Nationwide Public Safety Broadband Network Draft Programmatic Environmental Impact Statement for the Non-Contiguous United States

FirstNet®

First Responder Network Authority

Volume 2 - Chapter 4

HAWAII

Alaska
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American Samoa
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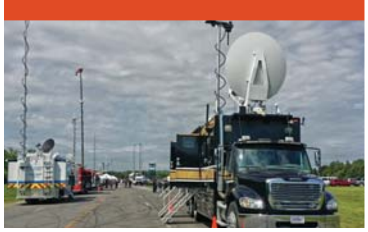
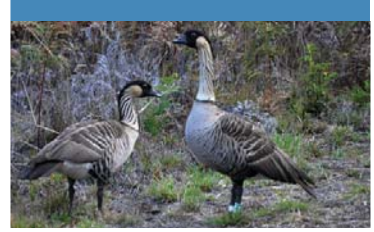
March 2016





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First Responder Network Authority

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Draft Programmatic Environmental Impact Statement
for the Non-Contiguous United States

Volume 2

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Cooperating Agencies
Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

March 2016

Cover Art Sources:

Map Service. 2015. *OpenStreetMap*. ArcGIS Map Image Layer by Esri. Sourced from: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community.

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ACRONYMS AND ABBREVIATIONS

°F	degree Fahrenheit
°N	degrees north
$\mu g/m^3$	microgram(s) per cubic meter
µPa	micro Pascal
%	percent
A	attained
AAC	Alaska Administrative Code
AAFIS	Alaska Public Safety Identification System
AAQS	Ambient Air Quality Standards
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey (U.S. Census Bureau)
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
AGL	above ground level
AIRFA	American Indian Religious Freedom Act
AJRCCM	American Journal of Respiratory and Critical Care Medicine
AKNHP	Alaska National Heritage Program
AKOSH	Alaska Occupational Safety and Health
AKWAS	Alaska Warning System
ALMR	Alaska Land Mobile Radio
ANFIRS	Alaska Fire Incident Reporting System
ANSCA	Alaska Native Claims Settlement Act
ANSI	American National Standards Institute
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
APSIN	Alaska Public Safety Information Network
AQCR	air quality control region
ARFF	Aircraft Rescue and Firefighting
ARMS	Alaska Records Management System
ARPA	Archaeological Resources Protection Act of 1979
AS	Alaska Statute
A.S.A.C.	American Samoa Administrative Code
ASCA	American Samoa Code Annotated
ASCMP	American Samoa Coastal Management Program
ASDMWR	American Samoa Department of Marine and Wildlife Resources
ASEPA	American Samoa Environmental Protection Agency
ASHPO	American Samoa Historic Preservation Office
ASPA	American Samoa Power Authority
ATO	Air Traffic Organization
ATWC	Alaska Tsunami Warning Center
AURORA	Alaska Uniform Response Online Reporting Access
BACT	best available control technology
BCE	before Common Era
BCR	Bird Conservation Regions
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BRFSS	Behavioral Risk Factor Surveillance System
BSAI	Bering Sea/Aleutian Island
BWG	BioInitiative Working Group
CAA	Clean Air Act
CAB	Clean Air Branch
CARB	California Air Resources Board
CBIA	Coastal Barrier Improvement Act of 1990
CBRA	Coastal Barrier Resources Act of 1982
CCP	Comprehensive Conservation Plan
CDC	Center for Disease Control
CDLNR	Commonwealth Department of Lands and Natural Resources
CE	Common Era
CELCP	Coastal and Estuarine Land Conservation Program
CEPD	Caribbean Environmental Protection Division
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFMC	Caribbean Fisheries Management Council
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CHC	Commonwealth Health Center
CIA	Central Intelligence Agency
CMIP3	Coupled Model Intercomparison Project phase 3
CNMI	Commonwealth of Northern Mariana Islands
CNMIAC	Commonwealth of Northern Mariana Islands Administrative Code
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalents
COMAR	Committee on Man and Radiation
CPA	Commonwealth Ports Authority

CRMP	Coastal Resources Management Program
CSP	Central South Pacific
CUC	Commonwealth Utilities Corporation
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DACA	Deployable Airborne Communications Architecture
DAR	Division of Aquatic Resources (Hawaii)
DAWR	Division of Aquatic and Wildlife Resources (Guam)
dB	decibel(s)
dBA	A-weighted decibel(s)
DBCP	1,2-dibromo-3-chloropropane
dBZ	Z-weighted decibel(s)
DCP	1,2-dichloropropane
DEC	Department of Environmental Conservation
DHHL	Department of Hawaiian Homelands
DLNR	Department of Land and Natural Resources (Hawaii)
DMA	Disaster Mitigation Act of 2000
DNER	Department of Natural and Environmental Resources of Puerto Rico
DOA	Department of Agriculture
DOD	Department of Defense
DOE	U.S. Department of Energy
DOH	Department of Health
DOH-CAB	Hawaii Department of Health, Clean Air Branch
DOT	U.S. Department of Transportation
DPNR	Department of Planning and Natural Resources (U.S. Virgin Islands)
DPS	Department of Public Safety
EA	Environmental Assessment
EAS	Emergency Alert System
EBS	Emergency Broadcast System
EDB	ethylene dibromide
EFH	essential fish habitat
EMS	emergency medical services
ENSO	El Niño/Southern Oscillation
EO	Executive Order
EPCRA	Emergency Planning and Community Right-to-Know Act
ERP	effective radiated power
ESA	Endangered Species Act
ESI	Environmental Sensitivity Index
FAA	Federal Aviation Administration
FAD	Fish Aggregating Device
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FirstNet	First Responder Network Authority
FMP	Fishery Management Plan
FPPA	Farmland Protection Policy Act of 1981
FR	Federal Register
ft	feet
g/hp-hr	grams per horsepower-hour
g/mi	grams per mile
GAP	Gap Analysis Program
GCA	Guam Code Annotated
GDA	Guam Department of Agriculture
GEPA	Guam Environmental Protection Agency
GHG	greenhouse gas
GIS	geographic information system
GMP	General Management Plan
GOA	Gulf of Alaska
GRHP	Guam Register of Historic Places
GWP	global warming potential
H_2S	hydrogen sulfide
HDOH	Hawaii Department of Health
HEI	Health Effects Institute
HHCA	Hawaiian Homes Commission Act of 1920
HIANG	Hawaii Air National Guard
HIARNG	Hawaii Army National Guard
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
HIOSH	Hawaii Occupational Safety and Health Division
hp	horsepower
HRD	(Guam) Historic Resources Division
HRHP	Hawaii Register of Historic Places
HRS	Hawaii Administrative Rules, Revised Statute
HTA	Hawai'i Tourism Authority
HUC	hydrologic unit code
I/M	Inspection/Maintenance
IARC	International Agency for Research on Cancer
IBA	Important Bird Area
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Finance Corporation
in	inches
IPCC	Intergovernmental Panel on Climate Change
IR	ionizing radiation
ITCZ	Intertropical Convergence Zone
IUCN	International Union for Conservation of Nature
kg/gal	kilograms per gallon
KIRC	Kaho'olawe Island Reserve Commission
LAER	lowest achievable emission rate
lb/day	pounds per day
lb/hp-hr	pounds per horsepower-hour

LBJ	Lyndon B. Johnson
Ldn	day-night average sound level
Leq	equivalent noise levels
LNG	liquefied natural gas
LTE	Long Term Evolution
$\mu g/m^3$	microgram(s) per cubic meter
µPa	micro Pascal
m/s	meter per second
MBTA	Migratory Bird Treaty Act
mg/m^3	Milligram(s) per cubic meter
mgd	million gallons per day
MHz	megahertz
MLRA	Major Land Resource Area
mm/s	millimeters per second
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MPA	Marine Protected Area
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MTR	Military Training Route
MUID	Map Unit Identification Data
MW	megawatt
mW/cm^2	milliwatts per centimeter squared
N	north; not attained
N_2O	nitrous oxide
NA	not applicable; not assessed
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NANSR	Nonattainment New Source Review
NAWAS	National Warning System
NCA	National Climate Assessment
NCD	non-communicable disease
NCDC	National Climatic Data Center
NCN	no common name
NCRP	National Council on Radiation Protection and Measurements
ND	no data
NE	northeast
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NFIRS	National Fire Incident Reporting System
NHPA	National Historic Preservation Act
NIR	non-ionizing radiation
NMFS	National Marine Fisheries Service
NMHC	non-methane hydrocarbon compounds
NMOG	non-methane organic compounds
NNE	north-northeast
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NP	National Park
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	nationwide public safety broadband network
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NTIA	National Telecommunications and Information Administration
NVSR	National Vital Statistics Report
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
NWWS	National Weather Wire Satellite System
OHA	Office of History and Archaeology
OIA	Office of Insular Affairs (USDI)
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAG	Port Authority of Guam
PAHO	Pan American Health Organization
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PDO	Pacific Decadal Oscillation
PEIS	Programmatic Environmental Impact Statement
PL	Public Law
PM	particulate matter
PM_{10}	particulate matter up to 10 micrometers in diameter
$PM_{2.5}$	particulate matter up to 2.5 micrometers in diameter
POPs	points of presence
ppm	parts per million
PRDNER	Puerto Rico Department of Natural and Environmental Resources
PREQB	Puerto Rico Environmental Quality Board
PR OSHA	The Puerto Rico Occupational Safety and Health Administration
PRASA	Puerto Rico Aqueduct and Sew Authority
PREPA	Puerto Rico Electric Power Authority
PRSHPO	Puerto Rico State Historic Preservation Office
PSD	Prevention of Significant Deterioration
PUAG	Public Utility Agency of Guam
PV	photovoltaic
RAN	radio access network
RCP	Representative Concentration Pathway
RCRA	Resource Conservation and Recovery Act

RF	radio frequency
RIN	Regulation Identification Number
rms	root mean square
ROW	right-of-way
SAAQS	State Air Quality Standards
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SARA	Superfund Amendments and Reauthorization Act of 1986
SCD	State Civil Defense
SE	Standard of Error
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLR	sea level rise
SMA	Special Management Area
SMS	Scenery Management System
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCZ	South Pacific Convergence Zone
SPOC	Single Point of Contact
SRES	Special Report on Emission Scenarios
SSA	sole source aquifer
STATSGO2	State Soil Geographic [Database]
SW	southwest
TAAQS	Territory Ambient Air Quality Standards
TCP	traditional cultural property
TEMCO	Territorial Emergency Management Coordinating Office
TMDL	Total Maximum Daily Load
TOC	total organic compound
tpy	tons per year
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
U.S.	United States
UAMES	University of Alaska Museum Earth Sciences
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Climate Change Research Program
USGS	U.S. Geological Survey
USVIDOH	U.S. Virgin Islands Department of Health
USVIPD	U.S. Virgin Islands Police Department
UVA	University of Virginia
VIC	Virgin Islands Code
VIPA	Virgin Islands Port Authority
VISHPO	Virgin Islands State Historic Preservation Office
VOC	volatile organic compound
vog	volcanic smog
VRM	Visual Resource Management
W	watt(s)
W/m^2	watts per meters squared
WAPA	Water and Power Authority
WHO	World Health Organization
WIMARCS	West Indies Marine Animal Research and Conservation Science
WNP	Western North Pacific
WNW	west-northwest
WPC	watts per channel
WPRFMC	Western Pacific Regional Fishery Management Council

4. HAWAII

This chapter provides details about the existing environment of Hawaii and potential impacts related to the Proposed Action.

Located within the Central North Pacific Ocean region, the Hawaiian Islands were among the last places on Earth to be colonized by humans. Most researchers agree that voyaging Polynesians from the Marquesas Islands (located in the South Pacific Ocean approximately 2,300 miles southeast of Hawaii) were the first people to colonize the islands (*Wilmshurst et al. 2011)*. However, the date of initial human habitation of the islands remains a highly contested topic, happening anywhere from A.D. 100 to 800 (*Graves and Addison 1995*). Captain James Cook landed on the island of Kauai in 1778, opening the islands to the western world. The political landscape of the islands was transformed from island-based chiefdoms to a centralized government based in Honolulu under the rule of King Kamehameha, who united warring factions on the island of Hawaii and by 1810 unified the islands into one royal kingdom. The second half of the nineteenth century witnessed large scale commercial agricultural development and associated waves of immigrant workers (*Chamberlain 1957*; *Kuykendall 1938*). As early as 1872, the U.S. Army was evaluating the defense possibilities of various Hawaiian ports. The Reciprocity Treaty of 1876 allowed the United States to develop Puuloa Lagoon into a harbor, and in 1887 the United States was granted exclusive use of the harbor that was to become known as Pearl Harbor. In 1898, Hawaii became a U.S. territory, and as a strategically important location, it quickly became a hub of military development. Hawaii became a state in 1959, further solidifying its status as a U.S. military stronghold (*Alvarez 1982*).

General facts about Hawaii are provided below:

- State Nickname: The Aloha State
- Area: 6,425 square miles; U.S. Rank: 47 (*U.S. Census Bureau 2010*)
- Capital: Honolulu
- Counties: 5
- Population: 1,419,561; U.S. Rank: 40 (*U.S. Census Bureau 2010*)
- Most Populated Cites: Honolulu, Hilo, Kailua, and Kahului
- Main Rivers: Wailua River, Wailuku River, Olokele River
- Bordering Waterbodies: Pacific Ocean
- Notable Mountain Ranges and Summits: Koolau Range, Mauna Kea, Haleakala, Mauna Loa
- Highest Point: Mauna Kea (13,796 feet) (*USGS 2001*)

The geographic area of Hawaii is comprised of 8 large islands (see Figure 4-1) and 124 smaller islands. The eight large islands include: Hawaii, Molokai, Kauai, Maui, Oahu, Kahoolawe, Lanai, and Niihau. The landmasses that make up the Hawaiian Islands were formed by numerous volcanic eruptions of fluid lava over several million years. Therefore, the majority of the geologic material on the Hawaiian Islands consists of basalt and other volcanic material. Three active volcanoes in Hawaii have erupted in the last 35 years, and two others have erupted in the past 230 years. One additional dormant volcano erupted approximately 3,600 years ago.

Hawaii's weather is shaped by the Central North Pacific High and northeast Trade Winds (*NOAA 2012*), a semi-permanent high-pressure area centered off the eastern coast of Japan (*Keener et al. 2013*). Hawaii's statewide annual precipitation is 47 inches, although this varies throughout the state, from 8 inches near the summit of Mauna Kea to more than 400 inches on the windward slope of Haleakala, Maui (*Giambelluca et al. 2013*). This precipitation can come in the form of rainfall, fog, hail, and snow (*Keener et al. 2013*). Due to Hawaii's geographic location, there is little seasonal variation, which translates to a seasonal average temperature range between 72°F (February) and 78°F (August), with average humidity ranging from 65 to 70 percent (*Keener et al. 2013*).

Native Hawaiians and Pacific Islanders comprise nearly 10 percent of Hawaii's population. Twenty-five percent of residents identify themselves as white and 38.3 percent identify themselves as Asian. Nearly 24 percent of Hawaiians identify themselves as being of more than one race *(U.S. Census Bureau 2013*).

The federal government owns approximately 13 percent of land in the state, most of which is on the islands of Hawaii and Oahu. The state government owns approximately 33 percent of the land in the state. Approximately 36 percent of land in Hawaii is in areas designated, managed, or available for recreation (*USGS 2012*).

In conjunction with its high percentage of area devoted to recreational land, Hawaii contains approximately 303 miles of recreational shoreline (*HDOH 2014*). The state has a complex geography and a fragmented landscape and is prone to natural catastrophes like hurricanes, tsunamis, and earthquakes, which add an extra level of challenge in ensuring adequate communication systems are in place (*State of Hawaii 2012*). Seismic activity and earthquakes in Hawaii occur as a result of volcanic activity associated with Hawaii's hotspot[1] (*USGS 2015*). Since the year 1811, approximately 32 tsunamis with a runup[2] of more than 3 feet have occurred in the state (*USGS 2015*). Most of the islands, such as Kauai and Oahu, are made up of mountainous regions and cliffs that are thousands of feet high, and gorges that are thousands of feet deep (*Hawaii Tourism Authority 2015*). Therefore, air transport is particularly important on the islands. There are 15 civilian airports and 3 military-only airfields in Hawaii.

Honolulu is the capital of Hawaii and is located on the Island of Oahu. Hawaii's government is based on its State Constitution, which includes a system of governance with three primary branches: legislative, executive, and judiciary. Hawaii's legislative branch has 76 members that develop laws (25 senators with staggered 4-year terms and 51 representatives who are elected every 2 years). The executive branch is comprised of the elected Governor's administration and

[1] A hotspot is a location where plumes of hot rock rise from within the Earth toward the surface. Lower pressures toward the surface allow rock to melt, which can result in molten rock, volcanism, and lava flows.
[2] The term runup refers to the height the wave reaches above sea level before washing to shore (*USGS 2015*).

several departments that enforce the laws; the judicial branch interprets the laws through the court system (*Hawaii State Legislature 2015*). The Hawaiian Department of Health: Office of Environmental Control, and the Department of Land and Natural Resources are the state environmental agencies. Each of the four major counties within the state (Kauai, Honolulu, Maui, and Hawaii) separately manages its own EMS, fire, and police service systems. The Hawaii State Civil Defense (SCD) acts to manage the state when an emergency situation affects one or more of the Hawaiian counties. Hawaii has adopted the National Response Framework, a federal emergency action plan under the U.S. Department of Homeland Security Federal Emergency Management Agency, intended to prepare the public for large-scale attacks or significant natural disasters and to protect critical infrastructure (*FEMA 2015*).

Hawaii's economy is heavily tied to the tourism industry, which spans numerous economic sectors. The arts, entertainment, recreation, accommodation, and food service industry alone provides approximately 16 percent of all jobs. Unemployment rates range from approximately 6.1 percent to 10.8 percent, compared to the national average of 9.7 percent in 2013, the most recent year for which data were available (*U.S. Census Bureau 2013*).

