DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

REEFENSE PROGRAM, RAPID RESILIENT REEFS FOR COASTAL DEFENSE PROJECT

AT

BAKER POINT, FLORIDA

April 2024

Pre-decisional Deliberative Process Privileged

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Environmental Branch, Mission Environmental Planning Program

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Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Reefense Program
Project Location:	Baker Point, Florida
Lead Agency for the EA:	Defense Advanced Research Projects Agency (DARPA)
Affected Region:	Florida (Gulf Coast)
Action Proponent:	DARPA
Point of Contact:	Dr. Catherine Campbell, Program Manager DARPA, Biological Technologies Office 675 N. Randolph Rd Arlington, VA 22204 Email address: catherine.campbell@darpa.mil
Date:	April 2024

The Defense Advanced Research Projects Agency (DARPA) has prepared this Environmental Assessment in accordance with the National Environmental Policy Act, as implemented by the Council on Environmental Quality Regulations. The Proposed Action would install hybrid reef structures to test whether such structures can attenuate wave energy more effectively than traditional hardscape solutions to protect coastal shorelines and infrastructure. The Reefense project within the Baker Point proposed action area in Florida would be deployed over two phases with multiple components being proposed for deployment. The Proposed Action would involve initial deployment starting as early as summer of 2024, and the Reefense structures would remain on the seafloor at Baker Point at least through May 2027, when DARPA's funding of the project would end. At the end of DARPA funding, responsibility for maintenance of the structures may transfer to a third party, or if a new responsible party cannot be identified, the structures may need to be removed. This Environmental Assessment evaluates the potential environmental impacts associated with the Action Alternative (Preferred Alternative) and the No Action Alternative to the following resource areas: physical resources, vegetation, invertebrates, birds, fish, essential fish habitat, reptiles, marine mammals, socioeconomic resources, and cultural resources.

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EXECUTIVE SUMMARY

a. Proposed Action

As part of the Reefense program, the Defense Advanced Research Projects Agency (DARPA) proposes to fund the development of bio-hybrid oyster reef structures to help attenuate wave energy at Baker Point, Florida (the Proposed Action).The Reefense project would be deployed over two phases with multiple components being proposed for deployment within the Baker Point proposed action area. Phase 1 is anticipated to occur as early as summer of 2024. Components would consist of reef module breakwaters, mosaic oyster habitat (MOH) structures (varying in height with low, medium, and high relief structures), and intertidal vegetation planting. The reef module breakwater would be deployed in a linear layout with some curvature. These structures would consist of irregularly shaped sections of submerged patch reef with a surface texture to facilitate oyster attachment and growth. Inshore of the reef module breakwater, there would be MOH structures to foster the integration of shoreline habitats comprised of local native species. Intertidal vegetation planting would occur closest to shore (inshore of all deployed structures).

These structures, or modules, created using cutting-edge scientific advances, are intended to create a self-sustaining oyster reef to attenuate wave energy and, thus, protect upland infrastructure by mitigating damage related to coastal flooding, erosion, and storm surge. However, the overall strategy also employs additional mosaic habitat components in order to further develop beneficial ecosystem services and maximize options for adaptive flexibility as the environment changes.

b. Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect civilian and Department of Defense (DoD) infrastructure and personnel by mitigating damage related to coastal flooding, erosion, and storm surge. Wave-driven storm damage, flooding, and erosion impair the DoD's ability to maintain its infrastructure and adversely affect military readiness. The need for the Proposed Action is to find cost-effective and novel solutions for protecting shorelines as the impacts of storm surges and sea level rise increase due to climate change.

c. Alternatives Considered

For the purposes of this Environmental Assessment (EA), DARPA is only evaluating the Preferred Alternative (i.e., the Baker Point location) and a No Action Alternative. No reasonable alternatives exist that would meet the purpose and need while offering fewer environmental impacts. Therefore, only the two alternatives will be considered herein.

d. Summary of Environmental Resources Evaluated in the EA

Council on Environmental Quality regulations implementing the National Environmental Policy Act (40 Code of Federal Regulations parts 1500–1508) specify that an EA should address those resource areas potentially subject to impacts. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact.

The resources evaluated in this EA are as follows: Physical Resources (benthic habitat); Biological Resources (vegetation, invertebrates, birds, fish, essential fish habitat, reptiles, and marine mammals); and Socioeconomic and Cultural Resources.

e. Summary of Potential Environmental Consequences of the Action Alternatives and Major Mitigating Actions

Table ES-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

f. Public Involvement

DARPA is circulating this Draft EA for public review for 30 days. After review of public comments, DARPA will issue a final decision on whether or not to implement the Preferred Alternative.

Table ES-1. Summary of Conclusions

Resource	*Vessel Noise*	*Vessel Movement*	*Reefense Deployment and Installation*	*Potential Reefense Removal*
Physical Resources				
Benthic Habitat	No effect	No effect	Although some potential impacts may be long-term (i.e., covering existing soft bottom with hard structures), they would be minimal (maximum footprint of 37,500 square feet [ft^2; (3,484 square meters [m^2]; 0.86 acres)]). Additionally, the changes would have positive impacts in creating a more diverse habitat and providing wave energy protection shoreward. **NEPA:** No significant impacts	Although removal would constitute a long-term loss of hard bottom habitat, such habitat would only exist because of the Proposed Action, and the footprint of change would be minimal (37,500 ft^2 [3,484 m^2; 0.86 acres]). **NEPA:** No significant impacts
Biological Resources				
Vegetation	No effect	No effect	No effect	Potential impacts would be long-term, including the loss of submerged aquatic vegetation and marsh grasses that established as a result of the structures, but no change would be expected from pre-deployment conditions. No population-level effects. **NEPA:** No significant impacts
Invertebrates	May cause some short-term physiological or behavioral effects, but invertebrates would be expected to return	No more than a minor, short-term impact. Population-level impacts are not	No more than a minor, short-term effect. Population-level impacts are not anticipated.	Potential impacts would be long-term, including the loss of established invertebrate colonies on Reefense

	to normal behavior shortly after the exposure. Population-level impacts are not anticipated. **NEPA:** No significant impacts	anticipated. **NEPA:** No significant impacts	**NEPA**: No significant impacts	structures, but no change would be expected from pre-deployment conditions. Population-level impacts are not anticipated. **NEPA:** No significant impacts
Birds	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts	No effect	No effect
Fish (ESA-listed Gulf sturgeon, smalltooth sawfish)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be long-term, including the loss of established habitat on Reefense structures, but no change would be expected from pre-deployment conditions. Population-level impacts are not anticipated. **NEPA:** No significant impacts **ESA:** NLAA
Essential Fish Habitat	No effect	No effect	May have long-term impacts (i.e., eliminating soft bottom or water column essential fish habitat [EFH]), but limited to a very small footprint, which is minimal in comparison to the total amount of EFH designated. Benefits would support creation of new fish habitat.	May have minimal, brief impacts on soft bottom or water column EFH. Would result in the total loss of hard bottom EFH within the proposed action area, but no change would be expected from pre-deployment conditions. **NEPA**: No significant impacts **MSFCMA:** Total loss of

			NEPA: No significant impacts **MSFCMA:** Minimal reduction in the quantity and/or quality of EFH	artificially created hard bottom EFH. No reduction in the quantity and/or quality of soft bottom or water column EFH
Reptiles (ESA-listed American alligator, alligator snapping turtle [proposed], green sea turtle (and proposed critical habitat), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No alteration to critical habitat essential features. **NEPA:** No significant impacts **ESA:** NLAA (all species), would not adversely modify (proposed critical habitat)	Potential impacts would be long-term, including the loss of established habitat and foraging resources on and around Reefense structures, but no change would be expected from pre-deployment conditions. Population-level impacts are not anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)
Marine Mammals (ESA-listed West Indian Manatee)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. Long-term impacts would be limited to loss of vegetation within the proposed action area, but this would constitute no change from pre-deployment conditions. **NEPA:** No significant impacts

				ESA: NLAA
Socioeconomic and Cultural Resources				
Socioeconomic and Cultural Resources	No effect	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. **NEPA:** No significant impacts	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. Some extremely limited long-term impacts could occur in that anything more than a small personal craft (e.g., kayak) would not be able to operate around the structures, but given the extremely small footprint and shallow waters, this impact would be minimal. **NEPA:** No significant impacts	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. **NEPA:** No significant impacts

ESA: Endangered Species Act
MSFCMA: Magnuson-Stevens Fishery Conservation and Management Act
NLAA = not likely to adversely affect (ESA conclusion)
EFH = essential fish habitat

Environmental Assessment

Defense Advanced Research Projects Agency Reefense Program

Baker Point, Florida

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Abbreviations and Acronyms

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
°N	degrees North latitude
AHMS	Atlantic Highly Migratory Species
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CZMA	Coastal Zone Management Act
DARPA	Defense Advanced Research Projects Agency
dB re 1µPa	decibels referenced to 1 micropascal
DEP	Department of Environmental Protection
DO	dissolved oxygen
DoD	United States Department of Defense
DPS	Distinct Population Segment
EA	Environmental Assessment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	foot/feet
ft^2	square feet
FWC	Fish and Wildlife Conservation Commission
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
HAPC	habitat areas of particular concern
Hz	hertz
INRMP	Integrated Natural Resource Management Plan
kHz	kilohertz
m	meter(s)
m^2	square meters
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MOH	mosaic oyster habitat
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ppt	parts per thousand
R3D	Rapid Resilient Reefs for Coastal Defense
SHPO	State Historic Preservation Officer
SOP	standard operating procedures
Tyndall AFB	Tyndall Air Force Base
U.S.	United States
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
yd	yard(s)

1 Purpose of and Need for the Proposed Action

1.1 Introduction

The Defense Advanced Research Projects Agency (DARPA) proposes to fund the development of bio-hybrid reef structures to help attenuate wave energy and protect United States (U.S.) Department of Defense (DoD) and coastal infrastructure through the Reefense program (the Proposed Action). The strategy of DARPA's Reefense program includes employing recent innovations in materials science, hydrodynamic modeling, and adaptive biology to develop growing structures that are optimized to rapidly implement coastal defenses suited to a changing environment. DARPA's Reefense program involves the construction of custom wave-attenuating base structures (herein referred to as "Reefense structures") to promote growth of reef-building organisms (e.g., coral or oysters). The reef-building organisms would enable the Reefense structures to naturally self-heal and keep pace with sea level rise over time. Reefense structures would also include components to attract non-reef building organisms necessary to help maintain a healthy, growing reef ecosystem. Finally, adaptive biology would enable improved resilience against disease and temperature stress for organisms present, to ensure compatibility with a changing environment. As soon as the Reefense structures are deployed, they would immediately attenuate coastal wave energy. As the structures facilitate the growth of the reef-building organisms, they would provide a biological benefit (e.g., habitat for mobile reef species) in just a few months or years that would be equivalent to decades of growth for a similarly-sized naturally-occurring reef.

DARPA has selected three universities that will deploy Reefense structures under DARPA's Reefense program at the following sites: Rutgers University at Baker Point, Florida; the University of Miami at Elliott Key, Florida; and the University of Hawai'i at Fort Hase, O'ahu, Hawai'i. While each project site would be part of DARPA's Reefense program, DARPA intends to evaluate and request permits for each site individually. Each performer must demonstrate that their proposed designs meet screening criteria established by DARPA for the Reefense program (Section 2.2). This Environmental Assessment (EA) will evaluate the Reefense project proposed for the Baker Point, Florida site, which is the only currently proposed site for oyster reefs.

The Proposed Action would involve initial deployment starting as early as summer of 2024, and the Reefense structures would remain on the seafloor at Baker Point at least through May 2027, when DARPA's funding of the project would end. At the end of DARPA funding, responsibility for maintenance of the structures may transfer to a third party, or if a new responsible party cannot be identified, the structures may need to be removed.

DARPA has prepared this EA in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §§ 4321 *et seq.*), as implemented by the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] parts 1500–1508).

1.2 Location

The Proposed Action would involve the deployment of Reefense structures within Baker Point, Florida (the proposed action area), located adjacent to Tyndall Air Force Base (Tyndall AFB) and within East Bay of the St. Andrew Bay estuary (Figure 1-1. P). The proposed action area is characterized as unvegetated, unconsolidated sandy bottom with 90 percent medium to coarse grain sand. The depth range is approximately 0–3.9 feet (ft; 0–1.1 meters [m]), and the proposed action area is located in the intertidal and subtidal zones.

Vessels would be the primary transportation for site access and supply delivery. Any vehicle use that would provide supplies and materials to the proposed action area would use established roadways. No terrestrial habitat is part of the proposed action area.

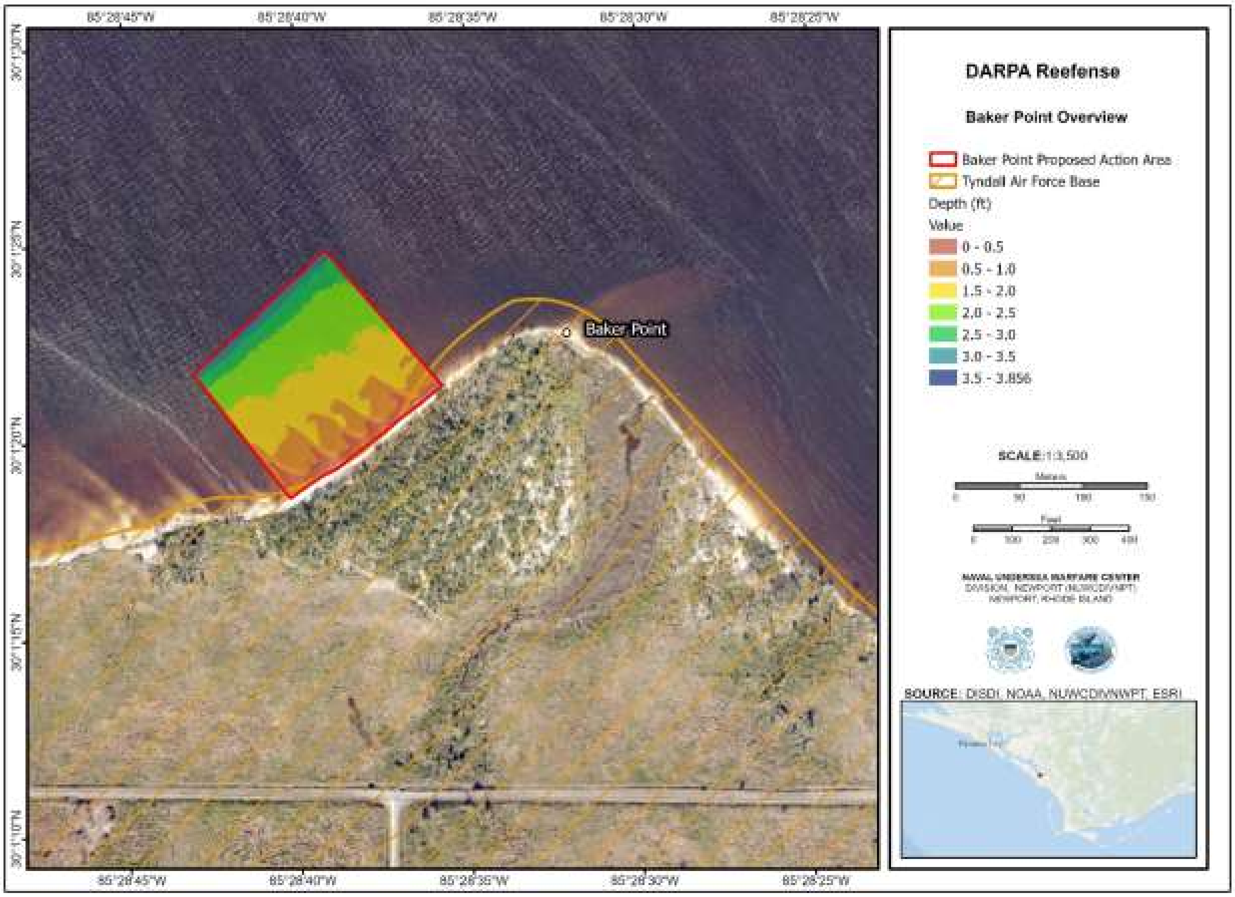

Figure 1-1. Proposed Action Area

1.3 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect civilian and DoD infrastructure and personnel by mitigating damage related to coastal flooding, erosion, and storm surge. Wave-driven storm damage, flooding, and erosion impair the DoD's ability to maintain its infrastructure and adversely impact military readiness. The need for the Proposed Action is to find cost-effective and novel solutions for protecting shorelines as the impacts of storm surges and sea level rise increase due to climate change.

1.4 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the Preferred Alternative and the No Action Alternative (Section 2.3). The environmental resource areas analyzed in this EA include the following: physical resources, biological resources, and socioeconomic and cultural resources. The area discussed and depth of discussion for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance, discussion of essential fish habitat (EFH) would only include the footprint of the Reefense structures, but area considered for fish would expand out to include areas that may be impacted by vessel noise.

1.5 Public and Agency Participation and Intergovernmental Coordination

Regulations from the CEQ direct agencies to involve the public in preparing and implementing their NEPA procedures. DARPA has prepared this Draft EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. The Draft EA public review period begins with a public notice, which will be published in the Federal Register and the Panama City News Herald. The notices will indicate the dates of the public review period and that the Draft EA will be made available on the following website (https://hsrl.rutgers.edu/research/darpa-reefense).

DARPA has initiated consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) regarding compliance with the Endangered Species Act (ESA). At the time of the public review period of the Draft EA, agency concurrences of DARPA's findings under the ESA (Section 4.6) are pending. Additionally, DARPA consulted with NMFS regarding the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). On February 29, 2024, NMFS, Southeast Region, Office of Habitat Conservation concurred with DARPA's analysis that any adverse effects that might occur on marine and anadromous fishery resources would be minimal. NMFS did not have any additional conservation recommendations to provide (Appendix C.

A Coastal Consistency Determination under the Coastal Zone Management Act (CZMA) was included as a part of the individual and conceptual permit application for living shorelines that was submitted to the Florida Department of Environmental Protection (DEP). The permit application remains pending as of the public comment period of this Draft EA. As a part of the same Florida DEP permit application, the Florida State Historic Preservation Officer (SHPO) was notified of the Proposed Action and DARPA's conclusion that it would have no effect on historic or archaeological resources within the proposed action area pursuant to Section 106 of the National Historic Preservation Act (NHPA).

DARPA applied for permits from the U.S. Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act 1899 and Section 404 of the Clean Water Act for the deployment of the structures (individual permit) and the deployment of oceanographic monitoring equipment (nationwide permit #5; Appendix B. At the time of the public comment period of the Draft EA, permit approvals are pending.

2 Proposed Action and Alternatives

2.1 Proposed Action

The Reefense project within the Baker Point proposed action area would be deployed over two phases with multiple components being proposed for deployment. Phase 1 is anticipated to occur as early as summer of 2024. Components would consist of reef module breakwaters, mosaic oyster habitat (MOH) structures (varying in height with low, medium, and high relief), and intertidal vegetation planting. Figure 2-1 shows the conceptual project plan within the Baker Point proposed action area. The reef module breakwater would be deployed in a linear layout with some curvature in water depths of 2 ft (0.6 m) or less. These structures would consist of irregularly shaped sections of submerged patch reef with a surface texture to facilitate oyster attachment and growth. Inshore of the reef module breakwater, there would be MOH structures to foster the integration of shoreline habitats comprised of local native species. Intertidal vegetation planting would occur closest to shore (inshore of all deployed structures).

These structures, or modules, created using cutting-edge scientific advances, are intended to create a self-sustaining oyster reef to attenuate wave energy and, thus, protect upland infrastructure by mitigating damage related to coastal flooding, erosion, and storm surge. However, the overall strategy also employs additional mosaic habitat components in order to further develop beneficial ecosystem services and maximize options for adaptive flexibility as the environment changes.

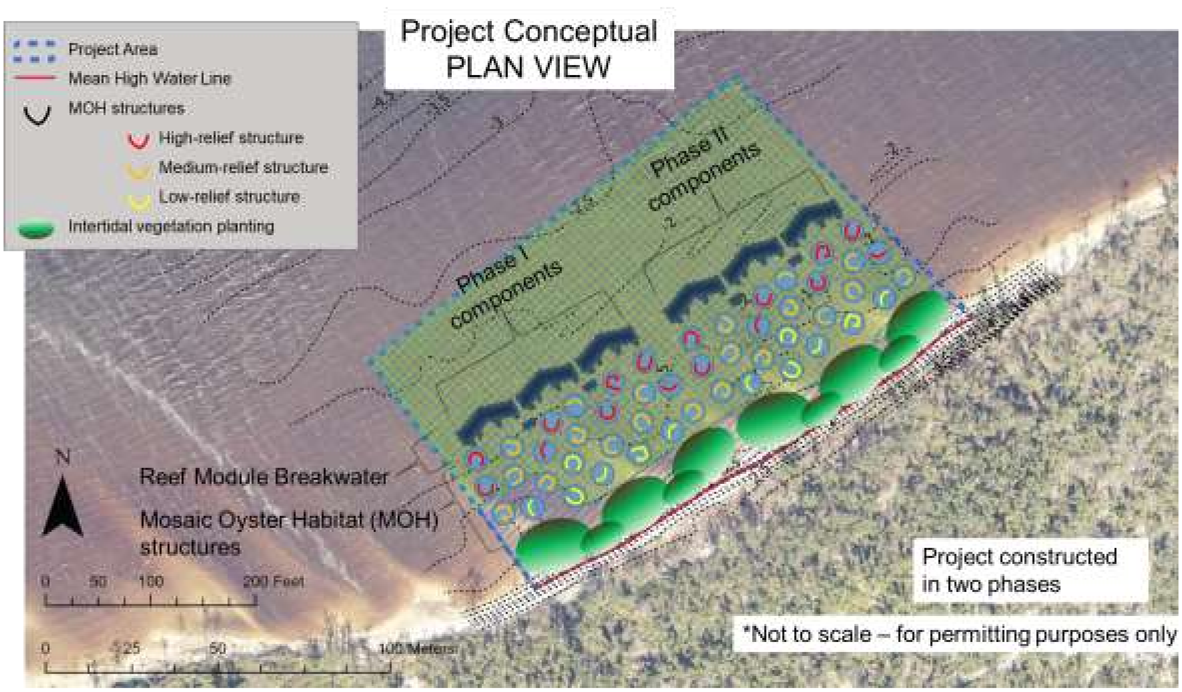

Figure 2-1. Conceptual Project Plan

Oyster reefs can help fortify shorelines and dissipate erosive energy while also promoting other ecological benefits. By occupying different niches in the tidal zone, they also have the potential to attenuate waves and buffer other stressors for each other. The mosaic oyster approach (incorporating a broader palette of sub-habitats within the same project footprint) can boost inter-habitat co-benefits and coastal resilience outcomes relative to any single targeted habitat type.

Therefore, the goals of the components in the MOH are to provide wave attenuation from the following:

a) the reef module breakwater;
b) submerged aquatic vegetation beds;
c) emergent vegetation and ribbed mussel beds; and
d) additional oyster colonization areas inland of the reef module breakwater.

The development, persistence, and co-benefits of the above habitats would benefit the entire ecosystem.

Some activities that are required to inform the deployment and installation of the Reefense structures at Baker Point may occur at partnering institutions and facilities in Florida, Louisiana, Mississippi, and New Jersey. For example, pre-deployment testing of attachment methods of oysters to the Reefense structures and aquaculture grow-out of dermo disease-resistant oysters would occur at established field sites and facilities. Because this research is ongoing and part of existing university research, it is not considered part of the Proposed Action for the purposes of NEPA and will not be considered further herein.

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally proposed action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and that meet the purpose and need require detailed analysis.

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

- Structure designs that can attenuate coastal wave energy by 70 to 90 percent, increase cover of calcareous reef-building species (oysters), grow to match sea level rise, demonstrate survivability in laboratory tests for an increase in water temperature and decrease in disease, and cost the equivalent to similarly-sized shoreline construction projects (e.g., rip-rap, seawalls);
- Minimum 35 percent live oyster coverage and increased oyster survivability against dermo disease.
- Location with sufficient wave energy (ongoing or storm-driven) to allow the testing of wave attenuation success;
- Suitable bottom type for deployment and long-term presence of artificial reef structures;
- Proper depth to allow each designed structure to attenuate wave energy;
- Proximity to performer to allow for cost-effective installation and monitoring; and
- Lack of existing, healthy reefs within the footprint designated for deployment so that the installation would not harm naturally-occurring reefs and those reefs would not interfere with the testing of the Reefense structure's wave attenuation capability.

DARPA thoroughly evaluated many alternatives as part of selecting Rutgers University-led team as the performer and Baker Point, Florida, as the deployment site for the Proposed Action. Currently, the other Reefense projects would be located great distances from Baker Point (e.g., Elliott Key, Florida in the Atlantic Ocean and Fort Hase, Hawai'i in the Pacific Ocean). Based on the geographic locations, there would be no cumulative impacts if multiple projects were funded. Additionally, the three projects are not connected actions. They are independent, not part of a larger action, and not dependent on each other for justification. One project does not automatically trigger either of the other two, and each may proceed independent of the other two in the event the other two are not funded. Therefore, DARPA considers the projects to be wholly independent from a NEPA standpoint.

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose of and need for the Proposed Action, only the Preferred Alternative and No Action Alternative were identified and will be analyzed in this EA. DARPA and the Rutgers University-led team have invested extensive time and research to shape the Reefense design and deployment details, eliminating alternative designs that ultimately did not meet the screening factors (Section 2.2) through their preliminary research. As the purpose of the Proposed Action is testing of this carefully selected design, no reasonable alternatives exist that would meet the purpose and need while offering fewer environmental impacts.

2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No deployment of Reefense structures would occur within the proposed action area, and the Baker Point area would be left undeveloped unless/until other in-water construction is proposed as part of a future project. The No Action Alternative would not meet the purpose of and need for the Proposed Action because there would be no furthering of research on climate change-related shoreline protection alternatives to hard armoring; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA to provide a baseline for measuring environmental consequences of the Preferred Alternative.

2.3.2 Action Alternative (Preferred Alternative)

The Preferred Alternative would install reef module breakwaters, MOH structures, and intertidal vegetation at Baker Point, Florida. The sections below outline the details of the project's site selection and survey; Reefense structure design and components; and deployment, monitoring, and potential removal of the Reefense structures.

2.3.2.1 Site Selection and Surveys

Surveys of the Baker Point proposed action area show that Baker Point is a soft bottom area composed of unconsolidated sand, with 90 percent cover of medium to coarse grain sand. During a recent survey of the proposed action area, there was one submerged vegetation bed along the southeastern border that had less than five roots per square meter of shoal grass (*Halodule wrightii*) (WSP 2022). The Baker Point proposed action area was chosen because it is adjacent to Tyndall AFB, which was highly impacted by Hurricane Michael, a category five hurricane that damaged almost 500 buildings beyond repair in 2018. After sustaining such drastic damage on the base, protecting coastal infrastructure and funding coastal resilience projects to protect the base and communities surrounding the East Bay became a top priority. Therefore, Baker Point was selected as one of the deployment sites for Reefense structures.

2.3.2.2 Reefense Structure Design and Components

Table 2-1 summarizes the different components of the Reefense structures that would be deployed in the proposed action area. All Reefense base structures (the reef module breakwaters [Figure 2-1]) would be constructed primarily of concrete components, and they would not contain any metal or plastic. The structures would be designed with adequate weight and form to remain stable in this environment. Since the structure may be visible from the shore at low tide, it was designed to have a natural, aesthetically pleasing appearance.

Table 2-1. Reefense Project Components at Baker Point Proposed Action Area

Component	*Description*
Bottom Type for Structure Deployment	Soft bottom – medium to coarse grain sand
Types of Structures/Materials being Deployed	Reef module breakwater: concrete base structure; oysters
	MOH: Stacked non-plastic shell bags; half scale modules; oyster castles; oyster catcher materials; reef balls; coir logs and mats
Weight of Reef Module Breakwater	Full-size module: 450 pounds each
	Three-quarter-size module: 338 pounds each
	Half-size module: 225 pounds each
	*Total mass of all modules: up to 243 metric tons
*Total Dimensions of Reef Module Breakwater Structures	Reef module breakwater: 328 ft (100 m) length; 40 ft (12.2 m) width
	Multiple segments: up to 75 ft (22.9 m) long, with at least 5 ft (1.5 m) gaps
	Approximately 788 individual modules: 320 full size, 202 three-quarter size, and 266 half size
	Approximate area: 13,496 square feet (ft^2; 1,253 square meters [m^2]; 0.31 acres)
*Dimensions of MOH	Up to 48 MOH total (up to 24 for each phase)
	Single MOH approximate dimensions: 25 ft (7.6 m) diameter; 491 ft^2 (45.6 m^2) area
	Total MOH footprint: approximately 24,000 ft^2 (2,230 m^2; 0.55 acre)
	Total weight of MOH: would not exceed 240,000 pounds (109 metric tons)
Biological Components	Marsh grass plantings: Approximately 21,500 ft^2 (2,000 m^2) to include natives *Spartina alterniflora*, *Spartina patens,* and/or *Juncus roemerianus*
	Local native eastern oyster stocks of *Crassostrea virginica* (coverage to follow installed reef elements through direct seeding and natural recruitment)
*Dimensions of Entire Project	Approximately 37,500 ft^2 (3,484 m^2; 0.86 acres) for Reef module breakwater + MOH
	Approximately 60,000 ft^2 (13,203 m^2; 1.01 acres) for Reef module breakwater + MOH + Marsh grasses
Anchoring Method	None – structures and materials would be stable under their own weight
Buoys/Markers	Reefense structures would be visible at low tide but will also be marked with aids to navigation, as directed by the U.S. Coast Guard.

*Calculation includes dimensions for both phases of deployment

Local oyster stocks selectively bred for disease resistance would be directly attached to the reef module breakwater and MOH structures, and the structures would serve as substrate for recruitment of oysters naturally over time. By using oysters as the biological component of this Reefense structure design, the structures would serve a dual purpose of mitigating wave impacts and improving local water quality. In total, the Reefense deployment and marsh grass plantings are expected to create up to 37,500 square feet (ft^2; 3,484 square meters [m^2]) of oyster reef habitat and up to 21,500 ft^2 (2,000 m^2) of intertidal marsh habitat along the northwestern shore of the Baker Point proposed action area. Additional details about the reef module breakwater structures (Section 2.3.2.2.1), MOH structures (Section 2.3.2.2.2), and the vegetation planting (Section 2.3.2.2.3) are provided in the subsections below.

2.3.2.2.1 Reef Module Breakwater

Figure 2-2 shows the proposed Reefense patch design that would be implemented within the reef module breakwater structures. The layout of the reef module breakwater structures is shown by the blue slightly curved structures in Figure 2-1. Reef materials would be placed to reach approximately median water level as measured using site-specific data. Reef module breakwater structures would be deployed in two phases. Conceptual design drawings and additional dimensions can be found in Appendix A.

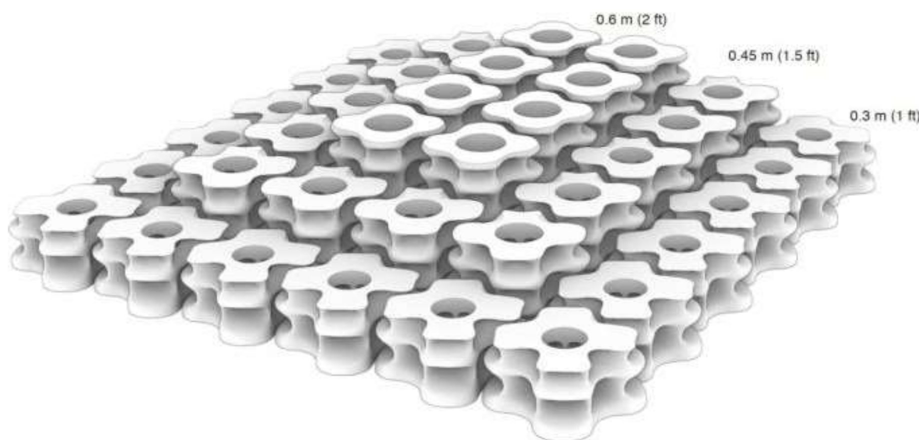

Figure 2-2. Reef Module Breakwater Patch Design

2.3.2.2.2 Mosaic Oyster Habitat Structures

These structures are intended to create additional pockets of energetic refuge, inland of the primary wave attenuation structures, for building elevation and recruiting flora and fauna. MOH structures would be deployed in the area between the module reef breakwaters and the mean low water contour with at least 15 ft (5 m) of spacing between each component. Components would consist of low-, moderate-, and high-relief structures in order to match the energetic and topographical conditions of the site. MOH structures would be deployed two to four months after each phase of reef module breakwater construction. A small, shallow draft boat (approximately 26 ft [8 m]) will be used to ferry MOH structures components to the project site for placement by hand in specified locations.

