-FINAL-
Document of Environmental Protection
(DEP)

ACTIVITY:
U.S. NAVY FLIGHT EXPERIMENT-2 (FE-2)
U.S. ARMY HYPERSONIC FLIGHT TEST 3 (FT-3)

CONTROL NUMBER DEP-19-RTS-01.0

November 2019

Modified: March 2021

U.S. ARMY KWAJALEIN ATOLL – ILLEGINNI ISLET
REPUBLIC OF THE MARSHALL ISLANDS

Prepared by:

KFS

303 Williams Avenue, Suite 116
Huntsville, Alabama 35801-6001

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CONTROL NUMBER DEP-19-RTS-01

FINAL DOCUMENT OF ENVIRONMENTAL PROTECTION FOR U.S. NAVY FLIGHT EXPERIMENT-2 (FE-2) AT U.S. ARMY GARRISON• KWAJALEIN ATOLL (USAG-KA)

DOCUMENT NUMBER DEP-19-RTS-01
NOVEMBER 2019

SHALL TAKE EFFECT UPON SIGNATURE

FOR THE U.S. ARMY GARRISON - KWAJALEIN ATOLL

Jeremy A. Bartel

JEREMY A. BARTEL
COL, SF
Commanding

17 December 2019
DATE

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REPUBLIC OF THE MARSHALL ISLANDS
ENVIRONMENTAL PROTECTION AUTHORITY
P.O. Box 1322
Majuro, Marshall Islands 96960
Phone: (692) 625-3035/5203 * Fax: (692) 625-5202 * Email: rmiepa@ntamar.net

December 10th 2019

Derek Miller
Environmental Engineer
US Army Garrison Kwajlein Atoll

Subject: RMIEPA response to DEP-19-RTS-01

RMIEPA agrees with Document of Environmental Protection for Flight Experiment-2 (FE-2) at U.S Army Garrison Kwajlein Atoll (USAG-KA) Control Number DEP-19-RTS-01.

Thank you.

Sincerely,

Moriana Phillip
General Manager, RMIEPA

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AGREE WITH DOCUMENT OF ENVIRONMENTAL PROTECTION

FOR

FLIGHT EXPERIMENT-2 (FE-2)

AT U.S. ARMY GARRISON KWAJALEIN ATOLL (USAG-KA)

CONTROL NUMBER DEP-19-RTS-01

U.S. Fish and Wildlife Service

Agency

DAN POLHEMUS

Name

18 Nov. 2019

Date

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AGREE WITH DOCUMENT OF ENVIRONMENTAL PROTECTION

FOR

FLIGHT EXPERIMENT-2 (FE-2)

AT U.S. ARMY GARRISON KWAJALEIN ATOLL (USAG-KA)

CONTROL NUMBER DEP-19-RTS-01

National Marine Fisheries Service

Agency

KOLINSKI.STEVEN.P.1365858787 Digitally signed by KOLINSKI.STEVEN.P.1365858787 Date: 2019.10.21 10:43:58 -10'00'

Name

21 October 2019

Date

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JUSTIFICATION FOR THE 2021 MINOR MODIFICATIONS TO THE NOVEMBER 2019 FINAL DEP FOR U.S. NAVY FLIGHT TEST EXPERIMENT – 2 (FE-2)

The United States (U.S.) Army Space and Missile Defense Command (USASMDC) and U.S. Navy completed the FE-2 Test at Kwajalein Atoll. Pre- and post-test soil and groundwater sampling on Illeginni Islet was conducted in support of the FE-2 test. Laboratory results of the soil samples showed beryllium, tungsten, and uranium were not detected above the limit of quantification (LOQ) in any of the 34 soil samples collected from the Illeginni impact site. For water quality, 12 pre-test samples were taken from six of the seven water quality wells over a 2-day period. The first day five of the wells were dry and on the second day six wells had enough water to sample. For post-test groundwater sampling two wells were dry, three wells were in the impact area and could not be recovered, and three samples were taken from the two remaining wells. Beryllium detected was below the LOQ in the 12 pre-test and 3 post-test samples. Uranium was detected in all pre- and post-test samples but did not exceed the U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL) screening level. Tungsten was detected in 8 of the 12 samples with concentrations well above the USEPA Regional Screening Level (RSL) for tap water. However, because the groundwater at Illeginni Islet is currently deemed to be too saline and not available year-round, it is not considered a viable source of potable water and USEPA RSL would not apply. The sampling report following the FE-2 flight test showed lower levels of tungsten than the 2018 sample results—with detected concentrations ranging from 0.0023 milligrams per milliliter (mg/L) to 0.99 mg/L compared to previously detected concentrations ranging from 0.055 mg/L to 1.2 mg/L.

The latest U.S. Army Hypersonic Flight Test–3 (FT-3) has an Environmental Assessment (EA) (U.S. Army Hypersonic Flight Test 3 EA) in development with an expected completion date of April 2021. For that program, launches will occur from the Pacific Spaceport Alaska (PSCA) to the U.S. Army Garrison-Kwajalein Atoll / Ronald Reagan Ballistic Missile Defense Test Site (USAG-KA) in the Republic of the Marshall Islands. Similar to the FE-2 test, the FT-3 would use a three-stage missile with a similar payload system. However, the FT-3 payload would only contain 10 percent as much tungsten as the FE-2 payload. All requirements, limitations, reporting, and mitigation measures identified for FE-2 would be implemented for FT-3.

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MILESTONE SCHEDULE (UES §2-17.3.6 (5))

Number	Requirement	Due Date
General Requirements and Limitations		
1	Evacuate nonessential personnel within the Mid-Atoll Corridor and shelter critical personnel. **(1.1.a)**	Prior to test
2	Publish Notices to Airmen and Notices to Mariners. **(1.1.a.i)**	Prior to test
3	Activate onboard flight termination if public safety is jeopardized. **(1.1.b)**	During payload descent
4	Bi-weekly survey by aircraft for sea turtles and sea turtle nesting for at least 8 weeks preceding each test flight. **(1.1.c)**	Weekly for at least 8 weeks prior to test
5	Monitor for and report observations of marine mammals and sea turtles. **(1.1.d & f)**	During travel to and from Illeginni Islet
6	Conduct overflights of Illeginni Islet to survey for marine mammals and sea turtles. **(1.1.e)**	Three flights during week prior to the test / as close to launch as safely practicable
7	Report sightings of marine mammals or sea turtles that occur during surveys, overflights or ship travel for consideration in approving launch. **(1.1.g)**	Prior to test
Land Impact Illeginni Requirements and Limitations		
8	Conduct search for black-naped tern nests and chicks prior to any pre-flight equipment mobilization. **(1.2.a)**	Prior to test
9	Conduct post-impact survey to observe impacts to adult black-naped terns or nests. **(1.2.a)**	After test
10	For land impact, inspect beach area for active turtle nests at Illeginni Islet. **(1.2.b)**	At least 30 days prior to launch and as close to launch as safely practicable
11	Conduct overflight of the islet vicinity to survey for dead or injured marine mammals and sea turtles. **(1.2.c** & 1.3.f)	As soon as safely practicable after the flight test
12	Survey the islet and near-shore waters for injured wildlife and damaged coral or sensitive habitat. **(1.2.d)**	When feasible, within 1 day after land impact test
Reporting Procedures		
13	Provide Incidental Take/Impact Report. **(1.4.c & 7.0.b)**	By 31 December of the flight test year
14	Notify the Appropriate Agencies and the Government of the Republic of the Marshall Islands of a test event which involves a test failure, anomalies, or termination within the RMI. **(7.0.a)**	Within 5 calendar days

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-FINAL- DOCUMENT OF ENVIRONMENTAL PROTECTION

ACTIVITY: U.S. NAVY FLIGHT EXPERIMENT-2 (FE-2) U.S. ARMY HYPERSONIC FLIGHT TEST 3 (FT-3) CONTROL NUMBER DEP-19-RTS-01.0

DATE SUBMITTED: 14 November 2019
DEP EFFECTIVE DATE: 17 December 2019
MODIFIED DATE: March 2021
DEP EXPIRES: Five years after final signature

The Compact of Free Association between the Republic of the Marshall Islands (RMI) and the United States (U.S.) requires that all U.S. Government activities at U.S. Army Garrison-Kwajalein Atoll (USAG-KA) (formerly U.S. Army Kwajalein Atoll [USAKA]) conform to specific compliance requirements, coordination procedures, and environmental standards identified in the USAKA Environmental Standards and Procedures (UES) (U.S. Army Space and Missile Defense Command/Army Forces Strategic Command [USASMDC/ARSTRAT] 20212018). As specified in UES Section (§) 2-2, these standards also apply to all USAG-KA activities and to Ronald Reagan Ballistic Missile Defense Test Site (RTS) tenant activities occurring elsewhere within the RMI, including the territorial waters of the RMI.

The U.S. Army Hypersonic Flight Test 3 (FT-3) U.S. Navy Flight Experiment–2 (FE-2) flight test, which could affect Illeginni Islet, must comply with the UES (USASMDC/ARSTRAT 202118). All missile demonstration programs proposed to occur at USAKA and within the RMI territorial waters must comply with the UES. The activities described in this Document of Environmental Protection (DEP) and companion document, Notice of Proposed Activity (NPA), apply to all mission programs conducted at USAKA with similar concepts and ultimate impact effects to the deep-water Broad Ocean Area (BOA) region southwest of Illeginni Islet and on Illeginni Islet. This DEP is prepared for compliance with UES § 2-17.3.1(j) Proposed Actions or Activities for which a biological opinion has been rendered.

REFERENCES

Kwajalein Range Services, 2016. Kwajalein Environmental Emergency Plan (KEEP). September.

National Marine Fisheries Service (NMFS), 2019. Formal Consultation under the Environmental Standards for United States Army Kwajalein Atoll Activities in the Republic of the Marshall Islands. Biological Opinion and Formal Consultation under Section 7 of the Endangered Species Act.

U.S. Army Rapid Capabilities and Critical Technologies Office, 2020. Biological Assessment for Hypersonic Flight Test 3 Activities. September.

U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT), 202118. Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands, 15th Edition. September.

U.S. Army, 2021. Hypersonic Flight Test 3 (FT-3) Environmental Assessment/Overseas Environmental Assessment. April 2021 (pending).

U.S. Navy, 2019. Flight Experiment 2 (FE-2) Environmental Assessment/Overseas Environmental Assessment. December.

U.S. Navy, 2017. Flight Experiment 1 (FE-1) Environmental Assessment/Overseas Environmental Assessment. 29 August.

TECHNICAL DESCRIPTION OF ACTIVITY

The activities described in this DEP are associated with an action sponsored by the United States Department of the Army (U.S. Army), which has designated the U.S. Army Rapid Capabilities and Critical Technologies Office (RCCTO) as the lead agency for the Proposed Action. the Office of the Under Secretary of Defense for Research and Engineering, which has designated the Department of the Navy (U.S. Navy) Strategic Systems Programs (SSP) as the lead agency and action proponent of the Proposed Action. FT-3 is designed to test a long-range, global strike capable technology. The purpose of this technology test is to stool-launch a payload to high altitude for accurate delivery.FE-2 is the next incremental step in the developmental process after Flight Experiment-1 (FE-1). FE-1 was a test flight conducted in 2017 from the Pacific Missile Range Facility (PMRF) in Hawaii to the RTS in the RMI. (U.S. Navy, 2017) FE-2 FT-3 would continue to develop, integrate, and flight test a payload system to demonstrate the maturity of key technologies.

The U.S. Army RCCTO proposes to conduct a single developmental hypersonic flight test, FT-3, from the Pacific Spaceport Complex Alaska (PSCA) to Kwajalein Atoll, RMI. Navy proposes one experimental flight test to take place within the first half of fiscal year (FY) 2020. The U.S. ArmyNavy, along with the Department of Energy (DOE) as a Cooperating Agency, and with USASMDC as a Participating Agency, will prepare the Environmental Assessment/Overseas Environmental Assessment (EA/OEA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations and U.S.

ArmyNavy regulations for implementing NEPA. The EA/OEA will evaluate the potential environmental consequences of conducting the FE-2FT-3 flight test. The FE-2FT-3 system consists of a three-stage Solid-Rocket Motor booster system, protective shroud, Payload Adapter Assembly, Booster Payload Separation System, and payload. The FE-2FT-3 experiment will be launched from PSCAPMRF with booster drops in the Pacific BOA, impacting on Illeginni Islet, USAKA/RTS within the RMI.

Prior to flight test activities, Illeginni Islet will be assessed to ensure all personnel are off-site prior to launch and exclusionary control (keeping personnel out of the impact zone) will be maintained until recovery actions are complete. Additionally, if needed, the Mid-Atoll Corridor will be cleared and monitored for unauthorized access prior to the flight test.

At impact, materials contained in the FE-2FT-3 experiment payload will break up into varying sized debris pieces. These debris pieces consist of small quantities of various heavy metals and heavy metal alloys, including a tungsten alloy. During impact at Illeginni Islet, soil containing residual concentrations of beryllium and depleted uranium, as a result of prior tests on Illeginni Islet, could be dispersed over the area. Therefore, prior to debris recovery and cleanup actions on Illeginni Islet, unexploded ordnance personnel will first inspect the impact crater and surrounding area for any residual explosive materials. Test support personnel will conduct an impact assessment and cleanup and recovery operations once the site is clear for safe entry.

Following assessment of the impact area for safety, personnel will manually recover FE-2FT-3 debris and, if present, to the extent possible, from surrounding shallow waters (less than 180 feet [55 meters] deep), as reasonably possible. The impact area will be wetted with freshwater to stabilize the disturbed soil. The impact crater will be excavated using a backhoe or front-end loader transported to the islet, and the excavated material will be screened to recover debris. Following debris removal, the crater will be backfilled and, if necessary, repairs made to surrounding structures. Accidental spills from support equipment operations will be contained and cleaned up, in accordance with the UES Kwajalein Environmental Emergency Plan (KEEP) (UES §3-6.4.1). All waste materials will be appropriately stored and returned to Kwajalein Island for proper disposal.

LOCATION OF ACTIVITY

The proposed activity is located on Illeginni Islet and in the BOA of the Pacific Ocean.

COMPLIANCE STATUS

The U.S. NavyArmy FE-2FT-3 flight test described in this DEP would be conducted in compliance with the UES.

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Table of Contents

Appendices

Acronyms and Abbreviations

ARSTRAT	Army Forces Strategic Command
BOA	Broad Ocean Area
DEP	Document of Environmental Protection
DOD	Department of Defense
~~DOE~~	~~Department of Energy~~
EA/OEA	Environmental Assessment/Overseas Environmental Assessment
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FE-1	Flight Experiment-1
FE-2	Flight Experiment-2
ft	Foot / Feet
FT-3	Flight Test 3
FTS	Flight Termination System
~~FY~~	~~Fiscal Year~~
IAW	In Accordance With
KEEP	Kwajalein Environmental Emergency Plan
LLNL	Lawrence Livermore National Laboratories
LOQ	Limit of Quantification
m	Meter(s)
MCL	Maximum Contaminant Level
MMPA	Marnie Mammal Protection Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOTAM	Notice to Airmen
NPA	Notice of Proposed Activity
NTM	Notice to Mariners

PMRF	Pacific Missile Range Facility
RCCTO	U.S. Army Rapid Capabilities and Critical Technologies Office
RMI	Republic of the Marshall Islands
RMIHPO	Republic of the Marshall Islands Historic Preservation Office
ROI	Region of Influence
RSL	Regional Screening Level
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
SSP	Strategic Systems Programs
STARS	Strategic Target System
U.S.	United States
UES	United States Army Kwajalein Atoll Environmental Standards and Protections
USACE	United States Army Corps Of Engineers
USAF	United States Air Force
USAG-KA	United States Army Garrison – Kwajalein Atoll
USAKA	United States Army Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1.0 Requirements and Limitations

1.1 General Requirements and Limitations[1]

a) Prior to a Flight Test 3Experiment 2 (FE-2FT-3) flight test, safety precaution measures shall be implemented:

   i) Within the Mid-Atoll Corridor, nonessential personnel shall be evacuated, and mission critical personnel shall be sheltered.

   ii) Notices to Airmen and Notice to Mariners shall be published and circulated in accordance with established procedures.

   iii) Radar and visual sweeps of the hazard area shall be accomplished immediately prior to a test flight to ensure clearance of non-critical personnel. [U.S. NavyArmy), U.S. Army Garrison Kwajalein Atoll (USAG-KA), and the Ronald Reagan Ballistic Missile Defense Test Site (RTS)]

b) If the flight deviates from its course or should other problems occur during descent that might jeopardize public safety, the onboard flight termination system shall be activated causing the payload to fall towards the ocean and terminate flight. [U.S. NavyArmy & RTS]

c) Preceding the FE-2FT-3 test, Illeginni Islet shall be surveyed bi-weekly (for up to 8 weeks) by qualified persons for sea turtles, sea turtle nesting activity, and sea turtle nests. Surveys will be conducted by fixed wing aircraft or helicopters. These persons shall also inspect the area within 2 days of the FE-2FT-3 launch and flight test. [U.S. NavyArmy & USAG-KA]

d) Pre-test persons at Illeginni Islet and in vessels traveling to and from Illeginni Islet shall look for and report any observations of sea turtles (including location, date, time, species, and number of individuals), evidence of sea turtle haul out or nesting, or of sea turtle nests at or near Illeginni Islet to USAG-KA Environmental Office (Environmental Engineer) which would maintain records of these observations and report sightings to National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS) [U.S. NavyArmy, USAG-KA & RTS]

e) USAG-KA and/or RTS personnel shall conduct a helicopter or fixed-wing aircraft overflight of the islet vicinity three times over the week prior to the flight test and as close to the FE-2FT-3 launch as safely practicable to survey for marine mammals and sea turtles. The final overflight shall be made within 1 day of the proposed launch. [U.S. NavyArmy, USAG-KA & RTS]

f) During ocean travel to and from impact and flight test support areas, ship personnel shall monitor for marine mammals and sea turtles to avoid potential ship strikes and report any

[1] Responsible parties are identified in brackets, after the identification of the Requirements and Limitations—this applies to the entire document.

observations (including location, date, time, species or taxa, and number of individuals) to the USAG-KA Environmental Office which would maintain records of these observations and report sightings to NMFS and/or USFWS. [U.S. NavyArmy & USAG-KA]

g) Any marine mammal or sea turtle sightings during surveys, overflights, or ship travel shall be reported to the USAG-KA Environmental Office, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch.

h) During the flight test, personnel in the vicinity of the impact area shall comply with the Army's Hearing Conservation Program. Depending on their location, personnel may be required to wear hearing protection. [U.S. NavyArmy, USAG-KA & RTS]

i) Vessel and equipment operations shall not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life. [U.S. NavyArmy & USAG-KA]

j) Vessel and heavy equipment operators shall inspect and clean equipment for fuel or fluid leaks prior to use or transport. [U.S. NavyArmy & USAG-KA]

k) Prior to the shipment of flight test support equipment and materials from the United States to USAKA, the equipment shall be washed and a certified Pest Control Technician or Military Veterinarian shall inspect the equipment to ensure that it does not contain any insects, animals, plants, or seeds. [U.S. NavyArmy]

l) Prior to returning the flight test support equipment and materials to the United States, the equipment shall be washed and a certified Pest Control Technician shall inspect the equipment again to ensure that it does not contain any insects, animals, plants, or seeds that might have been picked up during fielding. [U.S. NavyArmy & USAG-KA]

m) Prior to recovery and cleanup actions on Illeginni Islet, Explosive Ordnance Disposal (EOD) personnel shall first survey for any residual explosive materials. If found, such materials shall be collected and managed in accordance with the current Document of Environmental Protection (DEP) for Disposal of Munitions and Other Explosive Materials. [U.S. NavyArmy & USAG-KA]

n) Protected marine species including invertebrates shall be avoided or effects to them minimized, which may include movement of these organisms out of the area likely to be affected. [U.S. NavyArmy & USAG-KA]

o) All on-site personnel shall be briefed and provided with information on the need to protect and avoid harassment of sensitive species. The on-site supervisor shall ensure compliance with protection objectives. [U.S. NavyArmy & USAG-KA]

p) The U.S. NavyArmy 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. [U.S. NavyArmy, USAG-KA]

q) After the environmental analyses are completed, a fact sheet describing the project and the environmental controls shall be prepared and shall be provided at locations on Ebeye and the USAG-KA. [U.S. NavyArmy, USAG-KA]

1.2 Land Impact Illeginni Requirements and Limitations

a) The impact area shall be searched for black-naped tern nests and chicks prior to any pre-flight equipment mobilization. Any discovered nests shall be covered with an A-frame structure as per USFWS guidance. The area shall be monitored during pre-launch activities to ensure no black-naped tern nests are disturbed. Post-survey monitoring shall also be conducted to observe for impacts to adult black-naped terns or their nests. Results of the monitoring shall be reported to the USAG-KA Environmental Office to provide to the USFWS. [U.S. NavyArmy, USAG- KA]

b) Beginning at least 30 days prior to launch, USAG-KA environmental staff shall inspect beach area for active turtle nests at Illeginni Islet. If nests with eggs are discovered, USAG-KA shall immediately notify the appropriate agencies and implement USFWS recommendations to avoid or minimize project-related impacts to sea turtle nests. [U.S. NavyArmy & USAG-KA]

c) USAG-KA and/or RTS personnel shall conduct a helicopter or fixed-wing aircraft overflight of the islet vicinity as soon as safely practicable after the flight test to survey for any dead or injured marine animals and sea turtles. [U.S. NavyArmy, USAG-KA &/or RTS]

d) When feasible, within 1 day after the land impact test on Illeginni Islet, USAG-KA environmental staff shall survey the islet and the near-shore waters for any injured wildlife, damaged coral, or damage to sensitive habitats and apply the following: [U.S. NavyArmy & USAG-KA]

    i) For recovery and rehabilitation of any injured migratory birds or sea turtles found on or in near-shore waters of Illeginni Islet, USFWS and NMFS shall be notified to advise on best care practices and qualified biologists will be allowed to assist in recovering and rehabilitating any injured sea turtles found.

    ii) During inspections of the islet and near-shore waters, USAG-KA environmental staff shall assess any sea turtle mortality.

    iii) Any impacts to biological resources shall be reported to the Appropriate Agencies, with USFWS and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.

e) Site recovery and clean-up shall be performed for land or shallow water impact in a manner to minimize further harm to biological resources. [U.S. NavyArmy]

f) Vehicle and equipment movements on Illeginni Islet shall follow existing paths and roadways. Operational and emergency lighting shall be shielded and pointed down to minimize the potential for impacts to migratory birds and sea turtles. [U.S. NavyArmy, USAG-KA, RTS]

g) To prevent birds from nesting on the support equipment after initial setup, equipment shall be appropriately covered with tarps or other materials and deterrent techniques (e.g., scarecrows, mylar ribbons, and/or flags) shall be used on or near equipment. [U.S. NavyArmy & USAG-KA]

h) At Illeginni Islet, should any delivery vehicle components or falling debris impact in areas of sensitive biological resources (i.e., forested areas, sea turtle nesting habitat, and coral reef), USFWS and NMFS biologists shall be invited to inspect, as practicable, to assess, and to provide guidance on mitigations. Debris recovery operations shall be conducted to minimize impacts on such resources. In all cases, hand tools shall be used to the greatest extent possible. [U.S. ~~Navy~~Army, USAG-KA & RTS]

i) If the reef, reef flat, or shallow waters are inadvertently impacted, inspection shall occur within 24 hours to assess damage to determine mitigation measures. [U.S. ~~Navy~~Army, USAG-KA & RTS]

j) To minimize long-term risks to birds and marine life on Illeginni Islet, all visible debris and any other project-related debris shall be recovered during post-test operations. This shall include the recovery of floating or visible debris in the shallow lagoon or shallow ocean waters by range divers. [U.S. ~~Navy~~Army]

k) The land impact crater shall be excavated, and the excavated material screened to remove payload debris. The crater shall then be back-filled with ejecta from around the rim of the crater and clean fill transported to the islet. Best management practices (e.g., use of booms or other barriers) shall be implemented to contain exposed soil and minimize the potential for disturbed sediment from washing into nearby waters. [U.S. ~~Navy~~Army & USAG-KA]

l) Following cleanup and repairs to the Illeginni Islet site, soil and groundwater samples shall be collected at various locations around the impact area and tested for tungsten alloy and metals. [U.S. ~~Navy~~Army & USAG-KA]

m) As part of post-test cleanup activities on Illeginni Islet, personnel shall stabilize fugitive dust and disturbed soil by wetting/washing the site with clean water. [U.S. ~~Navy~~Army]

n) Following removal of all flight test payload items and any remaining debris from the impact area, necessary repairs shall be made and the crater backfilled. [U.S. ~~Navy~~Army]

1.3 Broad Ocean Area Impact Requirements and Limitations (Illeginni Islet)

a) Prior to flight test, the U.S. ~~Navy~~Army shall prepare a detailed cleanup plan that satisfies human health and safety requirements and incorporates measures to minimize ocean pollution. [U.S. ~~Navy~~Army]

b) USAG-KA and RTS personnel shall conduct a helicopter or fixed-wing aircraft overflight of the waters near Illeginni Islet as soon as safely practicable after the flight test to survey for any dead or injured marine animals. Such sightings shall be reported to the USAG-KA Environmental Office, the RTS Range Directorate, and the Flight Test Operations Director, who shall then forward information to the Appropriate Agencies. [U.S. ~~Navy~~Army, USAG-KA, RTS]

c) Although no floating debris from the payload impact is expected, any floating debris in the shallow waters near Illeginni after the impact shall be recovered and properly disposed of. [U.S. NavyArmy & USAG-KA]

d) Payload recovery/cleanup operations shall not be attempted in deeper waters (>180 feet [ft]) (>55 meters [m]). Payload debris from an impact in the ocean or lagoon beyond shallow waters shall not be recovered. [U.S. NavyArmy, USAG-KA, RTS]

e) If the payload impacts in the shallow waters of less than 50 ft (less than 15 m) of the lagoon or the open ocean, a dive team from USAG-KA shall be brought in by the U.S. NavyArmy to conduct underwater searches. Using surface craft for recovery operations, all practicable efforts shall be made to locate and recover the debris. If payload debris is found, divers shall recover debris manually. [U.S. NavyArmy, USAG-KA & RTS]

f) Recovery and cleanup operations shall be conducted in a manner to minimize any further impacts to sensitive biological resources or habitats. [U.S. NavyArmy, USAG-KA & RTS]

1.4 Incidental Take Terms and Conditions for the FE-2 Flight Test and FT-3 Flight Test

In accordance with the Final Biological Opinion provided by NMFS on 27 September 2019 (**Appendix B**; NMFS 2019) and the Final Biological Opinion provided by NMFS on 26 March 2021 (**Appendix C**; NMFS 2021), the U.S. NavyArmy must comply with the following terms and conditions to minimize impacts on UES-protected species and their habitats, and to monitor and report any incidental take. Non-discretionary measures which must be undertaken in order for the Incidental Take Statement to apply (NMFS 2019, NMFS 2021) include the following:

a) The U.S. NavyArmy 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 Islet, the U.S. NavyArmy shall require 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, and apply the following: [U.S. NavyArmy, USAG-KA]

   i) Ejecta greater than 6 inches (15 centimeters) 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 6 inches (15 centimeters) 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 shall be relocated to suitable habitat where it is not likely to become mobilized.

c) In the event that land based impact affects the reef at Illeginni Islet, the U.S. NavyArmy shall require personnel to reduce impacts on top shell snails. [U.S. NavyArmy, USAG-KA]

   i) Rescue and reposition any living top shell snails buried or trapped by rubble.

   ii) Relocate to suitable habitat, any living top shell snails in the path of any heavy equipment that must be used in the marine environment.

d) In the event that land based impact affects the reef at Illeginni Islet, the U.S. NavyArmy shall require its personnel to reduce impacts on clams. [U.S. NavyArmy, USAG-KA]

   i) Rescue and reposition any living clams 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.

e) The U.S. NavyArmy shall assign appropriately qualified personnel to record all suspected incidences of take of any UES-consultation species. [U.S. NavyArmy, USAG-KA]

f) The U.S. NavyArmy 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 Islet. [U.S. NavyArmy, USAG-KA] As practicable:

   i) Photograph all damaged corals and/or other UES-consultation species that may be observed injured or dead;

   ii) A scaling device (such as a ruler) shall be included in all photographs to aid in the determination of size; and

   iii) Location of the photograph shall be recorded.

g) In the event the payload impact affects the reef at Illeginni Islet, the U.S. NavyArmy shall require its personnel to survey the ejecta field for impacted corals, top shell snails, and clams, while being mindful for any other UES-consultation species that may have been affected.

h) Within 60 days of completing post-test clean-up and restoration, the U.S. NavyArmy shall provide photographs and records to the USAG-KA Environmental office. USAG-KA and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.

i) Within 6 months of completion of the action, USAG-KA will provide a report to NMFS. The report shall identify:

   i) The flight test and date;

   ii) The target area;

   iii) The results of the pre- and post-flight surveys;

   iv) The identity and quantity of affected resources (including photographs and videos as applicable); and

   v) The disposition of any relocation efforts.

j) Re-initiation of consultation shall occur if:

   i) The amount or extent of incidental take is exceeded;

ii) New information reveals effects of the agency action that may affect UES-protected species or critical habitat in a manner or to an extent not considered in the Biological Opinion;

iii) The agency action is subsequently modified in a manner that causes an effect to the UES-protected species or critical habitat not considered in the Biological Opinion; and

iv) A new species is listed or critical habitat designated that may be affected by the action.

k) In instances where the amount or extent of incidental take is exceeded, any operations causing such take shall cease, pending re-initiation of consultation.

In order to meet the terms and conditions in the NMFS Biological Opinion, the following monitoring and reporting procedures shall be implemented:

a) U.S. ~~Navy~~Army shall work with the USAG-KA Environmental Office to inspect the impact zones to assess UES consultation corals, top shell snails, and the two clam species mortality after the ~~FE-2~~FT-3 test.

b) U.S. ~~Navy~~Army shall submit a report by 31 December of the year in which the ~~FE-2~~FT-3 Flight Test(s) was conducted to USAG-KA Environmental Office that describes impacts to the identified species, if any, or any take that may have occurred at Illeginni Islet.

c) USAG-KA Environmental Office shall forward the U.S. ~~Navy~~Army annual report to the NMFS Pacific Islands Regional Office documenting take of the identified species and suggesting ways to further minimize incidental take at Illeginni Islet.

1.5 Material and Waste Management

a) Hazardous waste treatment or disposal is prohibited at USAG-KA [UES §3- 6.6.5(a)].

b) Hazardous materials shall be handled in adherence to the hazardous materials and waste management systems of USAG-KA.

c) All activities at USAG-KA importing activity-specific hazardous materials into USAG-KA are required to submit within 15 days of receiving the material or before actual use, whichever comes first, a separate Hazardous Materials Procedure to the Commander, USAG-KA, for approval (UES §3-6.4.3).

d) Hazardous waste incidents will comply with the emergency procedures set forth in the Kwajalein Environmental Emergency Plan (KEEP). Response to releases of oil, fuels, and lubricants into the USAG-KA environment shall be in accordance with the KEEP (UES §3-6.5.8).

e) Payload debris could consist of batteries and various heavy metal components that include small quantities of aluminum, steel, titanium, magnesium and other alloys, copper, chromate coated hardware, and tungsten alloys. All waste materials collected shall be returned to USAG-KA for proper storage and disposal in the United States in accordance with the UES.

f) For the post-test recovery and cleanup of payload debris from Illeginni Islet or in the shallow waters of the lagoon, U.S. NavyArmy, USAG-KA, and RTS personnel and contractors shall follow established safety procedures.

g) No ocean disposal shall occur or be associated with the FE-2FT-3 test. [U.S. NavyArmy & USAG-KA]

1.6 Climate Change

The FE-2FT-3 payload is not expected to emit hazardous air pollutants during flight, or impact, in USAKA that would contribute to climate change.

Emissions from equipment, vessels, and aircraft used during payload delivery and at identified locations at Illeginni Islet, for the single flight test, are not anticipated to be significant. Although global sea level is documented to be rising due to climate change, and the islands within the Republic of the Marshall Islands (RMI) are of low elevations, the subtle effects of rising sea level and climate change will not affect the test scheduled to occur within a year after signing of the Finding of No Significant Impact, nor would the FE-2FT-3 flight tests affect climate change. Therefore, there are no specified limitations or requirements for FE-2FT-3 activities related to climate change.