This chapter contains a discussion of the Affected Environment (see Section 4.1) and Environmental Consequences (see Section 4.2) for each of the 15 resources:

- Infrastructure
- Soils
- Geology
- Water Resources
- Wetlands
- Biological Resources
  - Terrestrial Vegetation
  - Wildlife
  - Fisheries and Aquatic Habitats
  - Threatened and Endangered Species and Species of Conservation Concern
- Land Use, Airspace, and Recreation
- Visual Resources
- Socioeconomics
- Environmental Justice
- Cultural Resources
- Air Quality
- Noise
- Climate Change
- Human Health and Safety

Source: Map Service 2015

Figure 4-1: Hawaii Geography

4.1. AFFECTED ENVIRONMENT

This section provides a description of those portions of the environment that could be affected by the Proposed Action in Hawaii. This information is used in the assessment of potential impacts from the Proposed Action as described in 4.2, Environmental Consequences; the level of detail in the description of each resource in this section corresponds to the magnitude of the potential direct, indirect, or cumulative impacts of the Proposed Action. The information presented was derived from government data or reports and scientific literature. This section describes the current conditions and characteristics of 15 distinct resources:

- Section 4.1.1, Infrastructure: existing transportation, public safety services and infrastructure, communication services, and other utilities and related emergency operational planning;
- Section 4.1.2, Soils: existing soil resources, features, and characteristics;
- Section 4.1.3, Geology: geologic features and characteristics that would be potentially sensitive to impacts from construction and operation of the Proposed Action, as well as geologic hazards that could potentially affect the Proposed Action;
- Section 4.1.4, Water Resources: surface water, floodplains, nearshore marine waters, and groundwater;
- Section 4.1.5, Wetlands: wetland resources, features, and characteristics;
- Section 4.1.6, Biological Resources: terrestrial vegetation, wildlife, fisheries and aquatic habitats, and threatened and endangered species and species of conservation concern;
- Section 4.1.7, Land Use, Airspace, and Recreation: overview of land use, airspace, and recreational facilities and activities;
- Section 4.1.8, Visual Resources: natural and human-made features, landforms, structures, and other objects;
- Section 4.1.9, Socioeconomics: demographic, cultural, and economic conditions;
- Section 4.1.10, Environmental Justice: demographic data on minority or low-income groups;
- Section 4.1.11, Cultural Resources: known historic properties, traditional cultural properties, and places of cultural or religious significance;
- Section 4.1.12, Air Quality: existing air quality conditions;
- Section 4.1.13, Noise: existing noise conditions;
- Section 4.1.14, Climate Change: setting and context of global climate change effects in Hawaii; and historical and existing climate parameters including temperature, precipitation, and severe weather; and
- Section 4.1.15, Human Health and Safety: health profile of the population of Hawaii, including basic population health indicators and a discussion of any key community health and safety issues identified.

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4.1.1. Infrastructure

4.1.1.1. Introduction

This section discusses existing infrastructure in the state of Hawaii. Information presented in this section focuses on existing transportation, public safety services and infrastructure, communication services, and other utilities and related emergency operational planning that could be augmented, supplemented, or otherwise affected by deployment and operation of the Proposed Action.

Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports, harbors, and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Infrastructure is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as "developed." Public safety infrastructure is any infrastructure utilized by a public safety entity[1] as defined in the Middle Class Tax Relief and Job Creation Act of 2012, including infrastructure associated with police, EMS, and fire services. This infrastructure includes fire and rescue departments, law enforcement precincts, medical centers and hospitals, transportation assets, and schools and libraries, which can be used as evacuation centers. First responder personnel include dispatch, fire and rescue, law enforcement, and medical professionals throughout the state.

Utilities typically consist of the power, water, sewer, transit, and telecommunications systems that are essential to support daily operations. Changes in land use, population density, and development usually generate changes in the demand for and supply of utilities.

4.1.1.2. Specific Regulatory Considerations

Hawaii State Civil Defense (SCD) acts to manage the state when an emergency situation affects one or more of the Hawaiian counties. In emergency situations, SCD coordinates with the Federal Emergency Management Agency (FEMA) and county government civil defense agencies in order to help protect the Hawaiian public (*Hashiro 2014*). County level emergency departments include the city and county of Honolulu Department of Emergency Management, Kauai County Civil Defense Agency, Maui County Defense Agency, and Hawaii County Civil Defense Agency.

Hawaii has adopted the National Response Framework, a federal emergency action plan under the U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA), intended to prepare the public for large-scale attacks or significant natural disasters and to protect critical infrastructure (*FEMA 2015*).

[1] The term "public safety entity" means an entity that provides public safety services (47 USC § 1401(26)).

State agencies with regulatory or administrative authority over other state infrastructure are identified in the sections below.

4.1.1.3. Transportation

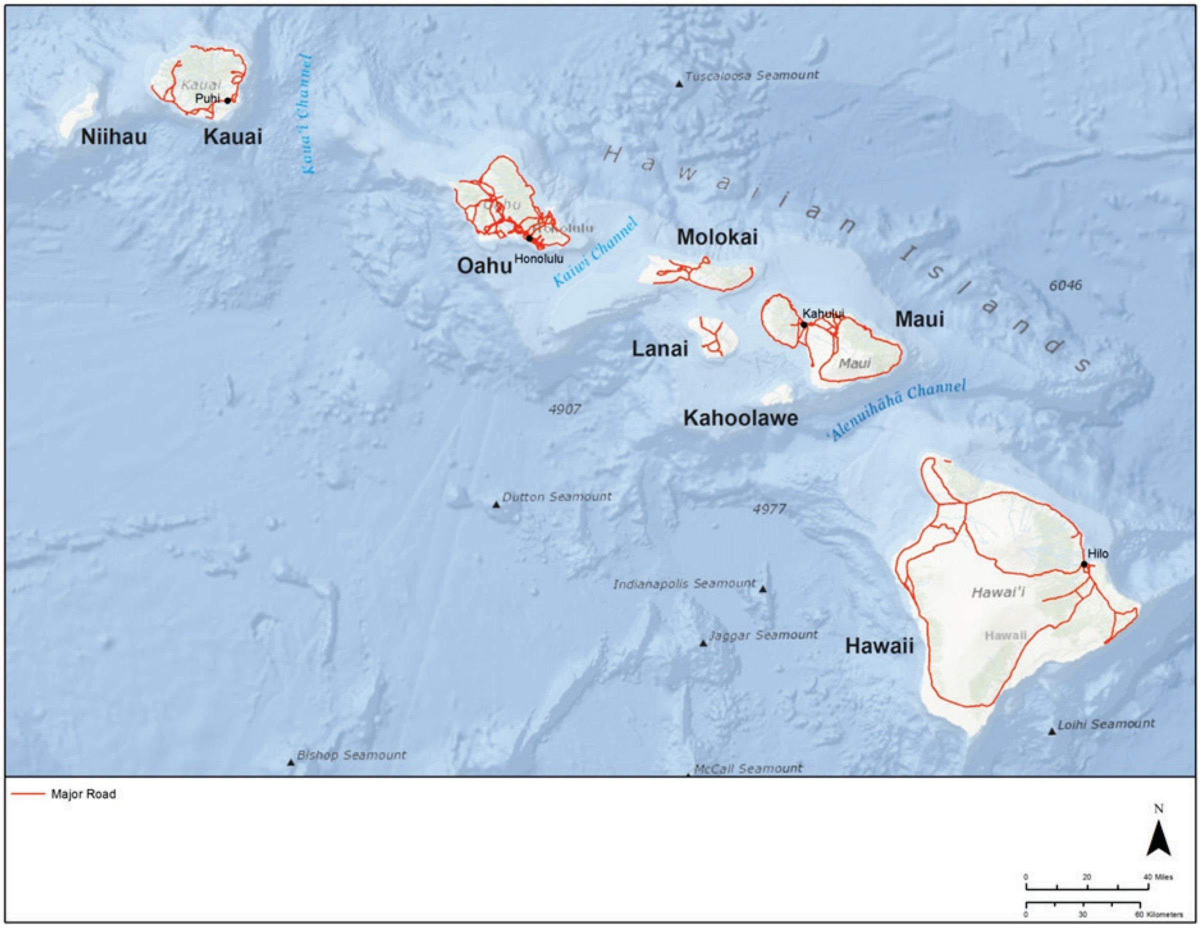
Hawaii is presented with a unique set of challenges as it relates to the transportation-related aspects of public safety telecommunications infrastructure given the diverse and rugged geography of the islands. The island of Hawaii, for example, is characterized by rugged lava rock terrain, active volcanoes, low population density, and the long distances between scattered, isolated pockets of land. The majority of land on the island of Hawaii is undeveloped, and communities are often widely dispersed (*Hawaii Tourism Authority 2015*). All the Hawaiian Islands have limited major roadways and highways and are otherwise characterized by many gulches and valleys creating an uneven terrain, which makes some areas inaccessible to land-based vehicles or that restricts the size and weight of vehicles that may be used to transport people and materials to deployment sites. This further makes air transport particularly important on the islands. For example, most of the islands, such as Kauai and Oahu, are made up of mountainous regions and cliffs that are thousands of feet high, and gorges that are thousands of feet deep (*Hawaii Tourism Authority 2015*). The Hawaiian Islands have several mountains that are between 10,000 and 14,000 feet high from sea level (Haleakala, Maui–10,023; Mauna Loa, Hawaii–13,678; Mauna Kea, Hawaii–13,796). In some rural and remote areas of the islands, providers must also overcome the lack of commercial electricity (*State of Hawaii 2012*). These factors play a major role in the availability of adequate infrastructure and equipment during emergency situations and first responder protocols.

Transportation systems in Hawaii are organized by district: Kauai, Oahu, Maui, and Hawaii. Within the District of Maui, the Islands of Molokai and Lanai house additional transportation infrastructure. The remaining two Islands, Kahoolawe and Niihau lack significant transportation infrastructure. Each district is regulated under the State of Hawaii Department of Transportation (DOT). The State of Hawaii Department of Transportation is responsible for the maintenance, design, construction, and planning of all facilities and infrastructure related to land, air, and water transportation in Hawaii. Airports, Harbors, and Highways are the three modal divisions within the department (*HDOT 2015*).

Roads, Highways, and Railroads

There are 2,450 lane miles[2] of highway in Hawaii (*ASCE 2015*). Among the state roads and highways, 12 are located in Kauai District, 20 in Oahu District, 8 in Hawaii District, and 18 in Maui District. Within the Maui District there are 12 state highways and roads on the Island of Maui, 1 on the Island of Lanai, and 5 on the Island of Molokai (*HDOT 2015*). Figure 4.1.1-1 shows the location of state roads and highways in Hawaii.

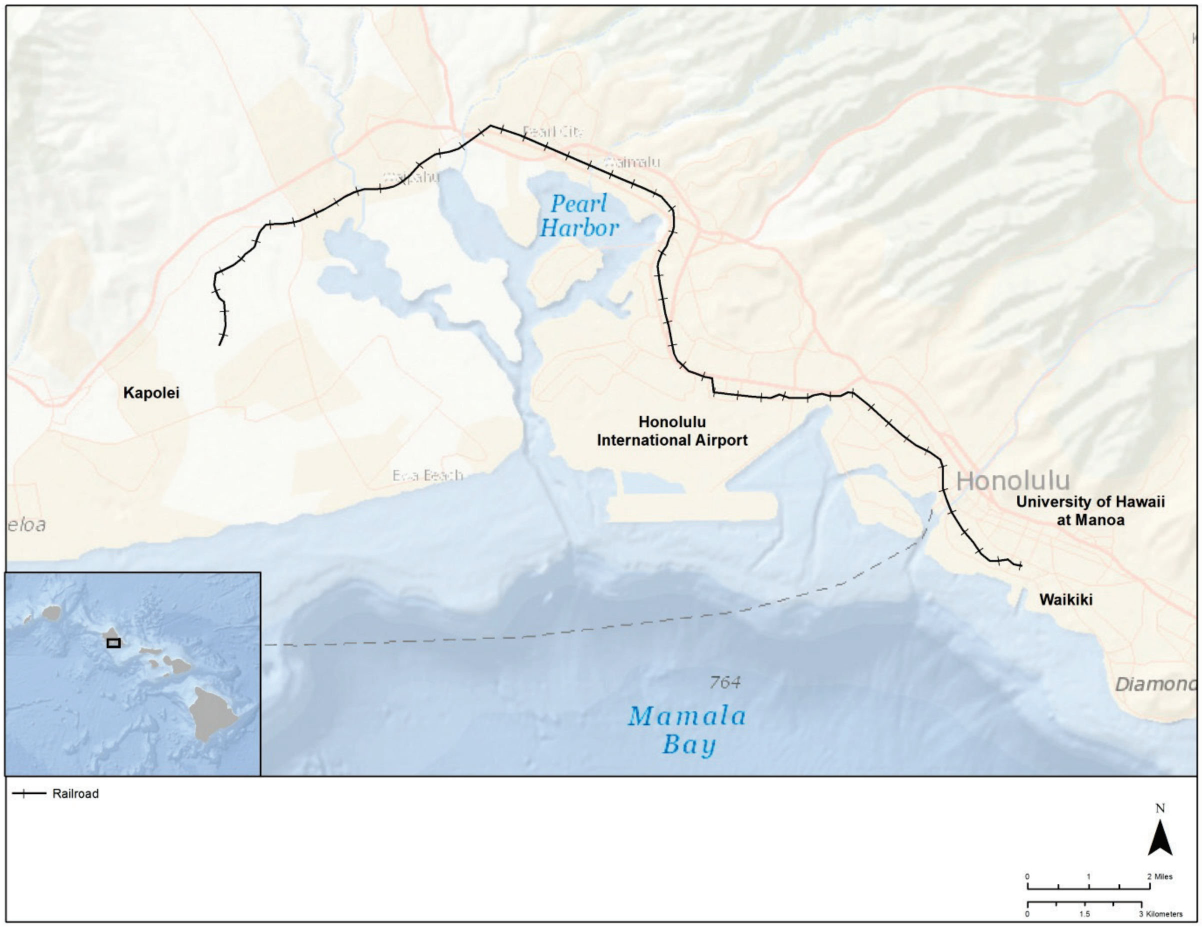
[2] Lane miles refer to the length of a roadway multiplied by the number of traffic lanes (*Rulebase Foundation 2015*).



Source: Esri, TomTom 2014a

Figure 4.1.1-1: Hawaii Road Transportation Systems

Although not yet operational, rail transit across the island of Oahu is in the planning phase. Estimated for launch in 2018, the Honolulu Authority for Rapid Transportation intends to operate the Honolulu Rail Transit, a 20-mile high-speed rail line made up of 21 stations from West Oahu to the Ala Moana Center in Honolulu to relieve traffic congestion between Kapolei and UH Manoa and Waikiki (see Figure 4.1.1-2) (*Honolulu Rail Transit 2015*). Hawaii does not currently operate any freight or passenger railroads; however, there are a number of defunct railroads in the state. The only railroads that still exist in Hawaii are used for tourism purposes (*American-Rails.com 2015*).



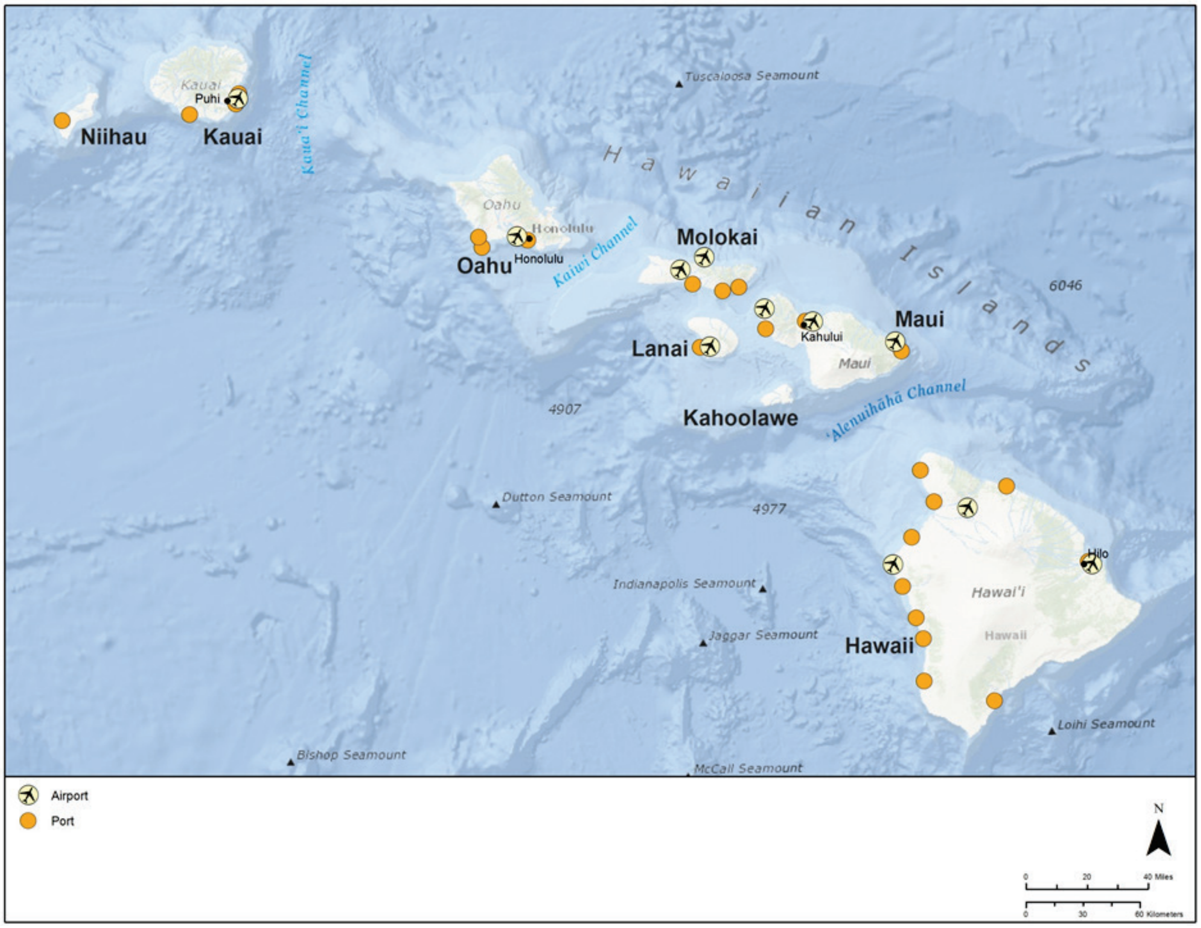
Source: Honolulu Rail Transit 2015

Figure 4.1.1-2: Honolulu Rail Transit Route Map

Ports

There are over 20 ports of different sizes in Hawaii that serve administrative, industrial, development, and commercial purposes (*World Port Source 2015*) (see Figure 4.1.1-3). In addition, the State of Hawaii Department of Transportation Harbors Division owns, maintains, and operates 10 separate commercial harbors. Together the 10 harbors create a port system referred to as Port Hawaii. The harbors are distributed throughout the four districts (*HDOT 2015*):

- Kauai District: Nawiliwili Harbor and Port Allen Harbor
- Hawaii District: Hilo Harbor and Kawaihae Harbor
- Maui District: Kahului Harbor, Kaunakakai harbor, Kaumalapau Harbor, and Hana Harbor
- Oahu District: Honolulu Harbor and Kalaeloa Barbers Point Harbor



Source: NGA 2015

Figure 4.1.1-3: Hawaii Port and Airport Tansportation Systems

Interisland Transport

Interisland transport is available by ferry or plane. There are only two interisland ferries in Hawaii, the Molokai-Maui Ferry and the Maui-Lanai Ferry. Therefore, air is typically the primary mode of interisland transport (*State of Hawaii 2015c*).

Airports

Hawaii operates 11 commercial service airports and four general aviation airports. The distribution of airport by island is shown in Table 4.1.1-1 and Figure 4.1.1-3.