High-relief structures would be located in deeper water depths and along the perimeter of the deployment area in order to provide further wave attenuation behind the module reef breakwater. Moderate- and low-relief structures would be interspersed in the interior and more-shallow areas closer to mean low water, where current and wave energy would be less intense. Each component type would occupy a similar footprint and would be composed of variable materials including half-scale versions of modules (Figure 2-3), non-plastic shell bags (Figure 2-4), Oyster Castles (Figure 2-5), Oyster Catcher materials (Figure 2-6), Reef Balls (Figure 2-7), and coir logs/matting (Figure 2-8). MOH structures would generally make up half-circle cusp shapes, oriented in contrasting directions to continuously redirect energy and create intended pockets of energetic refuge. Exact configurations of the MOH structures may vary slightly, with some being more or less curved and some consisting of a somewhat "amorphous" shape variation. A maximum of 48 MOH structures would be deployed, 24 MOH structures in each of the two phases (Figure 2-1). The total MOH footprint in both phases would not exceed 6,240 ft^2 (580 m^2; 0.14 acres), which is a conservative estimate because the footprint of each MOH would not be completely occupied with materials. However, it is more likely that only 25 percent of each MOH footprint would have materials placed directly on the seafloor. While MOH structures are designed to encourage recruitment of oysters and/or ribbed mussels, the project is expected to recruit submerged aquatic vegetation within the lower areas as well.

Additionally, submerged aquatic vegetation recruitment may be reached at higher elevations. Any established patches of target floral/faunal species can serve as a source population when conditions are favorable for expansion outside the refuge of the protective structures. Conceptual design drawings and additional dimensions can be found in Appendix A. .

2.3.2.2.3 Vegetation Planting

To help stabilize substrates and achieve multidirectional wave attenuation, up to 400 linear ft (122 linear m) of marsh grasses would be planted along the shoreline within the proposed action area. The arrangement of various intertidal marsh grasses would vary but would follow typical patterns along the marsh environment: smooth cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*S. patens*) would be planted in lower and higher intertidal areas, respectively, and black needlerush (*Juncus roemerianus*) would occupy space in between. Vegetation planting would be seasonally timed for optimal performance following similar deployment procedures for MOH structures (i.e., material logistics and hand planting).

Figure 2-3. Half Scale Modules

Figure 2-4. Stacked Non-Plastic Shell Bags

Figure 2-5. Oyster Castles

Figure 2-6. Oyster Catcher Materials

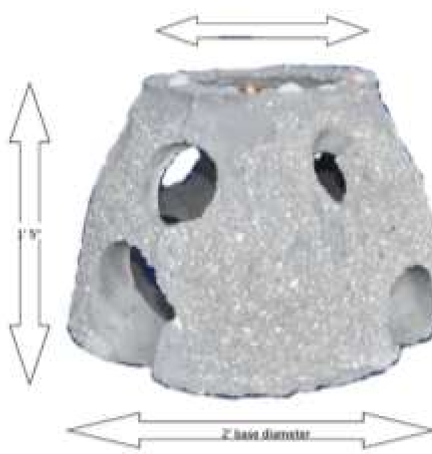

Figure 2-7. Reef Balls

Figure 2-8. Coir Logs and Mats

2.3.2.3 Deployment, Monitoring, and Potential Removal Activities

Deployment of the Reefense structures would occur from a temporarily moored large spud barge or small sectional barge. While unlikely, if a spud barge is used, it would have a 100 ft (31 m) radius crane. The barge would be approximately 45 ft (14 m) by 150 ft (46 m) with a 3 ft (1 m) draft. The barge would be deployed in deeper waters that would be close to (in reach of) the 2 ft (0.6 m) deployment depths. Most likely, a small sectional barge with a long-reach excavator would be used. The sectional barge is preferred since it would more easily access the deployment area for the Reefense structures. The sectional barge would be 40 ft (12 m) by 100 ft (31 m) with a 1 ft (0.3 m) draft. The barge would be moved to the proposed action area by a tugboat that operates under 10 knots. Within the proposed action area, the tugboat would operate at idle speed. Deployment and installation activities would be coordinated to avoid or minimize anchoring or spudding, as much as practicable. At a minimum, spudding or anchoring could occur once per day to move the barge to close proximity of the exact installation location. A second vessel would be used to transit to and from the site to bring supplies while the deployment barge would remain on-site.

Deployment of the reef module breakwater structures would occur in two phases; each would span approximately four weeks. The first phase of deployment is targeted for summer 2024, and the second phase of deployment is targeted for winter/spring 2026. At each phase, a maximum of 164 ft (50 m) of non-contiguous reef module breakwater would be deployed. Each section would be no more than 75 ft (23 m) in length, and there would be a minimum 5 ft (1.5 m) gap between each segment to prevent species entrapment.

Approximately two to four months after each breakwater deployment, up to 24 MOH components would be deployed between the breakwater structures and the low tide line, with a maximum height that would not exceed the height of the breakwater (maximum of 2 ft [0.6 m]) (Figure 2-1). A minimum 15 ft (4.6 m) buffer would be left between the structures and any existing submerged aquatic vegetation or oyster beds (Chapter 6). The materials would be delivered to the proposed action area by the barge or a small shallow-draft vessel (i.e., flat bottom skiff, no more than 26 ft [8 m] long) and installed by manual labor. This installation would take up to four weeks. Plugs for marsh grass planting would be driven by vehicle to a near-by location (referred to as Kayak launch), or brought in by the smaller shallow draft vessel. They would be floated to their installation location by the vessel, or via a non-motorized craft, and planted by hand. The 400 ft (122 m) of emergent intertidal vegetation (Section 2.3.2.2.3) would be protected with coir logs (Figure 2-8) and/or shell bags (Figure 2-4).

During deployment, the larger and heavier individual Reefense structures would be lowered slowly to the seafloor using a crane or excavator. Descent would be controlled to reduce or eliminate turbidity from sediment disturbance. Any materials that have the potential to increase turbidity would be surrounded by turbidity curtains during deployment. If safe to do so, personnel would be in the water to ensure the exact placement of the Reefense structures in the deployment locations. Structures were designed and wave flume-tested to be stable under their own weight, so no anchoring would be required. The maximum volume of reef materials added would be an estimated 654 cubic yards (500 cubic meters). The Reefense array would be marked by Coast Guard aids to navigation to assure safe navigation around the project area, and the structures would be visible at low tides.

Although the objective is for naturally occurring oysters to populate the Reefense structures (Figure 2-9 and Figure 2-10), oysters would be placed on the structures initially to begin colonization and allow for immediate wave attenuation, and water quality benefits. Oysters would be contained in bags or glued[1] directly to the structure, and loose oysters would be surrounded by contained, bagged oysters or other stabilizing features. Pre-deployment testing has been conducted at field sites in Florida, Louisiana, Alabama, and New Jersey, and this testing has demonstrated that these techniques remain stable even in higher wave energies than exist at the proposed action area. Over time, other organisms, such as mussels and barnacles, would establish themselves to the reefs through natural processes.

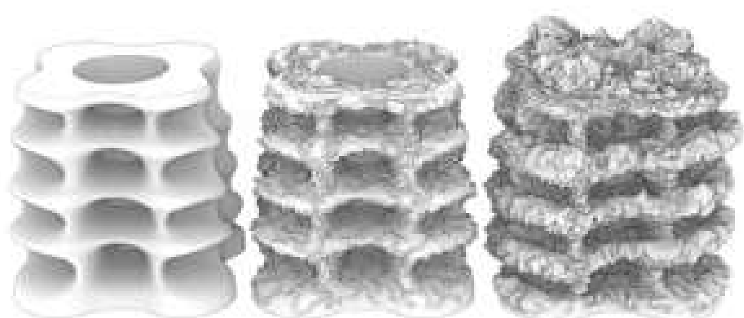

Figure 2-9. Conceptual Oyster Growth on a Reefense Module

[1] The epoxy used to glue oysters to the Reefense structures would be non-toxic, marine-life safe.

Figure 2-10. Oyster Growth Displayed on Testing of Reefense Modules

Before and after the Reefense structures are installed, oceanographic monitoring equipment would be deployed within the Baker Point proposed action area and a small control area outside of the proposed action area to validate how well the Reefense structures are attenuating wave energy. Details of the monitoring equipment were detailed in the USACE permit (Appendix B.).

Semi-annual monitoring by snorkel would occur after the Reefense structures are deployed; personnel would access the proposed action area by foot, kayak, or a small shallow-draft vessel from across the bay. Surveys would be conducted quarterly, and additional surveys would occur within one week following any storm event (if weather and conditions allow) for at least one-year post-deployment. Monitoring would include documenting oyster and other biological growth on the structures as well as removing any marine debris from the Reefense structures that could compromise its integrity or create a hazard to mariners or marine life (see Chapter 6).

Removal of the Reefense structures may be warranted if the project fails to meet project metrics or ownership of the structures is not transferred from DARPA to another entity. A craned barge would be used to remove the Reefense structures, similarly to the deployment. Protective measures specific to removal activities are specified in Chapter 6.

2.4 Alternatives Considered but not Carried Forward for Detailed Analysis

The design of the Reefense project at Baker Point that is being carried forward as the Preferred Alternative is a culmination of an iterative process based on the results of experiments on a test structure in New Jersey, wave flume testing of reef module breakwaters, and computer modeling efforts. Different shapes, heights, and materials for the reef module breakwaters and MOH structures were tested. Alternatives for the final design were considered, but they are not carried forward for detailed analysis in this EA as they did not satisfy the reasonable alternative screening factors presented in Section 2.2.

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3 Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that could be impacted from implementing the Proposed Action.

All potentially relevant environmental resource areas were initially considered for analysis in this EA. In compliance with NEPA and the CEQ regulations and guidance, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

NEPA requires federal agencies to consider the environmental impacts of major federal actions that significantly affect the quality of the human environment. “Significantly,” as used in NEPA, requires considerations of both the potentially affected environment and degree of potential impacts. The potential environmental impact can be thought of in terms of the amount of the likely change. In general, the more sensitive the environment, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the environment, the more intense a potential impact would need to be in order to be considered significant. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. The resource areas that are potentially subject to impacts resulting from the Proposed Action include physical, biological, cultural, and socioeconomic resources. The potential impacts to the following resource areas are considered to be negligible or non-existent; therefore, they were not analyzed in detail in this EA:

Air Quality: Air emissions generated from vessels would be minimal and of short-duration with one vessel operating at a time within the proposed action area for a maximum of 14 consecutive days each for each phase of installation and potential removal. Therefore, the Proposed Action would not constitute a significant impact to the air quality in the proposed action area.

Water Quality: The deployment of the structures would introduce concrete and potentially epoxy into seawater. However, the concrete structures would contain no hazardous materials. Although trace amounts of concrete components could be released as the materials degrade over long periods of time, the ocean chemistry would not be affected. The epoxy used to glue oysters to the Reefense structures would be non-toxic, marine-life safe. Only while curing could a negligible amount have the potential to leach into the environment. The Proposed Action would not release any chemicals or other pollutants into the water, and sediment disturbance would be minimal due to slow structure descent and the use of turbidity curtains if necessary. Therefore, the Proposed Action would not impact water quality.

Land Use: The Proposed Action would occur in nearshore and coastal waters with no land-based components. Therefore, the Proposed Action would not impact land use activities.

Visual Resources: The Proposed Action would install structures designed to have a natural, aesthetically pleasing appearance in the proposed action area, and the structures would largely be underwater. The addition of any aids to navigation would be consistent with current safety practices in the area. Therefore, the Proposed Action would not impact visual resources.

Airspace: The Proposed Action would not involve aircraft or any other use of airspace.

Infrastructure: No creation, destruction, or modification of traditional infrastructure (e.g., buildings, roads, etc.) would occur as a result of the Proposed Action. Rather, the Proposed Action only involves deployment of novel structures in a previously undeveloped space.

Public Health and Safety: The Proposed Action would present minimal to no interaction with the general public. The Reefense structures would be located in coastal water with low public access and marked by aids to navigation. They would not present safety hazards to swimmers or recreational boaters different than any naturally-occurring structure. As a result, the Proposed Action does not represent a significant risk to public health or safety.

Hazardous Materials and Wastes: The Proposed Action does not involve the generation or use of hazardous materials or wastes. The Proposed Action would install structures made out of natural materials, such as basalt, limestone, and concrete. Degradation of these materials over time would not affect ocean chemistry.

Environmental Justice: The Proposed Action would occur in coastal areas with limited public access. Any disturbance to customary access to these areas would be minimal and limited to the deployment and potential removal of the installations. There would be no disproportionately high or adverse human health or environmental impacts on minority or low-income populations. Therefore, the Proposed Action would not impact environmental justice.

3.1 Physical Resources

This discussion of physical resources includes an analysis of the benthic habitat (e.g., bathymetry, substrate, habitat type), the only physical resource that may be adversely affected by the Proposed Action.

3.1.1 Regulatory Setting

The federal laws regulating effects on physical resources that apply for the Proposed Action include the Rivers and Harbors Act (33 U.S.C. §§ 401 *et seq.*) and Section 404 of the Clean Water Act (33 U.S.C. §§ 1251 *et seq.*), both regulated by USACE, and the CZMA (16 U.S.C. §§ 1451 *et seq.*) regulated by each State and the National Oceanic and Atmospheric Administration's (NOAA's) Office for Coastal Management. The Clean Water Act's water quality provisions under the National Pollutant Discharge Elimination System would not be applicable because no pollutants would be discharged.

Section 10 of the Rivers and Harbors Act (33 U.S.C. § 403) requires a USACE permit for any in-water construction, including dredging or deposition of material, in navigable waters of the United States. Section 404 of the Clean Water Act (33 U.S.C. § 1344) authorizes the Secretary of the Army, acting through USACE, to issue permits for the discharge of dredge or fill material into wetlands and other waters of the United States. Fill regulated under this provision includes artificial structures, such as the Reefense structures. Additionally, DARPA applied for a nationwide permit #5 for the deployment of scientific measurement devices (Appendix B.).

The CZMA established national policy to preserve, protect, develop, restore, or enhance resources in the coastal zone. This Act encourages coastal states to properly manage use of their coasts and coastal resources, prepare and implement coastal management programs, and provide for public and governmental participation in decisions affecting the coastal zone. To this end, the CZMA imparts an obligation upon federal agencies whose actions or activities affect any land or water use or natural resource of the coastal zone to be carried out in a manner consistent to the maximum extent practicable with the enforceable policies of federally-approved state coastal management programs. Section 307 requires federal agencies having effects outside of federal property to determine whether their proposed actions would affect a state's coastal zone. DARPA has applied for a Florida DEP individual and conceptual permit for living shorelines, and that permit would include the necessary determination of consistency with the state's coastal zone management plan in compliance with CZMA. The permit application remains pending as of the publication of this Draft EA.

3.1.2 Affected Environment

The proposed action area is off Baker Point, Florida, which is adjacent to Tyndall AFB and within East Bay of the St. Andrews Bay estuary (Figure 1-1. P). The proposed action area is characterized as mostly unvegetated, unconsolidated sandy bottom with 90 percent medium to coarse grain sand (WSP 2022). During a recent survey of the proposed action area, there was one submerged vegetation bed along the southeastern border that had less than five shoots per square meter of shoal grass (WSP 2022). The area is subject to erosive forces. The depth range is approximately 0 to 3.9 ft (0 to 1.1 m), and the proposed action area is located in the intertidal and subtidal zones. The upland area beyond the proposed action area is characterized by a small beach berm in some areas and coastal scrub habitat. Many of the shorelines (bay and coastal) of Tyndall AFB are within the 100-year floodplain. As such, Tyndall AFB is vulnerable to flooding from torrential rainfall and tidal surges associated with tropical storms and hurricanes (Tyndall Air Force Base 2020b).

3.2 Biological Resources

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Within this EA, biological resources are divided into seven major categories: (1) vegetation, (2) invertebrates, (3) birds, (4) fish, (5) EFH, (6) reptiles, and (7) marine mammals.

3.2.1 Regulatory Setting

Laws that protect special-status species, or the habitats on which they rely, within the proposed action area include the ESA (Section 3.2.1.1), Marine Mammal Protection Act (MMPA) (Section 3.2.1.2), Migratory Bird Treaty Act (MBTA) (Section 3.2.1.3), and MSFCMA (Section 3.2.1.4).

3.2.1.1 Endangered Species Act

The purpose of the ESA (16 U.S.C. §§ 1531 *et seq.*) is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the USFWS or NMFS to ensure that the action proponents' actions are not likely to jeopardize the continued existence of federally-listed threatened and endangered species or result in the destruction or adverse modification of designated critical habitat.

NMFS regulations (50 CFR § 424.12(b)) state that, in determining what areas qualify as critical habitat, the agencies "shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection." These principal biological or physical constituent elements are referred to as "essential features" and "may include, but are not limited to, the following: spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, geological formation, vegetation type, tide, and specific soil types" (50 CFR § 424.12(b)).

3.2.1.2 Marine Mammal Protection Act

All marine mammals are protected under the provisions of the MMPA (16 U.S.C. §§ 1361 *et seq.*). The MMPA prohibits any person or vessel from “taking” marine mammals in the United States or the high seas without authorization. The MMPA defines “take” to mean “to harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal” (16 U.S.C. § 1362(13)). “Harassment” was further defined in the 1994 amendments to the MMPA, which provided two levels of harassment: Level A (potential injury) and Level B (potential behavioral disturbance). Level A harassment “has the potential to injure a marine mammal or marine mammal stock in the wild,” and Level B harassment “has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering” (16 U.S.C. § 1362(18)(A)). Based on the nature of the Proposed Action (e.g., small proposed action area, short periods of time required for daytime vessel activity [vessel would spend up to four weeks on site], no underwater noise except limited vessel noise, limited presence of marine mammals), the impacts do not rise to a level considered as take. Therefore, there is no accompanying MMPA permit associated with this Proposed Action.

3.2.1.3 Migratory Bird Treaty Act

The MBTA (16 U.S.C. §§ 703 *et seq.*) prohibits the taking, killing, or possessing of any migratory bird or any part, nests, or eggs of such birds, unless permitted by regulation. Based on the nature of the Proposed Action (e.g., all in-water work) and the lack of presence of nesting or foraging habitat for migratory birds within the proposed action area, there would be no effect from the Proposed Action on migratory birds.

3.2.1.4 Bald and Golden Eagle Protection Act

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668 *et seq.*). This act prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald eagles, including their parts, nests, or eggs. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” Based on the nature of the Proposed Action and the lack of presence of bald or golden eagle nesting or foraging habitat within the proposed action area, there would be no taking of a bald or golden eagle. Therefore, the Bald and Golden Eagle Protection Act does not require further consideration.

3.2.1.5 Magnuson-Stevens Fishery Conservation and Management Act

The MSFCMA (16 U.S.C. §§ 1801 *et seq.*) provides for the conservation and management of U.S. fisheries. Under the MSFCMA, EFH consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. Any activities that would reduce the quality and/or quantity of EFH would require consultation with NMFS. To protect fisheries resources, NMFS works with regional fishery management councils to identify the essential habitat for every life stage of each federally-managed species, based on the best available scientific information. EFH includes all types of aquatic habitat, including wetlands, coral reefs, seagrasses, and rivers; all locations where fish spawn, breed, feed, or grow to maturity. EFH is included in Fishery Management Plans (FMP). NMFS is responsible for approving and implementing FMPs under the MSFCMA. Habitat Areas of Particular Concern (HAPC) are a subset of EFH. Fishery management councils are encouraged to designate HAPC under the MSFCMA. However, there are no HAPCs in the proposed action area. See Appendix C. for concurrence from NMFS Office of Habitat Conservation.

3.2.2 Vegetation

Table 3-1 lists the major taxonomic groups of vegetation that may be encountered within the proposed action area. No ESA-listed vegetation species would occur within the proposed action area.

Table 3-1. Major Taxonomic Groups of Vegetation that May Occur within the Proposed Action Area

Common Name (Species Group)	***Description***
Diatoms (Phylum Ochrophyta)	Single-celled algae with a cylindrical cell wall (frustule) composed of silica. Diatoms are a primary constituent of the phytoplankton group.
Blue-green algae (Phylum Cyanobacteria)	Photosynthetic bacteria that are abundant constituents of phytoplankton and benthic algal communities, accounting for the largest fraction of carbon and nitrogen fixation by marine vegetation; existing as single cells or filaments, the latter forming mats or crusts on sediments and reefs.
Dinoflagellates (Phylum Dinophyta)	Most are single-celled, marine species of algae with two whip-like appendages (flagella). Some live inside other organisms, and some produce toxins.
Coccolithophores (Phylum Haptophyta)	Single-celled marine phytoplankton that surround themselves with microscopic plates of calcite.
Brown algae (Phylum Ochrophyta)	Brown algae are large multi-celled seaweeds that include vast floating mats of *Sargassum* spp. seaweeds.
Green algae (Phylum Chlorophyta)	May occur as single-celled algae, filaments, and seaweeds.
Red algae (Phylum Rhodophyta)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits. Most species occur close to shore and in coral reefs.
Vascular plants	Typically occur in intertidal to shallow (less than 40 ft [12 m]) subtidal water, generally in soft substrate. Common vascular plants in marine environments include seagrasses, cordgrasses, and mangroves, although the proposed action area has been designed to avoid mangrove habitat.

Table Sources: (Species 2000 and Catalogue of Life 2019; U.S. Department of the Navy 2018)

Salt marsh habitat is found along Tyndall AFB's Gulf of Mexico (GOM) coast, along the edges of bayous at Goose and Cedar Points, and in low energy areas along the bay side of the barrier islands, including the proposed action area (U.S. Army Environmental Command 2020). Salt marsh communities are herbaceous systems situated in areas where they are influenced by tides and seawater but protected from large waves. Vegetation within salt marsh communities occurs in distinct zones where one species will typically dominate. Characteristic vegetation frequently includes black needlerush, cordgrass (*Spartina* spp.), and grassworts (*Lilaeopsis* spp.). Mangroves would not be present within the proposed action area as the area was selected to avoid potential impacts on mangroves.

A survey of the proposed action area revealed one submerged aquatic vegetation bed along the southeastern border of the site (WSP 2022). This single bed contained shoal grass, and the density was extremely sparse (less than five shoots per square meter). No objects associated with the Proposed

Action would be deployed on marine vegetation (Chapter 6). A reduction in nearshore wave action from the Proposed Action could create the needed conditions for future marsh grass restoration in the proposed action area. The spatial arrangement of the Reefense structures would be designed to optimize habitat opportunities for submerged aquatic vegetation, *Juncus* spp., and *Spartina* spp., so these plants would be expected to occur within the proposed action area over time following Reefense deployment.

3.2.3 Invertebrates

Marine benthic and epibenthic (animals that live on the surface of the substrate) invertebrates may be sessile (immobile and attached to substrate), sedentary (limited mobility), or highly mobile (Cairns and Bayer 2009; University of California Berkeley 2019a, 2019b). Pelagic organisms vary in their swimming abilities, ranging from weak (e.g., larvae) to substantial (e.g., squid) (Segura-Puertas et al. 2009; University of California Berkeley 2019b). Species richness and overall abundance is typically greater in coastal water habitats, such as the proposed action area, compared to the open ocean, due to the increased availability of food and protection that coastal habitats provide.

Oysters can form the basis of reef systems. Oyster reefs provide extensive ecological benefits, including creation of structural habitat, improved water quality through filtration, nutrient cycling, and food sources for animals (Hemraj et al. 2023; Tomasetti et al. 2023). Due to the structural benefits provided by oyster reefs, reef restoration has become a popular from of shoreline protection (Tomasetti et al. 2023). Oyster biodeposits (i.e., feces and pseudofeces) enrich the sediment beneath them, encouraging growth of microbial communities to further support healthy biodiversity (Tomasetti et al. 2023).

Ideal conditions for successful growth of an oyster reef include moderate salinity levels (around 15 parts per thousand [ppt]), high dissolved oxygen, adequate larval supply, and low disease levels (Beseres Pollack et al. 2012). Although oysters are resilient to poor water quality conditions, acidification and hypoxia can cause deterioration of oysters (Hemraj et al. 2023). At and above 68 °F (20 °C), oysters become more susceptible to disease (Beseres Pollack et al. 2012).

Invertebrates are classified within major taxonomic groups, generally referred to as a phylum. Table 3-2 depicts invertebrate phyla found within the proposed action area (benthic or pelagic) in juvenile and adult form. Larvae of most species are water column-associated.

Table 3-2. Major Taxonomic Groups of Invertebrates that may Occur within the Proposed Action Area

Common Name (Species Group)	*Description*	*Preferred Habitat*
Foraminifera, radiolarians, ciliates (Phylum Foraminifera)	Benthic and pelagic single-celled organisms; can be planktonic or benthic infaunal (live in the sediment); shells typically made of calcium carbonate or silica.	Water column and bottom
Corals, hydroids, jellyfish (Phylum Cnidaria)	Group contains motile and sessile benthic and pelagic animals with stinging cells; can be solitary or colonial; some form hard calcium carbonate exoskeletons.	Water column and bottom
Flatworms (Phylum Platyhelminthes)	Mostly benthic infaunal; simplest form of marine worm with a flattened body.	Water column (rare) and bottom

Common Name (Species Group)	Description	Preferred Habitat
Ribbon worms (Phylum Nemertea)	Mostly benthic infaunal marine worms with a long extension from the mouth (proboscis) that helps capture food.	Water column (rare) and bottom
Round worms (Phylum Nematoda)	Small marine worms; many live in close association with other animals (typically as parasites).	Water column and bottom
Segmented worms (Phylum Annelida)	Mostly infaunal, highly mobile marine worms; many tube-dwelling species.	Bottom
Bryozoans (Phylum Bryozoa)	Lace-like animals that exist as filter feeding colonies attached to the substrate.	Bottom
Cephalopods, bivalves, sea snails, chitons (Phylum Mollusca)	A diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle; can be active swimmers and predators (e.g., squid), mobile predators or grazers (e.g., sea snails), or sessile filter feeders (e.g., bivalves).	Water column and bottom
Shrimp, crab, lobster, barnacles, copepods (Phylum Arthropoda – Crustacea)	Contains many benthic epifaunal or infaunal taxa, as well as many pelagic and demersal zooplankton taxa; distinguished by jointed exoskeleton; some are sessile, but most are motile; all feeding modes from predator to filter feeder.	Water column and bottom
Comb jellies (Phylum Ctenophora)	Gelatinous, pelagic animals that primarily propel themselves with large numbers of cilia; capture prey using sticky cells (colloblasts).	Water column
Sea stars, sea urchins, sea cucumbers (Phylum Echinodermata)	Epibenthic predators and filter feeders with tube feet.	Bottom

Sources: (University of California Museum of Paleontology 2022; World Register of Marine Species Editorial Board 2015)

Similar to other estuarine/marine environments in the northeast GOM that are rich in marine life, benthic communities within East Bay (and therefore within the proposed action area) would be dominated by nematodes (small worms), copepod crustaceans, polychaete worms, mollusks (clams and snails), and large crustaceans (shrimp and crabs) (Tyndall Air Force Base 2019). More specifically, at Tyndall AFB, the benthic community zonation includes mollusks (oysters [*Crassostrea virginica*] and periwinkles [*Littorina irrorata*]) and crustaceans (Gulf crab [*Calinectes smilis]* and Coastal flatwoods crayfish [*Procambarus apalachicolae*]) (Air Force Civil Engineer Center 2013). The proposed action area features sand flats and muddy bottom (Tyndall Air Force Base 2020b), so hard-bottom invertebrate communities, such as corals and sponges, would be absent. The spatial arrangement of the Reefense structures would be designed to optimize habitat opportunities for oysters and ribbed mussels (*Geukensia demissa*), so these species would be expected to occur within the proposed action area over time following Reefense deployment. No ESA-listed invertebrate species would occur within the proposed action area.

Hearing capabilities of invertebrates are largely unknown, but those that possess structures that could detect particle motion seem more likely to perceive sound than those that do not possess such structures. Species of cephalopods (e.g., octopus, squid) and crustaceans (e.g., crab, shrimp, lobster) have statocysts that may be involved in sound detection (Hawkins and Popper 2017). Many invertebrates have been shown to be more sensitive to particle motion associated with sound, rather than sound pressure (Popper and Hawkins 2018). Because any acoustic sensory capabilities, if present at all, are limited to detecting water motion, and water particle motion near a sound source falls off rapidly with distance, aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources. While data are limited, research suggests that some of the major cephalopods and decapods may have limited hearing capabilities, only hearing low-frequency sources (less than 1 kilohertz [kHz]), with best sensitivities at lower frequencies (Hawkins and Popper 2017; Mooney et al. 2010).

3.2.4 Birds

Marine birds are a diverse group that are adapted to living in marine environments, using nearshore waters, offshore waters, or open-ocean areas (Enticott and Tipling 1997; Harrison 1983). Some marine birds forage by gliding just above the sea surface, whereas others dive to variable depths to obtain prey (Burger 2001). Many marine birds spend most of their lives at sea and come to land only to breed, nest, and occasionally rest (Schreiber and Chovan 1986). Most marine bird species nest in colonies on the ground of coastal areas. This EA briefly describes all birds likely to occur within the proposed action area (including flying over), but only birds that may forage within the proposed action area (e.g., waterfowl, seabirds that forage in coastal waters) would be likely to occur at or near the water's surface where they could be affected by the Proposed Action. Therefore, the discussion within this document will focus on these coastal foraging species.

There are eleven orders of birds that may occur within the proposed action area. Table 3-3 provides general distribution on each order, although the information provided does not necessarily apply to all species within each order. No ESA-listed bird species would be expected to occur within the proposed action area.

Table 3-3. Major Orders of Birds that May Occur within the Proposed Action Area

Taxonomic Order	***Representative Species***	***Distribution Within the Proposed Action Area***
Accipitriformes and Falconiformes	osprey, eagles, falcons	Rare. Primarily associated with land, but some species may forage and migrate offshore (Xirouchakis and Panuccio 2019), such as osprey (*Pandion haliaetus*), which overwinter in Florida as well as other locations (Save Coastal Wildlife 2020; U.S. Fish & Wildlife Service 2022).
Anseriformes	ducks, sea ducks	Common. Includes birds that inhabit aquatic environments, including lakes, ponds, streams, rivers, swamps, and marine environments. Those found in marine environments forage for insects, plankton, mollusks, crustaceans, and small fish. Some species flock together outside the breeding season and may form groups ranging in size from a few individuals to many thousands. (Campbell and Lack 1985; del Hoyo et al. 1992).

Taxonomic Order	*Representative Species*	*Distribution Within the Proposed Action Area*
Charadriiformes	phalaropes, gulls, terns, jaegers, kittiwakes, noddies	Seasonally common. Primarily coastal birds; some are long-distance migrants, like terns and kittiwakes, which may enter the proposed action area during migration (Frederiksen et al. 2012).
Gaviiformes	loons	Winter. Loons use large lakes and bays during migration and coastal ocean waters during the winter. They move almost constantly when foraging, scanning the water's surface by dipping the head, then diving to pursue fish. They can locate prey while flying, often in large, dispersed flocks that quickly descend when schools of fish are detected (Holm and Burger 2002; Kenow et al. 2009).
Pelecaniformes	pelicans, egrets, ibis, herons	Potential. Could overlap with proposed action area when foraging. These birds are found mainly on or near oceans. All members of this group hunt for fish and other aquatic prey by diving or swimming (Ashmole 1971), and they could feed within the proposed action area, although diving species would be limited due to the shallow environment.
Phaethontiformes	tropicbirds	Rare. May pass through the proposed action area while migrating between the Caribbean and Bermuda (Winkler et al. 2020), but most migrations remain closer to the Atlantic Ocean.
Podicipediformes	grebes	Winter. Although they breed near freshwater, they migrate and overwinter in marine environments where they may congregate in large numbers as they migrate. Mostly they are solitary or live in small groups. They are underwater hunters (Stidworthy and Denk 2018). During migration and while foraging, grebes may enter the proposed action area.
Procellariiformes	albatrosses, petrels, storm-petrels, shearwaters	Rare. Highly pelagic and prolific seabirds that spend most of their lives at sea except during breeding and nesting seasons (Schreiber and Chovan 1986). During foraging and migrating, they may pass through the proposed action area, but they would be unlikely to spend time in this shallow, estuarine environment.
Strigiformes	owls	Rare. Although owls are likely to occur in terrestrial environments near the proposed action area, they would only rarely be expected to fly over the waters of the proposed action area (Marine Corps 2023; Tyndall Air Force Base 2020b).
Suliformes	boobies, cormorants, gannets, frigatebirds	Rare. These are primarily oceanic birds, but some species inhabit Gulf of Mexico waters and occasionally occur within the proposed action area (Enticott and Tipling 1997).

Tyndall AFB provides important nesting and foraging habitat for different species of birds. Of these, only those that forage within coastal waters (e.g., least tern [*Sternula antillarum*], black skimmer [*Rynchops niger*]) would be expected to overlap with and forage within the proposed action area (Florida Fish & Wildlife Conservation Commission 2023). Breeding occurs during the summer, generally between May and early September (Florida Fish & Wildlife Conservation Commission 2023), but the proposed action area would not be used for breeding or nesting. Nesting bird habitat identified in Tyndall AFB includes beach coastal habitat or gravel rooftops (Tyndall Air Force Base 2020b), which would not overlap with the proposed action area.

Although hearing range and sensitivity has been measured for many terrestrial birds, little research has been conducted on the hearing capabilities of marine birds, especially underwater hearing. Existing research indicates that birds generally have greatest hearing sensitivity between 1 and 4 or 5 kHz (Beason 2004; Dooling 2002). Research shows that very few birds can hear below 20 hertz (Hz). Most birds have an upper frequency hearing limit of no more than 10 kHz, and none exhibit the ability to hear frequencies higher than 15 kHz (Beason 2004; Dooling 2002).