2.0 Monitoring Procedures

a) During travel to and from Illeginni Islet, on-board personnel shall monitor for marine mammals and sea turtles to avoid potential strikes and report any observations (including location, date, time, species or taxa, and number of individuals) to the USAG-KA Environmental Office which would maintain records of these observations and report sightings to NMFS and/or USFWS. Vessel operators shall adjust their speed based on expected animal densities, and on lighting and turbidity conditions. [U.S. NavyArmy, USAG-KA, RTS]

b) USAG-KA and RTS aircraft pilots flying near Illeginni Islet shall report any opportunistic sightings of marine mammals and sea turtles to the USAG-KA Environmental Office. [U.S. NavyArmy, USAG-KA, RTS]

c) Personnel involved in cleanup and backfilling of craters created by impact shall monitor soil and debris for cultural or historic remains unearthed by impact or backfilling activities. [U.S. NavyArmy, USAG-KA, RTS]

d) If cultural or historic remains are discovered during the activities, work shall cease and the USAG-KA Environmental Office shall be notified by U.S. NavyArmy and RTS personnel. The RMI Environmental Protection Agency (EPA) and RMI Historic Preservation Office (RMIHPO) shall be notified by USAG-KA, and appropriate mitigation measures, developed in consultation with the RMIHPO, shall be implemented by the U.S. NavyArmy to minimize the effects on the resource or to recover as much of the resource as possible (conforming to professional standards for research), as directed by UES §3-7.5.7. [U.S. NavyArmy, USAG-KA, RTS]

e) The U.S. NavyArmy FE-2FT-3 program and RTS personnel shall monitor the worksite throughout each workday for any endangered or threatened species moving into the area. Work shall be delayed until any such species is out of harm's way, leaves the area, or is relocated (attached organisms only) beyond the influences of the project to similar habitat.

f) Relocation of benthic organisms shall be coordinated well in advance of removal with USAG-KA, USFWS, NMFS, and RMI EPA. [U.S. NavyArmy, RTS]

g) To monitor all reportable activities and incidents associated with FE-2FT-3 test, recordkeeping and reporting shall occur IAW applicable Department of Defense, U.S. NavyArmy, RTS, and USAG-KA policies and regulations, and UES requirements.

3.0 Environmental Area Potentially Affected by Proposed Activity

During similar tests, impacts to protected species were much less than expected, as witnessed by the USFWS personnel participating in the biological monitoring during the tests. Since similar impacts are expected for the proposed U.S. NavyArmy FE-2FT-3 test, the mitigations below shall be performed for the U.S. NavyArmy FE-2FT-3 test.

3.1 Illeginni Islet

a) Pre-flight monitoring by qualified personnel shall be conducted on Illeginni Islet for sea turtles or sea turtle nests.

b) On-site personnel will report any observations of sea turtles or sea turtle nests on Illeginni Islet (including location, date, time, species, and number of individuals) to the USAG-KA Environmental Office which would maintain records of these observations and report sightings to NMFS and USFWS.

c) During travel to and from Illeginni Islet, ship personnel shall monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators shall adjust speed or raft deployment based on expected animal locations, densities, and/or lighting and turbidity conditions. Personnel shall report any marine mammal or sea turtle observations to the USAG-KA Environmental Office. [U.S. NavyArmy, USAG-KA]

3.2 BOA Impacts (Illeginni Islet)

a) During surface travel to and from Illeginni Islet, ship personnel shall monitor for marine mammals and sea turtles to avoid potential strikes and report any observations to the USAG-KA Environmental Office. Vessel operators shall also adjust their speed based on expected animal densities, and on lighting and turbidity conditions. [U.S. NavyArmy, USAG-KA]

b) Any marine mammal or sea turtle sightings during overflights or surface travel will be reported to the USAG-KA Environmental Office, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch.

c) Vessel operations, particularly in the waters near Illeginni Islet, shall only occur when weather and sea conditions are acceptable for safe travel. [U.S. NavyArmy, USAG-KA]

d) Vessel operations shall not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life. [U.S. NavyArmy, USAG-KA]

4.0 Minor DEP Modifications

Minor modifications to this DEP may be accomplished under the provisions of UES §2- 17.3.6(e).

5.0 Notification Procedures

5.1 Emergency Notification

a) Within 24 hours of discovery of an emergency environmental condition, USAG-KA shall notify the public affected or potentially affected by the condition and the Appropriate Agencies by the most expeditious means available.

b) Within 10 days following emergency notification, USAG-KA shall submit written notification of the event to the Appropriate Agencies that contains at a minimum the relevant information described in UES §2-7.2.2.

c) Emergency notifications shall be made for any condition that the Commander, USAG-KA, determines to constitute an emergency condition.

5.2 Public Notification

a) Public notifications shall be made by USAG-KA to advise the public of an activity or action that the U.S. NavyArmy has taken or is planning as a result of emergency conditions. [U.S. NavyArmy, U.S. Army Space and Missile Defense Command (USASMDC)]

b) Public notification made as a result of emergency conditions shall be made in The Kwajalein Hourglass and The Marshall Islands Journal. Posters or bulletins shall be displayed in public places and announcements issued on Kwajalein Range Services Newsline and/or on public television. [U.S. NavyArmy, USASMDC]

5.3 Agency Notification

a) In the event that any USAG-KA species and habitats of Special Concern as stated in UES Appendices 3-4A thru 3-4D are disturbed, transplanted, injured, or killed due to test activities, the NMFS, the USFWS, and the RMI EPA shall be informed by USAG-KA and RTS within 24 hours of discovery. [USAG-KA, RTS]

b) If cultural or historic remains or artifacts are discovered during the course of FE-2FT-3 test activities, work at the site shall cease and the USAG-KA Environmental Office shall be notified by the U.S. NavyArmy. The RMIHPO shall be notified by USAG-KA, and appropriate mitigation measures, developed in consultation with the RMIHPO, shall be implemented by the U.S. NavyArmy to minimize the effects on the resource or to recover as much of the resource as possible (conforming to professional standards for research), as directed by UES §3-7.5.7. [U.S. NavyArmy, USASMDC, USAG-KA]

6.0 Records Keeping

a) The Notice of Proposed Activity (NPA), Environmental Comments and Recommendations, and the DEP authorizing FE-2FT-3 test activities at USAG-KA shall be preserved for the duration of the activity plus 10 years or for 10 years after expiration of the DEP, whichever is less. (UES §2-13.2.7)
b) All records associated with the activity shall be maintained for at least 5 years, unless another length of time is specified within the UES. (UES §2-13.2)
c) Personnel-training records shall be preserved for 10 years beyond the period the employee is engaged in activities potentially affecting the environment at USAG-KA (UES §2-13.2.1).

7.0 Reporting Procedures

The following reports are required IAW the UES:

a) The USAG-KA Environmental Office shall provide a notification statement to the UES Appropriate Agencies, and the Government of the Republic of the Marshall Islands, via the USAG-KA Host Nation Office and U.S. Embassy, within 5 calendar days of a test event which involves a test failure, anomalies, or termination within the RMI. This statement shall include the location, safety, and environmental consequences.
b) A report shall be submitted by 31 December of the year in which the flight test was conducted to USAG-KA that describes sea turtle impacts or any take that occurred at Illeginni Islet.
c) Within 60 days of completing post-test clean-up and restoration, provide photographs and records to the USAG-KA Environmental Office. USAG-KA, USFWS, and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.
d) Within 6 months of completion of the action, the U.S. NavyArmy will provide, through USASMDC and USAG-KA, a report to USFWS and NMFS. The report shall identify:
   i) The flight test and date;
   ii) The target area;
   iii) The results of the pre- and post-flight surveys;

    iv) The identity and quantity of affected resources (include photographs and videos as applicable); and
    v) The disposition of any relocation efforts.

e) USAG-KA Environmental Office shall forward the report to the USFWS Pacific Islands Office Field Supervisor documenting any take of green turtles and suggesting ways to further minimize incidental take at Illeginni Islet.
f) A written report shall be provided to NMFS, USFWS, and the RMI EPA within 10 days of an incident resulting in the disturbance, transplant, injury, or death of any USAG-KA species and habitats of Special Concern as stated in UES Appendices 3-4A [or under Section 3-4.5.1(a)] thru 3-4D. The report shall provide the type and number of organisms disturbed, transplanted, injured, or killed; their condition; the locations and conditions of the original and new habitats; and the projected chances of recovery if injured.
g) If any of the requirements of the DEP or the UES are violated during the activity covered by this DEP, a written report shall be provided to the UES Appropriate Agencies within 30 days of the violation.

8.0 Resolution of Non-Compliant Areas

Currently, there are no known UES non-compliant activities associated with the U.S. NavyArmy FE-2FT-3 test at USAG-KA. With the implementation of the requirements, limitations, and monitoring protocols described in this DEP, FE-2FT-3 test activities at USAG-KA shall be in full compliance with the UES 15th Edition, September 2018.

9.0 Environmental Comments and Recommendations Received on the Notice of Proposed Activity and USAG-KA Responses

NMFS – Received, Summary sheet attached

USFWS – Received, Summary sheet attached

USACE – Received, no comments

RMI EPA – Not received

U.S. EPA – Not received

NATIONAL MARINE FISHERIES SERVICE (NMFS)

NMFS COMMENT: NPA may affect resources within the jurisdiction of this agency. Conditionally agree with proposed environmental controls, subject to the enclosed comments/ recommendations.

> **USAG-KA RESPONSE:** Comment noted and recommendation incorporated into BA and EA/OEA as appropriate and specified below.

NMFS Comment 1: Page 5, para 1, line 4: "... radar sensors in waters no less than 10 ft (3 m) deep" versus Page 16, sect. 5.4 last para last line, "Sensor rafts would not be located in waters less than 12 ft (3.7 m) deep". Not a major difference, but which one might it be?

> **USAG-KA RESPONSE:** Sensor rafts would be deployed in waters at least 13 ft (4 m). All references to sensor raft location have been revised in the BA and EA/OEA.

NMFS Comment 2: Page 16, sect 5.4, 1st bullet: If the impact area "would be" searched for seabird nests prior to flight activity (a coordination resource category; i.e. 2nd control), why would a search for turtles/turtle nests (a UES consultation category) be limited to, "if possible"? The search for sea turtles/nests is very easy and, I believe, has historically been done to help ensure "take" avoidance. Absent such, I imagine a formal or informal consultation may be needed with the USFWS, as one enters into the "will", or "may" adversely affect realm.

> **USAG-KA RESPONSE:** Sea turtle and sea turtle nest searches would be conducted prior to flight activity. Text in BA and EA/OEA has been revised to address this comment.

NMFS Comment 3: Page 17, 5th bullet: Some of the controls and procedures have been standardized (such as outreach and involvement of NMFS and USFWS should a reef impact occur), so it may make sense to list a few of them here.

> **USAG-KA RESPONSE:** Comment has been addressed in the BA and EA/OEA.

NMFS Comment 4: Page 19, Sect 9, 1st sentence: Is the plan to consult now with both USFWS and NMFS for in water species, or USFWS for land based species and NMFS for marine? The former would be a change in current practice and may not work very well from a timing or consolidation standpoint.

> **USAG-KA RESPONSE:** Consultation would be initiated with USFWS for terrestrial species and with NMFS for marine species.

NMFS Comment 5: Page 19, sect 9 and Page 20 Table 13-1: A contrast in the numbers of species for which consultation is proposed exists here. Initially, consultation is proposed for 1 fish, 7 coral and 3 mollusk species. Yet, consultation is later defined in the paragraph as being needed for 11 marine mammal, 2 sea turtle, 3 fish, 5 mollusk and 22 coral species.

It may be that this is attempting to parse between "likely" and, "may, but not likely" to adversely affect species groupings. However, all UES consultation species that may be affected (i.e. both likely and, may but not likely) need to be consulted on. The combination of all of these species will need to be considered within a single consultation package. Suggest changing the language to reflect on and encompass all species requiring consultation (whether likely, or may, but not likely to be adversely affected). In the table, a column could be used if desired to distinguish between SMDCs suggestion on whether the action is likely, or may, but not likely to affect a given species.

USAG-KA RESPONSE: Text in BA and EA/OEA has been revised to clarify and effect determination tables have been included in the BA to address this comment.

NMFS Comment 6. Page 19, Sect 12, 2nd line: typo, add the word "the" between "fill" and "impact".

USAG-KA RESPONSE: Comment noted and addressed.

NMFS Comment 7. Page 21, Table 13-1, *Pocillopora meandrina*: *Pocillopora meandrina* is an ESA candidate species (it had a positive 90 day finding) and; thus, a full on UES consultation species.

USAG-KA RESPONSE: The BA and EA/OEA have been revised to reflect the positive 90-day finding for this species.

NMFS Comment 8. Page 20-21, Table 13-1. Might be best to change the ESA listing status column to a UES listing source column (i.e. a consolidation of ESA, MMPA, RMI, and UES status categories), which could be derived from the 4 source columns in UES 15th ed Table 3-4A. The UES is affected by multiple sources for listing species, which includes, but is not limited to the ESA. The combination is what is relevant for USAKA sponsored activities.

USAG-KA RESPONSE: This comment was addressed by adding the suggested column to Table 13-1.

U.S. ARMY CORPS OF ENGINEERS (USACE)

COMMENT: Reviewed the NPA and have no comments.

USAG-KA RESPONSE: Comment noted.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

COMMENT: NPA does not affect resources within the jurisdiction of this agency. Comments are provided.

USAG-KA RESPONSE: Comment noted.

USFWS Comment 1: The U.S. Fish and Wildlife Service (Service) received your request for comments dated January 17, 2019 for a Notice of Proposed Action (NPA) for one test flight from the Pacific Missile Range Facility (PMRF) to one of three locations at the Ronald Reagan Ballistic Missile Defense Test Range (RTS). The locations include the Northeast Deep Water Impact Zone and the Southwest Deep Water Impact Zone in the Broad Ocean Area (BOA) as well as the land area of Illeginni Islet. The test will take place within one year of the signed Finding of No Significant Impact.

USAG-KA RESPONSE: Comment noted.

USFWS Comment 2: The discussion in the NPA does not address coordination species listed by the USAKA Environmental Standards (UES) that may be impacted. These potentially include marine species and birds protected under the Migratory Bird Treaty Act (MBTA). There is legal controversy as to the culpability of unintentional take of MBTA species, and US Federal Courts are divided in their assessment of criminality of unintentional take. The UES require protection of coordination species during mission activities, and consideration should be given to avoiding impacts to these species. In particular, there may be impacts to the Black-naped Tern (BNTE; *Sterna sumatrana).* Below we provide some best management practices, but there remains the formal Coordination procedures under the USAKA Environmental Standards (UES). We therefore recommend that USASMDC implement the Coordination procedures of the UES (Section 3-4.6).

USAG-KA RESPONSE: Comment has been addressed and all relevant coordination species have been addressed in the FE-2 EA/OEA.

USFWS Comment 3: Marine Resources: The Service recommends that appropriate response measures be developed for possible impacts to marine species and reef habitats, to be implemented in the case of an unintentional direct impact to marine resources. These measures should include prompt notification to the Appropriate Agencies and a provision for a marine resource impact assessment so that restoration actions can be considered.

The marine resources covered under the coordination procedures include all corals (black coral, stony corals, organ-pipe corals, fire corals, and lace corals) as well as the giant clam (*Tridacna maxima*), certain conchs (*Lambis lambis*, *Lambis scorpius*, and *Lambis truncata*), certain fish (*Plectropomus laevis* and *Epinephelus lanoceolatus*), the coconut crab (*Birgus latro*), and sea grass (*Halophila gaudichaudii*). There is a high likelihood some of these species will be present within the vicinity of Illeginni. This analysis can be conducted under the Coordination procedures of Section 3-4.6.

> **USAG-KA RESPONSE:** Comment has been addressed and all relevant coordination species have been addressed in the FE-2 EA/OEA.

USFWS Comment 4: Terrestrial Resources: The most vulnerable seabird species at Illeginni is the ground-nesting Black-naped Tern, which nests within the targeted impact area near the helicopter pad on Illeginni Islet. Black-naped terns nest during most months of the year, and eggs or chicks may be present in the targeted impact area at any time of the year. Any active nests, eggs and chicks would likely be killed or injured by direct impact or ejected debris. The number of nests observed by USFWS on Illeginni has not exceeded three or four in any given seabird survey, and BNTE normally have one or two viable eggs or chicks. Locations of BNTE nests on Illeginni during the 2016 biological survey conducted by the Service are shown in Figure 1.

The maximum number of adversely affected BNTE should not exceed 12 birds (4 adults and 8 eggs or chicks) if impact of the reentry vehicle (RV) is during daylight hours, when one adult of each pair is over the open ocean foraging for small fish. A maximum of 16 birds could be injured or killed if the impact is at night when both adults are roosting at or near the nests. It is probable that support activities near the helicopter pad on Illeginni will deter some terns from initiating nests before launch, but terns incubating eggs or feeding chick s will attempt to continue nesting throughout such activities. Nests and young chicks can be protected with the construction of wooden "A-frame" structures as shown in Figure 2, which will serve to shade the eggs and chicks if adults are flushed from the nest and will provide warning to support personnel to avoid the nests. The A-frames could be painted orange or another highly visible color to serve as a warning to personnel to avoid the nests. Terns may abandon the A-frames, but this may be unavoidable, and such shelters will provide the maximum protection of birds and eggs during FE-2 activities.

We recommend that KRS Environmental Services search the area for nests and chicks prior to any equipment mobilization and cover any nests found with A-frames. We recommend monitoring the area during pre-launch activities to insure no nests are disturbed. Sturdy A-frames could also protect some nests and eggs from small ejected debris at impact, depending on their distance from the impact point.

> **USAG-KA RESPONSE:** Comment has been addressed and black-naped tern nest searches and nest protection measures have been included in the FE-2 EA/OEA.

USFWS Comment 5: Great Crested Terns (*Thalasseus bergii*) may also nest on Illeginni, but the Service has no positive data to report regarding where or when the great crested terns might breed. They nest on sand spits, and the most likely area would be the spit to the northwest of Illeginni Islet.

USAG-KA RESPONSE: Comment noted and great crested terns have been addressed in the FE-2 EA/OEA.

USFWS Comment 6: All the terrestrial and seabirds on Illeginni will likely exhibit startle reflexes when a payload RV impacts the island, but the startle reflex will not likely adversely affect any birds. Black noddies *(Anous minutus)* actively incubating eggs on nests in *Pisonia* trees several hundred meters to the south will briefly leave their nests, but the startle reflex should not cause any eggs or chicks to fall from the nest. The sound pressures of the sonic boom and impact may cause a temporary threshold shift (TTS) in the hearing of birds at a distance (uncertain distance) from the impact, and may cause a prolonged, but temporary, non-lethal threshold shift in the hearing of birds near the impact area. All bird species studied have healing mechanisms to regenerate damaged auditory tissues to prevent permanent hearing impairment (Dooling et al 1997, Smolders 1999). These sound pressure effects would not have a significant effect on local populations.

USAG-KA RESPONSE: Comment noted and noise effect to nesting seabirds has been addressed in the FE-2 EA/OEA.

USFWS Comment 7: **Consultation Species***:* We have not received a request for consultation to date. We would anticipate that a consultation may be needed for five species of sea turtles (*Caretta caretta, Chelonia mydas, Dermochelys coriacea, Eretmochelys imbricata,* and *Lepidochelys olivacea)* or four species of birds *(Pterodroma sandwichensis, Phebastria albatrus, Puffinus auricularis newelli,* and *Oceanodroma castro).* It is uncertain if a need exists to request a consultation for the launch at PMRF or if those activities will be covered under the August 20, 2018 Biological Opinion (BO) for the Proposed Base-wide Infrastructure, Operations, and Maintenance Activities at the Pacific Missile Range Facility, Island of Kauai, Hawaii. If they are anticipated to be covered under the August 20, 2018 BO, please include this information in the Document of Environmental Protection (DEP) or any consultation request so we know the complete scope of the project is covered.

USAG-KA RESPONSE: Comment noted. Launch at PMRF is evaluated in the EA/OEA, and FE-2 launch activities at PMRF are covered under the August 20, 2018 BO for the Proposed Base-wide Infrastructure, Operations, and Maintenance Activities at the PMRF.

USFWS Comment 8: The potential effects to Newell's shearwater *(Puffinus auricularis newelli),* band-rumped storm petrel *(Oceanodroma castro),* short-tailed albatross *(Phebastria albatrus),* and Hawaiian petrel *(Pterodroma sandwichensis)* are very unlikely to individual birds. In the event that a listed seabird was in the splashdown area of the broad ocean area (BOA), the bird would probably exhibit a startle reflex, which would not likely adversely affect the individual. Similarly, the possibility of direct contact with a listed seabird is remote. Within the impact area, we consider the only sea turtles potentially present to be the Green *(Chelonia mydas)* and Hawksbill *(Eretmochelys imbricata).* The others *(Caretta caretta,* *Dermochelys coreacea,* and *Lepidochelys olivacea)* have not been sighted around or on Illeginni and would therefore would not likely be subject to an adverse affect.

USAG-KA RESPONSE: Comment noted and addressed in FE-2 BA as appropriate.

USFWS Comment 9: **Conservation Measures***:* The following conservation measures are provided based on the information provided in the previous consultation for the U.S. Navy Strategic Systems Programs' Flight Experiment- I (FE- I) on Green and Hawksbill sea turtles and Newell's Shearwater. The following avoidance and minimization measures are considered part of the project description:

- If personnel observe sea turtles in or near potential impact zones, sightings will be reported to appropriate test and USAG-KA personnel for consideration in launch planning.
- Vessel and equipment operations will not involve any intentional discharges of fuel, toxic waters, or plastics and other solid wastes that could harm terrestrial or marine life.
- Hazardous materials will be handled in adherence to the hazardous materials and waste management systems of USAG-KA. Hazardous waste incidents will comply with the emergency procedures set out in the Kwajalein Environmental Emergency Plan (KEEP) and the UES.
- All equipment and packages shipped to USAG-KA 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 test launch, Illeginni Islet will be surveyed by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests on a bi-weekly basis. If possible, personnel will inspect the area within two days of the launch. If sea turtles or sea turtle nests are observed near the impact area, observations will be reported to appropriate test and USAG-KA personnel for consideration in approval of the launch and to NMFS and the Service.
- 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 and USFWS.
- Debris recovery and site cleanup will be performed on land. Recovery and cleanup will 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, a Service or NMFS biologist will be allowed to provide guidance and or/or assistance in recovery operations to minimize impacts on such resources.
- Although unlikely, any dead or injured marine mammals or sea turtles sighted by post- flight personnel will be reported to the USAG-KA Environmental Office and

USASMDC, who will then inform NMFS and the Service. USAG-KA aircraft pilots otherwise flying in the vicinity of the impact and test support areas will also similarly report any opportunistic sightings of dead or injured marine mammals or sea turtles.

- As soon as practical following payload impact at Illeginni Islet, qualified biologists will be allowed to assist in recovering and rehabilitating any injured sea turtles found.
- During post-test recovery and cleanup, should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work will be delayed until such species were out of harm's way or leave the area.
- To minimize impacts during post-flight operations, the Service and NMFS will be allowed to provide guidance and/or assistance during recovery and cleanup at Illeginni Islet. In all cases, recovery and cleanup operations will be conducted in a manner to minimize further harm to biological resources.

USAG-KA RESPONSE: Comment has been addressed and all relevant conservation measures have been included in the FE-2 BA and EA/OEA.

10.0 Environmental Comments and Recommendations Received on the Draft Document of Environmental Protection and USAG-KA Responses

No comments were received on the Draft FE-2 DEP.

The following request was included with the USFWS concurrence for the Final FE-2 DEP.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

COMMENT: The Service concurs with the Final DEP and NPA with the additional requests for samples results as given below.

USAG-KA RESPONSE: Comment noted.

USFWS DEP Comment 1: Section 1.2: Land Impacts Illeginni Requirements and Limitations. Reference is made in Paragraph 1): "Following cleanup and repairs to the Illeginni Islet site, soil and groundwater samples will be collected at various locations around the impact area and tested for tungsten alloy and metals". The Service is requesting the results of all groundwater testing of metals including tungsten.

USAG-KA RESPONSE: Comment noted.

USFWS NPA Comment 1: Sections 4.3: Water Quality. This section provides summary results of expected and measured ground water tungsten concentrations following the FE-1 test. The tungsten concentration of 0.65 mg/1 significantly exceeds the EPA Residential Regional Screening Level (RSL) level for potable water of 0.016 mg/L. Modelling done by Lawrence Livermore National Laboratories additionally predicted tungsten concentrations to reach 25 mg/1. "Based on the original model dimensions, 2.5 m/yr rainfall precipitation rate, and an equilibrium tungsten concentration of 25 mg/L, all tungsten would be predicted to migrate away from the original location within a year. (LLNL, 2018)". The Service is concerned with possible unknown toxicity effects on adjacent reef organisms including coral and coral larvae, which would be subjected to elevated levels of tungsten migrating into the lagoon and ocean adjacent to the impact sites of both FE-1 and FE-2 tests. The NPA explains in Section 4.3 that water sampling wells have been installed on Illeginni Islet and will be sampled every 3 to 6 months for metals to include tungsten. The Service is requesting results of these groundwater samples to assist in our planned toxicity testing with species of corals and coral larvae that could be impacted by groundwater migration into the lagoon or ocean adjacent to the test impact site. The planned coral toxicity testing includes only a subset of the marine species listed in the UES Consultation and Coordination Tables in Appendices 3-4A and 3-4C. The marine resources covered under the coordination procedures include all corals (black coral, stony corals, organ-pipe corals, fire corals, and lace corals) as well as the giant clam *(Tridacna maxima),* certain conchs *(Lambis lambis, Lambis scorpius, and Lambis truncata),* certain fish *(Plectropomus laevis* and *Epinephelus lanoceolatus),* the coconut crab *(Birgus latro),* and sea grass *(Halophila gaudichaudii).* There is a high likelihood some of these species will be present within the vicinity of Illeginni and could be impacted.

We appreciate the opportunity to provide comments as well as concurrence on this Final DEP and NPA.

USAG-KA RESPONSE: Comment noted.

APPENDIX A

U.S. NAVY FE-2 FLIGHT EXPERIMENT

NOTICE OF PROPOSED ACTIVITY

MODIFIED MARCH 2021

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NOTICE OF PROPOSED ACTIVITY (NPA)

ACTIVITY:

U.S. ARMY HYPERSONIC FLIGHT TEST 3 (FT-3)
U.S. NAVY FLIGHT EXPERIMENT-2 (FE-2)

CONTROL NUMBER NPA-19-RTS-01

July 2019

Modified March 2021

U.S. ARMY GARRISON KWAJALEIN ATOLL – ILLEGINNI ISLET
REPUBLIC OF THE MARSHALL ISLANDS

Prepared by:

KFS

303 Williams Avenue, Suite 116
Huntsville, Alabama 35801-6001

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NOTICE OF PROPOSED ACTIVITY

ACTIVITY: U.S. NAVY FLIGHT EXPERIMENT-2 (FE-2) U.S. ARMY HYPERSONIC FLIGHT TEST 3 (FT-3) CONTROL NUMBER NPA-19-RTS-01.0

DATE SUBMITTED: 3 July 2019
MINOR MODIFICATION: March 2021

The Compact of Free Association between the Republic of the Marshall Islands (RMI) and the United States (U.S.) requires that all U.S. Government activities at U.S. Army Garrison-Kwajalein Atoll (USAG-KA) (formerly U.S. Army Kwajalein Atoll [USAKA]) conform to specific compliance requirements, coordination procedures, and environmental standards identified in the USAKA Environmental Standards and Procedures (UES) (USASMDC/ARSTRAT, 202118). As specified in UES Section (§) 2-2, these standards also apply to all USAG-KA activities and to Ronald Reagan Ballistic Missile Defense Test Site (RTS) tenant activities occurring elsewhere within the RMI, including the territorial waters of the RMI.

The U.S. Army Hypersonic Flight Test 3 (FT-3) U.S. Navy Flight Experiment–2 (FE-2) flight test must comply with the UES (USASMDC/ ARSTRAT, 202118).

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TYPE OF ACTIVITY

This Notice of Proposed Activity (NPA) addresses a proposed experimental flight test of the Hypersonic Flight Test 3 (FT-3) Flight Experiment-2 (FE-2), impacting at RTS deep-water sites or at Illeginni Islet.

LOCATION OF ACTIVITY

The activity is located within the deep-water region southwest of Illeginni Islet, on Illeginni Islet, or northeast of Kwajalein Atoll within the KMISS BOA southeast of Gagan Islet.

COMPLIANCE STATUS

The FT-3FE-2 flight test described in this NPA and the companion Document of Environmental Protection (DEP) would be conducted in compliance with the UES.

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Tables

Acronyms and Abbreviations

ARSTRAT	Army Forces Strategic Command
ATSDR	Agency for Toxic Substances and Disease Registry
BA	Biological Assessment
BOA	Broad Ocean Area
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DEP	Document of Environmental Protection
DOD	Department of Defense
DOE	Department of Energy
DU	Depleted Uranium
EA	Environmental Assessment
ELTS	Early Launch Tracking System
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FE-1	Flight Experiment 1
FE-2	Flight Experiment 2
FONSI	Finding of No Significant Impact
ft	foot / feet
FT-3	Flight Test 3
FY	Fiscal Year
ICBM	Intercontinental Ballistic Missile
IRCPS	Intermediate Range Conventional Prompt Strike
KEEP	Kwajalein Environmental Emergency Plan
kg	kilogram
km	kilometer(s)
km^2	square kilometer(s)
KMISS	Kwajalein Missile Impact Scoring System
KRS	Kwajalein Range Services
lb	pound(s)
LCU	Landing Craft, Utility
m	meter(s)
m/yr	meter(s) per year
MCL	Maximum Contaminant Level
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
$mg/m^2/hr$	milligram(s) per square meter per hour

mi	mile(s)
mi^2	square mile(s)
NEPA	National Environmental Policy Act
nmi	nautical mile(s)
NMFS	National Marine Fisheries Service
NPA	Notice of Proposed Activity
OEA	Overseas Environmental Assessment
PMRF	Pacific Missile Range Facility
PSCA	Pacific Spaceport Complex Alaska
RMI	Republic of the Marshall Islands
RSL	Regional Screening Level
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SSP	Strategic Systems Programs
STARS	Strategic Target System
U.S.	United States
UES	United States Army Kwajalein Atoll Environmental Standards and Protections
USEPA	United States Environmental Protection Agency (also EPA)
USAG-KA	United States Army Garrison – Kwajalein Atoll
USAKA	United States Army Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
µg/L	micrograms per liter

1.0 Technical Description of Proposed Activity

This Notice of Proposed Activity (NPA) documents the Environmental Assessment / Overseas Environmental Assessment (EA/OEA) of the Hypersonic Flight Test 3 (FT-3)~~Flight Experiment-2 (FE-2)~~ test with launch from the Pacific Spaceport Complex Alaska (PSCA) ~~Missile Range Facility (PMRF), Barking Sands, Kauai, Hawaii~~ and three possible impact zones at Ronald Reagan Ballistic Missile Defense Test Range (RTS), U.S. Army Garrison Kwajalein Atoll (USAG-KA). The action is sponsored by the United States Department of the Army (U.S. Army), which has designated the U.S. Army Rapid Capabilities and Critical Technologies Office as the lead agency for the Proposed Action. ~~Office of the Under Secretary of Defense for Research and Engineering, which has designated the Department of the Navy (U.S. Navy) Strategic Systems Programs (SSP) as the lead agency and action proponent of the Proposed Action. FE-2 is the next incremental step in the developmental process after Flight Experiment-1 (FE-1). FE-1 was a very similar test flight conducted in 2017 from PMRF in Hawaii to the RTS in the Republic of the Marshall Islands (RMI).~~ FT-3 is designed to test a long-range, global strike capable technology. The purpose of this technology test is to stool-launch a payload to high altitude for accurate delivery. FT-3~~FE-2~~ would continue to develop, integrate, and flight test a payload system to demonstrate the maturity of key technologies.

The Proposed Action entails one experimental flight test to take place within the second~~first~~ half of fiscal year (FY) 2021~~0~~ after completion of the EA/OEA and the Finding of No Significant Impact (FONSI) is signed, if approved. The U.S. Army~~Navy~~, along with the ~~Department of Energy (DOE) as a Cooperating Agency, and with the~~ U.S. Army Space and Missile Defense Command~~/Army Forces Strategic Command~~ (USASMDC~~/ARSTRAT~~) as a Participating Agency, will prepare the EA/OEA in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations and U.S. Army~~Navy~~ regulations for implementing NEPA.

