Endangered Species Act – Section 7 Consultation

Action Agency:	Department of the Army, U.S. Army Rapid Capabilities and Critical Technologies Office (RCCTO), U.S. Army Space and Missile Defense Command (USASMDC) – Huntsville AL
Activity:	Single Hypersonic Flight Test-3 (FT-3)
Consulting Agency:	National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division
NMFS File No. (PCTS):	PIRO-2020-03120
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Approved By:	Michael D. Tosatto Regional Administrator, Pacific Islands Region
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ACRONYMS

AAC	Alaska Aerospace Corporation
ARSTRAT	Army Forces Strategic Command, US Army
BA	Biological Assessment
BMP	Best Management Practices
BO	Biological Opinion
BOA	Broad Ocean Area
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	Centimeter(s)
CO_2	Carbon Dioxide
dB	Decibel
DEP	Document of Environmental Protection
DPS	Distinct Population Segment
DQA	Data Quality Act
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FE-1	Flight Experiment-1
FE-2	Flight Experiment-2
ft	Feet
FR	Federal Register
FWS	US Fish and Wildlife Service
FT-3	Flight Test-3
Hz	Hertz
in	Inch(es)
kg	Kilogram(s)
km	Kilometer(s)
LAA	Likely to Adversely Affect
m	Meter(s)
MAC	Mid-Atoll Corridor
MMPA	Marine Mammal Protection Act
MMI	Minuteman I Program
MMIII	Minuteman III Program
NEPA	National Environmental Policy Act
NLAA	Not Likely to Adversely Affect
nm	Nautical Miles
NMFS	National Marine Fisheries Service (aka NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
PIRO	Pacific Islands Regional Office
PMRF	Pacific Missile Range Facility, Kauai
PSCA	Pacific Spaceport Complex Alaska
RCCTO	U.S. Army Rapid Capabilities and Critical Technologies Office
RMI	Republic of the Marshall Islands
ROV	Remotely Operated Vehicle
RTS	Ronald Reagan Ballistic Missile Test Site (aka Reagan Test Site)

RMS	Root Mean Square
USASMDC	Space and Missile Defense Command, US Army
SSP	Strategic Systems Programs
SEL	Sound Exposure Level
SPL	Sound Pressure Level
TTS	Temporary Threshold Shift
UES	USAKA Environmental Standards
US	United States
USAF	U.S. Air Force
USAKA	U.S. Army Kwajalein Atoll
yd^2	Square Yard(s)
μPa	Micro-Pascal (s)

1 INTRODUCTION

The proposed action involves launching a single developmental test missile (Hypersonic Flight Test-3, FT-3) from the Pacific Spaceport Complex Alaska (PSCA) on Kodiak Island, Alaska, which would travel across a broad ocean area (BOA) of the Pacific Ocean. The payload impact would be at the Ronald Reagan Ballistic Missile Defense Test Site (RTS) at Illeginni Islet in Kwajalein Atoll, Republic of the Marshall Islands (RMI) (Figure 1). The purpose of FT-3 is to demonstrate a reduction of risk for a longer-range payload system and the data collected from this flight would be used to improve performance prediction models of the system. The FT-3 is a flight test that will be similar to and a crucial step in the developmental process following the Flight Experiment-1 (FE-1) and Flight Experiment-2 (FE-2), which were flight tests conducted in 2017 and 2019, respectively.

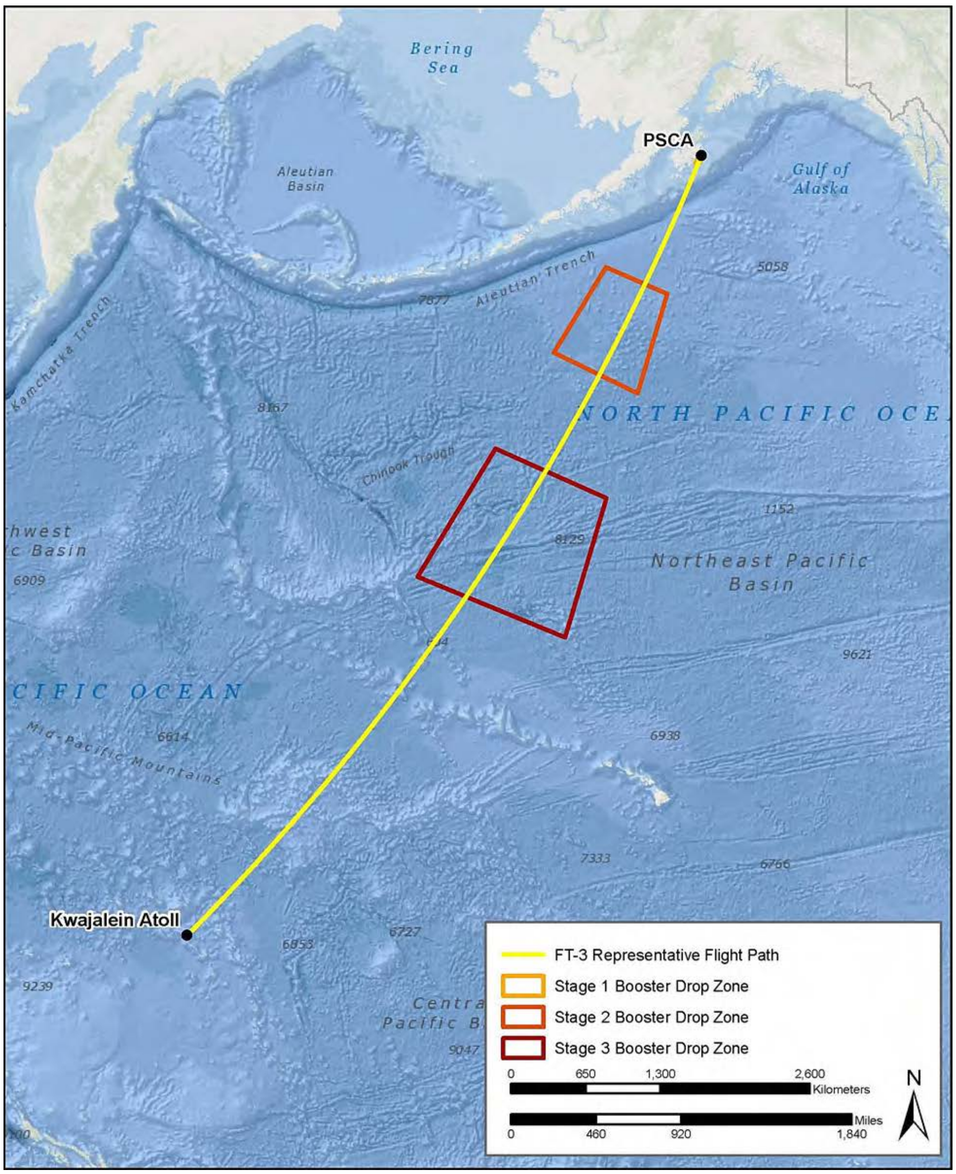

Figure 1. Flight Test-3 (FT-3) Representative Flight Path (Image provided by U.S. Army)

The Endangered Species Act (ESA) would apply for the portions of the action that would take place in and over United States (US) territory and international waters, but not for the portions of the action that would take place within the RMI. The Government of the RMI has agreed to allow the US Government to use certain areas of Kwajalein Atoll (collectively referred to as US Army Kwajalein Atoll or USAKA). "USAKA" is defined as "…the [USAKA]-controlled islands and the Mid-Atoll Corridor, as well as all USAKA-controlled activities within the [RMI], including the territorial waters of the RMI". The USAKA controls 11 islets around the atoll. The relationship between the US Government and the Government of the RMI is governed by the Compact of Free Association (Compact), as Amended in 2003 (48 USC 1681). Section 161 of the Compact obligates the US to apply the National Environmental Policy Act of 1969 (NEPA) to its actions in the RMI as if the RMI were a part of the US. However, the ESA does not apply within the RMI. Instead, the Compact specifically requires the US Government to develop and apply environmental standards that are substantially similar to several US environmental laws, including the ESA and the Marine Mammal Protection Act (MMPA). The standards and procedures described in the Environmental Standards and Procedures for USAKA Activities in the RMI (aka USAKA Environmental Standards or UES, 15th Edition) were developed to satisfy that requirement. Therefore, the US Government must apply the UES to its activities within the RMI. Because the ESA and UES both apply to this action, this biological opinion was written in a manner that considers and complies with each of those standards, as applicable.

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" a listed species or its designated critical habitat, that agency is required to consult formally with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR 402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species or their designated critical habitat, and NMFS or the FWS concur with that conclusion (50 CFR 402.14 (b)).

If an action is likely to adversely affect a listed species, the appropriate agency (either NMFS or FWS) must provide a Biological Opinion (Opinion) to determine if the proposed action is likely to jeopardize the continued existence of listed species (50 CFR 402.02). "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. *Id.*

The United States Army Rapid Capabilities and Critical Technologies Office (RCCTO) is the lead agency and action proponent for the proposed action, along with the United States Army Space and Missile Defense Command (USASMDC) as a participating agency. The UES requires all parties of the U.S. Government involved in this project to consult or coordinate with the NMFS and the FWS to conserve species and habitats of special concern at USAKA. We will address the USASMDC exclusively in this document as the participating agency. Section 3.4 of the UES establishes the standards and procedures to be followed "…to ensure that actions taken at USAKA will not jeopardize the continued existence of these species or result in destroying or adversely changing the habitats on which they depend." Section 3.4 is derived primarily from the regulations implementing the ESA, other U.S. regulations, and wildlife protection statutes of the RMI. As such, the list of UES consultation species includes all species present in the RMI that are listed under the ESA (including those that are candidates or are proposed for listing), all marine mammals protected under the MMPA, and all species and critical habitats as designated under RMI law. However, no critical habitat has yet been designated in the RMI.

Under the UES, "the final biological opinion shall contain the consulting agency's opinion on whether or not the action is likely to jeopardize the continued existence of a species or to eliminate a species at USAKA, or to eliminate, destroy, or adversely modify critical habitats in the RMI" (UES at 3-4.5.3(e)). Although the UES does not specifically define jeopardy, the Compact clearly intends that the UES provide substantially similar environmental protections as the ESA. We interpret this to include adoption of the ESA definition of jeopardy, as described above, and this review relies upon the ESA definition of jeopardy to reach its final conclusions.

This document represents NMFS' final Biological Opinion of the effects on marine species protected under the ESA and the UES that may result from the FT-3 flight test from the PSCA on Kodiak Island, Alaska, to the RTS at Illeginni Islet in Kwajalein Atoll. This Opinion is based on the review of: the RCCTO and USASMDC September 22, 2020, Biological Assessment (BA) for the proposed action; recovery plans for U.S. Pacific populations of ESA-listed marine mammals, sea turtles, and elasmobranchs; published and unpublished scientific information on the biology and ecology of ESA-listed marine species, UES-consultation marine species, and other marine species of concern in the action area; monitoring reports and research in the region; biological opinions on similar actions; and relevant scientific and gray literature (see Literature Cited).

1.1 Consultation History

A brief Section 7 consultation history for ongoing programmatic launch activities at PSCA is provided below for ESA-listed species and designated critical habitats:

In 2011, NMFS issued a programmatic Biological Opinion for space vehicle and missile launch operations at PSCA for the 5-year period from 2011-2016 (NMFS 2011). In this biological opinion, the NMFS concluded that launch operations at PSCA were not likely to adversely affect ESA-listed whales (i.e., fin whale, humpback whale, and North Pacific right whale). NMFS also concluded that launch operations would not destroy or adversely modify Steller sea lion (*Eumetopias jubatus*) critical habitat. NMFS concluded that launch noise from the loudest launch vehicles may affect and would likely adversely affect Steller sea lions through non-lethal incidental take[1]. The biological opinion concluded that this take was not likely to jeopardize the

[1] "Take" is defined by the ESA as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" 16 U.S.C. 1532 (19). NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Application and Interpretation of the Term "Harass" Pursuant to the Endangered Species Act: NMFS Guidance Memo May 2, 2016). NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering.

continued existence of the species and required monitoring of pinnipeds quarterly and during launches (NMFS 2011).

In 2017, the Alaska Aerospace Corporation (AAC) applied for a new 5-year programmatic permit under the MMPA for minimal takes of marine mammals incidental to launching of space launch vehicles and missiles at the PSCA (AAC 2016). In their application, AAC concluded that ongoing space and missile launch activities at the PSCA would not affect ESA-listed marine species in the action area (i.e., Steller sea lions, gray whales, and humpback whales) (AAC 2016). When NMFS issued regulations (valid May 2017 through April 2022) allowing for the issuance of Letters of Authorization under the. MMPA for the incidental take of harbor seals during launch operations at the PSCA (82 FR 14996 [24 March 2017]), NMFS determined that proposed activities would not affect Steller sea lions (or any other ESA-listed species) and that no consultation was required under the ESA.

On March 2, 2017 the US Navy SSP consulted with NMFS on the effects of a near identical operation to the proposed action, the Flight Experiment 1 (FE-1). NMFS concluded in a biological opinion dated May 12, 2017 that the FE-1 would not jeopardize 59 marine ESA/UES consultation species (PIR-2017-10125; I-PI-17-1504-AG).

On September 27, 2019 NMFS issued a Biological Opinion for FE-2 activities (NMFS 2019) (PIRO-2019-02607; I-PI-19-1782-AG). In this biological opinion, NMFS concluded that the FE-2 action was not likely to adversely affect 54 marine ESA/UES consultation species and would have no effect on critical habitats designated under the ESA and/or the UES at Kwajalein Atoll. NMFS determined that exposure to FE-2 payload debris or impact ejecta was likely to adversely affect 11 UES consultation species in reef habitats near Illeginni Islet. Furthermore, NMFS determined that the FE-2 test was not likely to jeopardize the continued existence of any of these species.

On July 23, 2020 NMFS held a pre-consultation/technical assistance and coordination meeting with USASMDC and KFS, LLC. During this meeting, USASMDC and KFS (supporting company), LLC personnel met with NMFS Pacific Islands Regional Office (PIRO) staff to provide NMFS with information regarding the proposed FT-3 project and to discuss a desired consultation plan for the proposed action. NMFS PIRO personnel requested that PIRO conduct consultation for all portions of the proposed action and that PIRO would be responsible for coordination with the Alaska Regional Office where necessary. During this coordination meeting, parties discussed using the Flight Experiment–2 (FE-2) Biological Assessment (U.S. Navy 2019) for baseline conditions in the Kwajalein Atoll portion of the action area.

On September 24, 2020 NMFS received from RCCTO and USASMDC this consultation request in a letter dated September 22, 2020 stating that they had determined that the FT-3 program (the proposed action) may affect, but is not likely to adversely affect 38 marine ESA and/or UES consultation species and stellar sea lion critical habitat, and requested consultation for those species.

On October 20, 2020 NMFS sent David Fuller (action agency contact) an email informing the U.S. Army that NMFS will be moving forward with formal consultation.

On October 22, NMFS sent David Fuller an email requesting clarification on the RCCTO/USASMDC species determinations.

On October 29, 2020 the RCCTO/USASMDC and KFS, LLC personnel conducted a call with NMFS to discuss the proposed action and NMFS' reasoning for moving forward with a Biological Opinion.

On November 4, 2020 we received an email from the RCCTO/USASMDC with an updated consultation request letter with modifications clarifying the species determinations, and stating that they had determined that the FT-3 program (the proposed action) may affect 46 marine ESA and/or UES consultation species (Table 1 and Table 2), and requested consultation for those species.

In the BA, RCCTO/USASMDC further determined that the proposed action was not likely to adversely affect (NLAA) 35 consultation species (Table 1), and likely to adversely affect (LAA) the 11 marine UES consultation species listed in Table 2. Formal consultation was initiated on November 4, 2020.

Table 1. Marine consultation species not likely to be adversely affected by the proposed action

Scientific Name	Species	ESA	MMPA	CITES	RMI
Sea Turtles					
Caretta caretta	North Pacific Loggerhead Sea Turtle Distinct Population Segment (DPS)	Endangered		X	X
Chelonia mydas	Central Western Pacific Green Sea Turtle DPS	Endangered		X	X
Dermochelys coriacea	Leatherback Sea Turtle	Endangered		X	X
Eretmochelys imbricata	Hawksbill Sea Turtle	Endangered		X	X
Marine Mamnmals					
Eumetopias jubatus	Western Steller Sea Lion DPS	Endangered	X		
Balaenoptera borealis	Sei Whale	Endangered	X	X	
B. musculus	Blue Whale	Endangered	X	X	X
B. physalus	Fin Whale	Endangered	X	X	
Delphinus delphis	Short-beaked common Dolphin				X
Feresa attenuata	Pygmy Killer Whale		X		
Globicephala macrorhynchus	Short-finned Pilot Whale		X		
Grampus griseus	Risso's Dolphin		X		
Kogia breviceps	Pygmy Sperm Whale			X	
Megaptera novaeangliae	Mexico and Western North Pacific Humpback Whale DPSs	Endangered	X	X	
Mesoplodon densirostris	Blainville's Beaked Whale		X		
Orcinus orca	Killer Whale		X		
Peponocephala electra	Melon-Headed Whale		X		
Physeter macrocephalus	Sperm Whale	Endangered	X	X	X

Scientific Name	Species	ESA	MMPA	CITES	RMI
Eschrichtius robustus	Western North Pacific Gray Whale DPS	Endangered	X	X	
Eubalaena japonica	North Pacific Right Whale	Endangered	X	X	
Stenella attenuata	Spotted Dolphin				X
S. coeruleoalba	Striped Dolphin				X
S. longirostris	Spinner Dolphin		X		X
Tursiops truncatus	Bottlenose Dolphin, Pacific		X		
Fish					
Alopias superciliosus	Bigeye Thresher Shark				X
Manta alfredi	Reef manta ray				X
M. birostris	Giant manta ray				
Sphyrna lewini	Scalloped Hammerhead Shark	Threatened			X
Thunnus orientalis	Pacific bluefin tuna				X
Carcharhinus longimanus	Oceanic white-tip shark	Threatened			
Oncorhynchus keta	Hood Canal Summer-run Chum Salmon Evolutionary Significant Unit (ESU)/DPS	Threatened			
Oncorhynchus kisutch	Lower Columbia River Coho Salmon ESU/DPS	Threatened			
Oncorhynchus mykiss	Lower Columbia River, Middle Columbia River, Snake River Basin, Upper Columbia River, and Upper Willamette River Steelhead ESUs/DPSs	Threatened			
Oncorhynchus nerka	Snake River Sockeye Salmon ESU/DPS	Endangered			
Oncorhynchus tshawytscha	Lower Columbia River, Puget Sound, Snake River Fall, Snake River Spring/Summer, Upper Columbia River Spring, and Upper Willamette River Chinook Salmon ESUs/DPSs	Threatened; Upper Columbia River Spring ESU/DPS Endangered			

Table 2. Marine consultation species likely to be adversely affected by the proposed action

Scientific Name	Species	ESA	MMPA	CITES	RMI
Fish					
Cheilinus undulatus	Humphead Wrasse			X	X
Corals					
A. microclados	No Common Name			X	X
A. polystoma	No Common Name			X	X
Cyphastrea agassizi	No Common Name			X	X
Heliopora coerulea	No Common Name			X	X
Pavona venosa	No Common Name			X	X
Turbinaria reniformis	No Common Name			X	X
Pocillopora meandrina	Cauliflower Coral				X
Mollusks					
Tectus niloticus	Top Shell Snail				X
Hippopus hippopus	Giant clam	Candidate			
Tridacna squamosa	Giant clam	Candidate			X

Furthermore, the U.S. Army has determined that the proposed action would have no effect on North Pacific right whale (*Eubalaena japonica*) or Hawaiian monk seal (*Neomonachus schauinslandi*) critical habitat, and is not likely to adversely affect Steller sea lion (*Eumetopias jubatus*) critical habitat.

The U.S. Army has determined that the proposed action would have no effect on 15 coral species (*Acanthastrea brevis, Acropora aculeus, A. aspera, A. dendrum, A. listeri, A. speciosa, A. tenella, A. vaughani, Alveopora verrilliana, Leptoseris incrustans, Montipora caliculata, Pavona diffluens, P. decussata, Turbinaria mesenterina, and T. stellulata*), two mollusk species (*Pinctada margaritifera and Tridacna gigas*), olive ridley sea turtles (*Lepidochelys olivacea*), or the North Pacific DPS of green turtles (*Chelonia mydas*).

On January 4th, 2021, NMFS sent the Action Agency a request to change the species determination for the humphead wrasse from NLAA to LAA. The Action Agency responded on January 7th, 2021, confirming their agreement to this change.

2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is described in detail in the RCCTO/USASMDC BA. The proposed FT-3 is designed to test a long-range, global strike capable technology. The purpose of the proposed action is to gain progress on testing, modeling, and to collect data on simulating developmental payload systems and to advance technologies necessary to establish operational strike capabilities. Specifically, the FT-3 experiment would develop, integrate, and flight test this longer-range payload system to demonstrate the maturity of key technologies. These technologies include precision navigation, guidance and control, and enabling capabilities, and data collected would be utilized to improve the models that predict the performance of the system. The developmental payload would be launched from the Pacific Spaceport Complex Alaska (PSCA) and would travel across a broad ocean area (BOA) of the Pacific Ocean, and payload impact at Ronald Reagan Ballistic Missile Defense Test Site (RTS) at Illeginni Islet, RMI.

The proposed action consists of pre-flight preparations in the BOA and at USAKA, the FT-3 flight test across the BOA with three motor splash downs, payload impact, and post-flight impact data collection, debris recovery, and clean-up operations at USAKA. The U.S. Army RCCTO proposes to conduct the one hypersonic flight test within the second half of fiscal year 2021. The following subsections include descriptions of the launch vehicle, pre-flight operations, flight, terminal phase operations, and post-flight operations.

Launch Vehicle Description

The FT-3 launch vehicle would consist of a 3-stage booster system (Table 3) and payload. Table 3 shows the FT-3 vehicle component characteristics. The first stage motor is 4.7 meters (m) (15.5 feet [ft]) long with a diameter of 74 inches (in) (188 centimeters [cm]). The second stage motor is 9.2 m (30 ft) long with a diameter of 50 in (130 cm) and the third stage motor is 3.1 m (10 ft) long with a diameter of 50 in (130 cm). The amount of solid propellant in the three boosters of the vehicle totals approximately 36,495 kilograms (kg; 80,461 pounds [lbs]).

Table 3. FT-3 Vehicle Component Characteristics. (Sources: MDA 2007, MDA 2019a, MDA 2019b)

Component	Type	Diameter	Approximate Length	Propellant Type and Mass
Payload	Sandia National Laboratories	Unknown	Unknown	N/A
Stage 3 Booster	Orion 50 XLT	130 cm (50 inches)	3.1 m (10 ft)	Solid 3,915 kg (8,632 lb)
Stage 2 Booster	Orion 50S XLT	130 cm (50 inches)	9.2 m (30 ft)	Solid 15,037 kg (33,152 lb)
Stage 1 Booster	C4	188 cm (74 inches)	4.7 m (15.5 ft)	Solid 17,543 kg (38,677 lb)

Table 4 details the launch vehicle and payload system characteristics. The FT-3 payload would weigh approximately 350 kilograms (kg) (750 pounds [lb]) and would be similar to the recently tested FE-2 payload (U.S. Navy 2019), except that the payload would contain approximately 10% of the tungsten contained on the FE-2 payload (which was 454 kg, or 1,000 lbs).

Table 4. Launch Vehicle and Payload Characteristics. (Sources: USASMDC/ARSTRAT 2014, U.S. Army 2020)

	Launch Vehicle	**Payload**
Major Components and Structure	Rocket motors, propellant, magnesium thorium (booster interstage), nitrogen gas, halon, asbestos, battery electrolytes (lithium-ion, silver zinc)	Aluminum, titanium, steel, tantalum, tungsten, carbon, silica, Teflon®, and alloys containing chromium, magnesium, and nickel
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency pulse	Various 5- to 20-watt (radio frequency) transmitters
Power	Rechargeable lithium batteries	Lithium-ion batteries
Other	Small Class C (1.4) electro-explosive devices	Mechanical and flight termination Systems: initiators and explosive charges

Pre-flight Preparations: PSCA, United States Army Garrison- Kwajalein Atoll (USAG-KA), RTS, and various other support facilities would participate in routine pre-flight support operations related to the proposed action. Support operations for the FT-3 proposed action would include base support, range safety, flight test support, and test instrumentation, at a minimum. *Pre-flight activities at these additional locations are covered under existing NEPA documentation and/or ESA Section 7 consultations (such as the FE-2 test) for their ongoing activities.*

Pre-flight preparation activities would also occur on land at Illeginni Islet as well as in Kwajalein Atoll waters. Pre-flight activities would include several vessel round-trips and helicopter trips to Illeginni Islet for personnel and equipment transport. It is anticipated that, similar to other flight tests with payload impact at Illeginni Islet, there would be increased human activity on Illeginni Islet over a 3-month period (U.S. Army 2020). Heavy equipment, such as a backhoe or loader, may be used for placement of test equipment on Illeginni Islet and would be transported to the islet by barge or landing craft.