Table 4.1.1-1: Airport Distribution by Island in the State of Hawaii

Island of Hawaii	Oahu	Kauai	Maui	Molokai	Lanai
Hilo International Airport (ITO)	Honolulu International Airport (HNL)	Lihue Airport (LIH)	Hana Airport (HNM)	Kalaupapa Airport (LUP)	Lanai Airport (LNY)
Kona International Airport at Keahole (KOA)	Dillingham Airfield (HDH)	Port Allen Airport (PAK)	Kahului Airport (OGG)	Molokai Airport (MKK)	
Upolu Airport (UPP)	Kalaeloa Airport (JRF)		Kapalua Airport (JHM)		
Waimea-Kohala Airport (MUE)					

Source: HDOT 2015

4.1.1.4. Public Safety Services

This section provides a description of baseline public safety telecommunications infrastructure conditions as it relates to police services, fire services, EMS and hospitals in Hawaii. Given the unique geography of the Hawaiian Islands, each of the four major counties within the State (Kauai, Honolulu, Maui, and Hawaii) separately manages their own EMS, fire and police service systems. In addition to police and fire services in the State, the State of Hawaii Department of Defense plays a major role in providing for the welfare, safety, and defense to the state, visitors, and citizens in the event of an emergency. The State of Hawaii Department of Defense is made up of the Hawaii Army National Guard (HIARNG), Hawaii Air National Guard (HIANG), SCD, Office of Veteran Services, and Hawaii National Guard Youth Challenge Academy. The Office of Veteran Affairs and National Guard Youth Challenge Academy focus primarily on veterans and youth, respectively, and do not provide as large a general public services role as HIARNG, HIANG and SCD. In total, the State of Hawaii Department of Defense has approximately 5,500 Guard members, 462 state employees, more than 440 Active Guard/Reserve, and more than 1,080 federal technicians (*Hawaii DOD 2013*).

HIARNG and HIANG play a major role in responding to national emergencies, natural and manmade disasters, and are also heavily involved in war and peacekeeping missions (State of Hawaii 2015b). HIARNG is present in 17 communities throughout Hawaii and maintains 21 armories (*GlobalSecurity.org 2015*). HIANG has six main bases distributed throughout the Hawaiian Islands (*State of Hawaii 2015b*):

- Air Station Barbers Point–Kapolei, Hawaii
- Hilo Air National Guard Communications Station–Keaukaha Military Reservation, Hawaii
- Joint Base Pearl Harbor-Hickam – Hickam, Hawaii
- Kauai Air National Guard Communications Station–Kekaha, Hawaii

- Maui Air National Guard Communications Station–Kahului, Hawaii
- Wheeler Army Airfield–Honolulu, Hawaii

The United States Coast Guard District Fourteen is based in Honolulu and is one of the primary agencies responsible for responding to emergencies at sea, marine, and coastal protection and law enforcement (*USDHS USCG 2015*).

Police Services

County of Hawaii

The Hawaii Police Department serves the County of Hawaii, locally known as the "Big Island" and is made up of eight police stations distributed along the perimeter of the island. These include Honokaa, Laupahoehoe, Hilo, Pahoa, Naalehu, Kona, Walmea, and Kapaau. For police purposes the island is divided into two areas: Area I, east Hawaii, which includes the districts of Hamakua, North Hilo, South Hilo and Puna; and Area II, west Hawaii, which includes North Kohala, South Kohala, North Kona, South Kona, and Kau. Each district is headed by a police captain, and each area by a commander (*Hawaii County 2015*). According to the 2014 census, they cover approximately 4,029 square miles of varied terrain with approximately 194,190 residents and thousands of visitors (*U.S. Census Bureau 2015)*.

City and County of Honolulu

Honolulu Police Department has jurisdiction over the entire Island of Oahu and is the principal law enforcement agency of the city and county of Honolulu. Oahu is approximately 596 square miles and has a population of approximately 900,700 (*City and County of Honolulu 2015a*). Honolulu Police Department is made up of 29 divisions, 1,933 sworn officers and 463 civilian personnel (*City and County of Honolulu 2015a*). There are eight patrol districts on the island with district stations located in Kalihi, Pearl City, Kapolei, Wahiawa, and Kaneohe, and police substations located in Waianae, Kailua, Kahuku, Waikiki, and Chinatown (*City and County of Honolulu 2015a*).

County of Maui

The Maui Police Department serves all of the County of Maui. Their Uniform Services Bureau is responsible for preventing crime in the community, ensuring the preservation of peace, and the protection of lives and property. There are six districts under the uniform services bureau: District I–Wailuku; District II–Lanai; District III–Hana; District IV–Lahaina; District V–Molokai; and District VI–Kihei. Maui County also operates an Emergency Alert System called Maka‘ala, which allows agencies to send accurate and up-to-date emergency alerts to the public via phone, email, text, and other devices (*County of Maui 2015a*).

County of Kauai

Kauai Police Department serves the County of Kauai. The Patrol Services Bureau is divided into three districts and a traffic safety unit. The three districts include Hanalei, Lihue, and Waimea. Hanalei and Lihue Districts are comprised of 35 squads, 3 sergeants, 21 officers, and 15 senior clerks each. Waimea District is made up of 35 squads, 3 sergeants, 24 officers, and 15 senior clerks (*County of Kauai 2015b*).

Fire Services

County of Hawaii

The island of Hawaii is divided into two battalions: East and West. There are 20 full time fire and medic stations in the county of Hawaii as well as 20 volunteer fire stations. The department has over 60 pieces of equipment available for use in the event of an emergency, including tankers, engines, medics, choppers, and fuel trucks (*Hawaii County Fire Department/EMS 2008*).

City and County of Honolulu

The Honolulu Fire Department is divided into five battalions and 45 fire stations. Over 1,000 fire fighters work within the Honolulu Fire Department. A typical platoon has access to the following resources (*City and County of Honolulu 2015b*):

- 43 engine companies
- Two rescue companies
- 13 ladder or quint companies
- Two hazardous materials companies
- Six tankers
- Two tower companies
- One fireboat company
- Two helicopters
- Several personal watercrafts
- Three rescue boats

County of Maui

The Maui Fire Department provides fire services for the islands of Maui, Molokai, Lanai, Kahoolawe, and surrounding waters. There are 14 fire stations within the department located throughout the county. There are 10 fire stations in Maui, 3 in Molokai, and 1 in Lanai. The Fire and Rescue Operations Division is made up of 279 trained fire fighters (*County of Maui 2015b*). The following resources are available to Fire and Rescue Operations (*County of Maui 2015b*):

- 14 engine companies
- Two ladder companies
- One rescue company

- One hazardous material company
- Four tankers
- Three mini-pumpers
- One helicopter
- Three rescue boats
- Four personal watercrafts
- 11 utility vehicles

County of Kauai

Kauai Fire Department is headquartered at the Pi‘ikoi Building in Lihue, Hawaii. The department is divided into four sections: Operations, Ocean Safety Bureau, Prevention Bureau, and Training and Research Bureau. Operations, which is responsible for fire protection and suppression, HazMat, and medical response, contains seven fire stations located in Hanalei, Kapaa, Lihue, Koloa, Kalaheo, Hanapepe, and Waimea (*County of Kauai 2015a*). The Waimea and Hanalei stations provide fire and EMS for the farthest settled communities in the county and act as an anchor to the system. The fire department is made up of the following resources (*Radio AH7E Hawaii 2009a*):

- Seven engines
- Seven rescue Humvees
- One hazmat truck
- Several pumper apparatuses
- One rescue helicopter
- Other support vehicles

EMS and Hospital Services

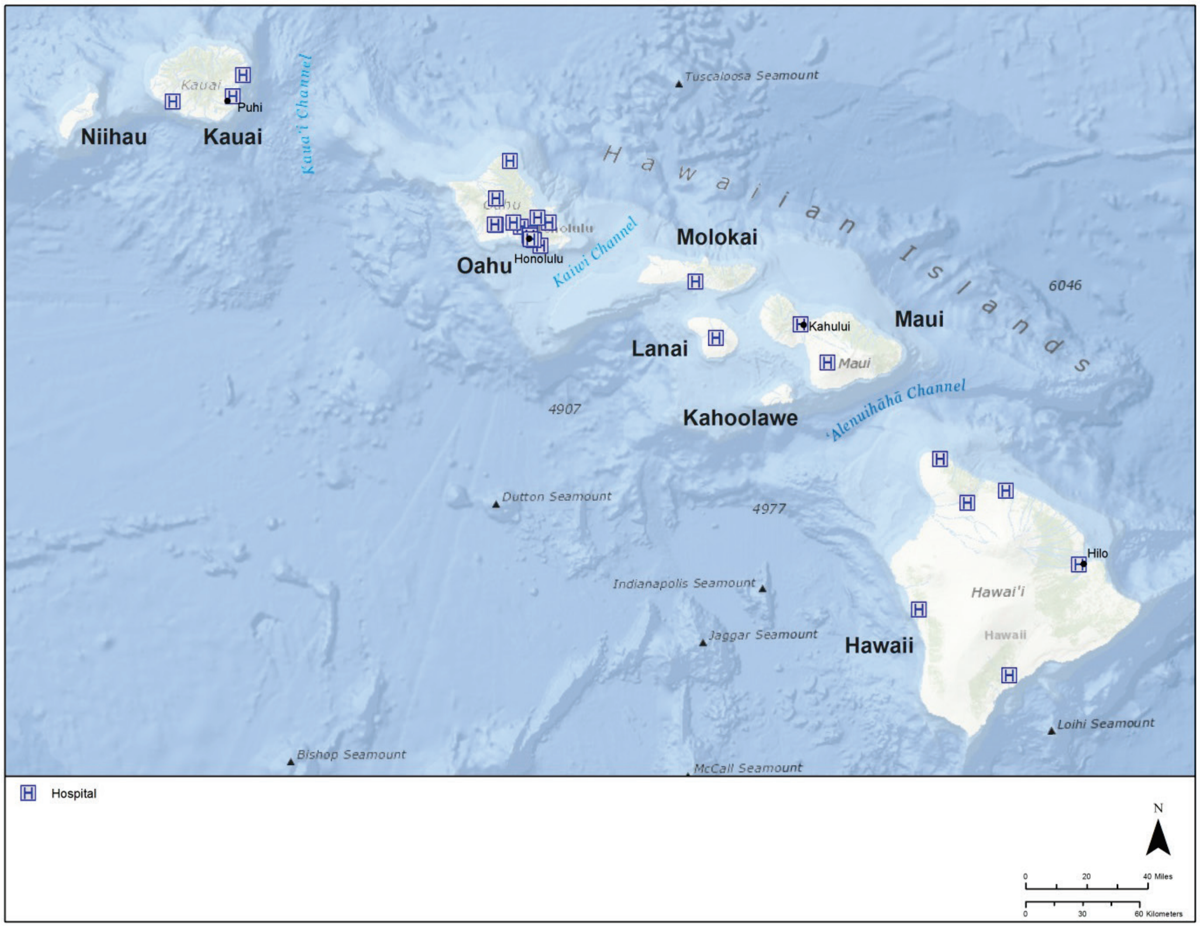
The State of Hawaii Department of Health EMS Branch administers, maintains, and operates the entire EMS system throughout Hawaii (*State of Hawaii 2015c*). There are approximately 30 hospitals in Hawaii, including both public and military facilities, as listed in Table 4.1.1-2 (*U.S. Hospital Finder 2015*). The only public trauma center in Hawaii designated by the American College of Surgeons is the Queen’s Medical Center in Honolulu. Many patients in Hawaii must be transported by airplane to various hospital facilities, like Queen’s Medical Center, if the medical need can only be addressed by specialists that are present on select islands. This has resulted in a number of issues including overcrowding of hospital facilities, backup of patients requiring aircraft transfer, delay of critical medical attention, and financial burdens (*State of Hawaii 2012*).

The distribution of hospitals by county is displayed in Figure 4.1.1-4.

Table 4.1.1-2: Hospitals by County in the State of Hawaii

County of Hawaii	City and County of Honolulu	County of Kauai	County of Maui
• Hale Hoʻola Hamakua • Hilo Medical Center • Kau Hospital • Kohala Hospital • North Hawaii Community Hospital • Kona Community Hospital	• Castle Medical Center • Hawaii Medical Center East • Hawaii State Hospital • Kahi Mohala Behavioral Health • Kaiser Permanente Medical Center • Kapiolani Med Center at Pali Momi • Kapiolani Med Center for Women • Kuakini Medical Center • Leahi Hospital • Straub Clinic & Hospital • St. Francis Medical Center-West • Shriners Hospital for Children • Rehab Hospital of the Pacific • Queen's Medical Center • Tripler Army Medical Center • Kahuku Hospital • Wahiawa General Hospital	• Kauai Veterans Mem Hospital • Samuel Mahelona Memorial Hospital • Wilcox Memorial Hospital	• Kula Hospital • Lanai Community Hospital • Maui Memorial Medical Center • Molokai General Hospital

Source: U.S. Hospital Finder 2015



Source: Oak Ridge National Laboratory 2014

Figure 4.1.1-4: Hawaii Hospitals

County of Hawaii

The county of Hawaii Fire Department provides emergency medical services (EMS) for the county of Hawaii. The Hawaii District Health Offices Manage all matters related to emergency preparedness, family health services, nursing, developmentally impaired, and environmental health services, and have offices located in Hilo, Kona, and Waimea (*State of Hawaii Department of Health 2015b*).

City and County of Honolulu

The Honolulu Emergency Services Department is responsible for EMS within the county of Honolulu. The city and county of Honolulu is home to two Rapid Response Paramedic units and 20 EMS Advanced Life Support Ambulances distributed over two districts (*City and County of Honolulu 2014*).

County of Maui

Maui County Fire Department is responsible for all EMS services that occur within the county of Maui (Maui, Molokai, Kahoʻolawe and Lanai). The EMS force in Maui County contains nine ambulances in Maui, one unit in Lanai and one unit on Molokai (*Radio AH7E Hawaii 2009b*). The Maui District Health Service Office, headquartered on the Island of Maui, is responsible for such services as family Health, public health nursing, and emergency preparedness (*State of Hawaii Department of Health 2015a*).

County of Kauai

The County of Kauai Fire Department provides EMS services for the County (*County of Kauai 2015a*).

4.1.1.5. Communications

Over the years numerous lives have been lost as a result of the lack of interoperability in public safety telecommunications in America. The Final Report of the Public Safety Wireless Advisory Committee identified three main issues in public safety communications: 1) congested radio frequencies; 2) the inability of public safety officials to communicate with each other due to incompatible equipment, multiple frequency bands and lack of standardization in repeater spacing and transmission formats; and 3) the lack of cutting edge communications technologies (*Public Safety Wireless Advisory Committee 1996*). Large-scale emergency situations like Hurricane Sandy and the September 11 attacks further exposed vulnerabilities in the public safety communications systems, especially as it related to inadequate infrastructure. Although these events did not impact Hawaii, similar vulnerabilities exist throughout the United States. During Hurricane Sandy, resilient infrastructure to withstand weather related risks was not available, which led to devastating power outages, fuel shortages, and significant road and transit complications (*HSRTF 2013*). Likewise, based on the September 11 attacks the National Task Force on Interoperability concluded that more effective infrastructure capable of supporting interoperable radio communications could have resulted in the preservation of numerous lives (*NTFI 20035*). Additionally the National Task Force on Interoperability asserts that during major emergencies it is often extremely difficult for first responders to communicate across jurisdictions given the reliance on multiple separate and incompatible communications systems (*NTFI 2003*).

Hawaii has a complex geography and a fragmented landscape and is prone to natural catastrophes like hurricanes, tsunamis, and earthquakes, which add an extra level of challenge in ensuring adequate communication systems are in place (*State of Hawaii 2012*).

Public Safety Communications

HIANG plays a key role in state communications. The operations at the Air National Guard communications stations include the installation, administrations, and maintenance of high frequency radio systems, telephone and computer networks, security, and air traffic control. These communications stations are key communications resources during state-declared emergencies and are able to disperse emergency communications throughout the world (*State of*

Hawaii 2015b). The communication methods used by various public safety services in Hawaii are listed in Table 4.1.1-3.

Table 4.1.1-3: Public Safety Communications System

Public Safety Service	Communications Systems
Police Services	• The Pacific Mobile Emergency Radio System (PACMERS) Land Mobile Radio (LMR) • State of Hawaii Emergency Alert System (EAS) • Amber Alert System • Silver Alert System • 911 Emergency
Fire Services	• The Pacific Mobile Emergency Radio System (PACMERS) Land Mobile Radio (LMR) • National Fire Incident Reporting System (NFIRS) • 911 Emergency
EMS/Hospital Services	• The Pacific Mobile Emergency Radio System (PACMERS) Land Mobile Radio (LMR) • MEDICOM radio network • 911 Emergency

Sources: State of Hawaii 2003; Radio Reference 2015

All Other Communications

The communication methods used during disaster events and other services in the state of Hawaii are listed in Table 4.1.1-4.

Table 4.1.1-4: Other Communication Systems

Public Safety Service	Communications Systems
Transportation	• The Pacific Mobile Emergency Radio System (PACMERS) Land Mobile Radio (LMR) • 511 Traveler Information
Hawaii Disaster Officials	• National Incident Management System (NIMS) • Amateur Civil Emergency Service (RACES) program
Watch/Warning communication	• National Weather Wire Satellite System (NWWS) • National Oceanic and Atmospheric Administration (NOAA) Weather Radio All Hazards • Very High Frequency (VHF) Radio System • Maka‘ala Maui County Emergency Alert System

Sources: Hashiro 2014; DHS 2008, NOAA 2015; County of Maui 2015a

4.1.1.6. Other Utilities

Energy

In 2012, Hawaii produced 21 trillion British thermal units of energy. Hawaii's crude oil refinery capacity was 147,500 barrels per calendar day as of January 14, 2014, and the state had an electric power industry net summer capacity of 2,673 megawatts in 2015. Total net electricity generation in Hawaii was approximately 776 thousand Megawatt hours in 2015. Of the total electricity in Hawaii in 2015, 67.9 percent was generated from petroleum-fired sources, 17.1 percent was generated from coal fired sources, and 12.1 percent was generated from other renewable sources (*EIA 2015*). Hawaii maintains 0.817 gigawatt-hours of renewable energy every year (*ASCE 2015*).

The State of Hawaii and the U.S. Department of Energy have joined together to form the Hawaii Clean Energy Initiative. This partnership is intended to increase energy efficiency in the state, maximize renewable energy resources, and eventually achieve a 100 percent sustainable energy plan by 2045. Currently, Hawaii utilizes a variety of renewable energy sources including solar energy, wind energy, thermal energy from the sea, and geothermal energy taps from the land, however, imported oil still supplies 90 percent of the State's energy (*State of Hawaii 2015a*). The only remaining coal-fired power plant in the State is the AES Corporation Hawaii Power Plant, located on the Island of Oahu (*EIA 2015*).

