reef structure. Natural recovery of reef structure at the Allie B grounding sites is only possible on a geologic time scale because the proximity of the injured reef habitats to major tidal passes north of Elliot Key has retarded Holocene reef growth (Shinn, 1988). The No Action alternative would likely result in further deterioration of the reef structure as observed at other vessel grounding sites (NOAA, 2002). In lieu of other restoration alternatives, natural processes will likely change the sites

into a permanently altered coral community (Tilmant et al. 2003), thereby resulting in conditions that do not resemble pre-grounding topography, structure, and function. The No Action alternative should be used when it is believed there is a low likelihood of secondary injury or injury expansion or where other social, environmental, or logistical considerations dictate that no action is the best course.

Alternative Relative Cost

There would be no cost associated with the No Action alternative

Monitoring and Study Alternative

Monitoring would provide information concerning the natural recovery of the Allie B grounding sites. The overall goals of monitoring are to determine the effects that vessel groundings have on the long-term stability of injured coral reefs, to determine the rates and types of natural recovery that occur, and to provide guidance in future restoration efforts. The proposed monitoring program must permit the detection of and response to significant changes in habitat and community structure due to external disturbances (e.g., major storms). Monitoring as it applies to reef structure should include, but not be limited to, repetitive photographic stations, random transects, and censusing of fish assemblages.

Although the literature provides conflicting views concerning the association of reef fish and habitat variables (Jones and Syms, 1998), it is strongly indicated that the number of reef fish species and their abundance is directly related to substrate and habitat complexity in the form of vertical relief and number of interstices (Luckhurst and Luckhurst, 1978). Studies indicate habitat topography and coral cover are closely related to characteristics of the fish assemblage (Lirman, 1999; Syms and Jones, 2000). Monitoring of fish at the Allie B grounding sites should provide valuable information concerning changes in the structural status of the injured habitats (Dennis and Bright, 1988) and aid in evaluating level of restoration goal attainment.

Alternative Relative Cost

Relative costs for a single monitoring event and completion of a Monitoring and Study Report would range from \$32,000 to \$70,900. Total cost for the Monitoring and Study alternative would be based on the number of monitoring events annually and the total number of years that monitoring is performed. It is recommended that monitoring and study be performed for a period of 10 years.

Seal/Fill Fractures Alternative

This alternative involves repairing the prominent fractures in the reef structure. Existing fractures characterized by lateral separation of substrate pieces would be filled and sealed to secure the exposed substrate and avert erosional degradation. Bonding agents used for filling and sealing fractures could include cement and/or epoxy. Fractures would require the bonding agent to be worked into visible fissure and cracks to create a cohesive substrate matrix. Prior to filling and sealing fractures, the opposing substrate surfaces would have to be cleaned and roughened to improve bonding.

Visible fractures that may warrant sealing and filling were observed at both of the Allie B reef contact sites. Most prominent fracturing at the barge site was observed at northern portion of the

impact area. Fracturing at the tug site occurred along the shoreward edge of the reef crest and directly adjacent to the primary blowhole formation.

Alternative Relative Cost

The relative cost for the Seal/Fill Fractures alternative would range from \$28,700 to \$63,700, which includes a report documenting the restoration actions completed. These costs do not include permitting or monitoring costs. It is recommended that monitoring and study be performed in conjunction with implementing active restoration actions to monitor the results of the alternative implementation.

Removal of Material Alternative

A restoration alternative to be considered for the Allie B grounding sites is the removal of loose and unconsolidated substrate. Loose substrate at the grounding sites has the potential of causing additional damage to adjacent habitats in the event the sites are disturbed by major storm events. This alternative would be considered for grounding-related substrate pieces that cannot be used in other restoration alternatives, such as for filling of fractures or for reattaching displaced substrate to restore lost topography. Removal of loose substrate that cannot be reattached or have its fractures filled would require a small barge or pontoon boat, winch/crane, and dive assistance. Transporting material offsite may be expensive and require state and federal permits (Jaap, 2000).

Alternative Relative Cost

The relative cost for the Removal of Material alternative would range from \$45,400 to \$100,900, which includes a report documenting the restoration actions completed. These costs do not include permitting or monitoring costs. It is recommended that monitoring and study be performed in conjunction with implementing active restoration actions to monitor the results of the alternative implementation.

Filling with Rubble Alternative

This alternative involves repairing the prominent fractures in the reef structure. Existing fractures characterized by lateral separation of substrate pieces would be filled with rubble acquired onsite and sealed to secure the exposed substrate and prevent erosional degradation. Onsite natural substrate rubble that is loose and without hard coral would be used in conjunction with a bonding agent as fill augmentation for large fractures. The types of bonding agents used to fill and seal fractures could include cement or epoxy. Smaller fractures would require the bonding agent to be worked into visible fissure and cracks to create a cohesive substrate matrix. Prior to filling and sealing fractures, the opposing substrate surfaces would have to be cleaned and roughened to improve bonding.

Visible fractures that may warrant sealing and filling were observed at both the Allie B barge and tug grounding sites. Most of the prominent fracturing at the barge site was observed at the northern portion of the impact area. Fracturing at the tug site occurred along the shoreward edge of the reef crest and directly adjacent to the primary blowhole formation.

Alternative Relative Cost

The relative cost for the Filling with Rubble alternative would range from \$28,800 to \$64,200, which includes a report documenting the restoration actions completed. These costs do not include

permitting or monitoring costs. It is recommended that monitoring and study be performed in conjunction with implementing active restoration actions to monitor the results of the alternative implementation.

Filling with Non-Native Materials Alternative

This alternative involves repairing the prominent fractures in the reef structure. Existing fractures characterized by lateral separation of substrate pieces would be filled and sealed to secure the exposed substrate and avert erosional degradation. Quarried rock would be used in conjunction with a bonding agent as fill augmentation for large fractures. Bonding agents could include cement or epoxy. Smaller fractures would require the bonding agent to be worked into visible fissures and cracks to create a cohesive substrate matrix. Prior to filling and sealing fractures, the opposing substrate surfaces would have to be cleaned and roughened to improve bonding.

Visible fractures that may warrant sealing and filling were observed at both the Allie B barge and tug grounding sites. Most of the prominent fracturing at the barge site was observed at the northern portion of the impact area. Fracturing at the tug site occurred along the shoreward edge of the reef crest and directly adjacent to the primary blowhole formation.

Alternative Relative Cost

The relative cost for the Filling with Non-Native Materials alternative would range from \$29,900 to \$66,500, which includes a report documenting the restoration actions completed. These costs do not include permitting or monitoring costs. It is recommended that monitoring and study be performed in conjunction with implementing active restoration actions to monitor the results of the alternative implementation.

Promote Natural Depositional Processes Alternative

This restoration alternative involves the use of a relatively new technology called Biorock™ that promotes mineral accretion in seawater. The method applies low-voltage electricity through seawater, which causes limestone (calcium carbonate) to accrete on a cathode (e.g., metal mesh). Electricity generated from a renewable resource such as solar panels, windmills, or tidal current generators can be used as power sources. Biorock™ structures are reported to bond to hard bottom substrates (Global Coral Reef Alliance, 2005), which would promote opposing substrate surfaces to bond across fractures. Developers of this technology estimate that hard coral growth is three to four times faster on Biorock™ structures than on natural rock (. The metal cathode could be configured to most shapes and sizes to create substrate and topography that closely resembles the existing habitat and minimizes visual degradation.

Alternative Relative Cost

The relative cost for the Promote Natural Depositional Processes alternative would range from \$97,400 to \$216,500, which includes a report documenting the restoration actions completed. These costs do not include permitting or monitoring costs. It is recommended that monitoring and study be performed in conjunction with implementing active restoration actions to monitor the results of the alternative implementation.

5. ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental consequences of the restoration alternatives presented in this document. The direct, indirect, and cumulative impacts of each alternative for the physical and biological communities are presented in Table 5-1, which presents a detailed description of the impacts. The evaluation of those impacts described in Section 5 is presented in Section 7, "Restoration Planning."

Because the impacts to T&E species and cultural resources are the same for each alternative, they are not included separately in the table, but instead discussed in each impacts section applicable for all alternatives.

Potential cultural resources have been observed near the Allie B grounding site, but in the absence of a complete cultural resources survey, specific impacts could not be determined. However, potential impacts from restoration actions on an underwater site having cultural resources are discussed below. Prior to implementing the selected restoration action, a cultural resources survey should be completed to ensure valuable resources would not be impacted by the restoration action.

5.1 Direct Impacts

Direct impacts those caused by the implementation of the alternative and that occur at the same time and in the same place as the restoration action (NPS Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision Making [DO#12]). In the case of the Allie B site, direct impacts would be impacts to the unnamed reef during the implementation of the restoration action. Direct impacts that were examined include potential physical damage to adjacent benthic resources (e.g., abrasion, displacement, etc.) and potential physiological damage to adjacent biological resources (e.g., exposure to residual cement material, sediment).

Threatened and Endangered Species

Although there are a number of T&E species that are present within BISC, the implementation of any of the restoration actions would not directly impact any T&E species. The permits that will be obtained prior to implementing any restoration actions will require that a T&E species observer be onsite during all restoration activities. Work will cease if a T&E species enters the area and will not resume until the area is cleared.

Cultural Resources

The Allie B site would require an archeological survey prior to implementing the selected restoration action to determine whether historic properties are present within the area of potential effect (APE). If historic properties within the APE cannot be avoided, appropriate treatment or mitigation would need to be developed and implemented prior to implementation of the selected restoration action. Direct impacts to potential submerged cultural resources would involve direct physical disturbance to the resources or to the context of the resources as a result of implementing a preferred remedy for the restoration of injured coral reefs at BISC. Direct impacts may affect cultural resources that may potentially be eligible for NRHP listing.

Buried submerged prehistoric period sites may have good contextual association of artifacts and other possible archeological features such as hearths, burials, and food storage pits. Direct disturbance of a buried in situ archeological site would disturb the integrity of the site and may therefore result in an adverse impact to a site that may qualify as a historic property.

Direct physical disturbance resulting from coral reef restoration may also affect historic shipwrecks and may therefore result in an adverse impact to a potential historic site. Shipwrecks may be viewed as self-contained archeological contexts with potentially important information about shipping within a particular time period, social and physical organization on a ship, past cultural behavior based on cargo, and methods of ship construction.

However, the cultural resources observed were outside the footprint of disturbance to the reef and relatively close to the edge of the blowhole so restoration actions performed on the reef have little potential for impacting any cultural resources that may be present. Work areas adjacent to the reef could be identified that would not impact any resources present.

5.2 Indirect Impacts

Indirect impacts are those caused by implementing the alternative but that occur later or farther in the distance from the restoration action (DO#12). Indirect impacts examined include unanticipated changes in community structure, such as competitive interactions.

Threatened and Endangered Species

Restoration activities identified within this document are not expected to cause indirect impacts to any of the T&E species found in BISC.

Cultural Resources

In the absence of a complete cultural resources survey, implementing the preferred coral reef restoration action may result in indirect impacts to potential submerged cultural resources. Activities associated with implementing a remedy may disturb overlying sediment and result in inadvertent exposure of a resource to erosion through natural or artificial wave action. If activities such as boat anchorage, equipment laydown, or diver impacts or blowholes disturb or cause removal of previously protective sediments, then cultural resources may be exposed to new erosional factors. Over time, corrosion may result if materials such as bonding agents are inadvertently spilled on newly exposed cultural resources.

5.3 Cumulative Impacts

Cumulative impacts are additive impacts to a particular resource and include impacts of actions in the past, the present, and the reasonable foreseeable future (DO#12). Cumulative impacts examined include additive impacts to the coral reef system.

Threatened and Endangered Species

Restoration activities identified within this document are not expected to cause any cumulative impacts to the T&E species found in BISC.

Cultural Resources

Potential cumulative impacts to potential submerged prehistoric or historic period cultural resources may also result from activities such as boat anchorage; equipment laydown; accidental dispersal of bonding agents, such as spills; and diver impacts on the sea floor or blowholes. Such impacts may adversely affect potential prehistoric and historic sites that may be eligible for NRHP listing.

5.4 Mitigation

Numerous management actions will be undertaken during implementation of restoration actions to minimize the environmental impacts of the work. These management actions are summarized here.

- An anchoring plan will be prepared and approved by BISC personnel to minimize the potential damage from anchoring vessels during restoration activities.
- Any native or non-native materials brought to the site for placement will be from a local quarry or direct from the manufacturer to ensure the placement of only clean materials.
- Care will be taken to prevent spilling of any bonding agents used.
- A T&E species observer will be onsite during all restoration activities. Work will cease if a T&E species enters the area and will not resume until the area is cleared.
- A cultural resources survey will be performed prior to implementing the selected restoration action to determine whether historic properties are present within the area of potential effect (APE).
- Divers will take care to minimize contact with the biota and the reef structure.
- Turbidity screens will be used as necessary.
- Laydown areas will be minimized.

5.5 Types of Injuries and Categories of Restoration Alternatives

The injuries at the Allie B grounding site have been divided into two broad types: those at Reef Contact sites (where either the tug or barge had direct contact with the reef) and those at Blowhole sites (where a blowhole was left in the substrate bottom). This has been done because restoration alternatives differ for the two types. In addition, restoration alternatives for all injury classifications are divided into two general categories, Geological and Biological. Table 5-1 is organized by the injury type and category.

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Injury Category	
Geological	
Fracture of Reef Substrate	Cumulative Impacts
No Action	• Physical Environment: Continued erosion under the No Action alternative could fractures remain at injured sites. Impact: Continued erosion from other forces acting on the reef structure. On the injured sites. Impact: Continued erosion will occur if the natural recovery rate is slower than • Biological Environment: Suitable substrate for bioturbation. Slower rate of community recovery. Community structure naturally altered and potential loss of coral reef habitat. Loss of species composition and diversity. Increased potential for establishment of unwanted species. Aesthetic and recreational value may be reduced.
Monitor and Study	• Physical Environment: Obtain useful data for implementation of future coral reef fractures remain at injured sites. Continued erosion could compound or amplify erosion from on the injured sites. If monitoring station setup. Impact to reef erosion rate. Monitoring may collect data useful to assess • Biological Environment: Obtain useful data for implementation of future restoration actions. Community structure potentially permanently altered and potential loss of coral reef habitat. Loss of species composition and potential for establishment of unwanted species. Aesthetic and recreational value may be reduced.
Seal/Fill Fractures	• Physical Environment: Stabilized injury sites substrate will contribute to more erosion. Introduces non-native material. More rapid recovery to pre-injury baseline conditions. May be enhanced to baseline conditions. • Biological Environment: Material could temporarily alter reef structure until fracture fills. May be enhanced to baseline conditions.
Removal of Material	• Physical Environment: More rapid recovery to pre-injury baseline conditions. Potential for disturbance of underlying substrate. Aesthetic and recreational value may be enhanced to baseline conditions. • Biological Environment: More rapid recovery to pre-injury baseline conditions. Potential for disturbance of underlying substrate. Aesthetic and recreational value may be enhanced to baseline conditions.
Filling with Rubble	• Physical Environment: Stabilizes reef and reduces the rate of erosion by relocating Potential to disturb underlying substrate. Decreased erosion rate of reef physical and chemical properties of collateral damage from loose substrate. More rapid appearance of reef structure baseline conditions. • Biological Environment: More rapid recovery to pre-injury baseline conditions. Potential for disturbance of underlying substrate. Aesthetic and recreational value may be enhanced to baseline conditions.
Filling with Non-Native Materials	• Physical Environment: Stabilizes reef structure. Decreased erosion rate of reef Introduces non-native materials. Long-term reef stability. Long-term durability, behavior, non-natural appearance of the non-native materials have not been studied on a geologic begins. Short-term impact: Non-native materials could bio-erode at different rate than native area. Provides stable substrate for bioturbation. • Biological Environment: More rapid recovery to pre-injury baseline conditions. Potential for disturbance of underlying substrate. Aesthetic and recreational value may be enhanced to baseline conditions.
Promote Natural Depositional Processes	• Physical Environment: Stabilizes reef structure. Decreased erosion rate of reef visual appearance at surface. Long-term reef stability. Long-term durability, behavior, process. Creates stable substrate. The electrochemically deposited minerals have not been studied maintenance. More rapid recovery to pre-injury baseline conditions. • Biological Environment: More rapid recovery to pre-injury baseline conditions. Potential for disturbance of underlying substrate. Aesthetic and recreational value may be enhanced to baseline conditions.