Launch: The FT-3 missile will be launched from land at PSCA and enter an over-ocean flight phase within seconds after the launch. The PSCA was developed/is operated by the Alaska Aerospace Corporation (AAC) on Kodiak Island, Alaska, where it supports the launch of rockets and satellites for commercial and Government aerospace interests. For the purposes of this consultation, the U.S. Army RCCTO and USASMDC have concluded that all launch activities at PSCA are covered under existing programmatic consultations for ongoing space and missile launch activities at PSCA, and that no further consultation is needed for launch activities portion of this proposed action (see Consultation History). Therefore, effects of the launch will not be covered under or discussed further in this consultation.

Over-Ocean Flight: After launching, a series of ground, sea, and/or air based sensors would monitor the FT-3 vehicle during flight and collect data on vehicle flight and system performance. Following motor ignition and liftoff from the launch location, the vehicle booster stages would burn out sequentially and drop into the North Pacific Ocean during the test flight. The first-stage motor would burn out, separate from the second stage, and drop in U.S. territorial waters off

Kodiak Island (Figure 2). Farther into flight over the BOA, the second-stage would burn out, separate, and splash down in the North Pacific Ocean. Jettison of the fairing and payload separation from the fairing would occur inside the atmosphere. Splashdown of all three spent motor stages and the fairing would occur at different points in the open ocean. Figure 1 depicts the drop zones for the rocket motors. After stage 3 motor burn-out and separation, the payload would continue flight over the Pacific Ocean toward Kwajalein Atoll while the stage 3 booster would splash down in the North Pacific Ocean.

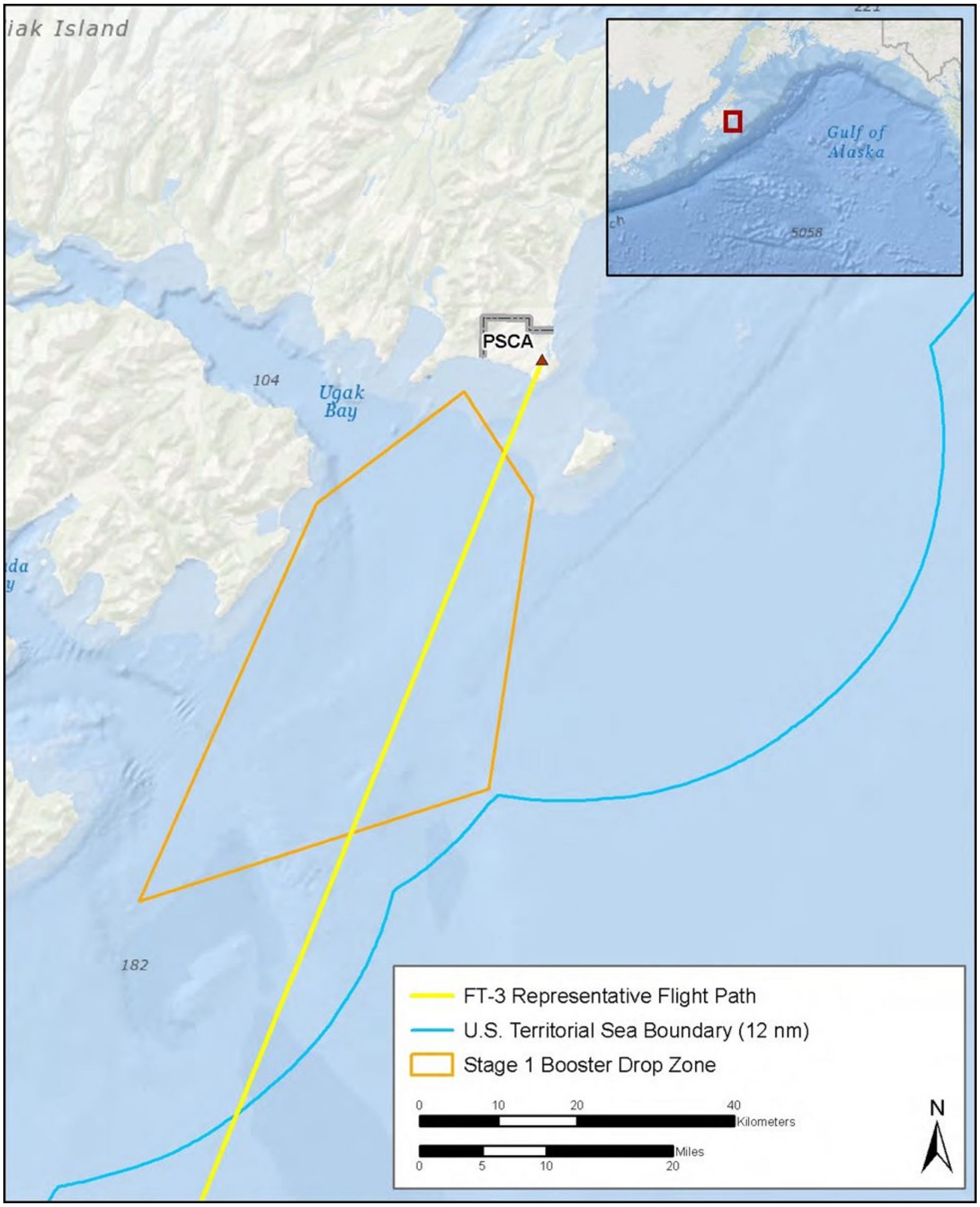

Figure 2. FT-3 Representative Flight Path and Stage 1 Booster Drop Zone.

If the launch vehicle were to deviate from its course or should other problems occur during flight that might jeopardize public safety, the onboard flight termination system would be activated. This action would initiate a predetermined safe mode for the vehicle, causing it to terminate flight and fall into the ocean. Computer-monitored destruct lines are pre-programmed into the flight safety software to avoid any debris falling on inhabited areas, and no termination debris would be expected to fall on land. Similarly, if data from the payload onboard sensors indicated that there was not sufficient energy to reach the target area, payload flight would be terminated, and the payload would fall along a ballistic trajectory into the BOA. The need for flight termination is unplanned and would be an unexpected and unlikely event.

The terminal end of the payload flight would be at Kwajalein Atoll in the RMI with payload impact at Illeginni Islet (Figure 3). The payload impact zone on Illeginni Islet is an area approximately 137 m (450 ft) by 290 m (950 ft) on the non-forested, northwest end of the islet. A reef or shallow water impact is not part of the proposed action, would be unintentional, and is considered very unlikely to occur. A crater would form as a result of payload impact and natural substrate (coral rubble) would be ejected around the rim of the crater. Information concerning the vehicle's energy release on impact is unknown. However, it is expected that cratering as a result of FT-3 payload impact would be similar cratering for previous test program impacts on Illeginni Islet. The proposed action has the potential to result in elevated noise levels near Illeginni Islet due to sonic booms from payload approach and payload impact.

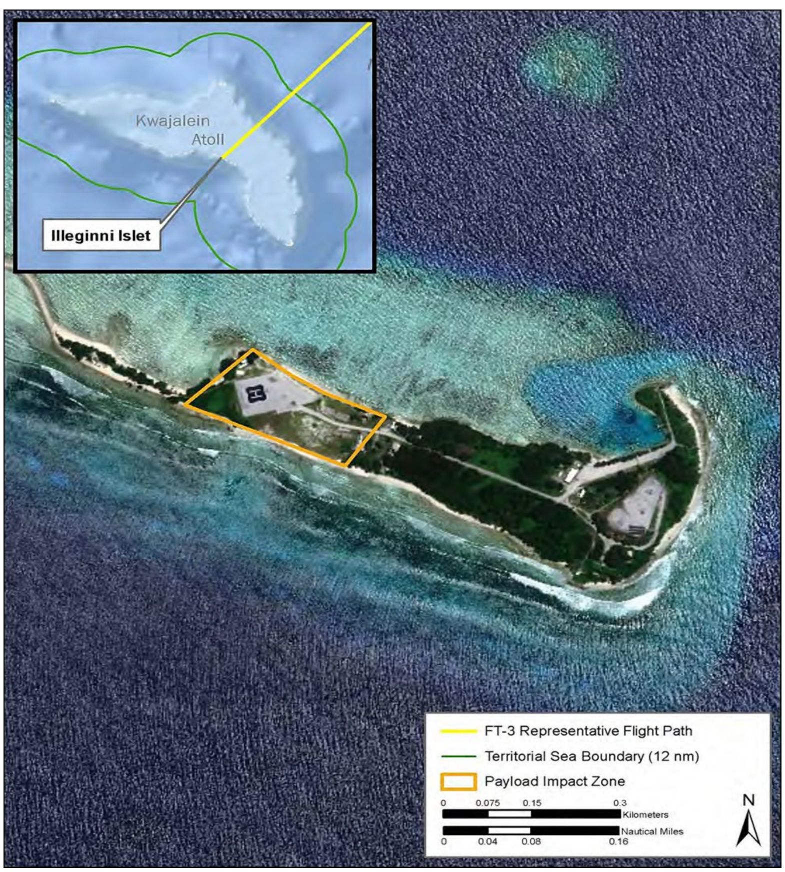

Figure 3. Representative Flight Path and Payload Impact Location, Illeginni Islet, Kwajalein Atoll, Republic of the Marshall Islands.

Sensor Coverage in the BOA:
The flight path would initiate from PSCA, travel across the BOA, and continue to USAKA in the RMI. A series of ground, sea, and/or air based sensors would monitor the FT-3 vehicle during flight and collect data on vehicle flight and system performance. All of these sensors are used for existing programs and would be scheduled for use based on availability. Ground based optics, telemetry, and radars at PSCA and USAG-KA may be used as well as several sea-based sensors (including the Range Safety System onboard the U.S. Motor Vessel Pacific Collector, the Kwajalein Mobile Range Safety System, and the Pacific Tracker). However, all of these sensors are used for existing programs and effects of their operation have been analyzed for those programs.

Sensor Coverage at USAKA:
Several self-stationing raft-borne sensors may be deployed and recovered on both the ocean and lagoon sides of Illeginni Islet to collect data on payload descent and impact. These rafts would be very similar used for the FE-2 flight, however the number of rafts is not specified for this test (Figure 4). Within a day of the flight test, one or two vessels would be used to deploy the rafts. These rafts would be equipped with battery-powered electric motors for propulsion to maintain position in the water. Two types of rafts would be used, hydrophone rafts and camera/radar rafts. Hydrophone rafts are equipped with hydrophones that are deployed off the back of the raft and hang in the water at a depth of approximately 3.7 m (12 ft). Camera rafts are equipped with stabilized cameras and/or radar as well as hydrophones as described above. Before the flight test, one or two landing craft utility vessels would be used to deploy the rafts. Rafts would be deployed in waters at least 4 m (13 ft) deep to avoid contact with the substrate and/or coral colonies (pers. comm. via email between Biologist Shelby Creager and David Fuller [U.S. Army], December 21, 2020).

Figure 4. Notional Locations of the LIDSS Rafts.

Post-flight Operations:

Post flight operations would include personnel recovering FT-3 post-flight debris from land either manually or with heavy equipment similar to that used during site preparation. While the U.S. Army RCCTO and USASMDC do not expect debris to reach the ocean, if any FT-3 debris is present in the shallow waters (less than 55 m [180 ft] deep) near Illeginni Islet, it would be removed where reasonably possible without impacting listed species or habitats such as reef. The impact crater would be excavated using a backhoe or front-end loader and the excavated material would be screened to recover debris. The crater would then be backfilled with the excavated material and substrate which was ejected during crater formation. USAG-KA and RTS personnel are usually involved in these operations. In preparation for the test, USASMDC would prepare a post-test recovery/cleanup plan detailing specific actions which would be taken, including the Mitigation Measures/Best Management Practices (BMPs) listed below, to avoid impacts to listed species. All waste materials would be appropriately stored and returned to Kwajalein Islet for proper disposal.

If an inadvertent impact occurs on the reef, reef flat, or in shallow waters less than 3 m (10 ft) deep, an inspection by project personnel would occur within 24 hours. Representatives from NMFS and the USFWS would also be invited to inspect the site as soon as practical after the test. The inspectors would assess any damage to coral and other natural and biological resources and, in coordination with USASMDC, USAG-KA, and RTS representatives, decide on any response measures that may be required. Payload recovery/cleanup operations and removal of surface floating debris in the lagoon and ocean reef flats, within 152 to 300 m (500 to 1,000 ft) of the shoreline, would be conducted similarly to land operations when tide conditions and water depth permit. In the event of an unintentional shallow water impact, visible debris would be removed as feasible and while protecting sensitive shallow-water resources.

Mitigation Measures/Best Management Practices (BMPs):

- During travel to and from impact zones, including Illeginni Islet, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and or lighting and turbidity conditions.
- Any observation of marine mammals or sea turtles during ship travel or overflights would be reported to the USAG-KA Environmental Engineer.
- Vessel and equipment operations would not involve any intentional discharges of fuel, toxic wastes, or plastics and other solid wastes that could harm terrestrial or marine life.
- Hazardous materials would be handled in adherence to the hazardous materials and waste management systems of USAG-KA.
- Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport and would not intentionally discharge fuels or waste materials into terrestrial or marine environments.
- All equipment and packages shipped to USAKA will undergo inspection prior to shipment to prevent the introduction of alien species into Kwajalein Atoll.
- Pre-flight monitoring by qualified personnel will be conducted on Illeginni Islet for sea turtles or sea turtle nests. For at least 8 weeks preceding the FT-3 launch, Illeginni Islet would be surveyed by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests. If possible, personnel will inspect the area within days of the launch. If sea

turtles or sea turtle nests are observed near the impact area, observations would be reported to appropriate test and USAG-KA personnel for consideration in approval of the launch and to NMFS.

- Personnel will report any observations of sea turtles or sea turtle nests on Illeginni to appropriate test and USAG-KA personnel to provide to NMFS.
- To avoid impacts on coral heads in waters near Illeginni Islet, sensor rafts would not be located in waters less than 4 m (13 ft) deep.
- When feasible, within one day after the land impact test at Illeginni Islet, USAG-KA environmental staff would survey the islet and the near-shore waters for any injured wildlife, damaged coral, or damage to sensitive habitats. Any impacts to biological resources would be reported to the Appropriate Agencies, with USFWS and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.
- Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel would be reported to the USAG-KA Environmental Office and SMDC, who would then inform NMFS and USFWS. USAG-KA aircraft pilots otherwise flying in the vicinity of the impact and test support areas would also similarly report any opportunistic sightings of dead or injured marine mammals or sea turtles.
- For recovery and rehabilitation of any injured migratory birds or sea turtles found at Illeginni Islet, USFWS and NMFS would be notified to advise on best care practices and qualified biologists would be allowed to assist in recovering and rehabilitating any injured sea turtles found.
- If an inadvertent impact occurs on the reef, reef flat, or in shallow waters less than 3 m (10 ft) deep, an inspection by project personnel would occur within 24 hours. Representatives from the NMFS and USFWS would also be invited to inspect the site as soon as practical after the test. The inspectors would assess any damage to coral and other natural and biological resources and, in coordination with SSP, USAG-KA and RTS representatives, decide on any response measures that may be required.
- Debris recovery and site cleanup would be performed for land or shallow water impacts. To minimize long-term risks to marine life, all visible project-related debris would be recovered during post-flight operations, including debris in shallow lagoon or ocean waters by range divers. In all cases, recovery and cleanup would be conducted in a manner to minimize further impacts on biological resources.
- At Illeginni Islet, should any missile components or debris impact areas of sensitive biological resources (i.e., sea turtle nesting habitat or coral reef), a USFWS or NMFS biologist would be allowed to provide guidance and/or assistance in recovery operations to minimize impacts on such resources. To the greatest extent practicable, when moving or operating heavy equipment on the reef during post-test clean up, protected marine species including invertebrates will be avoided or effects to them will be minimized. This may include movement of these organisms out of the area likely to be affected.
- During post-test recovery and cleanup, should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species were out of harm’s way or leave the area.

2.1 Interrelated/Interdependent Actions

Military training and testing at Kwajalein Atoll has been ongoing since World War II. Testing of missile programs at Kwajalein began in 1959 for the Nike Zeus missile program. The

Minuteman (MM) I program began in 1962, MMII began in 1965, and MMIII began in 1970. In addition to the MM program, anti-ballistic missile (ex. THAAD), and other missile development and testing take place at the RTS, along with other military training and testing activities, and commercial missile launches. If it were not for these numerous activities, it is doubtful that the facilities at USAKA and RTS would be required. Therefore, actions to develop and maintain USAKA and RTS facilities and infrastructure, and to support the various missions, are interrelated and/or interdependent with the training and testing activities that occur at the USAKA and RTS. However, much of the infrastructure and facilities are designed to support numerous programs and missions, with few being project-specific. Therefore, support activities that are solely attributable to the FT-3 program constitute a small portion of the total that occur at USAKA and RTS in support of the site's numerous missions. Further, per the Document of Environmental Protection (DEP) procedures outlined in the UES, any USAKA and RTS actions that may affect the USAKA environment require structured environmental review, with coordination and/or consultation as appropriate. Based on this, we expect that interrelated or interdependent actions that may be solely attributable to the FT-3 flight would be virtually inseparable from the routine activities at USAKA and RTS, and any impacts those actions may have would be considered through the DEP procedures outlined in the UES.

2.2 Action Area

As described above, the action area for this consultation begins after the launch immediately offshore from PSCA, Kodiak Island, Alaska, where the sonic boom of the accelerating missiles would reach the ocean surface. The PSCA was developed and is operated by the Alaska Aerospace Corporation (AAC) on Kodiak Island, Alaska. It supports the launch of rockets and satellites for commercial and Government aerospace interests. PSCA is located on State of Alaska land and is under an operating permit issued by the Federal Aviation Administration (FAA).

The action area then extends from there, across the Pacific Ocean along a relatively narrow band of ocean area directly under the flight path of the missile, where the sonic boom and spent missile components are expected to impact the surface (Figure 1). The flight path includes flight over the Northwest Hawaiian Islands including the waters of the U.S. exclusive economic zone (EEZ) there. However, FT-3 flight would occur at a high altitude over the BOA and no debris would enter U.S. territory or EEZ waters near the Hawaiian Islands. The action area also includes the area of and around Kwajalein Atoll, RMI where the payload would impact the target areas (Figure 3), as well as the areas immediately around support vessels and sensor rafts used to monitor the payload impacts, and the down-current extent of any plumes that may result from discharges of wastes or toxic chemicals such as fuels and/or lubricants associated with the machinery used for this activity.

The launch portion of this action is located within Steller sea lion (Western DPS) critical habitat.

3 SPECIES AND CRITICAL HABITATS NOT LIKELY TO BE ADVERSELY AFFECTED

As explained above in Section 1, RCCTO/USASMDC determined that the proposed action was not likely to adversely affect (NLAA) the 36 consultation species listed in Table 1. The proposed action would also have no effect on North Pacific right whale or Hawaiian monk seal critical habitat, and is not likely to adversely affect Steller sea lion critical habitat. This section serves as our concurrence under Section 7 of the ESA of 1973, as amended (16 U.S.C. §1531 et seq.), and under section 3-4.5.3(d) of the UES, 15th Edition, with RCCTO/USASMDC's determination.

The UES does not specifically define the procedure to make a NLAA determination. However, the Compact clearly intends that the UES provide substantially similar environmental protections as the ESA. We interpret this to include adoption of the ESA NLAA determination process. In order to determine that a proposed action is not likely to adversely affect listed species, under the ESA, we must find that the effects of the proposed action are expected to be insignificant, discountable[2], or beneficial as defined in the joint FWS-NMFS Endangered Species Consultation Handbook. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs; discountable effects are those that are extremely unlikely to occur; and beneficial effects are positive effects without any adverse effects (USFWS and NMFS 1998). As described in Section 2, test flights have three distinct phases: Launch; Over-Ocean Flight; and Terminal Flight and Impact in the RMI. Each phase has potential stressors, listed below, that are based on what the missile is doing, and on activities done to support the test. As discussed earlier, effects from launch activities associated with the proposed action are covered under an existing Programmatic and will not be discussed further in this consultation.

<u>Over-Ocean Flight</u>: The potential stressors during over-ocean flight are:

a. Exposure to elevated noise levels;
b. Impact by falling missile components; and
c. Exposure to hazardous materials.

<u>Terminal Flight and Reentry Vehicle Impact in the RMI</u>: The potential stressors during terminal flight, payload impact, and preparation and restoration work at Kwajalein Atoll are:

a. Exposure to elevated noise levels;
b. Impact by falling missile components;
c. Exposure to hazardous materials;
d. Disturbance from human activity and equipment operation; and
e. Collision with vessels.

NMFS has determined an additional stressor from this proposed action:

a. Long-term addition of man-made objects to the ocean.

Each of these stressors are addressed below to determine whether or not individuals of any of the ESA-listed and UES-protected marine species considered in this consultation are likely to be adversely affected by that stressor. The species that may be exposed to stressors during each phase, and their likely response to exposure are based on the biological and/or ecological characteristics of each species. Any incidence where a stressor has more than a discountable risk of causing an adverse effect on any individual of the ESA- and/or UES-protected species will result in that stressor and those species being considered in the following biological opinion.

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[2] When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with the ESA regulatory definition of "effects of the action."

Each stressor will have the exact same effects to species as described in the FE-2 program, with the exception of the differences listed below:

- Sound pressure levels at BOA/Alaska: no splashdown model was conducted for the FT-3, and therefore the FE-2 max will be used as a surrogate.
- Exposure to hazardous material at BOA/Alaska; same materials as FE-2 with the exception of larger quantities of propellant before launch.
- Elevated sound pressure levels at Kwajalein: sound pressure of payload impact expected to be less than 140 dB in-air at 18 m (59 ft) from impact. In-water sound pressures expected to be less than 166 dB.
- Exposure to hazardous material: there could be an introduction of up to 45 kg (100 lbs) of tungsten into terrestrial habitats.

a. <u>Exposure to elevated noise levels</u>: While in flight between PSCA and Kwajalein Atoll, the missile and the payload would travel at velocities that cause sonic booms. High-intensity in-water noise would be created when large missile components, such as spent rocket motors, impact the ocean's surface (splash-down). The impact from the payload hitting the ground will also create a sound to land that could transfer to water causing impulsive sound sources. High intensity impulsive noises can adversely affect marine life. The RCCTO/USASMDC will also create sounds from vessels and human activity in and near water during placement and retrieval of sensors and other data collecting instruments, and retrieval of debris from the impact. Effects vary with the frequency, intensity, and duration of the sound source, and the body structure and hearing characteristics of the affected animal. Effects may include: non-auditory physical injury; temporary or permanent hearing damage expressed as temporary threshold shift (TTS) and permanent threshold shift (PTS) respectively; and behavioral impacts such as temporarily masked communications or acoustic environmental cues and modified behaviors.

Sound is a mechanical disturbance consisting of minute vibrations that travel through a medium, such as air, ground, or water, and is generally characterized by several variables. Frequency describes the sound's pitch and is measured in hertz (Hz) or cycles per second. Sound level describes the sound's loudness. Loudness can be measured and quantified in several ways, but the logarithmic decibel (dB) is the most commonly used unit of measure, and sound pressure level (SPL) is a common and convenient term used to describe intensity. Sound exposure level (SEL) is a term that is used to describe the amount of sound energy a receiver is exposed to over time. The dB scale is exponential. For example, 10 dB yields a sound level 10 times more intense than 1 dB, while a 20 dB level equates to 100 times more intense, and a 30 dB level is 1,000 times more intense. Sound levels are compared to a reference sound pressure, based on the medium, and the unit of measure is the micro-Pascal (μPa). In water, sound pressure is typically referenced to a baseline of 1 μPa (re 1 μPa), vice the 20 μPa baseline used for in-air measurements. As a rule of thumb, 26 dB must be added to an in-air measurement to convert to an appropriate in-water value for an identical acoustic source (Bradley and Stern 2008). Root mean square (RMS) is the quadratic mean sound pressure over the duration of a single impulse. RMS is used to account for both positive and negative values so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units rather than by peak pressures. For brevity, all further references to sound level assume dBRMS re 1 μPa, unless specified differently.

Transmission loss (attenuation of sound intensity over distance) varies according to several factors in water, such as water depth, bottom type, sea surface condition, salinity, and the amount of suspended solids in the water. Sound energy dissipates through mechanisms such as spreading, scattering, and absorption (Bradley and Stern 2008). Spreading refers to the apparent decrease in sound energy at any given point on the wave front because the sound energy is spread across an increasing area as the wave front radiates outward from the source. In unbounded homogenous water, sound spreads out spherically, losing as much as 7 dB with each doubling of range. Toward the other end of the spectrum, sound may expand cylindrically when vertically bounded such as by the surface and substrate, losing only about 3 dB with each doubling of range. Scattering refers to the sound energy that leaves the wave front when it “bounces” off of an irregular surface or particles in the water. Absorption refers to the energy that is lost through conversion to heat due to friction. Irregular substrates, rough surface waters, and particulates and bubbles in the water column increase scattering and absorption loss. Shallow nearshore water around Illeginni where the payload may impact, is vertically bounded by the seafloor and the surface, but is considered a poor environment for acoustic propagation because sound dissipates rapidly due to intense scattering and absorption. The unbounded deep open ocean waters where the motors would impact is considered a good acoustic environment where spherical spreading would predominate in the near field.