Wastewater

County of Hawaii

The County of Hawaii Department of Environmental Management Wastewater Division controls all wastewater treatment and collection matters in the county. Main sewer lines in the County of Hawaii are located in Konokaa, Kailua-Kona, Hilo, Paukaa and Papaikou, Pepeekeo, Kapehu Camp, and Honokaa (*County of Hawaii 2014*).

City and County of Honolulu

As with public safety services, wastewater, and other environmental services are also managed by the county. The Department of Environmental Services manages wastewater systems in the City and County of Honolulu. The wastewater system is made up of 2,100 miles of pipeline and 70 pump stations (*City and County of Honolulu DES 2015b*). Nine wastewater treatment plants are distributed throughout the City and County of Honolulu. Each day approximately 100 million gallons per day (mgd) of wastewater is collected in the county (C*ity and County of Honolulu DES 2015b*).

County of Maui

The Department of Environmental Management Wastewater Reclamation Division manages wastewater in the County of Maui. The County of Maui recycles approximately 5 billion gallons of wastewater per year (*County of Maui DEM 2015*). Maui County has five wastewater reclamation facilities located in the county–three facilities on the Island of Maui, one on Lanai and one on Molokai (*Parabicoli 2013*).

County of Kauai

The County of Kauai operates four wastewater treatment facilities located in Waimea, Eleele, Lihue, and Wailua. Waimea Treatment Plant has the capacity to treat 0.3 mgd of wastewater, Eleele Treatment Plant has the capacity to treat 0.8 mgd of wastewater, Lihue Treatment Plant has a capacity of 2.5 mgd, and Wailua Treatment plant has a capacity to treat 1.5 mgd (*Carter and Burgess, Inc. 2002*).

Water Supply

Approximately 50 percent of the water supply in Hawaii comes from groundwater sources and about 50 percent comes from surface water sources (*State of Hawaii Department of Land and Natural Resources 2015*). The primary source of potable water in the State of Hawaii is groundwater. Groundwater is the source of 99 percent of the municipal water usage in Hawaii and is also the source of 50 percent of freshwater usage in the entire state (*USGS 2000*). The County of Hawaii Department of Water Supply (HDWS), Kauai Department of Water (KDOW), the Maui Department of Water Supply (MDWS), and Board of Water Supply are the public water supply agencies responsible for providing potable and non-potable water to the people of Hawaii (*State of Hawaii Department of Land and Natural Resources 2015*).

Storm Water

Hawaii Department of Transportation is responsible for storm water management in the state. The Storm Water Management Program is divided into three divisions within the DOT: Airports Division, Harbors Division, and Highways Division (*HDOT 2015*). Within the Airports Division, storm water plans exist for Molokai Airport, Lihue Airport, Kahului Airport, and Honolulu International Airport. Within the Harbors Division, Honolulu Harbor, and Kalaeloa Barber's Point Harbor have Storm Water Management Plans (*HDOT 2015*).

Only Oahu and Maui have storm water programs within the Highways Division. Oahu alone contains 9,000 storm drain inlets and 2,200 outfall locations (*City and County of Honolulu DES 2015a*). The City and County of Honolulu operates a Municipal Separate Sewer System (MS4). The system is made up of catch basins, curbs, ditches, storm drains, and man-made channels located along state roads. Storm water from the MS4 is not treated or filtered and is discharged into streams and the Pacific Ocean (*City and County of Honolulu DES 2015a*). Maui also operates an MS4 with storm drains located along the State-owned roadways in Kahului. Storm water from the Maui District is drained into the Pacific Ocean (*HDOT 2015*).

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4.1.2. Soils

4.1.2.1. Introduction

This section discusses the existing soil resources in Hawaii. Information is presented regarding soil features and characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

The Soil Science Society of America defines soil as:

> "(i) The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants.
>
> (ii) The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics." *(NRCS 2015*)

Five primary factors account for soil development patterns. A combination of the following variables contributes to the soil type in a particular area (*Anderson et al. 2001*):

- *Parent Material:* The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate:* Chemical changes in parent material occur slowly in low temperatures. However, hot temperatures evaporate moisture, which also facilitates chemical reactions within soils. The highest degree of reaction within soils occurs in temperate, moist climates.
- *Topography:* Steeper slopes produce increased runoff, and, therefore, downslope movement of soils. Slope orientation also dictates the microclimate to which soils are exposed, because different slope faces receive more sunlight than others.

4.1.2.2. Specific Regulatory Considerations

Local or state-level permits are required in Hawaii for ground disturbance activities in order to reduce soil erosion and sedimentation.[1] There are no other Hawaii-specific regulatory considerations that pertain to the Proposed Action outside of those discussed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders, and Appendix C, *Environmental Laws and Regulations*.

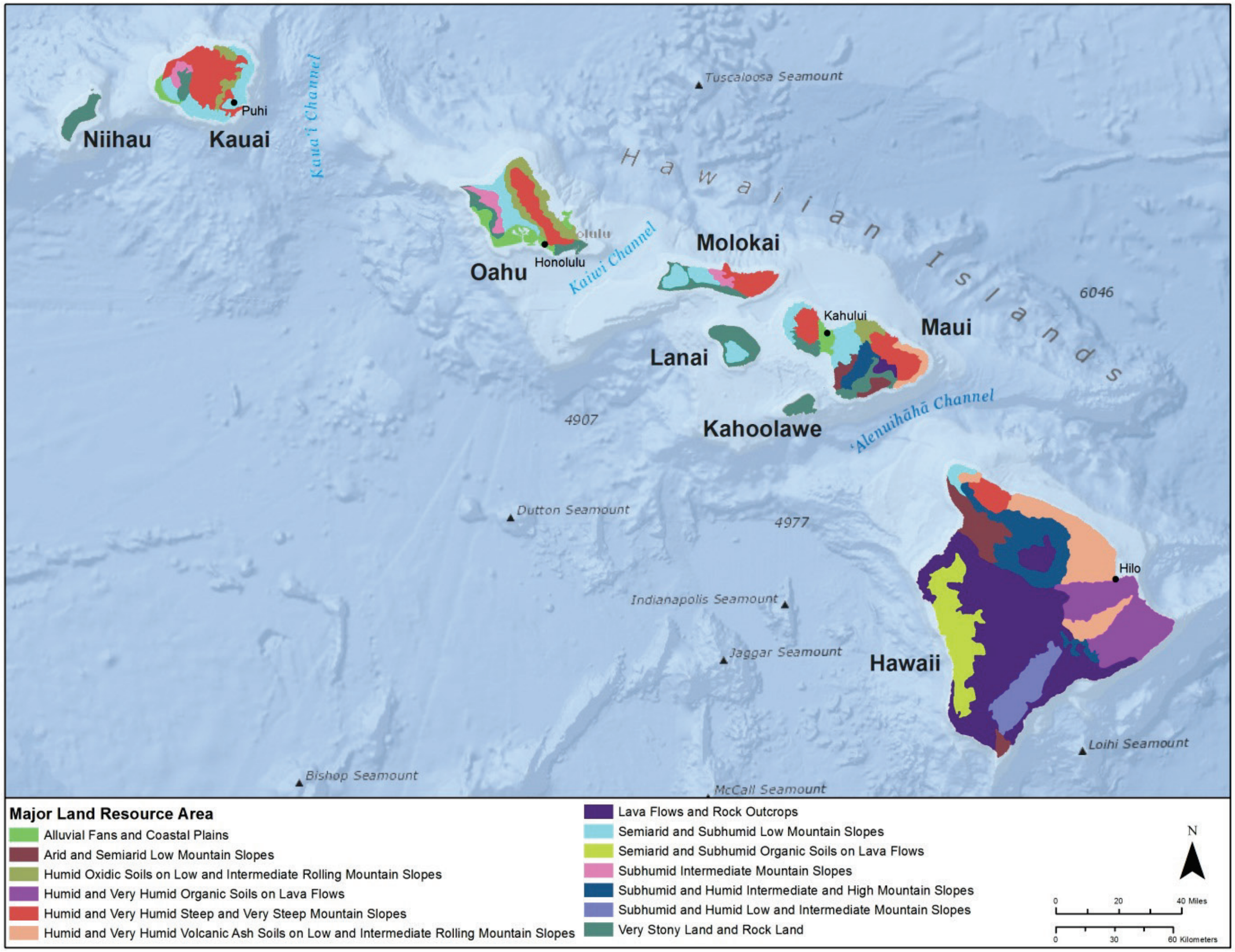
4.1.2.3. Environmental Setting

Soil formation occurs due to complex and multiple interactions among geologic material, climate, topography, biological processes (such as vegetation growth and interactions with other organisms), and time. The soil resources present in Hawaii were identified, evaluated, and described using information gathered from and characteristics as defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO2) soil order and suborder information (*STATSGO2 Database 2015*) database and the NRCS's Major Land Resource Areas (MLRAs) soil descriptions[2] (*NRCS 2006*).

Hawaii is located in the Hawaii land resource region. Within this region, there are 13 distinct land resource areas in Hawaii (see Figure 4.1.2-1). A summary of the typical physiographic characteristics and soils types found within each land resource area is included in Table 4.1.2-1.

[1] See Section 4.2.2 for specific information related to best management practices that would be implemented to reduce or avoid potential impacts to soil resources.

[2] The NRCS categorizes soil resources into land resource units based on significant geographic differences in soils, climate, water resources, or land use. These land resource units are typically coextensive with general soil map units at the state level. Geographically associated land resource units are further grouped into major land resource areas, which are then grouped into land resource regions. These large areas are important for statewide agricultural planning as well as interstate, regional, and national planning.



Source: NRCS 2006

Figure 4.1.2-1: Major Land Resource Areas of Hawaii

Table 4.1.2-1: Major Land Resource Areas in Hawaii

MLRA Name	Physiographic Characteristics	General Soil Characteristics
Alluvial Fans and Coastal Plains	Consists of nearly level and gently sloping coastal plains and alluvial fans	Very deep to shallow, excessively well drained to poorly drained, and clayey
Arid and Semiarid Low Mountain Slopes	Consists of moderately dissected, gently sloping to steep leeward mountain slopes on Maui and Hawaii	Moderately deep to very deep, well drained, and loamy
Humid Oxidic Soils on Low and Intermediate Rolling Mountain Slopes	Found on windward, low and intermediate mountain and hill slopes of the older islands; steep gulches dissect rolling mountain slopes	Very deep, well drained, well to poorly drained, and very fine textured
Humid and Very Humid Organic Soils on Lava Flows	Found on southeastern slopes of Mauna Loa and Kilauea volcanoes; slopes are undulating to very steep and follow topography of lava flows	Shallow over lava flows; in some areas lava flows are too young to have obtained enough organic material to form soils
Humid and Very Humid Steep and Very Steep Mountain Slopes	Consists of deeply dissected mountainous areas of older Hawaiian Islands; steep with ridges, gulches, and canyons	Deep, poorly drained to well drained
Humid and Very Humid Volcanic Ash Soils on Low and Intermediate Rolling Mountain Slopes	On the windward, wetter side of Hawaii and Maui; consists of rolling slopes	Very deep, well or moderately well drained
Lava Flows and Rock Outcrops	Consists of barren lava flows, rocky cliffs and outcrops, and steep cinder cones	Organic soils formed over lava flows or volcanic ash
Semiarid and Subhumid Low Mountain Slopes	Primarily on the leeward, drier side of older islands of the Hawaiian Islands chain; slopes are nearly level to moderately steep	Very deep, well drained, and fine textured
Semiarid and Subhumid Organic Soils on Lava Flows	Found on western slopes of Mauna Loa and Hualalai volcanoes; slopes are undulating to very steep and follow rugged topography of lava flows	Very shallow to moderately deep and well drained
Subhumid Intermediate Mountain Slopes	Found on leeward, drier slopes; slopes are rolling and dissected by steep gulches	Deep, well drained, and fine textured or very fine textured
Subhumid and Humid Intermediate and High Mountain Slopes	Gently sloping to hilly commonly with cinder cones	Deep and well drained
Subhumid and Humid Low and Intermediate Mountain Slopes	Found on low/intermediate slopes of Mauna Loa; moderately dissected, gently or rolling slopes	Very deep to very shallow, well drained or moderately well drained
Very Stony Land and Rock Land	Stoney complex slopes and rocky gulches	Shallow, well drained, and clayey

Source: NRCS 2006

4.1.2.4. Soil Suborder Characteristics

The STATSGO2 soil database identified 18 soil suborders in Hawaii. Table 4.1.2-2 provides a summary of the major physical-chemical characteristics of the various soil suborders in Hawaii, and Figure 4.1.2-2 (located after the table) depicts the distribution of the suborders addressed in the table. A summary of the major soil characteristics relevant to the types of activities expected to be associated with the Proposed Action is presented in the table below.

Slope and Runoff and Erosion Potential

Slopes on Hawaii range from 0 to 90 percent (flat to very steep). The characteristic clayey and loamy soils combined with steep slopes tend to result in a moderate to high potential for runoff and erosion, as indicated in Table 4.1.2-2. Generally, runoff and erosion diminish soil fertility as the topsoil is eroded away; this often leads to increased sedimentation in nearby surface waterbodies and can be exacerbated by ground disturbance activities. In addition, areas with very steep slopes with high potential for runoff and erosion are not well suited as construction locations. As explained in Section 4.1.2.3, Environmental Setting, about half of the major land resource areas in Hawaii are characterized as has having areas with steep slopes.

Drainage Class and Permeability

With the exception of the Udands, Aquepts, and Aquolls soil suborders that have high moisture content and/or groundwater at or near the soil surface, most other soils on Hawaii are characterized as moderately well drained, well drained, or excessively well drained. Permeability ranges from slow to fast (see Table 4.1.2-2).

Hydric Soils

Hydric soils are formed under wet conditions, such as in areas prone to flooding or ponding. In order for hydric soils to develop, these areas must be wet long enough during the growing season to develop anaerobic conditions that support the growth of water-tolerant vegetation, such as the vegetation found in certain wetland environments. Based on soil suborder level data, hydric soils were not identified in Hawaii. However, certain soil types on the islands of Hawaii, Molokai, Kauai, Maui, Oahu, and Kahoolawe do contain hydric soils based on the National Hydric Soils List.

Compaction and Rutting Potential

Compaction and rutting[3] potential for soils found on Hawaii is generally moderate given the soil textures and drainage classes of the soils present. Of the soils present on Hawaii, the Psamments, Aquepts, and Aquolls soil suborders likely have the greatest potential for compaction and rutting because these soil types are subject to flooding, are poorly drained, or are subject to blowing and drifting. In general, wet soils tend to have a lower resistance to compaction and rutting than dry soils.

[3] A soil rut is a sunken track or groove made by vehicle or equipment activity.

Table 4.1.2-2: General Characteristics of Soil Suborders Found in Hawaii

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
Andisols	Udands	Formed in volcanic material; most formed under forest vegetation and used primarily as forest; some have been cleared for cropland or pasture; found in humid climates; high moisture content.	Silty clay loam; cobbly loam	0 - 70	Low to high	Slight to severe	Well drained to somewhat poorly drained	Moderate	No	Moderate
	Ustands	Formed under forest or savanna vegetation; used mostly as forest, cropland, or pasture for urban development; found in semiarid and subhumid climates; high moisture content.	Loam; silt loam; fine sandy loam;	0 - 70	Low to high	Slight to severe	Well drained	Moderate	No	Moderate
	Vitrands	Most formed under coniferous vegetation and used mostly as forest, but some are used as rangeland and some cleared for crops or pasture.	Sandy loam	12 - 20	Moderate to high	Moderate	Somewhat excessively well drained	Moderate to fast	No	Low to moderate

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
Aridisols	Cambids	Characterized as having the least degree of soil development of the Ardisols; most areas used as rangeland or wildlife habitat and some used for crops.	Silty clay loam	0 - 12	Low to moderate	Slight to moderate	Well drained	Moderate	No	Moderate
Entisols	Fluvents	Commonly found on floodplains; sugarcane, cultivated crops; and improved pasture cover some areas; soils generally have good potential for farming.	Very fine sandy loam	0 - 10	Moderate	Moderate	Somewhat excessively well drained	Moderate	No	Moderate
	Orthents	Commonly on recent erosional surfaces; used mostly as rangeland, pasture, or wildlife habitat; orthents are common entisols that do not meet criteria for other suborders.	Silty clay; loamy coarse sand	10 - 90	Moderate to severe	Moderate to severe	Well drained to excessively well drained	Moderate	No	Moderate
	Psamments	Very sandy, young soils; commonly wet; subject to blowing and drifting; mostly used as rangeland, pasture, or wildlife habitat.	Sand	0 - 15	Low to moderate	Moderate to severe	Excessively drained	Moderate to fast	No	Moderate to high

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
Histosols	Folists	Freely drained soils formed from organic material on bedrock; soils support some forest vegetation but primarily grass; used for specialty crops or for urban or recreational development.	Muck; peat	0 - 25	Low to moderate	Slight to moderate	Well drained	Slow to moderate	No	Moderate
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage; if these soils have not been artificially drained, ground water is at or near the soil surface; primarily used for pasture, cropland, forest, or wildlife habitat; likely formed under forest vegetation.	Gravelly silty clay loam	3 - 70	Low to severe	Slight to severe	Poorly drained	Moderate	No	Moderate to high