Geological (cont.)	
Altered Topography	Cumulative Impacts
No Action	• Physical Environment: <i>Nont.</i> Continued erosion from no action could compound or altered topography remains other forces acting on the reef structure. On geologic time at natural rate at the injured recovery rate is slower than erosion rate, net erosion will occur. remains for short term. <i>Int.</i> Slower rate of community recovery. Community structure • Biological Environment: <i>Int.</i> Altered and potential loss of coral reef habitat. Loss of suitable substrate for biota and diversity. Increased potential for establishment of natural recovery rate. <i>Int.</i> Aesthetic and recreational value may be reduced.
Monitor and Study	• Physical Environment: <i>Nont.</i> Continued altered topography from no action could altered topography remains erosion from other forces acting on the reef structure. On at natural rate at the injured natural recovery rate is slower than erosion rate, net erosion remains for short term. If useful data for implementation of future ecosystem-wide station set-up. <i>Int.</i> Monitoring may collect data useful to assess impacts of other • Biological Environment: <i>Int.</i> As water quality. suitable substrate for biota <i>Int.</i> Continued erosion from no action could compound or natural recovery rate. other forces acting on the reef structure. If natural recovery osion rate, net erosion will occur. Obtain useful data for ure ecosystem-wide restoration actions.
Reestablish with Native Materials	• Physical Environment: <i>Rest.</i> Stabilizes reef structure by returning topography to natural ensure stability during high erosion rate of reef structure to increase long-term reef oceanographic properties, b appearance of the native materials are compatible on a impacts to bottom substrate. May lead to reversal of injured condition of reef and a more Disturbance of semi-consolidated injury baseline conditions. visual impacts to sites until <i>Int.</i> More rapid recovery to pre-injury baseline conditions. • Biological Environment: <i>Int.</i> Aesthetic value may be enhanced to baseline conditions. enhance vertical partitioning site and surrounding biota i
Reestablish with Non-Native Materials	• Physical Environment: <i>Rest.</i> Stabilizes reef structure by returning topography to natural ensure stability during high erosion rate of reef structure to increase long-term reef oceanographic properties, b appearance of the non-native materials may be incompatible non-native material that have. May lead to reversal of injured condition of reef and a appearance of reef structure to pre-injury baseline conditions. walking or from use of equipment <i>Int.</i> More rapid recovery to pre-injury baseline conditions. underlying substrates. Intro may be enhanced to baseline conditions. properties. Initially, creates occurs. • Biological Environment: <i>Int.</i> (zonation). Could cause micro stable substrate for biota re
Reestablish with Native and Non-Native Materials	• Physical Environment: <i>Cont.</i> Stabilizes reef structure by returning topography to natural returning them to pre-injury erosion rate of reef structure to increase long-term reef has different physical properties appearance of the non-native materials may be incompatible Initially, creates modified appearance. May lead to reversal of injured condition of reef and a appearance to sites until no pre-injury baseline conditions. mask the bonding agents. <i>Int.</i> More rapid recovery to pre-injury baseline conditions. • Biological Environment: <i>Int.</i> Aesthetic value may be enhanced to baseline conditions. (zonation). Could cause micro stable substrate for biota re create micro-relief and habi
Rubble	
No Action	• Physical Environment: <i>Nont.</i> Continued presence of unstable rubble may cause injury Continued collateral damage erosion. No action could compound or amplify erosion from at current rates on the injured the reef structure. On geologic time scale, if natural recovery • Biological Environment: <i>Int.</i> Aesthetic value may be enhanced to baseline conditions. unstable substrate for biota <i>Int.</i> Slower rate of community recovery. Community structure ly altered and potential loss of coral reef habitat. Loss of and diversity. Increased potential for establishment of aesthetic and recreational value may be reduced.

Geological (cont.)	
Rubble (cont.)	Cumulative Impacts
Monitor and Study	• Physical Environment: <i>Nent</i>: Continued presence of unstable rubble may cause injury. Natural recovery, if any, could compound erosion. No action could compound or amplify erosion from appearance remains for shn the reef structure. On geologic time scale, if natural recovery impact to reef appearance erosion rate, net erosion will occur. Obtain useful data for localized impact due to mature ecosystem-wide restoration actions. Monitoring may collect • Biological Environment: <i>h</i>: impacts of other factors on reef such as water quality. Suitable substrate for biota • Physical Environment: <i>ment</i>: Obtain useful data for implementation of future oration actions. Slower rate of community recovery. Community permanently altered and potential loss of coral reef habitat. position and diversity. Increased potential for establishment of esthetic and recreational value may be reduced.
Removal	• Physical Environment: <i>ment</i>: Stabilizes reef and reduces the rate of erosion by removing clamshell. Disturbance of seduces the potential of collateral damage from loose substrate, substrates. Reduces the ps of native materials to the site. visual impact until site is ab • Biological Environment: <i>ment</i>: More rapid recovery to pre-injury baseline conditions. tional value may be enhanced to baseline conditions. surrounding biota if clamsh
Stabilization and Relocation	• Physical Environment: <i>ment</i>: Stabilizes reef and reduces the rate of erosion by removing of semi consolidated matereduces the potential of collateral damage from loose substrate. the potential of collateral daf native material to the site. non-natural appearance. <i>ment</i>: More rapid recovery to pre-injury baseline conditions. gain of materials to site. tional value may be enhanced to baseline conditions. • Biological Environment: <i>l</i>: stable substrate for biota
Biological	
Loss of Living Organisms	Cumulative Impacts
No Action	• Physical Environment: <i>Nent</i>: Continued erosion from no action could compound or Natural recovery, if any, coother forces acting on the reef structure. On geologic time appearance remains for shvery rate is slower than erosion, net erosion will occur. an unnatural reef structure • Biological Environment: <i>ment</i>: Slower rate of community recovery. Community structure tly altered and potential loss of coral reef habitat. Loss of structure. Reduced amountand diversity. Increased potential for establishment of esthetic and recreational value may be reduced.
Monitor and Study	• Physical Environment: <i>Nent</i>: Continued erosion from no action could compound or Natural recovery, if any, coother forces acting on the reef structure. On geologic time appearance remains for shvery rate is slower than erosion, net erosion will occur. Obtain an unnatural reef structure.mentation of future restoration actions. Monitoring may collect monitoring station set-up. i impacts of other factors on reef such as water quality and • Biological Environment: <i>l</i>: structure. Reduced amountment: Obtain useful data for implementation of future lower rate of community recovery. Community structure tly altered and potential loss of coral reef habitat. Loss of and diversity. Increased potential for establishment of esthetic and recreational value may be reduced.
Reattach Living Biota	• Physical Environment: <i>ment</i>: Stabilizes reef and reduces the rate of erosion by non-native material that haishment of biota that in long-term will accrete and promote reef • Biological Environment: <i>bs</i> and are more able to withstand high-energy events. appearance. May increaseent: More rapid recovery to pre-injury conditions. Aesthetic e may be enhanced to baseline conditions.
Biological Seeding	• Physical Environment: <i>Nent</i>: None anticipated, but this is an unproven method with • Biological Environment: <i>l</i>: unknown. ent: More rapid recovery to pre-injury conditions. Aesthetic and be enhanced to baseline conditions.