1.1 Location of Activity

The locations analyzed in the EA/OEA are PSCA, Kodiak, Alaska~~PMRF, Barking Sands, Kauai, Hawaii~~; RTS, USAG-KA, Republic of the Marshall Islands (RMI); and the Broad Ocean Area (BOA) in the Pacific. This NPA addresses three possible impact locations. The first possible impact zone would be in the deep-water region southwest of Illeginni Islet. This zone would have an approximate area of 1,600 feet (ft) by 800 ft (488 meters [m] by 244 m). The second possible impact location would be a land impact on Illeginni Islet. This zone is approximately a 950 ft by 450 ft (290 m by 137 m) area on the northwest end of the islet, as limited by available land mass. The third possible impact zone would be within the Kwajalein Missile Impact Scoring System (KMISS) area southeast of Gagan Islet and would have an approximate area of 7,874 ft by 1,200 ft (2,400 m by 366 m). The proposed impact locations are shown on **Figures 1-1** and **1-2**.

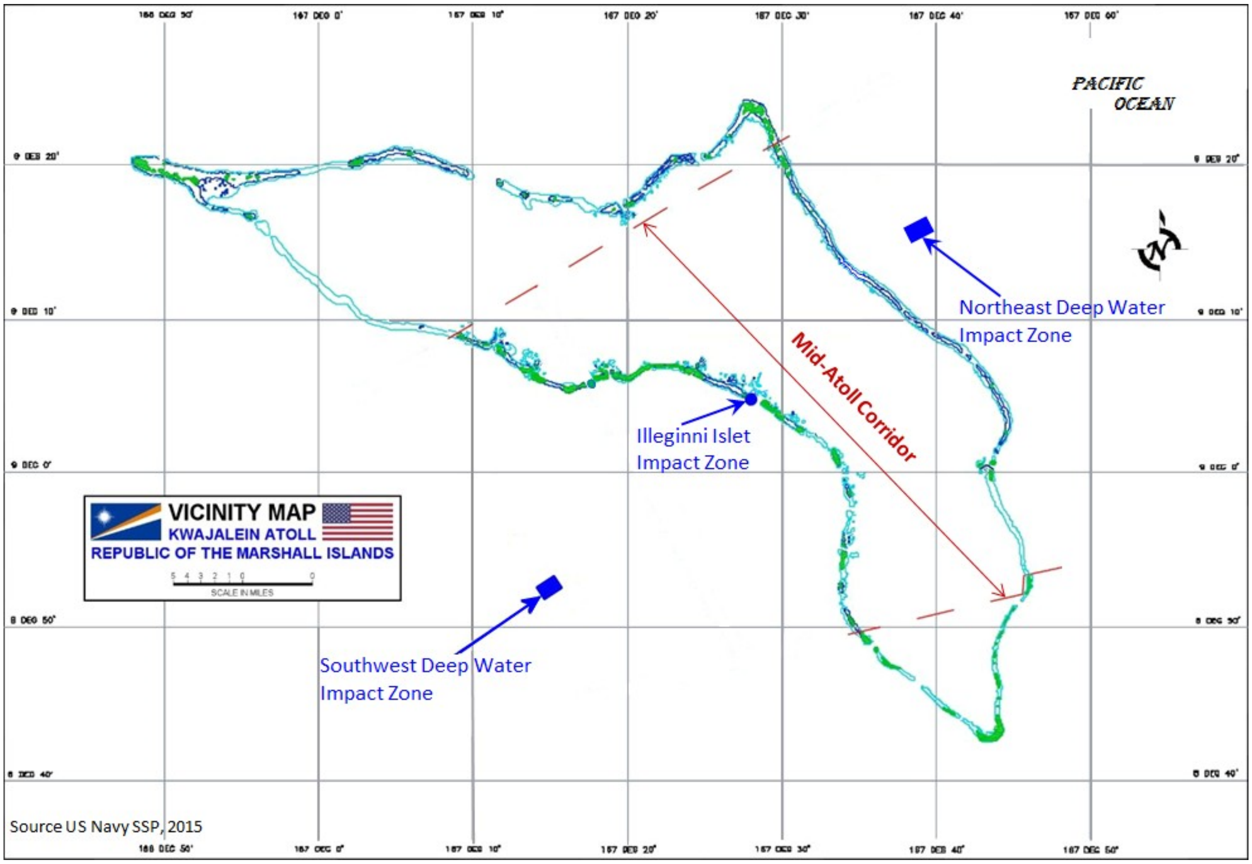


Figure 1-1. Notional FT-3~~FE-2~~ Impact Areas in the Vicinity of Kwajalein Atoll

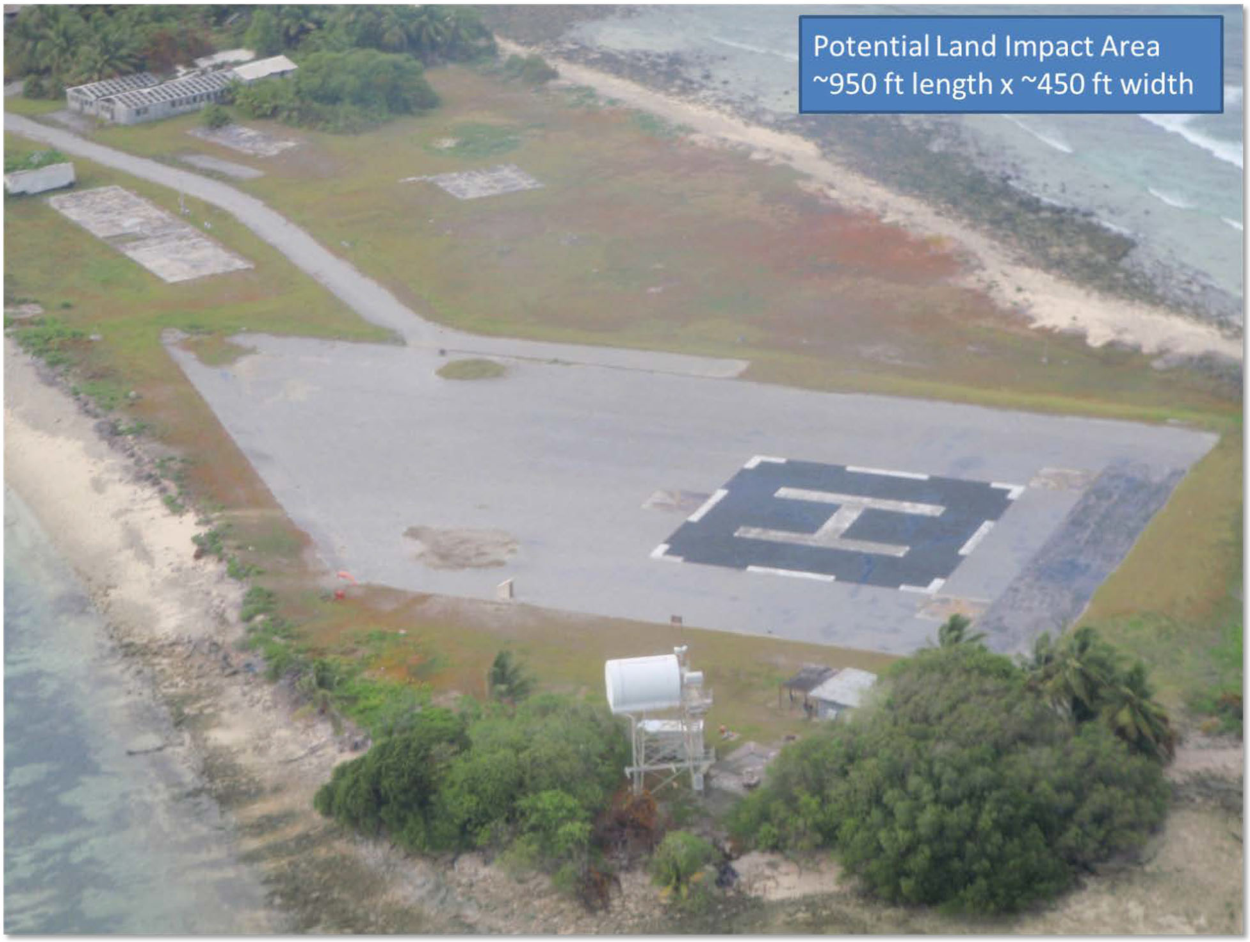


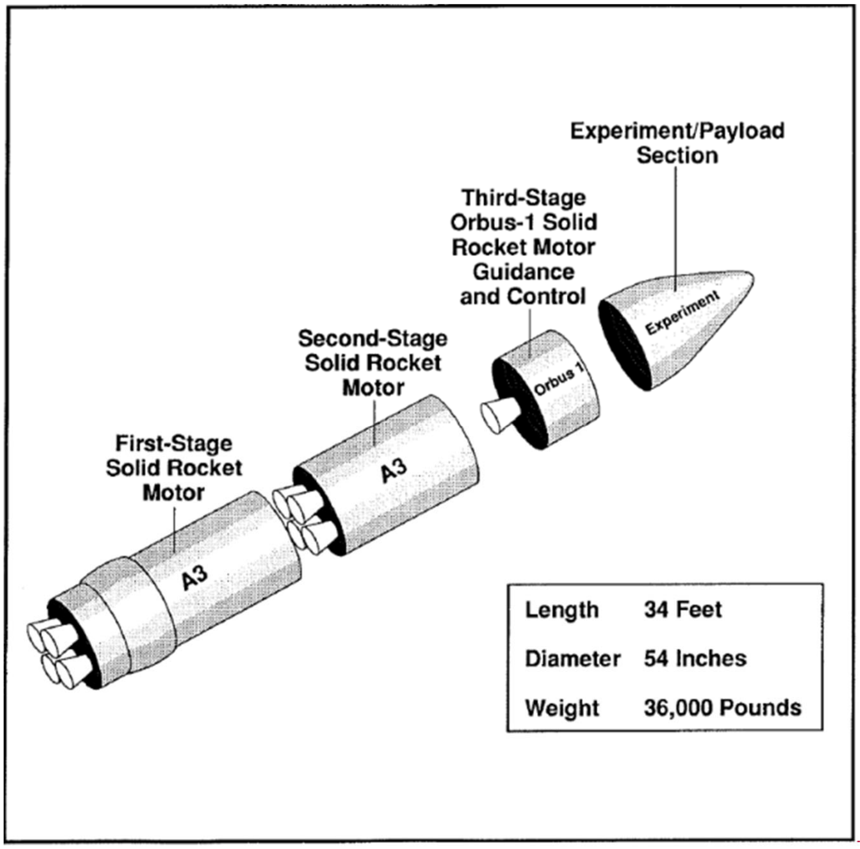
Figure 1-2. Impact Area on Illeginni Islet, Kwajalein Atoll.

1.2 Description of the Activity

The U.S. Army FT-3Navy SSP FE-2 program would consist of a flight test designed to prove various aspects of the system's capabilities. The FT-3FE-2 launch vehicle consists of a three-stage Strategic Target System (STARS) booster system (**Figure 1-3**). This test would be designed to collect data to provide a basis for ground testing, modeling, and simulation of payload performance.

The Proposed Action entails ground preparations for the flight test, launch and flight test, impact of the payload, and post launch operations.

Characteristics of the launch vehicle are presented in **Table 1-1.** The payload system characteristics are presented in **Table 1-2**. The Proposed Action flight test would occur within the secondfirst half of FY 202120 after signing of the FONSI, if approved.



~~**Figure 1-3. Typical Strategic Target System Vehicle**~~

Payload	Sandia Lab	750 lb
Stage 2 (third)	Orion 50 XLT	8,632 lb
Stage 1 (second)	Orion 50-S XLT	33,152 lb
Stage 0 (first)	C4	38,677 lb
Launch Method	Ground	
Launcher	Launch Stand	

Figure 1-3. FT-3 Launch Vehicle (Not Drawn to Scale)

Table 1-1. Launch Vehicle Characteristics

Major Components	Rocket motors, propellant, magnesium-thorium (booster interstage)[1], nitrogen gas, halon, asbestos (contained in second stage), battery electrolytes (lithium-ion, silver zinc)
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency pulse
Power	Up to nineRechargeable lithium ion polymer and silver zinc batteries, each weighing between 3 and 40 pounds (lb; 1.4 and 18 kilograms [kg])
Propulsion/Propellant	Rocket propellant and ~3 lb (1.4 kg) of pressurized nitrogen gas
Other	Small Class C (1.4) electro-explosive devices

Table 1-2. Payload System Characteristics

Structure	Aluminum, steel, titanium, magnesium and other alloys, copper, fiberglass, chromate coated hardware, tungsten, plastic, teflon, quartz, RTV
Communications	Various 5Two up-to 20-watt radio frequency transmitters
Power	Up to three lithium ion polymer batteries, each weighing between 3 and 50 lb (1.4 and 23 kg)
Propulsion/Propellant	None
Other	Class C (1.4) electro-explosive devices for safety and payload system subsystems operations

The U.S. ArmyNavy developmental payload would impact at RTS with three possible impact zone scenarios. For any of these scenarios and within one day preceding the test, existing USAG-KA based Landing Craft Utility (LCU) vessels maywill deploy up to 12 free-floating, battery-powered rafts with optical, acoustical, or radar sensors in waters no less than 13 ft (4 m) deep. The observation rafts will collect data from the FT-3FE-2 descent until impact.

For an impact at either deep water impact zone, a larger raft equipped with data collection instrumentation will be placed in the ocean waters near the impact site for up to 2 weeks in preparation for the flight test. Once the test is completed, the raft will be returned to port and the data will be delivered for analysis.

For impact at the Kwajalein Missile Impact Scoring System (KMISS) site southeast of Gagan Islet, existing optical and electronic sensors and system support equipment are already in place on the islet and in the offshore ocean waters. Fixed underwater sensors are located a minimum of 3 nautical miles (nmi) (5.5 kilometers [km]) offshore at depths ranging from 7,000 to 12,000 ft (2,134

[1] The skin of the STARS first/second interstage structure was manufactured from a magnesium-thorium alloy (HK31A-H24). This is a surplus Polaris A3R asset that has been adapted to STARS, and it contains less than 3% (<80 microcuries [µCi]) thorium. The interstage alloys are commercially available products containing magnesium-thorium alloy and are exempted from controls by the Nuclear Regulatory Commission (10 CFR 40.13) and the Radiological Procedures Protection Manual (RPPM) (Chapter 6, Attachment 6-2) since there is no physical, chemical, or metallurgical processing performed on the items.

to 3,658 m). The KMISS scores the precision of in-water impacts by reentry vehicles and other projectiles.

The vicinity of the selected impact zone for the FT-3FE-2 flight test will be evacuated prior to launch, and exclusionary control will be maintained until recovery actions are complete. Additionally, if needed, the Mid-Atoll Corridor will be cleared and monitored for unauthorized access prior to the flight test. Fly-overs of either deep water impact zone will be conducted before the flight test to observe and report on marine mammals and sea turtles in the impact zone and after the flight test to determine if any debris from the FT-3FE-2 remains on the surface.

At the land impact site prior to the flight test, up to two radars maywill be placed on previously disturbed areas outsidewithin the impact zone prior to the test to gather tracking data. These small radars (24-inch (in) by 15-in by 6-in [61-centimeter (cm) by 88-cm by 15-cm] cube) will be powered by automobile batteries. Up to two larger Early Launch Tracking System (ELTS) radars, powered by on-shore or portable generator power, will be on Illeginni Islet to gather tracking data but located far enough away from the impact area to eliminate the possibility of damage. Both radars are self-contained, transportable, and capable of remote operations.

For at least 8 weeks preceding the FT-3 launch, Illeginni Islet would be surveyed by qualified persons for sea turtles, sea turtle nesting activity, and sea turtle nests. The area would be inspected within a day preceding the flight test. On-site personnel would report any observations of sea turtles or sea turtle nests on Illeginni Islet to the USAG-KA Environmental Engineer to provide to the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS).

During ocean travel, travel to and from impact zones, including Illeginni Islet, and during potential raft deployment, ship personnel would monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and/or lighting and turbidity conditions. Any marine mammal or sea turtle sightings during overflights or ship travel would be reported to the USAG-KA Environmental Engineer, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch. Any records of marine mammal and sea turtle observations would include species, number of individuals, location and behavioral observations which would be provided to NMFS and the USFWS after the test. Vessel operations around Illeginni Islet would only occur when weather and sea conditions are acceptable for safe travel. Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life.

On Illeginni Islet, the impact area would be searched for black-naped tern nests and chicks prior to any pre-flight equipment mobilization. Any discovered nests would be covered with an A-frame structure per current USFWS guidance. The area would be monitored to ensure no black-naped tern nests are disturbed when heavy equipment would position diagnostic equipment. Likewise, to prevent birds from nesting on the support equipment after initial setup, the equipment would be appropriately covered with tarps or other materials and “scare” techniques (e.g., scarecrows, mylar ribbons, and/or flags) would be used on or near the equipment.

At impact, materials contained in the FT-3FE-2 payload will break up into small pieces (expected to be less than 1.5 in [3.8 cm]), most of which will be extremely small (less than 0.5 in [1.3 cm]). These materials consist of batteries and small quantities of various heavy metals and heavy metal alloys, including a tungsten alloy.

On land, the impact could form a crater. Should the FT-3FE-2 impact in areas adjacent to the existing paved helipad at Illeginni Islet, soil containing residual concentrations of beryllium and depleted uranium (DU) from prior intercontinental ballistic missile (ICBM) flight tests could be scattered over the area. Prior to debris recovery and cleanup actions on Illeginni Islet, unexploded ordnance (UXO) personnel will first inspect the impact crater and surrounding area for any residual explosive materials. Test support personnel will conduct an impact assessment and cleanup and recovery operations once the site is clear for safe entry.

Following completion of the impact area assessment, personnel will manually recover FT-3FE-2 debris from land and, if present, from surrounding shallow waters (less than 180 ft or 55 m deep) as reasonably possible. The impact area will be wetted with freshwater to stabilize the disturbed soil. The impact crater will be excavated using a backhoe or front-end loader transported to the island by a Landing Craft, Utility (LCU), and the excavated material will be screened to recover debris. Following debris removal, the crater will be backfilled and, if necessary, repairs made to surrounding structures. USAG-KA and RTS personnel will be involved in these operations. Accidental spills from support equipment operations will be contained and cleaned up. All waste materials will be appropriately stored and returned to Kwajalein Islet for proper disposal. Following cleanup and repairs to the Illeginni Islet site, soil samples will be collected at various locations around the impact area and tested for pertinent contaminants.

Should the FT-3FE-2 inadvertently impact in the deeper waters of the atoll lagoon (up to approximately 180 ft or 55 m), a dive team from USAG-KA or RTS will be brought in to conduct underwater searches. Using a ship for recovery operations, the debris field will be located and certified divers in scuba gear will attempt to recover the debris manually.

If the FT-3FE-2 impacts within one of the deep-water impact zones, debris remaining on the water surface will be recovered and removed. Although unlikely, accidental spills occurring from a support vessel will be contained and cleaned up in accordance with the Kwajalein Environmental Emergency Plan (KEEP) (KRS, 20152014 or current version).

Within 1 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. For recovery and rehabilitation of any injured migratory birds or sea turtles found at Illeginni Islet, the 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. Post-survey monitoring would be conducted to observe any impacts to adult black-naped terns or their nests. Results of the monitoring would be reported to the USAG-KA Environmental Engineer to provide to the USFWS. During inspections of the islet and near-shore waters, USAG-KA environmental staff would assess any sea turtle mortality. Any impacts to biological resources would be reported to the appropriate agencies, with the USFWS and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.

If an inadvertent impact occurs on the reef, reef flat, or in shallow waters less than 10 ft (3 m) 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. In the event of an unintentional shallow water impact, visible debris would be removed as feasible and while protecting sensitive shallow-water resources. Payload recovery/cleanup operations and removal of surface floating debris in the lagoon and ocean reef flats, within 500 to 1,000 ft (152 to 300 m) of the shoreline, would be conducted similarly to land operations when tide conditions and water depth permit. A backhoe would be used to excavate any crater. Excavated material would be screened for debris, and the crater would be backfilled with material ejected around the rim of the crater. Following removal of all payload items and any remaining test debris from the impact area, all waste materials would be returned to Kwajalein Islet for proper disposal.

Should the payload inadvertently impact in deeper waters offshore of Illeginni Islet (up to approximately 180 ft [55 m] deep), a dive team from USAG-KA or RTS would be brought in to conduct underwater searches for payload debris. Using a ship for recovery operations, the debris field would be located and certified divers in scuba gear would attempt to recover the debris manually. If warranted due to other factors, such as significant currents or mass of debris to be recovered, the recovery team would consider the use of remotely operated vehicles instead of divers. Due to the potential presence of sensitive species on the ocean bottom offshore of Illeginni Islet, NMFS and USFWS would be notified of an inadvertent lagoon or ocean side payload impact and would be provided the opportunity to provide input on debris recovery to protect UES-protected benthic species. A remotely operated vehicle video or dive inspection would be conducted where necessary to evaluate the presence of UES consultation species. If UES consultation species were found at a lagoon or ocean bottom impact site, recovery efforts would be coordinated with NMFS.

Test support is provided primarily by existing RTS and USAG-KA Government personnel and contractors and will be supplemented by ArmyNavy personnel and contractors, and Cooperating Agency personnel.

2.0 Description of Activity Environmental Setting

2.1 Environmental Setting of the Activity

Kwajalein Atoll is located in the Marshall Islands in the West Central Pacific, just west of the international dateline. It is 2,100 nmi (3,889 km) southwest of Honolulu, Hawaii and approximately 4,200 nmi (7,778 km) southwest of San Francisco, California. Less than 700 miles (mi) (1,127 km) north of the equator, Kwajalein is in the latitude of Panama and the southern Philippines, and in the longitude of New Zealand (2,300 mi [3,701 km] south), and the Kamchatka Peninsula of the former Soviet Union (2,600 mi [4,184 km] north).

Kwajalein Atoll is a coral reef formation in the shape of a crescent loop enclosing a lagoon. The approximately 100 small islets share a total land area of 5.6 square miles (mi^2) (14.5 square kilometers [km^2]). The largest islets are Kwajalein (1.2 mi^2 [3.1 km^2]), Roi-Namur (0.6 mi^2 [1.6 km^2]), and Ebadon at the extremities of the atoll; together they account for nearly half the total land area. While the “typical” size of the remaining islands may be about 450 ft by 2,100 ft (137 by 640 m), the smallest islets are no more than sand cays that merely break the water's surface at high tide. Kwajalein Atoll lagoon, which is enclosed by the reef atoll, is the world’s largest, with a surface area of 902 mi^2 (2,336 km^2), and a depth that is generally between 120 ft to 180 ft (36.5 to 55 m) (Sugerman, 1972). A notable characteristic of the atoll are the steep slopes of the mounts seaward of the reef. Around Kwajalein Atoll the depth plunges to as much as 6,000 ft (1,830 m) within 2 mi (3.2 km), and 13,200 ft (4,023 m) within 10 mi (16 km).

Illeginni Islet is located approximately 21 mi (34 km) directly south of Roi-Namur Island, the northernmost part in the atoll, and 30 mi (49 km) to the northwest of Kwajalein, the largest island and southernmost part of the atoll. Illeginni is a 31-acre (0.125 km^2) islet on the southwest side of the atoll. Illeginni Islet runs roughly west-northwest to east-southeast; it is approximately 2,790 ft (850 m) long and averages about 574 ft (175 m) across. The northwestern end is a narrow finger that extends into several sandbars, while the southeastern end has a hook-shaped harbor on the north side. Illeginni Islet consists of managed vegetation surrounding buildings and facilities, and four relatively large patches of littoral forest. After 1975, most facilities, including the Spartan and Sprint missile launch facilities, were abandoned-in-place.

2.1.1 Geology

Coral atolls are seamounts that have been capped by calcareous marine growth constructed by lime-secreting organisms (coral polyps and algae). The lower parts of atolls are composed of non-calcareous rocks, most often volcanic materials. The overlying coral superstructures may be hundreds or even thousands of feet thick. Emergent portions of the reef and islands tend to be composed of loose, poorly consolidated calcareous materials derived from foraminifera, coral, shells, and marine algae, or their debris resulting from destructive action of the elements. All of the islands that make up the atoll are relatively flat with few natural points exceeding 15 ft (4.6 m) above mean sea level (Sugerman, 1972).

The detailed geology of Kwajalein Atoll is primarily based on shallow boring log book prepared by the U.S. Army Corps of Engineers and drilling logs prepared during the construction of monitoring wells by the U.S. Geological Survey (Hunt, et al., 1995). Soils on Kwajalein Atoll mainly consist of unconsolidated, reef-derived calcium carbonate sand and gravel with minor consolidated layers of coral, sandstone, and conglomerate. The lagoon side of the island consists of unconsolidated sediments that are thicker and contain a greater proportion of low-permeability back-reef sand than the ocean side. Drilling logs suggest a greater proportion of coarse, high-permeability rubble on the ocean side than the lagoon side of the islets (Hunt, et al., 1995).

2.1.2 Hydrogeology

The thick accumulation of limestone layers, unconformities caused by sea level changes over time, and tidal activity play an important role in the fresh groundwater dynamics on Kwajalein Atoll islets. Groundwater is very shallow throughout the atoll; a thin freshwater lens lies atop the brackish groundwater on the largest islands, including Kwajalein and Roi-Namur. Freshwater lens thickness is generally proportional to island width and rate of groundwater recharge, and inversely proportional to hydraulic conductivity (Hunt, et al., 1995).

2.1.3 Deep Water Impact Zones

The proposed deep-water impact zones are located to the northeast and southwest of the atoll with depths generally at or greater than 8,000 ft (2,438 m). The proposed northeast deep-water impact zone is within the existing KMISS deep-ocean, hydrophone sensor array. The array is located about 3.2 to 8.6 nmi (5.9 to 15.9 km) southeast of and beyond the visual range of Gagan Islet. The KMISS hydrophones lie at depths from about 7,000 to 12,000 ft (2,134 to 3,658 m). The proposed deep-water impact zone southwest of Illeginni Islet is at a distance of 17 nmi (31 km) from Illeginni in water depths around 12,000 ft (3,658 m). Seafloor sediments at both deep-water locations are likely to be similar, consisting of Globigerina ooze, a soft seafloor sediment composed of microscopic shells from calcareous planktonic animals (foraminifera), with varying amounts of volcanic sand and possibly some brownish clay.

3.0 Environmental Areas Potentially Affected by Proposed Activity

3.1 Air Quality

Illeginni Islet. The Illeginni power plant was downsized in 2010 and is now a minor air emissions source utilizing small (80 kilowatt) Tier 3 generators. A helipad is located in the northwestern end of the islet.

Emission sources for the FT-3FE-2 flight test will include a combination of vessels (during testing) and trucks, fork lifts, backhoes/loaders, and/or portable power generators used during pre-test and post-test operations. Specific controls are discussed in **Section 5.0**. Some amount of fugitive dust could be generated at impact on land, and generated by impact crater ejecta. Potentially, small quantities of heavy metals and tungsten alloy could be dispersed into the air. Additionally, potentially hazardous air pollutants, including beryllium and DU residing in the soil from past testing, could be thrust into the air upon impact.

Deep Water Impact Zones. Emission sources in the deep-water impact zones will include diesel vessel engines used to position and maintain support vessels in specific locations, and aircraft during overflights.

3.2 Noise

Illeginni Islet. Illeginni Islet is uninhabited. Noise sources are produced by the 80-kilowatt generators located at the powerplant. No other stationary noise sources are known on the island. A diesel backhoe or front-end loader will be used on Illeginni Islet post-launch to backfill the crater.

Deep Water Impact Zones. The deep-water impact zones noise sources would include vessels used to position and maintain support vessels in specific locations, and aircraft during overflights.

3.3 Water Resources

Illeginni Islet. Illeginni Islet has no surface water, and groundwater is limited in quantity. Groundwater on the islet is saline and non-potable.

Deep Water Impact Zones. The deep-water impact zones are in the BOA.

3.4 Biological Resources

For purposes of this NPA, biological resources are defined as living organisms and the habitats within which they occur.

Illeginni Islet. On Illeginni Islet, habitats include many human modified habitats such as a helipad, roads, buildings, towers, and a dredged harbor, as well as several biologically significant terrestrial and marine habitats. Biologically significant terrestrial habitats on Illeginni Islet consist of disturbed vegetation near the helipad and around buildings, several patches of native vegetation including herbaceous vegetation and littoral forest, and shoreline habitat. While no vegetation species with special status occur on Illeginni Islet, several migratory birds use Illeginni for foraging, roosting, and/or breeding. Biological inventories conducted on the islet by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service have identified at least 14 migratory bird species that are protected under the Migratory Bird Treaty Act and therefore receive protection under the UES as coordination species. Black noddies (*Anous tenuirostris minutus*), white terns (*Gygis alba*), and black-napped terns (*Sterna sumatrana*) are known to nest on Illeginni Islet. Of these, only black-napped terns are known to nest in the impact area. The lagoon-side shoreline on the western end of Illeginni Islet has been documented as suitable haul-out and nesting habitat for green sea turtles (*Chelonia mydas*). However, no sea turtle nests or nesting activity has been recorded on Illeginni Islet in over 20 years. Green turtles are listed as an endangered species under the Endangered Species Act (ESA) and are subsequently protected under the UES as consultation species.

The marine environment surrounding Illeginni Islet includes reef flat, reef crest, and reef slope habitats on both the lagoon and ocean sides of the islet that support a diversity of coral, other invertebrates, fish, and sea turtles. The harbor also includes habitats that support diverse coral assemblages as well as a dense seagrass bed. Further offshore, the deep waters of the mid atoll corridor and ocean surrounding Kwajalein Atoll support a variety of fish and marine mammals. The marine habitats surrounding Illeginni Islet support many species which require coordination under the UES including many species of coral, mollusk, and fish. Consultation species which have been observed or may potentially occur in the shallow waters surrounding Illeginni Islet include 2 sea turtle species, 2 species of fish, 5 mollusk species, and 22 coral species. Additional information on consultation species occurring in the Action Area is provided in **Sections 910.0** and **13.0**.

Deep Water Impact Zones. The deep-water impact zones southwest and northeast of Illeginni Islet (**Figure 1-1**) have deep-water pelagic and benthic habitats. The deeper water habitats near Kwajalein Atoll may contain consultation species including several11 species of marine mammals, 2 sea turtle species, 2 fish species, and larval fish, coral, and mollusks. Additional information on consultation species occurring in the Action Area is provided in **Sections 910.0** and **13.0**.

3.5 Hazardous Material and Waste

Illeginni Islet. USAG-KA has removed all hazardous materials and wastes from buildings and facilities at Illeginni Islet.

The FT-3FE-2 contains small amounts of hazardous materials and heavy metals, including tungsten, that will be dispersed during impact. Land and reef waters could receive small amounts of contamination from hazardous materials due to spills of equipment fuels and lubricants used during the pre- and post-launch activities. (Specific controls are discussed in **Section 5.0**.)

Due to the single proposed test flight, only small amounts of hazardous wastes are expected to be generated and will be managed on Illeginni Islet. Any potential hazardous wastes will be gathered, sampled, and properly containerized. Containers will be relocated to the Hazardous Waste Storage Facility on Kwajalein Island until appropriate disposal/treatment can be completed.

Deep Water Impact Zones. Ocean waters of the selected deep water impact zone wouldwill receive small amounts of contamination from hazardous materials and heavy metals due to the FT-3FE-2 impact, and possibly from spills of equipment fuels and lubricants used during the pre- and post-launch activities.

3.6 Cultural Resources

Illeginni Islet. The proposed impact zone for the FT-3FE-2 flight test is located at the west end of Illeginni Islet. Existing surface cover and site disturbance from construction of a helipad, roads, and facilities and from prior missile testing operations encompass most of the islet. Land impact would not occur in the vicinity or proximity to known cultural resources on Illeginni Islet. Personnel involved in the FT-3FE-2 flight tests would be briefed on the presence and location of cultural resources prior to arrival on the islet and would follow all pertinent UES regulations and requirements in avoidance and handling of any cultural resources that may be uncovered during pre- and post-test activities.

Deep Water Impact Zones. There are no cultural resources identified at either of the offshore water impact locations.

4.0 Analysis of Effect on Environmental Areas in Absence of Environmental Controls

4.1 Air Quality

Illeginni Islet. Based on the size of the FT-3~~FE-2~~, the current environmental setting of Illeginni Islet, and the limited payload, no impacts to air quality are anticipated. Debris and dust associated with impact of the FT-3~~FE-2~~ would be minimal, due to the nature of the environment (asphalt helipad or crushed coral) that is proposed for the impact target. Winds for the region are predominantly out of the east with an average wind speed of about 14.5 mi per hour (23.3 km per hour). Dust caused by impact will be quickly swept from the area, over the west end of the island and open waters.