Although hearing is important to seabirds in air, it is unknown if seabirds use hearing or vocalizations underwater for foraging, communication, predator avoidance, or navigation (Crowell et al. 2015; Dooling and Therrien 2012). Diving birds may not hear well underwater because of adaptations to protect their ears from pressure changes during diving (Crowell et al. 2015). The few studies focused on hearing capabilities of marine birds have found their in-air hearing consistent with studies of general bird hearing capabilities (Beason 2004; Crowell et al. 2015). Because they spend a limited amount of time under water, Dooling and Therrien (2012) speculate that water birds may not depend on underwater hearing to locate prey or avoid predators while diving under water (although research in this area is lacking). A study of diving birds (ducks, gannets, and loons) showed best in-air hearing between 1 and 3 kHz (Crowell et al. 2015).

3.2.5 Fish

In general terms, coastal ecosystems like the proposed action area support a great diversity of fish species, including fish that spend their entire lives in these environments and others that use coastal environments periodically for feeding, breeding, or juvenile nursery habitat (Moyle and Cech Jr 2004; Nelson et al. 2016). The following discussion provides an overview of the predominant fish species known to occur in the proposed action area. ESA-listed species that may occur in the vicinity of the proposed action area are discussed in Section 3.2.5.1, and fish hearing is detailed in Section 3.2.5.2.

A complete survey of fish species that may occur within the proposed action area is not available, but the waters off Tyndall AFB are known to include the long-nosed killifish (*Fundulus similis*) and sheepshead minnow (*Cyprinodon variegatus*), and these two brackish water species may occur within the proposed action area (Tyndall Air Force Base 2020b). Naughton and Saloman (1978) conducted surveys of fish within St. Andrews Bay, including East Bay. They grouped results for the upper bays (i.e., East Bay, West Bay, and lower North Bay). Five species constituted three quarters of the fish caught between these three bays: the inland silverside (*Menidia beryllina*), long-nosed killifish, spot (*Leiostomus xanthurus*), rainwater killifish (*Lucania parva*), and sheepshead minnow.

The mixed seagrass beds, sand flats, and muddy bottom habitat in the waters surrounding Tyndall AFB (e.g., Crooked Island Sound and St. Andrews Bay) are significant areas for young sharks. Surveys in these waters have identified Atlantic sharpnose (*Rhizoprionodon terraenovae*) and bonnethead (*Sphyrna tiburo*) sharks as the dominant species (Bethea et al. 2014). Additional species included blacktip

(*Carcharhinus limbatus*), scalloped hammerhead (*S. lewini*), spinner (*C. brevipinna*), blacknose (*C. acrontous*), and finetooth (*C. isodon*) sharks. Only found in small numbers were Florida narrowfin smooth-hound (*Mustelus norrisi),* bull (*C. leucas*), great hammerhead (*S. mokarran*), and sandbar (*C. plumbeus*) sharks (Tyndall Air Force Base 2020b).

3.2.5.1 Threatened and Endangered Fish

The ESA-listed fish that may occur in the proposed action area are listed in Table 3-4. No critical habitat is designated within the proposed action area.

Table 3-4. ESA-Listed Fish within the Proposed Action Area

Common Name	***Scientific Name***	***ESA Status (DPS)***	***Likelihood of Occurrence within the Proposed Action Area***
Gulf sturgeon	*Acipenser oxyrhynchus desotoi*	Threatened	Likely
Smalltooth sawfish	*Pristis pectinata*	Threatened (U.S. DPS)	Likely

DPS = Distinct Population Segment

3.2.5.1.1 Gulf Sturgeon

NMFS and the USFWS, which jointly manage the Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), have listed it as threatened under the ESA throughout its entire range (56 Federal Register [FR] 49653; September 30, 1991). Critical habitat has been designated for the Gulf sturgeon (68 FR 13370; April 19, 2003), but the critical habitat occurs outside of the proposed action area and will not be considered further herein.

This anadromous species occurs in the GOM in bays, estuaries, rivers, and in the marine environment from Florida to Louisiana (National Marine Fisheries Service 2010). Adults inhabit nearshore waters from October through February (Robydek and Nunley 2012) with distribution influenced by prey availability (Ross et al. 2009). Their spring spawning migration toward natal rivers begins as riverine water temperatures reach 64 to 72 °F (18 to 22 °C) from around April to May (Edwards et al. 2003; Heise et al. 2004; Rogillio et al. 2007; Tyndall Air Force Base 2019). Spawning occurs during fall in some watersheds (Randall and Sulack 2012). Once post-spawned adults leave rivers, they remain within 3,281 ft (1,000 m) of the shoreline (Robydek and Nunley 2012) and often inhabit estuaries and nearshore bays in water less than 33 ft (10 m) deep (Ross et al. 2009), such as the proposed action area.

Sub-adult and adult foraging grounds include barrier island inlets with strong tidal currents and estuaries less than 7 ft (2 m) deep with clean sand substrate (Fox et al. 2002; Harris et al. 2005; Ross et al. 2009). Gulf sturgeon winter near beaches of northwestern Florida and southeast of the mouth of St. Andrews Bay (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009). Sturgeon from multiple river systems have been detected overwintering in marine nearshore waters off Tyndall AFB. Gulf sturgeon could occur in the shallow waters of the proposed action area year-round, although they would be more likely to occur in fall and winter.

Prey varies on life stage, but the Gulf sturgeon is considered an opportunistic feeder. In estuarine and marine habitats, they prey upon a wide range of benthic invertebrates (Florida Museum of Natural History 2017).

3.2.5.1.2 Smalltooth Sawfish

NMFS listed the smalltooth sawfish (*Pristis pectinata*) as endangered under the ESA throughout its entire range (68 FR 15674; April 1, 2003). Critical habitat has been designated (74 FR 45353; September 2, 2009), but the critical habitat occurs outside of the proposed action area and will not be considered further herein.

Smalltooth sawfish inhabit warm, shallow coastal and estuarine waters of southern Florida and the GOM. The species is often associated with sandy and muddy deep holes, limestone hard bottom, coral reefs, sea fans, artificial reefs, and offshore drilling platforms (McDonnell et al. 2020; National Oceanic and Atmospheric Administration 2023; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005). Nursery areas include estuaries and mangroves (National Oceanic and Atmospheric Administration 2023; Seitz and Poulakis 2006; Simpfendorfer and Wiley 2005). Smalltooth sawfish may occur year-round, although their affinity for structural complexity (e.g., coral reefs, mangroves) would make them less likely to occur before installation of the Reefense structures.

Smalltooth sawfish are nocturnal feeders and use the saw-like rostrum to disrupt the substrate to expose crustaceans and to stun and slash schooling fish.

3.2.5.2 Fish Hearing

Fish have two sensory systems that can detect sound in the water: the inner ear, which functions similarly to the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the body of a fish (Popper and Schilt 2008). The lateral line system is sensitive to external particle motion (only able to detect motion within a few body lengths of the animal) and can detect particle motion at low frequencies from below 1 Hz up to at least 400 Hz (Coombs and Montgomery 1999; Hastings and Popper 2005; Higgs and Radford 2013; Webb et al. 2008). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies (less than 1 to approximately 200 Hz) (Hastings and Popper 2005; Popper 2005).

Although limited species have been studied, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz. It is believed that most fish have their best hearing sensitivity from 100 to 400 Hz (Popper et al. 2003; Popper et al. 2014). Some species possess anatomical specializations that may enhance their sensitivity to changes in sound pressure, and thus, they have the ability to sense higher frequencies and lower intensities, including sounds above 4 kHz (Popper 2008; Popper and Fay 2011).

Cartilaginous fish (e.g., sharks, skates, rays) are able to detect sounds from 20 to 1,000 Hz, with best sensitivity at the lower ranges (Casper et al. 2003; Casper and Mann 2006, 2007, 2009; Myrberg 2001). The hearing range of smaller sharks is approximately 40 to 1,500 Hz (Myrberg 2001), and for smaller rays, hearing range is 100 to 1,000 Hz (Casper et al. 2003; Casper and Mann 2006). In playback studies of human generated sounds, sharks were attracted to pulsed low-frequency sounds (below several hundred hertz), in the same frequency range of sounds that might be produced by struggling prey or divers in the water (Myrberg et al. 1969; Myrberg et al. 1976; Myrberg et al. 1972; Nelson and Johnson 1972). However, sharks are not known to be attracted by continuous signals, such as vessel noise.

Popper (2005) reviewed various studies and determined that species from the genus *Acipenser* (i.e., sturgeon) may be able to detect sounds between 100 and 1,000 Hz, but he acknowledged that more research is needed to refine this preliminary range. Lake sturgeon (*Acipenser fulvescens*), a fish closely related to the ESA-listed Gulf sturgeon, has been determined to hear sounds ranging between 200 and 500 Hz (Lovell et al. 2005). Lake sturgeon also have low sensitivity to sound pressure (Lovell et al. 2005).

3.2.6 Essential Fish Habitat

The proposed action area is within the jurisdiction of the Gulf of Mexico Fishery Management Council (GMFMC), which is responsible for designating EFH and HAPC for federally-managed fisheries species off the Gulf Coast of Florida. NMFS works with the GMFMC to identify the EFH for every life stage of each federally-managed species using the best available science. Additionally, NMFS manages Atlantic Highly Migratory Species (AHMS), which are those species that frequently travel between the boundaries of regional fishery management councils' jurisdictions (e.g., tunas, billfish, swordfish, and sharks). Several AHMS have EFH designated within the proposed action area. The GMFMC has divided the GOM into five eco-regions for the purposes of designating EFH, and the proposed action area is located within eco-region 2.

EFH may be designated within the water column, in benthic habitat, or both. Table 3-5 presents Management Units with EFH designations that overlap with the proposed action area.

Table 3-5. Management Units with EFH Designated within the Proposed Action Area

Management Unit	***Species***	***Description of EFH for Life Stages that May be Affected by the Proposed Action***
Gulf of Mexico Fishery Management Council		
Red Drum	Red drum (*Sciaenops ocellatus*)	Larvae: Submerged aquatic vegetation, water column, and soft bottom in estuaries. Post-larvae: Submerged aquatic vegetation, emergent marsh, soft bottom, and sand/shell. Early Juveniles: Submerged aquatic vegetation, soft bottom, emergent marsh in water depths from 0 to 10 ft (0 to 3 m). Late Juveniles: Submerged aquatic vegetation, soft bottom, hard bottom, sand/shell in water depths from 0 to 16 ft (0 to 5 m). Adults: Submerged aquatic vegetation, emergent marsh, soft bottom, hard bottom, and sand/shell in water depths from 3 ft (1 m) to offshore waters.
Coastal Migratory Pelagics	King mackerel (*Scomberomorus cavalla)*	Adults: Water column in nearshore waters throughout the Gulf of Mexico (GOM) at depths of 0 to 656 ft (0 to 200 m), and at temperatures greater than 68 °F (20 °C).
	Spanish mackerel (*Scomberomorus maculatus*)	Eggs: Water column associated in nearshore waters in depths less than 164 ft (50 m). Larvae: Nearshore water column waters, at temperatures from 68 to 90 °F (20 to 32 °C). Juveniles: Estuaries nearshore water column habitats and water temperatures from 59.9 to 93.2 °F (15.5 to 34.0 °C). Adults/spawning adults: Estuaries nearshore water column, and water temperatures from 59.9 to 93.2 °F (15.5 to 34.0 °C).
	Cobia (Rachycentron canadum)	Eggs: Water column in estuarine and nearshore waters at temperatures of 82.6 to 85.5 °F (28.1 to 29.7 °C) and salinities of 30.5 to 34.1 ppt. Adults: Throughout the GOM in nearshore waters, water column associated at depths of 3 to 230 ft (1 to 70 m), temperatures of 73.4 to 82.4 °F (23.0 to 28.0 °C), and salinities of 24.6 to 30.0 ppt.
Reef Fish	Black grouper (*Mycteroperca bonaci*)	Early Juveniles: Submerged aquatic vegetation in estuarine waters 3.3 to 33 ft (1 to 10 m) deep. Late Juveniles: With their growth, habitat use shifts to reefs, hard bottom, and mangroves in estuarine waters, depth range of 3.3 to 62 ft (1 to 19 m).
	Gag (*Mycteroperca Microlepsis*)	Early Juveniles: Submerged aquatic vegetation and mangrove in estuarine waters 0 to 39 ft (0 to 12 m) deep. Late Juveniles: Submerged aquatic vegetation, mangrove, and hard bottom in estuarine waters 3.3 to 164 ft (1 to 50 m) deep.

Management Unit	*Species*	*Description of EFH for Life Stages that May be Affected by the Proposed Action*
	Gray snapper (*Lutjanus griseus*)	Post-larvae: Water column, submerged aquatic vegetation in estuarine waters. Early Juveniles: Submerged aquatic vegetation, mangrove, and emergent marsh in estuarine water depths of 3.3 to 10 ft (1 to 3 m). Late Juveniles: Submerged aquatic vegetation, mangrove, and emergent marsh in estuarine waters 0 to 591 ft (0 to 180 m) deep. Adults: Soft bottom, sand/shell, and emergent marsh in estuarine waters 0 to 591 ft (0 to 180 m) deep.
	Hogfish (*Lachnolaimus maximus*)	Eggs and Larvae: Water column in estuarine waters. Juveniles: Submerged aquatic vegetation in estuarine waters. Adults: Mostly hard bottom associated, but EFH includes sand/shell for spawning, including depths less than 3.3 ft (1 m).
	Lane snapper (*Lutjanus synagris*)	Post-larvae: Submerged aquatic vegetation in estuarine water 0 to 164 ft (0 to 50 m) deep. Juveniles: Submerged aquatic vegetation, sand/shell, and soft bottom in estuarine waters 0 to 79 ft (0 to 24 m) deep.
	Red grouper (*Epinephelus morio*)	Early Juveniles: Submerged aquatic vegetation and hard bottom in estuarine waters 0 to 49 ft (0 to 15 m) deep.
	Yellowtail snapper (*Ocyurus chrysurus*)	Eggs, Larvae, and Post-larvae: Water column associated in waters 3 to 600 ft (1 to 183 m) deep. Early Juveniles: Submerged aquatic vegetation in estuarine waters 1 to 4 ft (0.3 to 1.2 m) deep.
Shrimp	Penaid shrimp – pink shrimp (*Farfantepenaeus duorarum*	Larvae and Pre-settlement Post-larvae: Water column in estuarine and nearshore waters 3 to 164 ft (1 to 50 m) deep. Late Post-larvae and Juveniles: Submerged aquatic vegetation, soft bottom, mangroves, and sand/shell in estuarine and nearshore waters 0 to 10 ft (0 to 3 m) deep in temperatures from 43 to 100 °F (6 to 38 °C) and salinities from 0 to 65 ppt (optimum greater than 30 ppt). Sub-adults: Submerged aquatic vegetation, soft bottom, sand/shell, and oyster reefs, and mangroves in estuarine, nearshore, and offshore waters 3 to 213 ft (1 to 65 m) deep in temperatures from 43 to 100 °F (6 to 38 °C) and salinities from 10 to 45 ppt. Adults: Sand/shell bottoms in nearshore and offshore waters 3 to 361 ft (1 to 110 m) deep at temperatures from 61 to 88 °F (16 to 31 °C) and salinities from 25 to 45 ppt.

Management Unit	*Species*	*Description of EFH for Life Stages that May be Affected by the Proposed Action*
	Penaeid shrimp – white shrimp *(Litopenaeus Setiferus)*	Larvae and Pre-settlement Post-larvae: Estuarine, nearshore, and offshore waters 0 to 269 ft (0 to 82 m) deep and temperatures of 62.6 to 83.3 °F (17.0 to 28.5 °C). Late Post-larvae and Juveniles: Emergent marsh, submerged aquatic vegetation, oyster reefs, soft bottom and mangrove habitats in less than 3 ft (1 m) deep estuarine and nearshore waters with salinities of 0.4 to 37 ppt. Sub-adults: Soft bottom and sand/shell habitats in estuarine, nearshore, and offshore waters 3 to 98 ft (1 to 30 m) deep with temperatures of 45 to 100 °F (7.0 to 38 °C) and salinities of 2 to 35 ppt. Adults: Soft bottom in estuarine, nearshore, and offshore waters less than 89 ft (27 m) deep with temperatures greater than 43 °F (6 °C) and salinities of 1 to 21 ppt.
National Marine Fisheries Service		
AHMS – Large Coastal Sharks	Blacktip shark (*Carcharhinus limbatus*) (GOM Stock)	Neonates: Coastal areas, including estuaries, out to the 98 ft (30 m) depth contour. Neonate EFH is associated with water temperatures ranging from 69.4 to 90.0 °F (20.8 to 32.2 °C), salinities ranging from 22.4 to 36.4 ppt, water depth ranging from 3 to 25 ft (0.9 to 7.6 m), and dissolved oxygen (DO) ranging from 4.32 to 7.7 milligrams per liter in silt, sand, mud, and seagrass habitats.
	Bull shark (*Carcharhinus leucas*)	Juveniles and Adults: Freshwater creeks, ocean inlets, and seagrass habitats; temperatures as low as 61.5 °F (16.4 °C); salinities ranging between 1.7 to 41.1 ppt; and DO concentrations ranging between 4 and 7 milligrams per liter; located in shallow depths less than 30 ft (9 m).
	Lemon shark (*Negaprion brevirostris*)	Adults: Within the GOM, West coast of Florida through the Florida Keys, especially in areas where temperatures ranged between 84.7 to 85.8 °F (29.3 to 29.9 °C), salinities of 25.7 to 29.8 ppt, depth of 6.8 to 14.1 ft (2.1 to 4.3 m), and DO of 5.2 to 6.7 milliliters per liter in mud and seagrass areas. Bathymetric depth limit of 656 ft (200 m) in all locations.
	Scalloped hammerhead shark (Sphyrna lewini)	Neonates/Young of Year: Atlantic southeastern coast from Texas to North Carolina, including estuarine habitats. EFH is located in areas with temperatures of 74 to 86°F (23.2 to 30.2 °C), salinities of 27.6 to 36.3 ppt, DO of 5.1 to 5.5 milliliters per liter, depths of 16 to 20 ft (5 to 6 m), and mud and seagrass substrate.
	Spinner shark (*Carcharhinus brevipinna*)	Neonates/Young of Year: Coastal areas within the GOM surrounding the Florida Keys and from the Big Bend Region to southern Texas. GOM EFH consists of sandy bottom areas where sea surface temperatures range from 76.1 to 86.9 °F (24.5 to 30.5 °C) and mean salinity is around 36 ppt.

Management Unit	***Species***	***Description of EFH for Life Stages that May be Affected by the Proposed Action***
AHMS – Small Coastal Sharks	Atlantic sharpnose shark (*Rhizoprionodon terraenovae*) (GOM Stock)	Neonates/Young of Year: Coastal areas including offshore of Naples, Florida; localized areas between Panama City, Florida to Apalachicola; and between Mobile Bay, Alabama and southern Texas. Juveniles and Adults: Coastal areas from the Florida Keys to Texas, out to a depth of 656 ft (200 m). EFH is recognized in important nursery areas in concert with specific habitat associations, including in northeastern GOM, including St. Andrews Bay near the proposed action area in water temperatures between 60.8 to 90.3 °F (16 to 32.4 °C), salinities of 19.0 to 38 ppt, and DO of 4.5 to 8.3 milliliters per liter).
	Bonnethead shark (*Sphyrna tiburo*) (GOM Stock)	Neonates/Young of Year: Coastal areas from the Florida Keys through eastern Mississippi. In estuarine and shallow, coastal waters in the northeastern GOM (including St. Andrews Bay near the proposed action area) in waters with temperatures between 61 and 90.5 °F (16 and 32.5 °C), salinity 19 to 38 ppt, depth 2.3 to 21 ft (0.7 to 6.4 m). Juveniles: Coastal areas in the GOM from the Florida Keys to Chandeleur Sound, Louisiana. EFH occurs in the northeastern GOM (including St. Andrews Bay near the proposed action area) in temperature ranges between 60.8 and 90.5 °F (16 and 32.5 °C), salinity of 1.9 to 8.3 ppt, and depth ranges between 2.3 and 21 ft (0.7 and 6.4 m). Adults: EFH includes coastal areas from the Florida Keys to Chandeleur Sound, Louisiana.

3.2.6.1 Gulf of Mexico Fishery Management Council

The GMFMC has divided the Gulf of Mexico (GOM) into three habitat zones for management purposes: (1) estuarine (inside barrier islands and estuaries), (2) nearshore (60 ft [18 m] or less in depth), and (3) offshore (greater than 60 ft [18 m] in depth) (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016). Each habitat zone is then further broken down into the following specific habitat types: submerged aquatic vegetation, mangroves, drifting algae, emergent marshes, sand/shell bottoms, soft bottoms, hard bottoms, oyster reefs, banks/shoals, reefs, shelf edge/slope, and water column associated.

3.2.6.1.1 Red Drum Management Unit

Red drum (*Sciaenops ocellatus*) is the only species within the Red Drum Management Unit. Red drum inhabits the western Atlantic from Massachusetts to northern Mexico and is distributed throughout the GOM. The GMFMC has designated EFH for red drum to include the following primary habitat types in shallow coastal and estuarine waters: submerged aquatic vegetation, soft bottom, emergent marsh, hard bottom, and sand/shell (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016). Red drum EFH that overlaps with the proposed action area includes submerged aquatic vegetation, emergent marsh, and soft bottom habitat.

3.2.6.1.2 Coastal Migratory Pelagics Management Unit

There are three fish species in the Coastal Migratory Pelagics Management Unit: king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculates*), and cobia (*Rachycentron canadum*). These species inhabit coastal waters of the South Atlantic Bight and the GOM, in estuarine to offshore waters up to depths of 656 ft (200 m) (Gulf of Mexico Fishery Management Council 2005). Coastal Migratory Pelagics EFH that overlaps with the proposed action area includes water column in estuarine nearshore habitats.

King mackerel occur through the GOM and inhabit the offshore habitat zone throughout their life, except their larvae life stage which is found at greater depths. They spawn in offshore waters from May to October. Their migration into the northern GOM in the spring is temperature dependent, with the highest abundances of individuals found in waters with temperatures greater than 68 °F (20 °C). All life stages are water column associated (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016).

Spanish mackerel inhabit the offshore and nearshore habitat zones at all life stages, and throughout their life history, they will inhabit all eco-regions. Spanish mackerel spawn from May to September in depths less than 164 ft (50 m). Spring migrations are temperature dependent (greater than 68 °F [20 °C]) and to depths up to 246 ft (75 m). All life stages are water column associated (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016).

Only the egg life stage of cobia EFH overlaps with the proposed action area. Cobia larvae occur in both estuarine and pelagic waters of the GOM and South Atlantic, primarily from May through September (Ditty and Shaw 1992; Lefebvre et al. 2001). They spawn from April through September in coastal waters with temperatures ranging from 73 to 82 °F (23 to 28 °C) (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016).

3.2.6.1.3 Reef Fish Management Unit

The Reef Fish Management Unit consists of 31 fish species from multiple families, including snappers, groupers, tilefishes, jacks, triggerfishes, wrasses, and sand perches (Gulf of Mexico Fishery Management Council and National Marine Fisheries Service 2016), of which seven species have EFH designated within the proposed action area (Table 3-5). Species in this Management Unit inhabit coastal waters of the South Atlantic Bight and the GOM, in estuarine to offshore waters up to depths of 600 ft (200 m) (Gulf of Mexico Fishery Management Council 2005).

As adults, reef fish often inhabit coral reefs, limestone, or hard bottom with biogenic structure. Older individuals tend to congregate in deeper water, at the edge of the continental shelf, and they live on demersal habitats. Juveniles of many species of reef fish inhabit shallow, inshore waters, associated with seagrass. Rapid temperature and salinity changes can impact this Management Unit, particularly juveniles inhabiting nearshore waters. The majority of reef fish spawn in offshore waters of the GOM and produce pelagic eggs that drift inshore, where juveniles use estuarine and shallow or nearshore waters as nursery grounds (Gulf of Mexico Fishery Management Council 1981). EFH types designated for species within this Management Unit that may occur within the proposed action area include soft bottom, sand/shell, reef habitat; water column; and submerged aquatic vegetation.**Error! Reference source not found.**

3.2.6.1.4 Shrimp Management Unit

Four shrimp species are managed by the GMFMC: the penaeid shrimp (brown shrimp [*Penaeus aztecus*], pink shrimp [*Farfantepenaeus duorarum]*, white shrimp [*Litopenaeus setiferus]),* and the solenoceridae shrimp (royal red shrimp [*Pleoticus robustus*]). Of these, only penaeid shrimp species (pink and white) EFH occurs in the proposed action area.

Designated EFH for this Management Unit is broad. EFH for penaeid shrimp includes inshore-estuarine nursery areas (like the proposed action area), offshore marine habitats (outside the proposed action area), and the water bodies connecting the two.

Shrimp larvae are planktonic, but all other life stages are demersal. Most life stages of penaeid shrimp have preferences for mud, silt, clay, and sand substrate, and juveniles are commonly associated with vegetation (submergent, emergent, and floating), although this association is most common in nearshore, shallow, estuarine locations. Pink shrimp additionally may be associated with shell substrate. Adult penaeid shrimp spawn in offshore waters. Pink shrimp tend to remain in relatively deep waters on the continental shelf while white shrimp remain closer to shore. (South Atlantic Fishery Management Council 1998).

3.2.6.2 National Marine Fisheries Service – Atlantic Highly Migratory Species

NMFS has designated EFH within the proposed action area only for two Management Units: Small Coastal Sharks and Large Coastal Sharks. These shark species generally spend most of their time in waters over the continental shelf, limiting the amount of time they would be expected to occur within the estuarine waters of the proposed action area.

Because of limited information, the description of coastal sharks and their EFH is very broad. For that reason, DARPA considered the species' life histories in evaluating potential effects on EFH. In the GOM, Atlantic sharpnose sharks associate with silt, sand, mud, and seagrass habitat (NOAA Fisheries 2017). The bonnethead shark frequents sandy or muddy habitat (NOAA Fisheries 2017). Blacktip sharks, bull sharks, lemon sharks, scalloped hammerhead sharks, and spinner sharks all have some life stages that overlap shallow, estuarine areas, such as the proposed action area. Additionally, it is worth noting that EFH for spinner sharks have higher salinity than would be expected to occur in the proposed action area most of the year, limiting the likelihood that the proposed action area would qualify as EFH.

Overall, EFH habitat types designated for species within this Management Unit that may occur within the proposed action area include water column associated and soft bottom for both Large Coastal Sharks and Small Coastal Sharks.

3.2.7 Reptiles

Table 3-6 lists the reptile species that would be expected to occur within the proposed action area. Because all of these reptiles are ESA-listed or proposed for listing, only individual species' write-ups are included in this section with no general discussion.

Table 3-6. Presence of Reptiles within the Proposed Action Area

Common Name	***Scientific Name***	***ESA Status (DPS)***	***Likelihood of Occurrence within the Proposed Action Area***	***Critical Habitat within the Proposed Action Area***
Crocodilians				
American alligator	*Alligator mississippiensis*	Threatened due to similarity of appearance	Rare	None
Turtles				
Alligator snapping turtle	*Macrochelys temminckii*	Threatened (proposed)	Rare	None
Green sea turtle	*Chelonia mydas*	Threatened (North Atlantic DPS)	Likely	Proposed
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Potential	None
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	Likely	None
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Potential	None
Loggerhead sea turtle	*Caretta*	Threatened (Northwest Atlantic DPS)	Likely	None

DPS = Distinct Population Segment

3.2.7.1 American Alligator

The American alligator (*Alligator mississippiensis*) is listed as threatened under the ESA due to similarity of appearance to other ESA-listed crocodilians (50 FR 25672; June 20, 1985). No critical habitat has been designated for the American alligator.

Alligators occur in the vicinity of Tyndall AFB, so they could occur within the proposed action area. However, they can only tolerate salt water for short periods of time (Grigg and Gans 1993), and they are more common in freshwater, such as rivers, swamps, and lakes. Accordingly, they would be rare within the estuarine proposed action area, and if an alligator were present at all, it would be transient, moving briefly through the proposed action area.

3.2.7.2 Alligator Snapping Turtle

The USFWS has proposed to list the alligator snapping turtle (*Macrochelys temminckii*) as threatened under the ESA (86 FR 62434; November 9, 2021), but a final rule listing the turtle has not yet been published. No critical habitat designations have been proposed.

Alligator snapping turtles occur along the Florida panhandle, so they may occur within the proposed action area. The alligator snapping turtle is primarily a freshwater species, but the presence of barnacles on some turtles indicates that some spend extended periods of time in brackish water (U.S Fish and Wildlife Service 2021). However, because they are primarily found in rivers, lakes, and other freshwater locations, they would be rare within the estuarine proposed action area. If an alligator snapping turtle were present at all, it would be transient, moving briefly through the proposed action area.

3.2.7.3 Green Sea Turtle

The green sea turtle (*Chelonia mydas*) is listed as threatened under the ESA (43 FR 32800; July 28, 1978). In 2016, NMFS and the USFWS reclassified green sea turtles into 11 different Distinct Population Segments (DPSs) (81 FR 20058; April 6, 2016). Green sea turtles from the threatened North Atlantic DPS may occur in the proposed action area. Critical habitat has been designated for the species (63 FR 46693; September 2, 1998), but it occurs outside of the proposed action area. Additional critical habitat has been proposed for the species (88 FR 46572; July 19, 2023), and this proposed critical habitat overlaps with the proposed action area and will be analyzed herein.

The North Atlantic DPS of green sea turtles occurs between 19 and 48 degrees North latitude (°N) (81 FR 20057; May 6, 2016). They are primarily a coastal species, but oceanic areas are used by juveniles, migrating adults, and, on some occasions, foraging adults (NOAA Fisheries and U.S. Fish & Wildlife Service 2015). After emerging from their nests, green sea turtle hatchlings swim from the beach to offshore areas (Christiansen et al. 2016; Putman and Mansfield 2015). At the juvenile stage (estimated at five to six years), they leave the open-ocean habitat and retreat to protected lagoons and open coastal areas that are rich in seagrass or marine algae (Bresette et al. 2006), where they will spend most of their lives (Bjorndal and Bolten 1988). The optimal developmental habitats for late juveniles and foraging habitats for adults are warm, shallow waters (10 to 16 ft [3 to 5 m]), with abundant submerged aquatic vegetation, and close to nearshore reefs or rocky areas (Holloway-Adkins 2006; Seminoff et al. 2015; Seminoff et al. 2002). Sea turtles use the seagrass beds, sand flats, and muddy bottom habitat of St. Andrews Bay (Tyndall Air Force Base 2020b), so they would be likely to occur within the proposed action area.

The diet of green sea turtles differs between life stages (Bjorndal and Bolten 1988). Pelagic hatchlings' and juveniles' diets include mollusks, jellyfish, sponges, sea pens, and crustaceans (Hatase et al. 2006; Seminoff et al. 2015). Their diet shifts to feeding on seagrasses and macroalgae as they grow to adults and move closer to shore.

Based on the behavior of post-hatchling and juvenile green sea turtles raised in captivity, it is presumed that those in pelagic habitats live and feed within 10 ft (3 m) of the surface (National Marine Fisheries

Service and U.S. Fish and Wildlife Service 1998). Subadults routinely dive to 66 ft (20 m) (Lutcavage and Lutz 1997). Adults tend to be associated with shallow waters with abundant submerged aquatic vegetation close to reefs or rocky areas (Holloway-Adkins 2006; Seminoff et al. 2015; Seminoff et al. 2002). Because the proposed action area has limited aquatic vegetation present, adult green sea turtles would be expected to merely be transiting through the proposed action area, not foraging.

Proposed Green Sea Turtle Critical Habitat

Critical habitat has been proposed for the green sea turtle within the proposed action area (88 FR 46572; July 19, 2023). NMFS identified four essential features for the conservation of at least one DPS:

1. Reproductive. From the mean high water line to 66 ft (20 m) depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches designated as critical habitat by the USFWS, to allow for the transit, mating, and internesting of reproductive individuals and the transit of post-hatchlings.
2. Migratory. From the mean high water line to 66 ft (20 m) depth, sufficiently unobstructed waters that allow for unrestricted transit of reproductive individuals between benthic foraging/resting and reproductive areas. This feature is only identified for North Atlantic and East Pacific DPSs because other DPSs do not use a narrow, constricted migratory corridor.
3. Benthic foraging/resting. From the mean high water line to 66 ft (20 m) depth, underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.
4. Surface-pelagic foraging/resting. Convergence zones, frontal zones, surface-water downwelling areas, the margins of major boundary currents, and other areas that result in concentrated components of the *Sargassum*-dominated drift community, as well as the currents which carry turtles to *Sargassum*-dominated drift communities, which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles, and which are located in sufficient water depth (at least 33 ft [10 m]) to ensure offshore transport via ocean currents to areas which meet forage and refugia requirements. (88 FR 46572; July 19, 2023)

Only one unit of proposed critical habitat, FL01: Florida, overlaps with the proposed action area, and essential features 1, 2, and 3 are applicable to this critical habitat unit. Due to the importance of USFWS-designated critical habitat of nesting beaches to essential feature 1, it is worth noting that the proposed action area is not adjacent to nesting beaches proposed for designation as critical habitat (88 FR 46376; July 19, 2023).

3.2.7.4 Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricata*) is listed as endangered under the ESA (35 FR 8490; June 2, 1970). Critical habitat has been designated (63 FR 46693; September 2, 1998), but the critical habitat occurs outside of the proposed action area and will not be considered further herein.