In the absence of location-specific transmission loss data, equations such as RL = SL – #Log(R) (RL = received level (dB); SL = source level (dB); # = spreading coefficient; and R = range in meters (m)) are used to estimate RL at a given range (isopleth). Spherical spreading loss is estimated with spreading coefficient of 20, while cylindrical spreading loss is estimated with spreading coefficient of 10. Spreading loss in near shore waters is typically somewhere between the two, with absorption and scattering increasing the loss. $RL = SL - 20_{Log}(R)$ was used here to estimate ranges in deep open ocean water, and $RL = SL - 15_{Log}(R)$ was used to estimate ranges in the lagoon and reef flat areas around Illeginni.

The sound pressures associated with non-auditory injury are very high and are generally associated with a shock wave that is generally not found in sounds that are created by a splashdown. The Navy identified a threshold for non-auditory injury based on gastrointestinal bursting at 237 dB re: 1 µPa (Finneran and Jenkins 2012). The sounds estimated from the splashdowns and sonic booms are clearly below those thresholds and are not likely to cause non-auditory injury to marine mammals, sea turtles, elasmobranchs, and large fishes.

Table 5. Estimated thresholds for TTS and behavioral changes for hearing groups. (Sources: Finneran and Jenkins 2012; Popper et al. 2014; NMFS 2016)

Hearing Group	**TTS peak pressure threshold (SPL_{peak})**	**Weighted TTS onset threshold (SEL_{CUM})**	**Estimated threshold for behavioral changes**
Low-frequency cetaceans (humpback whale and other baleen whales)	213 dB	179 dB	Continuous = 120 dB_{RMS} Non-continuous = 160 dB (re: 1 μPa)
Mid-frequency cetaceans (dolphins, pilot whales and other toothed whales)	224 dB	178 dB	Continuous = 120 dB_{RMS} Non-continuous = 160 dB (re: 1 μPa)
High-frequency cetaceans (Kogia, true porpoises)	196 dB	153 dB	Continuous = 120 dB_{RMS} Non-continuous = 160 dB (re: 1 μPa)
Phocid pinnipeds (Hawaiian monk seals and other true seals)	212 dB	181 dB	Continuous = 120 dB_{RMS} Non-continuous = 160 dB (re: 1 μPa)
Sea turtles	224 dB	200 dB	160 dB
Sharks, rays, and fish	229 dB*	186 dB*	150 dB

* - SPL for lethal and sublethal damage to fish with swim bladders exposed to not specific to hearing.

The threshold for the onset of behavioral disturbance for all marine mammals from a single exposure to impulsive in-water sounds is ≥ 160 dB. Ongoing research suggests that these thresholds are both conservative and simplistic (detailed in Southall et al. 2007 and NOAA 2013). The draft revised thresholds for marine mammals uses two metrics: 1) exposure to peak sound pressure levels (SPL_{peak}); and 2) exposure to accumulated sound exposure levels (SELcum). The thresholds for single exposures to impulsive in-water sounds are listed in Table 5 for the onset of injury and temporary hearing impacts (NMFS 2016). Corals and mollusks can react to exposure to intense sound and could be affected by concussive forces if exposed to very intense sound sources such as an underwater detonation.

Sonic booms

A sonic boom is a thunder-like noise caused by the shock wave generated by an object moving at supersonic speed. As objects travel through the air, the air molecules are pushed aside with great force and this forms a shock wave much like a boat creates a bow wave (Kahle et al. 2019). Exposure to sonic booms would have insignificant effects on any of the species considered in this consultation. The FT-3 vehicle may generate sonic booms from shortly after launch, along the flight path in the BOA, to impact at or near Illeginni. Sound attenuates with distance from the source due to spreading and other factors. The higher the missile climbs, the quieter the sonic boom would be at the Earth's surface. Similarly, the greater the distance either side of the centerline of the flight path, the quieter the sonic boom. Therefore, the sound intensity would be loudest directly below the missile when the component is closest to the surface. Additionally, Laney and Cavanagh (2000) report that sound waves arriving at the air/water interface at an angle less steep than 13.3º from of the vertical will not normally propagate into water. This means that within the footprint of the sonic boom, only those marine animals within 13.3º of directly below the source could be expected to hear the sonic boom. Sounds originating in air, even intense ones like sonic booms transfer poorly into water, and most of its energy would refract at the surface or absorb in waves or natural surface disturbance at the surface. Once in the water, the sounds of a sonic boom would attenuate with distance. For this project, Kahle et al. (2019) estimated sound transfer from air to water using a model absent all atmospheric variables that would increase refraction, absorption, and dissipation. Sonic booms are also an impulsive and non-continuous sound. It's a "one shot" sound that doesn't repeat, and therefore, we use the peak sound as opposed to SEL. The loudest sounds were assumed to be near launch (145 dB re: 1 μPa) and at impact site (175 dB). Considering the short (few seconds) duration of the exposure, as noted below, neither are loud or long enough to cause TTS in animals of any of the hearing groups.

Using a model absent most variables that would reduce spreading, (Navy 2017) predicted the sonic boom footprint of sounds ≥ 160 dB to cover at most a 20.9 square mile radius, and 130.5 square mile radius for sounds ≥ 150 dB. The duration of a sonic boom at any given point within the footprint would be about 0.27 seconds.

In summary, at its loudest (175 dB), an in-water sonic boom exceeds no thresholds for injury to any of the species considered in this consultation, and it is well below the new proposed threshold for the onset of temporary hearing impacts for all hearing groups. Large areas were estimated to be affected by sounds high enough to cause behavioral responses for turtles and fish. However, the models did not account for refraction at the surface, wind or other atmospheric factors like wind and moisture that would dissipate the spreading; it will actually be a much smaller area, as would the corresponding estimate of animals affected by the sonic boom. Those factors would also significantly reduce the intensity of the noise in the water column where most of the UES consultation species spend the majority of their time. Nonetheless, the RCCTO/USASMDC estimated that they could affect animals in those respective areas of effect if they were near the surface. All animals in the action area could be exposed to the sonic boom at the impact site for no more than 0.3 seconds. We believe that, at most, an exposed individual may experience temporary behavioral disturbance in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure. Therefore, the exposure is expected to have insignificant effects.

Exposure to splash-down noise caused by the impact of the falling components in the BOA would be discountable for any of the species considered in this consultation. Three spent rocket motors and a nose fairing will fall into the ocean during the flight. The motors are the only components of sufficient size and velocity to create significant noise levels on splash-down. The noise generated by the splash-down will be heard by every hearing group, some even up to a few miles away. The RCCTO/USASMDC predicted the impulsive noises created by the splash based on the size of the components, listed in Table 6, and are based on the levels from the FE-2 flight.

While the location for the elevated noise levels would be different than for the FE-2 action, the effects on ESA-listed species in the BOA are not expected to be different.

Table 6. Stage Impact Contact Areas and Peak Sound Pressure Levels for FT-3 Vehicle Components (Kahle et al. 2019)

Stage	**Contact Area m^2 (ft^2)**	**Peak Sound Pressure Level (dB re 1 µPa)**
Stage 1 Spent Motor	27.73 (81.12)	218
Stage 2 Spent Motor	10.17 (33.38)	205
Nose Fairing	16.81 (55.14)	196
Stage 3 Spent Motor	5.94 (19.5)	201

Of the three motors, the first stage is the largest and the one expected to make the most noise on impact; a brief (less than one second) impulse of 218 dB @ 1m (Kahle et al. 2019). All objects would fall into deep open ocean waters. The first would splash-down shortly after takeoff in U.S. territorial waters just off Kodiak Island. The remaining objects would splash-down in deep ocean waters and closer to the target site at Illeginni Islet. The marine mammals, sea turtles, and fish (with the exception of humphead wrasses) listed in Tables 1 and 2 may be affected by this stressor. Steller sea lions and their critical habitat (discussed below) may be affected by this stressor near the launch.

As sounds dissipate with distance, they get less intense and are less capable of producing injury and behavioral responses. Assuming spherical spreading, the range to the hearing groups' TTS isopleths around each splash-down are listed in Table 7. Since exposure to sounds that could cause TTS would be harmful, we evaluated the probability of an exposure to UES consultation species. The best information available to describe the abundance and distribution of open ocean species considered in this consultation, supports the understanding that these animals are widely scattered, and their densities are very low in the open ocean areas where the motors would splash-down. We know of no information to suggest that the splash-down zones are in areas of any significance that would cause any congregations of these species.

Because the area of influence for TTS is within feet of their impact with the surface, the splash-downs will create an acoustic area of effect little or no greater than that of direct contact. As such, the probability of exposure is the same as a direct contact. Based on the methodology in the FE-2 BA, FT-3 BA, and the best available density estimates for consultation species in the action area, the number of expected exposures to sound pressures greater than the TTS threshold was calculated and modeled. Even when summed across all components, the maximum number of exposures to noise levels above the TTS threshold for any ESA-listed marine mammal was estimated to be less than 0.000001 individuals. Their modeling suggests that the probability of exposing marine mammals to a TTS-level exposure for a test flight would be between 1 in 1 million chance for the most common and sensitive species (Hanser et al. 2013; Rone et al. 2017; U.S. Navy 2014; Wade et al. 2016). This is likely an overestimate, since those calculations did not include weighting factors used in our evaluations, which reduce the zone of influence. Density estimates are not available to ESA-listed fish in the action area but these species would have similarly low densities and corresponding exposure risk. Based on the low annual number of splash-downs, their wide spacing, their small area of effect (< 100 m), and the expected low densities of the consultation species in the affected areas, we believe that the risk of exposure to splash-down acoustic effects in the open ocean is discountable for all of the species considered in this consultation.

Table 7. Estimated distances from source noise to TTS thresholds

Hearing Group		Low-frequency cetaceans (humpback whale and other baleen whales)	Mid-frequency cetaceans (dolphins, pilot whales and other toothed whales)	High-frequency cetaceans (Kogia, true porpoises)	Phocid pinnipeds (Hawaiian monk seals and other true seals)	Sea turtles	Sharks, rays, and fish
TTS peak pressure threshold (SPLpeak)		213 dB	224 dB	196 dB	212 dB	224 dB	229 dB*
Isopleths to TTS threshold from:	**218 dB**	1.8 m (5.9 feet)	0 m	0.2 m (0.65 feet)	1 m (3.28 feet)	0 m	0 m
	205 dB	0.4 m	0 m	0 m	0.2 m	0 m	0 m
	201 dB	0 m	0 m	0 m	0 m	0 m	0 m
	196 dB	0 m	0 m	0 m	0 m	0 m	0 m

In each hearing group, the individuals affected would have to be within six feet of the source to experience TTS. The sounds produced by splashdowns will be louder or equal to the 160 dB behavior response thresholds for all hearing groups, up to ½ mile away from the source for some species, and some species should be able to detect sounds (below behavior thresholds) for a few more miles. The sounds will be a short impulse, which will dissipate within seconds of impact. We believe that, at most, an exposed individual may experience temporary behavioral disturbance in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure.

The RCCTO/USASMDC will use vessels of varying size to install and retrieve equipment in water to gather data and remove debris. Large vessels can create sounds ranging from 170-190 dB (re: 1 µPa). Smaller vessels like skiffs with outboards range from 150-170 dB. Vessels are generally moving and the sound sources are considered non-impulsive and mobile. Human activity in water during retrieval of instruments, debris, and ejecta are not louder than those sources. Air bubbles from SCUBA are among the higher noise sources considered, and were reported by Radford et al. (2005) with mean levels of 161 dB and mean peak levels of 177 dB at 1 meter. We consider this source a non-impulsive, mobile, intermittent noise source. Because of the mobile nature of vessels and the intermittent nature of SCUBA bubbles, animals of all hearing groups are not likely to be exposed to the source long enough or continuously enough to experience TTS from vessels and SCUBA air bubbles. Furthermore, behavioral disturbances are likely brief because the mobile and temporary nature of the sources, and the noises will likely have an immeasurable effect on an individual's behavior during and after exposure.

For payload impacts in the ocean south of Illeginni, sea turtles, scalloped hammerhead sharks, oceanic white tip sharks, bigeye thresher sharks, manta rays, and humphead wrasse along the outer edge of the fringing reef may be exposed to a brief pulse of sound from air or underground. The RCCTO/USASMDC recorded similar payload strikes at Illeginni that produced sounds at a level of 140 dB re: 20 µPa 18 m from the source. Using backtracking, the measurements corresponds to a source level of 165 dB, and loosely corresponds to underwater sounds at 191 dB. This is likely an overestimate, because the model did not account for sound refraction, absorption, and other dissipation which happens in natural environments. By the time the sound reaches water, it will likely be less than 191 dB. The sound at payload impact will be too low to cause TTS. At most, we expect that an exposed individual may experience a temporary behavioral disturbance, in the form of slight change in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure. Therefore, the exposure is expected to have insignificant effects. Being much less acoustically sensitive, any exposed corals or mollusks that may be on the outer reef edge are expected to be unaffected by payload impact noise. Based on the best available information, exposure to splash-down noise is expected to have insignificant effects for all species considered in this consultation.

<u>b. Impact by falling missile components</u>: For the reasons discussed below, it is discountable that any of the species considered in this consultation would be hit by falling missile components, or to be close enough to an impact site to be significantly affected by concussive forces. It is also discountable that any of the species identified in Table 1 would be hit by payload or ejecta, or be significantly affected by concussive forces during the single planned payload strike on Illeginni Islet. However, the payload strike on Illeginni Islet may adversely affect the species identified in Table 2. Therefore, the potential effects of this stressor on those species are considered below in the effects of the action section (Section 6).

Direct Contact

The proposed action will result in spent rocket motors and the nose fairing splashing down into the BOA as well as impact of the payload on land at Illeginni Islet. These falling components will directly contact aquatic and/or terrestrial habitats and have the potential to directly contact consultation species. Payload component contact with the land may result in cratering and ejecta radiating out from the point of impact.

On January 11, 2005, the FWS issued a no-jeopardy Opinion regarding effects on nesting green sea turtles at Illeginni Islet for the U.S. Air Force's (USAF) Minuteman III (MMIII) testing, another missile test operation which is conducted at the same Islet and target site. The FWS Opinion included an incidental take statement for the annual loss of no more than three green sea turtle nests, or injury or loss of up to 300 hatchlings, per year as a result of reentry vehicles impacts at Illeginni Islet. While direct estimates for cratering and ejecta field size are not available for the FT-3 proposed payload, cratering and ejecta are expected to be similar to previous flight tests conducted at Illeginni Islet and less than those of MMIII reentry vehicles (RVs). Therefore, MMII estimates of cratering and shock waves (USAFGSC and USASMDC/ARSTRAT 2015) are used as a maximum bounding case for this proposed action.

Three spent rocket motors, and various smaller/lighter missile components would fall into the ocean during the flight. To be struck by a missile component, an animal would have to be at, or very close to the surface, and directly under the component when it hits. RCCTO/USASMDC (2020) reports that the first stage motor is about 4.7 m long and 74 in in diameter. The second stage motor is 9.2 m long with a diameter of 50 in and the third stage motor is 3.1 m long with a diameter of 50 in. If a spent rocket motor or other FT-3 component were to strike a cetacean, sea turtle, or fish near the water surface, the animal would most likely be killed or injured.

Based on FE-2 estimates, direct contact areas for these individual components are listed in Table 8 and total approximately 61 m^2. The number of expected exposures to direct contact from falling vehicle components was also calculated based on the methodology in the FE-2 BA and the best available density estimates for consultation species in the action area (U.S. Navy 2019).

A probability of direct contact and total number of exposures by falling components in the BOA were calculated for each marine mammal species and for a sea turtle guild for each FT-3 component based on component characteristics and animal density in the Action Area (SSP 2019). The probability analysis is based on probability theory and modified Venn diagrams with rectangular "footprint" areas for the individual animals and the component impact footprints within the Action Area. Sea turtles were combined into a "sea turtle guild" for analyses due to the lack of species specific occurrence data (Hanser et al. 2013). This sea turtle guild is composed of primarily green and hawksbill turtles as they account for nearly all sightings; however, in theory, the guild also encompasses leatherback, olive ridley, and loggerhead turtles (Hanser et al. 2013; SSP 2017, 2019). These analyses assume that all animals would be at or near the surface 100 percent of the time and that the animals are stationary. While these assumptions do not account for animals that spend the majority of time underwater or for any animal movement or potential avoidance to proposed activities, these assumptions should lead to a conservative estimate of direct contact effect on listed species.

Their modeling suggests that the probability of exposing marine mammals to direct impact or injurious concussive force for a test flight would be 0.00008 individuals. This corresponds to a 1 in 12,900 chance of being exposed to direct contact for the highest density species (i.e., fin whales) in the action area. These estimates are based on conservative analysis assumptions including that all animals would be at or near the surface 100 percent of the time and that the animals are stationary; therefore, these are likely overestimates of exposure. Density estimates are not available for listed fish or sea turtles in the booster drop zones; however, these species would have similarly low densities and corresponding exposure risk. Based on that and the expectation that they would be well below the surface most of the time, we believe that the probability of their exposure to direct impact or injurious concussive force would be as low or lower than those described above. While larval stages of fish, corals, and mollusks may also be found in the BOA we believe that the densities are also relatively low and will also be at depths greater than where significant impacts are expected to occur and therefore the probability that any will be impacted is extremely low. The corals considered in this consultation are restricted to shallow nearshore waters well away from missile components falling into the ocean. Therefore, that stressor would have no effect on them. Based on the best available information, we believe that it is discountable that any of the species considered in this consultation would be exposed to missile components falling into the BOA.

Table 8. Estimated Marine Mammal Density and Number of Exposure to Elevated Sound Pressures and Direct Contact in the FT-3 Booster Drop Zones

Scientific Name	Common Name	Stage 1 Booster Drop Zone			Stage 2 Booster Drop Zones			Stage 3 Booster Drop Zone		
		Density(1) (per km^2)	Number of Potential TTS Exposures	Number of Direct Contact Exposures	Density(2) (per km^2)	Number of Potential TTS Exposures	Number of Direct Contact Exposures	Density(3) (per km^2)	Number of Potential TTS Exposures	Number of Direct Contact Exposures
Cetaceans										
Balaenoptera borealis	Sei whale	0.0001	9.9E-10	6.0E-08	0.0001	9.9E-10	1.4E-07	0.0001	9.9E-10	3.4E-08
Balaenoptera musculus	Blue whale	0.0001	9.9E-10	1.1E-07	0.0014	1.4E-08	3.3E-06	0.0001	9.9E-10	6.6E-08
Balaenoptera physalus	Fin whale	0.0680	6.8E-07	5.8E-05	0.0040	4.0E-08	7.5E-06	0.0235	2.3E-07	1.2E-05
Eschrichtius robustus(4)	Gray whale	0.0487	4.8E-07	2.5E-05	0.0001	9.9E-10	1.2E-07			
Western North Pacific DPS(4)			ND			ND				
Eubalaena japonica	North Pacific right whale	0.00001	9.9E-11	5.2E-09	0.00001	9.9E-11	1.2E-08			
Megaptera novaeangliae(5)	Humpback whale							0.0001	9.9E-10	3.4E-08
Mexico DPS(5)	Mexico DPS(5)	0.0098	9.7E-08	5.9E-06	0.0001	1.0E-09	1.5E-07	0.0098	ND	
Western North Pacific DPS(5)	Western North Pacific DPS(5)	0.0005	4.6E-09	2.8E-07	0.00001	5.0E-11	7.0E-09	0.0005	ND	
Physeter macrocephalus	Sperm whale	0.0030		1.1E-06	0.0030		3.8E-06	0.0014		4.2E-07
Pinnipeds										
	(Western DPS)									

Abbreviations: DPS = distinct population segment, km2 = square kilometers, ND = no data, TTS = Temporary Threshold Shift, "-" = does not occur in this area or no exposures.

1. Density estimates for the stage 1 booster drop zone from inshore/nearshore estimates in Rone et al. 2017 and U.S. Navy 2014.
2. Density estimates for the stage 2 booster drop zone derived from offshore estimates in the GOA from Rone et al. 2017 and U.S. Navy 2014.
3. Density estimates for the stage 3 booster drop zone based on estimates and models for the U.S. Navy's Hawaii Range Complex from Hanser et al. 2017. Where possible average densities were calculated for the portion of the model area overlapping the stage 3 booster drop zone area.
4. Density estimates for gray whales include whales from all DPSs in the GOA and are not specific to ESA-listed populations. Gray whales in the GOA are likely from unlisted Eastern Populations. It is possible that a small (but unknown) number of these whales are from the Western DPS.
5. Density estimates for humpback whales included whales from all DPSs. Humpback whales feeding in the GOA may be from the Hawai`i DPS (89%), the Mexico DPS (10.5%), and the Western North Pacific DPS (0.5%) (Wade et al. 2016) and it was assumed the same DPSs may be represented in the stage 1 and 2 booster drop zones.

Debris and ejecta from a land impact would be expected to fall within 91 m of the impact point. Of the species identified in Table 1, only green and hawksbill sea turtles may occur close enough to the potential impact site at Illeginni Islet to be affected by these stressors. Therefore we believe that, with the exception of green and hawksbill sea turtles, it is discountable that any of those species would be exposed to debris from the payload impact on Illeginni Islet. Empirical evidence from previous tests corroborates predictions of the propagation of shock waves associated with impact were approximately 37.5 m through the adjacent reef from the point of impact on the shoreline (USAFGSC and USASMDC/ARSTRAT 2015). Although green and hawksbill sea turtles may occur around Illeginni Islet, they do so infrequently and in low numbers, and typically in waters closer to the reef edge, which is over 500 feet from shore, where they spend the majority of their time under water. Therefore, we consider it unlikely that either turtle species would be close enough to shore to be within the range of shock wave effects, and that any exposure to ejecta would be in the form of relatively slow moving material sinking to the bottom near the animal. In the unlikely event of a turtle being within the ejecta zone during the impact, at most, an exposed animal may experience temporary behavioral disturbance in the form of slight changes in swimming direction or speed, feeding, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure. Therefore, the exposure is expected to have insignificant effects.

Non-larval Fish, Corals, and Mollusks near Illeginni Islet. Non-larval forms of 7 coral species, 1 fish species, and 3 mollusk species have the potential to occur on the reefs and waters in the vicinity of Illeginni Islet. These forms include the relevant coral and mollusk species and adults and juveniles of the relevant fish species. Although coral reefs are not planned or expected to be targeted, a land payload impact on the shoreline of Illeginni could result in ejecta/debris fall, shock waves, and post-test cleanup operations, which may affect and will likely adversely affect at least some of the consultation fish, coral and mollusk species on the adjacent reef. The analysis of these potential effects are analyzed below in Section 6.

<u>c. Exposure to hazardous materials</u>: For all of the species considered in this consultation, exposure to action-related hazardous materials is expected to have insignificant effects. During over-ocean flight, any substances of which the launch vehicle is constructed or that are contained on the launch vehicle and are not consumed during FT-3 flight or spent motor jettison will fall into the BOA when first-, second-, and third-stage launch vehicle motors and nose fairing are released. The launch vehicle includes rocket motors, solid rocket propellant, magnesium thorium in the booster interstage, asbestos in the second stage, battery electrolytes (lithium-ion and silver-zinc), radio frequency transmitters, and small electro-explosive devices. Though the batteries carried onboard the rocket motors would be discharged by the time they splash down in the ocean, they would still contain small quantities of electrolyte material. The amount of other toxic substances, such as battery acid, hydraulic fluids, explosive residues and heavy metals is small (SSP 2017, 2019; USASMDC/ARSTRAT 2014; U.S. Army 2020). The affected areas would be very small locations within the drop zones, and the hazardous materials within the missile component debris would sink quickly to the seafloor at depths of multiple thousands of feet; well away from protected marine species. Materials leaked at the surface and in the water column as the debris sinks would be quickly diluted by the enormous relative volume of sea water, aided by the debris' movement through the water column and by ocean currents, thus never accumulating to levels expected to elicit a detectable response should a protected species be exposed to the material in the upper reaches of the water column. On the seafloor, the materials would leak or

leach into the water and be rapidly diluted by ocean currents, or leach into bottom sediments. However, it is discountable that any of the consultation species would encounter the diluted materials near the seafloor, or in the bottom sediments. Pre-test preparatory and post-test cleanup activities may involve heavy equipment and ocean-going vessels, which have the potential to introduce fuels, hydraulic fluids, and battery acids to terrestrial habitats as well as marine habitats. Any accidental spills from support equipment operations would be contained and quickly cleaned up. All waste materials would be transported to Kwajalein Islet for proper disposal in the U.S. With the payload impact on Illeginni, debris including hazardous materials would fall on Illeginni and possibly into nearshore habitats.