Injury Category	
Geological	
Altered Topography	Cumulative Impacts
No Action	• Physical Environment: Continued presence of altered topography and rubble altered topography and net erosion. No action could compound or amplify erosion at natural rate on the is acting on the substrate. On geologic time scale, if natural appearance remains slower than erosion rate, net erosion will occur. On-going going natural recovery continues at current rates. • Biological Environment: Community structure permanently altered • Loss of species composition and diversity. Increased wanted species. Aesthetic and recreational value may be
Reestablish with Native Materials	• Physical Environment: Stabilizes substrate by returning topography to natural Helps ensure stabilityases net erosion rate of surrounding areas to increase overall localized oceanography. Behavior and appearance of the native materials are Short-term impacts to geologic time frame. More rapid recovery to pre-injury equipment. Disturbance • Biological Environment: Aesthetic and recreational value may be enhanced adequate supply of suitions. More rapid recovery to pre-injury conditions. natural recruitment oc • Biological Environm
Reestablish with Non-Native Materials	• Physical Environment: Stabilizes substrate by returning topography to natural and stabilizes blowholesases net erosion rate of surrounding areas to increase overall change some current lity. Behavior and appearance of the non-native materials may incident conditions. Shle on a geologic time frame. More rapid recovery to pre-injury from the use of equipm • Biological Environment: More rapid recovery to pre-injury conditions. occurs. Introduces non-lue may be enhanced to baseline conditions. dependent upon supply appearance of area. • Biological Environm (zonation). Could caus Provides stable subst
Reestablish with Native and Non-Native Materials	• Physical Environment: Stabilizes substrate by returning topography to natural and stabilizes blowholesases net erosion rate of surrounding areas to increase overall change some current lity. Behavior and appearance of the non-native materials may incident conditions. Shle on a geologic time frame. More rapid recovery to pre-injury from the use of equipr • Biological Environment: More rapid recovery to pre-injury conditions. physical properties. Iscreational value may be enhanced to baseline conditions. Initially, creates modifi mask the bonding age • Biological Environm (zonation). Could caus Provides stable subst sessile biota to create
Rubble	
No Action	• Physical Environment: Continued presence of unstable rubble may cause Natural recovery, if anxpience net erosion. No action could compound or amplify appearance remains fier forces acting on the substrate. On geologic time scale, if Impacts to appearance rate is slower than erosion rate, net erosion will occur. • Biological Environment: None anticipated. for biotal recruitment c
Monitor and Study	• Physical Environment: Continued presence of unstable rubble may cause Natural recovery, if anxpience net erosion. No action could compound or amplify appearance remains faer forces acting on the substrate. On geologic time scale, if Impact to blowhole are rate is slower than erosion rate, net erosion will occur. Obtain future restoration actionmplementation of future restoration actions. Monitoring may • Biological Environmful to assess impacts of other factors on reef such as water of suitable substrate fc • Biological Environment: Obtain useful data for implementation of future ; restoration actions. Aesthetic and recreational value may be seline conditions.

Geological (cont.)	
Rubble (cont.)	Cumulative Impacts
Removal	• Physical Environment: Stabilizes substrate and reduces the rate of erosion. Disturbance of semi coarse rubble, which reduces the potential of collateral damage substrates. Reduces substrate, but there is a net loss of native materials to the site. More visual impact until site is pre-injury conditions. • Biological Environment: Aesthetic and recreational value may be enhanced. Temporary increased conditions. More rapid recovery to pre-injury conditions. Aesthetic value may be enhanced to baseline conditions.
Stabilization and Relocation	• Physical Environment: Stabilizes substrate and reduces the rate of erosion. Disturbance of semi coarse rubble, which reduces the potential of collateral damage substrates. Creates substrate. There is no net loss of native materials to the site. More stabilization there is no pre-injury conditions. • Biological Environment: More rapid recovery to pre-injury conditions. provide more stable recreational value may be enhanced to baseline conditions.

6. MONITORING

6.1 Monitoring Overview

Components of the proposed monitoring plan are based on the restoration alternatives selected for the Allie B grounding sites. Proposed monitoring should permit the detection of, and response to, significant changes in overall structural and functional habitat characteristics that occur as a result of the conducted restoration or external disturbances (e.g., major storms). The duration for monitoring should be at least 5 years; the restored habitat should have time to develop natural ecological services. The plan should incorporate a higher frequency of monitoring events immediately following implementation of restoration alternatives to provide early detection of relative restoration progress and guidance for possible remedial actions. Success criteria for monitoring components should be quantifiable to determine relative success in meeting restoration objectives.

6.1.1 Purpose and Objectives

Monitoring would provide information concerning the recovery status of the Allie B grounding sites. The overall goal of monitoring is to determine the relative success of the conducted restoration actions and to provide guidance in future restoration efforts. Monitoring as it applies to reef structure and function should include, but not be limited to, repetitive photography at fixed stations, random transects, and censusing of fish assemblages.

6.2 Parameters

6.2.1 Morphology/Topography of Site

6.2.1.1 Methods

Sampling transects and photography could be used to monitor the morphology and topography of the Allie B grounding sites. Transects could be established within (experimental) and adjacent to (control) the grounding site to determine proportions of substrate types (i.e., consolidated hard bottom, sand, and rubble). Due to the limited size of the grounding sites, transects should be repetitive. A demarcated lead-line (weighted tape measure) that conforms to the contours of the reef topography should be used to delineate sampling transects. The percent coverage of each substrate type would be proportional to the length of the lead-line overlaying that particular substrate type.

Specific photographic methodology would depend on the selected restoration actions. Quantitative photography could be performed at randomly selected and/or at repetitive sampling locations. Photographs should be collected using a digital camera in an underwater housing with a standard 1:1 port lens. The standard 1:1 port lens on the underwater housing restricts peripheral distortion of the photographic image. A stainless steel rod that extends beyond the camera lens can be attached to the top of the underwater housing to provide an aid in maintaining a constant distance from the photographed object. To collect quantitative data, the video camera and housing are held perpendicular to the photographed object.

Quantitative photographic data can be analyzed to determine percent cover of substrate types. Photographic analysis will be performed using desktop imaging software. Photographic images would be projected onto a computer screen and a digital image containing 25 to 100 randomly selected points would be superimposed on the image. The number of points that covered each

substrate type would be recorded for each image. The percent coverage of each substrate type is proportional to the number of points overlaying the particular image. Some of the random points may fall on deep shadows or areas that are out of focus and will therefore be unreadable. In these cases, the denominator in the percent-cover calculations will be reduced by the number of points overlaying the shadowed or blurred areas. These percentages would be combined for all images from each site to obtain the average percent cover of each substrate type.

6.2.1.2 Success Criteria

Proposed sampling would provide information concerning spatial and temporal changes in the topography and morphology of the Allie B grounding site habitats. The proportional difference, concerning substrate coverage at experimental and control sampling locations, expressed as a percentage could be used to assess changes to the topography and morphology of the grounding sites.