Hawksbill sea turtles are the most tropical of all sea turtles, inhabiting tropical and subtropical seas of the Atlantic and Pacific Oceans (Seminoff et al. 2003). Hawksbill sea turtles are primarily found in coastal habitats and use nearshore areas more exclusively than other sea turtles. Hawksbills have a mixed migratory strategy. Some will migrate long distances (up to 1,200 miles [1,931 kilometers]) between nesting beaches and foraging areas, while other hawksbill populations will stay within 50 to 200 miles

(80 to 322 kilometers) of their rookery (National Marine Fisheries Service and United States Fish and Wildlife Service 1993).

Hatchlings are believed to occupy the oceanic zone where water depths are greater than 656 ft (200 m), associating themselves with surface algal mats of *Sargassum* (Avens et al. 2021). These life stages would not be expected to occur within the proposed action area. Juveniles leave the open-ocean habitat after three to four years and settle in coastal foraging areas (Mortimer and Donnelly 2008), so juveniles and adults would be expected to occur within the proposed action area.

Although hawksbill sea turtles occur within the GOM and occupy estuaries among their habitats (National Oceanic and Atmospheric Administration 2022), they are not commonly found around Tyndall AFB (Tyndall Air Force Base 2020b). Adults in estuarine habitats tend to prefer areas with good habitat for sponge growth (their preferred food) (National Oceanic and Atmospheric Administration 2022), which does not occur within the proposed action area. Therefore, although hawksbill sea turtles have the potential to occur within the proposed action area, they would not be regularly expected within the area.

Hawksbill juveniles forage on sponges, sea squirts, algae, mollusks, crustaceans, jellyfish, and other invertebrates (Bjorndal 1997). Older juveniles and adults are more specialized, feeding primarily on sponges (Meylan 1988; Witzell 1983). Foraging dives in the northern Caribbean ranged from depths of 26 to 33 ft (8 to 10 m) (van Dam and Diez 1996). Blumenthal et al. (2009) reported consistent diving characteristics for juvenile hawksbill in the Cayman Islands, with an average daytime dive depth of 25 ft (8 m), a maximum depth of 140 ft (43 m), and a mean nighttime dive depth of 15 ft (5 m).

3.2.7.5 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle (*Lepidochelys kempii*) is listed as endangered under the ESA (35 FR 18319; December 2, 1970). Currently, no critical habitat has been designated for this species.

The Kemp's ridley sea turtle occurs primarily in the GOM and Atlantic Ocean. Juveniles are commonly associated with *Sargassum* (National Marine Fisheries Service 2021). Habitats frequently used by Kemp's ridley sea turtles in U.S. waters are warm-temperate to subtropical sounds, bays, estuaries, tidal passes, ship channels, and beachfront waters where their preferred food, the blue crab (*Callinectes sapidus*), is abundant (Lutcavage and Musick 1985; Seney and Musick 2005).

Kemp's ridley sea turtles have been observed and tagged in the waters around Tyndall AFB (Tyndall Air Force Base 2020b). Although not as common as the loggerhead sea turtle in the area, Kemp's ridley sea turtles are known to nest on Tyndall AFB's beaches, with nesting peaking in June and July (Tyndall Air Force Base 2020b). Accordingly, Kemp's ridley sea turtles are likely to occur within the proposed action area.

Kemp's ridley sea turtles feed on both benthic and pelagic prey, primarily on crabs but also on mollusks, shrimp, fish, jellyfish, and plant material (Frick et al. 1999; Márquez-Millán 1994; Robinson et al. 2020; Seney 2016). Blue crabs and spider crabs are important prey species for the Kemp's ridley sea turtle (Lutcavage and Musick 1985; Seney 2016). Juveniles feed on mollusks, natural and synthetic debris, fish species (e.g., sea horses, cownose rays), jellyfish, and tunicates (National Marine Fisheries Service and U.S. Fish & Wildlife Service 2015).

3.2.7.6 Leatherback Sea Turtle

The leatherback sea turtle (*Dermochelys coriacea*) is listed as endangered under the ESA (35 FR 8491; June 2, 1970). Critical habitat has been designated for the species (44 FR 17710; April 23, 1970), but the critical habitat occurs outside of the proposed action area and will not be considered further herein.

The leatherback sea turtle is the most widely distributed of all sea turtles (Eckert 2002). Adult leatherback sea turtles forage in temperate and subpolar regions in all oceans and migrate to tropical nesting beaches. Leatherback sea turtles are likely to occur in the waters off Florida, particularly around nesting season, because the majority of nesting beaches within the United States are located in Florida (National Marine Fisheries Service and U.S. Fish & Wildlife Service 2020).

Migrations of leatherback sea turtles between nesting seasons are typically to the north towards more temperate latitudes, which support high densities of jellyfish, their preferred prey, in the summer (James et al. 2005a). In the fall, leatherback sea turtles move farther offshore and begin their migration south for the winter (Payne and Selzer 1986). In general, leatherback sea turtles spend most of their time out at sea, but they are occasionally found in shallow coastal waters (Defenders of Wildlife 2021).

Leatherback sea turtles have been observed and tagged in the waters around Tyndall AFB (Tyndall Air Force Base 2020b). Although not as common as loggerhead sea turtles in the area, leatherback sea turtles have been known to nest on Tyndall AFB's beaches, with nesting peaking in June and July (Tyndall Air Force Base 2020b). Based on their uncommon occurrences around Tyndall AFB as well as the species preference for offshore waters, there is a potential for leatherback sea turtles to occur within the proposed action area, but they would not be considered common.

Juvenile and adult foraging habitats include both coastal and offshore feeding areas in temperate waters and offshore feeding areas in tropical waters (Frazier 2001). Leatherback sea turtles feed throughout the water column (Davenport 1988; Eckert et al. 1989; Eisenberg and Frazier 1983; Grant and Ferrel 1993; James et al. 2005b; James et al. 2005c; Salmon et al. 2004), predominantly on jellyfish (National Marine Fisheries Service and U.S. Fish and Wildlife Service 2013; Wallace et al. 2015).

3.2.7.7 Loggerhead Sea Turtle

Under the ESA, nine loggerhead sea turtle (*Caretta caretta*) DPSs have been identified and designated worldwide as endangered or threatened (76 FR 58868; September 22, 2011). The Northwest Atlantic Ocean DPS (threatened) would occur within the proposed action area. Critical habitat has been designated (79 FR 39855; July 10, 2014), but the critical habitat occurs outside of the proposed action area and will not be considered further herein.

Loggerhead sea turtles primarily occupy areas where the sea surface temperature is between 59 and 77 °F (15 and 25 °C) (Polovina et al. 2004). Migration between oceanic and nearshore habitats occurs during the juvenile stage as turtles move seasonally from open-ocean current systems to nearshore foraging areas (Bolten 2003; Mansfield 2006). As adults, loggerhead sea turtles continue to migrate seasonally from feeding areas to mating areas and, for females, to nesting areas (Bolten 2003; Mansfield 2006). Migratory routes can be coastal or can involve crossing deep ocean waters (Schroeder 2003). The species can be found hundreds of kilometers out to sea as well as in inshore areas, such as bays, lagoons, saltmarshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky areas, and shipwrecks are often used as feeding areas. Loggerhead sea turtle hatchlings tend to be oceanic (outside of the proposed action area), associated with mats of *Sargassum* for years before returning back to nearshore areas (The State of the World's Sea Turtles 2020; U.S. Fish and Wildlife Service 2020).

Loggerhead sea turtles are abundant in the waters around Tyndall AFB, and data suggest they show fidelity to these habitats (Lamont and Houser 2014). Loggerhead sea turtles nest every year on Tyndall AFB's beaches, although known nesting beaches are along oceanic waters (Tyndall Air Force Base 2020b). Nesting would not be expected to occur on the beach adjacent to the proposed action area. However, adult sea turtles may enter the proposed action area to forage or find shelter.

Loggerhead sea turtles are primarily carnivorous, although they also consume algae (Bjorndal 1997). Diet varies by age class (Godley et al. 1998) and location. Both juveniles and adults forage in coastal habitats, where they feed primarily on the seafloor, although they also capture prey throughout the water column (Bjorndal 2003; Robinson et al. 2020). Adult loggerheads feed primarily on hard-shelled invertebrates (Robinson et al. 2020), such as crabs, shrimp, sea urchins, sponges, and occasionally, fish. Hawkes et al. (2006) found that adult females forage predominantly in shallow coastal waters less than 328 ft (100 m) deep, likely exploiting bottom-dwelling prey. Robinson et al. (2020) tagged rehabilitated loggerhead sea turtles and observed that dives of less than 33 ft (10 m) were most common, although loggerheads also frequently dove to depths of 164 ft (50 m).

3.2.7.8 Reptile Hearing

Sea turtles have been determined to hear in the range of 50 Hz to 2 kHz, with a range of maximum sensitivity between 100 and 400 Hz (Bartol and Ketten 2006; Bartol et al. 1999; Lenhardt 1994, 2002; Papale et al. 2020; Piniak et al. 2016; Ridgway et al. 1969; Willis et al. 2013). The role of underwater low-frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983). Sensitivity within their best hearing range is low as threshold detection levels in water are at 160 to 200 decibels referenced to 1 micropascal (dB re 1µPa) (Lenhardt 1994).

Studies have indicated that green sea turtles have the broadest underwater hearing range (50 Hz to 1.6 kHz) (Papale et al. 2020). Subadult green sea turtles, on average demonstrate lowest hearing threshold at 300 Hz (93 dB re 1 µPa), with thresholds increasing at frequencies above and below 300 Hz (Bartol and Ketten 2006; Piniak et al. 2016). The relatively narrow hearing band and high thresholds suggest that hearing is not an important sense in sea turtles. Juvenile and sub-adult green sea turtles detect sounds from 100 to 500 Hz underwater, with maximum sensitivity at 200 to 400 Hz (Bartol and Ketten 2006). Auditory brainstem response recordings on green sea turtles showed a peak response at 300 Hz (Yudhana et al. 2010). Auditory brainstem response testing was also used to detect thresholds for juvenile green sea turtles (lowest threshold 93 dB re 1 µPa at 600 Hz) (Bartol and Ketten 2006).

Bartol et al. (1999) reported that the range of effective hearing for juvenile loggerhead sea turtles is from at least 250 to 750 Hz using the auditory brainstem response technique. In general, loggerhead sea turtles' hearing sensitivity is less than 1.13 kHz with greatest sensitivity between 50 and 800 Hz (Bartol et al. 1999; Lavender et al. 2014; Martin et al. 2012; Papale et al. 2020). Auditory thresholds for yearling and two-year-old loggerhead sea turtles were also recorded; both yearling and two-year-old loggerhead sea turtles had the lowest hearing threshold at 500 Hz (yearlings at approximately 81 dB re 1 µPa and two-year-olds at approximately 86 dB re 1 µPa), with thresholds increasing rapidly above and below that frequency (Ketten and Bartol 2006).

Research of leatherback sea turtle hatchlings using auditory evoked potentials showed the turtles respond to tonal signals between 50 and 1,200 Hz in water, with a maximum sensitivity of 100 to 400 Hz (Piniak et al. 2012). Papale et al. (2020), as part of a larger examination of studies on sea turtle hearing, noted two studies on Kemp's ridley sea turtles indicating a hearing range of 100 to 500 Hz.

The American alligator has a hearing range from below 100 Hz to between 2 and 3 kHz, and peak sensitivity occurs around 800 Hz (Kettler and Carr 2019). Information on hearing is limited for the alligator snapping turtle. However, given that turtles, generally, are known to respond to sound (Carr 2018), and the only sound of relevance for the Proposed Action is the broadband sound generated by vessels, DARPA assumes that the alligator snapping turtle can perceive vessel noise.

3.2.8 Marine Mammals

Jurisdiction over marine mammals is maintained by NMFS and the USFWS, but the only marine mammal that may occur within the proposed action area, the West Indian manatee (*Trichechus manatus*), is within the USFWS's jurisdiction. All marine mammals are protected under the MMPA, and some are additionally protected under the ESA, including the West Indian manatee.

The West Indian manatee is listed as threatened under the ESA (82 FR 16668, April 5, 2017) and as depleted under the MMPA. The Florida Manatee Sanctuary Act of 1978 established Florida as a refuge and sanctuary for manatees, protecting manatees from injury, disturbance, harassment, or harm in the waters of Florida and enabling enforcement of boat speeds and operations in areas where manatees are concentrated (U.S. Fish and Wildlife Service 2007). Critical habitat has been designated for the West Indian manatee (42 FR 47840; September 22, 1977), but the critical habitat is located outside of the proposed action area and will not be considered further herein.

West Indian manatees inhabit marine, brackish, and freshwater ecosystems in coastal and riverine habitats throughout their range, which includes Florida waters in both the Atlantic Ocean and GOM. During the winter months, their population is concentrated in the warmer waters around the Florida peninsula. During the summer months when the water temperatures are warmer, they have been sighted as far west as Texas. They are typically observed in the waters around Tyndall AFB in summer (Tyndall Air Force Base 2020b). They prefer nearshore habitats featuring underwater vegetation, like seagrasses (U.S. Fish and Wildlife Service 2001, 2023b). Although manatees have been found using waters as shallow as 1.3 ft (0.4 m), they typically utilize locations with access channels that are at least 3 to 7 ft (1 to 2 m) deep (USFWS 2001).

The Florida manatee population is divided into four management units, and the Northwest Florida management unit would be most likely to occur within the proposed action area (Cloyed et al. 2021; USFWS 2001). Although individuals from the Southwest Florida management unit might occur rarely within the proposed action area, individuals from the Atlantic populations rarely enter the GOM (USFWS 2001).

Manatees breed year-round, although there is some evidence of increased breeding between April and November (U.S. Fish and Wildlife Service 2001). Given the estimated gestation period of 11 to 14 months and year-round mating (U.S. Fish and Wildlife Service 2001), calving may occur during any season. Accordingly, calves may be present with female manatees in the proposed action area.

West Indian manatees forage on vegetation. They prefer submerged aquatic vegetation, such as seagrass, but they will feed on floating and emergent vegetation as well. Although manatees can live in saltwater ecosystems, they are known to seek out fresh water for drinking (USFWS 2001, 2017).

Marine mammals use sound to forage, orient, socially interact with others, and detect and respond to predators. Manatees rely primarily on sound for information about their environment because they have poor visual acuity (Rycyk et al. 2022). Manatee hearing range spans from approximately 250 Hz to 76.1 kHz with best hearing sensitivity from 6 to 32 kHz (Rycyk et al. 2022). Gerstein et al. (1999)

obtained behavioral audiograms for two West Indian manatees and found an underwater hearing range of approximately 400 Hz to 46 kHz, with best sensitivity around 16 to 18 kHz. Mann et al. (2009) obtained masked behavioral audiograms from two manatees; sensitivity was shown to range from 250 Hz to 90 kHz, although the detection level at 90 kHz was about 80 dB above the threshold level at that manatee's best sensitivity (16 to 32 kHz). Best sensitivity for the second manatee studied by Mann et al. (2009) was 8 to 22.627 kHz. Preliminary evidence suggests that manatees are able to detect low-frequency sounds outside of their hearing range through vibrotactile senses (i.e., via the hairs on their body) (Gerstein et al. 1999; Mann et al. 2009).

3.3 Socioeconomic and Cultural Resources

This section discusses cultural resources (e.g., archaeological resources, cultural items, and other properties of cultural significance) and socioeconomic resources (e.g., population demographics, employment characteristics, economic activity, and other data providing key insights into socioeconomic conditions) that might be affected by the Proposed Action.

3.3.1 Regulatory Setting

Socioeconomic data shown in this section are presented to characterize baseline socioeconomic conditions in the context of regional, state, and national trends. Data have been collected from previously published documents issued by federal, state, and local agencies and from state and national databases.

Cultural resources are governed by federal laws and executive orders: the Archeological and Historic Preservation Act (Public Law 93-291; incorporated into 54 U.S.C. §§ 312501 *et seq.*), American Indian Religious Freedom Act (42 U.S.C. § 1996), Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa *et seq.*), Executive Order 13007, Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §§ 3001 *et seq.*), and Section 106 of the NHPA (54 U.S.C. §§ 300101 *et seq.*). For the purposes of this analysis, the term "cultural resource" refers to all resources of cultural importance protected by these federal laws and executive orders.

NHPA is the nation's primary historic preservation law, which defines the legal responsibilities of federal agencies for the identification, management, and stewardship of historic properties. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties and consult with the applicable SHPO if a federal action may adversely affect historic or cultural resources. The Division of Historical Resources of the Florida Department of State was contacted to solicit comments regarding whether the Proposed Action may adversely affect significant historical and archaeological resources. The Division of Historical Resources provided data of known historical and archaeological resources near the project footprint, all which occur on land. Since no dredging is anticipated, the Proposed Action is not anticipated to unearth or impact any unknown historical or archaeological resources within the proposed action area. Therefore, no additional surveys were conducted. As a part of the individual and conceptual permit for living shorelines that was submitted to the Florida DEP, Florida SHPO was notified that the Proposed Action would have no effect on historic or archeological resources.

3.3.2 Affected Environment

Socioeconomics describe the basic attributes and resources associated with the human environment, particularly with regard to population and economic activity. Examples of economic activity typically include employment, personal income, and industrial or commercial growth. However, because the Proposed Action does not include any land-based activity, the impacts on socioeconomic resources would be limited, and unaffected resources (e.g., schools, housing, tax revenue) will not be considered further herein. Similarly, cultural resources tend to be concentrated on land, and this section will focus on cultural resources and uses of the waters within and near the proposed action area. This section examines data and information pertaining to cultural resources, commercial fishing, military use, transportation and shipping, and recreational activities.

Tyndall AFB has adopted an Integrated Cultural Resources Management Plan for management of cultural resources on AFB property, and six Native American tribes are recognized for consultation when cultural resources are impacted (U.S. Air Force 2023). There are 402 known archaeological sites and 35 sites listed or eligible for listing in the National Register of Historic Places on Tyndall AFB (U.S. Air Force 2023). However, none of these sites are within the proposed action area.

People first began to occupy northwest Florida 9,500 to 12,000 years ago when glacial retreat opened up the area, and due to lower sea levels, evidence of these early settlements are often found in what is now submerged lands (U.S. Air Force 2023). Although no archaeological or cultural resources are known to exist within the proposed action area, there is potential that artifacts exist beneath the seafloor.

Baker Point is located in Bay County, Florida, which has a population of approximately 172,000 people. The local economy relies on fishing, construction, manufacturing, tourism, logging, and services industries in addition to the military (Tyndall Air Force Base 2020b). While Baker Point is undeveloped, the 823rd RED HORSE Squadron, which includes training and other military facilities, lies west of the proposed action area. Eastern Shipbuilding Group, Inc.'s, Allanton Shipyard is located north of Baker Point across East Bay. It is not expected that the Proposed Action would interfere with shipyard transportation or activities.

Baker Point is within Tyndall AFB's East Unit, a 12,000 acre designated Wildlife Management Area established by the Florida Fish and Wildlife Commission. There is no military infrastructure along the shore adjacent to the proposed action area, although there are some roadways inland from the shore. In addition to military personnel, the general public can access the Baker Point shoreline for recreational activities, including wildlife viewing, hiking, hunting, and fishing (Tyndall Air Force Base 2020b). The nearby Strange and Farmdale Bayous contain boat launches for recreational boaters, fishers, and paddlers, providing access to the proposed action area and adjacent waters (Tyndall Air Force Base 2020b, 2023a). Waterfowl hunting may occur along the Baker Point shoreline or in and around the proposed action area by boat (Tyndall Air Force Base 2020b, 2023a). Tyndall AFB recreational permits are needed for the public to access recreational activities on base property (Tyndall Air Force Base 2020b, 2023a).

Pursuant to Florida fishing regulations, the proposed action area is open to both commercial and recreational fishing. Nearly $8 million of seafood was commercially landed in Bay County in 2021 (Florida Department of Agriculture and Consumer Services 2023a). Inshore species, including blue crabs, shrimp, and mullet, are commercially harvested in Bay County and may occur in or around the proposed action area. Recreational fishing is allowed from shore and boat, and popular game species include red drum and spotted seatrout. The proposed action area is within a closed shellfish harvesting zone; no shellfish aquaculture or wild harvest is allowed (Florida Department of Agriculture and Consumer Services 2023b). Generally, there are few restrictions on marine recreational activities in and around the proposed action area. Recreational boating, kayaking, sailing, and stand-up paddleboarding occur in East

Bay. Surfing, kite surfing, swimming, or paragliding are less common, and they typically occur off ocean-side beaches. Research activities that occur at Tyndall AFB and may occur in or around the proposed action area include fisheries and wildlife surveys (e.g., shorebird surveys, sea turtle surveys and monitoring) (Tyndall Air Force Base 2020b).

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4 Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of the Preferred Alternative and the No Action Alternative on the affected environment (Chapter 3). The approach to the analysis in this EA included the following general steps:

(1) Identification of potential stressors associated with the deployment/installation and potential removal of the Reefense structures; and

(2) Analysis of the potential impact of these stressors on each resource, including the following:

(a) Examination of the temporal nature, spatial extent, and intensity of the stressors;

(b) Examination of the potential for stressors to alter the function or habitat provided by the physical resource or for stressors to result in population-level impacts to the biological resource;

(c) Consideration of standard operating procedures (SOPs) and protective measures to reduce potential impacts (Chapter 6); and

(d) Determination of likelihood for "significant" impacts based on these criteria.

4.1 Potential Stressors Dismissed from Further Analysis

Stressors considered but not analyzed include the following:

- **Snorkeler disturbance:** Snorkelers would be required to support the deployment, and potential removal, of the Reefense structures; the mooring/anchoring of vessels, if needed; and monitoring the Reefense structures once they are installed, quarterly or one week following a storm event. Personnel supporting the Proposed Action would be instructed about the potential presence of ESA-listed species. Additionally, if boat outlook personnel or a snorkeler spot a sea turtle or marine mammal within 200 yards (yd; 183 m) while conducting underwater work, that work would be postponed or halted until the animal vacated the area. Due to the SOPs, protective measures, and protective measures (Chapter 6) that would be employed during the Proposed Action to prevent harassment to sea turtles and manatees, snorkeler disturbance is considered negligible.

- **Monitoring equipment noise:** Equipment used to monitor Reefense structures after installation would include Acoustic Doppler Current Profilers (Appendix B.), which may produce minimal noise. However, these devices operate at a frequency of 400 kHz, which is outside of the hearing range of species that would be expected to occur within the proposed action area. Therefore, monitoring equipment noise would not impact any resources within the proposed action area.

Any impact associated with these stressors on the physical, biological, or socioeconomic and cultural resources within the proposed action area would be minimal and of short duration. Neither of these stressors would have more than a negligible impact on any resource, so they will not be considered further herein.

Additionally, potential sediment disturbance and turbidity associated with deployment and potential removal of the Reefense structures will not be considered in this analysis. During deployment, the larger and heavier individual Reefense structures would be lowered slowly to the seafloor using a crane or excavator. Descent would be controlled to reduce or eliminate turbidity from sediment disturbance. Any materials that have the potential to increase turbidity would be surrounded by turbidity curtains during deployment.

Minimal spudding or anchoring may occur within the proposed action area during deployment and installation, monitoring, and potential removal. However, the footprint of bottom impact to the sandy bottom would be small and of a similar nature to the impacts associated with deployment and installation. Accordingly, any impacts from spudding and anchoring would be subsumed into the analysis of impacts from deployment and installation (Section 4.4.2.2.3) and will not be addressed separately.

4.2 Stressors Associated with the Proposed Action

Stressors resulting from the Proposed Action that may adversely impact the physical, biological, or socioeconomic resources within the proposed action area include the following:

- Vessel noise,
- Vessel movement,
- Reefense deployment and installation, and
- Potential Reefense removal.

A summary of the stressors analyzed and the resources potentially impacted by each stressor is presented in Table 4-1.

Table 4-1. Stressors Associated with the Proposed Action

		Vessel Noise	***Vessel Movement***	***Reefense Deployment/ Installation***	***Potential Removal***
Physical Resources	Benthic Habitat	n/a	n/a	x	x
Biological Resources	Vegetation	n/a	n/a	n/a	x
	Invertebrates	x	x	x	x
	Birds	x	x	n/a	n/a
	Fish	x	x	x	x
	EFH	n/a	n/a	x	x
	Reptiles	x	x	x	x
	Marine Mammals	x	x	x	x
Socioeconomic and Cultural Resources		n/a	x	x	x

x = Potential impacts analyzed herein; n/a = not applicable/minimal impacts

4.2.1 Vessel Noise

During the Proposed Action, vessel noise would be generated from the spud barge or tugboat that would be used to move the sectional barge, as described in Section 2.3.2.3. The tugboat would transit to the proposed action area at 10 knots and move at idle speed within the proposed action area. DARPA assumes a frequency between 1 and 5 kHz and an approximate level of 170 dB re 1 µPa at 1 m at the sources for these vessels (Miles et al. 1987; Richardson et al. 1995).

As described in Section 2.3.2.3, only a tugboat, barges, and small shallow-draft vessel would be used for the Proposed Action. Vessels would be anchored or moving at idle speeds during deployment and monitoring activities. Therefore, exposure to high-intensity vessel noise would be intermittent and minimal for animals within the proposed action area.

Marine species within the proposed action area may be exposed to vessel noise if they occur within the proposed action area while the tugboat is moving the barge. However, since the Proposed Action only includes one tugboat traveling at relatively slow speeds for brief periods of time, only physiological or behavioral responses would be expected (i.e., no physical injury or hearing threshold shift). Vessel noise from the barge would cover a wide bandwidth but would be loudest in low frequencies, similar to other ocean-going vessels.

The behavioral response of a marine species to an anthropogenic sound depends on the frequency, duration, temporal pattern, and amplitude of the sound, as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Common behavioral responses include an alert, avoidance, or other behavioral reaction (NRC 2005; Williams et al. 2015). Some marine species may have habituated to regular vessel noise in the area and may, therefore, have reduced reactions.

If a sound is detected (i.e., heard or sensed) by an animal, a stress response can occur. The generalized stress response is characterized by a release of hormones (Reeder and Kramer 2005) and other chemicals (e.g., reactive oxygen species and other free radicals) (Henderson et al. 2006). A physiological response may contribute to an animal's decision to alter its behavior. Marine animals may exhibit short-term behavioral reactions, such as alertness, startle, avoidance, or cessation of feeding, resting, or social interaction (Fleuren et al. 2018; Richardson et al. 1995). A common response is to leave the vicinity of a sound if that option is available to the individual, which would be the case for the Proposed Action.

Analysis of the potential for vessel noise associated with the Proposed Action to impact invertebrates (Section 4.4.2.2.1), birds (Section 4.4.2.3.1), fish (Section 4.4.2.4.1), reptiles (Section 4.4.2.6.1), and marine mammals (Section 4.4.2.7.1) are addressed within this chapter. Benthic habitats, vegetation, and EFH are not affected by noise and will not be considered further herein.

4.2.2 Vessel Movement

As described in Section 2.3.2.3, deployment of the Reefense structures would occur from a temporarily moored large spud barge or small sectional barge towed by a tugboat. Additionally, a small shallow-draft vessel may be used to move materials to be deployed as well as personnel required to be in the water for installation. After installation, on a quarterly basis, a small shallow-draft vessel would be employed for monitoring and maintenance of the Reefense structures. While in the proposed action area, vessels would be moving at slow speeds of less than five knots.

The deployment of the Reefense structures would be short term in nature and would not be expected to last longer than four weeks for each phase of installation or potential removal. Any impact from vessel movement would be minimal due to the slow speeds and short-term presence of vessels. The barge would mostly be anchored during the Proposed Action, except when transiting to and from the proposed action area or when moving to a new location to support installation or potential removal of Reefense structures.

Marine species within the proposed action area may encounter vessels if they occur near the surface of the water column as the vessel transits through the proposed action area, as such there is a potential of strike. However, since the Proposed Action only includes minimal vessels traveling at slow speeds, the risk of strike is extremely low. Vessel movement also could elicit a behavioral response from species that encounter a vessel. Reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement. Past experiences of the animals with vessels are important in determining the degree and type of response elicited from an animal-vessel encounter.

Analysis of the potential for vessel movement associated with the Proposed Action to impact vegetation (Section **Error! Reference source not found.**), invertebrates (Section 4.4.2.2.2), birds (Section 4.4.2.3.2), fish (Section 4.4.2.4.2), reptiles (Section 4.4.2.6.2), marine mammals (Section 4.4.2.7.2), and socioeconomic and cultural resources (Section 4.5.2.1) are analyzed below. Vessel movement would have no effect on benthic habitats because the vessel would not make contact with the bottom, and it would not affect EFH because vessel movement would be minimal and transient and, therefore, would not affect water column EFH in any measurable or lasting manner.

4.2.3 Reefense Deployment and Installation

The Proposed Action would include deployment and installation of the Reefense structures as well as the installation of marker poles and oceanographic monitoring equipment within the proposed action area. Reefense structures would be slowly lowered from the barge and placed on the seafloor. Descent would be controlled to reduce or eliminate turbidity from sediment disturbance. Any materials that have the potential to increase turbidity would be surrounded by turbidity curtains during deployment.

The Proposed Action would involve the deployment of multiple Reefense structures of varying design and size (Appendix A.). Deployment of the reef module breakwater structures would occur in two phases, each spanning approximately four weeks. At each phase, a maximum of 164 ft (50 m) of non-contiguous reef module breakwater would be deployed. Each section would be no more than 75 ft (23 m) in length, and there would be a minimum 5 ft (1.5 m) gap between each segment to prevent species entrapment. This gap would allow the passage of fish, reptiles, and marine mammals, especially important during low tide when the Reefense structures would reach beyond the water's surface. Approximately two to four months after each breakwater deployment, up to 24 MOH components would be deployed between the breakwater structures and the low tide line, with a maximum height that would not exceed the height of the breakwater (**Error! Reference source not found.**). The deployment of MOH structures would span approximately four weeks; once installed on the seafloor, the Reefense structures would remain stationary in place long term. The total footprint of the Reefense project is approximately 37,500 ft^2 (3,484 m^2; 0.86 acres).

While the installation and deployment may have minor impacts on some environmental resources, the presence of the Reefense structures would attenuate the wave and surge energy on the nearby shoreline, allowing for the recruitment and establishment of marsh grasses and lessening the wave energy impacts on the coast. The establishment of marsh grasses could benefit environmental resources, such as fish and invertebrates.

Analysis of the potential for Reefense deployment and installation to impact benthic habitat (Section 4.3.2.1.1), invertebrates (Section 4.4.2.2.3), fish (Section 4.4.2.4.3), EFH (Section 4.4.2.5.1), reptiles (Section 4.4.2.6.3), marine mammals (Section 4.4.2.7.3), and socioeconomic and cultural resources (Section 4.5.2.2) are analyzed below. Deployment and installation of Reefense structures, marker poles, and other oceanographic instruments would have no effect on vegetation because no structure would be deployed on the single patch of submerged aquatic vegetation present within the proposed action area. Deployment and installation would not affect birds because birds would not be common on or under the water within the proposed action area, and what few birds might be present would be expected to leave the area before deployment due to vessel presence.

4.2.4 Potential Reefense Removal

If DARPA cannot transfer ownership of the Reefense structures to a local entity, the structures would have to be removed at the end of the project in May 2027. The potential impacts associated with removal would be similar to those associated with Reefense deployment and installation (Section 4.2.3), except the end result would be removal of structures instead of their presence. Potential removal of the Reefense structures would result in major changes to the footprint where the Reefense structures were deployed as the hard surface of the structures would be removed, uncovering the original soft bottom. Additionally, areas along the surf zone and shoreline may receive increased wave action as the Reefense structures would no longer be present to dissipate the wave and current energy acting upon the shoreline. As such, the potential impact of the removal of the Reefense structures would be long term and localized due to the removal of benefits associated with the Proposed Action. However, the bottom habitat type is expected to shift back to its original characteristic. Temporary localized disturbances caused by the removal of the Reefense structures would not alter the function or habitat provided by marine substrates.

As with the deployment of the structures (Section 4.2.3), the removal would require the tugboat and barge with machinery that would ensure a gradual ascent of the Reefense structures from the seafloor. The risk of strike of mobile species within the area would be minimal because of the slow, controlled removal. Therefore, the potential removal activities would only be expected to result in behavioral responses (i.e., avoidance) from mobile species. Portions of the reef that can be used to improve or enhance other local habitats will be transferred to those areas. However, other sedentary species that have colonized the reef would not be relocated upon removal, and therefore, these species would suffer mortality.

If removal is required, portions of the reef that can be used to improve or enhance other local habitats will be transferred to those areas in collaboration with the Bay County and the State of Florida (Chapter 6). Flora and fauna will be removed if appropriate for transplantation, and structural materials would be discarded on land. Motile organisms will be allowed to disperse during removal or removed by washing with water pumped across the structure or by hand and released.

Analysis of the potential for removal of the Reefense structures to impact benthic habitat (Section 4.3.2.1.2), vegetation (Section 4.4.2.1.1), invertebrates (Section 4.4.2.2.4), fish (Section **Error! Reference source not found.**), EFH (Section 4.4.2.4.3), reptiles (Section 4.4.2.6.4), marine mammals (Section 4.4.2.7.4), and socioeconomic and cultural resources (Section 4.5.2.3) are analyzed below. Potential removal of Reefense structures would have no effect on birds because birds would not be common on or under the water within the proposed action area, and what few birds might be present would be expected to leave the area before removal due to vessel presence.

4.3 Physical Resources

The only physical resource that may be affected by the Proposed Action would be benthic habitat.