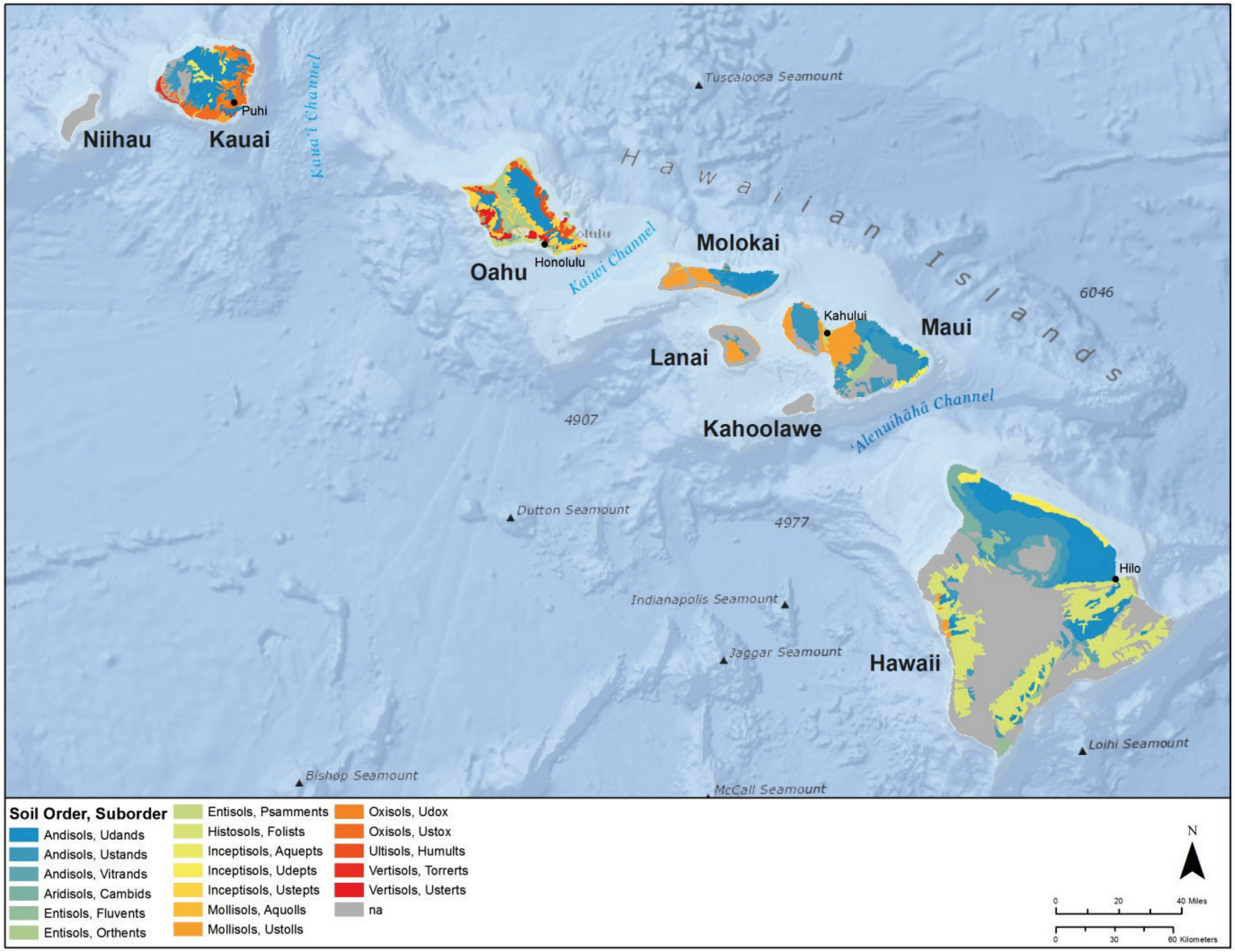
Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
	Udepts	Udepts often on steep slopes and are mainly freely drained; most areas currently support or formerly supported forest vegetation; some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Silty clay; silty clay loam	6 – 35	Moderate	Moderate	Well drained	Moderate	No	Moderate
	Ustepts	Found in semiarid and subhumid climates, on young geomorphic surfaces or resistant parent material (as with other Inceptisols).	Silty clay; silty clay loam	0 - 70	Moderate to high	Slight to severe	Well drained	Slow to moderate	No	Moderate

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
Mollisols	Aquolls	Grassland soils with a thick surface horizon, often very fertile due to organic materials; aquolls have a water table at or near the surface for much of the year; commonly wet.	Silty clay	0 – 2	Low	Slight	Poorly drained	Slow	No	Moderate to high
	Ustolls	Grassland soils with a thick surface horizon, often very fertile due to organic materials; ustolls are found in semiarid and subhumid climates.	Silty clay; silty clay loam	0 - 20	Low to moderate	Slight to moderate	Well drained	Slow to moderate	No	Moderate
Oxisols	Udox	Highly weathered soils rich in iron and aluminum; low fertility without fertilizers; udox are found in humid climates.	Silty clay	0 – 40	Low to high	Moderate to severe	Well drained	Slow to Moderate	No	Moderate
	Ustox	Highly weathered soils rich in iron and aluminum; low fertility without fertilizers; ustox are found in semiarid and subhumid climates.	Silty clay loam	0 – 40	Low to high	Moderate to severe	Well drained	Slow to Moderate	No	Moderate

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Runoff Potential	Erosion Potential	Drainage Class	Permeability[a]	Hydric Soil[b]	Compaction and Rutting Potential
Ultisols	Humults	Forest soils with low fertility with subsoil clay accumulation; humults are well-drained and have high organic matter content.	Silty clay loam	35 - 70	Moderate to high	Moderate to severe	Well drained	Slow to moderate	No	Moderate
Vertisols	Torrerts	Contain small cracks when dry; native vegetation consists of grasses and forbs and are mainly used as rangeland.	Clay	3 - 35	Low to moderate	Slight to moderate	Well drained	Slow	No	Moderate
	Usterts	Clayey soils with high shrink/swell capacity with changes in moisture; usterts are in semiarid and subhumid climates	Clay	6 - 12	Low to moderate	Slight to moderate	Moderately well drained	Slow	No	Moderate

Sources: STATSGO2 Database 2015

[a] Permeability refers to the ability and pace of the soil to allow water to pass through it.
[b] Hydric soils are explained in the text above.



Source: STATSGO2 Database 2015

Figure 4.1.2-2: Soil Suborder Map Hawaii

4.1.3. Geology

4.1.3.1. Introduction

This section discusses the geologic resources and hazards in Hawaii. Information is presented regarding geologic features and characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action, as well as geologic hazards that could potentially affect the Proposed Action.

The United States (U.S.) Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. The USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability. Several of these elements are discussed in other sections of this Draft Programmatic Environmental Impact Statement, including climate change (Section 4.1.14, Climate Change), biological resources (Section 4.1.6, Biological Resources), human health (Section 4.1.15, Human Health and Safety), and groundwater (Section 4.1.4, Water Resources).

4.1.3.2. Specific Regulatory Considerations

There are no Hawaii-specific regulatory considerations that pertain to geologic resources outside of those discussed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders, and Appendix C, *Environmental Laws and Regulations*.

4.1.3.3. Environmental Setting

General Geologic Resources

The landmasses that make up the Hawaiian Islands were formed by numerous volcanic eruptions of fluid lava over several million years (*USGS 1997a*). The volcanoes occurred (and are still occurring) as a result of the Pacific Plate passing over a relatively stationary hotspot.[1] The Pacific Plate is moving to the west-northwest over that hotspot at an average rate of about 2 to 3 inches per year, which means the oldest islands within the chain are those to the northwest (e.g., Puuwai and Kauai) and the youngest are the islands to the southeast (e.g., Hawaii and Maui; see Figure 4-1 in Chapter 4, Hawaii) (*USGS 2014b*). The island of Hawaii currently overlies the hotspot and this is where much of the current volcanic activity exists (*USGS 1999*). The volcanoes that formed the Hawaiian Islands are generally considered weakly explosive or nonexplosive as the basaltic lava is capable of easily flowing and releasing volcanic gases

[1] The Pacific Plate is a tectonic plate located within portions of the Pacific Ocean. Tectonic plates are the solid pieces of rock (or earth) that collide, move apart, or slide past each other over geologic time. A hotpot is a location where plumes of hot rock rise from within the Earth toward the surface. Lower pressures toward the surface allow rock to melt, which can result in molten rock, volcanism, and lava flows.

(*USGS 1999*).[2] Because of this, the shapes of Hawaiian volcanoes tend to be broad, with a relatively gentle slope.

As shown in Figure 4.1.3-1, the majority of the geologic material on the Hawaiian Islands consists of basalt and other volcanic material. As described in detail in Section 4.1.2, Soils, the general topography and physiographic[3] characteristics of the Islands range from nearly level and gently sloping to very steep and dissected.[4]

Mineral and Fossil Fuel Resources

Mineral production in Hawaii primarily consists of crushed stone and construction sand and gravel, which in 2011 totaled about 5,000 and 1,000 short tons[5] of material, respectively (*USGS 2015a*).[6] Gemstones are also produced in Hawaii. Although production volume estimates for gemstones are not available from the USGS, it is estimated that the value of production (based on shipments, sales, or marketable production) was about $150,000 in 2011 (*USGS 2015a*). In 2011, Hawaii ranked 47th among the 50 states for nonfuel mineral production (*USGS 2015a)*. Figure 4.1.3-2 displays the primary producing areas for each of the three mineral resource categories.

According to the U.S. Energy Information Administration, Hawaii does not produce or have any proven recoverable reserves of petroleum, natural gas, or coal (*EIA 2014*). Hawaii has two refineries, both located near Honolulu, which primarily process crude oil from Pacific Rim producers along with crude imported from Africa, Russia, South America, and the Middle East. Approximately 70 percent of Hawaii's power comes from petroleum-powered power plants, 20 percent from imported coal, and 10 percent from renewable sources.[7] Each island in Hawaii must generate their own power as the electricity grids are not connected by underwater transmission cables (*EIA 2014*).

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[2] The chemical composition of basaltic lava (including high amounts of iron, magnesium, calcium, and titanium) allows for it flow relatively easily. The ability of basaltic lava to easily allow gases to escape means that the gases usually do not build up to create high pressure environments; therefore, violent volcanic explosions are not common.

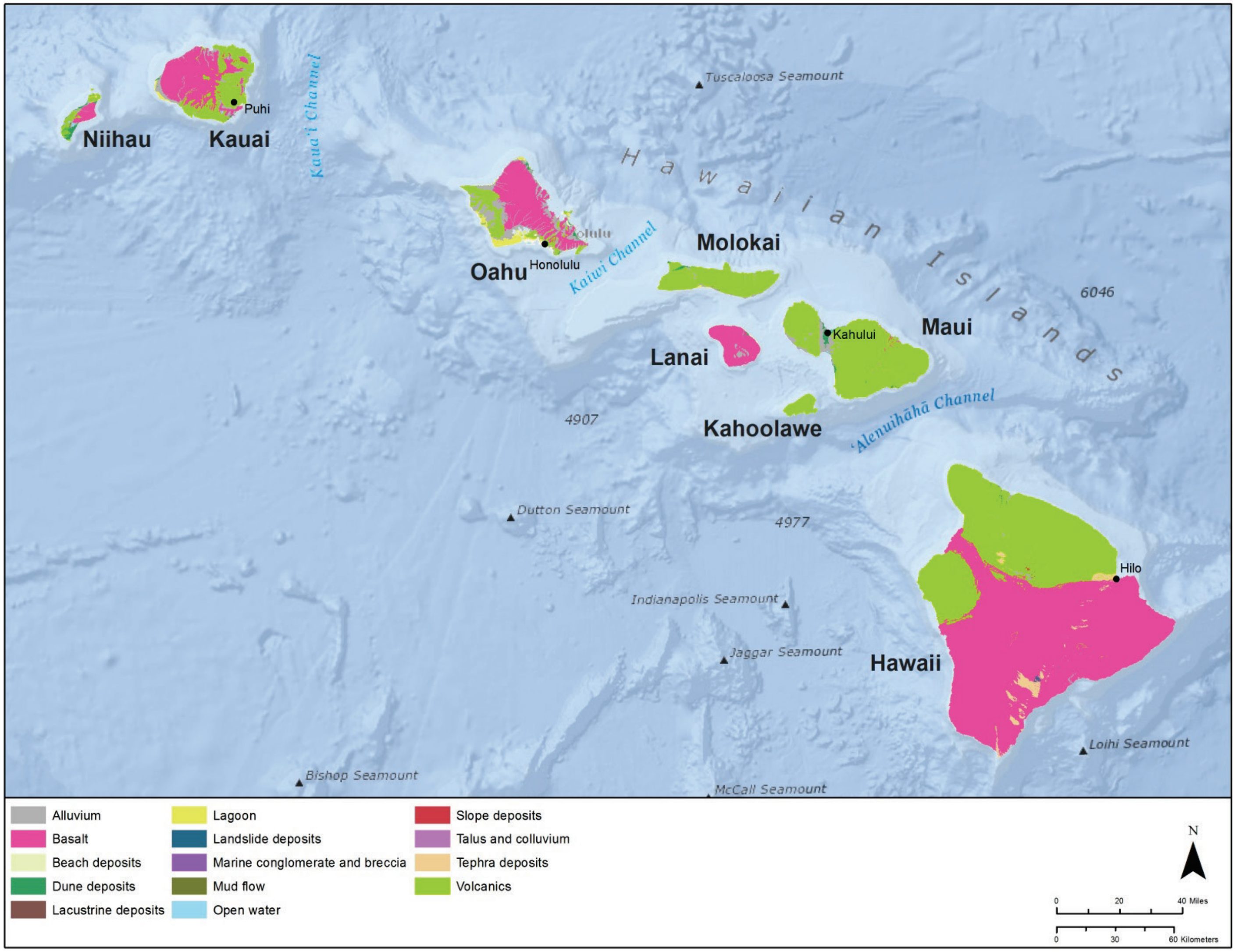
[3] Physiography refers to the description of the Earth's landforms and surface features.

[4] Table 4.1.2-1 in Section 4.1.2, Soils, provides a detailed explanation of the topography and physiographic characteristics and corresponding soil characteristics in Hawaii as they relate to the state's 13 distinct land resource areas.

[5] One short ton is equal to 2,000 pounds.

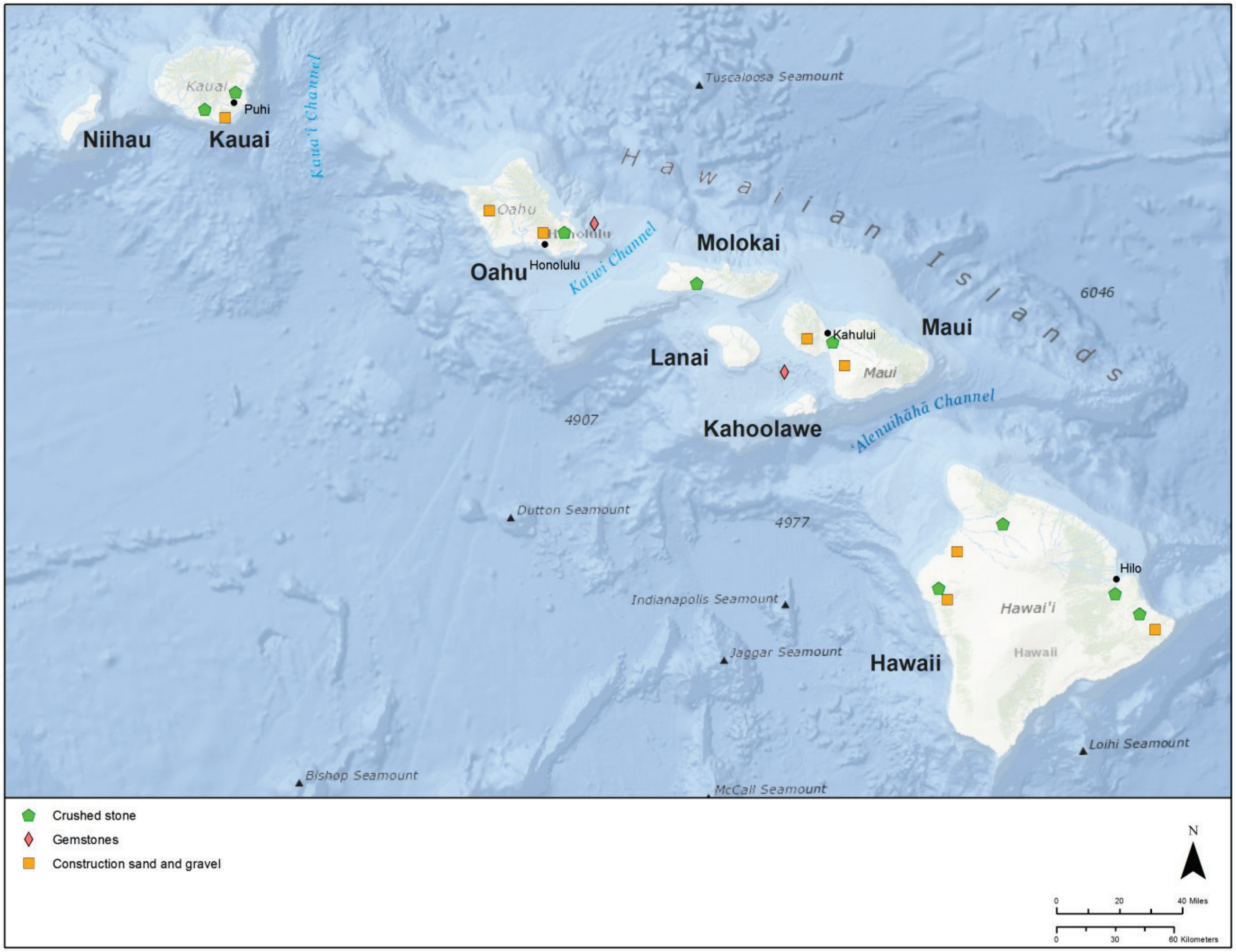
[6] The estimated production value of crushed stone in Hawaii in 2011 was $86 million; the estimated value for sand and gravel was $15.1 million (*USGS 2015a).*

[7] See Section 4.1.1, Infrastructure, for additional information regarding Hawaii's energy sources.



Source: Modified from Sherrod et al. 2007

Figure 4.1.3-1: Simplified Geologic Map of Hawaii



Source: USGS 2015a

Figure 4.1.3-2: Primary Mineral Production Areas in Hawaii

Paleontological Resources[8]

The Hawaiian Islands are much younger geologically than the contiguous U.S. Because of this and the fact that the islands are composed almost entirely of lava flows, very few fossils have been preserved in Hawaii in comparison to other U.S. states with longer geologic histories and more conducive preservation environments over geologic time.[9] Fossils known to exist in Hawaii include various reefs, corals and other sea animals, and birds. During the restoration of tidal pools in the Pearl Harbor National Wildlife Refuge in Oahu in 2009, for example, the U.S. Fish and Wildlife Service found fossilized bones of an extinct hawk, long-legged owl, Hawaiian sea eagle, petrel, two species of crow, Hawaiian finches and honeyeaters, and a mao nalo[10]. It was suggested that the bones could be between 1,000 and 8,000 years old (*USFWS 2009*). Additionally, some lava flows in Hawaii may preserve the shapes of trees and other materials if the molten material solidifies around them (*USGS 2009a*).

4.1.3.4. Geologic Hazards

Geologic hazards exist in many areas in Hawaii, including seismic and volcanic activity, landslides, and land subsidence.