6.2.2 Stability and Structural Integrity of Restoration

6.2.2.1 Methods

Survey sampling would include tactile assessment, direct observations, qualitative photography, and videography. Direct observations and qualitative photography will be collected at and directly adjacent to placed structures to monitor their structural integrity and their attachment to underlying reef framework. Observations would be made to assess the condition of the structure; the presence of structural fissures, matrix degradation, and bioerosion would be noted. The presence of scouring and subsequent undercutting between the structure and underlying substrate framework will also be monitored. Tactile assessment would be conducted to assess conditions compromising the stability and long-term placement of the structure.

6.2.2.2 Success Criteria

Success criteria concerning the stability and structural integrity of restoration is based on "presence/absence" evaluation. Intermediate degrees of stability or structural integrity would be very difficult to quantify.

6.2.3 Abundance/Diversity of Biota

6.2.3.1 Methods

Fish populations could be assessed using either the roving diver technique or the stationary sampling technique. The same level of effort (sampling time) for each technique should be expended for both the experimental and control areas. The proposed sampling techniques are described and reviewed by Bohnsack (1995).

Abundance and diversity of epibenthos can be determined using quantitative imaging data collected at the experimental and control areas. Quantitative data consisting of percent coverage of major epibiotal groups and density (colonies per square meter) of hard and soft corals would be collected during each survey. Quantitative data would be available for comparison between areas and between monitoring surveys. Quantitative imaging data could be collected along fixed transects and/or quadrats (fixed-size sampling plot, usually 1m x 1m) depending on the restoration. All images will be scaled to allow determination of surface coverage. To collect quantitative data, the camera and housing would be held perpendicular to the substrate.

6.2.3.1 Success Criteria

Proposed sampling would provide information concerning spatial and temporal changes in the abundance and diversity of biotal assemblages at the Allie B grounding site habitats. Proportional differences (expressed in percentages) in the sampling parameters between sampling areas and surveys concerning abundance and diversity at experimental and control sampling locations could be used to evaluate relative success of restoration.

6.2.4 Recruitment

6.2.4.1 Methods

Epibenthic recruitment can be assessed using fixed repetitive quadrats. Biota within the quadrats would be identified and mapped during the baseline survey. Mapping of epibenthos within the quadrat can be facilitated by using an X, Y coordinate grid established on the quadrat. The maximum and minimum dimensions should be measured for each hard coral within the quadrats. All quadrat data will be collected in situ. Photographic images of the quadrat should be collected as archival data. Recruitment data would be collected only at restoration locations.

6.2.4.2 Success Criteria

The change in number of biota per quadrat over the duration of the monitoring program would be used to evaluate recruitment. The net recruitment rate can be calculated as the change in the number of individuals per unit time. Recruitment at restoration locations would be a success indicator.

6.2.5 Community Structure

6.2.5.1 Methods

Quantitative imaging data as discussed previously for determining relative abundance and diversity at the experimental and control areas would also be analyzed to determine percent cover. Percent cover of major epibiotal groups would be estimated using the quantitative analysis method developed by Bohnsack (1976, 1979). Non-overlapping digital images at fixed transects or quadrats depending on the restoration would be saved as computer image files and reviewed using Adobe Photoshop computer software. An image file containing 25 randomly selected points would be superimposed on the image file. The number of points that covered each of the epibiotal groups will be recorded for each image file. The percent coverage of each distinguishable epibiotal group is proportional to the number of points overlaying the particular image. These percentages would be combined for all image files from each transect to obtain the average percent coverage for each epibiotal group.

6.2.5.2 Success Criteria

Proposed sampling would provide information concerning spatial and temporal changes in the percent coverage of biotal assemblages at the Allie B grounding site habitats. Proportional difference in the percent cover between sampling areas and surveys, expressed as a percentage, could be used to evaluate relative success of restoration.

6.2.6 Stability, Attachment Status, and Relative Health of Reattached Biota

6.2.6.1 Methods

Stability (i.e., integrity of cement bond) and relative health of reattached biota would be determined using tactile assessment, direct observations, and qualitative photography. Tactile assessment to assess the stability of the experimental group would be conducted by gently pulling on the colony edge. Direct observations and qualitative imaging would be used to evaluate the relative health of experimental and control groups, and would be compared between groups and between monitoring surveys. Relative health of hard corals would be based primarily on visual/digital qualitative imaging assessment of colony color (e.g., bleaching), tissue condition (e.g., degree of accretion/regression and presence of disease) and interspecific events (e.g., clionid [boring sponge] intrusion).

Monitored biota would include a set of reattached biota and reference (i.e., control) biota that remained intact during the grounding event. The experimental and control groups would be established during the initial (baseline) survey.

6.2.6.2 Success Criteria

The percentage of successful reattached biota versus failed reattachments could be used as a success threshold. The proportional difference concerning attachment status of reattached biota and relative health of reattached and reference biota, expressed as a percentage, will be used to assess the success of coral reattachment as a suitable means of long-term restoration at the Allie B grounding sites.

6.3 Schedule

A schedule will be included for the selected alternative.

7. RESTORATION PLANNING

An effective restoration planning process involves:

1. Identifying and describing the categories and types of injured resources;
2. Combining appropriate techniques and methods to develop a range of alternative restoration actions;
3. Identifying the environmental consequences (impacts) of each alternative on the injured resource;
4. Developing monitoring schedules, methods, and success criteria appropriate for the recovering resources; and
5. Selecting a preferred alternative by evaluating the proposed restoration alternatives against relevant evaluation criteria.

Steps 1-4 of this process are described for the Allie B site in Sections 1 through 6. The last step, selecting a preferred alternate, is described in Section 7. That step involves first stating the restoration strategy to be used, then selecting applicable criteria, and finally evaluating each proposed alternative against threshold and additional criteria in a comparative analysis to identify the preferred restoration action.

7.1 Restoration Strategy

The PSRPA allows NPS to seek compensation for injuries to National Park System resources and use the recovered funds to restore, replace, or acquire equivalent resources, and to monitor and study such resources (USDOI-NPS, 2003). When injury occurs, damages for grounding cases are sought and obtained under the PSRPA (16 USC 19jj).

Restoration actions under PSRPA are either primary or compensatory. Primary restoration involves actions taken to return injured natural resources and services to their baseline conditions. NEPA requires the Trustees of restoration actions to consider a "No Action" alternative or natural recovery under primary restoration. Under this alternative, NPS would take no direct action to restore injured natural resources or compensate for lost services pending environmental recovery. The principal advantages of this approach are ease of implementation and minimal or no monetary costs. NPS may select natural recovery under three conditions: (1) if feasible, (2) if cost-effective primary restoration is not available, or (3) if injured resources would recover quickly to baseline without human intervention. Alternative primary restoration activities can range from natural recovery to actions that prevent interference with natural recovery to more intensive actions expected to return injured natural resources and services to baseline faster than natural recovery. Applicable restoration actions have been developed and presented in this document for consideration for primary restoration.

Compensatory restoration is action taken to compensate for the interim losses of natural resources or services pending recovery to baseline conditions. The type and scale of compensatory restoration may depend on the nature of the primary restoration and the level and rate of recovery of the injured natural resources or services given the primary restoration action. When identifying the compensatory restoration components of the restoration alternatives, NPS should first consider compensatory restoration actions that provide services of the same type and quality and of comparable value as those lost. If such compensatory actions cannot provide a reasonable range of alternatives, NPS then considers other compensatory restoration actions that will provide services of at least comparable type and quality as those lost.

Although NPS has determined that natural recovery may be appropriate as one means of primary restoration for injuries resulting from the Allie B grounding, the No Action alternative is rejected for compensatory restoration. Losses were, and continue to be, suffered during the period of recovery from this grounding, and technically feasible, cost-effective alternatives exist to compensate for these losses.