Terminal impact may volatize minor quantities of some contaminants; however, it is anticipated that any emissions associated with impact will be within the UES air quality standards. There would be no change to air emission at Illeginni Islet from the Proposed Action.

Deep Water Impact Zones. For either of the deep-water impact sites, transient diesel emissions could present an inhalation hazard to shipboard personnel.

4.2 Noise

Illeginni Islet. No significant impacts would occur from noise generated during the pre-test and post-test activities or during the impact of the payload at Illeginni Islet. There is no resident population at or near Illeginni Islet, and during the testing activities, safety personnel would ensure that no non-mission essential vehicles would be in the area.

Noise associated with equipment (trucks, backhoes, generators) used during pre- and post-test site assessment will be limited to the immediate area, with no equipment running at decibels (>75 decibels) harmful to humans. Equipment would be present during pre- and post-test operations, only. Ship board personnel on mission vessels may be required to wear hearing protection during flight test operations, and weapon impact, to comply with the Department of Defense (DOD) Hearing Conservation Program. Noise at impact would be audible only once, with a short duration time.

No noise impacts are anticipated due to equipment utilization during pre- and post-test operations. Noise impacts to neighboring islands and personnel on observation vessels will be negligible, lasting only a few seconds.

Deep Water Impact Zones. Noise from vessels used to position and maintain support vessels in specific locations, and aircraft during overflights will be negligible with no impact.

4.3 Water Quality

Illeginni Islet. The FT-3FE-2 will have no liquid propellants within the body of the weapon system. No direct discharge of materials to surface and/or marine waters will occur during terminal impact. Water used to minimize dust after impact and during post-test operations would not be allowed to flow to the lagoon or ocean, would be directed toward the water catchment area and allowed to evaporate after completion of cleanup operations.

Soils at the impact area would be containerized for disposal; therefore, the potential for contaminants (metals and tungsten) to leach into groundwater would be minimal. Tungsten was originally considered a stable metal in soil that does not dissolve easily in water. However, tungsten-contaminated environmental media are now a growing concern to the Environmental Protection Agency (EPA) and the DOD because recent research indicates that tungsten may not be as stable as was indicated in earlier studies. Furthermore, varying soil properties such as pH may cause tungsten to dissolve and leach from soil into underlying aquifers (EPA, 2014).

~~In support of the FE-2 flight test the tungsten concentration in water has been estimated from a combination of experimental observation (column experiments) and modeling results. Column experiments quantified the rates of tungsten dissolution and degree of tungsten sorption to carbonate material, which were then used to calibrate the CrunchFlow model. The calibrated dissolution rate and sorption affinity were then used in a simple one-dimensional model of the area of tungsten deposition 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 and rainfall begins the dissolution process, aqueous tungsten concentrations increase; with regular precipitation (assumed at 2.5 meters per year [m/yr]) the concentrations reach a steady state in less than 1 year and remain constant for the following 25 years, the period for which the model was run. The steady state concentration is primarily controlled by the rate of tungsten alloy dissolution and the rate of precipitation on the island. Based on the model parameters, estimated aqueous tungsten concentrations would be between 0.006 milligrams per liter (mg/L) (at a dissolution rate of 1.0 mg/m^2/hr) and 0.015 mg/L (at a dissolution rate of 2.6 mg/m^2/hr). These modeling results fall below the EPA Residential Regional Screening Level (RSL) level for potable water of 0.016 mg/L. An additional model was run to estimate the maximum tungsten concentration in seawater and in a freshwater lens using the calcium concentration. This model estimated maximum tungsten concentrations of 9 and 25 mg/L, far exceeding the EPA RSL for potable water. However, this high initial concentration will tend to decrease with time as the tungsten is dissolved and migrates into the surrounding lagoon and ocean. The decrease in tungsten over time will be due to the limited total quantity of tungsten deposited in the soil. Based on the original model dimensions, 2.5 m/yr rainfall precipitation rate, and an equilibrium tungsten concentration of 25 mg/L, all tungsten would be predicted to migrate away from the original location within a year. (LLNL, 2018)~~

Water samples collected at the Flight Experiment 1 (FE-1) impact location shortly after the event had tungsten concentrations of 0.65 milligrams per liter (mg/L). These results exceed the EPA Residential RSL level for potable water, however, the groundwater at Illeginni is considered non-potable. Water sampling wells werehave recently been installed on Illeginni Islet to support the Flight Experiment 2 (FE-2) mission and werewill be sampled monthly for salinity and water level, and every 3 to 6 months for metals to include tungsten. An FE-2 post-test survey and sampling report described pre-test and post-test groundwater results for uranium, beryllium, and tungsten at seven wells (RGNext, 2020). The pre-and post-test sampling showed little variation in values, with beryllium remaining undetected, tungsten exceeding residential tap water screening levels, and uranium well below the USEPA maximum contaminant level for drinking water. **Table 1-2** includes tungsten in the payload structure for this flight test. However, the FT-3 vehicle would contain about 10 percent as much tungsten as analyzed for FE-2. Groundwater at Illeginni is currently considered non-potable and no impacts to water resources would be expected.

In the event of an accidental discharge (fuels, oils, etc.) during test flight operations or post-test cleanup activities, ground personnel would comply with the UES KEEP controlling the spill site and cleanup. No short or long-term impacts to surface or groundwater from materials associated with either the FT-3FE-2 or accidental spills are anticipated.

Deep Water Impact Zones. Hazardous chemicals will have minimal impact in the deep-water impact zones as components would be expected to sink fairly quickly to the bottom and the limited amount of chemicals on the payload would quickly become diluted in the ocean waters.

4.4 Biological Resources

The Proposed FE-2FT-3 flight test has the potential to affect biological resources and habitats due to elevated sound pressure levels, direct contact from vehicle components, vessel strike, hazardous chemicals, and human disturbance. A full analysis of biological effects of the Proposed Action on consultation species will behas been conducted in a Biological Assessment (BA) as detailed in **Section 9.0**.

Illeginni Islet. On Illeginni Islet, terrestrial organisms and habitats may be impacted by disturbance from pre- and post-test human activity and equipment operation, direct contact from vehicle components, introduction of hazardous chemicals, and elevated sound pressure levels. Nesting, roosting, and foraging birds might be temporarily disturbed by human activities and equipment operation and also by elevated sound pressure levels. Any seabirds located within the impact zone on Illeginni Islet may also be subject to the effects of direct contact from vehicle components. Sea turtles that are hauling out or nesting and sea turtle nests have the potential to be disturbed by human activity, equipment operation, introduction of hazardous chemicals, and elevated sound pressure levels. Little disturbance to native vegetation is planned or expected from human activity, equipment operation, or direct contact from FE-2test components.

No human activities or equipment operation will be conducted in reef flat or immediately adjacent to the reef on the shoreline, and the payload is not planned or expected to impact near the shoreline. Therefore, no direct impacts to reef and or marine organisms are anticipated from human disturbance, direct contact from FE-2test components, or introduction of hazardous chemicals. Even though no impacts are planned or expected on or near the shoreline, procedures will be in place to minimize impacts to the reef ecosystem in the event of a shoreline impact or if test debris enters the reef environment (outlined in **Section 5.0**). Marine organisms in the waters surrounding Illeginni Islet including sea turtles, fish, mollusks, and marine mammals may also be affected by Action associated vessel traffic and elevated sound pressure levels. Pre- and post-test operations will include vessel traffic to and from Illeginni Islet for personnel and equipment transport. To reduce the risk of vessel strike, mitigation measures will be in place to detect and avoid marine species of concern (outlined in **Section 5.0**). The incoming FE-2 payload vehicle and payload impact will result in elevated sound pressure levels in the air over Illeginni Islet. These in-air sound pressures will be transferred to the water where they may affect marine mammals, sea turtles, and fish. Analyses of the effects of elevated sound pressure levels on consultation species will behas been conducted in a Biological Assessment (BA) for the Proposed Action (see **Section 9.0**).

Deep Water Impact Zones. In the deep ocean waters near Kwajalein Atoll, marine organisms may be impacted by elevated sound pressures, direct contact from FE-2 payload components, vessel strike, introduction of hazardous chemicals, and human disturbance. Marine organisms such as cetaceans, pelagic fish, and sea turtles may be found in the deep ocean waters near Kwajalein. These marine species have the potential to be struck and injured by FE-2 payload components upon payload impact. Marine organisms in the deep ocean waters may also be exposed to elevated sound pressure levels that may cause temporary behavioral disturbance. Marine organisms would be expected to return to normal behavior within minutes of exposure to elevated sound pressure levels. Hazardous chemicals are not expected to impact marine organisms in the deep-water impact zones as components would be expected to sink fairly quickly to the bottom and the limited amount of chemicals on the payload would quickly become diluted in the ocean waters. Human activity and vessel operation will be increased in the deep-water impact zone both pre- and post-test for sensor raft placement and clean-up. Marine organisms may be temporarily disturbed by these activities and have an increased risk of vessel strike. Analyses of the effects of these stressors on consultation marine organisms in the deep-water impact sites will behas been conducted in a BA for the Proposed Action (see **Section 9.0**).

4.5 Hazardous Material and Waste

Illeginni Islet. Test flight activities have the potential to produce tungsten and metals contaminated asphalt and soil. Residual concentration of beryllium and DU detected in the soils on the western end of Illeginni Islet are within UES compliance levels. Test activities could produce trace amounts of tungsten and metals in soils from impact of the FT-3FE-2.

If not recovered, FT-3FE-2 debris could impact the terrestrial areas. If not prevented or cleaned up upon occurrence, spills of equipment fuels, lubricants, and hazardous materials will contaminate the land, groundwater, and/or reef waters and pose a health threat to wildlife resources and personnel. Control processes will ensure waste will be properly containerized, labeled and shipped to an approved disposal facility. Negligible to minor short-term impacts to soils could result from the FT-3FE-2 flight test.

Because of previous reentry vehicle tests on Illeginni Islet, residual concentrations of beryllium and depleted uranium remain in the soil near the helipad on the west side of the islet. In 2005, Lawrence Livermore National Laboratory analyzed over 100 soil samples collected around the helipad to determine concentrations of beryllium and depleted uranium in the soil. Soil samples were collected again following subsequent flight tests and results were reported in 2010 and 2013 (Robison et al. 2013). The observed soil concentrations of beryllium and uranium (as a surrogate for depleted uranium) on Illeginni Islet are within compliance with USEPA Region 9 Preliminary Remediation Goals as outlined in the UES. Results from the soil sampling conducted in September 2018 indicated possible beryllium and uranium above the screening levels. Beryllium was not detected in any of the 20 parent soil samples collected from the Illeginni Islet borings; however, it was detected in one of the duplicate samples with a concentration of 1.9 milligrams per kilogram (mg/kg), which exceeded the 1.1 mg/kg screening level for beryllium (U.S. Navy, 2019). This sample was a field duplicate of a sample in which beryllium was not detected above 0.089 mg/kg (U.S. Navy, 2019). This large discrepancy may be due to the heterogeneous nature of the soil matrix (described as gravelly sand). An FE-2 post-test survey and sampling report described pre-test and post-test soil sampling results for uranium, beryllium, and tungsten at 34 sites (RGNext, 2020). The pre-and post-test sampling revealed beryllium and tungsten were undetected, and uranium detected, but well below the USEPA composite worker regional screening level (ingestion and inhalation) (RGNext, 2020; USEPA, 2020). Residual concentrations of tungsten remaining in the soil following the FE-1 and FE-2 flight test were below the EPA Regional Screening Level (RSL) for residential areas (63 mg/kg) and commercial areas (930 mg/kg).

In September 2018, groundwater samples collected from the groundwater monitoring wells were analyzed for tungsten, beryllium, and uranium. Beryllium was not detected in any of the nine groundwater samples. Uranium was detected in three of the groundwater samples, but concentrations did not exceed the 30 micrograms per liter (µg/L) USEPA Maximum Contaminant Level (MCL) screening level. Tungsten was detected in seven of the nine groundwater samples collected from the Illeginni Islet wells (U.S. Navy, 2019). Detected concentrations ranged from 0.055 mg/L to 1.2 mg/L and all detected concentrations exceeded the USEPA residential tap water screening level (0.016 mg/L) (U.S. Navy, 2019). However, because the groundwater at Illeginni Islet is currently deemed to be too saline and not available year-round, it is not considered a viable source of potable water and the USEPA residential screening level would not apply. Groundwater samples collected from monitoring wells following the FE-1 flight test were analyzed for tungsten, beryllium, and uranium. Water samples collected in the impact crater shortly after the FE-1 test had tungsten concentrations of 0.65 mg/L (range of 0.64 to 0.67 mg/L) (U.S. Navy, 2019).

An FE-2 post-test survey and sampling report described pre-test and post-test groundwater results for uranium, beryllium, and tungsten at seven wells (RGNext, 2020). The pre-and post-test sampling showed little variation in values, with beryllium remaining undetected, tungsten exceeding residential tap water screening levels, and uranium well below the USEPA maximum contaminant level for drinking water. The 2020 sampling report following the FE-2 flight test showed lower levels of tungsten than the 2018 sample results—with detected concentrations ranging from 0.0023 mg/L to 0.99 mg/L (RGNext, 2020) compared to previously detected concentrations ranging from 0.055 mg/L to 1.2 mg/L (U.S. Navy, 2019). Tungsten was detected in 8 of the 12 groundwater samples collected from the Illeginni wells. The 2020 sampling report described that monitoring wells MW-03, MW-04, and MW-05 were located within the FE-2 impact zone and could not be sampled.

Deep Water Impact Zones. Hazardous chemicals will have minimal impact in the deep-water impact zones as components would be expected to sink fairly quickly to the bottom and the limited amount of chemicals on the payload would quickly become diluted in the ocean waters.

4.6 Cultural Resources

Illeginni Islet. For a land impact, the FT-3 flight test is proposed to occur on the west end of Illeginni Islet. Archaeological surveys have not found indigenous cultural materials or evidence of subsurface deposits on the islet. The Cold War-era properties potentially eligible for listing on the RMI National Register of Historic Places are located in the central and eastern portions of the islet. Because a land impact would not occur in proximity to known or potential cultural resources on Illeginni Islet, implementation of the Proposed Action would not result in impacts to cultural resources. Although cleanup activities may lead to inadvertent discoveries, no significant impact to cultural resources are expected. Due to the nature of hypersonic flight tests, the potential for inadvertent impacts to culturally sensitive lands and structures does exist. All structures at Illeginni Islet have been photographed and catalogued. Impact is not planned or expected to occur in proximity to known culturally sensitive sites. No significant impact to cultural resources is anticipated.

Deep Water Impact Zones. There are no cultural resources identified at either of the offshore water impact locations.

5.0 Technical Description and Analysis of Environmental Controls Used in Activity

5.1 Air Quality Controls

Air discharges related to impacts of the FT-3FE-2 are not anticipated to be at levels that exceed UES air quality standards. The proposed activities will undergo assessment in the pending Document of Environmental Protection (DEP) and EA to identify potential air quality issues.

Support equipment activities on Illeginni Islet will require minimal soil excavation (and dust suppression technologies); therefore, no hazardous air pollutant inhalation concerns from beryllium or DU residing in the soil from past testing are anticipated. Emissions from vehicles will be minimal during preparation activities on Illeginni Islet prior to the FT-3FE-2 impact. There will not be any construction of or use of permanent stationary emission sources for the test flight activities.

During impact, small quantities of hazardous air pollutants (tungsten and metals) may be generated. Due to the potential for hazardous air pollutant inhalation risks at the impact site on Illeginni Islet, precautionary procedures will be implemented. These include restricting access to the impact area and areas immediately downwind. Trade winds, and uninhabited status of the islet, should prevent any hazardous air pollutant inhalation risks to personnel.

Following impact, disturbed soil and debris will be stabilized by wetting the impact area with freshwater brought to Illeginni Islet by vessel. Personnel will use appropriate personal protective equipment. Direct air measurements of previous testing have provided sufficient information to conclude that there will be no potential hazardous air pollutants-related health effects in the vicinity from residual beryllium or DU. Long-term air sampling following such tests has shown that beryllium and DU concentrations in air downwind of impact areas are essentially indistinguishable from preexisting concentrations of beryllium and DU in air at other atoll locations (Robison et al, 2005, 2006, 2013). The Navy expects minimal post-test soil and air sampling, or monitoring may be necessary due to the small quantities of hazardous materials and heavy metals in the FE-2FT-3.

Emission sources are expected to be negligible for any impact directly into the ocean waters in the Broad Ocean Area (BOA) sites. Fuel fumes from vessels and aircraft will be transient and dispersed in the open ocean atmosphere.

5.2 Noise Quality Controls

A sonic boom will be generated by the FE-2FT-3 impact. The sonic boom will be instantaneous and expected not to cause any lasting effects. The elevated sounds are likely to only temporarily startle birds and terrestrial and marine wildlife. However, due to the potential for injury to organisms from elevated sound pressure levels at FE-2FT-3 impact, analyses will be conducted to evaluate expected sound pressure levels and the resulting effects on terrestrial and marine species and reported in the BA, prior to anticipated field activities for the flight test. No impacts to flora or fauna were identified at Illeginni during a post-impact sweep of the islet following the FE-1 flight test.

Noise from FE-2FT-3 impact will last a fraction of a second; and no humans will be on the island during impact. Noise impacts to humans are not anticipated.

Noise associated with equipment (trucks, backhoes, generators) will be limited to the immediate area, with no equipment running at decibels harmful to humans. No impacts from noise are anticipated. Noise from vessels used to position and maintain support vessels in specific locations, and aircraft during overflights will be negligible with no impact.

5.3 Water Quality Controls

The FE-2FT-3 test flight is expected to be a zero-discharge activity. Fragmentation of heavy metals and tungsten will be limited to soils. Soils will be sprayed with freshwater for the purposes of dust suppression, and limited leaching of heavy metals or tungsten is anticipated even though soils will be containerized for disposal. Groundwater on Illeginni is non-potable, and therefore no impacts to water quality are anticipated.

Hazardous chemicals will have minimal impact in the deep-water impact zones as components would be expected to sink fairly quickly to the bottom and the limited amount of chemicals on the payload would quickly become diluted in the ocean waters.

5.4 Biological Resource Controls

The following measures are proposed for the FE-2FT-3 test flight to minimize the effects of the Action on biological resources including the coordination and consultation species and habitats in **Section 3.4**. Additional mitigation measures may be proposed and implemented as indicated by the BA and subsequent part of consultation for the Proposed Action.

Controls to avoid impacts to sea turtles on land or sea turtle nests:

- Pre-flight and post-flight monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea turtle nests.

Controls to avoid impacts to birds and bird habitat:

- Payload impact would be in the non-forested area of Illeginni Islet.
- Bird deterrents such as flags, balloons, or scarecrows would be placed in the impact area and on equipment.
- The impact area would be searched for seabird nests prior to flight activity.

Controls to avoid vessel strike:

- During travel to and from Illeginni Islet, deep-water impact zones, or during sensor raft deployment, ship personnel would monitor for marine mammals, fish, and sea turtles to avoid potential vessel strikes.
- Sensor rafts would not be located in waters less than 10 ft (3 m)13 ft (4 m) deep to avoid contacting coral.

Controls to avoid introduction of hazardous chemicals:

- Vessel and equipment operations would not involve any intentional discharge of fuel, toxic wastes, plastics, or other solid waste into marine or terrestrial environments.
- Hazardous materials would be handled in adherence to the hazardous materials and waste management of USAG-KA and would comply with emergency procedures set forth in the KEEP and UES.
- Debris recovery and site cleanup would be performed to remove visible debris from land and shallow water habitats.

Controls to avoid introduction of alien or invasive species:

- All equipment shipped to USAG-KA would undergo inspection prior to shipment.

Controls to avoid impacts to marine species and reef habitats:

- Controls will be developed and implemented based on analyses of effects of an inadvertent impact to or ejecta introduction into the reef or shallow water habitats of Illeginni Islet. These controls are listed in the FE-2 FT-3 EA/OEA and the FE-2FT-3 BA.

Potential effects will behave been analyzed in a BA, and additional mitigation measures may be proposed and implemented resulting from the assessment and subsequent consultation with regulatory agencies.

5.5 Material and Waste Management Controls

Post-test recovery, cleanup, and disposal actions will ensure no significant impacts from hazardous materials. Waste management procedures described in the UES will be followed.

Prior to recovery and cleanup actions on Illeginni Islet, Explosive Ordnance Disposal personnel will first survey the impact site for remaining explosive materials. If UXO is found, such materials will be managed in accordance with the current DEP for Disposal of Munitions and Other Explosive Materials.

Following completion of the impact assessment by the Navy, personnel will recover as much visible debris as reasonably possible to minimize long-term risks to birds. The impact crater and surrounding area will be wetted to stabilize the disturbed soil and equipment will be washed off before being sent back to the United States. Only freshwater will be used to wet and/or wash the site. Freshwater will be transported to Illeginni Islet. Following removal of all supporting equipment and any remaining debris from the impact site, all craters will be backfilled and, if necessary, repairs made to surrounding structures. Certified divers will conduct underwater surveys and recover visible debris that may have entered the shallow lagoon or ocean waters less than 180 ft (55 m) deep. All waste materials will be returned to Kwajalein Island for proper disposal in accordance with the UES. In preparation for the FE-2 flight test, hazardous and non-hazardous waste handling procedures will be detailed in a post-test recovery/cleanup plan.

Because existing beryllium and DU concentrations in the soil on Illeginni Islet are similar to natural background concentrations, small quantities of additional heavy metal deposition from the FT-3FE-2 are expected to result in soil concentrations that meet the UES standards. The ArmyNavy SSP expects that minimal post-test soil sampling or monitoring will be necessary as part of the FT-3FE-2 flight test.

All collected tungsten and metals-contaminated asphalt and soil will be properly gathered and containerized and shipped to an off-site approved disposal/treatment facility, following UES KEEP standards.

Any floating FE-2 debris that is visible within a deep-water impact zone will be recovered to minimize risks to marine wildlife in accordance with the Navy SSP post-test recovery and clean-up operations plan.

5.6 Cultural Resource Controls

Cultural resources are a concern at all sites requiring ground disturbing activities. Should artifacts, remains, or any other archaeological resources be encountered during post test flight activities, work will stop, and the USAG-KA archaeologist will be notified (UES 3-7.5.7(a)). Controls applied will be in accordance with the UES, DEP, and the Protection of Cultural Resources (2004).

6.0 Dispersion Model for Modeling Air Sources

Activities are proposed to occur one time, resulting in minimal air emissions associated with the FT-3FE-2 flight test and cleanup; creating no significant air emission sources. The FT-3FE-2 flight test in USAG-KA will not involve operation of permanent major stationary sources. Air modeling is not required for the project activities described in this NPA.

7.0 Analysis of Waste Discharge (Point-Source Waste)

There are no point source discharges associated with the FT-3FE-2 flight test activities described in this NPA; therefore, analysis of waste discharges is not required. Freshwater used to wet the impact site and debris on Illeginni Islet will be isolated to the impact area and will be prevented from flowing into the ocean or lagoon. No activities will be conducted in or immediately adjacent to shorelines or negatively influence any reef environments.

8.0 Information for Hazardous Waste Treatment, Storage, or Disposal Facilities

The pending DEP and EA provide a detailed analysis of the waste streams associated with the FT-3FE-2 flight test. The analysis characterizes the waste streams, as well as the management strategies.

Hazardous materials will not be treated, permanently stored, or disposed of at USAG-KA. All spills will be cleaned-up in accordance with the KEEP and mission specific emergency response plans. All hazardous waste removed from Illeginni Islet will be properly containerized and shipped to Kwajalein Island for disposal. All hazardous waste will be disposed of in accordance with UES Section 3-6.6.5.

9.0 Biological Assessment if Endangered Resources May Be Affected

Consultation has beenwill be initiated with the National Marine Fisheries Service for the FT-3FE-2 flight test due to the possibility that the Action may adversely affect 161 marine mammal species, 2 sea turtle species, 73 fish species, 35 mollusk species, and 722 coral species listed as consultation species under the UES. Consultation waswill also be initiated and completed with the U.S. Fish and Wildlife Service due to the possibility that the Action may adversely affect sea turtles on land or sea turtle nesting habitat. A BA waswill be developed for the Proposed FT-3FE-2 flight test. The BA will includes a description of the proposed action, description of environmental stressor associated with the Proposed Action, description of consultation species in the action area, analysis of effects of the action on consultation species, and a discussion of cumulative effects related to the proposed action. Consultation species shall bewere defined as in the UES (USASMDCUSAKA, 202118) and included the 11 marine mammal species, 2 sea turtle species, 3 fish species, 5 mollusk species, and 22 coral species with the potential to occur in the Action

Area (listed in **Section 13.0**). Any control or conservation measures developed in consultation with Agencies during consultation will be included in the DEP.

10.0 Information on Receiving-Water Quality for Water Discharges

Any surface waters affected by the Proposed Action will be tested to meet UES water quality standards. No groundwater discharge will occur. No direct discharge or impacts to marine waters are anticipated. Freshwater used to wet a land impact site will be isolated to the impact area and will be prevented from flowing into the ocean or lagoon.

11.0 Marine Life, Currents and Other Characteristics of An Ocean Disposal Site

The proposed activity does not include direct or secondary ocean disposal actions. No direct or indirect impacts to Marine Life are anticipated, as no ocean disposal is associated with the proposed actions. Material and debris resulting from routine tests conducted at or near USAG-KA are not considered ocean disposal under the standards of the UES §3-5.5.5(a)(3).

12.0 Marine Life and Environment in Areas Where Dredging or Filling Will Take Place

No dredging will take place during the proposed test flight activities. Clean fill material will be brought from an offsite location to Illeginni Islet, to fill the impact site. No direct or indirect impacts to from fill activities are anticipated.

13.0 Species and Numbers of Migratory Birds and Other Wildlife Species and Habitats That May Be Affected

Several UES consultation and coordination species have the potential to be affected by the proposed FE-2 flight test. Consultation species that may occur in the Action Area are listed in **Table 13-1** and described in the FT-3 BA. Complete analysis of the effect of the Action on consultation species will behas been conducted in a BA as described in **Section 9.0**. For most consultation species, it is not anticipated that they will be affected by the Proposed Action. Sea turtles on land and sea turtle nests may be affected by disturbance from human activity and introduction of hazardous chemicals. However, no sea turtle nests or nesting activity has been recorded on Illeginni Islet in over 20 years. Any potentialThese effects are expected to be minimized by implementation of mitigation measures as outlined in **Section 5.0**. While a shoreline impact is not planned or expected, a shoreline impact or introduction of ejecta or payload components into the marine environment has the potential to affect seven species of coral, three species of mollusk, and one fish species due to direct contact or human disturbance. Mitigation measures will be in place to minimize effects to consultation species in the event of a shoreline impact or introduction of foreign materials into reef habitat.

Table 13-1. Species Requiring Consultation Known to Occur or Potentially Occurring at or near Illeginni Islet, Kwajalein Atoll. Species in red are species that may be adversely affected by the Action.

Scientific Name*	Common Name	UES Listing Source[1]Status[1]	Likelihood of Occurrence: on Illeginni Islet or in Nearshore Habitat	Likelihood of Occurrence: in Deeper Waters Near Illeginni Islet
Cetaceans				
Balaenoptera acutorostratamusculus	blueminke whale	E, MMPA, RMI-ESA-	-	P
B. physalusedeni	finBryde's whale	-E, MMPA	-	P
Delphinus delphis	short-beaked common dolphin	RMI-MMPA	-	P
Feresa attenuata	pygmy killer whale	MMPA	-	P
Globicephala macrorhynchus	short-finned pilot whale	MMPA	-	L
Grampus griseus	Risso's dolphin	MMPA	-	P
Kogia breviceps	pygmy sperm whale	MMPA	-	P
Megaptera novaeangliae	humpback whale	MMPA	-	L
Mesoplodon densirostris	Blainville's beaked whale	MMPA	-	P
Orcinus orca	killer whale	MMPA	-	P
Peponocephala electra	melon-headed whale	MMPA	-	P
Physeter macrocephalus	sperm whale	E, MMPA, RMI-ESA	-	L
Stenella attenuata	pantropical spotted dolphin	RMI -MMPA	-	LP
S. coeruleoalba	striped dolphin	RMI-MMPA	-	LP
S. longirostris	spinner dolphin	MMPA	-	L
Tursiops truncatus	bottlenose dolphin	MMPA	-	LP
Sea Turtles				
Chelonia mydas	green turtle	E, RMI-FA	L	L
Eretmochelys imbricata	hawksbill turtle	E, RMI-ESA and FA	P	P
Fish				
Alopias superciliosus	bigeye thresher shark	UES	-	P
Charcharhinus longimanus	oceanic whitetip shark	T	-	P
Cheilinus undulatus	**humphead wrasse**	**UES**	**L**	**-**
Manta alfredi	reef manta ray	UES	P	P
M. birostris	oceanic giant manta ray	UES	-	L
Sphyrna lewini	scalloped hammerhead shark	T	P	P
Thunnus orientalis	Pacific bluefin tuna	UES	-	P
Corals				
Acanthastrea brevis		UES	L	-
Acropora aculeus		UES	L	-
A. aspera		UES	L	-
A. dendrum		UES	L	-
A. listeri		UES	P	-
A. microclados		**UES**	**L**	**-**
A. polystoma		**UES**	**P**	**-**
A. speciosa		T	P	-

Scientific Name*	Common Name	UES Listing Source[1]Status[1]	Likelihood of Occurrence: on Illeginni Islet or in Nearshore Habitat	Likelihood of Occurrence: in Deeper Waters Near Illeginni Islet
A. tenella		T	L	-
A. vaughani		UES	L	-
Alveopora verilliana		UES	L	-
Cyphastrea agassizi		**UES**	**L**	**-**
Heliopora coerulea		**UES**	**L**	**-**
Leptoseris incrustans		UES	P	-
Montipora caliculata		UES	L	-
Pavona cactus		UES	L	-
P. decussata		UES	L	-
P. venosa		**UES**	**L**	**-**
Pocillopora meandrina		**C**	**L**	**-**
Turbinaria mesenterina		UES	P	-
T. reniformis		**UES**	**L**	**-**
T. stellulata		UES	L	-
Mollusks				
Hippopus hippopus	**giant clam**	**C**	**L**	**-**
Pinctada margaritifera	black-lipped pearl oyster	RMI-FA	P	-
Tectus (Trochus) niloticus	**top shell snail**	**RMI-FA**	**L**	**-**
Tridacna gigas	giant clam	C	P	-
Tridacna squamosa	**giant clam**	**C**	**L**	**-**

[1] UES listing source from Appendix 3-4A of the UES (USASMDC 20212018).
Abbreviations: ESA = Endangered Species Act; C = ESA candidate species; E = federal endangered; T = federal threatened; MMPA = Marine Mammal Protection Act; RMI = Republic of the Marshall Islands; RMI-ESA = RMI Endangered Species Act of 1975; RMI-MMPA = RMI Marine Mammal Protection Act of 1990; RMI-FA = RMI Fisheries Act of 1997; L = Likely; P = Potential.

With implementation of the mitigation measures in **Section 5.0**, migratory birds are not likely to be affected by the FT-3FE-2 flight test. Any effects to migratory birds are expected to be temporary, and birds would be expected to return to their normal behaviors after a few minutes. Several coordination mollusk, coral, and fish species occur in the reef habitats surrounding Illeginni Islet. As described above, a shoreline impact is not planned or expected, and it is not anticipated that the reef will be impacted by direct contact or introduction of foreign materials. However, in the event of a shoreline impact where debris or ejecta are introduced into the marine environment, mitigation measures will be in place to minimize the effects of the Action on these coordination species as described in **Section 5.0**.

14.0 Climate Change and Its Potential Impacts on the Activity

Due to the schedule and limited time frame of the proposed activity, climate change is not expected to have impacts on the test flight activities or associated effects of the Action. The single FT-3FE-2 flight test activities are not expected to significantly contribute to climate change.

15.0 Notification

15.1 Emergency Notifications

Within 24 hours of discovery of an emergency environmental condition, USAG-KA shall notify the public affected or potentially affected by the condition and the Appropriate Agencies by the most expeditious means available. Emergency environmental conditions are those that pose an immediate threat to human health and safety, incidental take of protected species or habitats, and unplanned impacts to sensitive natural and cultural resources. Within 10 days following emergency notification, USAG-KA shall submit written notification of the event to the Appropriate Agencies that contains, at a minimum, the relevant information described in UES Section 2-7.2.2. Emergency notifications shall be made for any condition that the Commander, USAG-KA, determines to constitute an emergency condition.