Seismic and Volcanic Activity

Seismic activity and earthquakes in Hawaii occur not as a result of movement and friction along the edges of tectonic plate boundaries as it does in most areas prone to earthquakes, but as a result of volcanic activity associated with Hawaii's hotspot (*USGS 2014c*). According to a seismicity map of the state from 1973 to March 2012, most earthquakes in Hawaii have occurred within or in the near vicinity of the island of Hawaii; this corresponds to the location of the most volcanic activity (*USGS 2014a*). Most of the earthquakes recorded away from the island of Hawaii were of the smallest magnitude mapped, from magnitude 5 to 6 on the Richter scale; the largest magnitude earthquakes were concentrated along the southeast portion of the island of Hawaii (*USGS 2014a*).[11]

Figure 4.1.3-3 below displays a graphical representation of the areas with the highest and lowest seismic hazard risks.[12]

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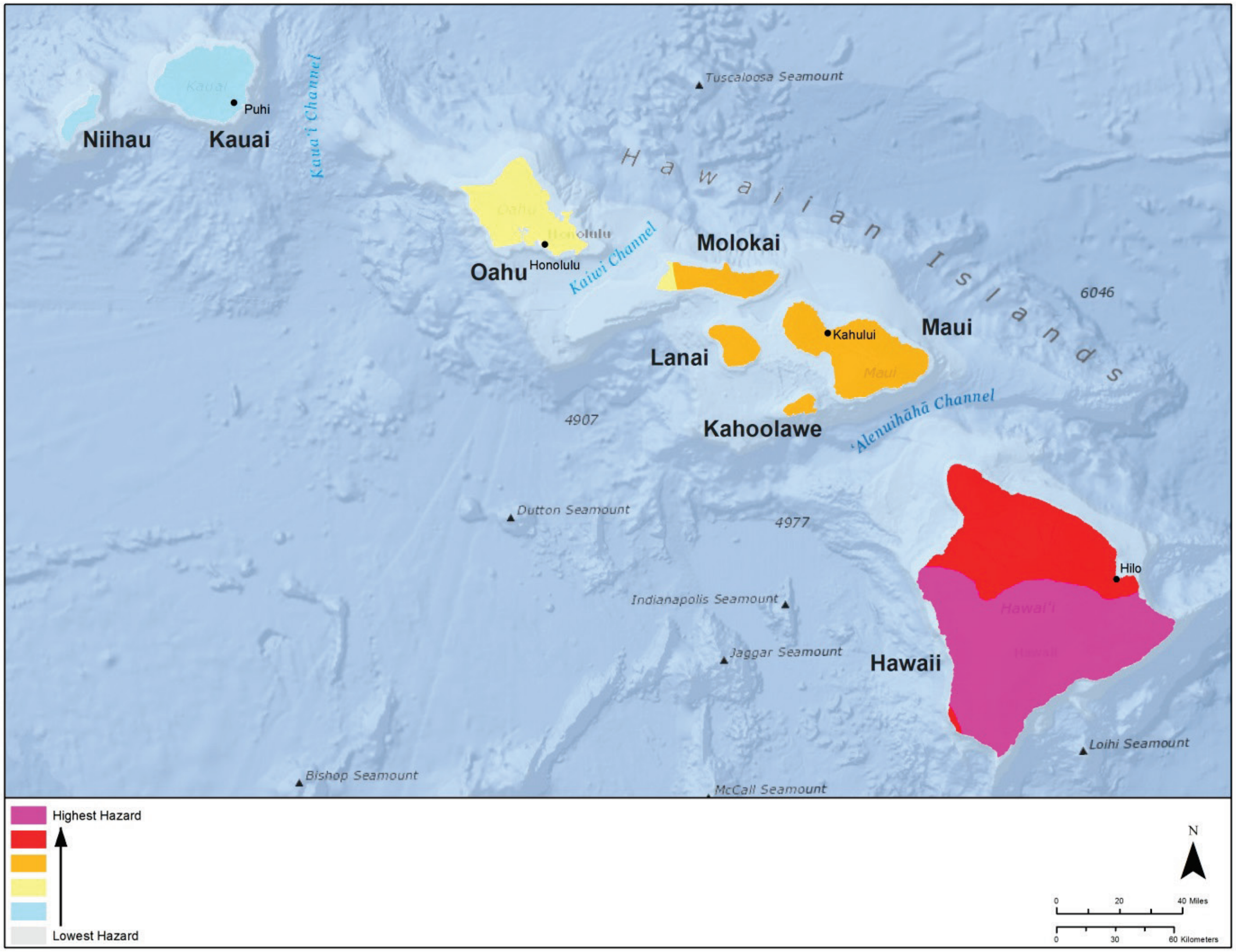
[8] Paleontological resources, or fossils, are the physical remains of plants and animals that have mineralized into or left impressions in solid rock or sediment.

[9] Dinosaurs, for example, were present on earth approximately 200 to 65 million years ago, well before the Hawaiian Islands were formed.

[10] A moa nalo (meaning lost fowl) is an extinct duck-like bird with small wings and large back limbs.

[11] Earthquakes with magnitudes of 3 or less are generally not felt. Magnitudes greater than 6 can cause widespread damage (*USGS 2012a*).

[12] Data from USGS were mapped showing the levels of horizontal ground shaking that have a 10 percent probability of exceedance in 50 years. This map was then simplified and scaled to show the areas ranging from high to low hazard potential.



Source: USGS 2012b

Figure 4.1.3-3: General Seismic Hazard Map of Hawaii

Earthquakes can lead to abrupt disturbances of the ocean floor and ocean water that can cause tsunamis. Tsunamis are large ocean waves that form as a result of water displacement (*USGS 1997b*). The source of a tsunami in Hawaii can originate from anywhere in the Pacific Ocean, or locally as a result of earthquakes on or near the island (*USGS 1997b*). Since the year 1811, approximately 32 tsunamis with a runup[13] of more than 3 feet have occurred in Hawaii (*USGS 2015d*).

There are currently six active or dormant volcanos in Hawaii and these include, in order from youngest to oldest: Loihi, Kilauea, Mauna Loa, Haualalai, Mouna Kea, and Haleakala (*NOAA Undated; USGS 2015f*). Figure 4.1.3-4 depicts the locations of these volcanoes and Table 4.1.3-1 provides a summary of their eruption history.

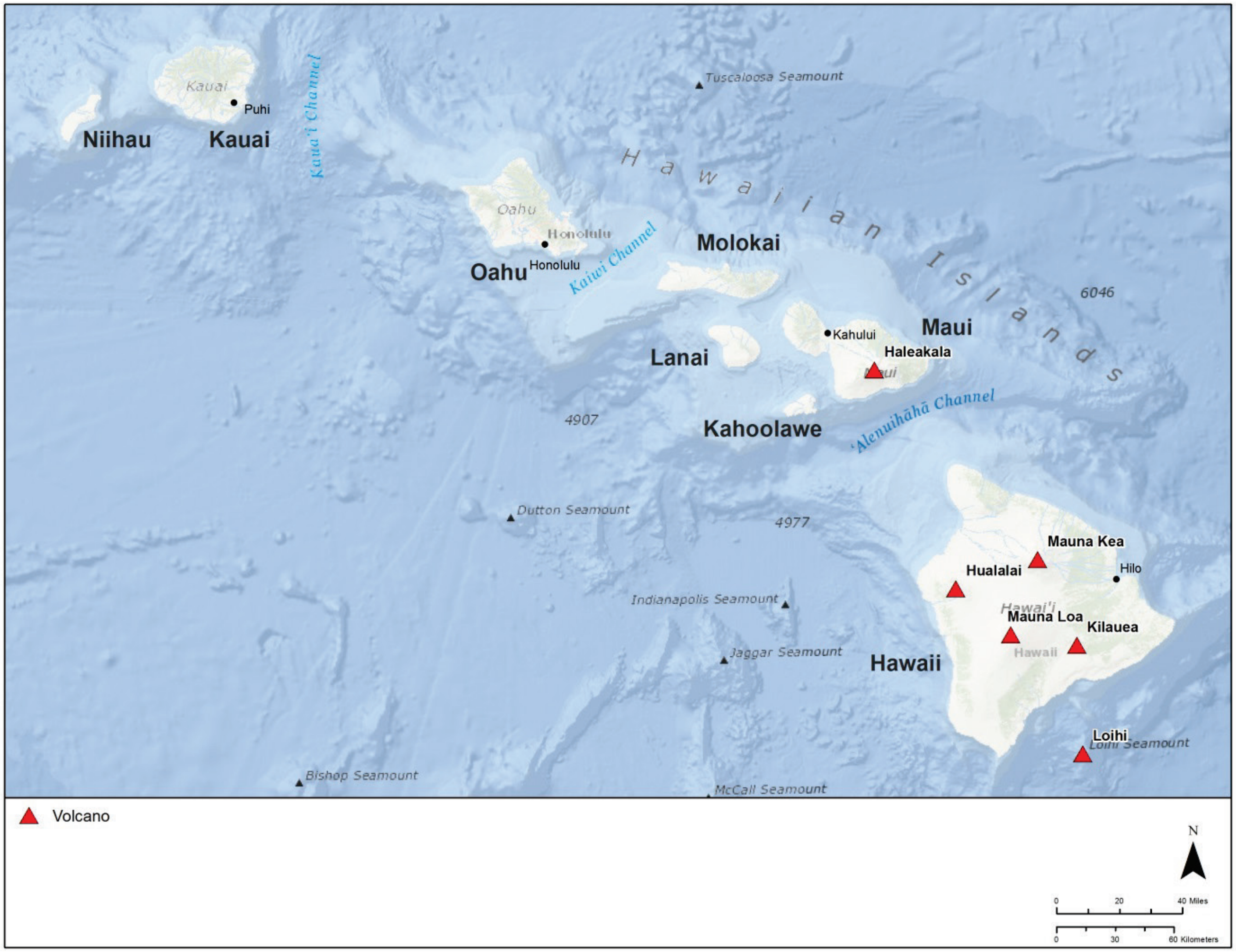
Table 4.1.3-1: Volcanoes in Hawaii

Name	Activity Status and Description[a]	Last Eruptions (Approximate)/Notes
Loihi	Active; Submarine volcano	1996
Kilauea	Active; Shield volcano	Recent and ongoing eruptions since 1983
Mauna Loa	Active; Shield volcano	1984
Haualalai	Active; Shield volcano	Erupted seven times in last 2,100 years; most recent eruptions were in 1800 and 1801
Mouna Kea	Dormant; Shield volcano	3,600 years ago
Haleakala	Active; Shield volcano	1790

Source: NOAA Undated; NPS 2015; USGS 2015c; USGS 2003

[a] Submarine volcanoes are those occurring beneath the ocean surface. In this context, shield volcanoes are above the ocean surface and have broad, gentle slopes and are composed of fluid basalt (*USGS 2009b).*

[13] The term runup refers to the height the wave reaches above sea level before washing to shore (*USGS 2015d*).



Source: NOAA Undated; USGS 2015f

Figure 4.1.3-4: Active and Dormant Volcanoes in Hawaii

Landslides

The term "landslide" refers to processes that lead to the downhill movement of earth materials due to gravity and other forces (*USGS 2004*). In the United States, the Pacific Coast ranges, the Rocky and Appalachian Mountain areas, and Alaska and Hawaii have the most severe risk for landslide susceptibility due to the abundance of potential factors that may cause slope instability (*American Geosciences Institute 2014*). In Hawaii, excessive rainfall, seismic activity, and volcanic activity can trigger local landslides, especially near areas with steep slopes having loose or unconsolidated material. In the Honolulu area in January 1988, for example, heavy rainfall led to more than 400 debris flows that accounted for approximately $34 million in damages (*USGS 1995*).

The latest USGS landslide hazard map of the U.S. was published in 1982; however, this map did not include the non-contiguous U.S. (*USGS 1982*; *American Geosciences Institute 2014*). The USGS is currently implementing a Landslide Inventory Pilot Project for displaying and analyzing landslide data; information for Hawaii, Alaska, and U.S. territories was not available at the time of writing this report (*USGS 2015b*).

Sea floor mapping off the coast of the Hawaiian Islands (as well as other research) has indicated that 17 distinct, catastrophic terrestrial landslides have occurred over the last several million years, occurring approximately once every 350,000 years (*USGS 2014b*).

Land Subsidence

Land subsidence is the downward settling or sudden sinking of the Earth's surface (*USGS 2013*). The main causes of land subsidence may include groundwater level declines, drainage of organic soils, underground mining, excessive wetting of soils, natural compaction, sinkholes, and thawing permafrost (*USGS 2013*). As is the case with karst topography[14], land subsidence can also occur in areas with an abundance of underlying soluble rocks and minerals, such as limestone, gypsum, or salt, which have the potential to dissolve in water and wash out from the area (*USGS 2013*). On all major islands in Hawaii, with the exception of Kaho'olawe and Hawaii, karst terrain can be found in some limestone rocks in small, island-fringing areas (*Weary and Doctor 2014*). The Ewa Plain, located in southwest Oahu, is the largest known karst area in Hawaii and possesses numerous surface and subsurface karst features such as sink holes (*Halliday 2003*). The Hawaii State Legislature recently recognized the historic, cultural, and scientific value of the Ewa Plain and its sinkholes as well as the karst aquifer of Pearl Harbor (*Hawaii State Legislature 2015*). Additionally, land subsidence in Hawaii can also occur locally if existing lava tubes[15] collapse.

[14] "Karst is a terrain with distinctive landforms and hydrology created from the dissolution of soluble rocks, principally limestone and dolomite. Karst terrain is characterized by springs, caves, sinkholes, and a unique hydrogeology." (*USGS Undated*)
[15] "Lava tubes are natural conduits through which lava travels beneath the surface of a lava flow." (*USGS 2015e*)

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4.1.4. Water Resources

4.1.4.1. Introduction

This section discusses water resources in Hawaii, including surface water, floodplains, nearshore marine waters, and groundwater. Information is presented regarding features and characteristics of these waters that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 4.1.5, Wetlands). These resources can be grouped into watersheds, areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and the maintenance of natural infrastructure and ecological services (*USGS 2014*).

4.1.4.2. Specific Regulatory Considerations

Water quality is federally regulated pursuant to the Clean Water Act (CWA) (see Section 1.8.7, Clean Water Act), which is administered by the Clean Water Branch, Environmental Management Division, State Department of Health in Hawaii.

The Sole Source Aquifer (SSA) protection program, authorized under the Safe Drinking Water Act (*42 United States Code [USC] Section 300f* et seq.) is designed to protect drinking water in areas with few or no alternatives to the groundwater resource and where, if contamination occurred, using an alternative source of drinking water would be extremely expensive. The U.S. Environmental Protection Agency defines an SSA as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. Any potential effects to SSAs or other critical aquifers, or adversely affect any surface water supplies would be controlled through these requirements.

The National Flood Insurance Program (NFIP) is a federal program managed by the Federal Emergency Management Administration (FEMA) that allows property owners in participating communities to purchase flood insurance with rates established through the National Flood Insurance Rate Maps.[1] The Hawaii Department of Land and Natural Resources is designated as the State Coordinating Agency responsible for administering the program.

[1] https://msc.fema.gov/portal

The Coastal Zone Management Act is implemented in Hawaii though the Hawaii Coastal Management Program, led by the Hawaii Office of Planning. Hawaii's Coastal Zone Management Law provides that the unifying policy for all agencies managing marine and coastal resources is that they actively work toward the goals, objectives, and policies established by the Act. The entire state of Hawaii falls within Hawaii's coastal zone boundary.

The Wild and Scenic Rivers Act (*Public Law 90-542; 16 USC 1271 et seq.*) established the National Wild and Scenic River System and prescribed methods and standards for adding rivers to the system. Rivers protected under this act are generally free of impoundments and inaccessible except by trail with watersheds or shorelines that are primitive and unpolluted waters. Some protected rivers may be accessible by roads; however, they maintain many of the primitive and unpolluted qualities of the inaccessible rivers. On protected rivers, federal funding for actions such as construction of dams or other instream activities that would harm the river's free-flowing condition, water quality, or outstanding resource values are prohibited (*Public Law 90-542; 16 USC 1271 et seq.*).

4.1.4.3. Environmental Setting

This section describes surface water, floodplain, nearshore marine, and groundwater characteristics in Hawaii. Water resources are discussed for Hawaii's eight major islands: Hawaii, Maui, Oahu, Kauai, Molokai, Lanai, Niihau, and Kahoolawe. Water resources are undeveloped and scarce on the smaller islands, atolls, and reefs of the Hawaiian Leeward Islands.

Inland Surface Water Characteristics

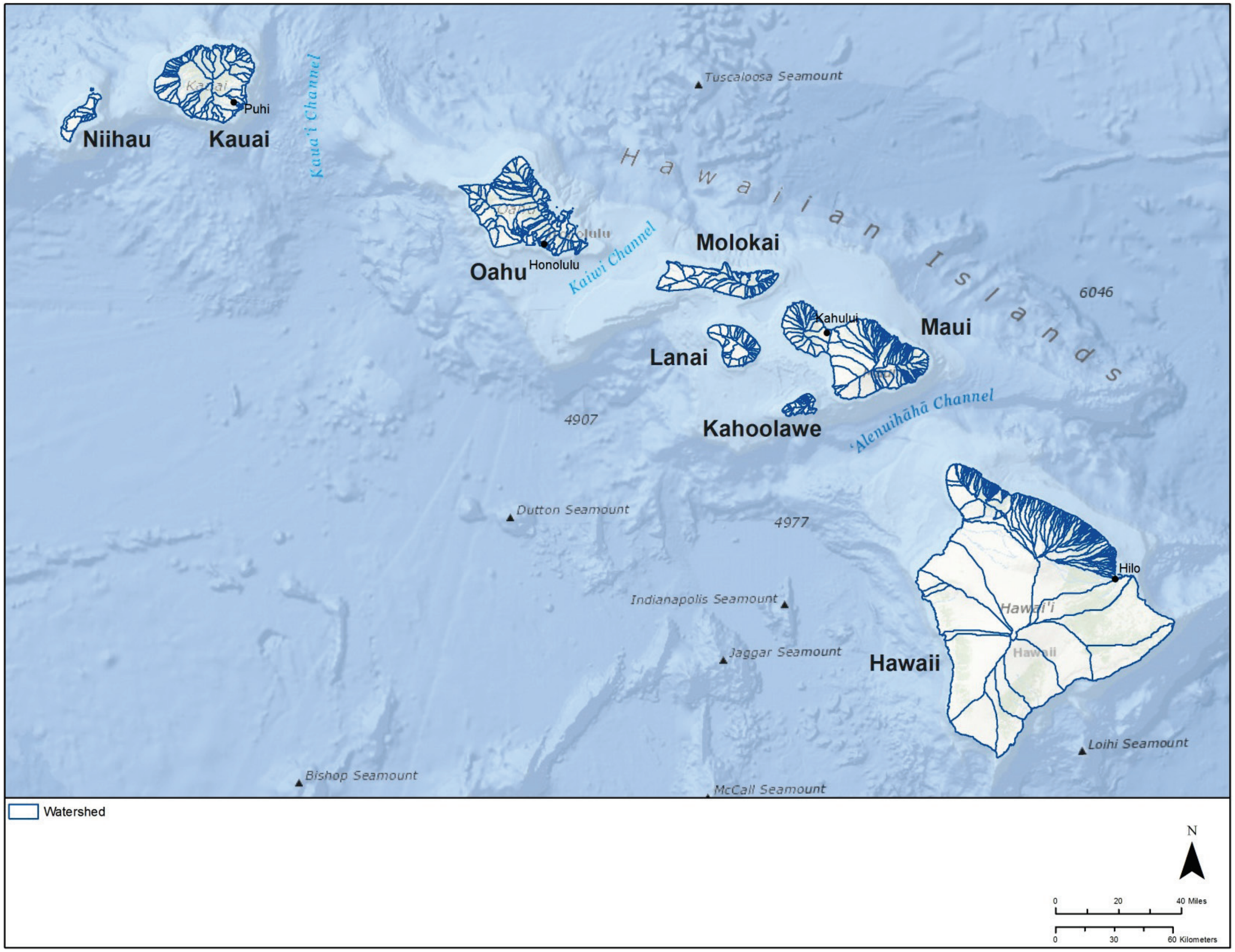
Surface waters include rivers, streams, lakes, and reservoirs. The amount of water in any surface water system is dependent upon quantity and timing of precipitation, storage in the watershed, soil permeability, climate and evaporation rates, and watershed land cover. The primary inland surface water features in Hawaii are streams; there are very few natural lakes in Hawaii. Hawaii contains approximately 3,326 miles of rivers and streams and 5 square miles of lakes and reservoirs (see Table 4.1.4-1) in 580 watersheds (*Hawaii Office of Planning 2013*).