NPS determined that damages will be applied “toward the restoration, replacement, or rehabilitation of the equivalent of the natural and National Park System resources or resource services which were injured, destroyed or lost as a result of the Allie B grounding.” For this grounding site, NPS considered the area affected by the grounding, estimates of initial lost ecological and recreational services, and recovery periods of each impacted habitat type to determine the magnitude of the damages. These estimates are included in the PED. In accordance with the scaling approach, NPS relied on available data, applicable literature, experience, and best professional judgment. Precise scaling calculations are often not possible because knowledge of relevant physical and biological processes is not sufficient. Accordingly, some general assumptions were adopted by NPS to allow an estimation of the scale of restoration necessary to compensate for injuries resulting from this grounding.

NPS developed criteria to evaluate applicable restoration actions presented, hereafter collectively referred to as “restoration alternatives.” The criteria include relevant federal and state statute provisions governing the use of recoveries for natural resource injuries. The restoration alternatives have been evaluated using the evaluation criteria to determine the appropriate actions to be undertaken at the Allie B grounding site that comply with BISC coral reef restoration goals and objectives.

7.2 Evaluation Criteria

The NEPA requires that Trustees of restoration actions examine a full range of alternatives and then identify the selected restoration alternative(s) based on specified selection criteria. For the Allie B grounding site, NPS developed selection criteria in two categories: “threshold” and “additional” criteria. Restoration alternatives must achieve a minimum level of acceptance on the threshold criteria to receive further consideration under the additional criteria. NPS used the evaluation criteria listed below to consider and prioritize all restoration alternatives currently identified. The criteria are not ranked in order of priority.

7.2.1 Threshold Criteria

Threshold criteria were developed to ensure that the restoration actions selected not only comply with laws, policies, and regulations but are technically feasible and consistent with site-specific restoration goals.

Technical Feasibility

The proposed restoration alternative is believed to be technically feasible, and its complexity and potential technical problems do not limit its chance of success.

Compliance with Policies and Procedures of Biscayne National Park

The proposed restoration alternative can be implemented in a manner consistent with the policies and procedures of BISC.

Compliance with Laws and Regulations

The restoration alternative complies with all applicable federal, state, and county laws and regulations.

Consistent with Restoration Goals

The proposed restoration alternative will achieve BISC's restoration goal, which is based on existing site conditions: to create, to the extent practicable, a stable, self-sustaining outer bank reef of similar topography and surface complexity to that existing prior to injury. It will also comply with the PSRPA (16 USC 19jj) and "restore, replace, or acquire the equivalent of resources which were the subject of that action and (to) monitor and study such resources."

Public Health and Safety

The proposed restoration alternative poses no threat to the health or safety of the public or agency staff, and it complies with applicable health or safety requirements and guidelines.

7.2.2 Additional Criteria

Additional criteria were developed to evaluate each restoration action against each other to determine the most appropriate restoration action.

Relationship to Injured Resources and Services

The proposed restoration alternative will restore, rehabilitate, enhance, or acquire the equivalent of the resources and services injured by the grounding and provide benefits to comparable resources and services providing appropriate nexus to injured resources.

Acceleration of Recovery Times

The proposed restoration alternative will expedite the site's full physical and ecological recovery and accomplish restoration goals in a short period.

Natural Recruitment

The proposed restoration alternative will enhance successful natural recruitment after implementation.

Potential for Collateral Injury

The proposed restoration alternative will avoid or minimize short-term and long-term adverse impacts to the environment and the natural resources at and near the injured sites.

Likelihood of Success

The proposed restoration alternative is likely to succeed at meeting restoration goals.

Aesthetics

The proposed restoration alternative should create a natural visual appearance and substrates and topography that resemble the adjacent habitat.

Benefits Relative to Costs

The proposed restoration alternative should be cost-effective and deliver high value in terms of benefits-to-costs.

Likelihood of Erosion

The proposed restoration alternative should minimize the threat of unnatural erosion of the reef substrate after implementation.

Introduction of Foreign Non-Native Materials

The proposed restoration alternative should minimize the introduction of materials not naturally found on the site (e.g., concrete, adhesives, quarried rock, reinforcing rods, matting materials).

Introduction of Foreign Biological/Genetic Material (Biological Restoration Only)

The proposed restoration alternative should minimize the introduction of foreign (e.g., transplanted from other reef locations) or genetically distinct biological material.

7.2.3 Criteria Considered but Eliminated from Further Consideration

The following criteria were considered as described below but eliminated from further consideration.

Timing of Restoration Implementation Activities

The proposed restoration alternative should be implementable during a range of seasons and weather conditions.

Likelihood of Evaluating Success

The success of implementing the proposed restoration alternative should be easy to assess using standard monitoring methods and frequencies.

Maintenance of Species Biodiversity/Community Composition

The proposed restoration alternative should contribute to maintaining the species biodiversity and community composition found at the site prior to disturbance. Those alternatives that are likely to result in a more rapid return to a comparable site biodiversity and community structure are preferred over those that may require longer periods of time or are less certain of achieving this.

Ecological Compatibility with Natural Process

The proposed restoration alternative should consider the extent that the proposed action makes use of natural processes for recovery or that resulting conditions will allow those naturally functioning ecological processes that occurred prior to site disturbance to continue to occur.

7.3 Evaluation of Restoration Actions

The NEPA process is being implemented concurrently with the development of this RP/EA. To comply with the requirements of NEPA, the Trustees analyzed the effects of each proposed restoration action on the environment. NEPA's implementing regulations direct federal agencies to evaluate the potential significance of proposed actions by considering both the context and the intensity of the action. For most of the restoration actions considered, the appropriate context and area of potential significance of the action is regional, not national or worldwide.

The Environmental Consequences, including the Direct, Indirect, and Cumulative Effects, of each restoration action are evaluated and discussed in Section 5 of this document. These effects are taken into account during the evaluation of the restoration actions using the evaluation criteria.

Each restoration action will be evaluated against each of the threshold criteria for a yes/no evaluation. If restoration action does not obtain a yes response to all threshold criteria, the restoration action is dropped from consideration. The restoration actions that pass the Threshold Criteria will be evaluated against the Additional Criteria and ranked using a 1–5 scoring system as follows:

Points	Rating
5	Excellent
4	Good
3	Moderate
2	Fair
1	Poor

The score for each restoration action will be added up to obtain a total. The alternatives with the highest total evaluation will be the preferred alternative.

Tables 7-1 and 7-2 present an evaluation of the alternatives described above for the reef contact sites and the blowhole sites, respectively.

7.4 Preferred Alternative

The evaluation that is performed by NPS will determine the preferred alternative.

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Criteria	Rubble				
	Re and Native Materials – Official Monotures	No Action	Monitor and Study	Removal	Stabilization and Relocation
THRESHOLD CRITERIA					
Technical Feasibility					
The proposed restoration alternative is believed to be technically feasible, and its complexity and potential technical problems do not limit its chance of success.					
Compliance with Policies and Procedures of Biscayne Nation					
The proposed restoration alternative can be implemented in a manner consistent with the policies and procedures of Biscayne National Park.					
Compliance with Laws and Regulations					
The restoration alternative complies with all applicable federal, state, and county laws and regulations.					
Consistent with Restoration Goals					
The proposed restoration alternative will achieve Biscayne National Park's restoration goal, which is based on existing site conditions: to create, to the extent practicable, a stable, self-sustaining outer bank reef of similar topography and surface complexity to that existing prior to injury. It will also comply with the PSRPA (16 USC 19jj) and "restore, replace, or acquire the equivalent of resources which were the subject of that action and (to) monitor and study such resources."					
Public Health and Safety					
The proposed restoration alternative poses no threat to the health or safety of the public or agency staff, and it complies with applicable health or safety requirements and guidelines.					
ADDITIONAL CRITERIA					
Relationship to Injured Resources and Services					
The proposed restoration alternative will restore, rehabilitate, enhance, or acquire the equivalent of the resources and services injured by the grounding and provide benefits to comparable resources and services providing appropriate nexus to injured resources.					
Acceleration of Recovery Times					
The proposed restoration alternative will expedite the site's full physical and ecological recovery and accomplish restoration goals in a short period.					
Natural Recruitment					
The proposed restoration alternative will enhance successful natural recruitment after implementation.					
Potential for Collateral Injury					
The proposed restoration alternative will avoid or minimize short-term and long-term adverse impacts to the environment and the natural resources at and near the injured sites.					
Likelihood of Success					
The proposed restoration alternative is likely to succeed at meeting restoration goals.					