The payload carries up to 45 kg (100 lbs) of tungsten alloy (which is only 10% of the tungsten associated with the FE-2 flight) which will enter the terrestrial and possible marine environments upon impact. The Navy estimated tungsten concentrations at Illeginni Islet over time by using a model which incorporated the results of the column experiments measuring dissolution and sorption of tungsten in Illeginni Islet soils (U.S. Navy 2017b). The dissolution rate and sorption affinities were used to estimate tungsten concentrations in the freshwater zone just below the zone of tungsten deposition in soil. Shortly after tungsten is deposited in the carbonate soil, aqueous tungsten concentrations would increase. With regular precipitation (assumed at 2.5 m/yr) modeled concentrations reached a steady state in less than one year and remained constant for the following 25 years, the period for which the model was run. The steady state concentration was primarily controlled by the rate of tungsten alloy dissolution and the rate of precipitation. Based on the model parameters, estimated aqueous tungsten concentrations will be between 0.006 mg/L and 0.015 mg/L. s Additional soil and groundwater testing was conducted after the FE-2 test, where tungsten was detected in most of the groundwater samples collected from Illeginni Islet wells in 2019 and tungsten samples in several of the samples exceed the U.S. Environmental Protection Agency residential tap water screening levels (RGNext 2019). Tungsten was also detected in the soil at Illeginni Islet in 2019 but at levels below the limits of quantification for the study (RGNext 2019).

Although possible that species could be exposed, we do not have enough information to suggest that this level of exposure would cause any adverse effects. In addition, it is expected that these concentrations will be so immeasurable due to the volume of water and orders of magnitude lower than known exposures and their effects to other fish species (https://cfpub.epa.gov/ecotox/search.cfm). Using rainbow trout as a surrogate, species considered in this consultation would be exposed to levels much lower than those known to cause mortality to rainbow trout (15.61 AI mg/L) and therefore we would not expect mortality. Considering these reasons described above, we expect that the effects from exposure would be insignificant to listed species.

The payload structure itself contains heavy metals including aluminum, titanium, steel, magnesium, tungsten, and other alloys. Debris and ejecta from a land impact would be expected to fall within 91 m of the impact point. Only trace amounts of hazardous chemicals are expected to remain in terrestrial areas. If any hazardous chemicals enter the marine environment, they are expected to dilute and disperse quickly by currents and wave action. Post-flight cleanup of the impact area will include recovery/cleanup of all visible debris including during crater backfill. Searches for debris would be attempted out to water depths of up to 55 m if debris enters the marine environment. Considering the quantities of hazardous materials, the planned land impact, and the dilution and mixing capabilities of the ocean and lagoon waters, we believe that any effects from chemicals will be insignificant to protected species in the area.

d. Long-term addition of man-made objects to the ocean: This operation will scatter missile components throughout the Pacific Ocean. Man-made objects in the form of vessels, piles, pipelines, vehicles, and purposeful and unintended marine debris has entered all oceans for millennia and most of it is unquantified, especially things that do not float. Whales and sea turtles are most commonly observed entangled in fishing gear that floats on the surface, and recent surveys of sea turtles noted that they ingest plastics that float (high-density polyethylene, low-density polyethylene, and polypropylene) more commonly than plastic that does not float (Jung et al. 2018; White et al. 2018). This may suggest that man-made objects that float may pose more risk than objects that lay at the bottom of the ocean.

Almost all of the products in the missiles sink as soon as they impact the water and will likely remain on the bottom after the project is implemented. The missile is approximately 17 m long and the payload weights approximately 350 kg (750 lbs). The booster contains a solid propellant of hydroxyl terminated polybutadiene (HTPB) composition. The amount of solid propellant in all three boosters weighs a total of approximately 80,461 lbs, most of which will burn and release into the atmosphere leaving very little left as it enters the ocean and sinks to the bottom (MDA 2007, MDA 2019a, MDA 2019b; U.S. Navy 2019; U.S. Army 2020). We expect complete combustion of propellant and liquid fuel therefore the amount of material expected to sit at the bottom of the ocean would be less than the reported maximums here.

All components of the missile (stages 1-3) are expected to sink immediately after entry into the water. If the payload does not detach and the missile is lost to the BOA, it would be expected to sink as well. We also understand that there is a paucity of data or observations of animals' interactions with debris at the bottom of the ocean, and that carcasses that do not float on the surface are almost never observed or captured for study. Nonetheless, based on empirical observation, the majority of entanglements are observed in gear that floats, and no animals have ever been observed to be entangled in gear from any RCCTO/USASMDC/ARSTRAT activities. Similarly, material that floats are observed more often in ingested non-organic material. The pelagic species are generally observed in the water column and are not considered bottom-dwelling, and they are less likely to be exposed to objects that are at the bottom than if they were mid-column or at the surface and impacts from projectiles are discussed in section b above. We therefore expect the addition to debris to the bottom of the ocean to have insignificant effects to listed species.

e. Disturbance from human activities and equipment operation: Many of the activities done to complete pre-flight preparations and post-flight restoration work at Kwajalein Atoll would take place in marine waters inhabited by protected marine species covered by this consultation. Those activities may affect any of the species considered in this consultation should those species encounter or be directly impacted by ongoing activities. However, none of the planned activities would intentionally contact marine substrates or consultation species, except those activities taken to restore in-water areas that may be impacted by the payload at Illeginni Islet. Impact restoration actions that may be taken in marine waters around Illeginni Islet may adversely affect species identified in Table 2, but not any of the species identified in Table 1. The motile species in Table 1 either do not occur in the area that may be impacted (marine mammals and three oceanic turtles), or they are expected to temporarily leave the area with no measurable effect on their fitness (green and hawksbill turtles, manta rays, oceanic white tip sharks, bigeye thresher sharks, and scalloped hammerhead sharks). The potential effects of in-water restoration activities on the corals, top shell snails, and giant clams in Table 2 will be considered later in the Effects of the Action Section.

For all other operations (vessel movement, dive operations, deployment and recovery of the LIDSS rafts, etc.) the most likely reaction to exposure to the activities, would be a short-term avoidance behavior, where motile species such as marine mammals, sea turtles, and fish temporarily leave the immediate area with no measurable effect on their fitness, then return to normal behaviors within minutes of cessation of the activity. Sessile organisms such as mollusks may temporarily close their shells or adhere more tightly to the substrate, also returning to normal behaviors within minutes of cessation of the activity. Although top shell snails and giant clams may be moved, because of their protective shells, it is unlikely that these animals would be killed or significantly injured.

Corals are not expected to have any measurable reaction to short-term non-contact activities. While it has properly been assumed for listed vertebrate species that physical contact of equipment or humans with an individual constitutes an adverse effect due to high potential for harm or harassment, the same assumption does not hold for listed corals due to two key biological characteristics:

1. All corals are simple, sessile invertebrate animals that rely on their stinging nematocysts for defense, rather than predator avoidance via flight response. So whereas it is logical to assume that physical contact with a vertebrate individual results in stress that constitutes harm and/or harassment, the same does not apply to corals because they have no flight response; and
2. Most reef-building corals, including all the listed species, are colonial organisms, such that a single larva settles and develops into the primary polyp, which then multiplies into a colony of hundreds to thousands of genetically-identical polyps that are seamlessly connected through tissue and skeleton. Colony growth is achieved mainly through the addition of more polyps, and colony growth is indeterminate. The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The individual of these listed species is defined as the colony, not the polyp, in the final coral listing rule (79 FR 53852). Thus, affecting some polyps of a colony does not necessarily constitute harm to the individual.

Planned protective measures would reduce the potential for interactions by watching for and avoiding protected species during the execution of pre-flight preparations and post-flight restoration work. Based on the best available information, project-related disturbance may infrequently cause an insignificant level of behavioral disturbance for the species identified in Table 1, but may adversely affect the species identified in Table 2.

<u>f. Collision with vessels</u>: The proposed action has the potential to increase ocean vessel traffic in the action area during both pre-flight preparations and post-flight activities. As part of FT-3 test monitoring and data collection, sea based sensors will be deployed along the flight path on vessels in the BOA. These vessels will travel from PSCA or USAKA to locations along the flight path. Pre-flight activities at or near USAKA will include vessel traffic to and from Illeginni Islet. Prior to launch, radars will be placed on Illeginni Islet and would be transported aboard ocean going vessels. Sensor rafts will also be deployed near the impact site from a LCU vessel.

Approximately four vessel round trips to Illeginni will be conducted for pre-flight and four for post-flight activities.

Post-flight, payload debris recovery and clean-up will take place at Illeginni Islet. These post-test cleanup and recovery efforts will result in increased vessel traffic to and from Illeginni Islet. Vessels will be used to transport heavy equipment (such as backhoe or grader) and personnel for manual cleanup of debris, backfilling or any craters, and instrument recovery. Deployed sensor rafts (Figure 4) will also be recovered by a LCU vessel. In the event of an unintended shallow water impact or debris entering the shallow water environments from a land impact near the shoreline, debris would be recovered. Smaller boats will transport divers, and ROVs if needed, to and from Illeginni to locate and recover this debris in waters up to approximately 30.5 m deep on the ocean side of Illeginni and within 152 to 305 m of the islet's shoreline on the lagoon side.

Sea turtles and cetaceans must surface to breathe air. They also rest or bask at the surface. Therefore, when at or near the surface, turtles and cetaceans are at risk of being struck by vessels or their propellers as the vessels transit. Corals could also be impacted if a vessel runs aground or drops anchors on the reef. Conversely, scalloped hammerhead sharks, bigeye thresher sharks, oceanic white tip sharks, manta rays, and humphead wrasse respire with gills and as such do not need to surface to breathe and are only infrequently near the surface. They are also agile and capable of avoiding oncoming vessels.

The conservation measures that are part of this action include requirements for vessel operators to watch for and avoid marine protected species, including adjusting their speed based on animal density and visibility conditions. Additionally, no action-related anchoring is planned and vessel operators are well trained to avoid running aground. Therefore, based on the best available information we consider the risk of collisions between project-related vessels and any of the consultation species identified in Tables 1 and 2 to be discountable.

<u>Critical Habitat</u>: The flight path of the FT-3 is expected to cross over Steller sea lion, North Pacific right whale, and Hawaiian monk seal critical habitat; however, given the in-air distance from the ocean's surface and location of the booster drops, the stressors associated with this action will have no effect on either North Pacific right whale or Hawaiian monk seal critical habitat (Figure 5).

The 20-nautical mile aquatic zones surrounding rookeries and major haulout sites provide foraging habitats, prey resources, and refuge considered essential to the conservation of lactating female, juvenile, and non-breeding Steller sea lions (58 FR 45269; August 27, 1993).

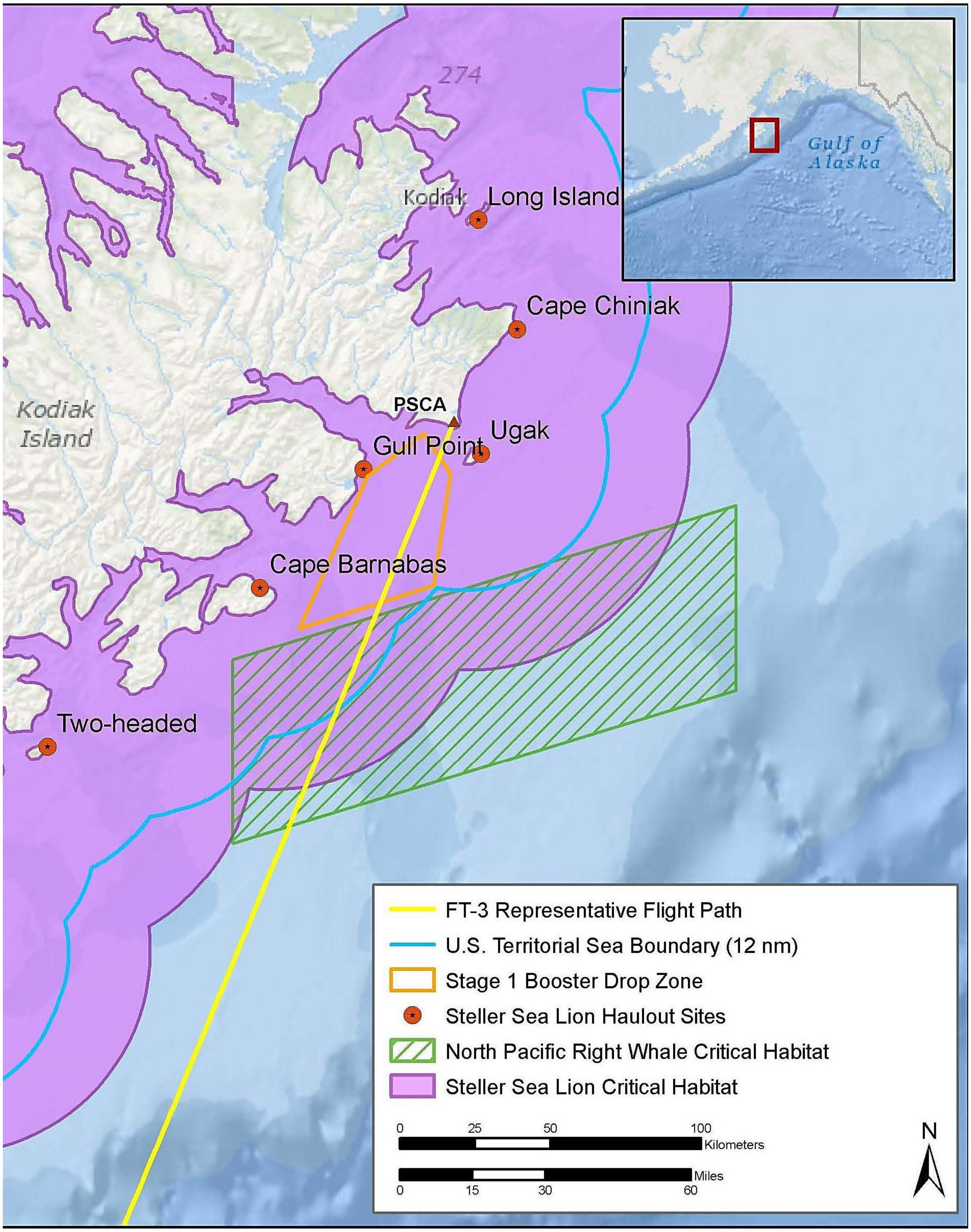

Figure 5. Representative Stage 1 Spent Motor Drop Zone near PSCA and designated Steller Sea Lion Critical Habitat (provided by U.S. Army).

For this project, designated critical habitat includes the following areas as described at 50 CFR 226.202:

- Terrestrial zones that extend 3,000 ft (0.9 km) landward from each major haulout and major rookery.
- Air zones that extend 3,000 ft (0.9 km) above the terrestrial zone of each major haulout and major rookery in Alaska.
- Aquatic zones that extend 20 nm (37 km) seaward of each major haulout and major rookery in Alaska that is west of 144^{o} W longitude.
- Three special aquatic foraging areas: the Shelikof Strait area, the Bogoslof area, and the Seguam Pass area, as specified at 50 CFR 226.202(c).

The first stage booster drop overlaps with the 20-nm critical habitat areas around three Steller sea lion major haulouts (Ugak, Gull Point, and Cape Barnabas) from the project footprint (Figure 5).

Terrestrial Zones: The FT-3 launch and flight activities are not located in a terrestrial zone that is 3,000 ft (0.9 km) landward from a major haulout or rookery, and any noise effects are extremely unlikely to occur in those areas. Therefore effects to the terrestrial zones are discountable. Terrestrial species and those marine species under the jurisdiction of the USFWS are addressed in a separate evaluation.

Air Zones: FT-3 launch and flight activities are nearby, but not located in an air zone that is 3,000 ft (0.9 km) above a major haulout or rookery. Any effects to the air zones are extremely unlikely to occur in those areas, as well as any effects from the unlikely situation that the FT-3 vehicle deviates course, and therefore, are discountable.

Aquatic Zones: Although FT-3 flight and first booster drop zone overlaps with the aquatic zones of major haulouts, the project is located about 25 miles from a well-developed harbor in which Steller sea lions are habituated to disturbance and noise associated with human activity and vessel traffic. Hazardous materials within the missile, including unburnt propellant, may affect water quality in the immediate area around the splash-down of the first stage booster drop. However, as described above, hazardous materials within missile debris would sink quickly to the seafloor, likely to depths of up to 200 ft (Figure 6). Any hazardous materials leaked at the surface and in the water column as the debris sinks would be quickly diluted by the enormous relative volume of sea water, aided by the debris' movement through the water column and by ocean currents. The leaching rate of unburned solid propellant in ocean water is very low. That material would sink to the deep seafloor where it would be quickly diluted by ocean currents as it slowly dissolves over years. Therefore, based on the best available information, potential launch failures are expected to have insignificant effects on Steller sea lion critical habitat.

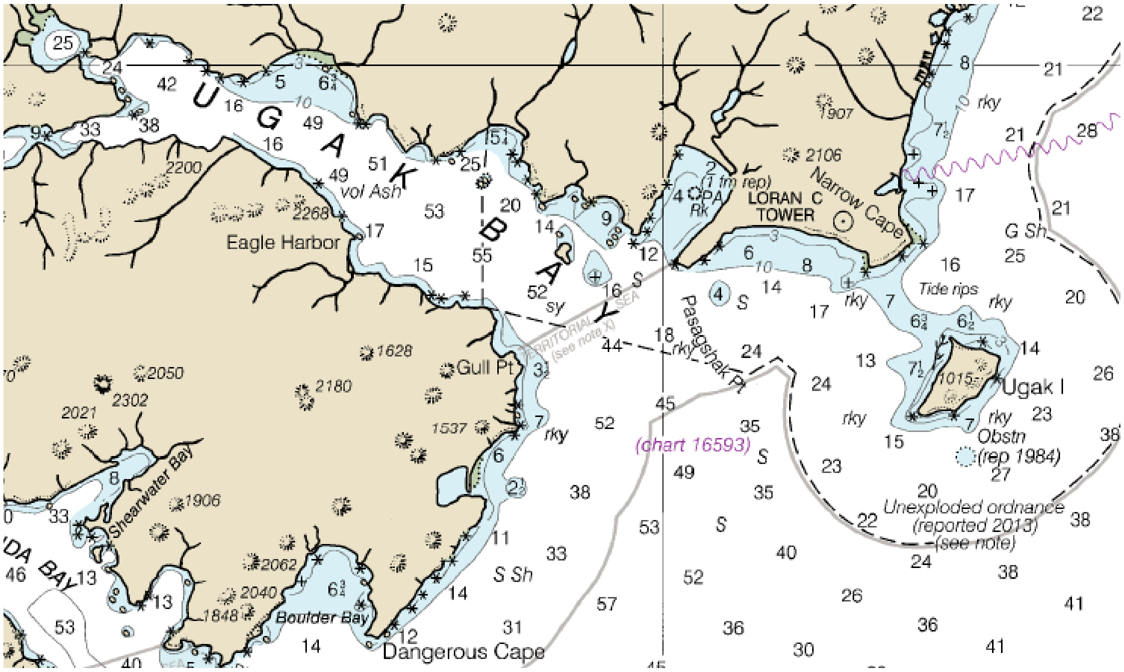

Figure 6. Water depths (measured in fathoms).

Aquatic Foraging Area: None of the flight activities associated with the proposed action will occur in or over any aquatic foraging areas. The closest foraging area is Shelikof Strait on the north side of Kodiak Island. Because the flight path stops prior to Shelikof Strait, this action will have no effect on this essential feature.

Considering the information presented above, and in the best scientific information available about the biology and expected behaviors of the marine species considered in this consultation, we agree that exposure to the proposed action would have insignificant effects, or the likelihood of exposure would be discountable for the consultation species identified in Table 1. Further, we have determined that the proposed action would have discountable or insignificant effects on designated critical habitat for the Steller sea lion. Therefore, we concur with your determination that conducting the proposed FT-3 is NLAA the consultation species identified in Table 1, and would have no effect on designated critical habitat in the RMI. We have also determined that the proposed FT-3 is NLAA. Steller sea lion critical habitat. Those species and critical habitats will not be considered further in this consultation.

4 STATUS OF THE SPECIES

This section presents biological or ecological information for the UES consultation species that the proposed action is likely to adversely affect. As stated above in Section 1, RCCTO/USASMDC determined that the proposed action was likely to adversely affect the 11 marine UES consultation species listed in Table 2 (including humphead wrasse).

As described above in the introduction, the jeopardy analyses in this Opinion considers the risk of reducing appreciably the likelihood of survival and recovery of UES-protected marine species within USAKA. As such, subsections 4.1 through 4.11 provide species-specific descriptions of distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, and other relevant information as they pertain to these animals within USAKA. Factors affecting these species within the action area are described in more detail in the Environmental Baseline (Section 5).

4.1 *Pocillopora meandrina* (Cauliflower coral)

Pocillopora meandrina is listed as a species of “least concern” by the IUCN (IUCN 2015). The Center for Biological Diversity petitioned the NMFS to list the cauliflower coral in Hawaii as endangered or threatened under the ESA in March 2018 (CBD 2018). In September 2018, NMFS found that *P. meandrina* may warrant listing under the ESA (83 FR 47592 [September 20, 2018]). On July 7, 2020 NMFS published a “Not Warranted” 12-month finding for the species (85 FR 40480). At this time, *P. meandrina* is still a UES consultation species.

Pocillopora meandrina is in the family Pociloporidae. This hard coral species forms small upright bushes up to 30 cm in diameter that are cream, green, or pink in color (CBD 2018). Colonies form flattened branches that uniformly radiate out from the original growth point (CBD 2018). This species has a relatively fast growth rate with high recruitment; however, colonies may also be short lived due to recolonization by other coral species and high sensitivity to disturbance (CBD 2018).

4.1.1 Distribution and Abundance

Pocillopora meandrina is found throughout tropical and subtropical Indian and Pacific oceans in shallow reefs (CBD 2018). This range includes Hawaii, Johnston Atoll, American Samoa, the Marshall Islands, Micronesia, the Northern Mariana Islands, and Palau among other island groups (CBD 2018). *Pocillopora meandrina* occurs in shallow reef environments with high wave energy at depths of 1 to 27 m (CBD 2018). The abundance of this coral is still being determined through the status review process.

4.1.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Pocillopora meandrina has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as in the Mid-Atoll Corridor. Overall, *P. meandrina* has been observed at 96% (120 of 125) survey sites in Kwajalein Atoll. This species was observed at 100% (5 of 5) of sites at Illeginni Islet since 2010 including in Illeginni harbor.

4.1.3 Threats to the Species

Major threats to *Pocillopora meandrina* include destruction and/or modification of habitat, harvest for the aquarium trade, disease, predation, and high susceptibility to bleaching due to thermal stress (CBD 2018). During a bleaching event in the coastal waters of West Hawaii in 2015, *P. meandrina* exhibited high post-bleaching mortality with approximately 96% of colonies exhibiting partial post-bleaching tissue loss (greater than 5%) and 78% of colonies exhibiting total post-bleaching mortality (CBD 2018). Other bleaching events in the Hawaiian Islands resulted in 1 to 10% mortality for this species (CBD 2018). NMFS is currently evaluating the threats to the species through its status review process.

4.1.4 Conservation of the Species

Pocillopora meandrina has been retained as a consultation species under the UES.

4.2 *Acropora microclados* (Coral)

A. microclados is broadly distributed across the Indo-Pacific region. As a candidate species for listing under the ESA, *A. microclados* became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.2.1 Distribution and Abundance

The reported range of *A. microclados* is from the Red Sea and northern Madagascar, the Chagos Archipelago in the central Indian Ocean, through the Indo-Pacific region, and eastward to the central Pacific Ocean out to Pitcairn Island. It ranges as far north as the Ryukyu Islands of Japan, and to the south down along the eastern and western coasts of Australia. *A. microclados* is reported as uncommon to common (Veron 2014). Within the area potentially impacted at Illeginni, *A. microclados* is estimated to be scattered across submerged hard pavement reef areas, mostly below the intertidal zone and very shallow water habitats, at a density of up to 0.08 colonies/m^2. It has been observed at Illeginni, all of the other USAKA islands, and at 34 of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *A. microclados* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.2.2 Life History Characteristics Affecting Vulnerability to Proposed Action

A. microclados is a scleractinian (stony) coral. Stony corals are sessile, colonial, marine invertebrates. A living colony consists of a thin layer of live tissue over-lying an accumulated calcium carbonate skeleton. The individual unit of a coral colony is called a polyp. Polyps are typically cylindrical in shape, with a central mouth that is surrounded by numerous small tentacles armed with stinging cells (nematocysts) that are used for prey capture and defense. Individual polyps secrete a cup-like skeleton (corallite) over the skeletons of its predecessors, and each polyp is connected to adjacent polyps by a thin layer of interconnecting tissue. Scleractinian corals act as plants during the day and as animals at night, or in some combination of the two. The soft tissue of stony corals harbor mutualistic intracellular symbiotic dinoflagellates called zooxanthellae, which are photosynthetic. Corals also feed by consuming prey that is captured by the nematocysts (Brainard et al. 2011).

A. microclados colonies are typically corymbose plates that are attached to hard substrate, with short, uniform, evenly spaced tapered branchlets. It occurs on upper reef slopes and subtidal reef edges at depths of 5 to 20 m. Like other corals, *A. microclados* feeds on tiny free-floating prey that is captured by the tentacles of the individual coral polyps that comprise the colony. *A. microclados* is a hermaphroditic spawner; releasing gametes of both sexes. It also reproduces through fragmentation, where broken pieces continue to grow to form new colonies (Brainard et al. 2011).