15.2 Public Notifications

Public notifications will be made by USAG-KA to advise the public of an activity or action that USAG-KA has taken or is planning. Public notification will be made through means that are widely available and consulted by the public at USAG-KA and the RMI. This normally includes publication in The Kwajalein Hourglass, posters or bulletins displayed in public places, announcements on Kwajalein Range Services Newsline, and/or on public television.

16.0 Records Keeping

The DEP with the NPA and all recommendations permitting impacts at Illeginni Islet shall be preserved for the duration of the activity plus 10 years, or for 10 years after expiration of the DEP, whichever is less.

17.0 Resolution of Non-compliant Areas

Currently, there are no known non-compliant activities associated with the FT-3FE-2 flight test at USAG-KA.

APPENDIX B

NMFS BIOLOGICAL OPINION
AND
USFWS LETTER OF CONCURRENCE (FE-2)

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Formal Consultation under the Environmental Standards for United States Army Kwajalein Atoll Activities in the Republic of the Marshall Islands

Biological Opinion

And Formal Consultation under Section 7 of the Endangered Species Act

Action Agencies:	Department of the Navy, Strategic Systems Programs (SSP) Department of the Army, U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) – Huntsville AL
	Activity: Single Flight Experiment-2 (FE-2)
Consulting Agency:	National Marine Fisheries Service, Pacific Islands Region
NMFS File No.:	PIRO-2019-02607
PIRO Reference No.:	I-PI-19-1782-AG
Approved By:	[signature]
	Michael D. Tosatto Regional Administrator, Pacific Islands Region
Date Issued:	09/27/19

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Acronyms

ARSTRAT	Army Forces Strategic Command, US Army
BA	Biological Assessment
BOA	Broad Ocean Area
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DPS	Distinct Population Segment
DQA	Data Quality Act
ESA	Endangered Species Act
FR	Federal Register
kg	Kilogram
km	Kilometer
m	Meter
MAC	Mid-Atoll Corridor
MMPA	Marine Mammal Protection Act
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
RMI	Republic of the Marshall Islands
ROV	Remotely Operated Vehicle
RTS	Ronald Reagan Ballistic Missile Test Site (aka Reagan Test Site)
SMDC	Space and Missile Defense Command, US Army
SSP	Strategic Systems Programs
UES	USAKA Environmental Standards
US	United States
USAF	U.S. Air Force
USAKA	U.S. Army Kwajalein Atoll
FWS	US Fish and Wildlife Service

1 Introduction

As described below, the proposed action involves launching a test missile (Flight Experiment-2, FE-2) from the Kauai Test Facility (KTF) located on the Pacific Missile Range (PMRF) in Hawaii which would travel across a broad ocean area (BOA) of the Pacific Ocean towards the Ronald Reagan Ballistic Missile Defense Test Site (Reagan Test Site [RTS]) at the US Army Kwajalein Atoll (USAKA), in the Republic of the Marshall Islands (RMI). The terminal end of the missile flight test would be at Illeginni Islet in Kwajalein Atoll. (Figure 1). FE-2 is the next incremental step in the developmental process after Flight Experiment 1 (FE-1), which was a very similar test flight conducted in 2017.

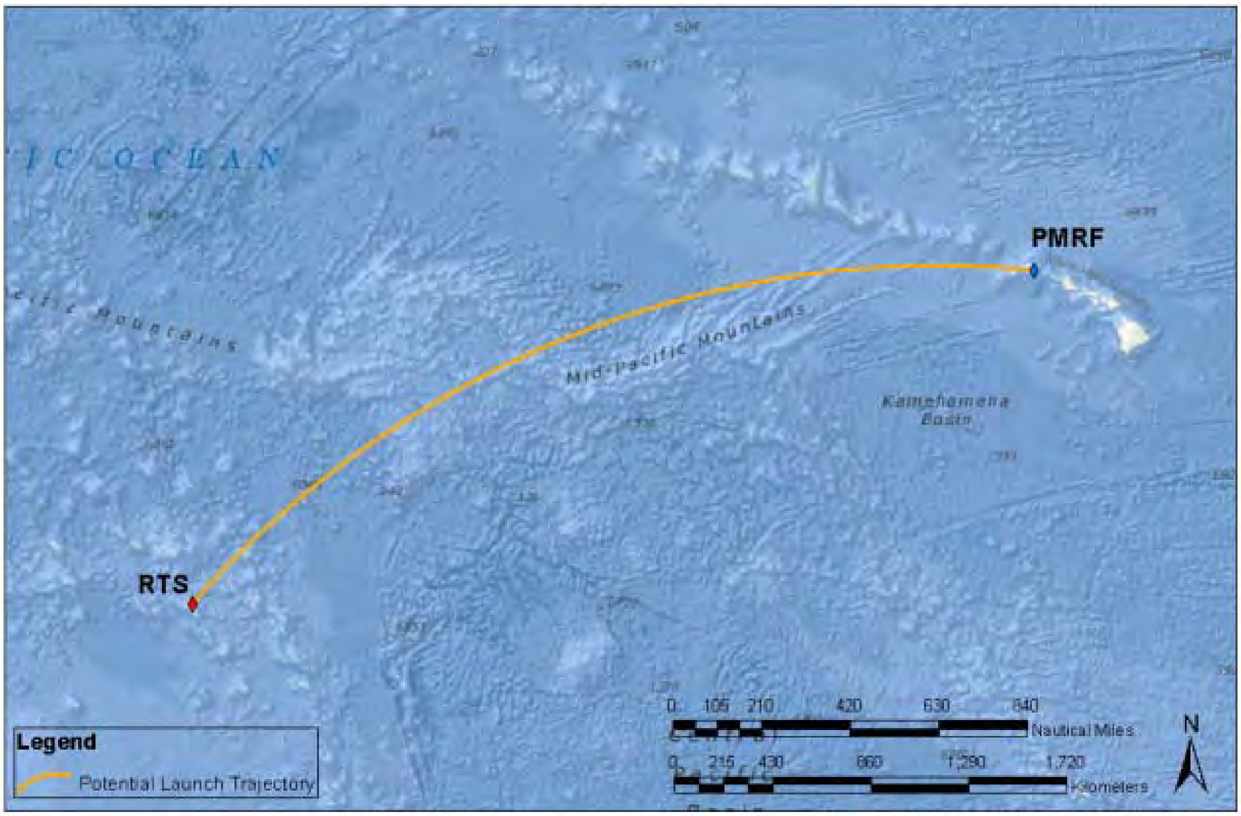

Figure 1. Flight Experiment-2 (FE-2) Representative Flight Path.

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 insure that any action it authorizes, funds, or carries 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" an ESA-listed species, that agency is required to consult formally with the National Marine Fisheries Service (NMFS; for marine species or their designated critical habitat) or the U.S. Fish and Wildlife Service (FWS; for terrestrial and freshwater species or their designated critical habitat). Federal agencies are exempt from this formal consultation requirement if they have concluded that an action "may affect, but is not likely to adversely affect" ESA-listed 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.

Updates to the regulations governing interagency consultations (50 CFR part 402) will become effective on October 28, 2019 [84 FR 44976]. Because this consultation was pending and will be completed prior to that time, we are applying the previous regulations to the consultation. However, as the preamble to the final rule adopting the new regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." Thus, the updated regulations would not be expected to alter our analysis.

The United States Department of the Navy (U.S. Navy) Strategic Systems Programs (SSP) is the lead agency and action proponent for the Proposed Action. The U.S. Navy, along with the Department of Energy and the National Aeronautics and Space Administration (NASA) as Cooperating Agencies, and with the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) 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/ARSTRAT 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 our Opinion of the effects on marine species protected under the ESA and the UES that may result from the FE-2 flight test at the Reagan Test Site (RTS) at Kwajalein Atoll. This Opinion is based on the review of: the USASMDC/ARSTRAT June 13, 2019, Biological Assessment (BA) for the proposed action (SSP 2019); recovery plans for U.S. Pacific populations of ESA-listed marine mammals and sea turtles; 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).

2 Consultation History

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 June 14, 2019 we received from USASMDC/ARSTRAT, on behalf of the US Navy SSP, this consultation request stating that they had determined that the FE-2 flight test (the proposed action) may affect 65 marine ESA and/or UES consultation species (Table 1 and Table 2), and requested consultation for those species.

Table 1. 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

Corals					
Pavona venosa	No Common Name			X	X
Turbinaria reniformis	No Common Name			X	X
Pocillopora meandrina	Cauliflower Coral	Candidate			X
Mollusks					
Tectus niloticus	Top Shell Snail				X
Hippopus hippopus	Giant clam	Candidate			
Tridacna squamosa	Giant clam	Candidate			X

In the BA, USASMDC/ARSTRAT further determined that the proposed action was likely to adversely affect the 11 marine UES consultation species listed in Table 1, and that the proposed action was not likely to adversely affect (NLAA) 54 consultation species (Table 2). Formal consultation was initiated on June 14, 2019, resulting in this Opinion.

Table 2. 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 North Pacific Green Sea Turtle DPS	Threatened		X	X
	Central Western Pacific DPS	Endangered		X	X
Dermochelys coriacea	Leatherback Sea Turtle	Endangered		X	X
Eretmochelys imbricata	Hawksbill Sea Turtle	Endangered		X	X
Lepidochelys olivacea	Olive Ridley Sea Turtle	Threatened		X	X
Marine Mammals					
Neomonachus schauinslandi	Hawaiian monk seal	Endangered	X	X	
Balaenoptera acutorostrata	Minke Whale		X		
B. borealis	Sei Whale	Endangered	X	X	
B. edeni	Bryde's Whale		X	X	
B. musculus	Blue Whale	Endangered	X	X	X
B. physalus	Fin Whale	Endangered	X	X	
Delphinus delphis	Common Dolphin		X		X
Feresa attenuata	Pygmy Killer Whale		X		
Globicephala macrorhynchus	Short-finned Pilot Whale		X		
Grampus griseus	Risso's Dolphin		X		
Indopacetus pacificus	Longman's Beaked Whale aka -Tropical Bottlenose Whale		X		
Kogia breviceps	Pygmy Sperm Whale		X		
K. sima	Dwarf Sperm Whale		X		
Lagenodelphis hosei	Fraser's Dolphin		X		
Megaptera novaeangliae	Humpback Whale	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

Marine Mammals					
Pseudorca crassidens	False Killer Whale		X		X
Stenella attenuata	Spotted Dolphin		X		X
S. coeruleoalba	Striped Dolphin		X		X
S. longirostris	Spinner Dolphin		X		X
Steno bredanensis	Rough-toothed Dolphin		X		
Tursiops truncatus	Bottlenose Dolphin, Pacific		X		
Ziphius cavirostris	Cuvier's Beaked Whale		X		
Fish					
Alopias superciliosus	Bigeye Thresher Shark				X
Manta alfredi	Reef manta ray				X
Sphyrna lewini	Scalloped Hammerhead Shark	Threatened			X
Thunnus orientalis	Pacific bluefin tuna				X
Carcharhinus longimanus	Oceanic white-tip shark	Threatened			
Corals					
Acanthastrea brevis	No Common Name			X	X
Acropora aculeus	No Common Name			X	X
A. aspera	No Common Name			X	X
A. dendrum	No Common Name			X	X
A. listeria	No Common Name			X	X
A. speciosa	No Common Name				X
A. tenella	No Common Name				X
A. vaughani	No Common Name				X
Alveopora verriliiiana	No Common Name			X	X
Pavona cactus	No Common Name				X
P. decussata	No Common Name				X
P. venosa	No Common Name				X
Leptoseris incrustans	No Common Name			X	X
Montipora caliculata	No Common Name			X	X
Turbinaria meseterina	No Common Name				X
T. stellulata	No Common Name			X	X
Mollusks					
Pinctada margaritifera	Black-Lip Pearl Oyster				X
Tridacna gigas	Giant clam	Candidate			X

3 Description of the Proposed Action and Action Area

The proposed action is described in detail in the USASMDC/ARSTRAT BA. The purpose of the Proposed Action is to collect data on a developmental payload by testing missile range performance and to demonstrate capabilities as a prospective means to strike capabilities. Specifically, the FE-2 experiment would develop, integrate, and flight test the developmental payload concept to demonstrate the maturity of key technologies. These technologies include precision navigation, guidance and control, and enabling capabilities. The developmental payload would be launched from Kauai Test Facility located on the PMRF in Hawaii and would travel across a BOA of the Pacific Ocean towards the RTS at the USAKA, formerly known as US Army Kwajalein Atoll, in the RMI. The terminal end of the missile flight test would be at Illeginni Islet in Kwajalein Atoll.

The Proposed Action consists of pre-flight preparations in the BOA and at USAKA, the FE-2 flight test across the BOA with three motor splash downs (Figure 3), payload impact, and post-flight impact data collection, debris recovery, and clean-up operations at USAKA. The Navy proposes to conduct the proposed action within the first half of fiscal year 2020., if a Finding of No Significant Impact (FONSI) under the National Environmental Policy Act (NEPA), can be reached and approved. The following subsections include descriptions of the launch vehicle, pre-flight operations, flight, terminal phase operations, and post-flight operations.

Launch Vehicle Description

The Navy Strategic Systems Program FE-2 program launch vehicle consists of a 3-stage Strategic Target System (STARS) booster (Figure 2) and the developmental payload. The STARS booster vehicle is composed of three motor stages and control electronics. Figure 2 shows a typical STARS vehicle and Table 3 outlines the launch vehicle characteristics. The first stage motor is 4.62 m (182 inches [in]) long with a diameter of 1.37 m (54 in). The second stage motor is 1.32 m (52 in) long with a diameter of 1.37 m (54 in) and the third stage motor is 1.32 (52 in) long with a diameter of 1.37 m (54 in). The amount of propellant in the three boosters of a STARS vehicle totals approximately 13,608 kilograms (kg; 30,000 pounds [lbs]) and the vehicle generates approximately 34,019 kg (75,000 lbs) of thrust (USASMDC/ARSTRAT 2011). The amount of propellant and the environmental impacts of STARS launches was analyzed in 2008 in the Hawaii Range Complex (HRC) EIS/OEIS (US Navy 2008). Since environmental impacts of STARS launches at PMRF have been analyzed as a part of activities at PMRF, we do not further analyze vehicle launch in this document.

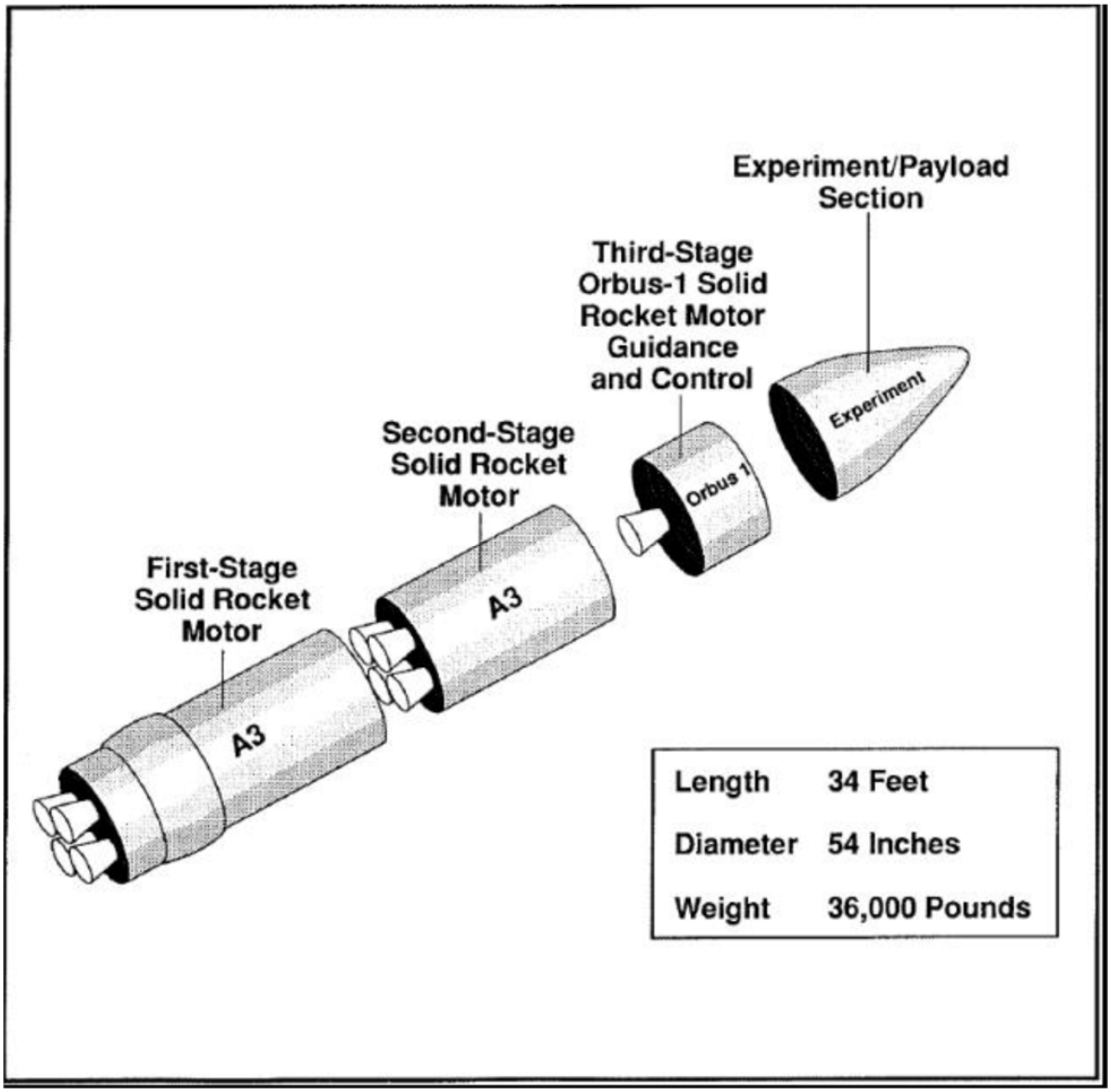

Figure 2. Typical Strategic Target System (STARS) Vehicle

Table 3. Launch Vehicle Characteristics

Major components	Rocket motors, propellant, magnesium thorium (booster interstage)[1], nitrogen gas, halon, asbestos (contained in second stage), battery electrolytes (lithium-ion, silver zinc)
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency transponder
Power	Up to nine lithium ion polymer and silver zinc batteries, each weighing between 3 and 40 pounds
Propulsion/Propellan	Solid Rocket propellant, 1.3 kg (3 lb) of pressurized nitrogen gas
Other	Small Class C (1.4) electro-explosive devices ,

1 The skin of the STARS first/second interstage structure was manufactured from a magnesium-thorium alloy (HK31A-H24). This is a surplus Polaris A3R asset that has been adapted to STARS and it contains less than 3% (<80 micro curies [µCi]) thorium. The interstage alloys are commercially available products containing magnesium-thorium alloy and are exempted from controls by the Nuclear Regulatory Commission (10 CFR 40.13) and the Radiological Procedures Protection Manual (RPPM) since there is no physical, chemical or metallurgical processing performed on the items.

Table 3 details the launch vehicle characteristics and Table 4 describes the payload system characteristics. Up to 454 kg or (1,000 lbs) of tungsten will be contained in the payload. A nose fairing covers the payload until separation from the third stage motor. This nose fairing is approximately 3.12 m (100 in) long composed with a diameter of 1.37 m (54 in) and then tapering to a 10.16 cm (4 in) diameter at the nose. The nose fairing is a single piece but there are two clamshell extensions on the bottom 61 cm (24 in) in length that separate into two symmetric halves.

Table 4. Payload System Characteristics

Structure	Aluminum, steel, titanium, magnesium and other alloys, copper, fiber glass, chromate coated hardware, tungsten, plastic, Teflon, quartz, RTV silicone
Communications	Two less-than-20-watt radio frequency transmitters
Power	Up to three lithium ion polymer batteries, each weighing between 3 and 50 lbs
Propulsion/Propellant	None
Other	Class C (1.4) electro-explosive devices for safety and payload subsystems operations

Launch: The FE-2 missile will be launched from land at PMRF and enter an over-ocean flight phase within seconds after the launch.

Over-Ocean Flight: During the planned FE-2 flight over the BOA, the first-stage motor will burn out and separate from the second stage. Further into flight, the second-stage and third-stage motors would also burn out and separate. 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 between 65 and 2,800 km from the launch pad. Figure 3 depicts the drop zones for the rocket motors. The nose fairing is expected to splashdown in motor drop zone 2. Following separation from the launch vehicle, the payload would use autonomous flight control to fly at high-speeds in the upper atmosphere towards RTS. If the payload's onboard computers determine that there is insufficient energy to reach the target area, the payload will be directed to descend in a controlled termination of the flight into the BOA.

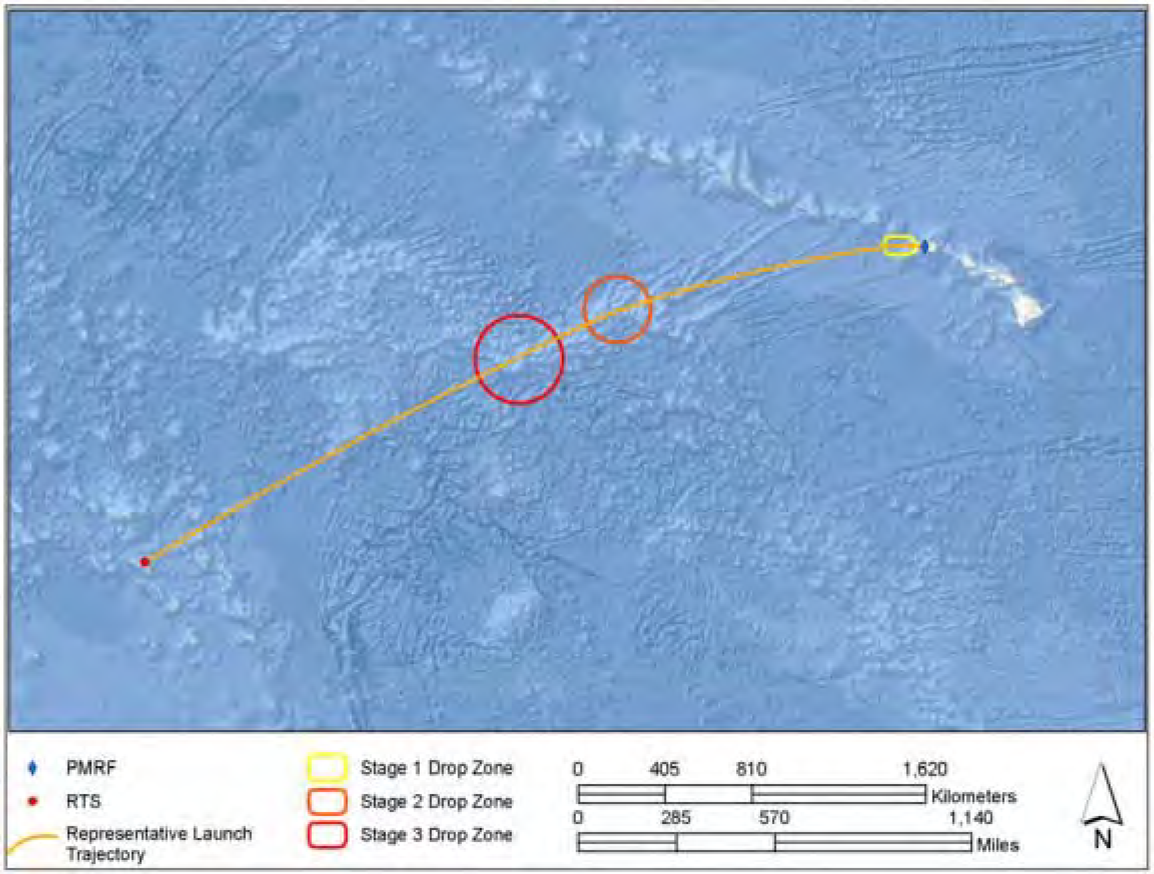

Figure 3. Representative Drop Zones for spent motor stages and nose fairing assembly.

Upon reaching the terminal end of the flight, the payload would impact on the non-forested northwestern end of Illeginni Islet (Figure 4 and Figure 5). A crater would form as a result of this impact and leave debris containing less than 454 kg (1,000 lbs) of tungsten. Targeted areas for the payload will be selected to minimize impacts to reefs and identified wildlife habitats. A coral reef or shallow water impact at Illeginni is not part of the proposed action, would be unintentional, and is unlikely (SSP 2019).

Figure 4. Location of Illeginni Islet, Kwajalein Atoll, Republic of the Marshall Islands.

Figure 5. Potential Land Impact Area on Illeginni Islet, Kwajalein Atoll.

Sensor Coverage in the BOA:
The flight path would initiate from the PMRF, travel across the BOA (avoiding the Northwest Hawaiian Islands) and continue to USAKA in the RMI. The flight path would essentially be the same as that analyzed in the Final Environmental Impact Statement for the Strategic Target System (USASDC 1992), the HRC EIS/OEIS (US Navy 2008), the FE-1 launch (NMFS 2017c) and the THAAD launch operation in 2019 (NMFS 2019). A series of sensors would overlap coverage of the flight from launch at Kauai Testing Facility (KTF) until impact at USAKA. The sensors would include:

- Ground-based optics and radars at PMRF
- Sea-based sensors on the Mobile Aerial Target Support System (MATSS) out of PMRF, the Kwajalein Mobile Range Safety System (KMRSS) on board the US Motor Vessel (USMV) Pacific Collector, and the Pacific Tracker
- Additional airborne and waterborne sensors on military or commercial aircraft are not planned as part of the FE-2 flight test but might be scheduled by other agencies to collect data on FE-2.

Sensor Coverage at USAKA:
Radars would be placed on Illeginni Islet to gather information on the payload. Up to four radar units, which would fit within a 61 cm by 38 cm by 15 cm (24 in by 15 in by 6 in) box, would be placed within the impact area and may be destroyed by payload impact. These radars are powered by on-shore generator power.

In addition to land-based radars and sensor vessel support, up to 12 self-stationing Lawrence Livermore National Laboratory Independent Diagnostic Scoring System (LIDSS) rafts may be placed in the lagoon and ocean waters near Illeginni Islet (Figure 6). These rafts would be equipped with battery-powered electric motors for propulsion to maintain position in the water. Two types of rafts will 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. Camera rafts are equipped with stabilized cameras and/or radar as well as hydrophones as described above. Before the flight test, one or two range landing craft utility (LCU) vessels would be used to deploy the rafts. Rafts will be deployed in waters at least 4 m deep to avoid contact with the substrate and/or coral colonies. Sensors on the rafts would collect data during the payload descent until impact.

Figure 6. Notional Locations of LIDSS Rafts.

Pre-Flight Preparation at Illeginni Islet:
Pre-flight preparation activities at Illeginni Islet would include several vessel round-trips and helicopter trips for equipment and personnel transport. There would be increased human activity on Illeginni Islet that would involve up to 24 persons over a 3-month period. Heavy equipment placement and use on Illeginni Islet would occur at times and be limited to transport on existing roads from the harbor to the impact area as well as in the impact area itself.

Flight Operations:
After launch from KTF, the vehicle would be monitored during flight over the BOA by land, sea and/or air-based sensors deployed prior to launch. The FE-2 vehicle would avoid flying over the Northwestern Hawaiian Islands (NWHI) and would traverse over the BOA to Illeginni Islet in the RTS at Kwajalein Atoll (Figure 1).

Following motor ignition and liftoff from the launch location, the first-stage motor would burn out downrange and separate from the second stage. Farther into flight, the second-stage would also burn out and separate, with the shroud assembly also being jettisoned prior to third stage ignition. Farther into flight, the third-stage would also burn out and separate from the payload. Splashdown of all three spent motor stages and the shroud assembly would occur at different points in the open ocean between 65 and 2,800 km from the launch pad . Jettison of the fairing and separation of the payload would occur outside the atmosphere. The mission planning process would avoid to the maximum extent possible all potential risks to environmentally significant areas. All actual impact zones would be sized based on range safety requirements and chosen as part of the mission analysis process.

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 (FTS) would be activated. The FTS would initiate a predetermined safe mode for the vehicle, causing it to fall towards the ocean and terminate flight. No inhabited land areas would be subject to unacceptable risks of falling debris. Computer-monitored destruct lines, based on no-impact lines, are pre-programmed for the flight safety software to avoid any debris falling on inhabited areas. An FTS on the payload would include a failsafe operation to further ensure the safety of the Marshall Islands. This failsafe requires positive action to be taken by range safety personnel to allow the payload to continue flight to the vicinity of Illeginni Islet. The FTS would also contain logic to detect a premature separation of the booster stages and initiate a thrust termination action on all of the prematurely separated stages. Thrust would be terminated by initiation of an explosive charge to vent the motor chamber, releasing pressure and significantly reducing propellant combustion. This action would stop the booster's forward thrust, causing the launch vehicle to fall along a ballistic trajectory into the ocean. The FTS would be designed to prevent any debris from falling into any protected area.

The payload would fly toward pre-designated target sites at Illeginni Islet. If data from payload onboard sensors indicate that there is insufficient energy to reach the target area, the payload would be terminated causing it to fall along a ballistic trajectory into the over-ocean flight corridor in the BOA.

Upon reaching the terminal end of the flight, the payload would impact on the non-forested northwestern end of Illeginni Islet (Figure 5). A crater would form as a result of this impact and leave debris containing less than 454 kg (1,000 lb) of tungsten[1]. Targeted areas for the payload would be selected to minimize impacts to reefs and identified wildlife habitats. The impact point on Illeginni Islet would be west of the forest tree line to avoid affecting sensitive bird habitat. A coral reef or shallow water impact at Illeginni is not part of the Proposed Action, would be unintentional, and is unlikely.

Post-flight Operations:

Post-flight operations may include manual cleanup of payload debris, use of heavy equipment for cleanup and repairs, retrieval of sensors, and use of remotely operated vehicles (ROVs) for underwater debris retrieval as described below.

Post-flight debris deposited on Illeginni Islet or in the adjacent ocean or lagoon would be recovered. Prior to recovery and cleanup actions at the impact site, unexploded ordinance

[1] The payload debris would include tungsten for ballast, etc., in accordance with Table 3-2 of the BA; exact quantities of tungsten are unknown at this time. In order to provide an appropriate conservative assessment, a quantity of up to 454 kg (1,000 lb) of tungsten alloy is used for the environmental effects analysis.

personnel would first survey the impact site for any residual explosive materials. For a land impact at Illeginni Islet, the impact areas would be washed down if necessary to stabilize the soil. Post-flight recovery operations at Illeginni Islet will involve manual cleanup and removal of all visible experiment debris, including hazardous materials, followed by filling in larger craters with ejecta using a backhoe or grader. Repairs will be made to the impact area if necessary. USAKA and RTS personnel are usually involved in these operations. Any accidental spills from support equipment operations would be contained and cleaned up. All waste materials would be returned to Kwajalein Island for proper disposal in the US. Following cleanup and repairs to the Illeginni site, soil samples would be collected at various locations around the impact area and tested for pertinent contaminants. Recovery and cleanup operations on Illeginni Islet could possibly cause some short-term disturbance to migratory bird habitat, potential sea turtle nesting habitat, and nearshore coral reef habitat.

While a shallow water impact is not planned or expected, any payload impact debris found in the shallow waters near Illeginni Islet would be removed while attempting to not further disturb or damage corals or other marine organisms. Payload recovery/cleanup operations in the lagoon and ocean reef flats, within 500 to 1,000 ft of the shoreline, are conducted similarly to land operations when tide conditions and water depth permit. A backhoe is used to excavate the crater. Excavated material is screened for debris and the crater is usually back-filled with ejecta from around the rim of the crater. While not planned or expected, should the payload impact in the deeper waters of the atoll lagoon, a dive team from U.S. Navy Supervisor of Salvage and Diving, USAKA or RTS would be brought in to conduct underwater searches. If warranted due to other factors, such as significant currents, mass of the debris to be recovered, etc., the recovery team would consider the use of a remotely operated vehicle (ROV) instead of divers.

If an inadvertent impact occurs on the reef, reef flat, or in shallow waters less than 3 m deep, an inspection by project personnel would occur within 24 hours. Representatives from the NMFS and FWS would also be invited to inspect the site as soon as practical after the test. The inspectors would be invited to assess any damage to coral and other natural and biological resources and, in coordination with SSP, USAKA and RTS representatives, decide on any mitigation measures that may be required. In general, payload recovery operations would not be attempted in deeper waters on the ocean side of the Atoll. Searches for debris would be attempted out to depths of up to 55 m. An underwater operation similar to a lagoon recovery would be used if debris were located in this area.