Allie B Grounding Site
Restoration Plan/Environmental Assessment

Criteria	Rubble				
	Use of Native Materials – Official	No Action	Monitor and Study	Removal	Stabilization and Relocation
Aesthetics					
The proposed restoration alternative should create a natural visual appearance and substrates and topography that resemble the adjacent habitat.					
Benefits Relative to Costs					
The proposed restoration alternative should be cost-effective and deliver high value in terms of benefits-to-costs.					
Likelihood of Erosion					
The proposed restoration alternative should minimize the threat of unnatural erosion of the reef substrate after implementation.					
Introduction of Foreign Non-Native Materials					
The proposed restoration alternative should minimize the introduction of materials not naturally found on the site (e.g., concrete, adhesives, quarried rock, reinforcing rods, matting materials).					
TOTAL					

- 1 = Poor
2 = Fair
3 = Moderate
4 = Good
5 = Excellent

**Table 7-1. Evaluation of Alternatives Against Evaluation Criteria—Reef Contact Sites
(Continued)**

REEF CONTACT SITES—BIOLOGICAL RESTORATION ALTERNATIVES				
Criteria	No Action	Monitor and Study	Reattach Living Biota	Biological Seeding
THRESHOLD CRITERIA				
Technical Feasibility				
The proposed restoration alternative is believed to be technically feasible, and its complexity and potential technical problems do not limit its chance of success.				
Compliance with Policies and Procedures of Biscayne National Park				
The proposed restoration alternative can be implemented in a manner consistent with the policies and procedures of Biscayne National Park.				
Compliance with Laws and Regulations				
The restoration alternative complies with all applicable federal, state, and county laws and regulations.				
Consistent with Restoration Goals				
The proposed restoration alternative will achieve Biscayne National Park's restoration goal, which is based on existing site conditions: to create, to the extent practicable, a stable, self-sustaining outer bank reef of similar topography and surface complexity to that existing prior to injury. It will also comply with PSRPA (16 USC 191j) and "restore, replace, or acquire the equivalent of resources which were the subject of that action and (to) monitor and study such resources."				
Public Health and Safety				
The proposed restoration alternative poses no threat to the health or safety of the public or agency staff, and it complies with applicable health or safety requirements and guidelines.				
ADDITIONAL CRITERIA				
Relationship to Injured Resources and Services				
The proposed restoration alternative will restore, rehabilitate, enhance, or acquire the equivalent of the resources and services injured by the grounding and provide benefits to comparable resources and services providing appropriate nexus to injured resources.				
Acceleration of Recovery Times				
The proposed restoration alternative will expedite the site's full physical and ecological recovery and accomplish restoration goals in a short period.				
Natural Recruitment				
The proposed restoration alternative will enhance successful natural recruitment after implementation.				
Potential for Collateral Injury				
The proposed restoration alternative will avoid or minimize short-term and long-term adverse impacts to the environment and the natural resources at and near the injured sites.				
Likelihood of Success				
The proposed restoration alternative is likely to succeed at meeting restoration goals.				
Aesthetics				
The proposed restoration alternative should create a natural visual appearance and substrates and topography that resemble the adjacent habitat.				
Benefits Relative to Costs				
The proposed restoration alternative should be cost-effective and deliver high value in terms of benefits-to-costs.				
Likelihood of Erosion				
The proposed restoration alternative should minimize the threat of unnatural erosion of the reef substrate after implementation.				

**Table 7-1. Evaluation of Alternatives Against Evaluation Criteria—Reef Contact Sites
(Concluded)**

REEF CONTACT SITES—BIOLOGICAL RESTORATION ALTERNATIVES				
Criteria	No Action	Monitor and Study	Reattach Living Biota	Biological Seeding
Introduction of Foreign Non-Native Materials				
The proposed restoration alternative should minimize the introduction of materials not naturally found on the site (e.g., concrete, adhesives, quarried rock, reinforcing rods, matting materials).				
Introduction of Foreign Biological/Genetic Material				
The proposed restoration alternative should minimize the introduction of foreign (e.g., transplanted from other reef locations) or genetically distinct biological material.				
TOTAL				

1 = Poor
2 = Fair
3 = Moderate
4 = Good
5 = Excellent

Table 7-2. Evaluation of Alternatives Against Evaluation Criteria—Blowhole Sites

Criteria	Reestablish Topography					Rubble				
	No Action	Native Materials	Non-Native Materials	Native and Non-Native Materials – Boulders with Bonding Agent	Native and Non-Native Materials – Artificial Structures	No Action	Monitor and Study	Removal	Stabilization and Relocation Onsite	Stabilization and Relocation Onsite – Articulating Mats
THRESHOLD CRITERIA										
Technical Feasibility										
The proposed restoration alternative is believed to be technically feasible, and its complexity and potential technical problems do not limit its chance of success.										
Compliance with Policies and Procedures of Biscayne National Park										
The proposed restoration alternative can be implemented in a manner consistent with the policies and procedures of Biscayne National Park.										
Compliance with Laws and Regulations										
The restoration alternative complies with all applicable federal, state, and county laws and regulations.										
Consistent with Restoration Goals										
The proposed restoration alternative will achieve Biscayne National Park's restoration goal, which is based on existing site conditions: to create, to the extent practicable, a stable, self-sustaining outer bank reef of similar topography and surface complexity to that existing prior to injury. It will also comply with 19jj and "restore, replace, or acquire the equivalent of resources which were the subject of that action and (to) monitor and study such resources."										
Public Health and Safety										
The proposed restoration alternative poses no threat to the health or safety of the public or agency staff, and it complies with applicable health or safety requirements and guidelines.										
ADDITIONAL CRITERIA										
Relationship to Injured Resources and Services										
The proposed restoration alternative will restore, rehabilitate, enhance, or acquire the equivalent of the resources and services injured by the grounding and provide benefits to comparable resources and services providing appropriate nexus to injured resources.										
Acceleration of Recovery Times										
The proposed restoration alternative will expedite the site's full physical and ecological recovery and accomplish restoration goals in a short period.										

Table 7-2. Evaluation of Alternatives Against Evaluation Criteria—Blowhole Sites (Concluded)

Criteria	Reestablish Topography					Rubble				
	No Action	Native Materials	Non-Native Materials	Native and Non-Native Materials – Boulders with Bonding Agent	Native and Non-Native Materials – Artificial Structures	No Action	Monitor and Study	Removal	Stabilization and Relocation Onsite	Stabilization and Relocation Onsite – Articulating Mats
Natural Recruitment										
The proposed restoration alternative will enhance successful natural recruitment after implementation.										
Potential for Collateral Injury										
The proposed restoration alternative will avoid or minimize short-term and long-term adverse impacts to the environment and the natural resources at and near the injured sites.										
Likelihood of Success										
The proposed restoration alternative is likely to succeed at meeting restoration goals.										
Aesthetics										
The proposed restoration alternative should create a natural visual appearance and substrates and topography that resemble the adjacent habitat.										
Benefits Relative to Costs										
The proposed restoration alternative should be cost-effective and deliver high value in terms of benefits-to-costs.										
Likelihood of Erosion										
The proposed restoration alternative should minimize the threat of unnatural erosion of the reef substrate after implementation.										
Introduction of Foreign Non-Native Materials										
The proposed restoration alternative should minimize the introduction of materials not naturally found on the site (e.g., concrete, adhesives, quarried rock, reinforcing rods, matting materials).										
TOTAL										

1 = Poor
2 = Fair
3 = Moderate
4 = Good
5 = Excellent

8. APPLICABLE LAWS, REGULATIONS, AND GUIDANCE

The two major environmental statutes that guide the restoration of the injured resources and lost services for the Allie B grounding site are PSRPA and NEPA. These statutes set forth a specific process of environmental impact analysis and public review. NPS must comply with several additional federal, state, and local applicable statutes, regulations, and policies as each relates to undertaking specific restoration alternatives with respect to natural and cultural resources management. Relevant and potentially relevant, statutes, regulations, and policies are discussed below.