4.2.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, predation, pollution, and exploitation. Increased exposure to thermal stress is a potential effect of anthropogenic climate change. Little specific information is available to describe the susceptibility of *A. microclados* to these threats. However, the genus *Acropora* is ranked as one of the more susceptible to bleaching, where the coral expels its zooxanthellae. The physiological stress and reduced nutrition from bleaching are likely to have synergistic effects of lowered fecundity and increased susceptibility to disease. Bleaching can also result in mortality of the affected colony (Brainard et al. 2011). Acidification experiments have demonstrated negative effects on *Acropora* calcification, productivity, and impaired fertilization, larval settlement, and zooxanthellae acquisition rates in juveniles (Brainard et al. 2011). The susceptibility and impacts of disease on *A. microclados* are not well understood, but subacute dark spots disease has been reported in this species, and its genus is considered moderate to highly susceptible to disease. The crown of thorns seastar (*Acanthaster planci*) and corallivorous snails preferentially prey on *Acropora spp.*, and the dead areas of the coral are rapidly overgrown by algae. Land-based toxins and nutrients are reported to have deleterious effects on *Acropora spp.* depending on the substance, concentration, and duration of exposure. The genus *Acropora* has been heavily involved in international trade, and *A. microclados* is likely included in this trade (Brainard et al. 2011). As described above, *A. microclados* is likely highly susceptible to effects attributed to anthropogenic climate change, and is likely being adversely affected by those effects on a global level.

4.2.4 Conservation of the Species

A. microclados is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.3 *Acropora polystoma* (Coral)

A. polystoma is broadly distributed across the Indo-Pacific region. As a candidate species for listing under the ESA, *A. polystoma* became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.3.1 Distribution and Abundance

The reported range of *A. polystoma* is from the Red Sea to central Africa and Madagascar, and the Chagos Archipelago in the central Indian Ocean, through the Indo-Pacific region, eastward to the Tuamotus in the southeastern Pacific Ocean. It ranges as far north as the south of Taiwan, through the South China Sea and the Philippines, and to the south down along the northern coast of Australia and the Coral Sea. *A. polystoma* is reported as uncommon to common (Veron 2014). Within the area potentially impacted at Illeginni, *A. polystoma* is estimated to be scattered across submerged hard pavement reef areas, mostly below the intertidal zone and very shallow water habitats, at a density of up to 0.08 colonies/m^2. It has been observed at Illeginni, all of the other USAKA islands, and at 34 of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *A. polystoma* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.3.2 Life History Characteristics Affecting Vulnerability to Proposed Action

A. polystoma is a stony coral. *A. polystoma* colonies are typically clumps or corymbose plates that are attached to hard substrate, with tapered branches of similar length. It occurs in highly active intertidal to shallow subtidal reef tops and edges with strong wave action and/or high currents, at depths down to about 10 m. *A. polystoma* is a hermaphroditic spawner; releasing gametes of both sexes. It also reproduces through fragmentation, where broken pieces continue to grow to form new colonies (Brainard et al. 2011).

4.3.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, predation, pollution, and exploitation. Increased exposure to thermal stress is occurring as part of the rising ocean temperatures being caused by anthropogenic climate change. Little specific information is available to describe the susceptibility of *A. polystoma* to these threats. However, the genus *Acropora* is ranked as one of the most severely susceptible to bleaching, where the coral expels its zooxanthellae. The physiological stress and reduced nutrition from bleaching are likely to have synergistic effects of lowered fecundity and increased susceptibility to disease. Bleaching can also result in mortality of the affected colony (Brainard et al. 2011). Acidification experiments have demonstrated negative effects on *Acropora* calcification, productivity, and impaired fertilization, larval settlement, and zooxanthellae acquisition rates in juveniles (Anthony et al. 2008). The genus *Acropora* is considered moderate to highly susceptible to disease, and *A. polystoma* has been reported to experience severe white-band/white plague disease. The crown of thorns seastar (*Acanthaster planci*) and corallivorous snails preferentially prey on *Acropora spp.*, and the dead areas of the coral are rapidly overgrown by algae. Land-based toxins and nutrients are reported to have deleterious effects on *Acropora spp.* depending on the substance, concentration, and duration of exposure. The genus *Acropora* has been heavily involved in international trade, and *A. polystoma* is likely included in this trade (Brainard et al. 2011). As described above, *A. polystoma* is likely highly susceptible to effects attributed to anthropogenic climate change, and is likely being adversely affected by those effects across its range.

4.3.4 Conservation of the Species

A. polystoma is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.4 *Cyphastrea agassizi* (Coral)

C. agassizi is found primarily in the Indo-Pacific. As a candidate species for listing under the ESA, *C. agassizi* became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.4.1 Distribution and Abundance

The reported range of *C. agassizi* is from Indonesia to the Hawaiian Islands in the central Pacific Ocean, and from southern Japan and the Northern Mariana Islands, south to Northeastern Australia. *C. agassizi* is reported as uncommon (Veron 2014). Within the area potentially impacted at Illeginni, *C. agassizi* is estimated to be scattered across submerged hard pavement reef areas, mostly below the intertidal zone and very shallow water habitats, at a density of up to 0.08 colonies/m^2. It has been observed at Illeginni, at six more of the 11 USAKA islands, and at 14 of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *C. agassizi* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.4.2 Life History Characteristics Affecting Vulnerability to Proposed Action

C. agassizi is a stony coral. *C. agassizi* typically forms deeply grooved massive colonies attached to hard substrate. It occurs in shallow reef environments of back- and fore-slopes, lagoons and outer reef channels at depths of about 2 to 20 m. Like other corals, *C. agassizi* feeds on tiny free-floating prey that is captured by the tentacles of the individual coral polyps that comprise the colony. The reproductive characteristics of *C. agassizi* are undetermined, but its congeners include a mix of hermaphroditic spawners and brooders (Brainard et al. 2011).

4.4.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, predation, pollution, and exploitation. Increased exposure to thermal stress is a potential effect of anthropogenic climate change. *Cyphastrea* are considered generally resistant to bleaching, but elevated temperatures may still cause mortality within this genus (Brainard et al. 2011). The effects of increased ocean acidity are unknown for this genus, but in general, increased ocean acidity is thought to adversely affect fertilization, larval settlement, and zooxanthellae acquisition rates for many corals. It also can induce bleaching more so than thermal stress, and tends to decrease growth and calcification rates. The specific susceptibility and impacts of disease on *C. agassizi* are not known, but some of its congeners have been infected with various “band” diseases. As such, it appears that *C. agassizi* is susceptible (Brainard et al. 2011). The susceptibility of *C. agassizi* to predation is unknown. The effects of land-based pollution on *C. agassizi* are largely unknown, but it may pose significant threats at local scales. This coral is lightly to moderately exploited in trade at the genus level (Brainard et al. 2011). As described above, the genus *Cyphastrea* is considered generally resistant to bleaching, but mortality due to elevated temperatures, which may be attributable to anthropogenic climate change, may still occur. As such, this species may be currently adversely affected by those effects on a global level.

4.4.4 Conservation of the Species

C. agassizi is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.5 Heliopora coerulea (Coral)

H. coerulea is a very broadly distributed Indo-Pacific coral. It is considered the oldest living coral species. *H. coerulea* became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.5.1 Distribution and Abundance

The reported range of *H. coerulea* is from southern east Africa to the Red Sea, across the Indian Ocean to American Samoa in central Pacific Ocean, and from Japan, south to Australia (Brainard et al. 2011). Colonies of *H. coerulea* are often patchy in their distribution, but can dominate large areas. Within the area potentially impacted at Illeginni, *H. coerulea* is estimated to be scattered across submerged hard pavement reef areas, including intertidal and/or inshore rocky areas, at a density of up to 0.53 colonies/m^2. It has been observed at Illeginni, at all of the other USAKA islands, and at 32 of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *H. coerulea* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.5.2 Life History Characteristics Affecting Vulnerability to Proposed Action

H. coerulea is a non-scleractinian stony coral. Stony corals are sessile, colonial, marine invertebrates. Unlike the calcium carbonate skeleton of scleractinian corals, the skeleton of *H. coerulea* consists of aragonite, and it is blue instead of white. As with scleractinian corals, the individual unit of a coral colony is called a polyp, which is typically cylindrical in shape, with a central mouth that is surrounded by numerous small tentacles armed with stinging cells (nematocysts) that are used for prey capture and defense, but instead of living in "cups on the surface of the coral, *H. coerulea* polyps live in tubes within the skeleton. Each polyp is connected to adjacent polyps by a thin layer of interconnecting tissue called the coenenchyme. As with other corals, *H. coerulea* acts as a plant during the day and as an animal at night, or in some combination of the two. The soft tissue harbors mutualistic intracellular symbiotic dinoflagellates called zooxanthellae, which are photosynthetic. Corals also feed by consuming prey that is captured by the nematocysts (Brainard et al. 2011).

H. coerulea is a massive coral that typically forms castellate blades. It occurs in water depths from the intertidal zone down to about 60 m. It is most abundant from the shallow reef crest down to forereef slopes at 10 m, but is still common down to 20 m. Like other corals, *H. coerulea* feeds on tiny free-floating prey that is captured by the tentacles of the individual coral polyps that comprise the colony. *H. coerulea* colonies have separate sexes. Fertilization and early development of eggs begins internally, but the planula larvae are brooded externally under the polyp tentacles. Larvae are considered benthic, as they normally distribute themselves by crawling away and drifting in the plankton (Brainard et al. 2011).

4.5.3 Threats to the Species

Brainard et al. (2011) suggest that *H. coerulea* is a hardy species. They report that it is one of the most resistant corals to the effects of thermal stress and bleaching, and although there is no specific research to address the effects of acidification on this species, it seems to have survived the rapid acidification of the oceans during the Paleocene-Eocene Thermal Maximum acidification. They also report that disease does not appear to pose a substantial threat, and that adult colonies are avoided by most predators of coral. However, the externally brooded larvae are heavily preyed upon by several species of butterflyfish. Although *H. coerulea* tends to prefer clear water with low rates of sedimentation, Brainard et al. (2011) report that sediment appears to pose no significant threat to the species. Land-based sources of pollution may pose significant threats at local scales. Collection and trade appear to be the biggest threat to this species. *H. coerulea* has been reported as one of the top 10 species involved in international trade. Its morphology and natural color make it highly desirable (Brainard et al. 2011). As described above, *H. coerulea* does not appear to be particularly susceptible to effects attributed to anthropogenic climate change, but it is likely being adversely affected by international trade.

4.5.4 Conservation of the Species

H. coerulea is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.6 *Pavona venosa* (Coral)

P. venosa is a broadly distributed Indo-Pacific. It became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.6.1 Distribution and Abundance

The reported range of *P. venosa* extends down the eastern shore of Saudi Arabia, into the Red Sea, down to central Africa and Madagascar, across the Indian Ocean to include the Chagos Archipelago and Sri Lanka, through the Indo-Pacific region, eastward to the Tuamotus in the southeastern Pacific Ocean. It ranges as far north as the Ryukyu Islands, through the South China Sea and the Philippines, and to the south down along the east and west coasts of Australia and the Coral Sea. *P. venosa* has been reported as common. Within the area potentially impacted at Illeginni, *P. venosa* is estimated to be scattered across submerged hard pavement reef areas, mostly below the intertidal zone and very shallow water habitats, at a density of up to 0.08 colonies/m^2. It has been observed at Illeginni, all of the other USAKA islands, and at 16 of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *P. venosa* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.6.2 Life History Characteristics Affecting Vulnerability to Proposed Action

P. venosa is a stony coral. *P. venosa* typically forms massive to encrusting colonies attached to hard substrate. It occurs in shallow reef environments at depths of about 2 to 20 m. The reproductive characteristics of *P. venosa* are unknown, but six of its congeners are gonochoric (separate sexes) spawners; releasing gametes of both sexes that become fertilized in the water (Brainard et al. 2011).

4.6.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, predation, pollution, and exploitation. Increased exposure to thermal stress is occurring as part of the rising ocean temperatures being caused by anthropogenic climate change. *P. venosa* has moderate to high susceptibility to thermal stress induced “bleaching” where the coral expels its zooxanthellae. The physiological stress and reduced nutrition from bleaching are likely to have synergistic effects of lowered fecundity and increased susceptibility to disease. Bleaching can also result in mortality of the affected colony (Brainard et al. 2011). In general, increased ocean acidity is thought to adversely affect fertilization, larval settlement, and zooxanthellae acquisition rates for many corals. It can increase the susceptibility to thermal stress, and tends to decrease growth and calcification rates (Anthony et al. 2008). No studies have examined the direct impacts of ocean acidification on *P. venosa*, but some evidence suggests that the genus *Pavona* has some degree of tolerance to acidification (Brainard et al. 2011). The specific susceptibility and impacts of disease on *P. venosa* are not known, but susceptibility is considered to be low (Brainard et al. 2011). There are a medium number of reports of acuter white disease for the genus *Pavona*. The susceptibility of *P. venosa* to predation is considered to be low, but there is no specific information. Members of the genus *Pavona* have varied susceptibility to predation by the crown of thorns seastar (*Acanthaster planci*). There is no specific information about the effects of land-based pollution on *P. venosa*, but it may pose significant threats at local scales. International trade includes the genus *Pavona*, but at relatively low levels (Brainard et al. 2011). As described above, *P. venosa* is susceptible to effects of thermal stress, which may be attributable to anthropogenic climate change. As such, this species is likely being adversely affected by those effects across its range.

4.6.4 Conservation of the Species

P. venosa is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.7 Turbinaria reniformis (Coral)

T. reniformis is very broadly distributed across the Indo-Pacific region. *T. reniformis* became a consultation species under UES section 3-4.5.1 (a), and retained that status, per the wishes of the RMI Government, after we determined that listing under the ESA was not warranted.

4.7.1 Distribution and Abundance

The reported range of *T. reniformis* includes the Persian Gulf, the Red Sea, and most of the Indian Ocean basin, through the Indo-Pacific region, and eastward to the central Pacific Ocean out to Samoa and the Cook Islands. It ranges as far north as central Japan, down through the Philippines, around New Guinea, and down along the east and west coasts of Australia, and also down the Marianas, the Marshalls, and east to the Line Islands. It has been reported as common (Veron 2014). Within the area potentially impacted at Illeginni, *T. reniformis* is estimated to occur in small aggregations on submerged hard pavement reef areas, at a density of up to 0.16 colonies/m^2. It has been observed at Illeginni, at five more of the 11 USAKA islands, and at nine of 35 sites within the mid-atoll corridor (NMFS 2014a). In a recent survey conducted at the Minuteman III impact area *T. reniformis* was observed in the study area and the density estimates are slightly less than what was predicted (NMFS 2017a).

4.7.2 Life History Characteristics Affecting Vulnerability to Proposed Action

T. reniformis is a stony coral. *T. reniformis* colonies are attached to hard substrate and typically form large lettuce-like assemblages of plates. The plates tend to be very convoluted in shallow active water, whereas they are broad and flat in deeper calmer waters. It has been reported from the surface down to over 0 to 40 m, commonly on forereef slopes at 10 m and deeper, but it prefers turbid shallow protected waters where it forms massive and extensive stands. Like other corals, *T. reniformis* feeds on tiny free-floating prey that is captured by the tentacles of the individual coral polyps that comprise the colony. *T. reniformis* is a gonochoric (separate sexes) spawner; releasing gametes of one sex or the other that become fertilized in the water (Brainard et al. 2011).

4.7.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, predation, pollution, and exploitation. Increased exposure to thermal stress is a potential effect of anthropogenic climate change. Susceptibility of *Turbinaria spp*. to thermal stress induced bleaching (where the coral expels its zooxanthellae) varies regionally, and among species, but ranges between low to moderate. The physiological stress and reduced nutrition from bleaching may have synergistic effects of lowered fecundity and increased susceptibility to disease. Bleaching can also result in mortality of the affected colony. However, *T. reniformis* has shown the potential to reduce bleaching impacts through increased heterotrophic feeding rates (Brainard et al. 2011). The susceptibility of *T. reniformis* to acidification appears to be lower than that of other genera of scleractinian corals tested. However, in most corals studied, acidification impaired growth, as well as impaired fertilization, larval settlement, and zooxanthellae acquisition rates in juveniles for some species (Brainard et al. 2011). Susceptibility and impacts of disease on *T. reniformis* are not known, but both white syndrome disease and black lesions have affected members of this genus. Adult colonies of *Turbinaria spp.* are rarely eaten by the crown of thorns seastar (*Acanthaster planci*), but the gastropod nudibranch (*Phestilla sibogae*) both feeds upon, and infects *Turbinaria spp.* with disease. *T. reniformis* appears to tolerate high turbidity and sedimentation, as well as low-salinity events, but land-based toxins and nutrients may have deleterious effects on a regional scale, depending on the substance, concentration, and duration of exposure. The genus *Turbinaria* has been heavily exploited in international trade, and *T. reniformis* is likely included in this trade (Brainard et al. 2011). As described above, *T. reniformis* may be susceptible to some effects attributed to anthropogenic climate change, and as such could be currently adversely affected by those effects on a global level.

4.7.4 Conservation of the Species

T. reniformis is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

4.8 *Tectus niloticus* (Top Shell Snail)

The top shell snail is also sometime referred to as *Trochus niloticus*. It is a broadly distributed marine gastropod, and is a consultation species under UES section 3-4.5.1 (a).

4.8.1 Distribution and Abundance

The top shell snail is distributed in sub-tropical to tropical waters of the Indo-Pacific region. They are indigenous to Yap, Palau, and Helen Reef in Micronesia, but have been introduced to nearly every island group across the Indo-Pacific region (Smith 1987). Larvae recruit to shallow intertidal zones, typically along exposed (seaward) shores. Individuals migrate into deeper water as they grow (Heslinga et al. 1984) with maximum reported depth being 24 m (Smith 1987). Data are insufficient to determine current population levels and trends across its range, including in the RMI. Within the area potentially impacted at Illeginni, the top shell snail is estimated to be scattered across submerged hard pavement reef areas, including intertidal and/or inshore rocky areas, at a density of up to 0.09 individuals/m^2. It has been observed at Illeginni, at all of the other USAKA islands, and at 12 of 35 sites within the mid-atoll corridor (NMFS 2014a).

4.8.2 Life History Characteristics Affecting Vulnerability to Proposed Action

The top shell is a nocturnal, herbivorous, marine gastropod mollusk. It is normally found on the reef surface in the intertidal and subtidal zones. The life span is between 15 and 20 years, with sexual maturity occurring at about 2 years. It is a hardy species that is commonly relocated between island groups with high success. Dobson (2001), reports that top shell snails can survive out of the water for up to 36 hours when kept cool and damp. After being relocated on a new reef area and left undisturbed for a brief period, top shell snails typically resume normal behaviors with no measurable effects assuming the relocation site supports adequate forage and shelter.

4.8.3 Threats to the Species

The top shell is highly susceptible to over-exploitation. It is an edible species whose shells are also commercially important in the mother of pearl button industry (Heslinga et al. 1984). They are slow moving and are easily spotted by reef-walkers and snorkelers. Unregulated or poorly regulated harvesting has led to their depletion across their range. Although top shell snails are probably beginning to be affected by impacts associated with anthropogenic climate change (described in more detail in the Environmental Baseline section below), no significant climate change-related impacts to its populations have been observed to date.

4.8.4 Conservation of the Species

The top shell is afforded protection at USAKA as a consultation species under the UES (USAKA 2014).

4.9 *Hippopus hippopus* (giant clam)

H. hippopus is broadly distributed across the Indo-Pacific region. It is a candidate species for listing under the ESA, *H. hippopus* became a consultation species under UES section 3-4.5.1 (a).

4.9.1 Distribution and Abundance

H. hippopus are reported to be found in the eastern Indian Ocean at Myanmar and east to the Fiji and Tonga Islands, in the north as far as southern Japan and then south to the Great Barrier Reef, New Caledonia and Western Australia. Within the area potentially impacted at Illeginni, *H. hippopus* was found throughout the lagoon area but was rare on the ocean side in a recent survey conducted at the impact area. It has been observed at Illeginni, and at eight more of the 11 USAKA islands, and at nine of 35 sites within the mid-atoll corridor (NMFS 2017b).

4.9.2 Life History Characteristics Affecting Vulnerability to Proposed Action

H. hippopus is a giant clam which is markedly stenothermal (i.e., they are able to tolerate only a small range of temperature) and thus restricted to warm waters. Giant clams are typically found living on sand or attached to coral rock and rubble by byssal threads (Soo and Todd 2014), but they can be found in a wide variety of habitats, including live coral, dead coral rubble, boulders, sandy substrates, seagrass beds, macroalgae zones, etc. (Gilbert et al. 2006; Hernawan 2010). The exact lifespan of tridacnines has not been determined; although it is estimated to vary widely between 8 to several hundred years (Soo and Todd 2014). Little information exists on the size at maturity for giant clams, but size and age at maturity vary by species and geographical location (Ellis 1997). In general, giant clams appear to have relatively late sexual maturity, a sessile, exposed adult phase and broadcast spawning reproductive strategy, all of which can make giant clams vulnerable to depletion and exploitation (Neo et al. 2015). All giant clam species are classified as protandrous functional hermaphrodites, meaning they mature first as males and develop later to function as both male and female (Chambers 2007); but otherwise, giant clams follow the typical bivalve mollusk life cycle. At around 5 to 7 years of age (Kinch and Teitelbaum 2010), giant clams reproduce via broadcast spawning, in which several million sperm and eggs are released into the water column where fertilization takes place. Giant clam spawning can be seasonal; for example, in the Central Pacific, giant clams can spawn year round but are likely to have better gonad maturation around the new or full moon (Kinch and Teitelbaum 2010). In the Southern Pacific, giant clam spawning patterns are seasonal and clams are likely to spawn in spring and throughout the austral summer months (Kinch and Teitelbaum 2010). Once fertilized, the eggs hatch into free-swimming trochophore larvae for around 8 to 15 days (according to the species and location) before settling on the substrate (Soo and Todd 2014; Kinch and Teitelbaum 2010). During the pediveliger larvae stage (the stage when the larvae is able to crawl using its foot), the larvae crawl on the substrate in search of suitable sites for settlement and metamorphose into early juveniles (or spats) within 2 weeks of spawning (Soo and Todd 2014). According to Munro (1993), giant clams are facultative planktotrophs, in that they are essentially planktotrophic (i.e., they feed on plankton) but they can acquire all of the nutrition required for maintenance from their symbiotic algae, *Symbiodinium*.

4.9.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, pollution, and exploitation. The harvest of giant clams is for both subsistence purposes (e.g., giant clam adductor, gonad, muscle, and mantle tissues are all used for food products and local consumption), as well as commercial purposes for global international trade (e.g., giant clam shells are used for a number of items, including jewelry, ornaments, soap dishes). The extent of each of these threats is largely unknown. Blidberg et al. (2000) studied the effect of increasing water temperature on *T. gigas, T. derasa,* and *H. hippopus* at a laboratory in the Philippines. *H. hippopus* experienced increased respiration and production of oxygen in elevated temperatures and was therefore more sensitive to higher temperature than the two other species tested. After 24 hours at ambient temperature plus 3°C, however, no bleaching was observed for any of the species. The susceptibility and impacts of disease on *H hippopus* are not known, but incidences of mortality from rickettsiales-like organisms in cultured clams in the western Pacific, one in the Philippines and one in Kosrae have been documented (Norton et al. 1993).

4.9.4 Conservation of the Species

H hippopus is listed in CITES Appendix II, is an ESA candidate species and is therefore a consultation species under the UES.

4.10 *Tridacna squamosa* (giant clam)

T. squamosa is broadly distributed across the Indo-Pacific region. It is a candidate species for listing under the ESA, therefore *T. squamosa* is a consultation species under UES section 3-4.5.1 (a).

4.10.1 Distribution and Abundance

T. squamosa has a widespread distribution across the Indo-Pacific. Its range extends from the Red Sea and East African coast across the Indo-Pacific to the Pitcairn Islands. It has also been introduced in Hawaii (CITES 2004). The species' range also extends north to southern Japan, and south to Australia and the Great Barrier Reef (bin Othman *et al*. 2010). This range description reflects the recent range extension of *T. squamosa* to French Polynesia as a result of observations by Gilbert et al. (2007). Within the area potentially impacted at Illeginni, *T.*

squamosa was observed in the lagoon area but not on the ocean side in a recent survey conducted at the impact area. It has been observed at Illeginni, at five more of the 11 USAKA islands, and at 24 of 35 sites within the mid-atoll corridor (NMFS 2017b).

4.10.2 Life History Characteristics Affecting Vulnerability to Proposed Action

T. squamosa is a giant clam which are markedly stenothermal (i.e., they are able to tolerate only a small range of temperature) and thus restricted to warm waters. *T. squamosa* is usually recorded on reefs or sand; it is found attached by its byssus to the surface of coral reefs, usually in moderately protected localities such as reef moats in littoral and shallow water to a depth of 20 m (Kinch and Teitelbaum 2010). This species tends to prefer fairly sheltered lagoon environments next to high islands; however, *T. squamosa* appears to be excluded by *T. maxima* in the closed atoll lagoons of Polynesia (Munro 1992). Neo et al. (2009) found that *T. squamosa* larvae, like many reef invertebrates, prefer substrate with crustose coralline algae. *Tridacna squamosa* is also commonly found amongst branching corals (staghorn, *Acropora* spp.; CITES 2004).