<u>Best Management Practices (BMPs):</u>

- 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. Hazardous waste incidents would comply with the emergency procedures set out in the Kwajalein Environmental Emergency Plan (KEEP) and the UES.
- 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 FE-2 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.

3.1 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 FE-2 testing 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 FE-2 test 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.

3.2 Action Area

As described above, the action area for this consultation begins after the launch immediately offshore from PMRF, Kauai, where the sonic boom of the accelerating missiles would reach the ocean surface. The action area 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 (Figures 1 and 3). The action area also includes the area of and around Kwajalein Atoll, RMI where the payload would impact the target areas (Figure 5), 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.

4 Species and Critical Habitats Not Likely to be Adversely Affected

As explained above in Section 1, USASMDC/ARSTRAT determined that the proposed action was not likely to adversely affect (NLAA) the 54 consultation species listed in Table 2, and would have no effect on critical habitats designated under the ESA and/or the UES. With the exception that we have determined that the proposed action may affect, but is NLAA critical habitat that has been designated under the ESA for Hawaiian monk seals and Main Hawaiian Islands (MHI) insular false killer whales, 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 USASMDC/ARSTRAT'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, 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 (FWS and NMFS 1998). As described in Section 2, test flights have 3 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.

Over-Ocean Flight: 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.

Terminal Flight and Reentry Vehicle Impact in the RMI: 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.

a. Exposure to elevated noise levels: While in flight between PMRF 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 and water that could transfer to water causing impulsive sound sources. High intensity impulsive noises can adversely affect marine life. The USASMDC/ARSTRAT 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 dB_{rms} 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. Source: 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 (SEL_{cum}). 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 FE-2 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. 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT predicted the impulsive noises created by the splash based on the size of the components, listed in Table 6.

Table 6. Stage Impact Contact Areas and Peak Sound Pressure Levels for FE-2 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). The vehicle is designed to avoid NWHI. All four objects would fall into deep open ocean waters. The first would splash-down shortly after takeoff near Kaula Rock in the Hawaiian Islands. The remaining objects would splash-down in tropical waters closer to the target site at Illeginni Islet than Hawaii but still in deep ocean waters. Cetaceans, sea turtles, adult scalloped hammerhead sharks, oceanic white tip sharks, bigeye thresher sharks, rays, and pelagic fish may be affected by this stressor. Hawaiian monk seals 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. The USASMDC/ARSTRAT compared marine mammal density information from Hawaii, and sea turtle density information from Guam, against the expected range of effect around falling missile components to estimate the probability of effect. Their modeling suggests that the probability of exposing marine mammals to a TTS-level exposure for a test flight would be between 1 in 261,327 chance for the most common and sensitive species (Hanser et al. 2013). This is likely an overestimate, since those calculations did not include weighting factors used in our evaluations, which reduce the zone of influence. 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	TTS peak pressure threshold (SPL_{peak})	Isopleths to TTS threshold from:			
		218 dB	**205 dB**	**201 dB**	**196 dB**
Low-frequency cetaceans (humpback whale and other baleen whales)	213 dB	1.8 m (5.9 feet)	0.4 m	0 m	0 m
Mid-frequency cetaceans (dolphins, pilot whales and other toothed whales)	224 dB	0 m	0 m	0 m	0 m
High-frequency cetaceans (Kogia, true porpoises)	196 dB	0.2 m (0.65 feet)	0 m	0 m	0 m
Phocid pinnipeds (Hawaiian monk seals and other true seals)	212 dB	1 m (3.28 feet)	0.2 m	0 m	0 m
Sea turtles	224 dB	0 m	0 m	0 m	0 m
Sharks, rays, and fish	229 dB*	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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 2 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 1. Therefore, the potential effects of this stressor on those species are considered below in the effects of the action section (Section 4).

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 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 FE-2 proposed payload, cratering and ejecta are expected to be 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. USASMDC/ARSTRAT (2019) reports that the first stage motor is about 4.6 m long, 1.37 m in diameter, and is the largest component. The second stage motor is 2.26 m long with a diameter of 1.37 m and the third stage motor is 1.32 m long with a diameter of 1.37 m. Direct contact areas for these individual components are listed in Table 6 and total approximately 61 m^2.

If a spent rocket motor or other FE-2 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 the above discussed affected areas, and the best available species density information, chances of direct contact to cetaceans and sea turtles in the BOA were calculated. Calculations are based on methodology in the Mariana Islands Training and Testing Activities Final EIS (Appendix G in US Navy 2015a) and the Hawaii-Southern California Training and Testing EIS (Appendix G in US Navy 2013).

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 FE-2 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 between 1 in 117,000 and 1 in 14,700,000 depending on the species (

Table 8). The probability of exposing sea turtles is 1 in 710,000 (SSP 2017, 2019). No density information is available for scalloped hammerhead sharks, bigeye thresher sharks, oceanic white tip sharks, bluefin tuna, and the reef or giant manta ray but their densities are believed to be relatively low. 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. Probability of Direct Contact from FE-2 Vehicle Components and Estimated Number of Marine Mammal and Sea Turtle Exposures in the BOA.[1]

Species / Group	Average Probability of Impacting One Animal Across Scenarios based on Animal and Component Size				Average Number of Exposures Across Scenarios (number of animals)				Estimated Total Number of Exposures
	1st Stage Motor	2nd Stage Motor	Nose Fairing	3rd Stage Motor	1st Stage Motor	2nd Stage Motor	Nose Fairing	3rd Stage Motor	
Marine Mammals									
Balaenoptera acutorostrata	3.18E-08	1.98E-09	3.24E-09	7.09E-10	1.56E-06	6.31E-07	1.03E-06	3.96E-07	3.62E-06
B. borealis	4.90E-08	3.49E-09	5.27E-09	1.37E-09	9.10E-08	4.21E-08	6.37E-08	2.90E-08	2.26E-07
B. edeni	4.56E-08	3.18E-09	4.86E-09	1.24E-09	6.56E-08	3.55E-08	5.43E-08	1.89E-08	1.74E-07
B. musculus	8.72E-08	7.23E-09	1.00E-08	3.15E-09	5.06E-08	2.73E-08	3.77E-08	2.08E-08	1.36E-07
B. physalus	6.84E-08	5.34E-09	7.65E-09	2.23E-09	4.77E-08	2.42E-08	3.46E-08	1.77E-08	1.24E-07
Feresa attenuata	1.78E-08	8.80E-10	1.66E-09	2.66E-10	9.09E-07	2.92E-07	5.50E-07	1.54E-07	1.91E-06
Globicephala macrorhynchus	2.30E-08	1.27E-09	2.24E-09	4.20E-10	2.65E-06	2.88E-07	5.07E-07	1.47E-07	3.59E-06
Grampus griseus	1.85E-08	2.50E-09	3.96E-09	9.36E-10	2.07E-06	8.88E-07	1.40E-06	5.81E-07	4.94E-06
Indopacetus pacificus	2.98E-08	1.81E-09	3.01E-09	6.39E-10	1.07E-06	4.24E-07	7.03E-07	2.62E-07	2.46E-06
Kogia breviceps	1.94E-08	9.98E-10	1.83E-09	3.11E-10	6.55E-07	2.19E-07	4.02E-07	1.19E-07	1.40E-06
K. sima	1.80E-08	8.93E-10	1.67E-09	2.70E-10	1.49E-06	4.81E-07	9.02E-07	2.55E-07	3.13E-06
Lagenodelphis hosei	1.80E-08	8.93E-10	1.67E-09	2.70E-10	4.38E-06	1.42E-06	2.65E-06	7.50E-07	9.20E-06
Megaptera novaeangliae	4.90E-08	3.49E-09	5.27E-09	1.37E-09	5.86E-06	6.58E-07	9.95E-07	4.54E-07	7.97E-06
Mesoplodon densirostris	2.40E-08	1.35E-09	2.35E-09	4.49E-10	2.39E-07	8.75E-08	1.52E-07	5.09E-08	5.30E-07
Orcinus orca	3.18E-08	1.98E-09	3.24E-09	7.09E-10	2.21E-08	8.95E-09	1.47E-08	5.62E-09	5.13E-08
Peponocephala electra	1.80E-08	8.93E-10	1.67E-09	2.70E-10	4.17E-07	1.35E-07	2.53E-07	7.14E-08	8.76E-07
Physeter macrocephalus	4.45E-08	3.08E-09	4.73E-09	1.19E-09	8.00E-07	3.06E-07	4.70E-07	1.72E-07	1.75E-06
Pseudorca crassidens	2.40E-08	1.35E-09	2.35E-09	4.49E-10	1.31E-06	1.17E-07	2.03E-07	7.43E-08	1.71E-06
Stenella attenuata	1.68E-08	8.04E-10	1.54E-09	2.37E-10	1.32E-06	2.58E-07	4.93E-07	1.81E-07	2.25E-06
S. coeruleoalba	1.80E-08	8.93E-10	1.67E-09	2.70E-10	7.49E-07	3.86E-07	7.24E-07	2.65E-07	2.12E-06
S. longirostris	1.68E-08	8.04E-10	1.54E-09	2.37E-10	1.58E-06	3.67E-07	7.02E-07	3.20E-07	2.97E-06
Steno bredanensis	1.78E-08	8.80E-10	1.66E-09	2.66E-10	1.05E-06	7.10E-08	1.33E-07	2.91E-08	1.28E-06
Tursiops truncatus	2.03E-08	1.07E-09	1.93E-09	3.37E-10	1.76E-06	4.61E-08	8.36E-08	2.00E-08	1.90E-06
Ziphius cavirostris	2.59E-08	1.50E-09	2.56E-09	5.09E-10	9.01E-08	3.39E-08	5.80E-08	2.02E-08	2.02E-07
Neomonachus schauinslandi	1.73E-08				6.02E-09				6.02E-09
Total Marine Mammal Exposures					**2.92E-05**	**6.68E-06**	**1.18E-05**	**4.01E-06**	**5.17E-05**
Sea Turtles									
Sea Turtle Guild [2]	1.55E-08	6.70E-10	1.25E-09	2.04E-10	6.70E-07	2.17E-07	4.06E-07	1.16E-07	1.41E-06

1 Animal densities used for analyses are presented in table 5-9. The first stage motor would splashdown in motor drop zone 1, the second stage motor and nose fairings in motor drop zone 2, and the third stage motor in motor drop zone 3.
2 Sea turtles were combined into a "sea turtle guild" in the Marine Species Density Database due to the lack of species specific occurrence data (Hanser et al. 2017). This sea turtle guild is composed of primarily green and hawksbill turtles as they account for nearly all sightings in the study area; however, in theory, the guild also encompasses leatherback, olive ridley, and loggerhead turtles (Hanser et al. 2017).

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 2, 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 23 coral species, three fish species, and five 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.

c. Exposure to hazardous materials: 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 FE-2 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). 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 1,000 lbs of tungsten alloy 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 (US 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, which are both below the US EPA Residential screening level of 0.016 mg/L.

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.

<u>d. Long-term addition of man-made objects to the ocean</u>

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. Missiles are approximately 10.4 m long and weigh approximately 36,000 lbs fully assembled. The booster contains a solid propellant of hydroxyl terminated polybutadiene (HTPB) composition. The amount of propellant is approximately 30,000 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. 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. Therefore assuming the maximum weight including if the experimental payload does not detach and is lost in the BOA, a total of 6,000 lbs of material could land in the ocean.

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. 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 from this proposed action to the bottom of the ocean to be insignificant.

<u>e. Disturbance from human activities and equipment operation</u>: 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 1, but not any of the species identified in Table 2. The sessile species in Table 2 (4 corals and black-lip pearl oyster) are not likely to occur in the area where they could be affected. Similarly, the motile species in Table 2, 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 and top shell snails in Table 1 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 this interaction 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 **2**, but may adversely affect the species identified in Table 1.

f. Collision with vessels: The Proposed Action has the potential to increase ocean vessel traffic in the action area during both pre-flight preparations and post-flight activities, however it is discountable that any of the species considered in this consultation would experience a collision with a project-related vessel. As part of FE-2 flight test monitoring and data collection, sea based sensors will be deployed along the flight path on vessels in the BOA. These three vessels (Figure 1) will travel from PMRF 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 6) 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.

Critical habitat: Critical habitat for the Hawaiian Monk Seal has been designated in the main Hawaiian Islands and the Northwestern Hawaiian Islands. Critical habitat was designated for this species in 1986 with revisions in 1988 and 2015 (80 FR 50925). In the revised rule, critical habitat includes terrestrial areas used for pupping, nursing, and haul-out as well as marine habitat within 10 m of the seafloor out to the 200 m depth contour (80 FR 50925). No Hawaiian monk seal critical habitat was designated immediately adjacent to the Pacific Missile Range Facility on Kauai, Hawaii.

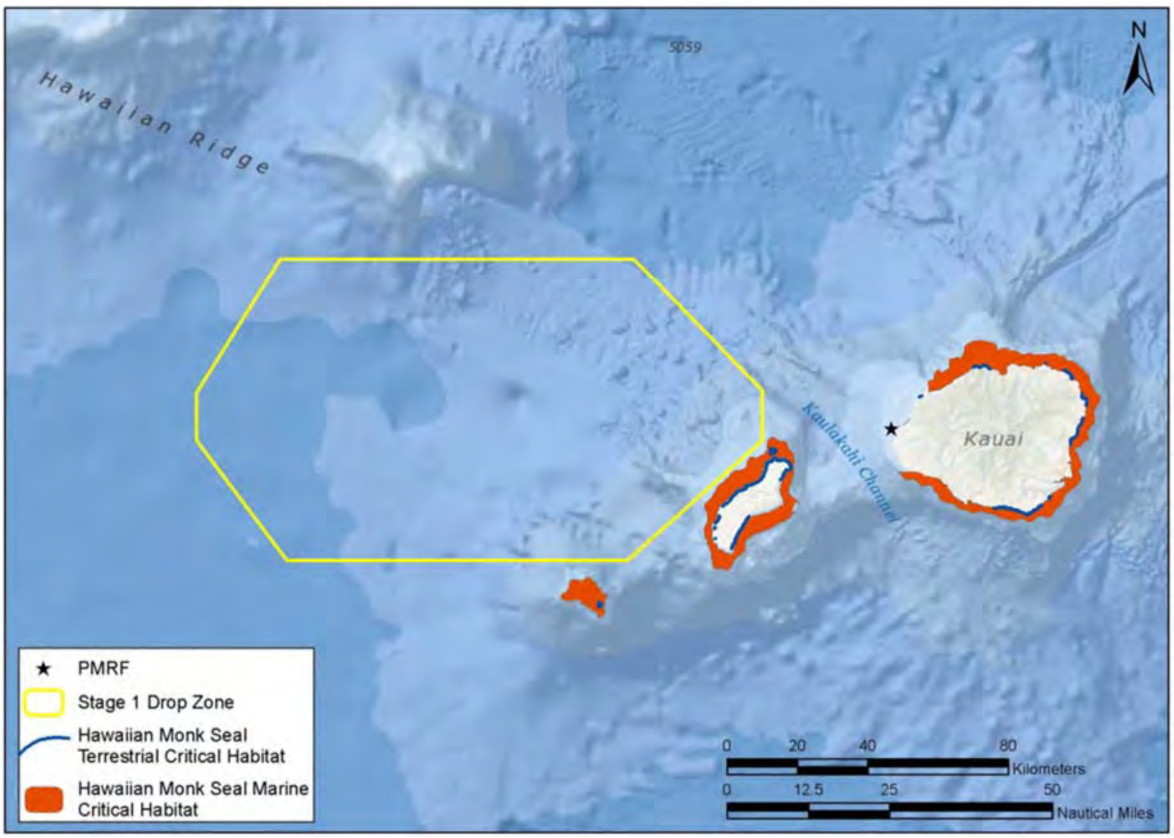

Figure 7. Representative Stage 1 Spent Motor Drop Zone and designated Hawaiian Monk Seal Critical Habitat.

The flight path of the FE-2 flight test is not expected to cross designated critical habitat for Hawaiian monk seals but is expected to cross MHI insular false killer whale critical habitat in the MHI. However, the first stage booster could potentially land in or near monk seal designated critical habitat. Additionally, there is no designated critical habitat within the RMI. The essential features for the conservation of the Hawaiian monk seal are: 1) terrestrial areas and adjacent shallow, sheltered aquatic areas with characteristics preferred by monk seals for pupping and nursing; 2) marine areas from 0 to 200 m in depth that support adequate prey quality and quantity for juvenile and adult monk seal foraging; and 3) significant areas used by monk seals for hauling out, resting or molting.

Designated critical habitat for Hawaiian monk seals is outside the area of effect for the FE-2 flight test. The spent stage one motor drop zone in the BOA is the closest potential action which could affect Hawaiian monk seal critical habitat (Figure 7). The stage one motor drop zone is at least 26 km (16 mi) from critical habitat at Kaula Island, 48 km (30 mi) from critical habitat at Niihau, and 70 km (43 mi) from critical habitat at Nihoa. Therefore any effects to any essential feature of Hawaiian monk seal critical habitat are extremely unlikely to occur. These effects are therefore discountable.

Hazardous materials within the missile, including unburnt propellant, may affect water quality in the immediate area around the splash-down of each stage of the missile. However, as described above, hazardous materials within missile debris would sink quickly to the seafloor, likely to depths of multiple thousands of feet. 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 monk seal designated critical habitat.

NMFS has also identified that critical habitat for the MHI insular false killer whale is within the action area and potentially includes the transit route of the missile's flight path from Kauai and the proposed device's first stage re-entry location (Figure 7) overlaps a portion of the bathymetric profile of the designated critical habitat (45 m to 3,200 m; 83 FR 35062), specifically north of Niihau and Warning Area 187. The expected area of overlap is rather small (shown in orange; Figure 8) and we do not suspect the first stage booster will significantly affect physical and biological features of the designation critical habitat. Specifically, (1) adequate space for movement and use within shelf and slope habitat; or (2) waters free of pollutants of a type and amount harmful to MHI insular false killer whales. The booster is not of sufficient size to exclude the species from accessing preferred habitat. Additionally, if the booster were to actually land in shallower designated critical habitat and sink the bottom, it may act as artificial reef until such time corrosion dissolves the material. Furthermore, we expect all propellant to be used and no liquid chemicals would be introduced into the environment other than the metal material of the first stage. Furthermore, the addition of material to deep ocean depths was already discussed in Section b above. NMFS therefore concludes this proposed action may affect, but is not likely to adversely affect designated MHI insular false killer whale critical habitat, and is therefore considered insignificant.

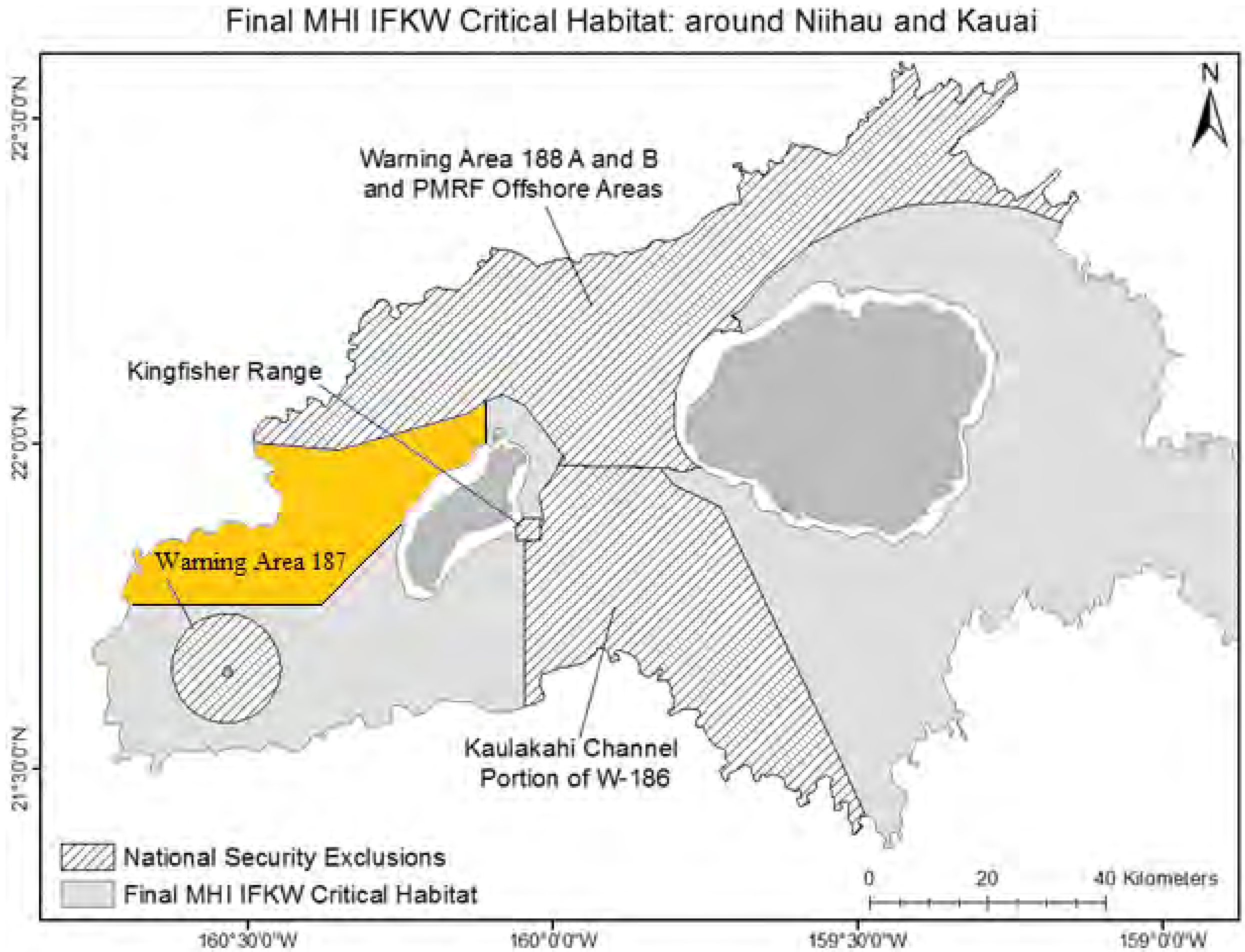

Figure 8. Designated MHI insular false killer whale critical habitat with National Security Exclusion Areas as noted in 83 FR 35062 with approximate projected area of overlap from the proposed action shown in orange[2].

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 2. Further, we have determined that the proposed action would have discountable or insignificant effects on designated critical habitat for the Hawaiian monk seal or MHI insular false killer whale.

Therefore, we concur with your determination that conducting the proposed FE-2 flight test is NLAA the consultation species identified in Table 2, and would have no effect on designated critical habitat in the RMI. We have also determined that the proposed FE-2 flight test is NLAA to Hawaiian monk seal and MHI insular false killer whale designated critical habitats. Those species and critical habitats will not be considered further in this consultation.

[2] The orange area shown is designated critical habitat and not Warning Area 187- the circled area around Kaula.

5 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, USASMDC/ARSTRAT determined that the proposed action was likely to adversely affect the 11 marine UES consultation species listed in Table 1.

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 5.1 through 5.11.4 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 6).

5.1 *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]). This species is now a candidate for listing under the ESA and is therefore protected under the UES. NMFS is currently conducting a Status Review for the species per the ESA standards.

Pocillopora meandrina is in the family Pocilloporidae. 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).

5.1.1 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.

5.1.2 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.

5.1.3 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.

5.1.4 Conservation of the Species

Pocillopora meandrina is considered an ESA proposed species and has been retained as a consultation species under the UES.

5.2 *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.

5.2.1 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).

5.2.2 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).

5.2.3 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.

5.2.4 Conservation of the Species

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

5.3 *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.

5.3.1 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. ploystoma* is reported as uncommon to common (Veron 2014).

Within the area potentially impacted at Illeginni, *A. ploystoma* 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).

5.3.2 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).

5.3.3 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.

5.3.4 Conservation of the Species

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

5.4 *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.

5.4.1 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).

5.4.2 Life History Characteristics Affecting Vulnerability to Proposed Action

C. agassizi is 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).

5.4.3 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 light 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.

5.4.4 Conservation of the Species

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

5.5 *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.

5.5.1 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).

5.5.2 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 vice drifting in the plankton (Brainard et al. 2011).

5.5.3 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.

5.5.4 Conservation of the Species

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

5.6 *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.

5.6.1 Distribution and Abundance

The reported range of *P. venosa* extends down the eastern shore of the Saudi Arabian, 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).

5.6.2 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).

5.6.3 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.

5.6.4 Conservation of the Species

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

5.7 *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.

5.7.1 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).

5.7.2 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).

5.7.3 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.

5.7.4 Conservation of the Species

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

5.8 *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).

5.8.1 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).

5.8.2 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.

5.8.3 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.

5.8.4 Conservation of the Species

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

5.9 *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).

5.9.1 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).

5.9.2 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, *Symbodinium*.

5.9.3 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).

5.9.4 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.

5.10 *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).

5.10.1 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).

5.10.2 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, *Symbodinium*.

5.10.3 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).

5.10.4 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.

5.11 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.

5.11.1 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); thus, a total of eight adult individuals might be exposed to potential MMIII impacts in this region. 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 ARRW impacts to humphead wrasse eggs and developing larvae (NMFS 2014a).

5.11.2 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.

5.11.3 Threats to the Species

The ERA team 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 effect on species risk of extinction.

5.11.4 Conservation of the Species

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

6 Environmental Baseline

The UES does not specifically describe the environmental baseline for a biological opinion. However, under the ESA, the environmental baseline includes: past and present impacts of all State, Federal, or private actions and activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone 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 within a biological opinion is to provide the context for the effects of the proposed action on the 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 9).

Figure 9. Illeginni Islet, RMI

The Marshall Islands consist of 29 atolls and 5 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 8 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 eleven 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 would result in up to up to 10,417 colonies of UES consultation corals (as quantified in table 7) could experience complete mortality, up to four top shell snails may be killed by the proposed action, and up to 90 clams, and 108 humphead wrasses could be injured or killed by the proposed action. 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 Air-launched Rapid Response Weapon (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 would result in up to 10,417 colonies of UES consultation corals could experience complete mortality, up to four top shell snails may be killed by the proposed action, and up to 90 clams, and 108 humphead wrasses could be 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.

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).

7 Effects of the Action

In this section of a biological opinion, we assess the probable effects of the proposed action on UES-protected species. Effects of the Action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that would be added to the environmental baseline. Direct effects are caused by exposure to the action related stressors that occur at the time of the action. Indirect effects are those that are likely to occur later in time, but are still reasonably certain to occur (50 CFR 402.02). 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 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.

7.1 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: exposure to elevated noise levels; impact by falling missile components; exposure to hazardous materials; disturbance from human activity and equipment operation; and 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 2 are unlikely to be adversely affected, and therefore considered no further in this Opinion. In summary, the 7 coral species, top shell snail, and two giant clams, and the humphead wrasse identified in Table 1 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.

7.2 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 FE-2 flight test 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 likely over-estimates the number of coral and mollusk species that may be within the action area at Illeginni, but that it 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, and THAAD impact area and hence the FE-2 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 payload impact (US Navy 2017) 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 Affect 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 affect 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.

As described above in Sections 2 and 3, there is a chance that the FE-2 flight test 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, 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). The USASMDC/ARSTRAT estimates that an area equal to 15,557 yd^2 (13,008 m^2) could be affected by ejecta impact along either shore (Figure 10). 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 professional judgement of the NMFS survey divers, up to 80% of the area potentially affected by ejecta, 12,445 yd^2 (10,406 m^2), is suitable habitat for the consultation species (Kolinski 2014 in USASMDC/ARSTRAT 2015). Similarly, approximately 9,756 m^2 (0.004 mi^2; 75%) of the ocean-side affected area is considered to be potentially viable habitat for consultation fish, coral and mollusk species (S. Kolinski, NMFS-PIRO, pers. comm. 2014). Since the debris fall affect area is larger than the shock wave affect area, we calculated the effects of the action based on the debris fall/ejecta area. Although the exact shape of the affected area is impossible to pre-determine, the seaward portion of such an area is conceptually illustrated as a rough semi-circle on the lagoon and ocean sides of Illeginni with a radius of 300ft (Figure 10).

Figure 10. 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 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. Also, the area within the shockwave 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 effects that would extend outward from the point of strike. On both sides of Illeginni Islet, the area may potentially be affected 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 affect 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.

The aerial extent of potential debris fall effects on the lagoon and ocean sides of Illeginni were calculated to be 13,008 m2. Each of these areas would be subject to potential debris fall based on debris fall distance analyses for similar impacts of the MMIII (USAFGSC and USASMDC/ARSTRAT 2015) and the FE-1 payload (US Navy 2017a). Based on the best professional judgment of NMFS survey divers, approximately 80% or 10,406 m2 of the lagoon-affected area is considered potentially viable habitat for consultation fish, corals, and mollusks (NMFS-PIRO 2017). Similarly, approximately 75% or 9,756 m2 (11,668 yd2) of the ocean-side affected area is considered potentially viable habitat for consultation fish, coral, and mollusk species (NMFS-PIRO 2017).

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 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 shockwave effects by a payload land impact at Illeginni Islet (Table 9).

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

Scientific Name	Species	Colonies or Individuals Affected
Corals		
Acropora microclados	No Common Name	17
A. polystoma	No Common Name	17
Cyphastrea agassizi	No Common Name	14
Heliopora coerulea	No Common Name	4,683
Pavona venosa	No Common Name	14
Turbinaria reniformis	No Common Name	14
Pocillipora meandrina	Cauliflower coral	5,658
Mollusks		
Tectus niloticus	Top Shell Snail	4
Hippopus hippopus	Giant clam	63
Tridacna squamosa	Giant clam	12
Fish		
Cheilinus undulates	Humphead wrasse	108 (8 adults/100 juveniles)

7.3 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 FE-2 payload and/or ejecta.

Redacted for Operational Security Concerns

[redacted]

The intensity of the payload impact, and the uniformity of exposure to ejecta and the shockwave 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 shockwave. 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 shockwave.

The response of corals to ejecta and the ground borne shockwave 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 shockwave 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 shockwave 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 numbers of 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 effects of exposure to ejecta and shockwave 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 shockwaves 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 shockwave 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 at 7.2, 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 shockwave 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 5), 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 shockwaves would likely be similarly restricted to the area along the water's edge. Therefore, we expect that 4 top shell snails 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 effects of exposure to ejecta and shockwave 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 shockwaves 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 shockwave 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 at 7.2, 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 shockwave 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 (see Section 5), 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 shockwaves would likely be similarly restricted to the area along the water's edge. Therefore, we expect that 75 clams 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 humphead wrasse, the USASMDC/ARSTRAT estimated that there will be up to 100 juvenile, and eight adult humphead wrasses in the area of impact pictured in Figure 10 (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 at that personal observations from NMFS biologists familiar with the species, documented observations on deep dives and 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. It is unlikely that any humphead wrasse will be actually be contacted by ejecta.

7.4 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.

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

As described in the exposure analyses above, up to 10,404 colonies of 7 UES-consultation coral species (Table 9) 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 shockwave. The USASMDC/ARSTRAT plans just one FE-2 flight test 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 10,404 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 shockwave 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.

7.4.2 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 4 top shell snails could experience mortality as the result of a single direct payload impact, ejecta, and ground based shockwave. 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, these 4 top shell snails 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 shockwave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

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

As described in the exposure and response analyses above, we expect up to 63 *H. hippopus* and 12 *T. squamosa* clams could experience mortality as the result of a single direct payload impact, ejecta, and ground based shockwave. 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 75 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 shockwave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

7.4.4 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 shockwave, 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 shockwave would eliminate this species at USAKA, or appreciably reduce the likelihood of its survival and recovery at USAKA and across their global range.

8 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.

9 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. 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 7.

9.1 Corals

As described in the Effects of the Action section, a total of up to 10,404 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; *Pocillopora meandrina* and *Heliopora 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 fisheries interactions, direct take, and climate change are expected to continue and likely worsen in the future for these corals. However, the impact and time scale of these effects on the trajectory of the affected coral populations at USAKA, and across Oceania is currently uncertain, and those impacts are expected to occur on a time scale against which the impacts of the proposed action would be indistinguishable.

The proposed action is anticipated to result in the mortality of up to 10,404 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. 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.

9.2 Top Shell Snail

As described in the Effects of the Action section, a total of up to 4 top shell snails 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 coastal development, direct take, and climate change are expected to continue and likely worsen in the future for this species. However, the impact and time scale of these effects on the trajectory of the affected top shell snail populations at USAKA is currently uncertain, and those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

The proposed action is anticipated to result in death of up to four top shell snails at Illeginni. The affected snails 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. The potential loss of four 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.