8.1 Federal Statutes

8.1.1 *National Environmental Policy Act, as amended, 42 USC 4321, et seq., 40 CFR Parts 1500–1508*

NEPA requires an assessment of any federal action that may impact the environment. NEPA applies to restoration actions undertaken by federal trustees, except where a categorical exclusion or other exception to NEPA applies. Congress enacted NEPA in 1969 to establish a national policy for the protection of the environment. NEPA established the CEQ to advise the President and to carry out certain other responsibilities relating to implementation of NEPA by federal agencies. Pursuant to presidential executive order, federal agencies are obligated to comply with the NEPA regulations adopted by the CEQ. These regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing environmental documentation to comply with NEPA. NEPA requires that an EA be prepared to determine whether a proposed restoration action would have a significant effect on the quality of the human environment.

Generally, when it is uncertain whether an action would have a significant effect, federal agencies would begin the NEPA planning process by preparing an EA. The EA may undergo a public review and comment period. Federal agencies may then review the comments and make a determination. Depending on whether an impact is considered significant, an EIS or a FONSI would be issued.

8.1.2 *National Park System Resource Protection Act, 16 USC 19jj*

Public Law 101-337, the National Park System Resource Protection Act (16 USC 19jj), requires the Secretary of the Interior to assess and monitor injuries to NPS resources. The act specifically allows the Secretary of the Interior to recover response costs and damages from the responsible party(ies) causing the destruction, loss of, or injury to National Park System resources. Any monies recovered by NPS may be used to reimburse the costs of response and damage assessment and to restore, replace, or acquire the equivalent of the injured resources.

8.1.3 *40 CFR 1500–1508; Executive Order 11514 as amended by Executive Order 11991*

EO 11514, as amended by EO 11991, directs all federal agencies to provide leadership in protecting and enhancing the quality of the environment to sustain and enrich human life. This EO defines the responsibilities and procedures for preparation of an EA.

8.1.4 National Park Service Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision Making, and the Handbook for DO#12

NEPA created the CEQ, an agency of the President's office that would be the "caretaker" of NEPA. DO#12, issued in 1982, is the most recent update to NEPA. The DO#12 Handbook is an update and revision of DO#12, and it supersedes the 1982 version. Most of the sections in this handbook derive in whole or in part from the CEQ regulation or Department of Interior NEPA guidelines, giving them the force of law. The DO#12 handbook contains basic information needed to meet the legal requirements of NEPA and to practice excellent impact assessment and resource conservation.

8.1.5 Endangered Species Act, 16 USC § 1531-1543

The purpose of ESA is to conserve "the ecosystem upon which endangered and threatened species depend" and to conserve and recover listed species. The ESA is a comprehensive wildlife conservation law administered by the Department of Interior's U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration-Fisheries. This act mandates that all federal agencies protect listed species and preserve their habitats.

8.1.6 Magnuson-Stevens Fisheries Conservation and Management Act, Public Laws 94-265, as amended

The passage of the Sustainable Fisheries Act in 1996, reauthorizing the Magnuson-Stevens Fishery Conservation Management Act, changed NOAA's National Marine Fisheries Service (NOAA Fisheries) legislative mandate to manage living marine resources. It provided NOAA Fisheries with strengthened management authority to address human impacts on the marine environment. This new authority resulted from a greater recognition of the need to prioritize essential fish habitat, catch reduction, fishing communities, and fishing vessel safety. The act also changed the management of marine fisheries in the United States, including more stringent requirements to rebuild overfished fisheries and prevent overfishing.

8.1.7 National Park Service Director's Order #14: Resource Damage Assessment and Restoration, and the Handbook for DO#1—Guidance for Damage Assessment and Restoration Activities in the National Park Service

The goal of the damage assessment and restoration process, regardless of the specific underlying statutory authority is to restore injured resources to their baseline conditions. Specifically, the PSRPA (16 USC 19jj) allows NPS to seek compensation for injuries to NPS resources and use the recovered funds to restore, replace, or acquire equivalent resources, and to monitor and study such resources. Resources covered by PSRPA include natural and cultural resources as well as other park facilities. PSRPA provides for civil damages only, not penalties. PSRPA also allows retention of monetary donations or services to meet expected or ongoing response costs. PSRPA is a broad authority that applies to all park resource injuries. As such, it differs from other damage assessment and restoration authorities (i.e., Comprehensive Environmental Response, Compensation and Liability Act; Oil Pollution Act; and Clean Water Act) that apply only to natural resource injuries caused by oil spills or hazardous substance releases.

8.1.8 Section 106 of the National Historic Preservation Act

Section 106 of the NHPA, 1966, as amended, (16 USC 470), requires federal agencies to consider the effects of their proposed undertakings on historic properties (cultural resources that meet the criteria for listing in the NRHP). The Section 106 process requires federal agencies to consult with respective state historic preservation officers, tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation (ACHP) and provides a reasonable opportunity for their review and comment on proposed actions. If a proposed project cannot avoid affects to historic properties, steps would be taken to develop appropriate treatment plan that would be formalized within a project-specific Memorandum of Agreement signed by the federal agency, respective state historic preservation officers, Tribal Historic Preservation officer, and possibly other stakeholders and the ACHP. Implementation of the proposed treatment plan would be required prior to implementation of the proposed federal undertaking.

8.2 State Statutes

8.2.1 Florida Water Quality Standards FDEP 62-302.530

The restoration action is required to comply with the state water quality standards by including turbidity monitoring, during backfilling operations, with a water quality meter at 30-minute intervals in the area of backfill operations. If the turbidity exceeds the state water quality standards, then backfill operations will cease until water quality standards are met. If water quality standards are exceeded more than twice a day, the backfill operations will be evaluated for implementation of mitigation measures.

8.2.2 Pollution Control Sections 403.141 and 403.161 FS

These sections prohibit pollution that harms or injures human health or welfare and animal, plant, or aquatic life or property. Violators are liable to the state for any damage to the state's air, waters, or property, (including animal, plant, or aquatic life) and for reasonable costs and expenses incurred by the state in tracing the source of the discharge, in controlling and abating the source and the pollutants, and in restoring the state's air, waters, and property, (including animal, plant, and aquatic life) to their former condition. Violators are also subject to the judicial imposition of a civil penalty of not more than \$10,000 per offense. However, the court may receive evidence in mitigation.

8.3 County Statutes

8.3.1 Miami-Dade County Department of Environmental Resource Management

The Miami-Dade County Board of Commissioners created the Department of Environmental Resource Management (DERM) in 1974 to regulate and manage activities affecting South Florida's environment. Section 24-58 of the Miami-Dade County Code requires that a Class I permit be obtained prior to performing any work in tidal waters or coastal wetlands. DERM's objective is to determine that proposed projects have been designed to avoid and/or minimize environmental, aesthetic, and navigational impacts.

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Appendix A

Responsiveness Summary

To be provided in the final version of this document.

Appendix B

Implementation and Monitoring Schedules

To be provided in the draft final version of this document.

Appendix C

Cost Estimate Documentation

To be provided in the draft final version of this document.