4.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No deployment of artificial reef structures would occur, and the area would be left undeveloped unless/until other in-water construction is proposed as part of a future project. The No Action Alternative would not meet the purpose of and need for the Proposed Action, and the advancement of alternatives to traditional hard armoring would not be supported. The No Action Alternative would leave coastal development both at Baker Point and beyond more vulnerable to climate change impacts or limited to traditional hardscape solutions, which are detrimental to the environment.

4.3.2 Action Alternative (Preferred Alternative)

4.3.2.1 Benthic Habitat

The stressors that would impact benthic habitat in the proposed action area would be Reefense deployment and installation as well as potential removal. In accordance with the CZMA, DARPA consulted with the Florida DEP via the individual and conceptual permit for living shorelines, which is pending as of the publication of this Draft EA.

4.3.2.1.1 Reefense Deployment and Installation

As shown in Figure 1-1, water depths within the proposed action area are between 0 and 3.9 ft (0 and 1.1 m) deep, located in the intertidal and subtidal zones. The majority of the proposed action area is comprised of soft sediment (WSP 2022). The area for the Reefense deployment and installation has been surveyed, confirming the absence of vegetation and the presence of unconsolidated sandy bottom with 90 percent medium to coarse grain sand (WSP 2022). This section considers the potential harm of the Reefense deployment and installation on soft sediments within the proposed action area.

Given the nature of the proposed action area, the Reefense structures would be deployed on primarily soft sediment. They would not be deployed on any existing vegetation. The primary impact on benthic habitat from deployment and installation of the Reefense structures would be obstruction of existing soft sediment, covering that sediment with hard surfaces. This would be a long-term impact as the change would remain unless the Reefense structures are removed (Section 4.3.2.1.2). Effectively, deployment would alter the habitat from soft bottom to hard bottom. The soft sediment does provide foraging grounds and habitat for some species, such as invertebrate communities. This change from soft to hard bottom would make the affected areas unable to support these functions. However, the maximum total footprint of the objects is minimal in comparison to the general availability of soft sediment within East Bay. The Reefense structures would not exceed a maximum combined footprint of 37,500 ft^2 (3,484 m^2; 0.86 acres).

The change of a small portion of the proposed action area from soft bottom to hard bottom would increase the complexity of the bottom sediments, allowing use and recruitment by a wider diversity of species, a positive environmental benefit. Local oyster stocks selectively bred for disease resistance would be directly attached to the reef module breakwater and some MOH structures, and the structures would serve as substrate for the natural recruitment of oysters. By using oysters as the biological component of this Reefense structure design, the structures would serve a dual purpose of mitigating wave impacts and improving local water quality. Additionally, by attenuating the wave action on the shore at Baker Point, the Reefense structures could protect benthic habitat landward of their location from erosion and other harm caused by storm-driven waves and currents.

Overall, deployment and installation of the Reefense structures associated with the Proposed Action may cause long-term changes to the benthic habitat, but these changes would affect only a small footprint in the context of East Bay. Additionally, the changes would have positive impacts in creating a more diverse habitat and providing wave energy protection shoreward. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to the benthic habitat within the proposed action area.

4.3.2.1.2 Potential Reefense Removal

The actions associated with the potential removal of the Reefense structures would be similar to Reefense deployment. During the removal activity, the barge would slowly lift Reefense structures from the seafloor. Removal of the Reefense structures would be slow and deliberate to ensure minimal to no sediment suspension.

If removal of the Reefense structures occurs, the long-term result of this removal would be a change from hard bottom back to soft bottom within the footprint of the structures. This would result in major changes to the bottom habitat type because it would be a complete elimination of hard bottom habitat within the proposed action area; however, this would equate to restoration of the pre-Reefense deployment bottom composition (i.e., all soft bottom). The benthic habitat would no longer be able to support species dependent upon hard bottom. Additionally, some areas along the surf zone and shoreline that had benefited from reduction in wave action from the Reefense structures would again be exposed to this wave energy. The potential impact of the removal of the Reefense structures would be long term and localized.

Although removal would constitute a long-term loss of hard bottom habitat, such habitat would only exist because of the Proposed Action, and the footprint of change would be minimal (37,500 ft^2 [3,484 m^2; 0.86 acres]). Therefore, in accordance with NEPA, potential Reefense removal associated with the Proposed Action would not result in significant adverse impacts to benthic habitat within the proposed action area.

4.4 Biological Resources

This section will analyze the potential effects of stressors on the following biological resources: vegetation (Section 4.4.2.1), invertebrates (Section 4.4.2.2), birds (Section 4.4.2.3), fish (Section 4.4.2.4), EFH (Section **Error! Reference source not found.**), reptiles (Section 4.4.2.5), and marine mammals (Section 4.4.2.7).

4.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No deployment of artificial reef structures would occur, and the area would be left undeveloped unless/until other in-water construction is proposed as part of a future project. The No Action Alternative would result in no effect to biological resources in the immediate future. However, the No Action Alternative would not meet the purpose of and need for the Proposed Action, and the advancement of alternatives to traditional hard armoring would not be supported. The No Action Alternative would leave coastal development both at Baker Point and beyond more vulnerable to climate change impacts or limited to traditional hardscape solutions, which can be harmful to biological resources by inhibiting movement between water and land or otherwise disrupting the ecosystems upon which they rely.

4.4.2 Action Alternative (Preferred Alternative)

4.4.2.1 Vegetation

The only stressor that may affect vegetation within the proposed action area would be potential Reefense removal. As stated in Section 1.2, no submerged aquatic vegetation would be impacted by the deployment/installation of Reefense structures. The site was chosen because it was devoid of submerged aquatic vegetation. No ESA-listed vegetation species would occur within the proposed action area.

4.4.2.1.1 Potential Reefense Removal

In the proposed action area and the adjacent shoreline, the attenuation of wave action that the Reefense structures would provide could enhance the recruitment and growth of submerged aquatic vegetation and marsh grasses. If the structures need to be removed, these habitat protections would be lost. The return to pre-installation wave energy conditions would likely result in the destruction of much of the aquatic and shoreline vegetation. Additionally, any vegetation that had recruited to the Reefense structures themselves would suffer mortality because attached organisms would not be replanted. However, due to the small maximum total footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), potential adverse impacts would be minimal and highly localized. As the proposed action area currently has minimal vegetation presence, the most likely result would be a return to the pre-Reefense deployment state.

Overall, potential Reefense removal associated with the Proposed Action would be expected to have long-term but spatially limited effects on vegetation. No population-level effects would be expected. In accordance with NEPA, potential removal would not cause significant adverse impacts to vegetation.

4.4.2.2 Invertebrates

The stressors associated with the Proposed Action that have the potential to impact invertebrates would include vessel noise, vessel movement, Reefense deployment and installation, and potential Reefense removal. No ESA-listed invertebrate species would occur within the proposed action area.

4.4.2.2.1 Vessel Noise

As addressed in Section 3.2.3, hearing capabilities of invertebrates are largely unknown (Hawkins and Popper 2017). However, research has suggested that the major cephalopod and decapod species perceive sounds below 1 kHz (Hawkins and Popper 2017; Mooney et al. 2010), which would include broadband sounds produced by vessels. Therefore, invertebrates within the proposed action area would likely perceive vessel noise generated by the support vessel.

As noted in Section 4.2.1, vessel noise associated with the Proposed Action would not be expected to cause injury or hearing threshold shifts. Invertebrates within close proximity to the support vessel could experience physiological effects or behavioral reactions. However, most marine invertebrates are known to detect only particle motion associated with sound waves (Graduate School of Oceanography 2021), which drop off rapidly with distance, limiting the exposure to the short period when an invertebrate is very close to the support vessel.

Behavioral effects resulting from vessel noise playback have been observed in various crustacean, cephalopod, and bivalve species and include shell closing and changes in feeding, coloration, swimming, and other movements. In addition to disruption of important processes, like feeding or seeking shelter, behavioral reactions can result in increased energy expenditure (Hudson et al. 2022). Vessel noise may contribute to masking of relevant environmental sounds, such as predator detection or communication (Staaterman et al. 2011). Overall, underwater vessel noise associated with the Proposed Action would be similar to other vessels in the area. Although the proposed action area is not along major shipping routes, vessels do periodically transit through or near the area, including from the Allanton Shipyard located across East Bay from the proposed action area. The short-term presence of vessels supporting the Proposed Action would not substantially elevate ambient noise levels, and what elevation occurs would be limited to the short time that the vessel would be present within the proposed action area. Vessels would only remain within the proposed action area for a maximum of four weeks for each phase of deployment of reef module breakwaters, for each phase of MOH installation as well as for potential removal activities; therefore, exposure of invertebrates to vessel noise would be short-term. Additionally, vessels would move slowly within the proposed action area (maximum of five knots), so the vessel noise would be quieter than vessels moving at higher speeds.

Although vessel noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed invertebrates would be expected to return to normal behavior shortly after the exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. In accordance with NEPA, vessel noise would not cause significant adverse impacts to invertebrates.

4.4.2.2.2 Vessel Movement

Vessels have the potential to harm marine motile invertebrates by disturbing the water column or directly striking organisms. The only contact vessels may have with benthic invertebrates is during anchoring.

Most vessels have hydrodynamic hulls that allow water to flow around their hulls, so smaller organisms (e.g., pelagic invertebrates) are more likely to be disturbed rather than struck. Vessel movement may result in short-term and localized disturbances to invertebrates, such as zooplankton and cephalopods, utilizing the upper water column. Propeller wash (i.e., water displaced by propellers used for propulsion) from vessel movement can potentially disturb marine invertebrates in the water column and would be a likely cause of zooplankton mortality (Bickel et al. 2011). However, most invertebrates are broadcast spawners and experience high mortality rates under normal conditions. Any additional impacts caused by vessel movement would be considered biologically insignificant (U.S. Department of the Navy 2018), and no population-level impacts would occur since the number of organisms, eggs, and larvae exposed to vessel movements would be low relative to total biomass of the species. Similarly, anchoring of the support vessel could cause behavioral responses in mobile benthic invertebrates or crush and kill immobile benthic invertebrates. However, given the extremely small footprint that would be affected by periodic anchoring, any adverse impacts to benthic invertebrates would be immeasurably small.

Overall, vessel movement associated with the Proposed Action would be expected to have no more than a minor, short-term effect on invertebrates. No population-level effects would be expected. In accordance with NEPA, vessel movement would not cause significant adverse impacts to invertebrates.

4.4.2.2.3 Reefense Deployment and Installation

With the deployment of the Reefense structures and other instrumentation, disturbance would occur throughout the water column and at the seafloor as each object descends and settles. Objects would be deployed at such a slow rate that zooplankton would be more likely to be dispersed than destroyed, so no adverse effects would be expected. Mobile invertebrates may have brief behavioral reactions, moving away from the deployment location. Due to the slow, controlled descent of objects through the water column, strike of mobile invertebrates by structures is not expected to occur. Additionally, object descent would be so slow that creation of sediment plumes is not anticipated.

Reefense deployment would be on areas covered with sand or sediment, away from submerged aquatic vegetation. Immobile invertebrates on or buried within the soft sediment may become covered, crushed, or smothered by the Reefense structures. However, due to the small footprint of the structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), no population impacts would occur. Additionally, benthic invertebrate communities in soft-bottom sediments have repeatedly been shown to recolonize rapidly following dredging (McCauley et al. 1977; Michel et al. 2013; Newell et al. 2004; Normandeau Associates 2001), and the placement of Reefense structures on a small footprint would be far less damaging than dredging. Mobile benthic invertebrates associated with soft bottoms would be expected to move away from the deployment, and due to the slow descent of the objects, these species would not be expected to experience mortality from crushing. Any disturbed individuals would be expected to quickly resume normal behavior. Soft-bottom habitats, characteristic of the proposed action area, generally have a lower species biomass than hard bottom communities and coral reefs, reducing potential impacts on invertebrate populations.

The reef module breakwater would have a minimum 5 ft (1.5 m) gap between structures, and the MOH structures would have at least 15 ft (5 m) gaps between structures. As such, the design of the Reefense project would allow egress of motile invertebrates, and thus, no adverse impacts are anticipated once the structures are deployed. Even at low tide when the structures are exposed above the water, it is extremely unlikely that an invertebrate would become trapped by the structures. Invertebrates (e.g., oysters and crabs) would likely recruit to these hard surfaces on the otherwise soft bottom seafloor.

Overall, deployment of the Reefense structures during the Proposed Action may cause short-term disturbance or limited mortality of invertebrates within or immediately adjacent to the footprint of the Reefense structures. After the Reefense structures settle on the seafloor, their presence would not present any additional risk to invertebrate communities and would instead provide enhanced habitat for invertebrate species.

Overall, deployment and installation of the Reefense structures and other equipment associated with the Proposed Action would result in no more than a minor, short-term effect on invertebrate communities. Although some mortality could be associated with deployment and installation, it would be extremely limited. Invertebrate communities regularly experience high mortality, and no population-level effects would be expected. The long-term presence of the Reefense structures would be expected to have positive impacts on invertebrate communities. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to invertebrates.

4.4.2.2.4 Potential Reefense Removal

Benthic invertebrates could experience injury or mortality during the potential removal of Reefense structures. Most impacts of removal would be similar to those occurring during deployment and installation (i.e., short-term behavioral responses). However, sessile invertebrates on the structures may experience mortality. Portions of the reef that can be used to improve or enhance other local habitats will be transferred to those areas, but species that cannot be transferred would be removed and disposed of with the Reefense structures. Additionally, removal of the structures would constitute loss of potential habitat, a long-term effect. However, this would equate to returning the habitat to its pre-deployment state (i.e., barren soft bottom).

Although removal would constitute a long-term loss of hard bottom habitat, such habitat would only exist because of the Proposed Action. Additionally, due to the relatively small footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), change in habitat and potential invertebrate mortality would be too small to be meaningfully evaluated. No population-level effects would be anticipated in light of the large biomass of invertebrates and inconsequential numbers expected to recruit to the objects. Therefore, in accordance with NEPA, potential Reefense removal would not result in significant adverse impacts to invertebrates.

4.4.2.3 Birds

The stressors associated with the Proposed Action that have the potential to impact birds include vessel noise and vessel movement. No ESA-listed bird species would be expected to occur within the proposed action areas.

4.4.2.3.1 Vessel Noise

Given the location of the proposed action area in the nearshore, birds that are most likely to be present and exposed to vessel noise are waterfowl, especially birds that dive underwater to forage. However, exposure to vessel noise would be minimal, even for species present within the proposed action area. Vessels would only remain within the proposed action area for a maximum of four weeks for each phase of deployment of reef module breakwaters, for each phase of MOH installation as well as for potential removal activities. Diving birds typically spend extended periods on land, so their exposure to vessel noise associated with the Proposed Action would be limited to the rare occasions when they would be in the water foraging when vessels are present.

Birds foraging on or in the water would be able to detect sound from the vessel. As noted in Section 4.2.1, no injury or hearing threshold shift would be expected. Noise from the vessel may elicit short-term behavioral or physiological responses in exposed birds, such as an alert or startle response or temporary increase in heart rate. A behavioral response may include increased alertness, birds moving away from the area, or the disruption of feeding. Vessel noise associated with the Proposed Action would be similar to other vessels in the area, so birds within the proposed action area may be habituated to vessel noise.

Although vessel noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed birds would be expected to return to normal behavior shortly after the exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. In accordance with NEPA, vessel noise would not cause significant adverse impacts to invertebrates.

4.4.2.3.2 Vessel Movement

As described in Section 4.4.2.3.1, vessels associated with the Proposed Action would have limited overlap with birds. Any impact from vessel movement would be minimal due to the slow speeds and temporary nature of vessel activities within the proposed action area.

The risk for birds to be struck by vessels when they are foraging or resting on the water's surface would be extremely low given the slow speed of the vessels, the fact that most birds would be alert while on the surface, early detection by birds who would hear the approaching vessel. The more likely impacts from vessel movement would be physiological or behavioral responses. Bird reactions to vessel movement would be the same as for vessel noise as it is unclear in most circumstances whether a bird is responding to the sound or visual presence of a vessel. Birds would be expected to move away from the vessel and quickly resume normal behavior.

Overall, vessel movement associated with the Proposed Action would be expected to have no more than a minor, short-term effect on birds. No population-level effects would be expected. In accordance with NEPA, vessel movement would not cause significant impacts to birds.

4.4.2.4 Fish

The stressors associated with the Proposed Action that have the potential to impact fish include vessel noise, vessel movement, Reefense deployment and installation, and potential Reefense removal. ESA-listed fish species expected to occur in the proposed action area include Gulf sturgeon and smalltooth sawfish. No critical habitat is designated within the proposed action area.

4.4.2.4.1 Vessel Noise

As discussed in Section 3.2.5.2, it is believed that most fish, including the ESA-listed Gulf sturgeon and smalltooth sawfish, have their best hearing sensitivity from 100 to 400 Hz (Popper et al. 2003; Popper et al. 2014), which would include the low-frequency sounds produced by the vessels associated with the Proposed Action. As noted in Section 4.2.1, vessel noise associated with the Proposed Action is unlikely to result in injury or hearing threshold shift, so the most likely impacts from vessel noise would be physiological or behavioral responses.

Vessels would only remain within the proposed action area for a maximum of four weeks for each phase of deployment of reef module breakwaters, for each phase of MOH installation as well as for potential removal activities. Additionally, the use of slow vessel speeds reduces the amplitude of the vessels' sound signature, therefore reducing the distance at which the sound would persist at levels substantially elevated above ambient noise levels within the proposed action area. Vessel noise associated with the Proposed Action would be similar to other vessels operating in the area.

Underwater noise from vessels is generally loudest at relatively low frequencies, usually between 5 and 500 Hz (Hildebrand 2009; NRC 2003; Southall et al. 2017; Urick 1983; Wenz 1962), although the exact level of noise produced varies by vessel. Accordingly, potential responses to vessel noise would be expected to be limited because of the minimal sounds generated and the likely habituation of fish within the area to vessel noise. Given the short-term nature of the vessel presence, the Proposed Action would be unlikely to cause any significant, lasting increase in the ambient noise of the proposed action area. However, exposure to vessel noise could result in masking of biologically relevant sounds or short-term behavioral reactions, such as an alert or avoidance (NRC 2003, 2005; Williams et al. 2015). Because the distance over which most fish are expected to detect sounds is limited and because most vessel noise would be transient or intermittent (or both), most behavioral reactions and masking effects from the Proposed Action would likely be short-term, ceasing soon after the vessel passes by.

Although vessel noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed fish would be expected to return to normal behavior shortly after exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. In accordance with NEPA, vessel noise would not cause significant adverse impacts to fish. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that the Proposed Action may affect, but is not likely to adversely affect, the Gulf sturgeon or smalltooth sawfish. NMFS' concurrence is pending as of the publication of this Draft EA.

4.4.2.4.2 Vessel Movement

Vessel movement has the potential to impact fish by causing a physiological or behavioral reaction from operating near a fish or mortality or serious injury from a collision between the vessel and a fish. While vessels do not usually collide with adult fishes, most of which can detect and avoid them, some species may be more susceptible than others. Vessel strike poses a risk of mortality for adult fish, as shown with previous studies of Atlantic sturgeon in the Delaware estuary (Brown and Murphy 2010). In general, vessels pose greater risks of strikes of slow-moving animals (e.g., sea turtles and marine mammals) than fish. However, the risk does depend on the size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, the behavior of fish in the area (e.g., foraging, migrating, etc.), and the geographic conditions (e.g., narrow channels, restrictions, etc.) during active operation. Fish are capable of detecting approaching objects by sound (pressure and particle motion), water movement, or vision (Becker et al. 2013; Misund 1997). The likelihood of collision between vessels and adult or juvenile fish would be extremely low because fish are highly mobile and would avoid an approaching vessel, especially one moving slowly (Becker et al. 2013; Misund 1997), such as the support vessel (maximum speed of five knots within the proposed action area). Due to slow vessel speeds, short-term presence of the vessel, limited presence of fish in the water column of the coastal nearshore habitat, and the highly mobile nature of fish, strike and/or injury is extremely unlikely to occur.

The more likely impacts of vessel movement on fish would be physiological or behavioral reactions, which would be similar to the reactions resulting from vessel noise (Section 4.4.2.4.1). As for vessel noise, fish would be expected to respond to vessel movement by swimming away and resuming normal behaviors shortly after moving away from the vessel.

In summary, vessels could strike and injure or kill fish transiting the proposed action area, but most fish encountering vessels would be expected to incur only a temporary physiological or behavioral response. Temporary behavioral reactions caused by vessel movement associated with the Proposed Action would not be expected to result in significant changes to an individual fish's fitness. Population-level impacts are not anticipated. In accordance with NEPA, vessel movement would not cause significant adverse impacts to fish. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that the Proposed Action may affect, but is not likely to adversely affect, the Gulf sturgeon or smalltooth sawfish. NMFS' concurrence is pending as of the publication of this Draft EA.

4.4.2.4.3 Reefense Deployment and Installation

With the deployment of the Reefense structures and other instrumentation, disturbance would occur throughout the water column and at the seafloor as each object descends and settles. Due to the mobile nature of fish and the slow, controlled descent of objects through the water column, strike of fish by structures is not expected to occur. Therefore, the only anticipated impacts to fish during deployment and installation would be physiological and behavioral responses.

Deployment of Reefense structures and other instruments could potentially cause momentary behavioral reactions in fish. Many fish species engage in fast maneuvers, often termed fast-start responses, for predator avoidance or by predators to surprise and catch prey. These fast-start responses also function as a startle response, such as to an object breaking the water's surface (Fleuren et al. 2018). Therefore, a fish is likely to detect and evade an object, potentially resulting in a cessation of current activity (e.g., foraging). Affected fish are likely to resume their normal behaviors readily, and no long-term behavioral effects are anticipated.

The reef module breakwater would have a minimum 5 ft (1.5 m) gap between structures, and the MOH structures would have at least 15 ft (5 m) gaps between structures. As such, the design of the Reefense project would allow egress of fish, and thus, no adverse impacts are anticipated once the structures are deployed. Even at low tide when the structures are exposed above the water, it is extremely unlikely that a fish would become trapped by the structures. Fish would be expected to recruit to the structures. Therefore, the long-term effect of deployment and installation of the Reefense structures would be creation of habitat for fish, potentially increasing fish recruitment to and utilization of the proposed action area.

Overall, the deployment of the Reefense structures and other equipment in the proposed action area may result in no more than minor, short-term and local disturbance of fish. It would be expected that any fish temporarily displaced during object deployment would resume normal behavior once the installation is completed. Temporary behavioral reactions caused by deployment are not expected to result in significant changes to an individual fish's fitness. Population-level impacts are not anticipated. The long-term presence of the Reefense structures would be expected to have positive impacts on fish communities. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to fish. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that Reefense deployment and installation may affect, but is not likely to adversely affect, the Gulf sturgeon or smalltooth sawfish. NMFS' concurrence is pending as of publication of this Draft EA.

4.4.2.4.4 Potential Reefense Removal

The same potential short-term effects to fish from the deployment and installation of the Reefense structures would be applicable to the potential removal of the structures because the actions would essentially be the same, only in reverse (Section 4.4.2.4.3). The Reefense structures would be raised in a controlled manner, making strike extremely unlikely as fish would be expected to swim away when work commences. In addition to the short-term behavioral reactions, removal of the structures would constitute loss of potential habitat, a long-term effect. However, this would equate to returning the habitat to its pre-deployment state (i.e., barren soft bottom).

Although removal would constitute a long-term loss of reef and submerged aquatic vegetation habitat, such habitat would only exist because of the Proposed Action. Additionally, due to the relatively small footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), change in habitat would be too small to be meaningfully evaluated. Affected fish may show a brief behavioral reaction due to the raising of the structures by swimming away from the proposed action area, but the behavioral response would be minor and brief and would not affect an individual's overall fitness. No population-level effects would be anticipated. Therefore, in accordance with NEPA, potential Reefense removal would not result in significant adverse impacts to fish. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that potential Reefense removal may affect, but is not likely to adversely affect, the Gulf sturgeon or smalltooth sawfish. NMFS' concurrence is pending as of publication of this Draft EA.

4.4.2.5 Essential Fish Habitat

The stressors associated with the Proposed Action that have the potential to impact EFH include Reefense deployment and installation and potential Reefense removal. EFH designated by the GMFMC that overlaps with the proposed action area includes the following Management Units: Coastal Migratory Pelagics, Reef Fish, Red Drum, and Shrimp. EFH designated for AHMS by NMFS that would overlap with the proposed action area includes species from both the Large Coastal Sharks and Small Coastal Sharks groups. No federally-listed HAPC exists within the proposed action area.

4.4.2.5.1 Reefense Deployment and Installation

The primary impacts associated with the deployment and installation of Reefense structures and other instruments would be bottom disturbance and alteration of the seafloor from soft bottom to hard bottom. However, water column EFH may be impacted by the deployment and long-term presence of the structures as well.

Potential Impacts to Water Column EFH

Water column EFH would not be affected by bottom disturbance from the deployment of the Reefense structures due to the methods utilized to deploy the Reefense structures that would keep turbidity to a minimum. Water column EFH would be impacted during low tides when the Reefense structures are exposed above the surface of the water. Since Reefense structures would be visible above the surface of the water during low tides, during that time the Reefense structures would replace water column EFH for Red Drum, Coastal Migratory Pelagics, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units. During these low tides, water column EFH would be restricted where the Reefense structures are deployed. Due to the shallow waters of the proposed action area (deepest area less than 5 ft [1.5 m]), an extremely small amount of water column EFH would be removed during low tides and only impact water column EFH periodically while the Reefense structures extend above the surface of the water. When considering the large area that is designated as EFH, the Reefense structures represent a relatively small area. The largest deployed Reefense structures (i.e., Reef module breakwaters) would be no longer than 75 ft (22.9 m) with at least 5 ft (1.5 m) gaps in between segments. The MOH structures are smaller with at least 15 ft (5 m) gaps between structures.

Although the Proposed Action has the potential to affect water column EFH for Red Drum, Coastal Migratory Pelagics, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units, the effects would not exceed the footprint of the structures. Additionally, the impacts would be minimal and periodic given that the Reefense structures mimic natural oyster reefs that are exposed during low tide. These impacts would be long-term, lasting as long as the structures remain within the proposed action area. If removal of the Reefense structures occurs, water column EFH would return to its baseline state.

Potential Impacts to Benthic Substrate

Bottom disturbance associated with the deployment of the Reefense structures may result in impacts to soft bottom benthic substrate designated as EFH for the Red Drum, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units. Within the proposed action area, deployment of the Reefense structures would occur in two phases (Chapter 2). Deployment would be slow and deliberate with minimal to no sediment plume where the Reefense structures are placed. Large amounts of suspended sediments are not anticipated because the Reefense structures would be lowered slowly when placed on the seafloor. Effects beyond the footprint of the structure would be minimal and short-lived, as any minor sediment disturbance would quickly resettle in this soft bottom environment comprised predominantly of coarse sand. Overall, the deployment process would have no more than a minor impact to benthic habitat, limited to the immediate footprint of the Reefense structures.

The long-term presence of the Reefense structures would physically alter marine substrates from soft bottom to hard bottom (i.e., by covering sand with the hard surface of the Reefense structures). Therefore, the structures would impair the substrate's ability to function as a soft bottom habitat. This alteration would last for the duration of the structures' existence (either for DARPA's oversight of the program after Reefense structures are deployed, or indefinitely if another entity takes permanent ownership).

The first deployment would result in 164 ft (50 m) of soft bottom habitat covered by the hard surface of the Reefense structures. After a second deployment, the Reefense structures would double in combined length from 164 ft (50 m) to 328 ft (100 m). An additional 24,000 ft^2 (2,230 m^2; 0.55 acre) would be covered by MOH structures. The total footprint affected would be less than 37,500 ft^2 (484 m^2), and that area would represent the maximum total footprint of long-term alteration of soft bottom EFH to hard bottom habitat. This footprint is considered very small relative to the overall amount of designated benthic EFH for all Management Units.

Wave attenuation provided by the Reefense structures would reduce coastal erosion and encourage establishment of oyster reefs and marsh vegetation (in addition to the vegetation planting from the Proposed Action), encouraging development and expansion of biogenic EFH within the proposed action area. Once the Reefense structures have been installed, they are designed to be stationary and would not move with waves or currents, thus preventing damage to structures as well as the seafloor (Bryant et al. 2023). The patch reef design and the MOH structures would create a more structurally diverse habitat, which would promote oyster colonization (through both anthropogenic and natural means) and attenuate up to 90 percent of wave energy, per DARPA's screening criteria. Although the Reefense structures would alter existing soft bottom, any benefits to the overall habitat would likely outweigh loss of soft bottom EFH, as long as the structures remain in place. In addition to providing the designed wave mitigation and marsh promotion benefits, the Reefense structures would become colonized with oysters as well as other sessile invertebrates and plants. By stabilizing the substrate in the proposed action area, the Reefense structures would enable the transplant and recruitment enhancement of marsh grasses; this would have additional beneficial impacts to the proposed action area's ecology.

Potential Impacts to Biogenic Habitats

Bottom disturbance associated with the deployment of the Reefense structures may result in localized alterations to biogenic habitats. There are essentially two types of biogenic habitat that may occur within the proposed action area: invertebrate colonies (e.g., echinoderms, hydroids, amphipod tubes, bryozoans, or shellfish beds) and vegetation (e.g., emergent marsh, submerged aquatic vegetation). Bottom disturbance may impact biogenic habitat designated as EFH for the Red Drum, Reef Fish, Shrimp Management, AHMS (Small Coastal Sharks) Management Units. Red Drum, Reef Fish, Shrimp, and AHMS (Small Coastal Sharks) EFH includes vegetated habitat, including emergent marsh and submerged aquatic vegetation. Shrimp EFH also includes oyster reefs. As discussed in Section 1.2, based on a survey of the proposed action area, a small patch of submerged aquatic vegetation exists on the southeastern border. All structures and activities associated with the Proposed Action will avoid this biogenic habitat area.

The Reefense structures (patch reef design and MOH structures) are designed with an intricate surface structure to promote colonization by oysters (via both anthropogenic and natural means) in addition to other benthic invertebrates (e.g., sponges, worms, sea squirts). As such, the Reefense structures would augment the seafloor habitat with enhanced structure and promotion of biogenic growth, as long as the structures remain in place.

Marine invertebrate populations typically extend across wide areas containing hundreds or thousands of discrete patches of suitable habitat. Sessile invertebrate populations may be maintained by complex currents dispersing adults and young. Disturbances to biogenic habitats from deployment activities would be limited to the immediate area under the Reefense structures once they are deployed. The only harm to biogenic habitats would be potential covering/crushing of invertebrate colonies if they cannot be avoided during Reefense structure placement. However, this loss of biogenic habitat would affect a very small footprint (maximum of 37,500 ft^2 [484 m^2]) of overall habitat. Reductions in habitat quantity would be largely temporary because invertebrates and vegetation would be expected to colonize the structures with time, and due to the larger surface area, there is potential for an increase in biogenic habitat over time. As described in Section 4.2.3, suspended sediment resulting from the deployment are not anticipated because the Reefense structures would be lowered slowly and placed carefully on the seafloor, and turbidity curtains would be used when suspended sediments are anticipated.

Reefense structures would be placed in soft bottom substrates maintaining a minimum of a 15 ft (5 m) buffer from any existing submerged aquatic vegetation or oyster reef beds, minimizing the effects of bottom disturbance on this biogenic habitat. Biogenic habitats, such as marsh grasses, would not be reduced due to protective measures (Chapter 6). Due to the proposed vegetation planting, the Proposed Action would increase the biogenic habitat within the proposed action area.

Summary

Overall, deployment and installation of the Reefense structures may have long-term impacts to EFH (i.e., eliminating soft bottom or water column EFH), but these adverse impacts would be limited to a very small footprint (maximum of 37,500 ft^2 [484 m^2]) of overall habitat, which is minimal in comparison to the total amount of EFH designated for these species. Additionally, the benefits gained from the Reefense structures (i.e., new hard bottom habitat, wave attenuation promoting vegetation growth) would support creation of new fish habitat. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to EFH. Pursuant to the MSFCMA, Reefense deployment and installation may result in temporary and localized reduction in the quantity of water column EFH designated for the Red Drum, Coastal Migratory Pelagics, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units, but there would be no effect to the quality of water column EFH. Reefense deployment and installation may result in localized reduction in the quantity and/or quality of soft bottom benthic substrate and biogenic habitat EFH designated for the

Red Drum, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units. DARPA consulted with NMFS on this conclusion, and on February 29, 2024, NMFS, Southeast Region, Habitat Conservation Division concurred with DARPA's analysis that any adverse effects that might occur on marine and anadromous fishery resources would be minimal. NMFS did not have any additional conservation recommendations to provide.

4.4.2.5.2 Potential Reefense Removal

If removal of the Reefense structures occurs, the short-term effects would be the same as the short-term effects associated with Reefense deployment and installation, minimal bottom disturbance (Section 4.4.2.5.1). This section will focus on long-term effects, which would vary from installation because it would involve the removal of colonized structures and a return of the previously lost soft bottom EFH. Because of the slow removal of the structures over a short period of time, potential removal would have no adverse effects on water column EFH.

If removal of the Reefense structures occurs, the long-term result of this removal would be restoration of the previously lost soft bottom EFH. It would also involve loss of any newly established hard bottom reef EFH. Although this would involve a total loss of hard bottom EFH within the proposed action area, prior to the Proposed Action, no hard bottom EFH exists within the area. Therefore, the removal of the structures would not result in a net loss of hard bottom EFH.