9.3 Giant Clams

As described in the Effects of the Action section, a total of up to 75 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 coastal development, direct take, and climate change are expected to continue and likely worsen in the future for this species. However, the impact and time scale of these effects on the trajectory of the affected giant clam populations at USAKA is currently uncertain, and those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

The proposed action is anticipated to result in death of up to 75 giant clams (63 *H. hippopus* and 12 *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. 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.

9.1 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 coastal development, direct take, and climate change are expected to continue and for climate change in particular expect to worsen in the future. However, the impact and time scale of these effects on the trajectory of the humphead wrasse population at USAKA is currently uncertain, and those impacts are expected to occur on a time scale, against which the impacts of the proposed action would be indistinguishable.

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. 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.

10 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 USASMDC/ARSTRAT's implementation of the FE-2 experimental flight test 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. As described above in Section 3 and 4, 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 4, designated critical habitat has been identified near the launch site in the MHI for Hawaiian monk seals and MHI insular false killer whales. NMFS concludes the proposed action will have no adverse effects for Hawaiian monk seal critical habitat; and may affect, but is not likely to adversely affect or modify designated critical habitat for the MHI insular false killer whale.

11 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. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. 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.

11.1 Anticipated Amount or Extent of Incidental Take

Based on the analysis in the accompanying Opinion we conclude that the FE-2 flight test at the USAKA RTS, would result in the take of 7 species of UES consultation corals, top shell snails, humpback wrasse, and two clam species. As described above in the exposure and response analyses, we expect that up to 10,404 colonies of UES consultation corals (as quantified in Table 10) could experience complete mortality, up to 4 top shell snails, 108 humphead wrasse, and up to 75 clams could be killed by the proposed action.

Table 10. Expected Take of Marine UES consultation species due to FE-2 flight test

Scientific Name	Species	Colonies or Individuals Affected
Corals		
Acropora microclados	No Common Name	17
A. polystoma	No Common Name	17
Cyphastrea agassizi	No Common Name	14
Heliopora coerulea	No Common Name	4,683
Pavona venosa	No Common Name	14
Turbinaria reniformis	No Common Name	14
Pocillipora meandrina	Cauliflower coral	5,658
Mollusks		
Tectus niloticus	Top Shell Snail	4
Hippopus	Giant clam	63
Tridacna squamosa	Giant clam	12
Fish		
Cheilinus undulates	Humphead wrasse	108 (8 adults/100 juveniles)

11.2 Effect or 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.

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

11.4 Terms and Conditions

The USASMDC/ARSTRAT 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 USASMDC/ARSTRAT shall ensure that their personnel comply fully with the best management practices and conservation measures identified in the BA and below.
    a. The USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT shall assign appropriately qualified personnel to record all suspected incidences of take of any UES-consultation species.
    b. The USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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.

12 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 5 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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 USASMDC/ARSTRAT 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.
   a. Acquire required permits and training to perform necropsies and/or to take and transport tissue samples.
   b. Develop professional relations with qualified federal agencies and universities to capitalize on samples and information gained at USAKA.
   c. Develop mechanisms to collect and disseminate the information.

Reinitiation Notice

This concludes formal consultation on the implementation of the FE-2 flight test 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.

13 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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.

13.1 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 USASMDC/ARSTRAT. Other interested users could include the citizens of RMI, USFWS, and NOAA. Individual copies of this Opinion were provided to the USASMDC/ARSTRAT. The format and naming adheres to conventional standards for style.

13.2 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.

13.3 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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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

Mark Hubbs
Environmental Engineer
U.S. Army Space and Missile Defense Command/
Army Forces Strategic Command (USASMDC/ARSTRAT)
PO Box 1500
Huntsville, AL 35807-3801

July 29, 2019

Dear Mr. Hubbs:

The U.S. Fish and Wildlife Service (Service) received your request for concurrence for nesting sea turtle and listed birds dated June 14, 2019 for flight tests of Flight Experiment-2 (FE-2). In addition, we received your biological assessment and request for concurrence on the consultation of four species of birds (*Pterodroma sandwichensis*, *Phoebastria albatrus*, *Puffinus auricularis newelli*, and *Oceanodroma castro*) and five species of sea turtles (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*). The NPA includes up to four impacts within 2 years associated with the ARRW testing to demonstrate and collect data on key technologies, such as thermal control, precision navigation, guidance, control, and enabling capabilities of the ARRW vehicle and development payload during hypersonic flight.

The Biological Assessment (BA) analysis of possible effects to Newell's shearwater (*Puffinus auricularis newelli*) in the broad ocean area (BOA) are explained and demonstrate very unlikely effects to individual birds. In the event that a listed seabird was in the splashdown area of the broad ocean area (BOA), the bird would probably exhibit a startle reflex, which would not likely adversely affect the individual. Similarly, the possibility of direct contact with a listed seabird is remote. Within the impact area, we consider the only sea turtles potentially present to be the Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata*). The others (*Caretta caretta*, *Dermochelys coriacea*, and *Lepidochelys olivacea*) have not been sighted around or on Illeginni and would therefore would not likely be subject to any adverse affect.

Conservation Measures

The following conservation measures are provided based on the information provided within the January 29, 2019 BA as well as the previous consultation for the U.S. Navy Strategic Systems Programs' Flight Experiment-1 (FE-1) on Green and Hawksbill sea turtles and Newell's Shearwater. The following avoidance and minimization measures are considered part of the project description:

- If personnel observe sea turtles in or near potential impact zones, sightings will be reported to appropriate test and USAG-KA personnel for consideration in launch planning.
- Vessel and equipment operations will not involve any intentional discharges of fuel, toxic waters, or plastics and other solid wastes that could harm terrestrial or marine life.
- Hazardous materials will be handled in adherence to the hazardous materials and waste management systems of USAG-KA. Hazardous waste incidents will comply with the emergency procedures set out in the Kwajalein Environmental Emergency Plan (KEEP) and the UES.
- All equipment and packages shipped to USAG-KA 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 test launch, Illeginni Islet will be surveyed by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests on a bi-weekly basis. If possible personnel will inspect the area within two days of the launch. If sea turtles or sea turtle nests are observed near the impact area, observations will be reported to appropriate test and USAG-KA personnel for consideration in approval of the launch and to NMFS and the Service.
- 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 and USFWS.
- Debris recovery and site cleanup will be performed on land. Recovery and cleanup will 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, a Service or NMFS biologist will be allowed to provide guidance and or/or assistance in recovery operations to minimize impacts on such resources.
- Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel will be reported to the USAG-KA Environmental Office and USASMDC, who will then inform NMFS and the Service. USAG-KA aircraft pilots otherwise flying in the vicinity of the impact and test support areas will also similarly report any opportunistic sightings of dead or injured marine mammals or sea turtles.
- As soon as practical following payload impact at Illeginni Islet, qualified biologists will be allowed to assist in recovering and rehabilitating any injured sea turtles found.
- During post-test recovery and cleanup, should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work will be delayed until such species were out of harm's way or leave the area.
- To minimize impacts during post-flight operations, the Service and NMFS will be allowed to provide guidance and/or assistance during recovery and cleanup at Illeginni Islet. In all cases, recovery and cleanup operations will be conducted in a manner to minimize further harm to biological resources.

Summary

After reviewing the new information provided, we have concluded that the location of the target site is clear of the shoreline, however, payload impact debris and ejecta could impact adjacent sandy shoreline. While Illeginni Islet has shoreline habitat that a sea turtle could successfully lay a nest, a significant portion of the habitat is submerged or inundated during high tide events; thus drowning any sea turtle nests that may be present. In addition, any turtle nesting or terrestrial activity sign that could identify any nesting or terrestrial behaviors would be washed away if they are below the high tide line.

Based on the proposed action, information provided in your January 29, 2019 BA, and the minimization measures included within this letter, it is not probable the proposed action will impact sea turtle(s), Newell's shearwater(s) (*Puffinus auricularis newelli*). Therefore, the Service has determined any effects are discountable and not likely to adversely affect the sea turtles (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*) and their nests, or the Newell's shearwater (*Puffinus auricularis newelli*). Therefore, the Service concurs with your determination that the proposed test flight may effect, but is not likely to adversely affect, the sea turtles (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*) and their nests and the Newell's shearwater (*Puffinus auricularis newelli*).

This letter does not cover any action taken at Kauai Test Facility (KTF) Pacific Missile Range Facility (PMRF). We recommend you working with the PMRF for any ESA issues associated with the launch. It is our understanding that they are currently covered under the Biological Opinion (2015-F-0227).

Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to Section 3-4.5 of the UES and Section of the ESA is necessary.

If you have questions regarding this concurrence, please contact Aquatic Ecosystem Conservation Program Coordinator Dan Polhemus (Dan_Polhemus@fws.gov or 808-792-9400). For specific comments on terrestrial resources, please contact Environmental Toxicologist Michael Fry (Michael_Fry@fws.gov or 808-792-9461). For specific comments on marine resoures, please contact Marine Biologist Tony Montgomery (Tony_Montgomery@fws.gov or 808-792-9456.

Sincerely,

Dan Polhemus
Aquatic Ecosystem Conservation Program Coordinator

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APPENDIX C

NMFS BIOLOGICAL OPINION
AND
USFWS LETTER OF CONCURRENCE
(FT-3)

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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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1. 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.

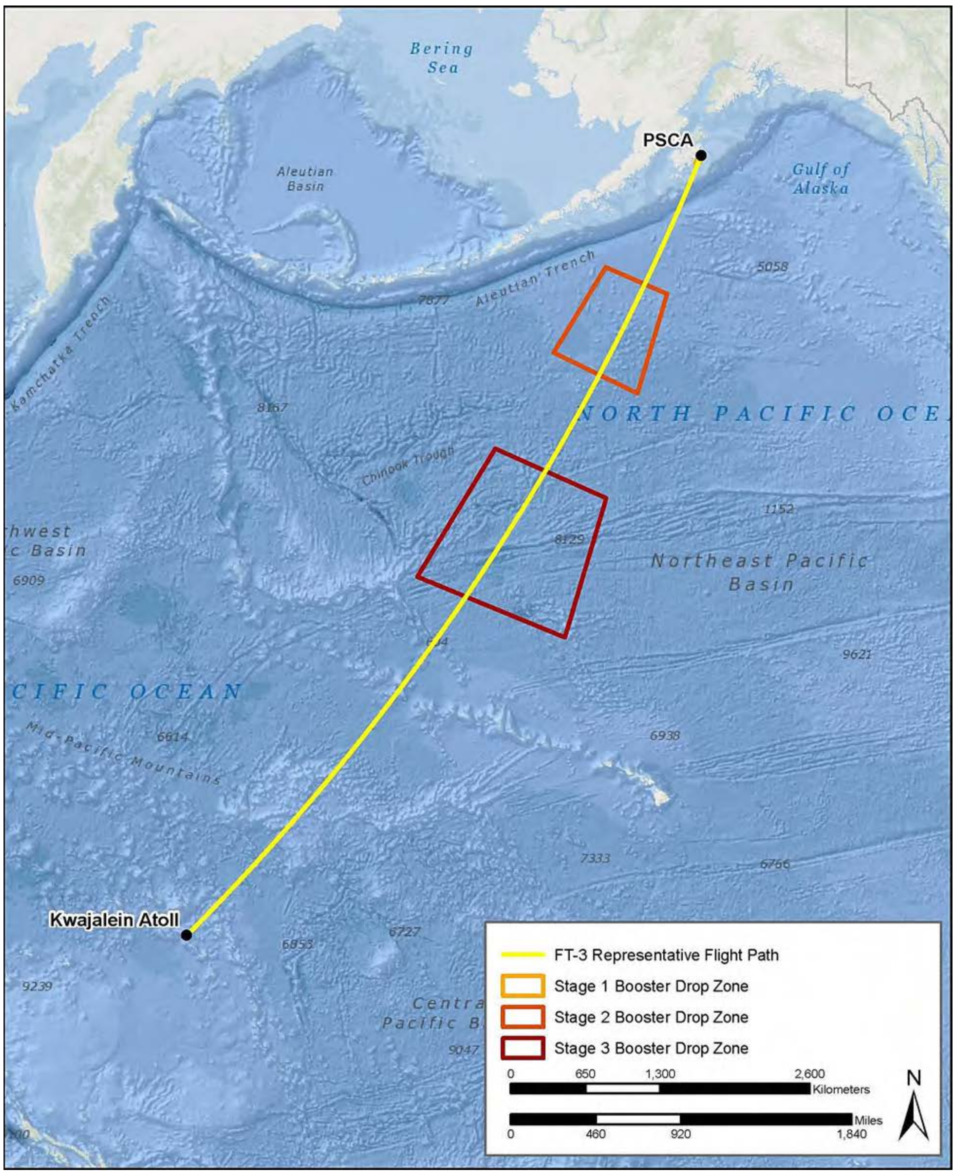

Figure 1. Flight Test-3 (FT-3) Representative Flight Path (image provided by the U.S. Army).

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) 36 consultation species (Table 1), and likely to adversely affect (LAA) the 10 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 Mammals					
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	Melon-Headed Whale		X		

Scientific Name	Species	ESA	MMPA	CITES	RMI
electra					
Physeter macrocephalus	Sperm Whale	Endangered	X	X	X
Eschrichtius robustus	Western North Pacific Gray Whale DPS				
Eubalaena japonica	North Pacific Right Whale				
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

Component	Representative Launch Vehicle (not to scale)	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)

Sources: MDA 2007, MDA 2019a, MDA 2019b

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

	Launch Vehicle	Payload [a]
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

Sources: USASMDC/ARSTRAT 2014, U.S. Army 2020.

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.

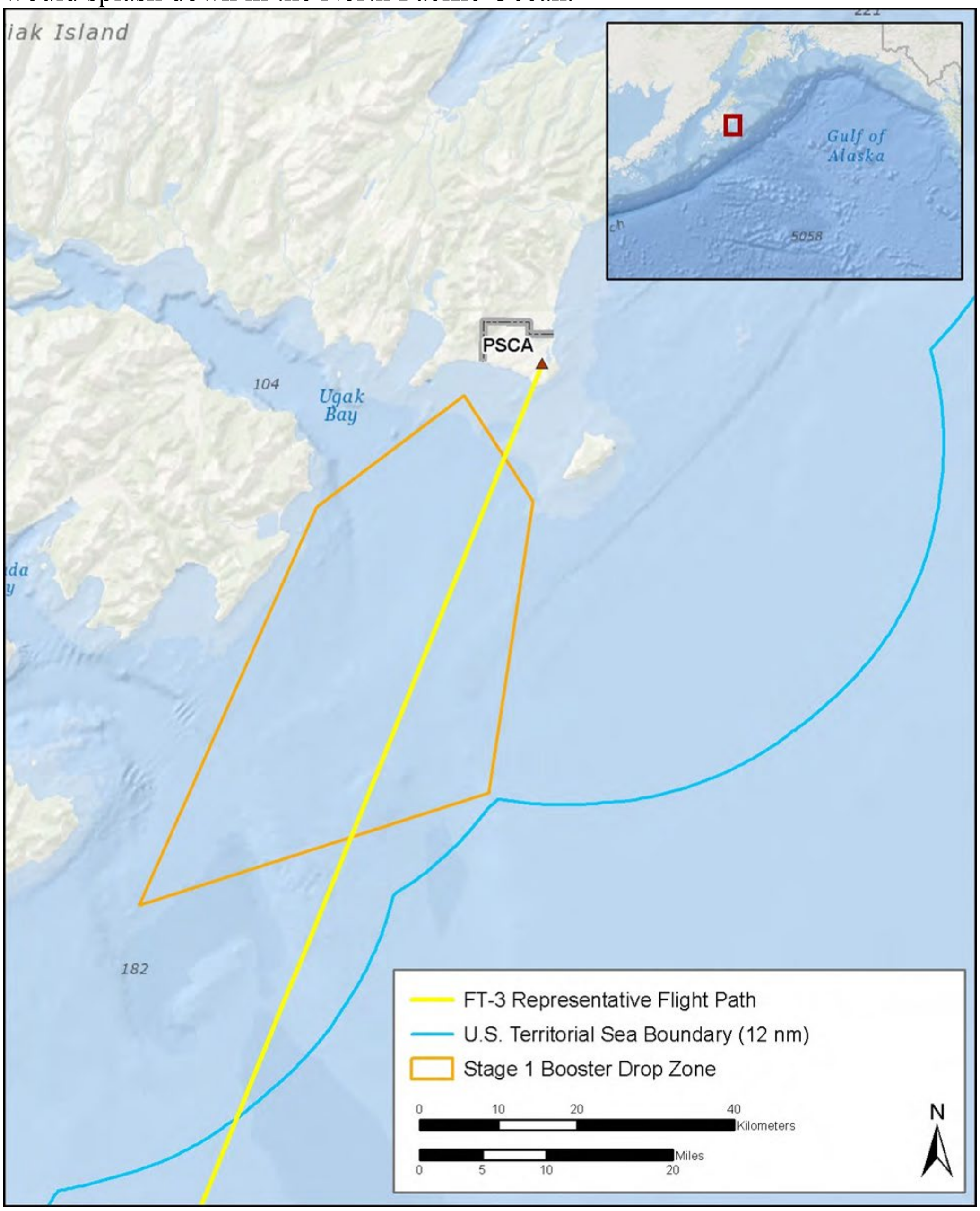

Figure 2. FT-3 Representative Flight Path and Stage 1 Booster Drop Zone.

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.

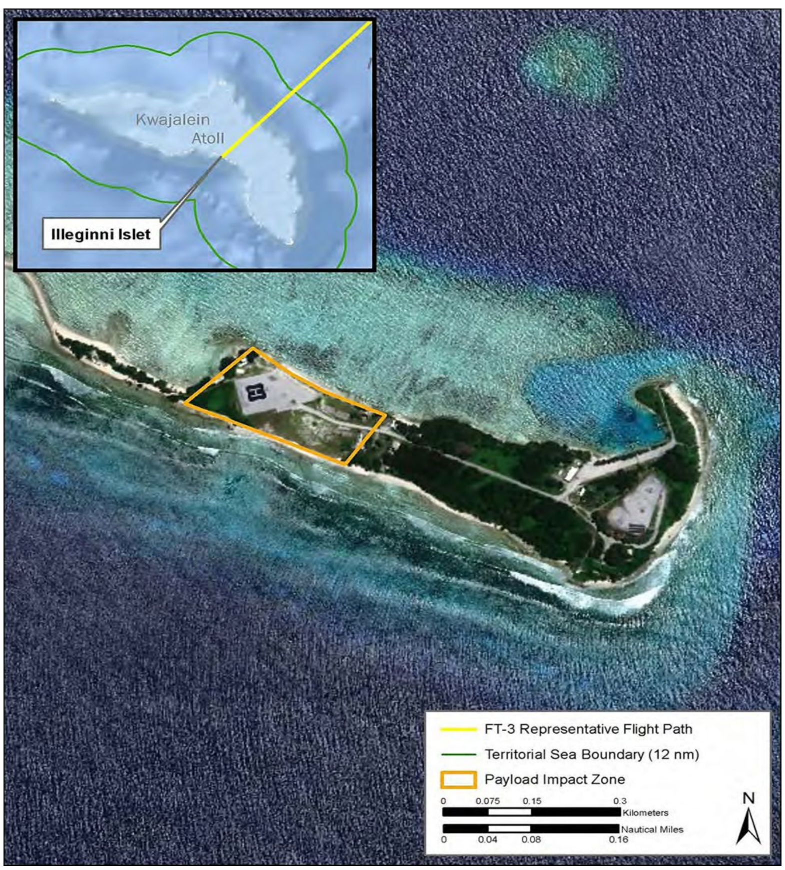

Figure 3. Representative Flight Path and Payload Impact Location, Illeginni Islet, Kwajalein Atoll, Republic of the Marshall Islands.

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 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.

Over-Ocean Flight: 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.

Terminal Flight and Reentry Vehicle Impact in the RMI: 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

[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."

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. 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.

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.
Source: Finneran and Jenkins 2012; Popper et al. 2014; NMFS 2016.

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

b. Impact by falling missile components: 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 Zone			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)		0.0098	9.7E-08	5.9E-06	0.0001	1.0E-09	1.5E-07	ND		
Western North Pacific DPS(5)		0.0005	4.6E-09	2.8E-07	0.00001	5.0E-11	7.0E-09	ND		
Physeter macrocephalus	Sperm whale	0.0030	-	1.1E-06	0.0030	-	3.8E-06	0.0014	-	4.2E-07
Pinnipeds										
Eumetopias jubatus	Steller sea lion									
Western DPS		0.0098	-	2.2E-06	0.0098	-	5.6E-06	-	-	-

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.

f. Collision with vessels: 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.

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).

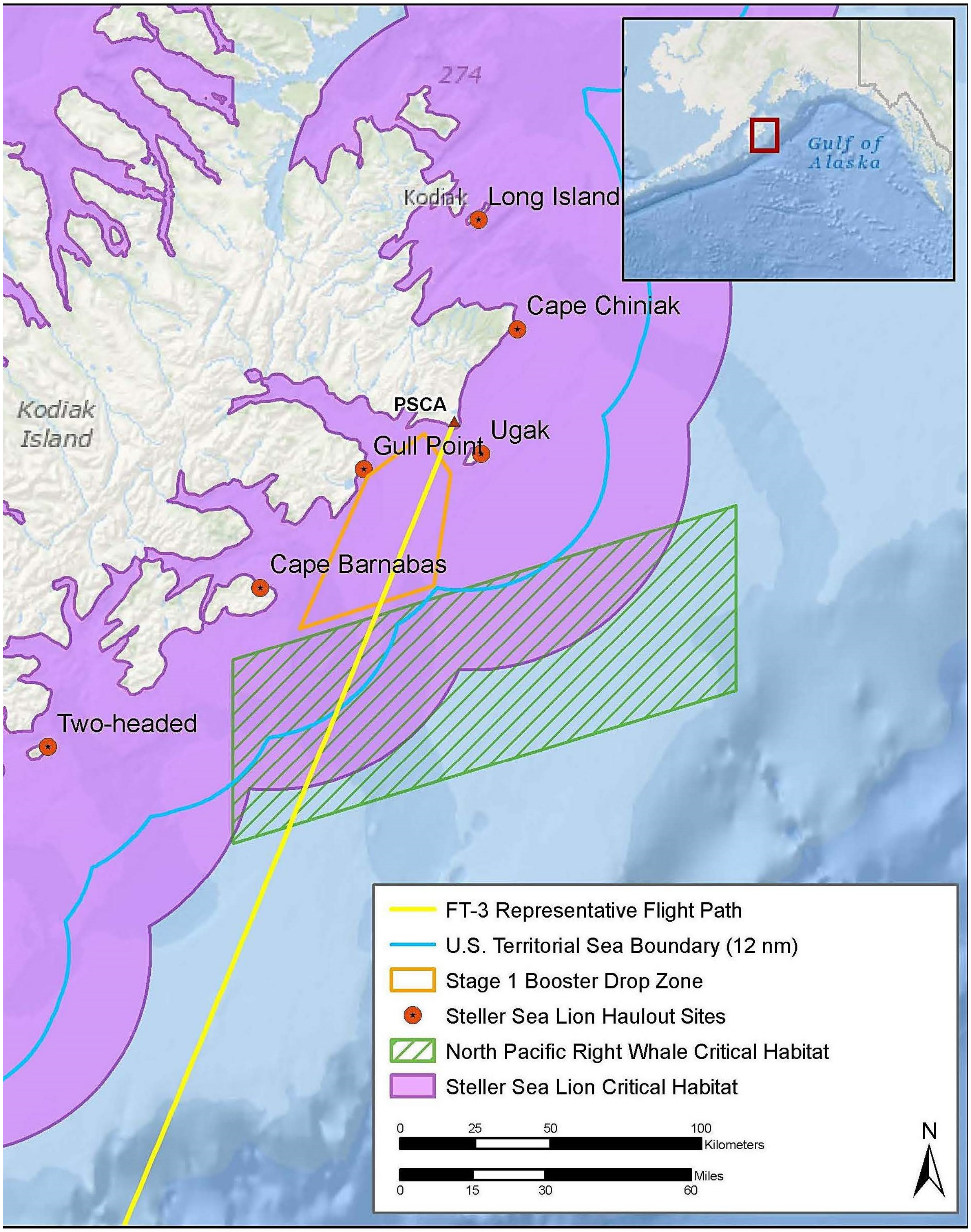

Figure 5. Representative Stage 1 Spent Motor Drop Zone near PSCA and designated Steller Sea Lion Critical Habitat (provided by U.S. Army).

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° 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.

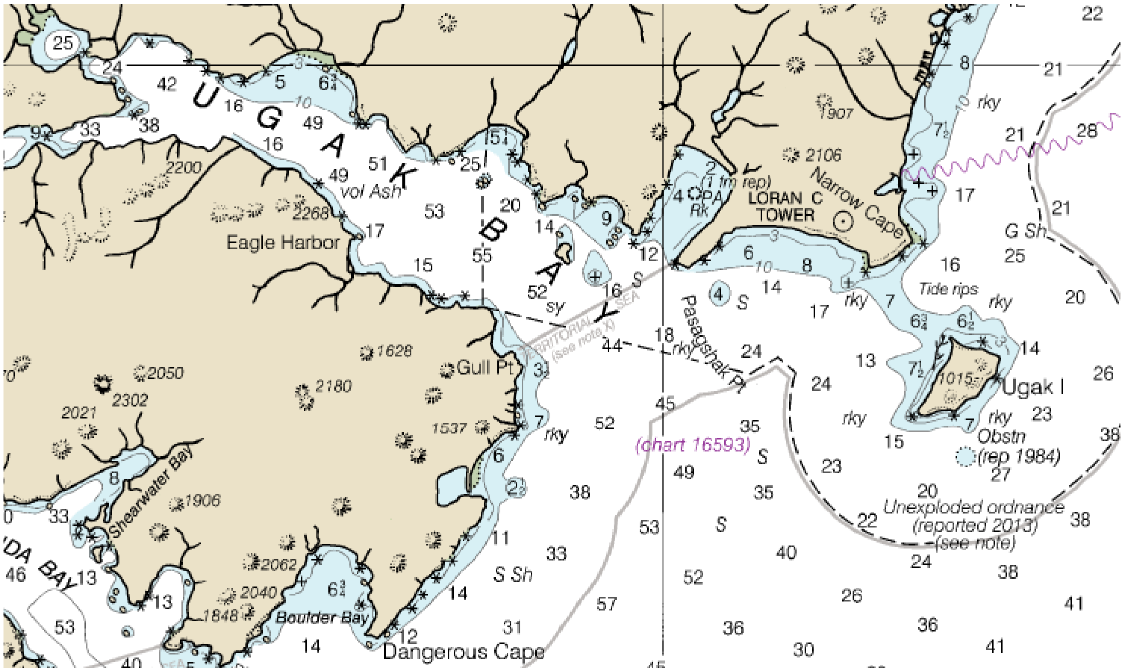

Figure 6. Water depths (measured in fathoms).

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 Pocilloporidae. 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).

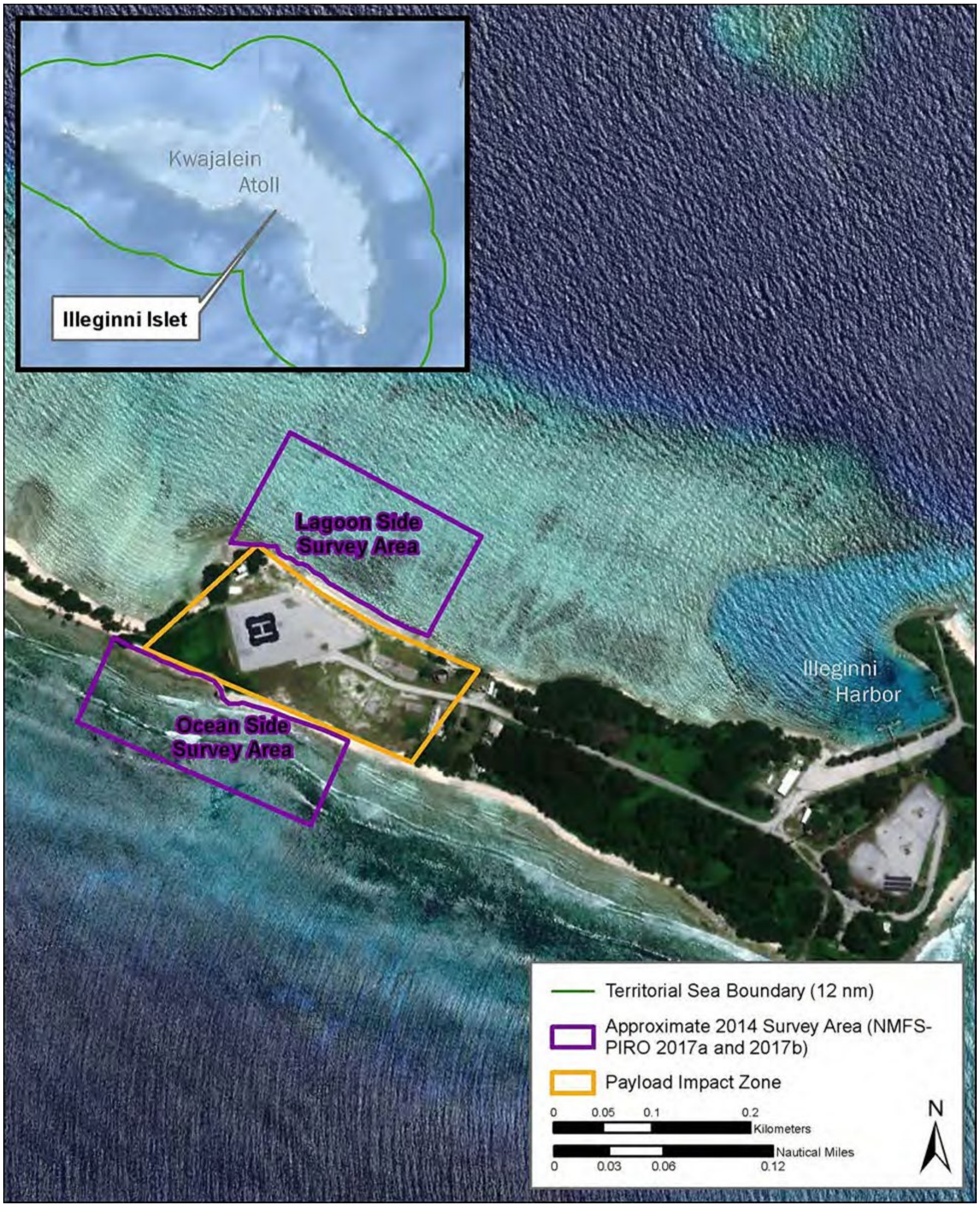

Figure 8. NMFS 2014 Marine Resource Survey Areas at Illeginni Islet, Kwajalein Atoll (provided by U.S. Army).

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 numbers of consultation coral colonies, 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.

1.1 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.

2 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.

3 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.

3.1 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 test

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

Scientific Name	Species	Colonies or Individuals Affected
	Fish	
Cheilinus undulates	Humphead wrasse	108 (8 adults/100 juveniles)

3.2 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.

3.3 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.

3.4 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.

4 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.

4.1 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.

5 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.

5.1 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.

5.2 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.

5.3 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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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaiʻi 96850

October 13, 2020

Mr. David Fuller
U.S. Army Space and Missile Defense Command
SMDC-ENE
Post Office Box 1500
Huntsville, AL 35807-3801

Subject: U. S. Fish and Wildlife Service comments on the Coordinating Draft Environmental Assessment / Overseas Environmental Assessment (EA/OEA) for Hypersonic Flight Test 3 (FT-3)

Dear Mr. Fuller:

The U.S. Fish and Wildlife Service (Service) is in receipt of the request from U.S. Army Space and Missile Defense Command (SMDC) for review and comment on the Coordinating Draft Environmental Assessment / Overseas Environmental Assessment (EA/OEA) for the Hypersonic Flight Test 3 (FT-3) dated 22 September 2020. The Service appreciates the opportunity to review this document, and commends SMDC for the protections to be given to black-naped terns and sea turtles, as explained in Sections 2.5.4.1, 4.3.1.2 and Table 4-7. Our remaining comments and concerns, provided below, center primarily around the potential for heavy metal contamination of ground water and air at the impact site.

Groundwater Quality. Section 3.3.4. This section provides summary results of expected and measured ground water tungsten concentrations following the FE-1 and FE-2 tests. The tungsten concentration of 0.65 mg/l significantly exceeds the EPA Residential Regional Screening Level (RSL) level for potable water of 0.016 mg/L. Modelling done by Lawrence Livermore National Laboratories additionally predicted tungsten concentrations to reach 25 mg/l. "Based on the original model dimensions, 2.5 m/yr rainfall precipitation rate, and an equilibrium tungsten concentration of 25 mg/L, all tungsten would be predicted to migrate away from the original location within a year" (LLNL, 2018).