The exact lifespan of tridacnines has not been determined; although it is estimated to vary widely between 8 to several hundred years (Soo and Todd 2014). Little information exists on the size at maturity for giant clams, but size and age at maturity vary by species and geographical location (Ellis 1997). In general, giant clams appear to have relatively late sexual maturity, a sessile, exposed adult phase and broadcast spawning reproductive strategy, all of which can make giant clams vulnerable to depletion and exploitation (Neo *et al.* 2015). All giant clam species are classified as protandrous functional hermaphrodites, meaning they mature first as males and develop later to function as both male and female (Chambers 2007); but otherwise, giant clams follow the typical bivalve mollusk life cycle. *T. squamosa* reaches sexual maturity at sizes of 6 to 16 cm, which equates to a first year of maturity at approximately four years old (CITES 2004). Giant clam spawning can be seasonal; for example, in the Central Pacific, giant clams can spawn year round but are likely to have better gonad maturation around the new or full moon (Kinch and Teitelbaum 2010). In the Southern Pacific, giant clam spawning patterns are seasonal and clams are likely to spawn in spring and throughout the austral summer months (Kinch and Teitelbaum 2010). Once fertilized, the eggs hatch into free-swimming trochophore larvae for around 8 to 15 days (according to the species and location) before settling on the substrate (Soo and Todd 2014; Kinch and Teitelbaum 2010). During the pediveliger larvae stage (the stage when the larvae is able to crawl using its foot), the larvae crawl on the substrate in search of suitable sites for settlement and metamorphose into early juveniles (or spats) within two weeks of spawning (Soo and Todd 2014).

According to Munro (1993), giant clams are facultative planktotrophs, in that they are essentially planktotrophic (i.e., they feed on plankton) but they can acquire all of the nutrition required for maintenance from their symbiotic algae, *Symbiodinium*.

4.10.3 Threats to the Species

Current threats include: thermal stress, acidification, disease, pollution, and exploitation. The harvest of giant clams is for both subsistence purposes (e.g., giant clam adductor, gonad, muscle, and mantle tissues are all used for food products and local consumption), as well as commercial purposes for global international trade (e.g., giant clam shells are used for a number of items, including jewelry, ornaments, soap dishes). The extent of each of these threats is largely unknown. Blidberg et al. (2000) studied the effect of increasing water temperature on *T. gigas, T. derasa,* and *H. hippopus* at a laboratory in the Philippines. *H. hippopus* experienced increased respiration and production of oxygen in elevated temperatures and was therefore more sensitive to higher temperature than the two other species tested. After 24 hours at ambient temperature plus 3°C, however, no bleaching was observed for any of the species. In a lab experiment, short-term temperature increases of 3 °C resulted in *T. squamosa* maintaining a high photosynthetic rate but displaying increased respiratory demands (Elfwing et al. 2001). Watson et al. (2012) showed that a combination of increased ocean CO_2 and temperature are likely to reduce the survival of *T. squamosa*. Specifically, in a lab experiment, *T. squamosa* juvenile survival rates decreased by up to 80 percent with increasing pCO_2 and decreased with increasing seawater temperature for a range of temperatures and pCO_2 combinations that mimic those expected in the next 50 to 100 years. The susceptibility and impacts of disease on *T. squamosa* are not known, but incidences of mortality from rickettsiales-like organisms in cultured clams in the western Pacific, one in the Philippines and one in Kosrae have been documented (Norton et al. 1993).

4.10.4 Conservation of the Species

T. squamosa is listed in CITES Appendix II, is an ESA candidate species and is therefore a consultation species under the UES.

4.11 Humphead wrasse

In October 2012, NMFS was petitioned to list the humphead wrasse as threatened or endangered under the ESA and to designate critical habitat for the species. In February 2013, in its 90-day finding, NMFS determined that this action may be warranted and initiated a status review to determine whether the species would be officially listed (78 FR 13614 [February 28, 2013]). In September 2014, NMFS determined that ESA listing of the humphead wrasse was not warranted (79 FR 57875 [September 26, 2014]). However, this species remains protected under the UES and is therefore a consultation species.

1.1.1 Distribution and Abundance

The humphead wrasse is widely distributed on coral reefs and nearshore habitats throughout much of the tropical Indo-Pacific Ocean. The biogeographic range of the humphead wrasse spans from 30° N to 23° S latitude and includes the Red Sea south to Mozambique in the Indian Ocean, from southern Japan in the northwest Pacific south to New Caledonia in the south Pacific and into the central Pacific Ocean including French Polynesia. The humphead wrasse has been recorded from many islands of Oceania including Kwajalein Atoll, but appears to be absent from the Hawaiian Islands, Johnston Island, Easter Island, Pitcairn, Rapa, and Lord Howe Island with the exception of occasional waifs (Randall et al. 1978).

Although humphead wrasses are widely distributed, natural densities are typically low, even in locations where habitats are presumably intact. Unfished or lightly fished areas have densities ranging from 2–27 individuals per 10,000 square meters of reef. At sites near human population centers or at fished areas, densities are typically lower by tenfold or more and in some locations humphead wrasse are rarely observed (Sadovy et al. 2003). Total abundance throughout its range is difficult to estimate because survey methods may not cover all habitable areas. Existing information suggests that humphead wrasse populations are most abundant and stable in the Indian Ocean.

The humphead wrasse is known to occur in the vicinity of Illeginni Islet. As was found in other studies (Donaldson and Sadovy 2001), the humphead wrasse appears to occur in low densities throughout the Kwajalein Atoll area in NMFS and USFWS biennial surveys. Occurrence records of humphead wrasse suggest a broad, but scattered distribution at USAKA with observations of the species at 26% (32 of 125) of sites at 10 of the 11 surveyed islets since 2010. Adult humphead wrasses have been recorded in seaward reef habitats at Illeginni Islet (shallowest depths approximately 5 m deep (USFWS and NMFS 2012; NMFS and USFWS 2018). Although encountered on numerous occasions at USAKA, direct density measures of humphead wrasse have not been obtained. The adults of this species may range very widely, with typically four or fewer individuals observed within a broad spatial reef area (Dr. R. Schroeder pers, comm.). Two neighboring seaward reef flat sites in 2008 were noted to have adult humphead wrasse present (USFWS 2011). Absent a direct physical or sound related impact, the adults might be expected to show temporary curiosity, altered feeding patterns, and/or displacement.

Shallow inshore branching coral areas with bushy macro-algae, such as those which may exist along the shallow lagoon reef flat at Illeginni Islet, have been noted as potential essential nursery habitat for juvenile humphead wrasse (Tupper 2007). Recent settler and juvenile numbers are presumed to greatly exceed 20 in such habitat (Tupper 2007) and might be grossly approximated to range from 0 to 100 within the lagoon-side waters of Illeginni (NMFS 2014a). A direct physical strike from a payload fragment, toppling or scattering of coral habitat and/or reef substrate, increased exposure to predation through displacement, and/or sound impacts may result in mortalities of juvenile humphead wrasse, assuming they are present within the impact area. Otherwise, loss of habitat may lead to simple displacement, but with a longer-term functional loss of nursery potential contingent both spatially and temporarily on habitat recovery potential (NMFS 2014b).

Humphead wrasse have been observed to aggregate at discrete seaward edges of deep slope drop-offs to broadcast spawn in the water column; they do not deposit their eggs on the substrate (Colin 2010). This type of behavior is not known at Illeginni Islet, but it may exist; however, similar habitat would occur in nearby waters. The flow dynamics of developing fish eggs and larvae around Illeginni Islet are not understood. Initial flow may be away from the islet, with future return or larval/adult source dynamics from another area. No information exists to support any reasonable estimation of potential Air-launched Rapid Response Weapon (ARRW) impacts to humphead wrasse eggs and developing larvae (NMFS 2014a).

1.1.2 Life History Characteristics Affecting Vulnerability to Proposed Action

The humphead wrasse is the largest member of the family Labridae. The humphead wrasse is distinguished from other coral reef fishes, including other wrasses, due primarily to its large size along with its fleshy lips in adults (Myers 1999), prominent bulbous hump that appears on the forehead in larger adults of both sexes, and intricate markings around the eyes (Marshall 1964; Bagnis et al. 1972; Sadovy et al. 2003).

Similar to other wrasses, humphead wrasses forage by turning over or crushing rocks and rubble to reach cryptic organisms (Pogonoski et al. 2002; Sadovy et al. 2003 citing P.S. Lobel, pers.

comm.). The thick fleshy lips of the species appear to absorb sea urchin spines, and the pharyngeal teeth easily crush heavy-shelled sea snails in the genera *Trochus* spp. and *Turbo* spp. The humphead wrasse is also one of the few predators of toxic animals such as boxfishes (*Ostraciidae*), sea hares (*Aplysiidae*), and crown-of-thorns starfish (*Acanthaster planci*) (Randall 1978; Myers 1989; Thaman 1998; Sadovy et al. 2003).

Both juveniles and adults utilize reef habitats. Juveniles inhabit denser coral reefs closer to shore and adults live in deeper, more open water at the edges of reefs in channels, channel slopes, and lagoon reef slopes (Donaldson and Sadovy 2001). While there is limited knowledge of their movements, it is believed that adults are largely sedentary over a patch of reef and during certain times of the year they move short distances to congregate at spawning sites (NMFS 2009). Humphead wrasse density increases with hard coral cover, where smaller fish are found in areas with greater hard coral cover (Sadovy et al. 2003).

Field reports reveal variable humphead wrasse spawning behavior, depending on location (Sadovy et al. 2003; Colin 2010). Spawning can occur between several and all months of the year, coinciding with certain phases of the tidal cycle (usually after high tide) and possibly lunar cycle (Sadovy et al. 2003; Colin 2010). Spawning can reportedly occur in small (< 10 individuals) or large (≤ 100 individuals) groupings, which can take place daily in a variety of reef types (Sadovy et al. 2003; Sadovy de Mitcheson et al. 2008; Colin 2010). Based on available information, it is suggested that the typical size of female sexual maturation for the humphead wrasse occurs at 40–50 cm TL (Sadovy de Mitcheson et al. 2010). Choat et al. (2006) estimated length at first maturity as 45–50 cm FL for females (6–7 years) and 70 cm FL (9 years) for males.

1.1.3 Threats to the Species

USAKA identified four major threats to humphead wrasse: 1) habitat destruction, modification, or curtailment; 2) overutilization for commercial, recreational, scientific or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) natural and other man-made factors. Habitat destruction, overfishing, and inadequacy of existing regulatory mechanisms, and some man-made factors such as pollution are threats locally throughout portions of its range. However, the ERA team concluded that four of the five threats evaluated are not significant risks to extinction. Natural and man-made factors, namely climate change, were noted as a small to moderate effects on species risk of extinction.

1.1.4 Conservation of the Species

Humphead wrasse is listed in CITES Appendix II, and has been retained as a consultation species under the UES.

5 ENVIRONMENTAL BASELINE

The UES does not specifically describe the environmental baseline for a Biological Opinion. However, under the ESA, environmental baselines include the past and present impacts of all state, federal or private actions and other human activities in the Action Area, anticipated impacts of all proposed federal projects in the Action Area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is “an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the Action Area” (FWS and NMFS 1998). The purpose of describing the environmental baseline in this manner in a biological opinion is to provide context for effects of the proposed action on listed species. We apply the ESA standards consistent with the intent of the UES agreement in our effects analysis. As described in Sections 2 and 3 above, the action area where the proposed action may adversely affect consultation species consists of the marine waters adjacent to Illeginni Islet at Kwajalein Atoll, RMI (Figure 7**)**.

Figure 7. Illeginni Islet, RMI.

The Marshall Islands consist of 29 atolls and five islands aligned in two roughly parallel northwest-southeast chains: the northeastern Ratak Chain and the southwestern Ralik Chain. The total land area is about 70 square miles, and the total lagoon area is about 4,500 square miles. Kwajalein Atoll is located near the center of the island group, about eight degrees above the equator, and is one of the largest coral reef atolls in the world. The past and present impacts of human and natural factors leading to the status of UES-protected species within the action area include coastal development, armed conflict, direct take, fishing interactions, vessel strikes and groundings, marine debris, and climate change.

Kwajalein Atoll was the site of heavy fighting during World War II (1940s), when the U.S. took it from the Japanese. Many of the islets have been heavily modified by dredge and fill construction operations by both the Japanese and U.S. forces. More recently, the RMI has provided 11 islets around the rim of Kwajalein Atoll for the use by the U.S. Government as part of the RTS. Hundreds of U.S. personnel live on some of the islets, and Marshallese workers commute daily between the U.S. occupied islets and the ones on which they reside. Vessel traffic occurs regularly between the islets, and to and from the atoll. This includes fishing boats, personnel ferries, military service craft, visiting military ships, and cargo vessels that supply the peoples of Kwajalein Atoll. For more than 18 years, the USAKA has participated in testing hypersonic vehicles from ICBM and other flight tests launched from Vandenberg AFB and other locations. Vehicle impacts from such tests have occurred and continue to occur on and in the vicinity of Illeginni Islet and in adjacent ocean waters. In the Opinion on the Minuteman III operations through the year 2030 it was estimated that 49,645 colonies of the 15 species of UES corals and 117 top shell snails may be killed (NMFS 2015).

On May 16, 2005, we issued a letter of concurrence (LOC) with the USAF's "not likely to adversely affect" determination for sea turtles and marine mammals under our jurisdiction. It is important to note that sea turtles are under the jurisdiction of the FWS while in terrestrial habitats, whereas they are under our jurisdiction when in marine habitats. Therefore, any impacts on hauled-out or nesting adult turtles, eggs in nests, or hatchlings before they reach the water, were considered in the 2005 FWS Opinion, not in our LOC.

On March 2, 2017, the US Navy SSP consulted with NMFS on the effects of a near identical action, the Flight Experiment 1 (FE-1). NMFS concluded in a biological opinion dated May 12, 2017 that the FE-1 would not jeopardize 59 marine ESA/UES consultation species." (PIR-2017-10125; I-PI-17-1504-AG). In that opinion, NMFS estimated that the action could result in up to 10,417 colonies of UES consultation corals (as quantified in table 7) experiencing complete mortality, up to four top shell snails being killed, and up to 90 clams, and 108 humphead wrasses being injured or killed. The target site was the exact same as this proposed action and made an impact on land and not in water. No take was quantified for this action.

On February 12, 2019, USASMDC/ARSTRAT, consulted on the ARRW Flight Tests NMFS' Biological Opinion was dated July 30, 2019 (PIRO-2019-00639; I-PI-19-1751-AG). This missile test is expected to impact the same islet targeted in this proposed action. As with the FE-1 and FE-2, impact is expected to occur on land, but could occur in water. In that opinion, NMFS estimated that the action could result in up to 10,417 colonies of UES consultation corals experiencing complete mortality, up to four top shell snails being killed by the proposed action, and up to 90 clams, and 108 humphead wrasses being injured or killed by the proposed action.

On July 4, 2019, we completed informal consultation on the effects of launching a Terminal High Altitude Area Defense (THAAD) missile and subsequent intercept of a medium-range ballistic missile over the Pacific Ocean concluding the operation was not likely to adversely affect 44 species protected under the standards and procedures described in the Environmental Standards and Procedures for U.S. Army Kwajalein Atoll (PIRO-2019-01962; I-PI-19-1769-AG). This test is expected to launch from a neighboring islet within USAKA.

On June 14, 2018, USASMDC/ARSTRAT, on behalf of the U.S. Navy SSP, requested consultation on the effects of launching a single Flight Experiment-2 (FE-2) missile from the PMRF on Hawaii, across the Pacific, and impact at Kwajalein Atoll. NMFS concluded in a Biological Opinion dated September 27, 2019 that the FE-2 would not jeopardize any of the marine ESA/UES consultation species covered under that consultation (PIR-2019-02607; I-PI-19-1782-AG). In that opinion, NMFS estimated that the action could result in up to 10,404 colonies of UES consultation corals (as quantified in Table 10) experiencing complete mortality, and up to 4 top shell snails, 108 humphead wrasse, and up to 75 clams being killed. The target site was the exact same as this proposed action and made an impact on land and not in water.

On November 16, 2020, the USASMDC/U.S. Air Force requested consultation on the effects of launching multiple Ground Based Strategic Defense (GBSD) flight tests from Vandenberg Air Force Base, California, across the Pacific, and impact at Kwajalein Atoll. NMFS concluded in a Biological Opinion dated March 15, 2021 that the GBSD tests would not jeopardize any of the marine ESA/UES consultation species covered under that consultation (PIRO-2020-03355; I-PI-20-1884-AG). In that opinion, NMFS estimated that the action could result in up to 31,224 colonies of UES consultation corals (as quantified in Table 8) could experience complete mortality, up to nine top shell snail, up to 219 clams, and up to 324 humphead wrasse could be killed by the proposed action. The target sites included on land at Kwajalein Atoll, in the vicinity of the island, and/or in the KMISS.

These estimates are likely higher than what the total impacts will be due to the unlikely event of a shoreline impact and the data the estimates were based on. The estimates were based on surveys that have been conducted throughout the area but not in the impact zone. A survey was completed after these estimates were made and some of the corals that were predicted to be in the area were not observed and others were observed at densities lower than what had been estimated (NMFS 2017a). Additional surveys could show that they are indeed in the area but not at higher levels than estimated. Direct take through harvest continues in the RMI for several of the UES consultation species. For example, sea turtles, black lip pearl oysters, and top shell snails (all of which are UES consultation species) are considered a food source or of economic value by many RMI nationals. The harvest of these and other UES-protected marine species is believed to continue on most of the inhabited islands and islets of the RMI, with the possible exception of the USAKA-controlled islets, where access is limited and the UES prohibits those activities. However, the level of exploitation is unknown, and no concerted research or management effort has been made to conserve these species in the RMI. No information is currently available to quantify the level of impact direct take is having on consultation species in the Marshall Islands.

Despite the development, wartime impacts, and human utilization of marine resources mentioned above, the atoll's position at the center of the Pacific Ocean is far from highly industrialized areas, and its human population remains relatively low. Consequently, the water quality level of the lagoon and the surrounding ocean is very high, and the health of the reef communities, along with the overall marine environment of Kwajalein Atoll, borders on pristine.

Climate change may be affecting marine ecosystems at Kwajalein Atoll. Climate refers to average weather conditions within a certain range of variability. The term climate change refers to distinct long-term changes in measures of climate, such as temperature, rainfall, snow, or wind patterns lasting for decades or longer. Climate change may result from: natural factors, such as changes in the Sun's energy or slow changes in the Earth's orbit around the sun; natural processes within the climate system (e.g., changes in ocean circulation); and human activities that change the atmosphere's makeup (e.g., burning fossil fuels) and the land surface (e.g., cutting down forests, planting trees, building developments in cities and suburbs, etc.), also known as anthropogenic climate change (U.S. Environmental Protection Agency). The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Solomon et al. 2007). Sea level rose approximately 17 cm during the 20th century (Solomon et al. 2007) and further increases are expected. Climate change is a global phenomenon so resultant impacts have likely been occurring in the action area. However, scientific data describing impacts in the action area are lacking, and no climate change-related impacts on UES-protected species within the action area have been reported to date.

Climate change-induced elevated water temperatures, altered oceanic chemistry, and rising sea level may be contributing to changes to coral reef ecosystems, and is likely beginning to affect corals and mollusks found in the action area. Globally, climate change is adversely affecting many species of corals. Increasing thermal stress due to rising water temperatures has already had significant effects on most coral reefs around the world. It has been linked to widespread and accelerated bleaching and mass mortalities of corals around the world over the past 25 years (Brainard et al. 2011). As the atmospheric concentration of CO_2 has increased, there has been a corresponding reduction in the pH of ocean waters (acidification). As ocean acidity increases, the calcium carbonate saturation state of the water decreases. Increased ocean acidity has the potential to lower the calcium carbonate saturation state enough to slow calcification in most corals and may increase bioerosion of coral reefs. It is thought to adversely affect fertilization, larval settlement, and zooxanthellae acquisition rates for corals, and can induce bleaching more so than thermal stress, and tends to decrease growth and calcification rates (Brainard et al. 2011). By the middle of this century, ocean acidity could lower calcium carbonate saturation to the point where the reefs may begin to dissolve (Brainard et al. 2011).

Attempting to determine whether recent biological trends are causally related to anthropogenic climate change is complicated because non-climatic influences dominate local, short-term biological changes. However, the meta-analyses of 334 species and the global analyses of 1,570 species show highly significant, nonrandom patterns of change in accord with observed climate warming in the twentieth century. In other words, it appears that these trends are being influenced by climate change-related phenomena, rather than being explained by natural variability or other factors (Parmesan and Yohe 2003). However, the implications of these changes are not clear in terms of population level impacts, and data specific to the action area are lacking. Over the long-term, climate change-related impacts could influence the biological trajectories of UES-protected species on a century scale (Parmesan and Yohe 2003). However, due to a lack of scientific data, the specific effects climate change could have on these species in the future are not predictable or quantifiable to any degree that would allow for more detailed analysis in this consultation (Hawkes et al. 2009).

6 EFFECTS OF THE ACTION

In this section of a biological opinion, we assess the probable effects of the proposed action on UES-protected species. In Effects of the Action sections of biological opinions, NMFS presents the results of its assessment of the probable effects of federal actions on threatened and endangered species and designated critical habitat that are the subject of a consultation. According to 50 CFR 402.02, Effects of the Action "are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action." Furthermore, 50 CFR 402.17 explains: "A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available." Factors to consider when evaluating whether activities caused by the proposed action (but not part of the proposed action) or activities reviewed under cumulative effects are reasonably certain to occur include, but are not limited to: (1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;(2) existing plans for the activity; and (3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward." (50 CFR 402.17). The effects of the action are considered within the context of the Status of the Species, together with the Environmental Baseline and Cumulative Effects sections of this Opinion to determine if the proposed action can be expected to have direct or indirect effects on UES-protected species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination. The actions are not expected to adversely affect any essential features of critical habitat that has been designated in the action area.

Approach. We determine the effects of the action using a sequence of steps. The first step identifies potential stressors associated with the proposed action with regard to listed species. We may determine that some potential stressors result in insignificant, discountable, or beneficial effects to listed species, in which case these potential stressors are considered not likely to adversely affect protected species, and subsequently are considered no further in this Opinion. Those stressors that are expected to result in significant negative (i.e., adverse) effects to listed species are analyzed via the second, third, and fourth steps described below.

The second step identifies the magnitude of the stressors (e.g., how many individuals of a particular species would be exposed to the stressors; *exposure analysis*). In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to a proposed action's effects, and the populations or subpopulations those individuals represent.

The third step describes how the exposed individuals are likely to respond to the stressors (*response analysis*). In this step, we determine if the stressors are likely to result in any adverse effects on exposed individuals.

The final step in determining the effects of the action is to establish the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, as mentioned above, the action area includes no designated critical habitat, thus it is not considered in this Opinion. Our jeopardy determinations must be based on an action's effects on the continued existence of UES-protected species within USAKA. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of extinction or probability of persistence) of listed species depends on the viability of their populations.

6.1 Stressors

As described above in Section 3, we believe that the proposed action would cause five stressors that may affect the consultation species considered in this consultation: 1) exposure to elevated noise levels; 2) impact by falling missile components; 3) exposure to hazardous materials; 4) disturbance from human activity and equipment operation; and 5) collision with vessels. Of those stressors, impact by falling missile components, specifically for the payload that would target

Illeginni Islet, is the only stressor that is likely to adversely affect consultation species. The remaining stressors are expected to have insignificant effects (i.e. effects would not result in take) and/or exposure is discountable (extremely unlikely to occur), and those stressors are discussed no further in this Opinion. Similarly, Section 3 described why all of the species identified in Table 1 are unlikely to be adversely affected, and therefore considered no further in this Opinion. In summary, the 7 coral species, top shell snail, two giant clams and the humphead wrasse identified in Table 2 may be hit by the falling payload or by ejecta, or be significantly affected by concussive forces during the single planned payload on Illeginni Islet.

Note: Within the seven coral species that may be adversely affected by the proposed action, the effects are expected to be practically identical. Addressing the species individually would significantly increase the length of this Opinion with no discernible improvement in the evaluation. Therefore, all seven coral species are referred to together as “corals”, unless an individual species needs to be identified due to some unique sensitivity or response. The same is true for the two clam species.

6.2 Exposure to Impact by Falling Missile Components

This section analyzes the proposed action’s potential for exposing UES-consultation corals and top shell snails to being hit by the FT-3 payload or ejecta thereof planned to strike on Illeginni Islet. This analysis is based on the distribution and density report completed for the MM III proposed action, the follow-up survey post action, and on personal communication with the survey team (NMFS 2014b, NMFS 2017a, Kolinski pers. comm. 2015), and on the description of the effects of the FE-1 flight test (SSP 2017), a biological survey conducted at USAKA launch sites by NMFS in preparation for the THAAD operation (NMFS 2018), the recent THAAD test (MDA/USASMDC/ARSTRAT 2019), and the FE-2 flight test (SSP 2019). We believe that the distribution and density report represents the best available information to make those estimates.