Oysters and other organisms growing on the structures would be removed with the Reefense structures since transplantation would likely have low success. Biogenic habitat beyond the footprint of the structures (e.g., marsh grass, submerged aquatic vegetation) may also be lost because of the loss of protection from wave energy that the structures had been providing. Potential removal of the structures would reduce the quantity of biogenic EFH, although original seafloor conditions would be restored to their baseline state. If removal of the Reefense structures occurs, DARPA would employ protective measures outlined in Chapter 6 to mitigate adverse impacts to the biogenic habitat EFH for all Management Units.

Overall, potential removal of the Reefense structures may result in adverse effects to hard bottom and biogenic EFH, and the benefits of the structures protecting and encouraging development of new fish habitat would be lost. However, in comparison to the current state of the proposed action area, effects would be minimal, limited to minor, temporary disturbance of the bottom. In accordance with NEPA, potential Reefense removal would not cause significant adverse impacts to EFH. Pursuant to the MSFCMA, potential Reefense structure removal associated with the Proposed Action may result in a long-term reduction in the quantity and/or quality of hard bottom EFH as well as temporary and localized reduction in the quantity and/or quality of biogenic EFH designated for Red Drum, Reef Fish, Shrimp, and AHMS (Large Coastal Sharks and Small Coastal Sharks) Management Units. Potential removal would not result in the reduction of quantity and/or quality of water column or soft bottom EFH for these management units. DARPA consulted with NMFS on this conclusion, and on February 29, 2024, NMFS, Southeast Region, Habitat Conservation Division concurred with DARPA's analysis that any adverse effects that might occur on marine and anadromous fishery resources would be minimal. NMFS did not have any additional conservation recommendations to provide.

4.4.2.6 Reptiles

Stressors associated with the Proposed Action that have the potential to impact reptiles include vessel noise, vessel movement, Reefense deployment and installation, and potential Reefense removal. Within the proposed action area, the following species are likely to occur (all ESA-listed or proposed): the American alligator, alligator snapping turtle (proposed), green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. Of these species, green, Kemp's ridley, and loggerhead sea turtles are the most likely to occur (Section 3.2.7).

Green sea turtle critical habitat has been proposed within the proposed action area (Section 3.2.7.3), and the relevant essential features relate to oceanographic conditions and the ability of turtle passage. Therefore, only Reefense deployment and installation have the potential to impact critical habitat because vessel noise, vessel movement, and potential Reefense removal would neither affect oceanographic conditions nor limit sea turtle movement.

4.4.2.6.1 Vessel Noise

As discussed in Section 3.2.7.8, sea turtles have low-frequency hearing in the range of 50 Hz to 1.6 kHz, with a range of maximum sensitivity between 100 and 400 Hz (Bartol and Ketten 2006; Bartol et al. 1999; Lenhardt 1994, 2002; Piniak et al. 2016; Ridgway et al. 1969; Willis et al. 2013). The American alligator has a hearing range from below 100 Hz to between 2 and 3 kHz, and peak sensitivity occurs around 800 Hz. Information on hearing is limited for the alligator snapping turtle. However, given that turtles, generally, are known to respond to sound, and the only sound of relevance for the Proposed Action is the broadband sound generated by vessels, DARPA assumes that the alligator snapping turtle can perceive vessel noise. Therefore, reptiles would be expected to perceive vessel noise associated with the Proposed Action. As noted in Section 4.2.1, vessel noise associated is unlikely to result in injury or hearing threshold shift, so the most likely impacts from vessel noise would be physiological or behavioral responses.

Vessels would only remain within the proposed action area for a maximum of four weeks for each phase of deployment of reef module breakwaters, for each phase of MOH installation as well as for potential removal activities. Additionally, the use of slow vessel speeds reduces the amplitude of the vessels' sound signature, therefore reducing the distance at which the sound would persist at levels substantially elevated above ambient noise levels within the proposed action area.

The role of underwater low-frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983). Although it is likely that sea turtles would be able to perceive the low-frequency sounds of the support vessel, sea turtles appear to rely on senses other than hearing for foraging and navigation. Accordingly, masking is not anticipated to be a significant impact.

There is little information on assessing behavioral responses of sea turtles to vessel noise. Sea turtles have been both observed to respond (DeRuiter and Doukara 2012) and not respond (Weir 2007) during seismic surveys, although any reaction could have been due to the active firing of air gun arrays, vessel noise, vessel presence, or some combination thereof. Lacking data that assesses sea turtle reactions solely to vessel noise, the American National Standards Institute's Sound Exposure Guidelines (Popper et al. 2014) suggest that the relative risk of a sea turtle behaviorally responding to a continuous noise, such as vessel noise, is high when near a source (tens of meters), moderate when at an intermediate distance (hundreds of meters), and low at farther distances. While it is reasonable to assume that sea turtles may exhibit some behavioral response to vessel noise, numerous sea turtles bear wounds and scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al. 2007; Lutcavage et al. 1997).These injuries may have been exacerbated by a sea turtle's surfacing reaction or lack of reaction to vessels. Behavioral effects may include disruption or alteration of natural activities, such as swimming, feeding, breeding, and migrating. Sea turtles may exhibit startle or alert reactions, disruption of current behavior, changes in respiration, alteration of swim speed or direction, diving, and area avoidance (Huntington et al. 2015; Pirotta et al. 2015; Williams et al. 2014).

Vessels would only remain in a single area long enough to install, monitor, or potentially remove the Reefense structures (a maximum of four weeks at a time during deployment activities); therefore, exposure of sea turtles to high-intensity vessel noise would be short-term within the proposed action area. Additionally, the support tugboat and any smaller vessels used for monthly monitoring would have lookouts monitoring for sea turtles (Chapter 6).

Although vessel noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed reptile would be expected to return to normal behavior shortly after exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. In accordance with NEPA, vessel noise would not cause significant adverse impacts to reptiles. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that vessel noise associated with the Proposed Action may affect, but is not likely to adversely affect, the green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtle and that there would be no destruction or adverse modification of proposed green sea turtle critical habitat. NMFS' concurrence is pending as of publication of this Draft EA. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that vessel noise may affect, but is not likely to adversely affect, the American alligator or alligator snapping turtle (proposed). USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.6.2 Vessel Movement

Reptile response to vessel movement would be similar to disturbances caused by vessel noise. They would be expected to have no more than a behavioral reaction, such as exhibiting an alert reaction, disruption to a current behavior, changes in respiration, or alteration in their swimming speed and direction (Erbe et al. 2022).

Reptiles need to surface to breathe, so any turtle or alligator present within the proposed action area has the potential to co-occur with a vessel, creating the potential for behavioral reactions or strike. Given the low density of reptiles within the proposed action area, slow speed of the vessel (maximum of five knots within the proposed action area), the shallow-water environment making reptiles more easily visible, and the presence of lookouts onboard the vessel (Chapter 6), the likelihood of strike is extremely low.

Dinets (2013) demonstrated that alligators show a directional response to underwater sound, so they would most likely exhibit a behavioral response upon detecting vessels associated with the Proposed Action. Chelonians (i.e., turtles, tortoises, and terrapins) are also known to respond to sound, although it is unclear whether they perceive the sound itself or vibrations in the water (Carr 2018). As described in Section 4.4.2.6.1, as a vessel approaches, a sea turtle could have a detectable behavioral or physiological response (e.g., swimming away or increased heart rate). Behavioral reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance) and changes in speed and direction of movement. Temporary behavioral reactions (e.g., temporary cessation of feeding or avoidance response) would not be expected to affect the individual fitness of a sea turtle, as individuals would be expected to resume normal behavior after the vessel passes through the area.

In summary, vessels associated with the Proposed Action could strike and injure a reptile, but this would be extremely unlikely to occur. The most likely impact of vessel movement on a reptile would be a temporary physiological or behavioral response. Temporary behavioral reactions caused by vessel movement would not be expected to result in significant changes to an individual reptile's fitness. No population-level impacts are anticipated. Therefore, in accordance with NEPA, vessel movement would not cause significant adverse impacts to reptiles. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that vessel movement associated with the Proposed Action may affect, but is not likely to adversely affect, the green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles and that there would be no destruction or adverse modification of proposed green sea turtle critical habitat. NMFS' concurrence is pending as of publication of this Draft EA. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that vessel movement may affect, but is not likely to adversely affect, the American alligator or alligator snapping turtle (proposed). USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.6.3 Reefense Deployment and Installation

With the deployment of the Reefense structures and other oceanographic monitoring equipment, disturbance would occur throughout the water column and at the seafloor as each object descends and settles. Due to the mobile nature of reptiles, the slow, controlled descent of objects through the water column, and established SOPs and protective measures (Chapter 6) that dictate that deployment would not occur within a 200 yd (183 m) radius of an observed sea turtle, strike of reptiles by structures is not expected to occur. Therefore, the only anticipated impacts to reptiles during deployment and installation would be physiological and behavioral responses.

If an alligator or snapping turtle were present in the proposed action area during deployment and installation, they would be expected to perceive movement of the structures within the water, and they would respond with a behavioral change, exhibiting an alert reaction, a physiological change (e.g., change in respiration rate), or a behavioral change (e.g., alteration in their swimming speed and direction).

Sea turtles may exhibit avoidance behavior from the descent of the Reefense structures in the water column. Sea turtles have well-developed underwater vision and would likely detect objects descending through the water column (Southwood et al. 2008). Object avoidance behavior similar to avoidance behavior displayed with a slow moving vessel, would be short and of low intensity, such as moving a short distance away (Hazel et al. 2007), and therefore, the descent of the Reefense structures would not increase the likelihood of injury or disruption of breeding, feeding, or sheltering. Sea turtles within the proposed action area may be temporarily displaced during Reefense structure deployment and dispersal, but they would be expected to resume normal behavior shortly after exposure, likely swimming away from the area and resuming normal behavior a short distance away.

The reef module breakwater would have a minimum 5 ft (1.5 m) gap between structures and the MOH structures would have at least 15 ft (5 m) gaps between structures. As such, the design of the Reefense project would allow egress of reptiles, and thus, no adverse impacts are anticipated once the structures are deployed. Even at low tide when the structures are exposed above the water, it is extremely unlikely that a reptile would become trapped by the structures. Invertebrates (e.g., oysters) would be expected to recruit to the structures, and reduction in wave energy would promote development of submerged aquatic vegetation within the proposed action area, creating a more balanced ecosystem and enhancing foraging opportunities for reptiles, especially seagrass eating green sea turtles. The reduction in wave energy would also reduce erosion on the nearby shoreline, which would be utilized by alligators, alligator snapping turtles, and potentially sea turtles Therefore, the long-term effect of deployment and installation of the Reefense structures would have a positive impact on reptiles.

Reefense deployment and installation also would not adversely modify or destroy proposed green sea turtle critical habitat. As noted in Section 3.2.7.3, the essential features of this critical habitat are rooted in oceanographic conditions and the allowance of sea turtle passage. Installation of the structures would not affect the oceanographic conditions identified as essential features. Although the Proposed Action would involve placement of structures in the proposed critical habitat, the structures would be specifically designed to avoid potential entrapment of species, including a minimum of 5 ft (1.5 m) gaps between reef module break water structures and 15 ft (5 m) gaps between MOH structures to allow passage.

Overall, the deployment of Reefense structures and other oceanographic equipment in the proposed action area may result in no more than minor, short-term and local disturbance of reptiles. Due to protective measures (Chapter 6) halting deployment of Reefense structures within a 200 yd (183 m) radius around any observed sea turtle and the rarity of alligators and snapping turtles within the proposed action area, encounters with descending structures are unlikely. However, if a reptile were temporarily displaced during object deployment, it would be expected to resume normal behavior shortly after the encounter. Infrequent, minor, and short-lived behavioral disturbances would not affect an individual’s fitness, and no population-level impacts would be anticipated. The long-term presence of the Reefense structures would be expected to have positive impacts on reptiles utilizing the proposed action area and the adjacent shoreline. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to reptiles. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that Reefense deployment and installation may affect, but is not likely to adversely affect, the green, hawksbill, Kemp’s ridley, leatherback, or loggerhead sea turtles and that there would be no destruction or adverse modification of proposed green sea turtle critical habitat. NMFS’ concurrence is pending as of publication of this Draft EA. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that Reefense deployment and installation may affect, but is not likely to adversely affect, the American alligator or alligator snapping turtle (proposed). USFWS’s concurrence is pending as of publication of this Draft EA.

4.4.2.6.4 Potential Reefense Removal

The same potential short-term effects to reptiles from the deployment and installation of the Reefense structures are applicable to the potential Reefense removal (Section 4.4.2.6.3). Overall, the risk of strike would be extremely low, and the most likely impacts would be short-term physiological or behavioral reactions.

In addition to the short-term behavioral reactions, removal of the structures would constitute loss of potential habitat, a long-term effect. However, this would equate to returning the habitat to its pre-deployment state (i.e., barren soft bottom).

Although removal would constitute a long-term loss of reef and submerged aquatic vegetation, such habitat would only exist because of the Proposed Action. Additionally, due to the relatively small footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), change in habitat would be too small to be meaningfully evaluated. Affected reptiles may show a brief behavioral reaction due to the raising of the structures by swimming away from the proposed action area, but the behavioral response would be minor and brief and would not affect an individual’s overall fitness. No population-level effects would be anticipated. Therefore, in accordance with NEPA, potential Reefense removal would not result in significant adverse impacts to reptiles. DARPA initiated consultation with NMFS under Section 7 of the ESA, concluding that potential Reefense removal may affect, but is not likely to adversely affect, the green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles and that there would be no destruction or adverse modification of proposed green sea turtle critical habitat. NMFS' concurrence is pending as of publication of this Draft EA. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that potential Reefense removal may affect, but is not likely to adversely affect, the American alligator or alligator snapping turtle (proposed). USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.7 Marine Mammals

Only one marine mammal species, the ESA-listed West Indian manatee, may occur in the proposed action area. No critical habitat has been designated within the proposed action area for this species. Stressors associated with the Proposed Action that may have potential impacts on manatees include vessel noise, vessel movement, Reefense deployment and installation, and potential Reefense removal. While manatees are common throughout the Atlantic and GOM waters of Florida, including shallow coastal and estuarine and riverine habitats where they graze on sea grasses, their presence within the proposed action area would be limited to the summer (Tyndall Air Force Base 2020b). Any activities conducted outside of summer would have no effect on manatees. Additionally, due to the lack of submerged aquatic vegetation, their primary food source, within the proposed action area, any occurrence would likely be an individual moving through the proposed action area.

4.4.2.7.1 Vessel Noise

West Indian manatees within the proposed action area may be exposed to vessel noise during the Proposed Action, and broadband vessel noise could potentially overlap with the manatee's hearing capabilities. Vessel noise could disturb manatees and potentially elicit an alerting, avoidance, or other behavioral reaction. In addition to behavioral reactions, vessel noise may cause auditory masking, potentially prohibiting animals from hearing vocalizations and other biologically important sounds (e.g., sounds of conspecifics or predators) on which species may rely (Mann et al. 2009; Rycyk et al. 2022). Some individuals may have habituated to vessel noise, and some may be more likely to respond to the vibrotactile sense of vessel movement and sound, a possibility suggested by Mann et al. (2009).

Miksis-Olds (2006) observed West Indian manatee behavior in the presence of various levels of ocean noise in their natural habitats and by conducting playbacks of various types of vessel noise. The manatees exhibited an increase in vocalization rate, duration, and source level in noisier environments, especially when calves were present. It is likely that vessel noise causes some level of masking in manatee communication, which causes them to increase the source level of their vocalizations in areas of increased noise level. Miksis-Olds (2006) also observed that manatees responded differently to different types of vessels and had stronger reactions (leaving the geographic area) to the playback of personal watercraft than to the playback of motorboats (with inboard or outboard engines). Overall, this study indicated that manatees exhibited behaviors ranging from startle response to leaving the geographic area when exposed to vessel noise. When manatees leave the area due to vessel noise, they typically move towards deep water (Mann et al. 2009; Miksis-Olds 2006).

Faster vessels produce louder sounds than vessels moving slowly (Findlay et al. 2023). Therefore, slower vessels would be less likely to produce behavioral responses or masking in manatees, although Mann et al. (2009) determined that a manatee should be able to detect even a slow moving vessel at least 40 seconds before the vessel passes the manatee's location (not accounting for potential masking from ambient noise).

Given the slow speed of the vessels associated with the Proposed Action (maximum of five knots), the short period of time (maximum of four weeks) that a vessel would be present within the proposed action area for each activity (i.e., deployment, monitoring, potential removal), the presence of lookouts who would halt operations within 200 yd (183 m) of a manatee (Chapter 6), and the seasonal presence of manatees within the proposed action area, vessel noise would have periodic, short-term impacts on manatees. Any behavioral reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. In accordance with NEPA, vessel noise would not cause significant adverse impacts to manatees. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that vessel noise associated with the Proposed Action may affect, but is not likely to adversely affect, the West Indian manatee. USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.7.2 Vessel Movement

Vessel movement has the potential to impact manatees by causing a physiological or behavioral reaction from operating near a manatee or mortality or serious injury from a collision between the vessel and a manatee. The largest source of human-related death and injury to West Indian manatees is from vessel strikes (Laist and Shaw 2006). For example, the most recent stock assessment report for the Florida stock of the West Indian manatee reported that from 2014 to 2018, the average annual reported manatee deaths related to human causes was 118, and of these, 101 were attributed to watercraft (U.S. Fish and Wildlife Service 2023a). However, there is evidence that when vessels travel at slow speeds, animals may be afforded more time to take action to avoid contact. Rycyk et al. (2022) found that manatees would be able to detect and avoid vessels moving at slow or medium speeds (7 to 17.4 miles per hour [6 to 15 knots]). Accordingly, due to the seasonal presence of manatees within the shallow proposed action area, the slow vessel speeds (maximum of five knots), the ability of manatees to detect and avoid slow-moving vessels, and the presence of lookouts onboard the vessel monitoring for marine mammals (Chapter 6), the possibility of strike is extremely remote.

The more likely impact of vessel movement on manatees would be behavioral responses. Specifically, manatees when frightened or startled will explode with a burst of power and can reach swimming speeds of up to 21 ft (6.4 m) per second in an instant (Gerstein 2002). However, their avoidance behavior and speed would depend on their ability to detect the noise and movement of the vessel (Gerstein 2002). As a vessel approaches, manatees could have a detectable behavioral or physiological response (e.g., swimming away or increased heart rate) as the passing vessel displaces them. Behavioral reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance) and changes in speed and direction of movement. After moving away from the vessel, a manatee would be expected to resume normal behavior.

It would be anticipated that temporary behavioral reactions (e.g., temporary cessation of feeding or avoidance response) would not affect the individual fitness of marine mammals, as individuals are expected to resume normal behavior after the vessel passes through the area. Avoidance of a vessel as it moves through the proposed action area would be unlikely to cause abandonment or significant alteration of behavioral patterns, including breeding, feeding, or sheltering. No population-level impacts would be expected. In accordance with NEPA, vessel movement associated with the Proposed Action would not cause significant adverse impacts to marine mammals. DARPA initiated consultation with the

USFWS under Section 7 of the ESA, concluding that vessel movement associated with the Proposed Action may affect, but is not likely to adversely affect, the West Indian manatee. USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.7.3 Reefense Deployment and Installation

The likelihood that a manatee would encounter the Reefense structures during deployment would be extremely low because manatees are only seasonally present within the proposed action area, the area is very shallow, the vessel would have trained lookouts monitoring for marine mammal presence, and a mitigation zone of at least 200 yd (183 m) would be maintained around all marine mammals (Chapter 6).

In the rare instance that a manatee was present and undetected, the manatee would be unlikely to be struck by a Reefense structure due to the slow lowering of the structures and the ability of manatees to detect and avoid objects moving slowly in the water. The most likely impact to manatee would be a brief behavioral or physiological response (e.g., swimming away and increased heart rate). However, the potential for a behavioral disturbance from descending objects to impact manatee foraging would be considered remote given the limited footprint of the proposed action area compared to their large foraging areas, lack of submerged aquatic vegetation in the proposed action area, and the low likelihood that a manatee would be present when the Reefense structures are descending.

The reef module breakwater would have a minimum 5 ft (1.5 m) gap between structures, and the MOH structures would have at least 15 ft (5 m) gaps between structures. As such, the design of the Reefense project would allow egress of manatees, and thus, no adverse impacts are anticipated once the structures are deployed. Even at low tide when the structures are exposed above the water, it is extremely unlikely that a manatee would become trapped by or prevented from transiting the array of structures. The reduction in wave energy created by the Reefense structures would promote development of submerged aquatic vegetation within the proposed action area, providing more vegetation upon which manatees may forage. Therefore, the long-term effect of deployment and installation of the Reefense structures may outweigh the temporary, short-term adverse effects of deployment and installation.

The Reefense deployment and installation in the proposed action area would have a low risk of short-term and local displacement of manatees. Due to protective measures (Chapter 6), deployment of objects would not occur within a 200 yd (183 m) radius around any observed marine mammal. Additionally, due to manatee's limited presence in the very shallow nearshore waters of the proposed action area that are devoid of their primary food source, their seasonal presence in this region, and their highly mobile nature, co-occurrence is unlikely, and it would be expected that any individual temporarily displaced during Reefense structure deployment would resume normal behavior once the deployment is completed. Temporary behavioral reactions would not be expected to result in significant change to an individual's fitness. No population-level impacts would be anticipated. In accordance with NEPA, Reefense deployment and installation would not cause significant adverse impacts to marine mammals. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that Reefense deployment and installation may affect, but is not likely to adversely affect, the West Indian manatee. USFWS's concurrence is pending as of publication of this Draft EA.

4.4.2.7.4 Potential Reefense Removal

The same potential short-term effects to manatees from the deployment and installation of the Reefense structures are applicable to the potential removal of the structures because the actions would essentially be the same, only in reverse (Section 4.4.2.7.3). The Reefense structures would be raised in a controlled manner while monitoring for manatees, making strike extremely unlikely and short-term behavioral reactions possible but limited. Long-term impacts from the potential removal would be loss of foraging habitat as any developed submerged aquatic vegetation would likely be lost when the wave attenuation benefit of the structures is removed. However, this would equate to returning the habitat to its pre-deployment state (i.e., barren soft bottom).

Although removal would constitute a long-term loss of submerged aquatic vegetation, such vegetation would only exist because of the Proposed Action. Manatees affected by the potential removal itself may exhibit a brief behavioral reaction due to the raising of the structures by swimming away from the proposed action area, but the behavioral response would be minor and brief and would not affect an individual's overall fitness. No population-level effects would be anticipated. Therefore, in accordance with NEPA, potential Reefense removal would not result in significant adverse impacts to marine mammals. DARPA initiated consultation with the USFWS under Section 7 of the ESA, concluding that potential removal of Reefense structures may affect, but is not likely to adversely affect, the West Indian manatee. USFWS's concurrence is pending as of publication of this Draft EA.

4.5 Socioeconomic and Cultural Resources

The Division of Historical Resources of the Florida Department of State was contacted to solicit comments regarding whether the Proposed Action may adversely affect significant historical and archaeological resources. The Division of Historical Resources provided data of known historical and archaeological resources near the project footprint, all which occur on land. Since no dredging is anticipated, the Proposed Action is not anticipated to unearth or impact any unknown historical or archaeological resources within the proposed action area. Therefore, no additional surveys were conducted. As such, the Proposed Action does not have the potential to cause effects to historic or archeological resources. If the Proposed Action were to uncover any previously unknown artifacts, work would cease immediately, and DARPA would contact the Florida Department of State.

Socioeconomic resources within the proposed action area are primarily based in commercial fishing and various forms of recreation. Recreation is the primary use, with wildlife viewing, hiking, hunting, recreational fishing, paddling, kayaking, and recreational boating all occurring within the proposed action area or on the adjacent shoreline (Tyndall Air Force Base 2020b, 2023a). Commercial fishing in inshore waters in Bay County includes blue crabs, shrimp, and mullet, although commercial shellfish harvest is not permitted within the proposed action area (Florida Department of Agriculture and Consumer Services 2023b). There is also limited commercial transportation, tourism, and research that occur within the proposed action area. Socioeconomic resources may be impacted by vessel movement, Reefense deployment and installation, and potential Reefense removal. Vessel noise associated with occasional, short-term (maximum of four weeks) presence of a single vessel for deployment, monitoring, and potential removal would not be sufficient to affect any existing socioeconomic resources because vessel traffic, although limited, does occur within this area. Noise from a single vessel would not be sufficient to alter any human use of the area.

4.5.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and there would be no change to the socioeconomics and cultural resources of the local area. No deployment of artificial reef structures would occur, and the area would be left undeveloped and unused (except for current existing uses by other entities) unless/until other in-water construction is proposed as part of a future project. The No Action Alternative would not meet the purpose of and need for the Proposed Action, and the advancement of alternatives to traditional hard armoring would not be supported. The No Action Alternative would leave coastal development both at Baker Point and beyond more vulnerable to climate change impacts or limited to traditional hardscape solutions, which can inhibit passage between the coast and water for recreational or other uses.

4.5.2 Action Alternative (Preferred Alternative)

The stressors associated with the Proposed Action with potential to impact socioeconomic resources would be vessel movement, Reefense deployment and installation, and potential Reefense removal.

4.5.2.1 Vessel Movement

Vessel movement would displace other uses within the proposed action area for the short period of time while deployment, monitoring, or potential removal occur. Because the proposed action area is small, an actively working vessel could temporarily disrupt nearby recreational activities, and given the likelihood that fish would leave the proposed action area during these periods (Section 4.4.2.4), catch per unit effort of fishing within the proposed action area may temporarily decrease. Therefore, while the vessel is present within the proposed action area, customary transportation, fishing (both commercial and recreational), recreation activities, research, and tourism activities could potentially be impacted. However, these impacts would be limited to the short periods (maximum of four weeks) when the vessel would be present for structure deployment, monitoring, and potential removal. Prior to installation of the Reefense structures within the proposed action area, a Notice to Mariners would be issued informing the local populace that an action would be occurring, so potential users of the site would know in advance and could make alternate plans. Therefore, any impacts on socioeconomic activities would be minor and temporary. In accordance with NEPA, vessel movement associated with the Proposed Action would not result in significant adverse impacts to socioeconomic or cultural resources.

4.5.2.2 Reefense Deployment and Installation

The physical deployment and installation of the Reefense structures would displace other uses of the proposed action area for the short period of time (maximum of four weeks) while deployment occurs because the proposed action area is small, recreational activities would be less pleasant nearby the activity, and given the likelihood of fish to leave the proposed action area during these periods (Section 4.4.2.4), commercial fishing would be less effective during these periods.

The long-term presence of the Reefense structures would have only a minor impact on boat traffic (recreational and commercial) within the proposed action area as vessels would need to avoid the structures in the water. Prior to installation of the Reefense structures within the proposed action area, a Notice to Mariners would be issued informing the local populace that an action would be occurring. Given the small footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]),their marking with aids to navigation, and the fact that the proposed action area is not within the main navigation channel of East Bay, any impacts would be minimal. Some paddleboards or kayaks may be able to continue to navigate the area. The structures would be visible at low tide, but they are designed to be aesthetically pleasing, resembling natural reef systems. Therefore, adverse visual impacts would not be anticipated.

In the long term, the presence of the Reefense structures would benefit socioeconomic resources within the proposed action area and beyond it. Within the area, the creation of new habitats (i.e., oyster reefs and submerged aquatic vegetation) would attract more fish to the area, which could benefit both commercial and recreational fishing. The structures would protect the adjacent shoreline from storm events, flooding, and other natural impacts that could lead to erosion or sediment displacement into the marine environment, thereby benefitting recreational and military uses of the shore. Additionally, if the Reefense structures prove successful at wave energy mitigation, they could be deployed in other locations nationally or globally, protecting shoreline uses in new locations.

Overall, impacts to socioeconomic resources within the proposed action area from Reefense deployment and installation would be either short-term (maximum of four weeks per phase) or minor (inability of boats to access this small, shallow area that is not heavily trafficked). The potential benefits of the structures would substantially outweigh any minor adverse effects. In accordance with NEPA, Reefense deployment and installation would not result in significant adverse impacts to socioeconomic and cultural resources.

4.5.2.3 Potential Reefense Removal

If the Reefense structures needed to be removed, the removal process would displace other uses of the proposed action area for the short period of time similar to displacement during deployment (Section 4.5.2.2). The long-term impacts of removal would be loss of the benefits provided by the structures (e.g., increasing fish habitat to support fishing, shoreline protection). Although removal would constitute a long-term loss of potential benefits, such benefits would only exist because of the Proposed Action. There would be no substantial change from current conditions. Therefore, in accordance with NEPA, potential Reefense removal associated with the Proposed Action would not result in significant adverse impacts to socioeconomic and cultural resources.

4.6 Summary of Potential Impacts to Resources

A summary of the potential impacts to resources for the Action Alternative (Preferred Alternative) caused by each stressor is presented in Table 4-2.

Table 4-2. Summary of Conclusions

Resource	*Vessel Noise*	*Vessel Movement*	*Reefense Deployment and Installation*	*Potential Reefense Removal*
Physical Resources				
Benthic Habitat	No effect	No effect	Although some potential impacts may be long-term (i.e., covering existing soft bottom with hard structures), they would be minimal (maximum footprint of 37,500 ft^2 [3,484 m^2; 0.86 acres]). Additionally, the changes would have positive impacts in creating a more diverse habitat and providing wave energy protection shoreward. **NEPA:** No significant impacts	Although removal would constitute a long-term loss of hard bottom habitat, such habitat would only exist because of the Proposed Action, and the footprint of change would be minimal (37,500 ft^2 [3,484 m^2; 0.86 acres]). **NEPA:** No significant impacts
Biological Resources				
Vegetation	No effect	No effect	No effect	Potential impacts would be long-term, including the loss of established submerged aquatic vegetation and marsh grasses, but no change would be expected from pre-deployment conditions. No population-level effects. **NEPA:** No significant impacts
Invertebrates	May cause some short-term physiological or behavioral effects, but invertebrates would be expected to return to normal behavior shortly after the exposure.	No more than a minor, short-term impact. Population-level impacts are not anticipated. **NEPA:** No significant impacts	No more than a minor, short-term effect. Population-level impacts are not anticipated. **NEPA**: No significant impacts	Potential impacts would be long-term, including the loss of established invertebrate colonies on Reefense structures, but no change would be expected from pre-

	Population-level impacts are not anticipated. **NEPA:** No significant impacts			deployment conditions. Population-level impacts are not anticipated. **NEPA:** No significant impacts
Birds	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts	No effect	No effect
Fish (ESA-listed Gulf sturgeon, smalltooth sawfish)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be long-term, including the loss of established habitat on Reefense structures, but no change would be expected from pre-deployment conditions. Population-level impacts are not anticipated. **NEPA:** No significant impacts **ESA:** NLAA
Essential Fish Habitat	No effect	No effect	May have long-term impacts (i.e., eliminating soft bottom or water column EFH), but limited to a very small footprint, which is minimal in comparison to the total amount of EFH designated. Benefits would support creation of new fish habitat. **NEPA:** No significant impacts **MSFCMA:** Minimal reduction	May have minimal, brief impacts on soft bottom or water column EFH. Would result in the total loss of hard bottom EFH within the proposed action area, but no change would be expected from pre-deployment conditions. **NEPA**: No significant impacts **MSFCMA:** Total loss of artificially created hard bottom EFH. No reduction in

			in the quantity and/or quality of EFH	the quantity and/or quality of soft bottom or water column EFH
Reptiles (ESA-listed American alligator, alligator snapping turtle [proposed], green sea turtle (and proposed critical habitat), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No alteration to critical habitat essential features. **NEPA:** No significant impacts **ESA:** NLAA (all species), would not adversely modify (proposed critical habitat)	Potential impacts would be long-term, including the loss of established habitat and foraging resources on and around Reefense structures, but no change would be expected from pre-deployment conditions. Population-level impacts are not anticipated. No effect to proposed green sea turtle critical habitat. **NEPA:** No significant impacts **ESA:** NLAA (all species), no effect (proposed critical habitat)
Marine Mammals (ESA-listed West Indian Manatee)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA:** No significant impacts **ESA:** NLAA	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. Long-term impacts would be limited to loss of vegetation within the proposed action area, but this would constitute no change from pre-deployment conditions. **NEPA:** No significant impacts **ESA:** NLAA

Socioeconomic and Cultural Resources				
Socioeconomic and Cultural Resources	No effect	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. **NEPA:** No significant impacts	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. Some extremely limited long-term impacts could occur in that anything more than a small personal craft (e.g., kayak) would not be able to operate around the structures, but given the extremely small footprint and shallow waters, this impact would be minimal. **NEPA:** No significant impacts	Potential impacts would be limited to minor and short-term displacement of recreational or commercial activities within the proposed action area. **NEPA:** No significant impacts

ESA: Endangered Species Act
MSFCMA: Magnuson-Stevens Fishery Conservation and Management Act
NLAA = not likely to adversely affect (ESA conclusion)
EFH = essential fish habitat

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5 Cumulative Effects

This section (1) defines cumulative effects; (2) describes past, present, and reasonably foreseeable actions relevant to cumulative effects; (3) analyzes the incremental interaction the Proposed Action may have with other actions; and (4) evaluates cumulative effects potentially resulting from these interactions.