The Service is concerned with possible unknown toxicity effects on adjacent reef organisms including coral and coral larvae, which would be subjected to elevated levels of tungsten migrating into the lagoon and ocean adjacent to the impact sites of the FE-1, FE-2, and proposed FT-3 tests. Although the reported amount of tungsten in the FT-3 payload will not exceed 45 kg, the additional tungsten in groundwater may pose a hazard for reef invertebrates. The NPA for FE-2 explains in Section 4.3 that water sampling wells have been installed on Illeginni Islet and will be sampled every 3 to 6 months for metals to include tungsten. The Service is requesting continuation of these monitoring tests, and requests results of these groundwater samples to assist in our ongoing toxicity testing with species of corals and coral larvae that could be impacted by groundwater migration into the lagoon or ocean adjacent to the test impact site. The Service request the inclusion of a discussion of this in Section 3.3.4

In addition to tungsten in the payload vehicle, tantalum is included in the list of metals, although the quantity is not given. Tantalum has a lower melting point (3017^{o} C) compared to tungsten (3400^{o} C) and could be expected to vaporize and enter the air and groundwater as well. The Service requests adding tantalum to the list of metals to be analyzed in groundwater. Additionally, tantalum vapor in the air exceeding 2.5 g/m^3 is classified as immediately dangerous to life and health (CDC-NIOSH 2015). Because tantalum is listed as a Toxic Substances Control Act (TSCA) chemical, OSHA has a permissible exposure limit (PEL) of 5 mg/m^3. A safety precaution should be included in Section 2.5.6.1 under hazardous materials to protect the initial UXO personnel entering the site after impact if winds are calm. The Service recommends that a similar precautionary statement could be included in Section 3.3.3 Public Health and Safety or Section 3.3.4 Hazardous Materials if the expected concentrations of tantalum vaporized in air would exceed these limits. The Service could find no information on tantalum exposure to wildlife.

The coral toxicity testing being conducted by the University of Hawaii includes only a subset of the marine species listed in the UES Consultation and Coordination Tables in Appendices 3-4A and 3-4C. The marine resources covered under the coordination procedures include all corals (black coral, stony corals, organ-pipe corals, fire corals, and lace corals) as well as the giant clam (*Tridacna maxima*), certain conchs (*Lambis lambis, Lambis scorpius, and Lambis truncata*), certain fish (*Plectropomus laevis* and *Epinephelus lanoceolatus*), the coconut crab (*Birgus latro*), and sea grass (*Halophila gaudichaudii*). There is a high likelihood some of these species will be present within the vicinity of Illeginni and could be impacted, although no data exist evaluating the toxicity of tungsten or tantalum to these marine organisms.

Finally, because the Service is responsible for the protection of sea turtles on land and sea turtle nests. All preflight monitoring reports of sea turtles on land or sea turtle nests should be reported to the Service.

We appreciate the opportunity to provide comments as well as concurrence on this Final DEP and NPA. If you have questions regarding our comments, please contact our Aquatic Ecosystem and Environmental Contaminants Program Manager, Dan Polhemus (dan_polhemus@fws.gov or 808-792-9400). For specific comments regarding coral toxicity testing, please contact

Environmental Toxicologist Michael Fry (michael_fry@fws.gov or 808-792-9461). For specific comments regarding marine resources, please contact marine biologist Jeremy Raynal (jeremy_raynal@fws.gov).

Sincerely,

Dan Polhemus

Aquatic Ecosystem and Environmental
Contaminants Program Manager

Reference:

CDC_NIOSH 2015. Pocket Guide to Chemical Hazards, https://www.cdc.gov/niosh/npg/

From: Polhemus, Dan <dan_polhemus@fws.gov>
Sent: Friday, January 22, 2021 3:34 PM
To: Fuller, David G CIV USARMY SMDC (USA)
Cc: Cooper, Douglass; Kolinski, Steven P CIV (USA); McCarroll.John@epa.gov; kanalei.shun@usace.army; milmorianaphillip.rmiepa@gmail.com; Wes Norris; Karen Hoksbergen; Hasley, David C CIV USARMY SMDC (USA); Raynal, Jeremy M; Fry, Michael
Subject: Re: [EXTERNAL] FT3 USFWS Pacific Islands Informal Consultation Letter (UNCLASSIFIED)
Attachments: USFWS FT-3 Comments - 13 Oct. 2020.pdf

David -

We sent a letter with comments and concurrence on the FT-3 to your office on 13 October 2020 (see attached).

There is a possibility that the DOD firewall or other security software intercepted the message containing this attachement, and that as a result it never got to you. We were having a variety of similar problems in communicating with other DOD commands, particularly in the Mariana Islands, at around this same time. As with this case, we only tend to find out about these lost communications well after the fact, since we never receive any indication of non-delivery on our end. From what I understand, DOI and DOD staff at the DC level have been working to address this problem.

In addition, if the above letter needs to be slightly reformatted to indicate it is addressing the UES process we can easily do that, but the comments and concurrence will remain the same, so presumably the above letter can suffice in its present form.

- Dan Polhemus

Dr. Dan A. Polhemus
Pacific Islands Fish and Wildlife Office
U. S. Fish and Wildlife Service
Honolulu, HI 96850 USA

From: Fuller, David G CIV USARMY SMDC (USA) <david.g.fuller6.civ@mail.mil>
Sent: Friday, January 22, 2021 8:52 AM
To: Polhemus, Dan <dan_polhemus@fws.gov>
Cc: Cooper, Douglass <douglass_cooper@fws.gov>; Kolinski, Steven P CIV (USA) <steve.kolinski@noaa.gov>; McCarroll.John@epa.gov <McCarroll.John@epa.gov>; kanalei.shun@usace.army <kanalei.shun@usace.army>; milmorianaphillip.rmiepa@gmail.com <milmorianaphillip.rmiepa@gmail.com>; Wes Norris (norrisw@kfs-llc.com) <norrisw@kfs-llc.com>; Karen Hoksbergen <HoksbergenK@kfs-llc.com>; Hasley, David C CIV USARMY SMDC (USA) <david.c.hasley.civ@mail.mil>
Subject: RE: [EXTERNAL] FT3 USFWS Pacific Islands Informal Consultation Letter (UNCLASSIFIED)

Dr. Polhemus,

When can we expect to receive a letter of concurrence regarding the FT-3 informal consultations? We are working on the Preliminary Final EA due first of next month and we need the FWS concurrence letter.

Thank you,
David

David Fuller
NEPA Program Manager
Environmental Division/NEPA Branch
U.S. Army Space & Missile Defense Command
Redstone Arsenal, AL

From: Polhemus, Dan [dan_polhemus@fws.gov]
Sent: Thursday, September 24, 2020 10:30 AM
To: Fuller, David G CIV USARMY SMDC (USA)
Cc: Cooper, Douglass; Kolinski, Steven P CIV (USA); McCarroll.John@epa.gov; kanalei.shun@usace.army; milmorianaphillip.rmiepa@gmail.com; Wes Norris (norrisw@kfs-llc.com); Karen Hoksbergen
Subject: [Non-DoD Source] Re: [EXTERNAL] FT3 USFWS Pacific Islands Informal Consultation Letter (UNCLASSIFIED)

David -

Thank you for the notice of the impending FE-3 flight test and request for informal consultation under the UES.

This item has been assigned to appropriate staff within my program for review and comment, and we will provide you with a response in the near future.

- Dan Polhemus

Dr. Dan A. Polhemus

APPENDIX DC

IMPACT AVOIDANCE AND MINIMIZATION MEASURES FROM THE U.S. ARMY HYPERSONIC NAVY FE-2 FLIGHT EXPERIMENT 3 (FT-3) ENVIRONMENTAL ASSESSMENT/OVERSEAS ENVIRONMENTAL ASSESSMENT

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A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative and impact avoidance are presented in **Table D-1**. Minimization measures for each alternative are presented in **Table D-2**.

Table D-1. Potential Impacts Associated with the No Action Alternative and the Proposed Action

Location	Resource Area	No Action Alternative	U.S. Army RCCTO FT-3 Proposed Action
PSCA	**Air Quality**	There would be no change to baseline air quality and, therefore, no significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.	Within the launch pad area short-term effects of the Proposed Action are anticipated to be high temperature exhaust gases and elevated carbon monoxide concentrations. However, because comparable rocket launches done at PSCA observed a return to ambient conditions within minutes of booster ignition and flight, and environmental studies done at PSCA have shown that chemical exhaust products do not accumulate in surface water or affect the local environment, then it can reasonably be assumed that there would be no significant air quality effects anticipated as a result of the FT-3 flight test.
	Water Resources	There would be no change to baseline water resources, and therefore, no significant impacts to water resources from implementation of the No Action Alternative.	Based on levels previously observed during STARS booster launches, the FT-3 is not anticipated to release levels of aluminum oxide that would cause impacts to water quality. Additionally, because the Proposed Action is for a single launch, levels of aluminum oxide would not be anticipated to accumulate and cause water quality issues. Under normal launch conditions rocket motor emissions would be expected to rapidly disperse to non-toxic levels, based on dilution and buffering from the ocean waters. Similar launches of the STARS booster and Trident I (C4) Target have been analyzed in various environmental documents and have been determined to not have a significant impact on water resources. The implementation of this Proposed Action would not be anticipated to result in significant impacts to water resources.
	Biological Resources	There would be no change to biological resources, and therefore, no significant impacts to biological resources from implementation of the No Action Alternative.	Launch Activities: Based on the characteristics of the FT-3 vehicle, proposed launch activities would be within the parameters of ongoing programmatic launch activities at PSCA. The effects of ongoing launch activities on biological resources at and near PSCA have previously been evaluated and there would be no new or additional impacts to biological resources at PSCA as a result of Proposed Action launch activities. As for other launch activities from PSCA potential impacts of proposed launch activities from PSCA include heat and emissions from vehicle launch and elevated noise levels. There would be no significant impacts to terrestrial vegetation, terrestrial wildlife, marine biological resources, threatened and endangered species, or environmentally sensitive habitats as a result of Proposed Action launch activities or vehicle overflight.

Table D-1. Potential Impacts Associated with the No Action Alternative and the Proposed Action (Continued)

Location	Resource Area	No Action Alternative	U.S. Army RCCTO FT-3 Proposed Action
PSCA	**Biological Resources (Continued)**		Stage 1 Booster Drop Activities: Marine wildlife, including ESA-listed species, have the potential to be injured or otherwise affected by elevated noise levels, direct contact from the falling booster, and exposure to hazardous chemicals. Based on the characteristics of the FT-3 vehicle and vehicle flight and on the expected density of species in the ROI, it is very unlikely that rare or sensitive marine wildlife would struck by the falling booster or exposed to sound loud enough to injure individuals. Overall, stage 1 booster splash down would not significantly impact marine wildlife in the ROI. For ESA-listed species in the ROI, the U.S. Army has concluded that the stage 1 booster drop activities may affect but are not likely to adversely affect ESA-listed cetaceans, pinnipeds, sea turtles, or fish, and would have no effect on ESA-listed seabirds or northern sea otters. The U.S. Army has consulted with NMFS and USFWS and received their concurrence with these determinations. The Proposed Action would not significantly impact designated critical habitats, biologically important areas, or Essential Fish Habitat in the PSCA ROI.
	Airspace	There would be no change to airspace use or control, and therefore, no impacts to airspace from implementation of the No Action Alternative.	Under the Proposed Action, there would be no permanent alterations to airspace resources. NOTAMs would be temporary, and any potentially affected flight plans would either be re-directed or resume after the FT-3 flight test officials and the FAA give permission. PSCA has tested several similar vehicles and is practiced in working with local, state, and federal air safety entities to prevent risks to human health and safety. By following the prescribed safety measures, there would be no unmanageable human-health hazards in the airspace ROI from the Proposed Action.
	Noise	There would be no change to noise sources, and therefore, no impacts from noise resulting from implementation of the No Action Alternative.	Noise analysis from FAA 1996, FAA 2016, and DOD 2017 all concluded that no impacts to the noise environment would occur from launch activities under those Proposed Actions, which included up to nine launches per year. This EA/OEA analyzes a single launch of a similarly sized vehicle, and because no changes have occurred to PSCA's noise receptor environment since the PSCA EA (DOD 2017), it can be determined that the Proposed Action would not result in impacts to the noise receptors.
	Public Health and Safety	There would be no significant change to public health and safety. No significant impacts to public health and safety would result from the No Action Alternative.	PSCA has abundant procedures and policies in place to prevent any threats to public health and safety and can mitigate any potential hazards from a nominal or off-nominal FT-3 launch. The Proposed Action would not introduce materials or operations in the ROI that would cause a potential public or occupational health hazard, nor would the Proposed Action create an unmanageable human health and/or safety hazard in the ROI.
PSCA	**Hazardous Materials and Wastes**	There would be no change to hazardous materials and wastes, and, therefore, no significant impacts from	All applicable state and federal regulations, range operating procedures, and FT-3-specific safety plans would be followed to prevent accidents that could release hazardous materials or waste into the local environment. Although unlikely, should a release of hazardous materials or waste occur, PSCA is capable of mitigating

Table D-1. Potential Impacts Associated with the No Action Alternative and the Proposed Action (Continued)

Location	Resource Area	No Action Alternative	U.S. Army RCCTO FT-3 Proposed Action
		hazardous materials and wastes that would result from implementation of the No Action Alternative.	personnel and environmental health risks by following SOPs and utilizing on-site emergency response teams. The Proposed Action would not be expected to exceed PSCA's ability to manage, store, and dispose of hazardous materials and waste.
Pacific Ocean BOA	**Air Quality**	Under the No Action Alternative, the FT-3 flight test would not occur and there would be no change to baseline air quality in the flight corridor. No significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.	Because the emissions of carbon dioxide, hydrogen chloride, aluminum oxide, and nitrogen oxide from a launch of a comparable STARS booster or Trident I (C4) Target would be relatively small compared to global emissions from industry; the large air volume over which these emissions would be spread; rapid dispersion of the emissions by stratospheric winds; and no apparent EPA NAAQS violations; a single launch of the FT-3 would not have a significant impact on air quality in the Pacific Ocean Flight Corridor.
	Biological Resources	There would be no change to biological resources, and therefore, no significant impacts to biological resources from implementation of the No Action Alternative.	The Proposed Action has the potential to impact marine biological resources in the BOA through elevated noise levels, direct contact from falling vehicle components, and exposure to hazardous chemicals. Marine wildlife and environmentally sensitive habitats would not be impacted by vehicle overflight. Based on available density data for special status marine wildlife in the stage 2 and 3 drop zones, the estimated number of animal exposures to elevated noise levels or direct contact from falling components is so low as to be discountable. Similarly, it is very unlikely that marine wildlife would be impacted by hazardous chemicals. Overall, splashdown of vehicle components in the BOA would not have significant impacts on marine wildlife. The U.S. Army has evaluated the effects of the Proposed Action on ESA-listed species and critical habitats in the FT-3 Biological Assessment (U.S. Army 2020) and has determined that the Proposed Action may affect but is not likely to adversely affect ESA-listed species in the BOA and would have no effect on designated critical habitat. The U.S. Army has consulted with NMFS and USFWS and has received their concurrence with these determinations.
	Water Resources	There would be no change to baseline water resources, and therefore, no significant impacts to water resources from implementation of the No Action Alternative.	Considering the small quantities of hazardous materials contained in the batteries; the likelihood of the solid rocket propellant to be burnt up before vehicle component impact in the BOA; the relatively large expanse between component drop stages; the single test; the lack of anticipated floating debris; and the dilution and mixing capabilities of the ocean waters, the potential for hazardous materials released during component impact to adversely affect the water resources of the BOA should be deemed insignificant.

Table D-1. Potential Impacts Associated with the No Action Alternative and the Proposed Action (Continued)

Location	Resource Area	No Action Alternative	U.S. Army RCCTO FT-3 Proposed Action
USAG-KA, RMI Illeginni Islet and Offshore Waters Impact Zones	**Biological Resources**	There would be no change to biological resources under the No Action Alternative. Therefore, no impacts would occur to biological resources with implementation of the No Action Alternative.	**Illeginni Islet (Proposed Impact Location):** Potential impacts on biological resources at Illeginni Islet may include exposure to elevated noise levels, direct contact from payload components or impact debris, disturbance from human activity and equipment operation, and exposure to hazardous chemicals. No impacts to terrestrial or marine vegetation are expected. Birds nesting or roosting near the impact zone may be impacted by noise and human activity but with implementation of avoidance measures impacts would be short term and minimal. No sea turtle nests or nesting activity have been observed on Illeginni Islet in over 20 years and it is very unlikely that sea turtles will haul out or nest on Illeginni Islet. With implementation of measures to minimize the potential impacts to sea turtles, sea turtles in terrestrial habitats are not likely to be impacted. Marine mammals, sea turtles, and fish in offshore waters might be exposed to elevated noise levels or vessel traffic; however, any effects would likely be limited to short-term startle reactions and animals would be expected to return to normal behaviors within minutes. The impacts of elevated noise levels on marine wildlife would be minimal and less than significant. In the event of a payload impact on or near the shoreline, marine wildlife in nearshore reef habitats may be impacted by direct contact from debris or ejecta or by human activity during cleanup operations. Several special status coral, mollusk, and reef-associated fish species are known to occur in the nearshore waters of Illeginni Islet and have the potential to be injured by proposed activities. The U.S. Army has concluded that the Proposed Action may affect and is likely to adversely affect seven UES-consultation coral species, three mollusk species, and one fish species in reef habitats offshore of Illeginni Islet (U.S. Army 2020). The U.S. Army has consulted with NMFS and the USFWS on the effects of the Proposed Action on UES-consultation species at Kwajalein Atoll. The USFWS issued a letter of concurrence and the NMFS issued a biological opinion for the effects of the Proposed Action on UES-consultation species. Several measures would be in place to reduce impacts to these species and the impact to populations of these species would be less than significant. **Offshore Waters (Alternative Impact Location):** Potential impacts on biological resources in the alternative deep water impact zones may include exposure to elevated noise levels, direct contact from payload components or impact debris, disturbance from human activity and vessel operation, and exposure to hazardous chemicals. Based on the expected noise levels and short duration of the noise (lasting only seconds), any effects on marine wildlife or seabirds is likely to be limited to startle response or short-term avoidance behavior. Animals would be expected to

Table D-1. Potential Impacts Associated with the No Action Alternative and the Proposed Action (Continued)

Location	Resource Area	No Action Alternative	U.S. Army RCCTO FT-3 Proposed Action
USAG-KA, RMI Illeginni Islet and Offshore Waters Impact Zones	**Biological Resources (continued)**		return to their normal behavior within minutes of exposure and the impact of noise on marine wildlife would be minimal. Given the low densities of rare or sensitive marine wildlife in the ROI, the chances of an animal being impacted by human disturbance, being contacted by payload debris, being exposed to hazardous chemicals, or being struck by a vessel are very low. Marine wildlife would not be significantly impacted by Proposed Action activities under the deep water payload impact alternative.
	Noise	There would be no change to noise levels in the ROI. Therefore, no significant impacts would occur from noise with implementation of the No Action Alternative.	Noise levels during pre-test and post-flight activities at the predetermined impact site would occur in mostly unpopulated areas without sensitive resident receptors. Depending on meteorological conditions, peak sound pressure levels locally could reach 123 dB based on a sonic boom overpressure of 0.6 psf (USASMDC/ARSTRAT 2014). Although this is considered reasonably loud, this noise would be audible once, last for a fraction of a second, and would be below the Army standard of 140 dB (peak sound pressure level) for impulse noise (USASMDC/ARSTRAT 2014). During the flight test, RTS would verify that no non-mission vessels would be in the area. Depending on a mission vessel's location, on-board personnel may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program.
	Public Health and Safety	There would be no change to public health and safety under the No Action Alternative.	The presence of non-mission vessels and aircraft in proximity to the USAG-KA impact zone represents the greatest risk to public health and safety for the FT-3 flight test. All efforts would be made by USAG-KA and RTS to follow SOPs and ensure clearance of the hazard areas. No unmanageable risks to public health and safety would result from implementation of the Proposed Activity.
	Hazardous Materials and Wastes	Under the No Action Alternative, there would be no change to hazardous materials and waste at Illeginni Islet.	Although unlikely, if there were any floating debris it would be recovered and brought onboard a vessel for appropriate handling and disposal from USAG-KA to the U.S. per the hazardous waste management plan. Considering the small quantities of hazardous materials contained in the batteries; the capacity of the USAG-KA hazardous waste management to accept and properly dispose of potential debris per UES standards; the single test; and the dilution and mixing capabilities of the ocean waters, the potential for hazardous materials released during the FT-3 flight test to adversely affect human health or the environment should be deemed insignificant.

Table D-2. Impact Avoidance and Minimization Measures

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
PSCA					
	Transportation, handling, and storage of rocket motors and other ordnance would occur in accordance with AAC, DOD, Army, and U.S. DOT policies and regulations.	Safeguard the materials from fire or other mishap	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with AAC, DOD, Army, and U.S. DOT policies and regulations	Army RCCTO, USAF
	SMDC would conduct range responsibilities.	Ensure appropriate launch preparation, including explosive safety, support to PSCA launch safety and coordination	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with AAC, DOD, Army, and other applicable policies and regulations	PSCA
	Publication and circulation of Notices to Airmen (NOTAMs) and Notices to Mariners (NTMs) prior to launch	Provide safety and warning to personnel, including private citizens and commercial entities, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with AAC, DOD, Army, USCG, and FAA policies and regulations	Army RCCTO, PSCA
	Check launch pad area for safe access after vehicle liftoff	Ensure worker safety for post-launch inspection, clean-up, and maintenance	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with AAC, DOD, Army, and OSHA policies and regulations	PSCA

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
Pacific Over-Ocean Flight Corridor					
	Payload's flight path would avoid flying over the Northwestern Hawaiian Islands.	Avoid impacts to protected species and habitats	Determine that actual flight path complies	Recordkeeping and reporting in accordance with DOD, Army, RTS and flight safety policies and regulations, USFWS regulations, and the ESA and MMPA	Army RCCTO, PSCA
	During travel in the BOA, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed based on expected animal locations, densities, and or lighting and turbidity conditions when possible.	Avoid impact on marine mammals and sea turtles.	Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel would be reported to USASMDC, who would then inform NMFS and USFWS.	Recordkeeping and reporting to the appropriate authorities	Army RCCTO, RTS
	Computer-monitored destruct lines, based on no-impact lines, are pre-programmed into flight safety software.	Avoid debris falling on inhabited areas, ensure compliance with Space System Software Safety Engineering protocols and U.S. range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with DOD, Army, RTS, and flight safety policies and regulations	Army RCCTO, PSCA
USAG-KA, RMI Illeginni Islet and Deep Ocean Impact Areas in Kwajalein Atoll					
	Computer-monitored destruct lines, based on no-impact lines, are pre-programmed into flight safety software.	Avoid debris falling on inhabited areas, ensure compliance with Space System Software Safety Engineering protocols and U.S. range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DOD, Army, KMISS and RTS range and flight safety policies and regulations	Army RCCTO, RTS
	Pre-flight monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea	Avoid impacts to sea turtles and sea turtle nests	Determine the rate of successful compliance and incident prevention or	For at least 8 weeks preceding the FT-3 launch, Illeginni Islet would be	RTS/USAG-KA, Army RCCTO

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	turtle nests. On-site personnel would report any observations of sea turtles or sea turtle nests on Illeginni to appropriate test and USAG-KA personnel to provide to NMFS.		occurrence	surveyed by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests on a bi-weekly basis. If possible, personnel would inspect the area within two 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. Recordkeeping and reporting in accordance with UES, DOD, Army, and USFWS regulations	
	RTS would conduct range responsibilities.	Ensure appropriate launch preparation, including explosive safety, support to U.S. Army and inter-range coordination	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DOD, Army, and RTS applicable policies and regulations	RTS

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	During travel to and from impact zones, including Illeginni Islet, and during raft deployment, ship personnel would monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and or lighting and turbidity conditions.	Avoid impact on marine mammals and sea turtles.	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 USASMDC, 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.	If personnel observe sea turtles or marine mammals in potential impact zones, sightings would be reported to appropriate test and USAG-KA personnel for consideration in launch planning, recordkeeping and reporting in accordance with UES, DOD, Army, and RTS policies and regulations.	Army RCCTO, RTS
	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. Hazardous material releases would comply with the emergency procedures set out in the KEEP and the UES.	Avoid introduction of hazardous chemicals into terrestrial and marine environments.	Determine the rate of successful compliance and incident prevention	Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport, recordkeeping of all incidents and outcomes	Army RCCTO, RTS

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	All equipment and packages shipped to USAG-KA would undergo inspection prior to shipment.	Prevent the introduction of alien species of plants and animals to Kwajalein Atoll	Determine the rate of successful prevention, identifying the need for treatment applications, as necessary	Recordkeeping of all inspections and outcomes	Army RCCTO
	Sensor rafts would not be located in waters less than 3 m (10 ft) deep.	To avoid impacts on coral heads off Illeginni Islet	Determine the rate of successful compliance and incident prevention	Recordkeeping of deployments and outcomes	Army RCCTO, LLNL
	FTS on the payload would include a failsafe operation.	Further ensure the safety of the Marshall Islands and avoid debris falling on inhabited areas or any protected area, ensure compliance with Space System Software Safety Engineering protocols and U.S. range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DOD, Army, and RTS policies and regulations	Army RCCTO, PSCA, RTS
	Payload impact would be in the non-forested area, place scarecrows, Mylar flags, helium-filled balloons, and strobe lights or tarp coverings on or near equipment and in the impact area.	Avoid affecting the bird habitat	Determine the rate of successful compliance and incident prevention or occurrence	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS, and RMIEPA policies and regulations	Army RCCTO, RTS
	The impact area would be searched for seabird nests, including eggs and chicks, prior to pre-flight activity. Any discovered seabird nest would be covered with an A-frame structure to protect eggs or chicks and to warn project personnel.	Avoid impacts to seabirds, especially black-naped terns	Post-test monitoring to observe impacts to seabirds, especially black-naped terns, their nests, eggs, or chicks	Results of monitoring would be reported to USAG-KA Environmental and to USFWS	Army RCCTO, RTS

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	Debris recovery and site cleanup would be performed for land or shallow water impacts.	To minimize long-term risks to terrestrial and marine life	Comparison of recovered debris to known materials in the payload	All visible project-related debris would be recovered during post-flight operations, including debris in shallow lagoon or shallow ocean waters by range divers. In all cases, recovery and cleanup would be conducted in a manner to minimize further impacts on biological resources. Protected marine species including invertebrates would be avoided or effects to them would be minimized, which may include movement of these organisms out of the area likely to be affected.	RTS, Army RCCTO
	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.	Minimize impacts on terrestrial and marine biological resources	Determine whether components or debris impact sensitive resources, determine if a USFWS or NMFS biologist was contacted and allowed to provide guidance	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies and regulations	Army RCCTO
	Should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species leave the area or were out of harm's way.	Avoid impacts to terrestrial and marine wildlife	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting with UES, DOD, Army, RTS, USFWS, and RMIEPA policies and regulations	Army RCCTO

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	Evacuation of nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor; publication and circulation of NOTAMs and NTMs; perform radar and visual sweeps of the hazard area immediately prior to test flights	Provide safety and warning to personnel, including native Marshallese citizens, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DOD, Army, and RTS policies and regulations	Army RCCTO, RTS
	Ordnance personnel survey of impact site, removal of residual explosive materials, manual cleanup and removal of debris including hazardous materials, backfill impact crater, dive team or remotely operated vehicle survey and debris recovery for deeper water lagoon impact	Ensure post-test personnel safety, avoid impacts to terrestrial and marine vegetation and wildlife	Determine the rate of successful compliance and incident prevention with appropriate disposition of recovered materials	Recordkeeping in accordance with UES, DOD, Army, and RTS policies and regulations	RTS
	Inspect reef, reef flat, or shallow waters within 24 hours if inadvertently impacted, assess damage, decide on any mitigation measures	Avoid or minimize impacts to marine vegetation and wildlife	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS and RMIEPA policies and regulations	RTS, Army RCCTO, possibly NMFS/USFWS
	Ensure that all relevant personnel associated with this project are fully briefed on the BMP and the requirement to adhere to them for the duration of this project.	Ensure awareness of and application of BMP for the duration of the FT-3 flight test	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO
	In the event the payload land impact affects the reef at Illeginni, personnel shall 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.	Avoid impacts to marine wildlife, determine impacts to reef and disposition of ejecta	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	Ejecta greater than 6 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. If possible, coral fragments greater than 6 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. UES consultation coral fragments that cannot be secured in-place should be relocated to suitable habitat where it is not likely to become mobilized.				
	In the event the payload land impact affects the reef at Illeginni, USASMDC shall require its personnel to reduce impacts on top shell snails. Rescue and reposition any living top shell snails that are buried or trapped by rubble. 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.	Avoid impacts to marine wildlife	Post-test monitoring to observe impacts to reef and top shell snails, and determine disposition of ejecta	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	In the event the payload land impact affects the reef at Illeginni, personnel shall be required to reduce impacts on UES coordination and consultation clam species. Rescue and reposition any living UES-listed clams that are buried or trapped by rubble. Relocate to suitable habitat, any living UES-listed clams that are in the path of any heavy equipment that must be used in the marine environment.	Avoid impacts to marine wildlife	Post-test monitoring to observe impacts to reef and living clams, and determine disposition of ejecta	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA
	Appropriately qualified personnel shall be assigned to record all suspected incidences of take of any UES-consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Identification or refutation of all suspected incidences of take	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA
	Digital photography shall be utilized 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	Ensure accuracy of data collection and applicability to incidences of take	Photo-documentation prepared as per NMFS guidance	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	photograph.				
	In the event the payload impact affects the reef at Illeginni, personnel shall survey the ejecta field for impacted corals, top shell snails, and clams within 60 days of completing post-test clean-up and restoration. Also be mindful for any other UES-consultation species that may have been affected.	Avoid impacts to marine wildlife; ensure accuracy of data collection and applicability to incidences of take	Post-test monitoring to observe impacts to reef and identified organisms, including UES consultation species	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA
	Within 60 days of completing post-test clean-up and restoration, provide photographs and records to the USAG-KA Environmental Office. USAG-KA and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Submittal of photographs and records within 60 days of completing post-test clean-up and restoration	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	Within 6 months of completion of the action, U.S. Army RCCTO shall provide a report to USAG-KA to forward to NMFS. 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.	Ensure compliance with UES and NMFS Biological Opinion Terms and Conditions	Submittal of report within 6 months of completing the action	Recordkeeping and reporting in accordance with UES, DOD, Army, RTS, USFWS and NMFS policies, regulations, and guidance	Army RCCTO, USAG-KA
	Prepare a project specific NPA and DEP	Ensure UES compliance	Complete the NPA and DEP prior to occurrence of the Proposed Action	Final DEP authorized with UES Appropriate Agencies' signatures prior to occurrence of the Proposed Action	Army RCCTO
	Raft would have running lights and station-keeping; no intentional ocean dumping should the instrumentation raft be inadvertently struck during the conduct of the mission; possible use of scarecrows, Mylar flags, helium-filled balloons, and strobe lights.	Maritime safety; compliance with international policy; visual deterrents to avoid inadvertent impacts to birds that might be on the raft	Determine the rate of successful compliance and incident prevention or occurrence	Recordkeeping and reporting in accordance with UES, DOD, Army, and RTS range and flight safety policies and regulations	Army RCCTO, RTS, LLNL

Table D-2. Impact Avoidance and Minimization Measures (Continued)

Location	Measure	Anticipated Benefit	Evaluating Effectiveness	Implementing and Monitoring	Responsibility
	Visible debris on the water surface would be recovered and removed	Avoid physical impacts to marine life	Collection of any visible debris on the water surface or documentation of the lack of visible debris	All visible project-related debris on the water surface would be recovered during post-flight operations. In all cases, recovery and cleanup would be conducted in a manner to minimize further impacts on biological resources. Recordkeeping and reporting in accordance with UES, DOD, Army, and RTS, policies and regulations	RTS/USAG-KA, Army RCCTO
	Publication and circulation of a fact sheet describing the project and the environmental controls would be prepared and would be provided at locations on Ebeye and Kwajalein Islet; perform radar and visual sweeps of the hazard area immediately prior to test flights.	Provide safety and warning to personnel, including native Marshallese citizens, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DOD, Army, and RTS policies and regulations	Army RCCTO, RTS