The quantitative estimates of species distribution and abundance within the potentially affected areas at Illeginni are based on surveys of 136 sites around the 11 USAKA islets, including four sites around Illeginni (NMFS 2014b). Species observed to occur on reef flat, crest, and gently sloping substrates around USAKA islets at depths less than or equal to 35 feet water depth were considered as potentially being present within the MMIII, FE-1, THAAD, and FE-2 impact area and hence the FT-3 impact area. Because the available survey information also includes the observed distribution and abundance of the affected consultation species in numerous habitat types around the 11 USAKA islets and at 35 survey sites throughout the mid-atoll corridor (MAC), we believe that the existing information also serves as a reasonable foundation to estimate the distribution and abundance of these organisms throughout USAKA. Analyses of effect of MMIII reentry vehicles (USAFGSC and USASMDC/ARSTRAT 2015) and FE-1 and FE-2 payload impact (US Navy 2017; 2019) at Illeginni Islet were conducted based on coral, mollusk, and fish densities extrapolated from coral presence and abundance from similar reef habitats throughout USAKA. In 2017, NMFS-PIRO completed a report with revised density estimates for many consultation species based on 2014 assessments of the reefs adjacent to the impact area at Illeginni Islet (NMFS-PIRO 2017a and 2017b). The areas surveyed for this assessment encompassed all of the action area reef habitat on the lagoon side and 99% of the reef area on the ocean side (NMFS 2017a and 2017b). Additionally, NMFS-PIRO conducted a survey within USAKA at two launch sites in 2018 to provide data for the THAAD operation (NMFS

2018). Based on coverage area of this assessment, these data are considered the best available information for coral and mollusk species presence and density in the action area.

The humphead wrasse (*Cheilinus undulatus*) was not observed during the 2014 surveys for the most recent assessment of consultation organisms at Illeginni Islet (NMFS 2017a); however, this species has been recorded in both ocean-side and lagoon-side habitats adjacent to the impact area in other surveys. Since the humphead wrasse is a highly mobile species, the extrapolation methods for estimating density which were previously used for impact analysis are still considered the best available data for a conservative approach. Therefore, humphead wrasse densities were estimated by NMFS Pacific Islands Regional Office (NMFS-PIRO) based on quantitative data collected during the 2008 species inventory, recent impact assessments on natural substrates at USAKA and, for egg and fish recruit derivations, from the literature (NMFS 2014b). *Cheilinus undulatus* typically occurs in broadly distributed low numbers and has been seen near Illeginni islet. It is possible that and estimated 8 adults may occur within the entire potential ocean-side affected area, and 0 to 100 juveniles may occur within the entire potential lagoon-side affected area.

There is a chance that the FT-3 payload could strike the water's edge along the lagoon or ocean shore at Illeginni. Empirical observations of historical reentry vehicle impacts from MMIII tests in very shallow waters found that most debris was contained within the crater and ejecta were concentrated within 1.5 to 3 m of the crater rim (USAFGSC and USASMDC/ARSTRAT 2015). As with MMIII reentry vehicles, FE-1, FE-2, or THAAD test, we estimate that the payload land impact may produce ejecta and debris concentrated near the impact site and extending outward to 91 m. Empirical evidence from MMIII tests corroborates predictions of the propagation of shock waves associated with impact were approximately 37.5 m through the adjacent reef from the point of impact on the shoreline (USAFGSC and USASMDC/ARSTRAT 2015). Coral, and mollusk mortality or injury could occur from impact by shock/vibration. These reef impacts were based on observations of damaged corals, which can be affected by ground borne vibration.

Habitat suitability for consultation species is lowest along the water's edge and with the exception of sandy patches, typically increases with distance from shore. Based on the 2014 NMFS surveys and the best professional judgment of NMFS survey divers, approximately 80 percent of the lagoon-side survey area and 75 percent of the ocean-side survey area (Figure 8 below) are considered potentially viable habitat for consultation fish, coral, and mollusks (NMFS 2019; U.S. Army 2020). Using these estimates of suitable habitat and assuming the ejecta would be equally distributed on the lagoon and ocean sides of the islet (i.e., half of debris on each side); approximately 7.8 m^2 (9.3 yd^2) of lagoon-side suitable habitat and 7.3 m^2 (8.7 yd^2) of ocean-side suitable habitat may be impacted by debris. (Figure 8).

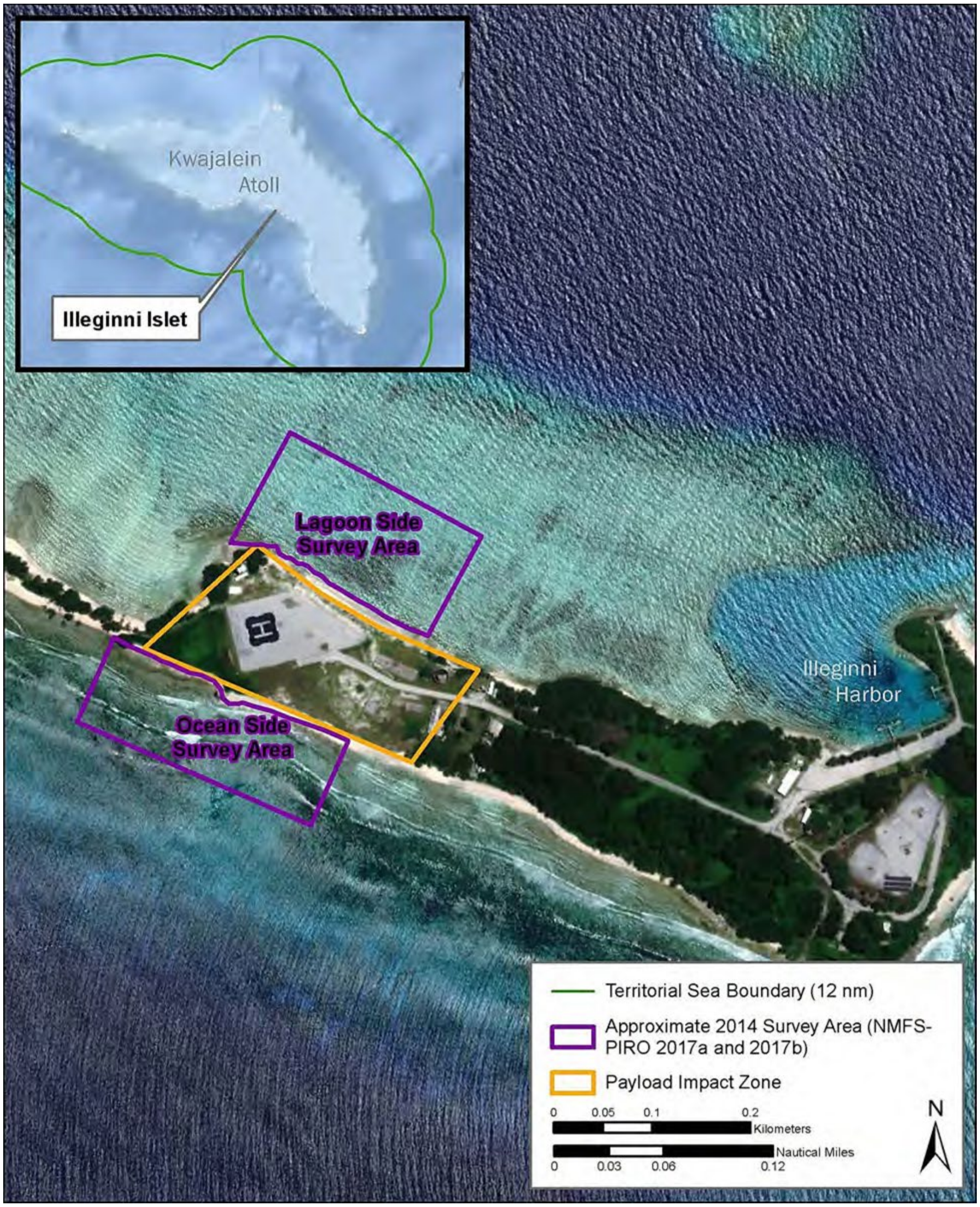

Figure 8. NMFS 2014 Marine Resource Survey Areas at Illeginni Islet, Kwajalein Atoll (provided by U.S. Army).

It is reasonable to assume that the effects of debris fall and shock waves would not occur evenly across an entire area of potentially viable habitat. Thus, the actual habitat area that would be affected is considered to be a proportion of the total estimated viable habitat. Since there are no data available to identify this unknown proportion or the actual amount of viable habitat that would be affected by debris fall or shock waves, these analyses should be regarded as an overestimate and those of maximum effect.

The effects of ejecta impact would not occur evenly across the affected area. Chunks of ejecta would be scattered across the area; impacting a small proportion of the suitable habitat. The U.S. Army anticipates that only 1 percent of ejecta could reach the water's edge, while 99 percent of the ejecta is anticipated to fall on land.

Also, the area within the shock wave range of effect would be completely contained within the area at risk for ejecta impacts. The anticipated worst-case scenario of a payload land impact at Illeginni islet is a shoreline strike, which would result in effects that would extend outward from the point of strike. On both sides of Illeginni Islet, the area may potentially be affected by debris fall. Since these areas overlap and since harmed individuals should be counted only once in the effects of the Action, the affected habitat area with the largest estimated take was selected as the worst-case scenario. Although the exact shape of the affected area is impossible to estimate, the seaward portion of such an area is conceptually illustrated as a rough semi-circle on the lagoon and ocean sides of Illeginni Islet with a radius of 91 m (Figure 9).

Figure 9. Representative Maximum Direct Contact Affect Areas for a Shoreline Payload Impact at Illeginni Islet, Kwajalein Atoll.

It is reasonable to assume that the effects of debris fall and shock waves would not occur evenly across an entire area of potentially viable habitat. Thus, the actual habitat area that would be affected is considered to be a proportion of the total estimated viable habitat. Since there are no data available to identify this unknown proportion or the actual amount of viable habitat that

would be affected by debris fall or shock waves, these analyses assume that the entire area will be affected and should be regarded as an overestimate and those of maximum effect.
The number of potential coral and mollusk exposures to direct contact was calculated based on the density of coral colonies and mollusks reported by NMFS in 2017 (NMFS-PIRO 2017a, 2017b). The 99% upper confidence level of the bootstrap mean densities for the potentially affected consultation species in the area was multiplied by the areal extent of potentially affected suitable habitat to estimate the number of coral colonies and top shell snails that may be adversely affected by ejecta and/or shock wave effects by a payload land impact at Illeginni Islet (Table 9). Based on new information available for the FT-3, the number of species anticipated to be adversely affected is slightly different than what was anticipated for the FE-2 test. To err on the side of the species, each fraction is rounded up to the next whole individual number.

Table 9. Estimated number of consultation coral colonies, fish, and individual mollusks in affected habitat

Scientific Name	Species	Colonies or Individuals Affected
Corals		
Acropora microclados	No Common Name	<0.01 - 0.01 = 1
A. polystoma	No Common Name	<0.01 - 0.01 = 1
Cyphastrea agassizi	No Common Name	<0.01 - 0.01 = 1
Heliopora coerulea	No Common Name	1.25 - 3.51 = 4
Pavona venosa	No Common Name	<0.01 - 0.01 = 1
Turbinaria reniformis	No Common Name	<0.01 - 0.01 = 1
Pocillopora meandrina	Cauliflower coral	2.19 - 4.24 = 5
Mollusks		
Tectus niloticus	Top Shell Snail	<0.01 = 1
Hippopus hippopus	Giant clam	0.02 – 0.05 = 1
Tridacna squamosa	Giant clam	<0.01 – 0.01 = 1
Fish		
Cheilinus undulates	Humphead wrasse	108 (8 adults/100 juveniles)

6.3 Response to Falling Missile Components

This section analyzes the responses of UES-consultation corals, top shell snails, giant clams, and humphead wrasse that may be exposed to being hit by the FT-3 payload and/or ejecta.

The FT-3 payload would be traveling at hypersonic velocity when it impacts the islet. The kinetic energy released into the substrate would be similar to the detonation of high explosives. The payload will effectively “explode”, with some of its mass reduced to very fine particles (“aerosolized”) and the remainder reduced to an undescribed range of fragment sizes. The substrate at the impact site would be blasted into a range of fragment sizes ranging from powder to larger rocks toward the outer edges of the crater. Some debris and substrate rubble would remain in the crater. The remainder would be thrown from the crater (ejecta). Initially, some of the ejecta would be moving at high velocity (bullet speeds). Some ejecta would move laterally, some would travel upward then fall back down up to 91 m from the impact site. The substrate immediately around the crater would be covered by larger chunks of ejecta from the outer edges of the crater as well as finer material that was thrown more vertically before falling back down. The movement of ejecta away from the crater would act to spread it out (scatter) over an increasing area, with decreasing available material being scattered over an increasing area. The velocity of the ejecta would also diminish with distance.

The intensity of the payload impact, and the uniformity of exposure to ejecta and the shock wave would decrease with distance from the point of impact. Any corals and top shell snails directly beneath the payload, or within the crater radius are expected to be instantly killed, with very little left of the organisms that would be recognizable. Beyond the crater, corals and top shell snails would be exposed to ejecta and the ground borne shock wave. Corals and top shell snails immediately beyond the crater would likely experience mortality from impact by high-velocity ejecta, from burial under mobilized crater material, or from exposure to the ground borne shock wave.

For corals, the USASMDC/RCCTO estimated that there could be up to 14 impacted coral colonies in the action area. The response of corals to ejecta and the ground borne shock wave would depend largely on the scale and intensity of the exposure. Impact by high-velocity dense ejecta (rock or metal), could fracture the hard structure of corals and would likely injure or destroy soft tissues. Fracturing would depend largely on the size and intensity of the impact and on morphology of the impacted coral. Plate-forming and branching corals are more easily broken than large massive or encrusting forms. Fractures due to payload impact are expected to range from pulverization of colonies in and close to the crater, to cracks and/or loss of branches in colonies toward the outer edge of effect. Additionally, exposure to the ground based shock wave could also fracture or dislodge coral colonies out to about 37.5 m from the payload impact. Because the coral skeletons are hard rock-like structures that are rigidly fixed to the hard substrate through which the shock wave would travel, much of the available energy in the substrate can be transferred directly into the coral’s skeletal structure. If the shock wave is intense enough, the coral’s structure may crack or fracture and/or it may become unattached from the substrate. At close ranges, impact by lower velocity and/or lower density ejecta could affect the soft tissues of corals, ranging from burial to scouring away all or most of the living polyps and interconnecting soft tissues from a colony. At greater ranges, localized damage of a small part of a colony is possible.

Pulverization of a colony’s structure, deep burial, or loss of a large proportion of a colony’s soft tissue would likely result in the mortality of the colony. Partial fracturing of a coral skeleton and/or dislodgement of a coral from the substrate due to ejecta impact or from exposure to the ground based shock wave would injure the soft tissues at and around the break. Re-growth of soft tissues has energetic costs that could slow other growth and reproduction. Exposed areas of coral skeleton are prone to bioerosion and overgrowth by algae and certain sponges. Large areas of damaged or dead tissue could result in the introduction of algae that may prevent the regeneration of healthy coral tissue, or that may overcome the whole colony. Damaged and stressed tissues may also be more susceptible to infection by coral diseases that may hinder or prevent healing to the point that the colony dies.

Fragmentation is a form of asexual reproduction in some branching corals, resulting in the development of new, but genetically identical colonies. Bothwell (1981) reports that several *Acropora* species successfully colonize through fragmentation and translocation of fragments by storm-driven waves. However, not all coral fragments, or dislodged colonies would be expected to survive. Survival would depend largely on where a fragment falls and how it is oriented after it settles to substrate. A fragment or colony is likely to die if the living tissue is on the underside of the fragment or if the fragment settles into fine sediments. Additionally, in areas that experience regular high surf, such as the ocean side reef at Illeginni, loose coral fragments and colonies could repeatedly become mobilized by the waves. This reduces the likelihood of their survival, and potentially injures additional coral colonies should the fragments be cast against them.

Based on the available information, we believe that the 14 coral colonies, identified above in Table 9, represent a conservative yet reasonable estimate of the corals that may be adversely affected by the proposed action. Further, this Opinion conservatively assumes that mortality would result for all exposed coral colonies. This approach is being taken to ensure a precautionary assessment is made of the jeopardy risk for the affected species.

In the case of the top shell snail, the USASMDC/RCCTO estimated that there will be up to one top shell snail in the area of impact pictured in Figure 9. The effects of exposure to ejecta and shock wave is expected to quickly diminish to insignificance with distance from the payload impact site. Impact by high-velocity dense ejecta (rock or metal) immediately around the crater could penetrate or fracture an exposed snail's shell, either killing the animal directly, or leaving it vulnerable to predation. Conversely, with movement away from the payload impact site, ejecta would become slower, and the ejecta would have to penetrate increasing water depth to impact the snails. Considering the conical shape and thickness of a top shell snail's shell, most ejecta that may strike one that is under water and at any distance from the payload impact site is likely to be deflected without imparting a significant proportion of its kinetic energy to the shell or the animal within.

Top shell snails immediately around the payload crater may also be buried by ejecta. The potential for burial, and the depth of the material under which a snail may be buried would likely decrease quickly with distance from the payload impact site. Mortality could result if the snail is crushed, smothered, or permanently pinned beneath rubble. Non-lethal effects could include energetic costs and/or foraging impacts.

Exposure to intense ground borne shock waves could injure the soft tissues of top shell snails. Mortality of the snail is possible if the injury is significant enough. The range to the onset of significant injuries for top shell snails exposed to a ground based payload impact shock wave is unknown, but it is likely much less than that estimated for corals (37.5 m). Top shell snails are not rigidly attached to the substrate as are corals. Instead, they adhere to the reef using a muscular foot. Whereas rigidly attached corals would be directly linked to the substrate such that the energy could readily travel into and along its skeletal structure, the muscular foot of the snail would act to isolate the snail's shell from the vibration, and to reduce the transfer of the energy to other soft tissues and organs. Non-lethal effects could include bruising of the foot and other tissues, which may have energetic costs and/or may have reproductive impacts.

As stated above, habitat suitability for the consultation species is lowest along the water's edge and typically increases with distance from shore. Therefore, top shell snail density would be lowest in the area immediately adjacent to the payload impact site, where ejecta effects and shock wave would be greatest. Conversely, in the areas where top shell snail density would be highest, ejecta would be slower, and it would have to penetrate several feet of water to impact the snails. Based on this, on the robust nature of snails (see Section 4), and the characteristics of its shell, most ejecta that may strike top shell snails is likely to be deflected without imparting any significant proportion of its kinetic energy to the shell or the animal within. In this situation, ejecta impact would result in little more than inducing the affected snail to briefly adhere more tightly to the substrate before resuming normal behaviors. The range to adverse effects from burial and shock waves would likely be similarly restricted to the area along the water's edge. Therefore, we expect that up to one top shell snail that may be exposed to the combined effects of a payload land strike (Table 9, above), would be adversely affected by the exposure.

In the case of the clams, the USASMDC/RCCTO estimated that there will be up to two clams impacted in the impact area pictured in figure 9. The effects of exposure to ejecta and shock wave is expected to quickly diminish to insignificance with distance from the payload impact site. Impact by high-velocity dense ejecta (rock or metal) immediately around the crater could penetrate or fracture an exposed clam shell, or damage soft tissue that is exposed possibly killing the animal. Conversely, with movement away from the payload impact site, ejecta would become slower, and the ejecta would have to penetrate increasing water depth to impact the clams. Considering the thickness of a clam shell, most ejecta that may strike one that is under water and at any distance from the payload impact site is likely to be deflected without imparting a significant proportion of its kinetic energy to the shell or the animal within unless it is able to lodge itself in the shell opening.

Clams immediately around the payload crater may also be buried by ejecta. The potential for burial, and the depth of the material under which a clam may be buried would likely decrease quickly with distance from the payload impact site. Mortality could result if the clam is crushed, smothered, or permanently pinned beneath rubble. Non-lethal effects could include foraging impacts if the clam is unable to filter feed due to debris.

Exposure to intense ground borne shock waves could injure the soft tissues of clams. Mortality is possible if the injury is significant enough. The range to the onset of significant injuries for clams exposed to a ground based payload impact shock wave is unknown. Clams can be buried in substrate or attached to corals which means they would be directly linked to the substrate such that the energy could readily travel into the shell and affect the soft tissue and organs. Non-lethal effects could include bruising of the tissues, which may have energetic costs and/or may have reproductive impacts.

As stated above, habitat suitability for the consultation species is lowest along the water's edge and typically increases with distance from shore. Therefore, clam density would be lowest in the area immediately adjacent to the payload impact site, where ejecta effects and shock wave would be greatest. Conversely, in the areas where clam density would be highest, ejecta would be slower, and it would have to penetrate several feet of water to impact the clams. Based on this, on the robust nature of clams, and the characteristics of its shell, most ejecta that may strike clams is likely to be deflected without imparting any significant proportion of its kinetic energy to the shell or the animal within. In this situation, ejecta impact would result in little more than inducing the affected clam to close before resuming normal behaviors. The range to adverse effects from burial and shock waves would likely be similarly restricted to the area along the water's edge. Therefore, we expect that up to two clams may be exposed to the combined effects of a payload land strike (Table 9, above), and would be adversely affected by the exposure.

In the case of the humphead wrasse, the USASMDC/RCCTO estimated that, based on estimated abundance, density, and survey data, there will be up to 100 juvenile, and eight adult humphead wrasses in the area of impact pictured in Figure 9 (MDA/USASMDC/ARSTRAT 2019; SSP 2019). An individual animal could be exposed to ejecta hitting and traveling through the water and from the shock wave produced from the main projectile's impact. An animal subjected to a direct impact, concussive shock waves from the impact, ejecta, or a near miss of ejecta would result in wounding or death. Potential injuries may include cuts, gashes, bruises, broken bones, rupture or hemorrhage of internal organs, amputation, or other broken body parts; any of which could result in an animal's death. Since the arcs (the affected area on the lagoon and the affected area on the ocean) were drawn and estimated based on shoreline strikes on each side, the model assumes mishits on every test, which is highly unlikely to occur. Furthermore, it assumes that ejecta will uniformly spread, especially to the outer extents of those circles (~100 m away). Humphead wrasses were observed beyond the reef crest near the edges of those arcs.

As mentioned in previous sections, the USASMDC/ARSTRAT observed the majority of ejecta stayed within a few meters of the impact area. The density of ejecta is expected to decrease with distance from the point of impact (USAFGSC and USASMDC/ARSTRAT 2015). Ejecta is also likely to lose velocity the further it travels from the source. The depth of the water in the 91 m radius is expected to be less than 3 m. Humphead wrasses are generally not surface-dwelling fish where they would be the most vulnerable to strikes. Graham et al. (2015) reports that humphead wrasse are most often encountered on outer reef slopes and reef passes/channels at depths of only a few meters to at least 60 m (Randall 1978); other reports document humphead wrasses to depths of up to 100 m (Russell 2004; Zgliczynski et al. 2013). Graham et al. (2015) further notes from personal observations from NMFS biologists familiar with the species and documented observations on deep dives that the species was caught at depths greater than 100 m and up to approximately 180 m by deep gillnet (G. Davis pers. comm. as cited in Graham et al. 2015). On impact, the parts of the payload and substrate will explode into numerous pieces from "aerosolized" bits to mid-sized rocks. The largest sized ejecta is likely to travel through the air slower than smaller and lighter pieces, and fall closer to the source. When ejecta hits the water, it slows down quickly before falling to the reef or substrate. Furthermore, ocean conditions are dynamic in the nearshore (i.e. waves, currents, etc.) and projectiles would lose the majority of their energy within a few inches of the surface. Humphead wrasse, even juveniles, are large and mobile and will likely flee from falling debris as it hits the water. We expect that up to 108 humphead wrasse may be exposed to the combined effects of a payload land strike (Table 9, above), and would be adversely affected by the exposure.

6.4 Risk

This section analyzes the risk posed by the proposed action for populations of UES-protected marine species at USAKA due to exposure to direct impact and removal from the water as described above. Because this Opinion assumes mortality for all exposed individuals, regardless of the stressor, the risk assessment below focuses on the species impacts from the direct impact.

6.4.1 Risk for coral populations due to expected levels of action-related mortality

As described in the exposure analyses above, up to 14 colonies of seven UES-consultation coral species (Table 9, above) could experience mortality from the payload strike on Illeginni Islet. This would be due to the combined exposure to direct payload impact, ejecta, and ground based shock wave. The RCCTO/USASMDC plans just one FT-3 so this represents the maximum possible impact associated with this action.

Based on the best information available, we believe that these corals are all widely distributed around the atoll, and that the potentially impacted area represents a very small fraction (not currently quantifiable) of coral-occupied habitat at Illeginni, and likely below 1% of coral-occupied habitat at USAKA. As described above at 7.2, we further believe that the distribution and abundance of these coral species in similar habitat areas outside of the potentially impacted zones would be similar to their estimated distribution and abundance within the impacted zones, and as such, these 14 colonies likely represent a tiny fraction of their species found at Illeginni and across USAKA. Therefore, based on the best available information, we consider the risk negligible that project-related effects from direct payload impact, ejecta, and ground based shock wave would eliminate any of these species at USAKA, or appreciably reduce the likelihood of their survival and recovery at USAKA and across their global range.