5.1 Definition of Cumulative Effects

The approach taken in the analysis of cumulative effects follows the objectives of NEPA, CEQ regulations, and CEQ guidance. Cumulative effects are defined in 40 CFR § 1508.1(g)(3) as "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time."

To determine the scope of environmental effect analyses, agencies shall consider cumulative actions that, when viewed with other proposed actions, have cumulatively significant effects and should, therefore, be discussed in the same effects analysis document.

CEQ guidance on cumulative impacts under NEPA states that cumulative impact analyses should determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions (Council on Environmental Quality 2005; United States Environmental Protection Agency 1999).

Cumulative effects are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the Proposed Action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative effects. To identify cumulative effects, the analysis needs to address the following three fundamental questions.

- Does a relationship exist such that affected resource areas of the Proposed Action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If such a relationship exists, would the Proposed Action affect or be affected by effects of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant effects not identified when the Proposed Action is considered alone?

These actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making.

5.2 Scope of Cumulative Effects Analysis

The scope of the cumulative effects analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the proposed action area and the limited surrounding area where noise associated with the Proposed Action might be perceived delimits the geographic extent of the cumulative effects analysis. The Proposed Action would not have any effects beyond this small area, and therefore, effects from the Proposed Action would not aggregate with effects from actions beyond this space. The time frame for cumulative effects will primarily focus on actions that would co-occur with the deployment of the Reefense structures, but any action preceding will be considered if that action's effects would linger. Reasonably foreseeable actions would only be considered for whether their effects would aggregate with the physical existence of the Reefense structures or could interplay with the potential removal of the structures.

5.3 Past, Present, and Reasonably Foreseeable Actions

The proposed action area lies just north of Baker Point in shallow East Bay waters. While Baker Point is undeveloped, the 823rd RED HORSE Squadron, which includes training and other military facilities, lies west of the proposed action area. Eastern Shipbuilding Group, Inc.'s, Allanton Shipyard is located north of Baker Point across East Bay.

Eight recently completed, ongoing, or anticipated activities were identified that have potential for cumulative impacts with the Proposed Action (Table 5-1).

Table 5-1. Baker Point Past, Present, and Reasonably Foreseeable Actions

Action Projects	*Federal/State Agency*	*Level of NEPA Analysis and Date Documentation Complete*
Tyndall Installation Development Plan	U.S. Air Force	n/a, 2015
Tyndall Installation Recovery Plan (Master Plan)	U.S. Air Force	n/a, ongoing and proposed
Training Activities	U.S. Air Force	n/a, ongoing
NSWC Panama City Division Mission Activities	U.S. Navy	EIS/OEIS, 2009
Gulf of Mexico Range Complex	U.S. Navy	EIS/OEIS, 2010
Deepwater Horizon Oil Spill Phase V.2 Florida Coastal Access Project: Final Restoration Plan and Supplemental EA	NOAA	EA, 2016; EA, 2018
Tyndall INRMP		
Atlantic Fleet Training and Testing	U.S. Navy	EIS/OEIS, 2018

EA = Environmental Assessment; EIS = Environmental Impact Statement; INRMP = Integrated Natural Resources Management Plan; n/a = not applicable; NOAA = National Oceanic and Atmospheric Administration; NSWC = Naval Surface Warfare Center; OEIS = Overseas Environmental Impact Statement

In addition to the specific activities listed in Table 5-1, the following activities have occurred in the past and are likely to continue into the reasonably foreseeable future: development, tourism and recreation, vessel activity, commercial and recreational fishing and bycatch, marine pollution, climate change, and marine scientific research (Section 3.3.2). Generally, past, present, and reasonably foreseeable actions fall within one of three categories: (1) land-based infrastructure changes, which would not be expected to have cumulative impacts with the Proposed Action (although the Proposed Action could provide storm protection and alleviate future adverse harm to these developments); (2) activities occurring within the proposed action area (e.g., research, recreation), which could have cumulative impacts with the Proposed Action; and (3) climate change, whose effects the Proposed Action is designed to mitigate.

5.3.1 Past Actions

The proposed action area lies just off the shore of an undeveloped portion of Tyndall AFB. The land shoreside of the area is part of Tyndall AFB's East Unit, which allows hunting and outdoor recreation for base personnel and the public. Fishing, boating, and other activities, including natural resource management actions, take place in and around the proposed action area and are guided broadly by the

Tyndall Integrated Natural Resource Management Plan (INRMP) (Tyndall Air Force Base 2020b) and recreation regulations (Tyndall Air Force Base 2023a). The region has a long history of economic activities, including commercial and recreational fishing, construction, manufacturing, tourism, logging, and service industries in addition to the military (Tyndall Air Force Base 2020b). However, the East Bay, where the proposed action area is located, is typically less trafficked than waters closer to Panama City and the ocean side of Bay County. The proposed action area is adjacent to relatively undeveloped portions of the county, with the exception of a shipyard and small housing development on the north side of East Bay, but these few small developments would not be expected to have effects that reach to the proposed action area (e.g., no discharge that would affect water quality within the proposed action area).

The region is at risk from storms and other disasters. In 2018, Hurricane Michael devastated the region, and Tyndall AFB had over 200 buildings rendered unsalvageable (Tyndall Air Force Base 2023c). An installation recovery plan (i.e., Master Plan) is now in place to rebuild base facilities. This and other events, such as the 2010 Deepwater Horizon oil spill, have tempered local tourism and recreation, likely reducing activities in and around the proposed action area.

5.3.2 Present and Reasonably Foreseeable Actions

Tyndall AFB has implemented its Master Plan to rebuild and recover from the impacts of Hurricane Michael. The plan involves facilities construction, infrastructure improvements, and management actions. The Master Plan initiative includes a Landscape Master Plan that outlines future actions to improve the base's coastal zone, which is delineated as "a composite of marine influenced habitats (e.g., tidal waters, wetlands, beaches, dunes, and coastal grasslands) and a 200-foot boundary from the shoreline" around Tyndall AFB (Tyndall Air Force Base 2023b). The proposed action area falls within this coastal zone. However, currently planned actions for the zone, such as boardwalk construction or marina repairs, do not overlap with the proposed action area. The Proposed Action aligns with future plans to evaluate "nature-based solutions in the Back Bay area" (Tyndall Air Force Base 2023b).

The Master Plan also includes plans that align with objectives from the Tyndall AFB INRMP to restore native vegetation and improve stormwater drainage, infiltration, and detention throughout the base, which could reduce freshwater inputs into East Bay and limit intrusion of brackish water into forested areas (Tyndall Air Force Base 2020a, 2020b). Climate change impacts, including sea level rise, may affect Baker Point, potentially limiting landward access to recreational and other activities in and around the proposed action area (Tyndall Air Force Base 2020b). Climate change is anticipated to result in an increase in the number and intensity of storms in this region. The Reefense structures have been designed with the expectation that they will remain in place in strong storms, reducing the likelihood of cumulative effects from storms dislodging the structures and causing damage to shore-based structures. Additionally, the purpose of the Reefense structures is to attenuate wave energy associated with storms, helping to mitigate the effects of climate change.

Commercial and recreational fishing (and associated boating) may increase over time, and "fishing opportunities are likely to continue unimpeded" as local population grows and access to East Bay remains consistent (Tyndall Air Force Base 2020b). Similar increases in tourism and other recreational activities are expected as the local economy and infrastructure recovers. However, none of these fishing and recreational increases would be expected to be substantial within the limited, shallow area of the proposed action area. Military activities typically occur on base or in the GOM, rather than in East Bay, and while new actions are expected in the future, they would remain adjacent to and outside the proposed action area.

5.4 Cumulative Effects Analysis

Quantifiable data related to past, present, and reasonably foreseeable actions within the proposed action area are very limited and not useful to a discussion of cumulative effects relevant to the Proposed Action. Accordingly, a qualitative analysis was undertaken. The analytical methodology presented in Chapter 4, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

5.4.1 Physical Resources

The proposed action area is soft bottom with no intertidal marsh, oyster reefs, or submerged aquatic vegetation. There is limited activity in and around the proposed action area. As described in Section 4.3.2, the primary effect of the Proposed Action on the physical resources of the proposed action area would be covering of soft bottom sediment with hard structures. Although this impact would be long-term in duration, it would affect a relatively small footprint (37,500 ft^2 [3,484 m^2; 0.86 acres]), and it would provide benefits by increasing the complexity of the seafloor within East Bay and providing wave attenuation to protect the adjacent shoreline.

Most of the past, present, and reasonably foreseeable actions that may occur within the proposed action area are recreational in nature (e.g., fishing, boating) and would not affect benthic sediment. Some limited boat anchoring and/or fishing could affect the soft bottom present within the proposed action area, but these bottom effects would have no long-term effects on otherwise barren soft bottom. When combined with the limited bottom effects of the Proposed Action, bottom effects associated with other past, present, and reasonably foreseeable actions would not appreciably add to the affected bottom habitat.

As the oyster reefs associated with the Proposed Action are settled and mature, the reef itself would change the local substrate and potentially affect fishing patterns. However, given the size of the Reefense structures proposed, any increased fishing pressure and effects on physical and benthic resources would be marginal.

The purpose of the Proposed Action is to improve shoreline resilience and attenuate wave energy along the shore; therefore, the Proposed Action would likely have beneficial effects on the physical resources on land near the proposed action area. Specifically, the Baker Point shoreline will receive greater protection from storm events, flooding, and other natural impacts that could lead to erosion or sediment displacement. This protection would complement existing plans for drainage control and other natural resource management that is part of the Tyndall AFB Landscape Master Plan. Therefore, the overall cumulative effects on physical resources would be insignificant, and the Proposed Action would lead to overall beneficial effects on physical resources just beyond the proposed action area (i.e., the shoreline).

5.4.2 Biological Resources

Biological resources that may be impacted by the Proposed Action include vegetation, invertebrates, birds, fish, EFH, reptiles, and marine mammals. Overall, vessel noise, vessel movement, and the physical installation and potential removal of Reefense structures would cause no more than minor, short-term behavioral reactions for most resources. Immobile invertebrates could be crushed by deployment of the

Reefense structures, but mobile species would be expected to swim away. Soft bottom EFH would be covered by hard substrate within the small footprint of the Reefense structures. However, the long-term presence of the Reefense structures would not have adverse effects on biological resources, and the habitat creation and wave attenuation would have positive benefits, creating a net positive impact for biological resources. If removal were required, these positive benefits would be lost.

Few of the past, present, and reasonably foreseeable actions listed in Section 5.3 would be expected to impact biological resources in the proposed action area. The proposed action area is adjacent to largely undeveloped portions of Tyndall AFB property, and there are limited recreational activities, commercial and recreational fishing, or transportation activities within or around the proposed action area. While nearby population growth and development could increase vessel traffic, fishing, and recreational activity, much of this activity is concentrated west of the proposed action area or on the ocean side of Tyndall AFB, rather than East Bay. While maintenance or other research activities could periodically disturb marine species, these localized disturbances would be short term with no long-term impacts on biological organisms. As a result, expected impacts on local biological resources above the surface, within the water column, and on the seafloor would all be minimal. The effects of the Proposed Action, when combined with these minimal effects, would remain insignificant; the oyster reef created by the Proposed Action may serve as nursery habitat or coverage for other species in addition to the oysters. Underwater sound, physical activities within the proposed action area, or bottom disturbance associated with the Proposed Action or other past, present, or reasonably foreseeable actions may result in temporary avoidance by fish, marine birds, reptiles, or marine mammals, but those effects would be minimal and would be short enough in duration to have negligible long-term or population-level impacts, even when considered in combination. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable projects would not result in significant impacts within the proposed action area.

5.4.3 Socioeconomic and Cultural Resources

Socioeconomic resources within the proposed action area are limited (e.g., limited fishing, boating, and other recreational uses) given the small size, shallow waters, and proximity to a military base. No cultural resources are known to occur within the proposed action area itself. Potential effects on the limited socioeconomic resources from the Proposed Action would be minimal. Vessel movement and the physical deployment and potential removal of the Reefense structures would displace other uses of the proposed action area for the short period of time while deployment, monitoring, or potential removal occur because the proposed action area is small, recreational activities would be less pleasant nearby the activity, and given the likelihood of fish to leave the proposed action area during these periods (Section 4.4.2.4), commercial fishing would be less effective during these periods. However, the physical presence of the Reefense structures would have only a minor impact on boat traffic (recreational and commercial) within the proposed action area as vessels would need to avoid the structures in the water. However, given the relatively small footprint of the Reefense structures (37,500 ft^2 [3,484 m^2; 0.86 acres]), and their marking with aids to navigation, any impacts would be minimal.

The past, present, and reasonably foreseeable actions anticipated within or adjacent to the proposed action area would similarly have minimal effects on socioeconomic resources because they would, at most, temporarily displace other uses from the proposed action area. For example, recreational activities may not be able to occur within the proposed action area if there is active research or Tyndall AFB maintenance activities occurring in the area. However, no major activities are planned within the proposed action area in the foreseeable future, so effects on socioeconomic resources from past, present, and reasonably foreseeable actions would not appreciably contribute to effects of the Proposed Action.

Given the small size and limited use of the proposed action area and the short period of time that either the Proposed Action or other actions would interfere with uses of the area, cumulative impacts would remain insignificant. Therefore, implementation of the Proposed Action combined with other past, present, and reasonably foreseeable actions would not result in significant impacts within the proposed action area.

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6 Standard Operating Procedures and Protective Measures

Both SOPs and protective measures would be implemented during the Proposed Action. Additionally, if the Reefense structures require removal, the additional protective measures outlined below would be employed. SOPs serve the primary purpose of providing for safety and mission success, and they are implemented regardless of their secondary benefits (e.g., to a resource). Protective measures are used specifically to avoid or reduce potential impacts to a resource. This section presents an overview of the SOPs and protective measures that are incorporated into the Proposed Action in this document.

Standard Operating Procedures

- Personnel on lookout aboard the vessel would conduct visual monitoring for marine species during all operations.
- All lookouts aboard platforms involved in the Proposed Action would review the NMFS-approved Marine Species Awareness Training material prior to Reefense deployment.
- Lookouts shall be trained in the most effective means to ensure quick and effective communication to facilitate implementation of protective measures if marine species are spotted.
- Personnel on lookout on the deck of the vessel would have a set of binoculars available for each person to aid in the detection of large fish, marine mammals, and sea turtles.
- All vessels would use extreme caution and proceed at a “safe speed” so proper and effective action can be taken to avoid a collision with any sighted object or disturbance, and the vessel can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- Movement of the vessel would be limited to a maximum speed of five knots within the proposed action area and 10 knots when approaching the proposed action area.

Protective Measures for Deployment and Monitoring Activities

- DARPA and any permittee shall ensure that all personnel associated with the Proposed Action are instructed about the potential presence of species protected under the ESA and the MMPA. All on-site project personnel are responsible for observing water-related activities for the presence of protected species. All personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing listed species and all marine mammals. To determine which protected species and critical habitat may be found in the transit area, please review the relevant marine mammal and ESA-listed species at Find A Species (https://www.fisheries.noaa.gov/findspecies) and the consultation documents that have been completed for the project.
- Vessels would avoid approaching large marine fish (visible at the surface), marine mammals, and sea turtles head on and would maneuver to maintain a mitigation zone of 200 yd (183 m) around manatees and sea turtles.
- The Reefense structures’ deployment would not occur within a 200 yd (183 m) radius around any observed marine mammal or sea turtle.
- Surveys would be conducted in the site prior to the deployment of Reefense structures.

- The proposed action area would be monitored quarterly to ensure the structures would not become hazards to navigation or marine life. Monitoring would include removal of fishing nets or any other hazards that have become entangled in the Reefense structures.
- Individual reef structures would be no longer than 75 ft (23 m) and would have minimum 5 ft (1.5 m) wide openings between reefs to eliminate the chance of entrapment of marine organisms.
- Reefense structures would not be placed within 15 ft (5 m) of any submerged aquatic vegetation.
- Newly created reefs would be marked with aids to navigation, as directed by the U.S. Coast Guard.
- Only native species of marsh grasses would be planted within the proposed action area.
- Only native oyster stocks would be used on the Reefense structures.
- Oyster reef materials shall be placed and constructed in a manner that ensures materials would remain stable and that prevents movement of materials to surrounding areas (e.g., oysters would be contained in bags or attached to mats and loose clutch must be surrounded by contained bagged oysters or another stabilizing feature).
- Oyster reef materials would be placed in designated locations only (i.e., the materials shall not be indiscriminately or randomly dumped or allowed to spread outside of the Reefense structures).
- All materials used for the Reefense structures shall be clean and free from asphalt, creosote, petroleum, other hydrocarbons and toxic residues, loose free-floating material, or other deleterious substances.
- All reef materials that have a significant potential for creating temporary turbidity problems during installation would be surrounded with floating turbidity curtains during placement, and the curtains would remain in place until turbidity levels return to acceptable levels.

Standard Manatee Conditions for In-water Work

- All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act**.**
- All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a 4-ft (1.2 m) clearance from the bottom. All vessels will follow routes of deep water whenever possible.
- Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

- All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.
- Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the USFWS in Jacksonville (1-904-731-3336) and emailed to FWC at ImperiledSpecies@myFWC.com.
- Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign that reads “Caution: Boaters” must be posted. A second sign measuring at least 8.5 inches (22 centimeters) by 11 inches (28 centimeters) explaining the requirements for “Idle Speed/No Wake” and the shutdown of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities.

Protective Measures for Removal

If removal is required, portions of the reef that can be used to improve or enhance other local habitats will be transferred to those areas in collaboration with the Bay County and the State of Florida. Flora and fauna will be removed if appropriate for transplantation and structural materials discarded on land. Motile organism will be allowed to disperse during removal or removed by washing with water pumped across the structure or by hand and released.

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7 Other Considerations Required by NEPA

7.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 CFR § 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 7-1 identifies the principal federal and state laws and regulations that are applicable to the Proposed Action and describes briefly how compliance with these laws and regulations would be accomplished.

Table 7-1. Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	***Status of Compliance***
National Environmental Policy Act (NEPA); CEQ NEPA implementing regulations; Navy procedures for Implementing NEPA	EA (this document) and forthcoming Finding of No Significant Impact (FONSI) of the selected alternative
Clean Water Act	Section 404 permit pending from the USACE via an individual permit for the Reefense structures and Nationwide permit #5 for scientific measurement devices
Rivers and Harbors Act	Section 10 permit pending from the USACE via an individual permit for the Reefense structures and Nationwide permit #5 for scientific measurement devices
Coastal Zone Management Act	Consistency Determination pending from the Florida Coastal Management Program via Florida DEP permit
National Historic Preservation Act	Concurrence with conclusion of no effects to historic resources pending from the Florida SHPO via Florida DEP permit
Endangered Species Act	Informal consultation in progress with both the Florida Ecological Services Office of the USFWS and the Southeast Regional Office of NMFS.
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	Consultation completed on 29 February 2024 with NMFS, Southeast Region, Office of Habitat Conservation
Marine Mammal Protection Act	Based on the nature of the Proposed Action (e.g., small proposed action area, short periods of time required for daytime vessel activity, no underwater noise except limited vessel noise), the impacts do not rise to a level considered as take. Therefore, there is no accompanying permit associated with this Proposed Action.
Migratory Bird Treaty Act	Based on the nature of the Proposed Action (e.g., all in-water work) and the lack of presence of nesting or foraging habitat for migratory birds within the proposed action area, there would be no effect from the Proposed Action on migratory birds.
Bald and Golden Eagle Protection	Based on the nature of the Proposed Action and the lack of presence of bald or golden eagle nesting or foraging habitat within the proposed action area, there would be no taking of a bald or golden eagle. Therefore, the Bald and Golden Eagle Protection Act does not require further consideration.
Florida Manatee Sanctuary Act of 1978	Vessels associated with the Proposed Action would be operated in compliance with all boat speed and operations requirements. No consultation is required.

7.2 Relationship between Short-term Use of the Environment and Long-term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

In the short-term, effects to the human environment with implementation of the Proposed Action would primarily relate to disturbance of the seafloor and biological resources within the immediate vicinity during deployment of the Reefense structures. These impacts would be minimal and short-term. In contrast, the Proposed Action would have beneficial long-term effects to the human environment. The Reefense structures would act as artificial reefs, encouraging increased biomass and biodiversity within the area, and the structures would provide shoreline protection, benefiting both biological and socioeconomic uses of the shore. If the Reefense structures need to be removed at the end of the project period, then these long-term benefits would be lost. There would again be short-term adverse disturbance effects within the proposed action area, and the area would eventually return to its original state prior to Reefense installation. The Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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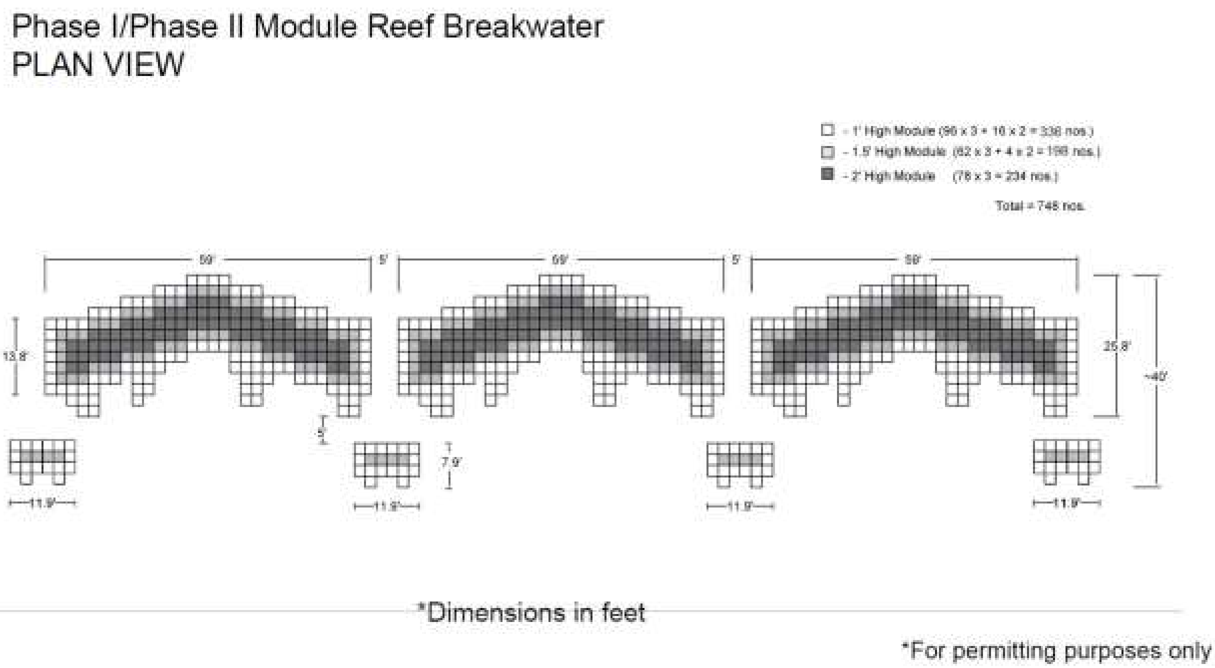
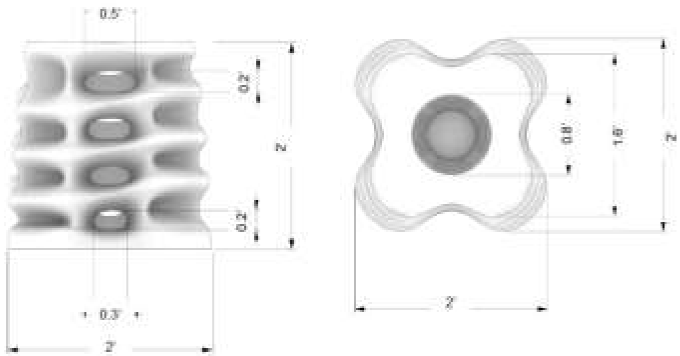
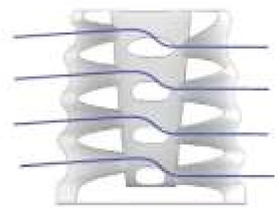
Appendix A. Additional Structure Details



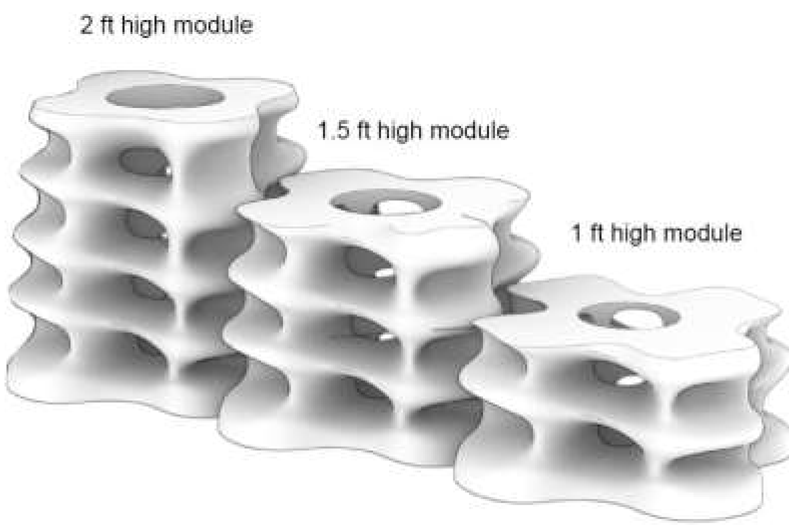
2' high (full size) module details



*Dimensions in feet



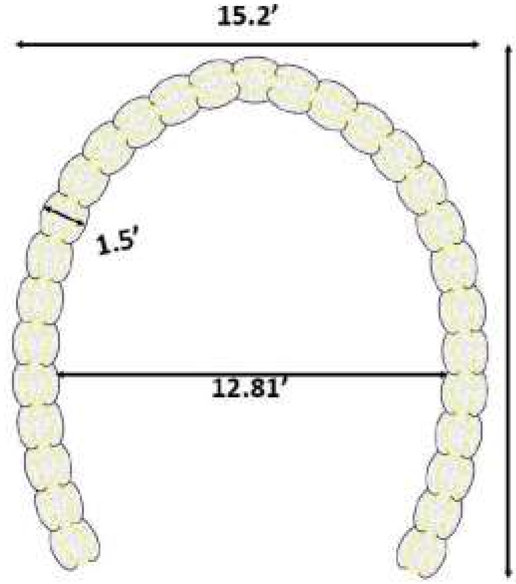
Holes on opposite sides adjusted to slow water movement. However, **solid base is maintained** in pouring process.



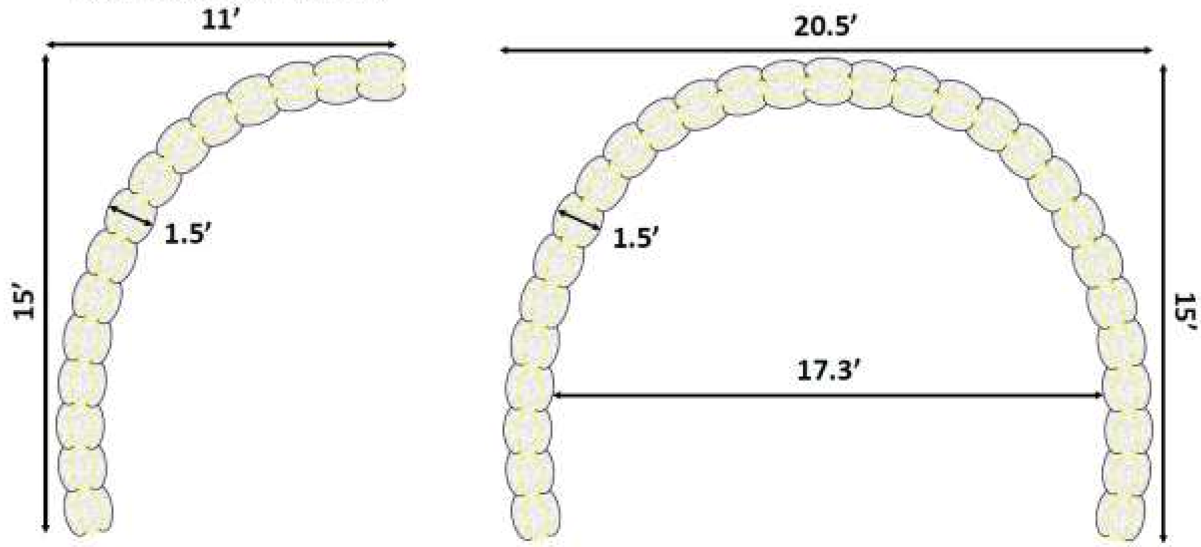
Varying height units achieved simply by limiting the amount of concrete mix used

Low-relief MOH structure typical arrangement OVERHEAD VIEW

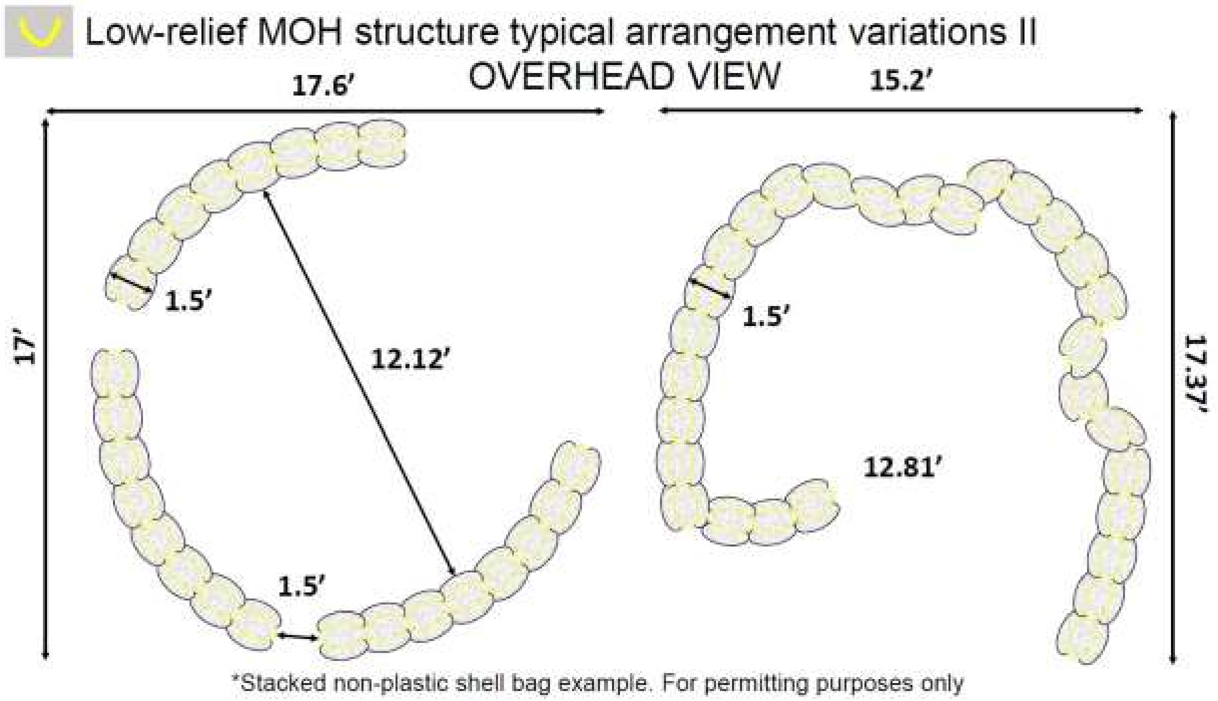
*Example material shown for permitting only. Options considered for MOH materials are shown and described in Section 2.2.2.2.