Table 4.1.4-1: Total Surface Waters for Hawaii

Waters	Size	Units
Rivers and streams	3,326	miles
Bays and harbors	37	square miles
Lakes and reservoirs	5	square miles

Source: HDOH 2014

Stream hydrology in Hawaii is made up of rainfall and overland flow as well as groundwater. Streams generally are small and have steep gradients, and many flow only immediately after periods of rainfall. Some streams, however, receive water from aquifers and have perennial flow (*Oki et al. 1999*). Most streams originate in the islands' interiors and drain to the coasts. Watersheds in Hawaii are generally smaller than those delineated in the contiguous United States due to the steep volcanic topography of the islands (see Figure 4.1.4-1).

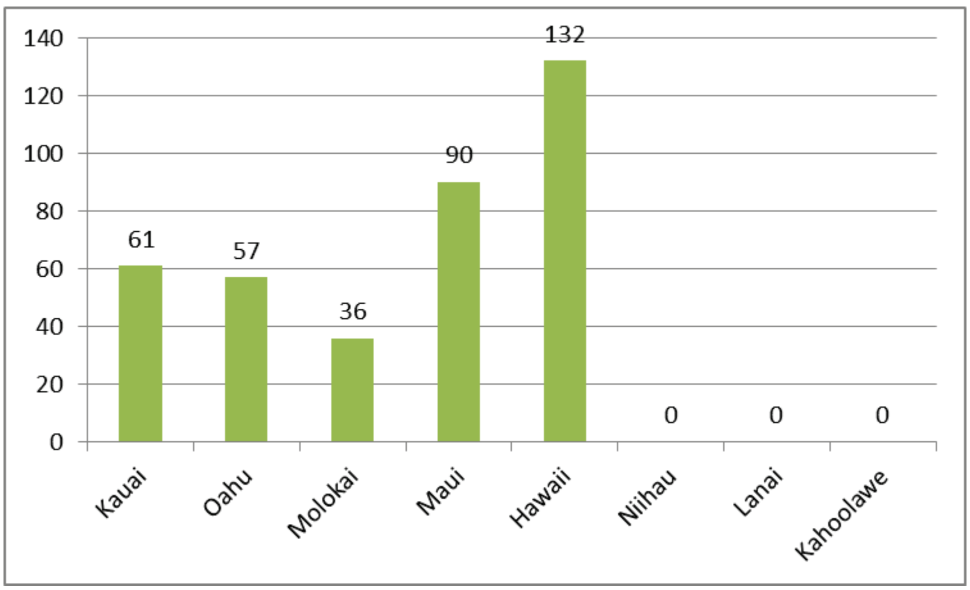


Source: GDSI 1995

Figure 4.1.4-1: Spatial Distribution of Hawaii Watersheds

Trade winds from the northeast dominate Hawaii's weather pattern and carry moisture-rich air over the islands, resulting in relatively high rainfall on the windward sides of the islands. These rainfall-fed streams often have a flashy pattern of streamflow over time due to limited water storage in the small, steep watersheds and the intensity of rainfall (*Oki et al. 1999*).

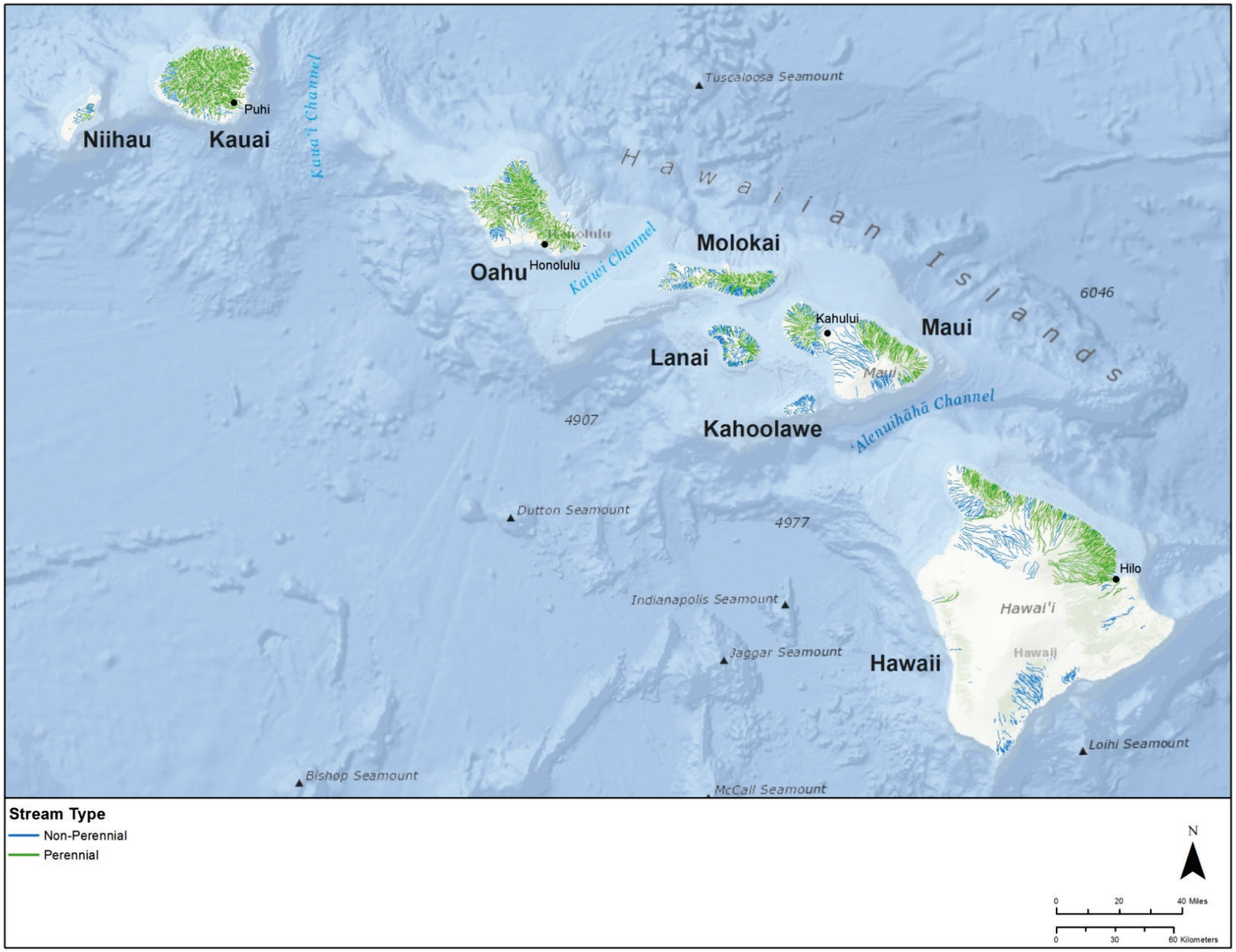
Perennial streams are those which normally have surface flow year-round, in all or part of their course. Intermittent and ephemeral streams are normally dry during part of the year. A 1990 stream assessment identified 376 perennial streams in Hawaii, shown in Figure 4.1.4-2. Geographically, streams are primarily concentrated on the windward sides, or the sides facing the wind (generally from the northeast), on four of the five largest islands (Oahu, Molokai, Maui, and Hawaii); on Kauai they are evenly distributed. Streams are also concentrated in geologically older areas of the islands, as well-defined channels often have not yet developed in geologically younger areas due to the permeability of the surface rocks (*USGS 2003*).



Source: Data from Hawaii Cooperative Park Service Unit 1990

Figure 4.1.4-2: Perennial Streams in Hawaii by Island

Figure 4.1.4-3 depicts the spatial distribution of perennial and non-perennial streams in Hawaii. The 1990 study also evaluated flow data from the 110 streams in Hawaii that have continuous gaging records and categorized streams as large, medium, or small based on flow rates. Large streams were defined as having average flow rates greater than 80 cubic feet per second (cfs); medium streams had average flow rates between 20 and 80 cfs; small streams had average flow rates of less than 20 cfs. This evaluation indicated that the majority of the gaged streams fit into the category of small streams, with 11 large, 36 medium, and 63 small (*Hawaii Cooperative Park Unit 1990*).



Source: DLNR 2008

Figure 4.1.4-3: Spatial Distribution of Hawaii Surface Waters

Streams supply more than 50 percent of the irrigation water in Hawaii. Although streams supply only a small percentage of the state's drinking water, surface water is the main drinking water source in some locations (*Hawaii Cooperative Park Service Unit 1990*).

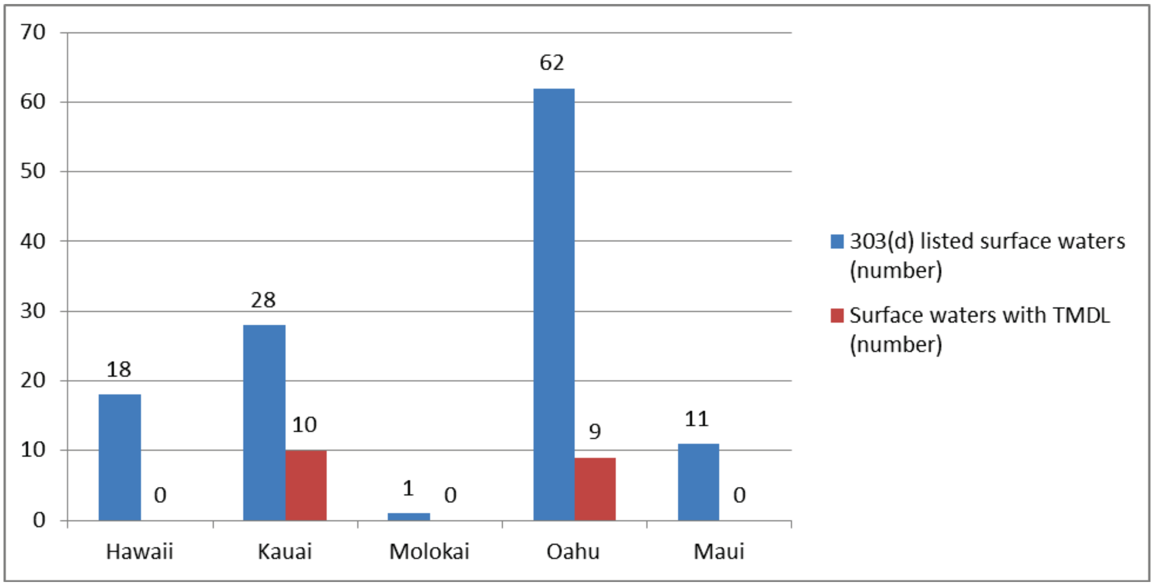
Current human-caused stressors to Hawaii's surface waters include (*Hawaii Cooperative Park Service Unit 1990*):

- Channelization, or the lining or partial lining or alteration of a stream course. More than 70 streams (19 percent) of Hawaii's 376 perennial streams have been channelized, including most of those on Oahu.
- Eighteen hydroelectric power plants on Hawaii supply about 1.5 percent of the state's total electrical energy consumption – the largest is Wailuku River hydroelectric plant on Hawaii, supplying 12.1 megawatts of the state's total 31 megawatts from hydropower.
- Dams and diversions allow for agricultural use and settlement of otherwise arid land. Hawaii's sugar industry depends on irrigation. Some counties depend on surface water for municipal use. About a hundred streams in Hawaii have dams or diversions, most of which are related to the sugar industry, including over half of Maui's streams and one third of Oahu and Hawaii's streams. There is very little diversion on Molokai, east Maui, and north Kauai.
- Consumptive use of streams for water supply.

Water quality of surface waters in Hawaii is regulated according to the CWA. The state's inland waters are assigned to a class (1 or 2) depending upon the beneficial uses that are to be protected. General designations of these areas are as follows:

- Class 1 waters are to "remain in their natural state as nearly as possible with an absolute minimum of pollution from any human-caused source. To the extent possible, the wilderness character of these areas shall be protected. Waste discharge into these waters is prohibited." (*Hawaii Administrative Rules Chapter 11-54*)
- Class 2 waters are to be protected for "recreational purposes, the support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation." (*Hawaii Administrative Rules Chapter 11-54*)

The state's 303(d) and 305(b) integrated water quality report (*HDOH 2014*) describes water quality conditions for waters in Hawaii. The report contains a list of 120 stream segments that were listed as impaired, and 20 for which Total Maximum Daily Loads (TMDLs) have been developed. TMDLs are a regulatory tool used for impaired waterbodies, and describe a maximum amount of a pollutant that a waterbody can receive while still meeting water quality standards. TMDLs must be developed for all waterbodies on a state or territory's 303(d) list. Turbidity is the parameter for which standards are most often not met, followed by nitrate-plus-nitrogen (see Figure 4.1.4-4; *HDOH 2014*).



Source: Data from HDOH 2014

TMDL = Total Maximum Daily Load

Figure 4.1.4-4: Number of Impaired Inland Waterbodies in Hawaii

Streams with special designations in Hawaii include the following:

- Wild and Scenic River status eligibility. There are 18 streams and rivers on this list in Hawaii, including 6 on Kauai, 3 on Molokai, 3 on Maui, and 3 on Hawaii (*Hawaii Cooperative Park Service Unit 1990*).
- Priority Aquatic Sites, including streams meeting one or more of the following criteria: best intact remnants of damaged or declining systems, best opportunities for protection or representative viable examples of major regional systems, sites of endangered species, or sites of endangered communities. There are eight streams in Hawaii considered to be Priority Aquatic Sites, including three on Kauai, one on Molokai, and four on Maui (*Hawaii Cooperative Park Service Unit 1990*).
- High Quality Streams are designated by U.S. Fish and Wildlife Service as those meeting the following criteria: high habitat value for native, migratory stream animals; presence of candidate endangered species the Hawaiian freshwater goby (*Lentipes concolor*); presence of riparian wetlands of value to migratory birds and endangered Hawaiian waterbirds; recognition on the Hawaii Component list of the National Park Service's Nationwide Rivers Inventory; streams in National Parks or wildlife refuges, state wilderness areas, natural area reserves, and private nature preserves; and streams that are the subject of ongoing scientific research projects. More than 80 streams across the state of Hawaii and distributed amongst the islands are considered to be high quality streams (*Hawaii Cooperative Park Service Unit 1990*).

Floodplain Characteristics

Floodplains are lowland and flat areas adjoining inland and coastal waters. These areas are often prone to flooding, depending on streamflow amounts and timings. FEMA maps 100-year floodplains on its NFIP Rate Maps, and defines 100-year floodplains as areas that have a 1 percent chance of being flooded in a given year. Regulations for 100-year floodplains include requirements for new development and substantial redevelopments of existing property to have certain flood resistant qualities. Flood insurance may also be required. Additionally, any fill of the floodplain by new development is limited, so as to not increase flood elevations elsewhere in the floodplain. The 500-year recurrence interval flood is also included on FEMA NFIP floodplain maps; however, these events are rare and the 500-year floodplain is generally not regulated.

FEMA NFIP floodplain maps are available for most of the United States. Often floodplain data are not available in areas where floodplain maps were not created because the areas are not flood prone (sometimes called map "panels not printed"). Hawaii's NFIP maps are viewable online on FEMA's Map Service Center (*FEMA 2015*), which allows the user to navigate to any location of the United States and, where data are available, zoom into any area to view flood zones. An example of flood data for Hawaii is provided in Figure 4.1.4-5. The land area shown in Figure 4.1.4-5 is surrounding the city of Kahluli on the northern edge of Maui. The figure shows coastal areas, inland stream areas, and inland reservoirs of low accumulation prone to flooding. Interested parties are directed to FEMA's Map Service Center[2] to obtain more information on the location and extent of floodplains in Hawaii (*FEMA 2015*).

Nearshore Marine Characteristics

Hawaii contains approximately 303 miles of recreational shoreline and 37 square miles of bays and harbors (*HDOH 2014*). Nearshore waters include estuaries[3], bays and harbors, and recreational shorelines. Fresh water from streams, estuaries, and surface water runoff flows into nearshore marine waters. Land development and water use affect the way this water travels across the landscape, impacting both the quantity and quality of water reaching the coastal zone. Irrigation ditches increase the quantity of freshwater reaching the ocean (*Hawaii Office of Planning 2013*).

For management purposes, Hawaii has designated 575 marine waterbodies, for which 160 have available water quality data. Of these 160 marine waterbodies, 136 do not meet state numeric water quality criteria for at least one conventional pollutant (*HDOH 2014*). Marine waters are assessed for compliance with standards established for recreation (bacterial indicators) and ecosystem (nutrient and biological) health. Sources of marine pollutants include polluted surface water runoff due to urban and agricultural inputs, as well as inputs from sewage systems (*HDOH 2014*).