6.4.2 Risk for top shell snails due to expected levels of action-related mortality

As described in the exposure and response analyses above, we expect up to one top shell snail could experience mortality as the result of a single direct payload impact, ejecta, and ground based shock wave. We believe that top shell snails are widely distributed at all of the USAKA islets around the atoll, and that the potentially impacted area represents a very small fraction (not currently quantifiable) of top shell snail-occupied habitat at Illeginni, and likely below 1% of top shell snail-occupied habitat at USAKA. As described above at 7.2, we further believe that the distribution and abundance of these mollusks in similar habitat areas outside of the potentially impacted zones would be similar to their estimated distribution and abundance within the impacted zones, and as such, this one top shell snail likely represent a tiny fraction of their species found at Illeginni and across USAKA, and their loss would be virtually indistinguishable from natural mortality levels in the region. Therefore, based on the best available information, we consider the risk negligible that the effects of direct payload impact, ejecta, and ground based shock wave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

6.4.3 Risk for clams due to expected levels of action-related mortality

As described in the exposure and response analyses above, we expect up to one *H. hippopus* and one *T. squamosa* clam could experience mortality as the result of a single direct payload impact, ejecta, and ground based shock wave. We believe that both species of clams are widely distributed at all of the USAKA islets around the atoll, and that the potentially impacted area represents a very small fraction (not currently quantifiable) of clam-occupied habitat at Illeginni, and likely below 1% of clam-occupied habitat at USAKA. As described above at 7.2, we further believe that the distribution and abundance of these mollusks in similar habitat areas outside of the potentially impacted zones would be similar to their estimated distribution and abundance within the impacted zones, and as such, these two clams likely represent a tiny fraction of their species found at Illeginni and across USAKA, and their loss would be virtually indistinguishable from natural mortality levels in the region. Therefore, based on the best available information, we consider the risk negligible that the effects of direct payload impact, ejecta, and ground based shock wave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

6.4.4 Risk for humphead wrasses due to expected levels of action-related mortality

As described in the exposure and response analyses above, we expect up to 108 humphead wrasses could experience mortality as the result of direct payload impacts from all four payload strikes, ejecta, and ground-based shock wave, but more likely minor injury if any, will occur. We believe that humphead wrasse are widely distributed at all of the USAKA islets around the atoll, and that the potentially impacted area represents a very small fraction (not currently quantifiable) of habitat at Illeginni, and likely below 1% of humphead wrasse-occupied habitat at USAKA. As described above at 7.2, we further believe that the distribution and abundance of these fish in similar habitat areas outside of the potentially impacted zones would be similar to their estimated distribution and abundance within the impacted zones, and as such, these 108 humphead wrasse likely represent a tiny fraction of their species found at Illeginni and across USAKA, and their loss would be virtually indistinguishable from natural mortality levels in the region. Therefore, based on the best available information, we consider the risk negligible that the effects of direct payload impact, ejecta, and ground-based shock wave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

7 CUMULATIVE EFFECTS

The UES does not specifically describe "cumulative effects" for a biological opinion. However, Section 161 of the Compact provides that for U.S. Government activities requiring the preparation of an environmental impact statement (EIS) under NEPA, the U.S. Government shall comply with environmental standards that protect public health and safety and the environment that are comparable to the U.S. environmental statutes, including the Endangered Species Act. Although not all USAKA actions that require formal consultation also require the preparation of an EIS, such as this action, we analyze cumulative effects in all USAKA consultations as that term is defined in the ESA implementing regulations. Cumulative effects, as defined in the ESA, are limited to the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). These effects do not include the continuation of actions described under the Environmental Baseline, and future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

The impacts of RMI coastal development, fisheries interactions, vessel groundings, direct take, marine debris, and global climate change are not only expected to continue, they are likely to intensify over time. The intensification of those impacts is expected to cause cumulative effects on UES-protected marine species at USAKA. Continued growth of the human population at

Kwajalein Atoll would likely result in increased coastal development, fishing pressure, vessel traffic, and pollution of the marine environment.

Anthropogenic release of CO_2 and other greenhouse gases is considered the largest contributor to global climate change, and it is expected that the release of those gases is not only likely to continue, but the rate of their release is expected to increase during the next century (Brainard et al. 2011). Therefore, global climate change is expected to continue to impact UES-protected marine species and their habitats, especially on those species that are dependent on shallow coastal reefs and shorelines, such corals and marine mollusks. There is uncertainty associated with the analysis of potential impacts of climate change on species and ecosystems (Barnett 2001). Effects of climate change will not be globally uniform (Walther et al. 2002) and information regarding the magnitude of future climate change is speculative and fraught with uncertainties (Nicholls and Mimura 1998). In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to UES-protected marine species.

In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Impact assessment models that include adaptation often base assumptions (about when, how, and to what conditions adaptations might occur) on theoretical principles, inference from observed observations, and arbitrary selection, speculation, or hypothesis (see review in Smit *et al.* 2000). Impacts of climate change and hence its 'seriousness' can be modified by adaptations of various kinds (Tol et al*.* 1998). Ecological systems evolve in an ongoing fashion in response to stimuli of all kinds, including climatic stimuli (Smit et al. 2000).The effects of global climate change, the most significant of which for corals are the combined direct and indirect effects of rising sea surface temperatures and ocean acidification, are currently affecting corals on a global scale, particularly in parts of the Caribbean. The return frequency of thermal stress-induced bleaching events has exceeded the ability of many reefs and coral species to recover there. Brainard et al. (2011) report that those effects likely represent the greatest risk of extinction to ESA-candidate corals over the next century. Field observation and models both predict increasing frequency and severity of bleaching events, causing greater coral mortality and allowing less time to recover between events. However, predicting how global climate change may impact particular species remains poorly understood, especially in understudied areas such as USAKA.

The effects of global climate change could act synergistically on corals affected by the proposed action. The ability of impacted corals to respond to the effects of the proposed action could be reduced due to the effects of elevated temperatures and increased ocean acidity, and the longer it takes for impacted corals to recover from the effects of the proposed action, the more likely it becomes that the effects of climate change would synergistically impact those corals. However, the degree to which those synergistic impacts may affect corals over the time required for them to recover from project impacts is unknown.

The effects of global climate change could also act synergistically on mollusks affected by the proposed action. However, no specific information is currently available to assess the impacts. Changes in ocean temperature and chemistry, and rising sea level may be affecting these species because they depend on an exoskeleton that is comprised primarily of calcium carbonate. We expect that minimally, increased acidity could have effects that parallel those described for corals above.

Given the small area and low numbers of individuals expected to be adversely affected by the proposed action, the possible synergistic impacts of climate change combined with the effects of the proposed action are not expected to be significant for the corals and mollusk considered in this Opinion.

8 INTEGRATION AND SYNTHESIS OF EFFECTS

The purpose of this Opinion is to determine if the proposed action is likely to jeopardize the continued existence of UES-protected marine species at USAKA. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a UES-protected marine species at USAKA by reducing the reproduction, numbers, or distribution of that species. *See* 50 CFR 402.02 This Opinion considers the Effects of the Action within the context of the Status of the Species, the Environmental Baseline, and Cumulative Effects as described in Section 7 under "Approach".

We determine if reduction in fitness to individuals of marine consultation species that may result from the proposed action are sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the risk of reducing the likelihood of survival and recovery of UES-protected species). In order to make that determination, we use the population's base condition (established in the Status of Listed Species and Environmental Baseline sections of this Opinion), considered together with Cumulative Effects, as the context for the overall effects of the action on the affected populations at USAKA. The following discussion summarizes the probable risks the proposed action poses to corals, top shell snails, giant clams, and the humphead wrasse identified in Section 6.

8.1 Corals

As described in the Effects of the Action section, a total of up to 14 colonies of UES-consultation corals (7 species) could be killed through some combination of exposure to direct payload impact, ejecta, and ground based shock wave. Over 99% of the colonies are from two highly abundant and widely distributed species within USAKA; *P. meandrina* and *H. coerulea*.

As discussed in the Status of Listed Species, abundance and trend data are lacking for these corals at USAKA. However, they are all widely distributed around the atoll, with four of the seven corals being known to occur at all USAKA islets. Others are known to occur on at least half of the USAKA islets. All seven species have also been observed at survey sites in the MAC, with three found at over 30 of the 35 sites. It is important to recognize that survey data for USAKA is far from complete. Only a small portion of the total reef area around the USAKA islets and MAC has been surveyed, and surveys to specifically identify and quantify these species are yet to be done. A recent survey was completed at Illeginni Islet in the MM III reef impact area, which is also the area that has been analyzed for impacts from the ARRW payload and the results suggest that the estimate for corals in the area may be lower than what has been estimated (NMFS 2017a). Additionally, NMFS conducted a survey in 2018 at two launch sites in preparation of the THAAD test (NMFS 2018).

As discussed more fully in the Environmental Baseline and Cumulative Effects sections, the effects of continued flight testing, fisheries interactions, direct take, and climate change are expected to continue and likely worsen in the future for these corals. Although many actions at USAKA beyond what are described in the Environmental Baseline and Cumulative Effects sections are uncertain, we do have expected estimates (worst-case scenarios) for the actions described above in those sections, and we acknowledge that there are other federal actions occurring in the Atoll (previous, ongoing and known future actions) impacting these species. For example, the FE-1 testing will remove up to 10,417 coral colonies, the ARRW testing will remove up to 10,417 colonies, the FE-2 testing will remove up to 10,404 colonies, and the GBSD testing will remove up to 31, 224 colonies (for a total of up to 62,462 colonies cumulatively). PRD has considered the action's impacts with the other threats incurring on the species, and even with the worst-case scenario (loss of individuals due to this action) added to other losses discussed in the Environmental Baseline and Cumulative Effects sections, we do not expect these actions to result in appreciable reduction of the species.

The proposed action is anticipated to result in the mortality of up to 14 coral colonies at Illeginni Islet. These coral colonies represent an extremely small fraction of the total number of colonies found at Illeginni, and even less around USAKA. In the context of this action, the potential loss of these coral colonies is not expected to significantly impact reproduction or to impede the recovery of their species across USAKA and the MAC. Therefore, when taken in context with the status of these species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to eliminate any of the seven UES consultation corals considered in this Opinion from Illeginni, or appreciably reduce the likelihood of their survival and recovery across USAKA including the MAC.

8.2 Top Shell Snail

As described in the Effects of the Action section, a total of up to one top shell snail could be killed through some combination of exposure to direct payload impact, ejecta, and ground based shock wave.

As discussed in the Status of Listed Species, top shell snails have been reported at all of the 11 USAKA islets as well as at 59 of 103 survey sites throughout Kwajalein Atoll including all four survey sites on Illeginni. It is important to recognize that survey data for USAKA is far from complete. Only a small portion of the total reef area around the USAKA islets has been surveyed, and surveys to specifically identify and quantify this species are yet to be done. As such, it is possible that the distribution and abundance of top shell snails at USAKA is higher than the current information can confirm.

As discussed more fully in the Environmental Baseline and Cumulative Effects sections, the effects of continued flight testing, coastal development, direct take, and climate change are expected to continue and likely worsen in the future for this species. Although many actions at USAKA beyond what are described in the Environmental Baseline and Cumulative Effects sections are uncertain, we do have expected estimates (worst-case scenarios) for the actions described above in those sections, and we acknowledge that there are other federal actions occurring in the Atoll (previous, ongoing and known future actions) impacting these species. For example, the FE-1, ARRW, andFE-2 testing will remove up to four top shell snails for each project, and the GBSD testing will remove up to nine top shell snails(for a total of up to 21 top shell snails cumulatively). PRD has considered the action's impacts with the other threats incurring on the species, and even with the worst case scenario (loss of individuals due to this action) added to other losses discussed in the Environmental Baseline and Cumulative Effects sections, we do not expect these actions to result in appreciable reduction of the species.

The proposed action is anticipated to result in death of up to one top shell snail at Illeginni. The affected snail would represent a small fraction of the total number of top shell snails found at Illeginni, and an even smaller proportion of the population across USAKA. In the context of this action, the potential loss of one top shell snails across the area is not expected to significantly impact reproduction or to impede the recovery of this species across USAKA and the MAC. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to eliminate top shell snails at Illeginni, or appreciably reduce the likelihood of their survival and recovery across USAKA including the MAC.

8.3 Giant Clams

As described in the Effects of the Action section, a total of up to two giant clams could be harassed, injured, or killed through some combination of exposure to direct payload impact, ejecta, and ground-based shock wave.

As discussed in the Status of Listed Species, the two clam species have been reported at most of the 11 USAKA islets, (9 for *H. hippopus* and 6 for *T. squamosa*) as well as at 9 and 24 respectively of 35 survey sites in the mid-atoll corridor. It is important to recognize that survey data for USAKA is far from complete. Only a small portion of the total reef area around the USAKA islets has been surveyed, and surveys to specifically identify and quantify this species are yet to be done.

As discussed more fully in the Environmental Baseline and Cumulative Effects sections, the effects of continued flight testing, coastal development, direct take, and climate change are expected to continue and likely worsen in the future for this species. Although many actions at USAKA beyond what are described in the Environmental Baseline and Cumulative Effects sections are uncertain, we do have expected estimates (worst-case scenarios) for the actions described above in those sections, and we acknowledge that there are other federal actions occurring in the Atoll (previous, ongoing and known future actions) impacting these species. For example, the FE-1 testing will remove up to 90 giant clams, the ARRW testing will remove up to 90 giant clams, the FE-2 testing will remove up to 75 giant clams, and the GBSD tests will remove up to 219 clams (for a total of up to 474 giant clams cumulatively). PRD has considered the action's impacts with the other threats incurring on the species, and even with the worst-case scenario (loss of individuals due to this action) added to other losses discussed in the Environmental Baseline and Cumulative Effects sections, we do not expect these actions to result in appreciable reduction of the species.

The proposed action is anticipated to result in the death of up to two giant clams (one *H. hippopus* and one *T. squamosa*) at Illeginni. The affected clams would represent a small fraction of the total number of clams found at Illeginni, and an even smaller proportion of the population across USAKA. In the context of this action, the potential loss of giant clams across the area is not expected to significantly impact reproduction or to impede the recovery of this species across USAKA and the mid-atoll corridor. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to eliminate giant clams at Illeginni, or appreciably reduce the likelihood of their survival and recovery across USAKA including the mid-atoll corridor.

8.4 Humphead Wrasse

As described in the Effects of the Action section, a total of up to 108 humphead wrasses could be harassed, injured, or killed through some combination of exposure to direct payload impact, ejecta, and ground-based shock wave.

As discussed in the Status of Listed Species section, humphead wrasses are commonly observed at Kwajalein Atoll, and have been observed at 10 of the 11 surveyed islets since 2010. Observations suggest a broad but scattered distribution. It is important to recognize that survey data for USAKA is incomplete. Only a small portion of the total reef area around the USAKA islets have been surveyed, especially in deeper waters where humphead wrasse could live.

As discussed in the Environmental Baseline and Cumulative Effects section, the effects of continued flight testing, coastal development, direct take, and climate change are expected to continue and for climate change in particular expect to worsen in the future. Although many actions at USAKA beyond what are described in the Environmental Baseline and Cumulative Effects sections are uncertain, we do have expected estimates (worst-case scenarios) for the actions described above in those sections, and we acknowledge that there are other federal actions occurring in the Atoll (previous, ongoing and known future actions) impacting these species. For example, the FE-1, ARRW, and FE-2 testing will remove up to 108 humphead wrasse for each project, and the GBSD tests will remove up to 324 humphead wrasse (for a total of up to 648 humphead wrasse cumulatively). PRD has considered the action's impacts with the other threats incurring on the species, and even with the worst-case scenario (loss of individuals due to this action) added to other losses discussed in the Environmental Baseline and Cumulative Effects sections, we do not expect these actions to result in appreciable reduction of the species.

The proposed action is anticipated to result in the injury or death of up to 108 humphead wrasse (100 juveniles and 8 adults) at Illeginni. The affected individuals would represent a small portion of the total number of humphead wrasse found at Illeginni, and an even smaller proportion of the population across USAKA. In the context of this action, the potential loss of humphead wrasses by the action is not expected to significantly impact reproduction or to impede the recovery of this species across USAKA and the MAC. Therefore, when taken in context with the status of the species, the environmental baseline, cumulative impacts and effects, the proposed action is not likely to eliminate humphead wrasses at Illeginni, or appreciably reduce the likelihood of their survival and recovery across USAKA including the MAC.

9 CONCLUSION

After reviewing the current status of UES-protected marine species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our Opinion that the RCCTO/USASMDC's implementation of the FT-3 at the Reagan Test Site, USAKA, RMI is not likely to jeopardize the continued existence of any of the UES-protected corals considered in this Opinion, the top shell snail, humphead wrasse, or two species of giant clams. No critical habitat has been designated or proposed for designation for any UES-protected marine species in the BOA or elsewhere in the RMI. Therefore, the proposed action would have no effect on designated or proposed critical habitat in the RMI. As described in Section 3, designated critical habitat has been identified near the launch site in the MHI for Steller sea lions. NMFS concludes the proposed action may affect, but is not likely to adversely affect or modify designated critical habitat for the Steller sea lion.

10 INCIDENTAL TAKE STATEMENT

The UES does not specifically describe "take" for a biological opinion. However, under the ESA "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. 16 USC 1532. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. 50 CFR 402.02. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITS). Although the ESA does not specifically apply to actions taken at USAKA, under section 161 of the Compact and the UES, the ESA provides the basis for determining the level of incidental take, so the ESA definitions will be used for this Opinion.

10.1 Anticipated Amount or Extent of Incidental Take

Based on the analysis in the accompanying Opinion we conclude that the FT-3 flight test at the USAKA RTS, may result in the take of seven species of UES consultation corals, top shell snails, humphead wrasse, and two clam species. As described above in the exposure and response analyses, we expect that up to 14 colonies of UES consultation corals (as quantified in Table 10, below) could experience complete mortality, up to one top shell snail, up to two clams, and up to 108 humphead wrasse could be killed by the proposed action.

Table 10. Expected take of marine UES consultation species due to FT-3 flight tests

Scientific Name	Species	Colonies or Individuals Affected
Corals		
Acropora microclados	No Common Name	<0.01 - 0.01 = 1
A. polystoma	No Common Name	<0.01 - 0.01 = 1
Cyphastrea agassizi	No Common Name	<0.01 - 0.01 = 1
Heliopora coerulea	No Common Name	1.25 - 3.51 = 4
Pavona venosa	No Common Name	<0.01 - 0.01 = 1
Turbinaria reniformis	No Common Name	<0.01 - 0.01 = 1
Pocillopora meandrina	Cauliflower coral	2.19 - 4.24 = 5
Mollusks		
Tectus niloticus	Top Shell Snail	<0.01 = 1
Hippopus hippopus	Giant clam	0.02 – 0.05 = 1
Tridacna squamosa	Giant clam	<0.01 – 0.01 = 1
Fish		
Cheilinus undulates	Humphead wrasse	108 (8 adults/100 juveniles)

10.2 Effect of Impact of the Take

In the accompanying Opinion, we determined that this level of anticipated take is not likely to result in the jeopardy of any of the UES consultation species expected to be taken by the proposed action.

10.3 Reasonable and Prudent Measures

We believe the following reasonable and prudent measures, as implemented by the terms and conditions, are necessary and appropriate to minimize impacts of the proposed action and monitor levels of incidental take. The measures described below are non-discretionary and must be undertaken in order for the ITS to apply.

1. The RCCTO/USASMDC shall reduce impacts on UES-protected corals, top shell snails, clams and their habitats through the employment of conservation measures.
2. The RCCTO/USASMDC shall record and report all action-related take of UES-consultation species.

10.4 Terms and Conditions

The RCCTO/USASMDC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To meet reasonable and prudent measure 1 above, the RCCTO/USASMDC shall ensure that their personnel comply fully with the conservation measures identified below.
    a. The RCCTO/USASMDC shall ensure that all relevant personnel associated with this project are fully briefed on the best management practices and the requirement to adhere to them for the duration of this project.
    b. In the event the payload land impact affects the reef at Illeginni, the RCCTO/USASMDC shall require its personnel to secure or remove from the water any substrate or coral rubble from the ejecta impact zone that may become mobilized by wave action as soon as possible.
        i. Ejecta greater than six inches in any dimension shall be removed from the water or positioned such that it would not become mobilized by expected wave action, including replacement in the payload crater.
        ii. If possible, coral fragments greater than six inches in any dimension shall be positioned on the reef such that they would not become mobilized by expected wave action, and in a manner that would enhance its survival; away from fine sediments with the majority of the living tissue (polyps) facing up.
        iii. UES consultation coral fragments that cannot be secured in-place should be relocated to suitable habitat where it is not likely to become mobilized.
    c. In the event the payload land impact affects the reef at Illeginni, the RCCTO/USASMDC shall require its personnel to reduce impacts on top shell snails.
        i. Rescue and reposition any living top shell snails that are buried or trapped by rubble.
        ii. Relocate to suitable habitat, any living top shell snails that are in the path of any heavy equipment that must be used in the marine environment.
    d. In the event the payload land impact affects the reef at Illeginni, the RCCTO/USASMDC shall require its personnel to reduce impacts on clams.
        i. Rescue and reposition any living clams that are buried or trapped by rubble.
        ii. Relocate to suitable habitat, any living clams that are in the path of any heavy equipment that must be used in the marine environment.

2. To meet reasonable and prudent measure 2 above:
    a. The RCCTO/USASMDC shall assign appropriately qualified personnel to record all suspected incidences of take of any UES-consultation species.

b. The RCCTO/USASMDC shall utilize digital photography to record any UES-consultation species found injured or killed in or near the ocean target areas and/or at Illeginni. As practicable: 1) Photograph all damaged corals and/or other UES-consultation species that may be observed injured or dead; 2) Include a scaling device (such as a ruler) in photographs to aid in the determination of size; and 3) Record the location of the photograph.

c. In the event the payload impact affects the reef at Illeginni, the RCCTO/USASMDC shall require its personnel to survey the ejecta field for impacted corals, top shell snails, and clams. Also be mindful for any other UES-consultation species that may have been affected.

d. Within 60 days of completing post-test clean-up and restoration, provide photographs and records to the USAKA environmental office. USAKA and our biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.

e. Within 6 months of completion of the action, USAKA will provide a report to us. The report shall identify: 1) The flight test and date; 2) The target area; 3) The results of the pre- and post-flight surveys; 4) The identity and quantity of affected resources (include photographs and videos as applicable); and 5) The disposition of any relocation efforts.

11 CONSERVATION RECOMMENDATIONS

The following conservation recommendations are discretionary agency activities provided to minimize or avoid adverse effects of a proposed action on UES-protected marine species or critical habitat, to help implement recovery plans, or develop information.

1. We recommend that the RCCTO/USASMDC continue to work with NMFS staff to conduct additional marine surveys around Illeginni Islet to develop a comprehensive understanding of the distribution and abundance of species that are there.
2. We recommend that the RCCTO/USASMDC consider constructing a berm, artificial Hesco Bastion ("Concertainer"), or Bremer wall, around the perimeter of the island above the beach line (see start of grass line in Figure 2 for example) at the impact site in order to reduce the amount of potential ejecta material which can enter the ocean from an impacting projectile. We understand that depending on impact characteristics ejecta may arch at a higher angle than a berm's height. Additionally, consultation may be required with the USFWS for landbased activities. However, we believe it should be considered. This would reduce the risk to UES/ESA-listed species in the nearshore, allow for more precise definition of the target, and aid in the recovery of munition materials after impact.
3. We recommend the RCCTO/USASMDC equip USAG-KA personnel with metal detectors for recovery of projectile materials in the nearshore environment, if not already doing so. Furthermore, we recommend the RCCTO/USASMDC attempt to quantify the amount of recovered materials to determine the amount of tungsten that remains in the nearby environment.

4. We recommend that the RCCTO/USASMDC continue to work with NMFS staff to conduct marine surveys at additional sites around all of the USAKA islets and in the mid-atoll corridor to develop a more comprehensive understanding of the distribution and abundance of species and habitats at USAKA.
5. We recommend that the USAKA develop capacity and procedures for responding to marine mammal and turtle strandings by:
    a. Acquiring required permits and training to perform necropsies and/or to take and transport tissue samples.
    b. Developing professional relations with qualified federal agencies and universities to capitalize on samples and information gained at USAKA.
    c. Developing mechanisms to collect and disseminate the information.

11.1 Reinitiation Notice

This concludes formal consultation on the implementation of the FT-3 program at the USAKA RTS, RMI. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of anticipated incidental take is exceeded;
2. New information reveals that the action may affect UES-protected marine species or critical habitat in a manner or to an extent not considered in this Opinion;
3. The action is subsequently modified in a manner that may affect UES-protected marine species or critical habitat to an extent, or in a manner not considered in this Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

12 DATA QUALITY ACT DOCUMENTATION

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Supplement has undergone pre-dissemination review.

12.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this Opinion are the SSP, and RCCTO/USASMDC. Other interested users could include the citizens of RMI, USFWS, and NOAA. Individual copies of this Opinion were provided to the RCCTO/USASMDC. The format and naming adheres to conventional standards for style.

12.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

12.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and reviewed in accordance with Pacific Islands Region ESA quality control and assurance processes.

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