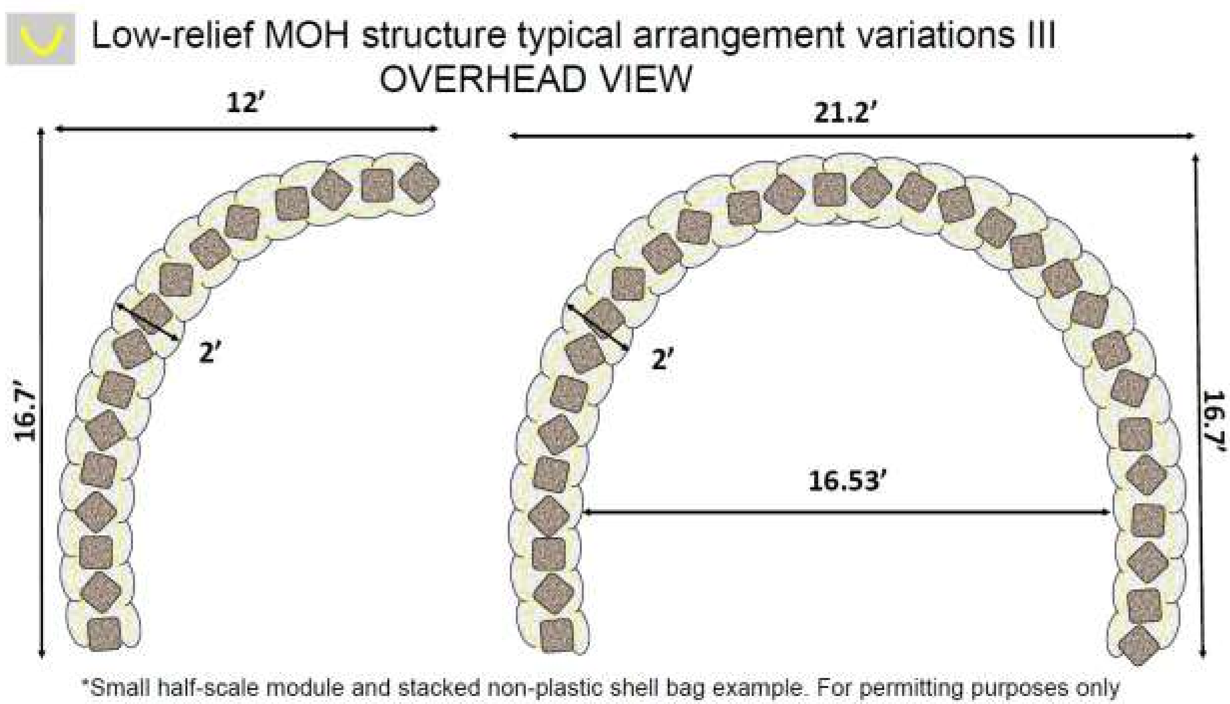


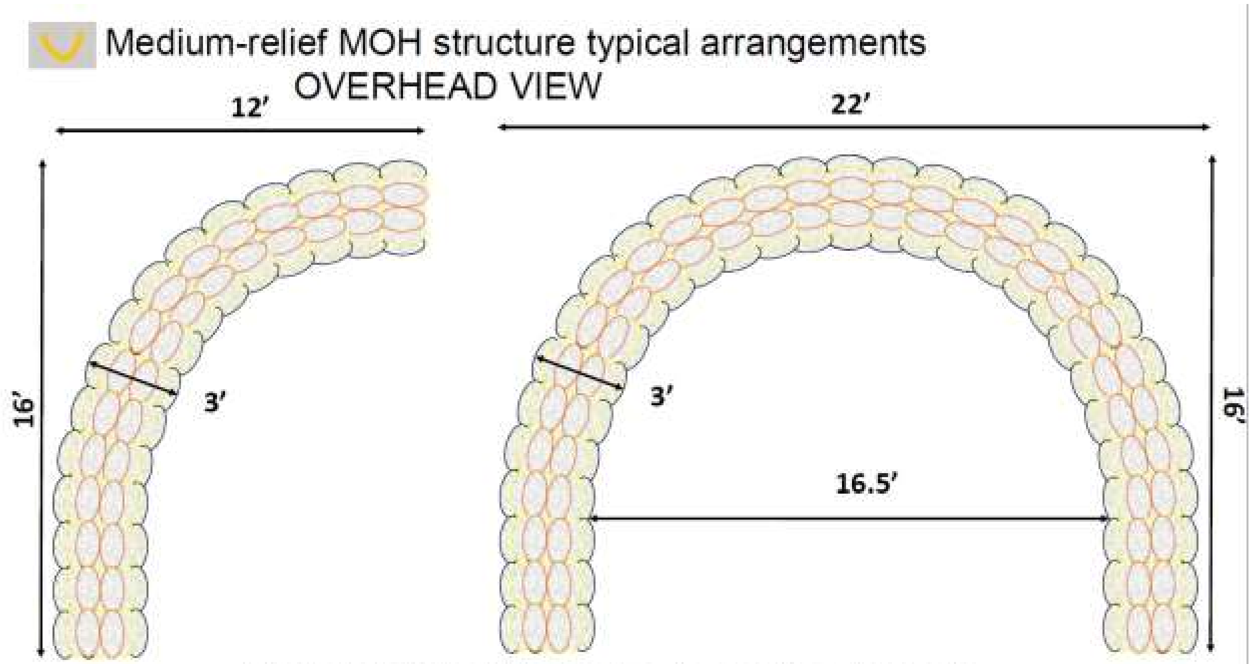
Low-relief MOH structure typical arrangement variations I OVERHEAD VIEW



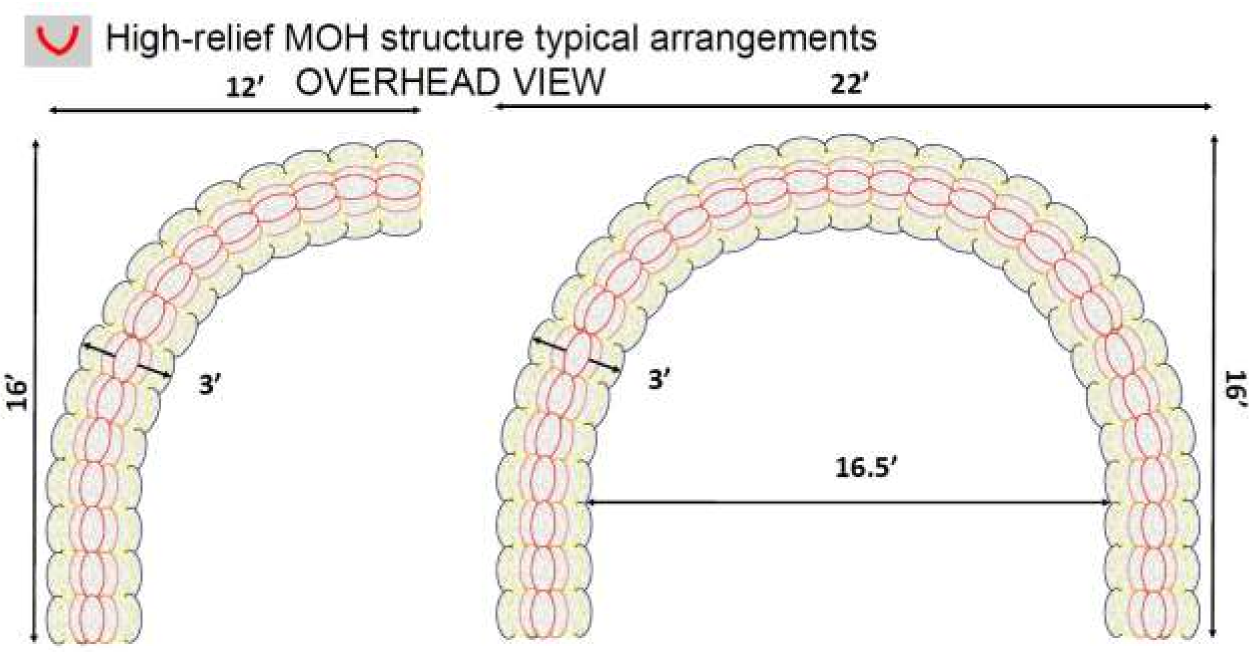
*Stacked non-plastic shell bag example. For permitting purposes only


Low-relief MOH structure typical arrangement variations II
OVERHEAD VIEW
17.6'
15.2'
1.5'
12.12'
17'
1.5'
17.37'
12.81'
1.5'
*Stacked non-plastic shell bag example. For permitting purposes only

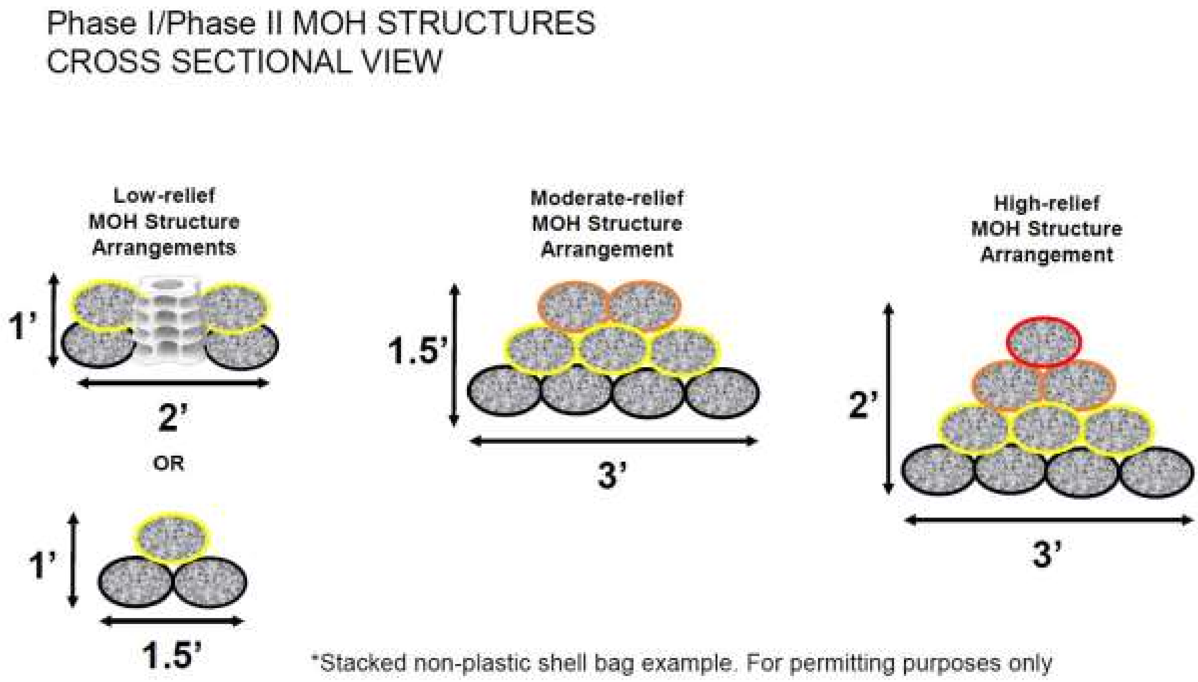

Low-relief MOH structure typical arrangement variations III
OVERHEAD VIEW
12'
21.2'
2'
2'
16.7'
16.7'
16.53'
*Small half-scale module and stacked non-plastic shell bag example. For permitting purposes only



*Stacked non-plastic shell bag example. For permitting purposes only



*Stacked non-plastic shell bag example. For permitting purposes only


Phase I/Phase II MOH STRUCTURES
CROSS SECTIONAL VIEW
Low-relief
MOH Structure
Arrangements
1'
2'
OR
1'
1.5'
Moderate-relief
MOH Structure
Arrangement
1.5'
3'
High-relief
MOH Structure
Arrangement
2'
3'
*Stacked non-plastic shell bag example. For permitting purposes only

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Appendix B. U.S. Army Corps Permit Application (Nationwide #5) for Environmental Sensing Equipment

This permit is requested to deploy various environmental sensing instruments and equipment to support a planned experimental oyster reef project northeast of Tyndall Air Force Base (AFB) within St. Andrew Bay in Bay County, Florida to inform DARPA's Reefense project at Baker Point. The permit requested here (Nationwide Permit 5) will allow for the collection of baseline data to support the project design, evaluate its effectiveness, and/or guide adaptive management of the design after installation.

Equipment will be deployed by various entities and includes various instruments to assess turbidity, sedimentation, and hydrodynamic conditions (Table 1) at or near the project site (Figure 1A). Instrument type and deployment method, location, and period varies by lead entity. The Mississippi State University (MSU) and WSP team will deploy two wave gauges and two water quality sondes in the nearshore intertidal zone and two other wave gauges and an acoustic doppler current profiler (ADCP) in the offshore subtidal zone (Figure 1B – C). The ADCP and wave gauges will be deployed within PVC pipes forced into the bed (6 and 1 inch inside diameter, respectively). The sondes will be secured to commercial cinder blocks and placed directly on the bed floor, with additional weight added for stabilization, as necessary (see Attachment 1 for additional details and photos of equipment and deployment methods). MSU and WSP equipment will be deployed continuously following receipt of this permit, during and after anticipated project installation (estimated between May and July 2024). USGS equipment will be deployed continuously for a period of 6 months immediately following project installation. USGS equipment will include a moored surface wave buoy offshore, and arrays of wave gauges, turbidity sensors, and an ADCP deployed to weighted bed platforms at nearshore and offshore locations and within intertidal to subtidal zones (Table 1; Attachment 2). The University of Central Florida (UCF) team will deploy instruments at the anticipated project site (green box, Figure 1B) and at two reference site locations (red X's, Figure 1B) on a limited basis (biannually up to 30 days per deployment; Table 1; Attachment 3).

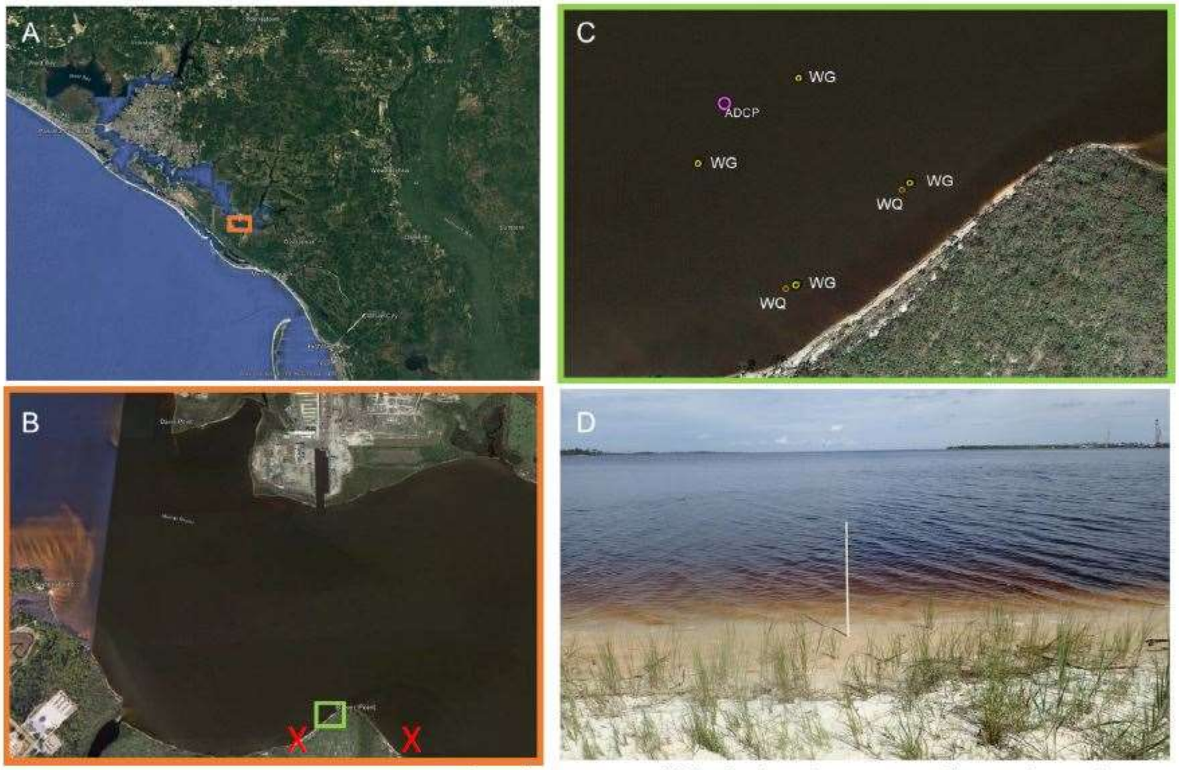


Figure 1. **Equipment Deployment Site.** Various instruments will be deployed to assess sedimentation and hydrodynamic conditions at sites northeast of Tyndall AFB, Bay County, Florida (orange square; panel A). Equipment deployment locations include a proposed oyster reef project site (green square; panel B) and two reference sties (red X's; panel B). The length of equipment deployment varies, however, a select array of instruments will be deployed continuously at the anticipated project site (panel C). These instruments include an ADCP and two wave gauges (WG) offshore (~5-6 foot depth) and an additional two wave gauges accompanied by water quality sondes (WQ) at intertidal locations (≤ 2 foot depth; panel C).

Table 1. Summary of Proposed Sensing Instruments and Deployment Information. Equipment information includes the entity responsible for deployment along with a description of the equipment, frequency of planned deployment and method of deployment, and general depth (water depth zone: surface, intertidal and subtidal) and shore-perpendicular locations (i.e., general deployment location: nearshore to offshore).

Entity	Equipment Description	Frequency of Planned Deployment	Deployment Method	Deployment Water Depth Zone	General Deployment Location
MSU/WSP	Nortek Signature 1000 Acoustic Doppler Current Profiler	Continuous	PVC Pipe Pile Supported	Subtidal	Offshore
	Insitu Aquatroll 500 Water Quality Sondes (2)	Continuous	Weighted Bed Platform	Intertidal	Nearshore
	RBR SoloD wave gauges (4)	Continuous	PVC Pipe Pile Supported	Intertidal to Subtidal	Nearshore to Offshore
USGS	Sofar Spotter Wave Buoy	Continuous (6 mos)	Moored Surface Buouy	Surface	Offshore
	RBR VirtuosoD wave gauges (8)	Continuous (6 mos)	Weighted Bed Platform	Intertidal to Subtidal	Nearshore to Offshore
	RBR Tu optical turbidity sensor	Continuous (6 mos)	Weighted Bed Platform	Subtidal	Offshore
	Nortek Signature 1000 Acoustic Doppler Current Profiler	Continuous (6 mos)	Weighted Bed Platform	Subtidal	Offshore
UCF	Nortek Aquadopp HR Acoustic Doppler Current Profiler	Biannually, up to 30 days	Weighted Bed Platform	Subtidal	Offshore
	Onset Hobo Water Level Logger	Biannually, up to 30 days	Weighted Bed Platform	Subtidal	Offshore
	Nortek Vector Acoustic Doppler Velocimeter	Biannually, up to 30 days	PVC Pipe Pile Supported	Surface to Intertidal	Offshore
	Nortek Vectrino Acoustic Doppler Current Profiler	Biannually, up to 30 days	PVC Pipe Pile Supported	Subtidal	Offshore
	Seapoint Turbidity Meter + ISCO pump sampler	Biannually, up to 30 days	PVC Pipe Pile Supported	Subtidal	Offshore
	Wind Speed Anemometer and Direction Vane	Biannually, up to 30 days	PVC Pipe Pile Supported	Above Surface	Nearshore
	Sediment Deposition Tiles	Biannually, up to 30 days	Bed Platform	Intertidal	Nearshore

Attachment 1 (MSU/WSP Equipment Details)

MSU/WSP Field Equipment Descriptions and Typical Deployment

Figure 1. MSU/WSP Equipment Deployment at Baker Point. MSU/WSP will deploy various instruments at Baker Point, located northeast of Tyndall AFB, Bay County, Florida. These instruments include an ADCP and two wave gauges (WG) offshore (~5-6 foot depth) and an additional two wave gauges accompanied by water quality sondes (WQ) at intertidal locations (≤ 2 foot depth).

MSU/WSP plan to deploy various instruments at the Baker Point project area (Figure 1). Two RBR soloD wave gauges will be deployed in offshore locations (WG; Figure 1) at approximately 5-6 ft depth. An Nortek Signature 1000 Acoustic Doppler Current profiler will be deployed at a similar depth near these gauges (ADCP; Figure 1). Each of these instruments will be deployed within PVC pipes pushed into bed sediments (1.5 inch x 4+ ft and 6 inch x 4+ ft pipes for WGs and ADCP, respectively; Figure 2). Two additional WGs will be deployed following the same method but within the intertidal area nearshore (≤ 2 ft depth; Figure 1). Two Insitu Aquatroll 500 water quality sondes (WQ; Figure 1) will be deployed next to nearshore WGs but using different methods. WQs are secured to a 16 x 24 x 1 inch concrete block base which is chained to one or more standard construction cider blocks (8 x 8 x 16 inch) to prevent instrument movement (e.g., Figure 3).

Figure 2. Wave Gauge and ADCP Equipment and Example Deployment Methods. RBR soloD wave gauges (yellow instruments) will be deployed within 1.5 inch PVC pipes forced into bed sediments. A zip tie secures the instrument to the pipe through a hole at the top of the RBR (A). Nortek Signature 1000 ADCPs (black instruments) are secured to a 6 inch PVC pipe pushed into bed sediments using a rubber pipe coupler (B).

Figure 3. Water Quality Sonde Equipment and Example Deployment Method. Insitu Aquatroll 500 series water quality sondes will be attached to concrete block base and further secured using standard construction cinder blocks.

Attachment 2 (USGC Equipment Details)

Soak Time = 6 months; Start Date = within 1 month after reef structures go in

1 x Sofar Buoy

Deployment platform:
Surface buoy attached to line and chain, anchored to bottom weights. Buoy is yellow with LED lights.

Size: ~ 17"diam x 12"H
Anchor Wt: ~150 lbs

Sofar Spotter Buoy: collects meterologic and oceanographic data (wind velocitiy, barometric pressure, wave height, wave direction, wave period) transmitted in real time (cellular).

2 x RBR + Signature

Deployment platform:
RBR (mounted to vertical rod) & Signature attached to flat gridded plate with weights.

Size: ~ 24"W x 24"L x 20"H
Wt: ~150 lbs

Nortek Signature 1000: 1 MHz acoustic transmission; 5 beams: 4 slanted at 25° and 1 vertical, 2.9° beam width.

6 x RBR waves

Deployment platform:
RBR mounted to vertical rod attached to a flat gridded plate with weights.

Size: ~ 24"W x 24"L x 20"H
Wt: ~50 lbs

RBR Virtuoso Dwave: pressure sensor

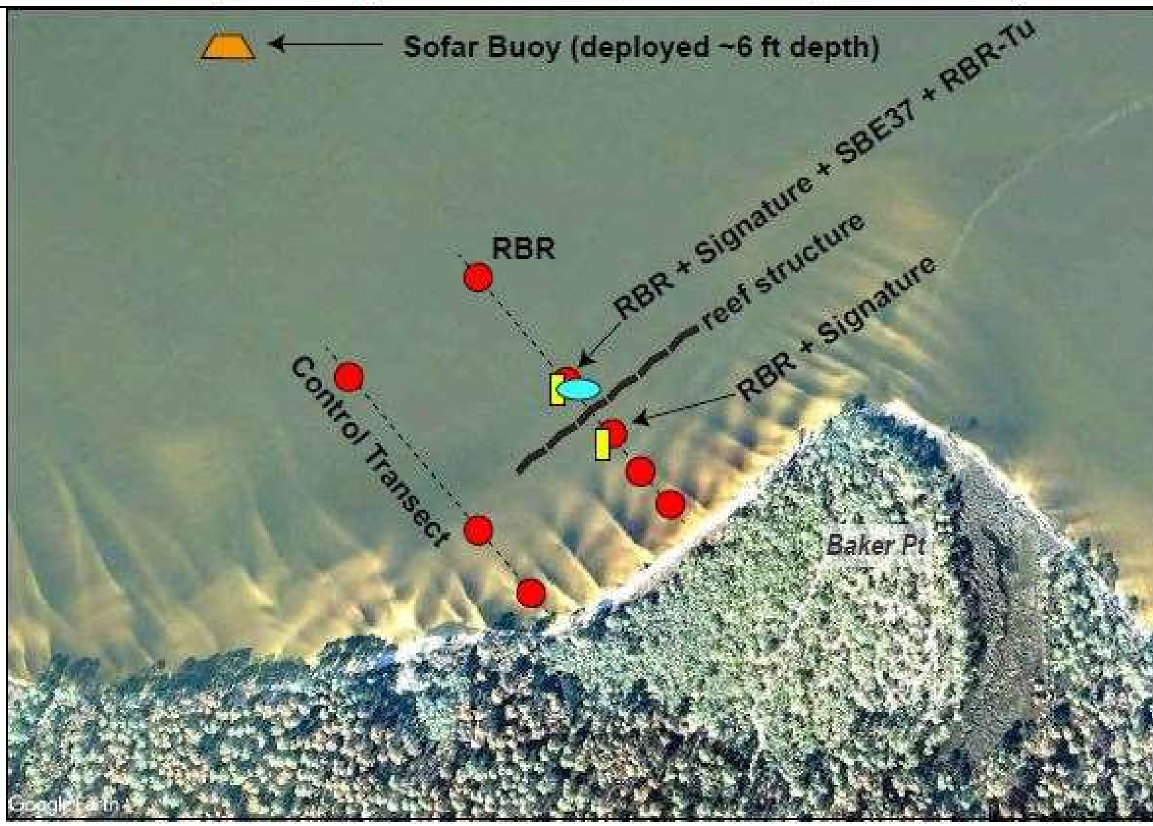
1 x SBE37 + RBR Tu

These two sensors will be installed on the offshore RBR+Signature platform.

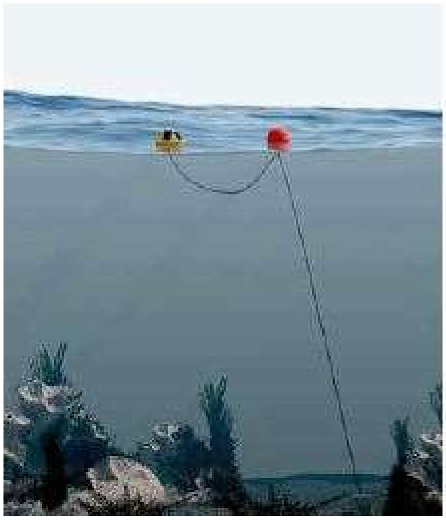
RBR Tu: optical turbidity sensor

SBE37: SeaBird MicroCAT temperature & conductivity sensor

**Note: no planned drilling into benthic substrate; we will secure all platforms with weights



Sofar Spotter Buoy:



~ 17" Diam x 12" H

Attached to surface buoy, anchored with weights at seabed.

RBR Virtuoso Dwave sensor:

~ 14" L x 2.5" Diam

Example of instruments mounted vertically on rod

Nortek Signature1000:

~ 8.5" L x 5.6" Diam

Example of Signature attached to gridded plate

<u>SeaBird Electronics SBE37 MicroCAT:</u>

~ 25" L x 6" W

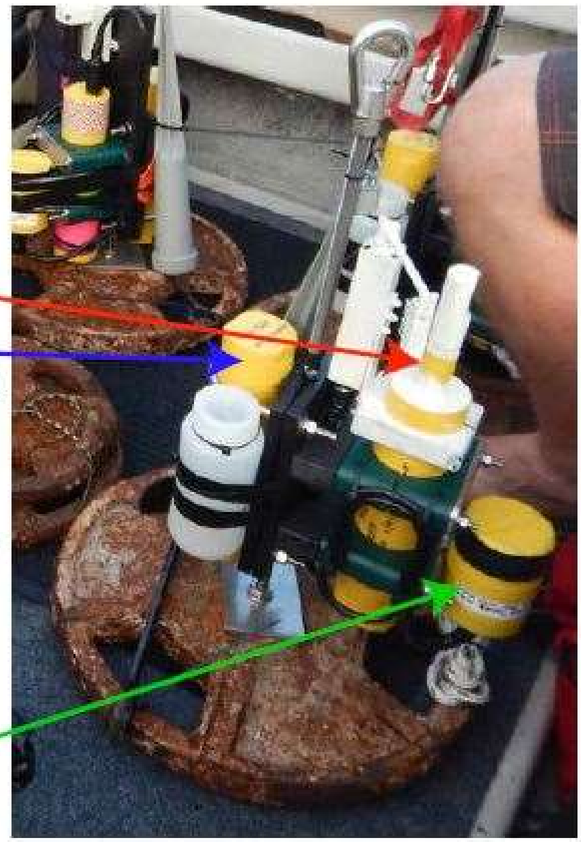
SBE37 will be attached lying flat to the gridded plate.

<u>RBR Turbidity sensor:</u>

~ 16" L x 2.5" Diam

The RBR Turbidity sensor will be installed vertically to same rod as the RBR Virtuoso Dwave sensor. The rod and two sensors will be mounted to the gridded plate base.

This photo shows an example of this configuation.



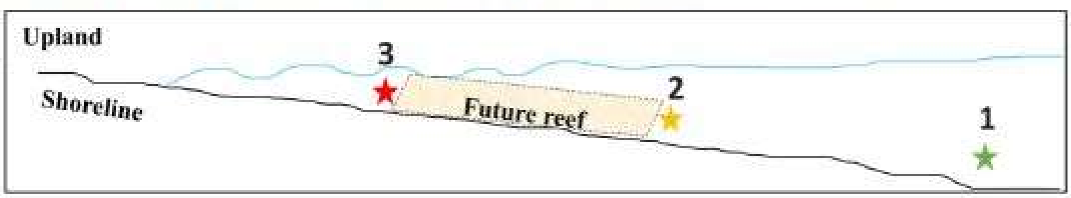
The RBR turbidity sensor will also have a ZebraTech Hydro Wiper attached to it.

Attachment 3 (UCF Equipment Details)

UCF Environmental monitoring instruments deployed at Baker Point, near Tyndall Airforce Base

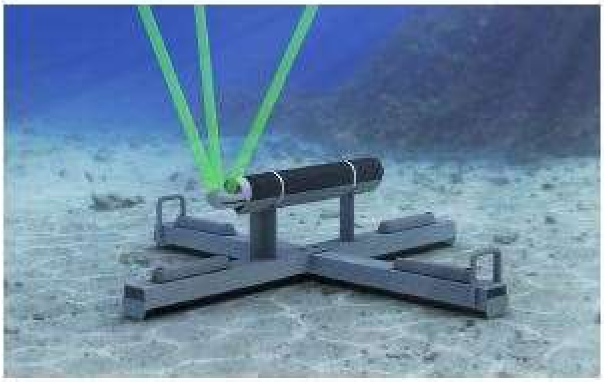
Transects will be monitored biannually up to 30 days per deployment in three sites (Reef site, Control site, Control East):

Each transect will include monitoring equipment in positions 1-3:



Transect Position 1:

Nortek Aquadopp HR Profiler + Onset Pressure Transducer (depth sensor): deployed biannually up to 30 days per deployment in shallow subtidal zone. Seafloor mooring platform is 24 in X 7 in.



Wind speed anemometer and direction vane: deployed biannually up to 30 days per deployment in shallow subtidal zone; Mooring is 2 in aluminum pole.

Transect Position 2:

Nortek Vector Acoustic Doppler Velocimeter + Seapoint Turbidity Meter and wiper: deployed biannually up to 30 days per deployment in shallow subtidal zone. Mooring is 2.5 in aluminum pole.

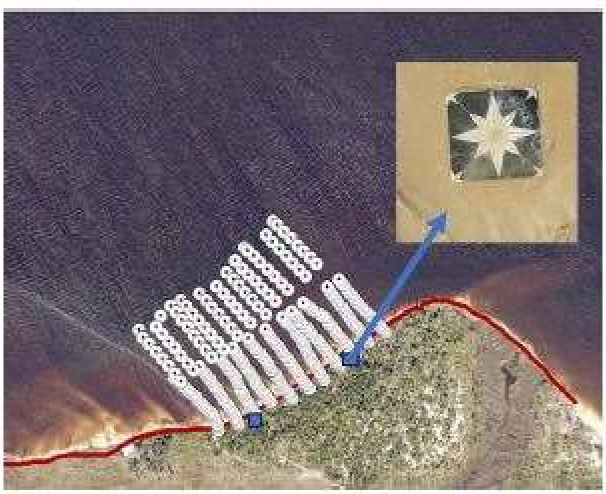
Transect Position 3:

Nortek Vectrino Acoustic Doppler Current Profiler (x2) + Seapoint Turbidity Meter and wiper: deployed biannually up to 30 days per deployment in intertidal zone. Mooring is 2.5 in aluminum pole.

Seapoint Turbidity Meter + ISCO pump sampler: deployed biannually up to 30 days per deployment in intertidal zone. Mooring is 1 in aluminum pole.

Water samples and turbidity collection at Baker point (T6)

Sediment deposition tile: deployed weeks to months in intertidal zone (example location shown in Reef site and Control site). Tile is 12 in X 12 in, mooring is 1 in PVC pole.



Appendix C. Magnuson-Stevens Fishery Conservation and Management Act Documentation

Reply Reply All Forward IM

Thu 2/29/2024 3:54 PM

Mark Sramek - NOAA Federal <mark.sramek@noaa.gov>

[Non-DoD Source] Re: DARPA Reefense: Baker Point (Tyndall Air Force Base)

To Felins, Erica M CIV USN NUWC DIV NEWPORT RI (USA)

Cc Campbell, Catherine E CIV (USA); Goodwin, Jacob D CTR (USA); Borcuk, Jocelyn R CIV USN NUWC DIV NEWPORT RI (USA); McLean, Elizabeth L CTR USN (USA); _NMFS ser HCDconsultations

You replied to this message on 2/29/2024 9:03 PM.

DARPA_Reefense_EFHA_Baker Point FL_29 FEB.pdf
7 MB

Hi Erica,

NOAA's National Marine Fisheries Service (NMFS), Southeast Region, Habitat Conservation Division (HCD) has reviewed your office's attached essential fish habitat (EFH) Assessment regarding the following Proposed Action: the Defense Advanced Research Projects Agency's Reefense Program adjacent to Tyndall Air Force Base at Baker Point, in East Bay, in Bay County, Florida. The purpose of the Proposed Action is to develop reef-mimicking structures to protect civilian and Department of Defense infrastructure and personnel by mitigating damage related to coastal flooding, erosion, and storm surge.

From our review of the EFH Assessment and evaluation of the project area using Google Earth software and the Florida Fish and Wildlife Conservation Commission's Seagrass Habitat in Florida website, we anticipate any adverse effects that might occur on marine and anadromous fishery resources would be minimal. Accordingly, the NMFS HCD does not have any EFH conservation recommendations to provide regarding these activities. This satisfies the consultation procedures outlined in 50 CFR Section 600.920, of the regulation to implement the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act.

Therefore, no further consultation with NMFS HCD is required for this action unless the proposed activities are modified.

I hope you are having a productive week.
Mark
727-824-5311

Substrate (Sand/Shell, Estuarine)
Substrate (Silt/Mud, Estuarine)
Latitude: 30.02282 N
Longitude: -085.47639 W