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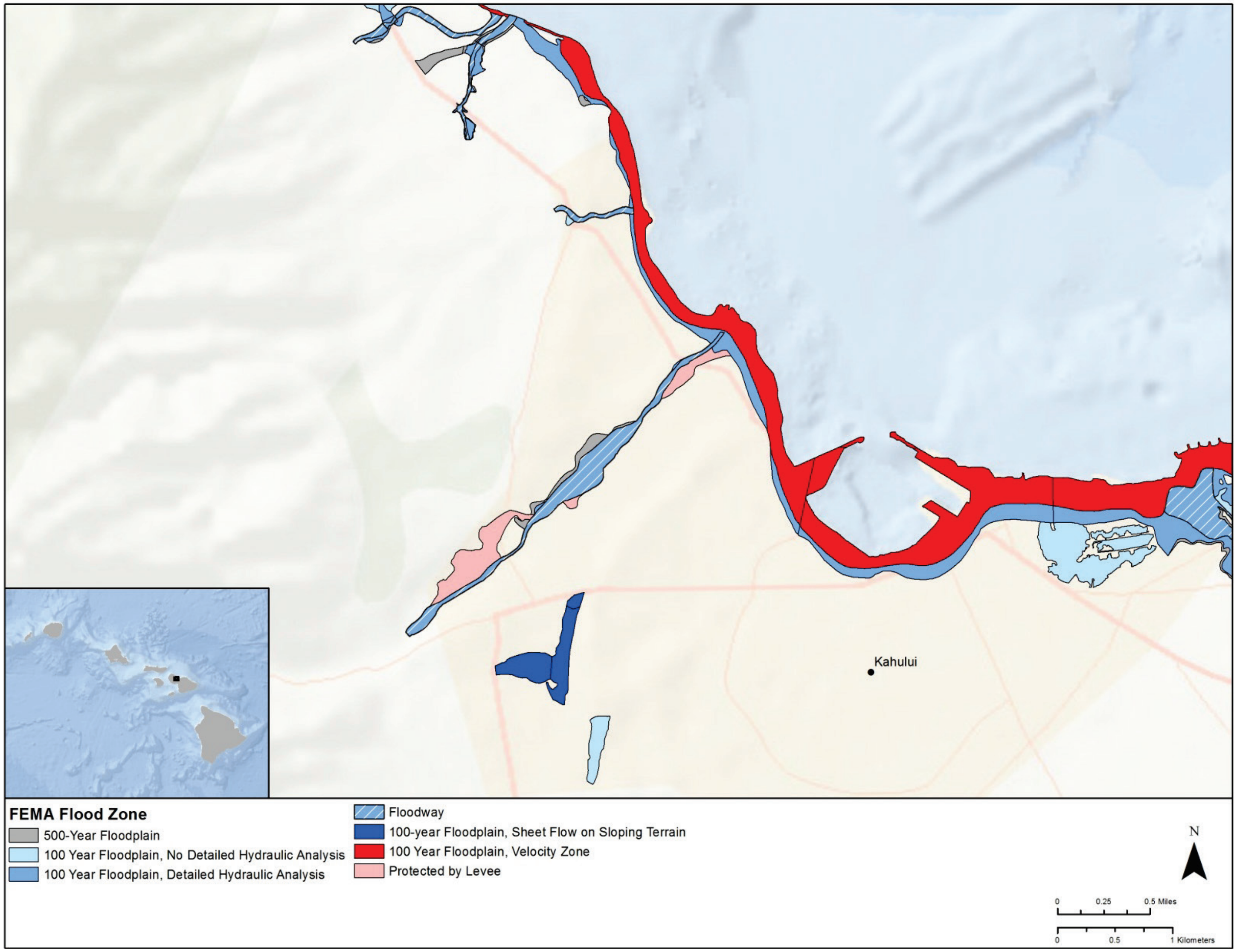
[2] https://msc.fema.gov/portal

[3] Estuaries are defined as coastal areas where salt water from the sea mixes with rivers and streams, and may be called bays, harbors, inlets, lagoons, or estuaries.



Source: FEMA 2015

Figure 4.1.4-5: Example Floodplain Map for Hawaii

The pollutant that most frequently exceeds water quality standards in marine waters is turbidity, with 94 percent of Kauai's assessed marine waters exceeding the standard, as well as 92 percent of Maui's marine waters, 80 percent of Hawaii's, and 78 percent of Oahu's. Turbidity is the sole source of impairment in 40 of the state's 117 impaired marine waterbodies. Other pollutants often found in marine waters were nutrients and chlorophyll. Of the assessed marine waterbodies, 90 percent achieved the state standard for bacterial water quality criteria (*HDOH 2014*).

Table 4.1.4-2 describes the impairments for marine waterbodies assessed in Hawaii. A total of 117 of the 160 assessed waterbodies were impaired; some for multiple pollutants, such that the total number of non-attaining data points is greater than the total number of impaired waterbodies.

Table 4.1.4-2: Summary of Impaired and Attaining Marine Waterbodies in Hawaii

Island	Total Assessed Marine Waterbodies	Bacteria		Nutrients		Turbidity		Chlorophyll a	
		A	N	A	N	A	N	A	N
Kauai	32	20	9	18	14	0	30	8	0
Oahu	51	40	1	53	3	7	25	9	4
Molokai	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lanai	2	NA	NA	7	1	1	1	1	1
Maui	24	19	1	12	28	2	22	5	5
Hawaii	51	39	2	17	45	10	41	8	7
Total	**160**	**118**	**13**	**107**	**91**	**20**	**119**	**31**	**17**

Source: HDOH 2014

A = Attaining; N = Not attaining (impaired); NA = Not assessed

The National Ecosystem Research Reserve program has established a system of 28 research estuaries across the country, representing different biogeographic regions of the United States, all of which are protected for long term research, water quality monitoring, education, and coastal stewardship. The Hawaii Coastal Zone Management Program is coordinating the selection of a National Ecosystem Research Reserve site in Hawaii, which is currently under development.

Groundwater Characteristics

Groundwater is the water found underground in the cracks and spaces in soil, sand, and rock. It is stored in and moves slowly through geologic formations of soil, sand, and rocks called aquifers. Groundwater occurrence and quantities are generally dictated by geology. Hawaii has two general geologic rock categories: older volcanic rocks and younger deposits (*Oki et al. 1999*). Older volcanic materials are found throughout the islands (*Oki et al. 1999*). The younger deposits include alluvium[4] derived from erosion of volcanic rock, coralline limestone, and cemented beach or dune sand, and are scattered about the islands–mostly in coastal areas–and, where present, generally overlay volcanic rock (*Gingerich and Oki 2000*).

[4] Alluvium is defined as a sediment (clay, silt, sand, and/or gravel) deposited by flowing streams in a river valley.

The flanks of each volcano, which represent the largest area of the islands, were formed by thousands of lava flow eruptions from the caldera or associated rift zones. The most productive aquifers in the islands are in thick sequences of numerous thin lava flows; these are also the most widespread aquifers throughout the islands (*Gingerich and Oki 2000*). The basalt found in some areas, such as much of Kahoolawe, Niihau, and the western third of Molokai, may be permeable, but yields little potable water mainly because these areas receive little recharge (*Oki et al. 1999*).

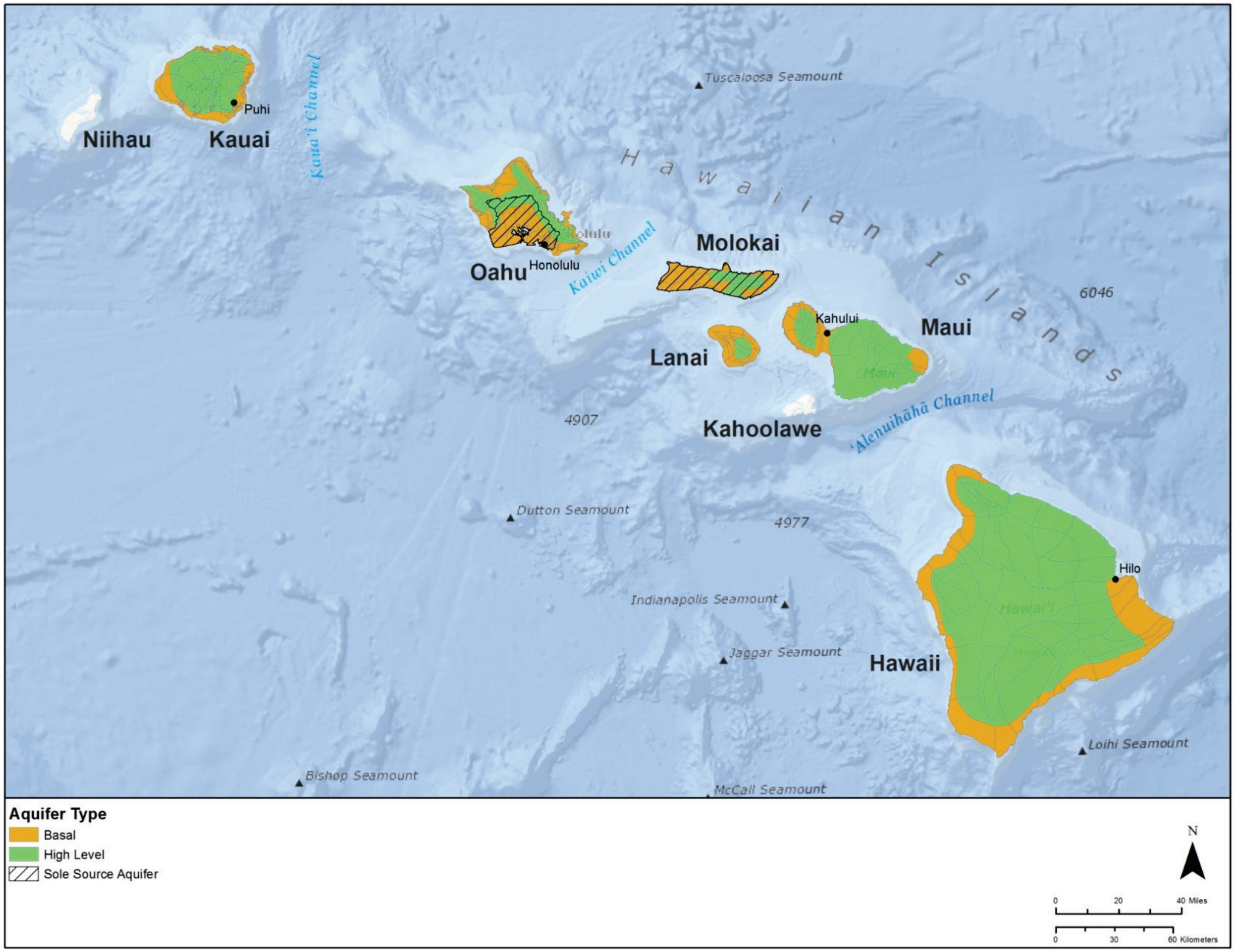
Hardened sheets of basalt rock or dikes that formed in the center area of volcanos and along rift zones where molten lava intruded are also important to the distribution of groundwater. These sheets are generally dense, with low permeability, and can extend vertically and laterally for long distances (*Gingerich and Oki 2000*). These dikes restrict and often trap groundwater flows within intervening permeable lava flows. At high elevations in the rift zones, these dikes can occur in great numbers and are called dike complexes. In these areas, percolating rainwater can be caught in the compartments formed by the dikes. In areas where these compartments overflow or are cut into by erosion, the water can discharge as springs and feed streams or feed streams directly (*UH Hilo 1998*). Alternatively, water flowing from the dike areas can continue to move downward into deeper aquifers.

The younger consolidated sedimentary deposits[5] are found mostly in the coastal areas. The limestone can be very permeable in places, but generally yields brackish water because it has good connectivity with the ocean and receives little recharge from percolating precipitation (*Oki et al. l999*). In some areas, weathered volcanic rock and overlying sedimentary deposits have combined to form a low permeability material called caprock. Sedimentary deposits and some types of volcanic rocks, such as pyroclastic material, are typically productive aquifers in the contiguous United States, but are commonly confining units or aquifers with poor production in Hawaii. Even though it has low permeability, caprock can still be saturated, primarily with ocean water, and can result in brackish water overlying fresh water in the volcanic rock (*Oki et al. 1999*).

Aquifer recharge in Hawaii is generally from precipitation (rain, with some snow at high elevations) and fog drip. Fresh water reaching the islands that is not lost to evapotranspiration[6] or moved across the landscape as surface water is collected as groundwater. Most of this groundwater capture occurs at high elevations, so regional movement of groundwater is from the interior toward the ocean, with water diffusing to the ocean or discharging to springs near sea level (*Oki et al. l999*).

Hawaii's primary aquifer systems are freshwater-lens (basal groundwater) and high-level groundwater types, as shown in Figure 4.1.4-6. Freshwater-lens systems are systems where freshwater floats on saltwater separated by a transition zone of brackish water, found in areas where groundwater is not held up by impermeable barriers. These systems are found in the large flanks of the islands with layered volcanic materials.

[5] Sedimentary rocks are formed by the deposition of material at the Earth's surface and within bodies of water.
[6] Evapotranspiration is defined as the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere.



Source: HDOH 1992

Figure 4.1.4-6: Spatial Distribution of Hawaii Basal and High-Level Aquifers

High-level groundwater is generally found in the central areas of the islands where volcanic dikes influence where water is present and where it can move. The largest freshwater-lens groundwater bodies are the freshwater-lens systems that float on salt water within aquifers. The distribution of aquifers varies by island. Generally, islands receiving little precipitation and with highly permeable rock have a very thin layer of freshwater-lens groundwater, whereas islands with greater permeability and greater precipitation have a thicker layer of freshwater-lens groundwater. Islands with permeable rocks generally have lower elevation groundwater, whereas islands with less permeable rock have higher elevation groundwater (*Oki et al. 1999*).

As discussed in Section 4.1.4.2, Specific Regulatory Considerations, the SSA[7] protection program protects groundwater in areas with no drinking water source that could physically, legally, and economically supply all those who depend on the aquifer for drinking water. This designation requires U.S. Environmental Protection Agency to review certain proposed projects within the designated area, and all proposed projects receiving federal funds are subject to review to ensure they do not danger the water source. Two SSAs exist in Hawaii: the Molokai Aquifer SSA includes the entire island of Molokai; the Southern Oahu Basal Aquifer SSA includes most of the island of Oahu and the metropolitan area of Honolulu (*USEPA Watershed Branch 2005*).

[7] The U.S. Environmental Protection Agency defines an SSA as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer.

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4.1.5. Wetlands

4.1.5.1. Introduction

This section discusses wetland resources on the Hawaiian Islands. Information is presented regarding wetland features and characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Wetlands are a subset of Waters of the United States (U.S.), defined for regulatory purposes by the U.S. Environmental Protection Agency under the Clean Water Act (CWA) as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions (*USEPA 2004*). Similarly, the U.S. Fish and Wildlife Service (USFWS) classification system (*Cowardin et al. 1979)* defines wetlands as "…lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water…" (*Cowardin et al. 1979).*Wetlands can be vegetated or non-vegetated, but where vegetation is present, the plants are adapted for life in saturated or flooded soil. Examples of wetlands include marshes, bogs, ponds, intertidal areas, and estuaries.[1]

In contrast to wetlands, deepwater habitats (referred to as waters) are defined as any "permanently flooded lands lying below the deepwater boundary of wetlands" (*Cowardin et al. 1979)*. Waters are typically non-vegetated, have a bed and bank, and include intermittent, ephemeral, or perennial streams[2], rivers, or standing water (e.g., lakes). Waters are not included in this wetlands section, as they are discussed in Section 4.1.4, Water Resources.

The Environmental Protection Agency estimates that "more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives" (*USEPA 1995*). In addition to providing habitat for many plants and animals, wetlands also provide benefits to human communities. Wetlands store water during flood events, improve water quality by filtering polluted runoff, help control erosion by slowing water velocity and filtering sediments, serve as points of groundwater recharge, and help maintain base flow in streams and rivers. Additionally, wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.

4.1.5.2. Specific Regulatory Considerations

Under Section 404 of the CWA (Section 404), activities that adversely affect Waters of the U.S., including wetlands, must be authorized through a Section 404 permit issued by the U.S. Army Corps of Engineers, and adverse impacts must be mitigated to the extent practicable. The following government agencies are also involved in local wetland management and regulation

[1] Estuaries are found where salt water from the sea mixes with rivers and streams.

[2] Intermittent streams carry water for part of the year (generally winter and spring), ephemeral streams carry water only as a result of precipitation (any time of year), and perennial streams carry water year round (under normal precipitation conditions) (*NCDEQ Undated*).

within Hawaii: Consolidated Farm Service Agency; Natural Resource Conservation Service; National Oceanic and Atmospheric Administration; U.S. Marine Corps; U.S. Navy; USFWS; National Park Service; and U.S. Environmental Protection Agency. The following Hawaii state departments are involved: Department of Health; Department of Land and Natural Resources; Coastal Zone Management Program. County governments are also involved in wetland regulation. Guidance on compliance with wetland permitting in Hawaii can be found on U.S. Army Corps of Engineers website (*USACE 2015*).

In addition to regulation, there are 10 USFWS National Wildlife Refuges (NWRs), several state Forest Reserves, and many State and National Parks where wetlands would be protected to varying degrees or regulated with regards to development.

4.1.5.3. Environmental Setting

As mentioned above, wetlands are recognized as important for maintaining watershed and environmental health due to their potential to perform various ecological, hydrologic, biogeochemical, and social functions, although not all wetlands perform these functions equally. Typical wetland functions include bank stabilization, flood mitigation, maintenance of water quality, maintenance of fish and wildlife habitat, sediment retention, groundwater discharge and recharge, and maintenance of nutrient retention and export. Their capacity or degree to which they perform individual functions depends on the wetland characteristics including soil type, substrate, type and percent cover of vegetation, water source, landscape position, location within a watershed, and location relative to populated areas (*USGS 1997*). As part of CWA Section 404 permitting, a wetland functional assessment is typically used to place wetlands into one of three categories, with Category 1 wetlands being the highest quality and/or functioning wetlands (and/or rare types); Category 2 wetlands being of moderate to high quality and/or function; and Category 3 wetlands being lower quality and/or functioning wetlands (and/or more common types). While a formal assessment of wetland functions and categorization is beyond the scope of this Draft Programmatic Environmental Impact Statement, potential functions for Hawaiian wetlands are discussed broadly in the section below.

The formation of Hawaii's wetlands was driven by geologic, geographic, hydrologic, and climatic features present on the islands. The islands each have two primary physiographic zones: windward and leeward. Trade winds from the northeast dominate Hawaii's weather pattern and carry moisture-rich air over the islands, resulting in relatively high rainfall on the windward sides of the islands (*USGS 2003*).

The primary inland surface water features in Hawaii are streams, which can be associated with wetland fringes along the stream edge; there are very few natural lakes in Hawaii. Streams generally are small and have steep gradients, and many flow only immediately after periods of rainfall. Some streams, however, receive water from aquifers and have perennial flow. Most streams originate in the islands' interiors and drain to the coasts (*USGS 2003*).

For specific information about Hawaii's soils, see Section 4.1.2, Soils. The water resources on Hawaii are discussed in more detail in Section 4.1.4, Water Resources.

Wetlands were assessed using the USFWS National Wetland Inventory (NWI) (*USFWS 2015a*), which maps and classifies wetlands using the NWI classification system (*Cowardin et al. 1979*). NWI for all islands except Oahu was mapped using aerial imagery from 1976, 1977, and 1978 at a scale of 1 to 24,000. NWI mapping for the island of Oahu was completed using aerial imagery from 2003 and 2005. NWI mapping is created exclusively using geographic information system-based methods, with limited groundtruthing as required by the Federal Geographic Data Committee standards[3]. However, for the purpose of this broad-scale Draft Programmatic Environmental Impact Statement, the NWI mapping is considered to be of sufficient accuracy to assess wetland locations and type. The NWI mapping includes both wetlands and waters, of which only wetlands are included in this section. For the purpose of this assessment, all areas that are classified by the NWI (per *Cowardin et al. 1979*) as either palustrine,[4] marine intertidal,[5] and estuarine intertidal[6] were included as wetlands. The remaining classifications were unvegetated waters and were not included in this assessment: marine subtidal, estuarine subtidal, lacustrine (lake-based), and riverine (river-based) (*Cowardin et al. 1979*). These waters areas are assessed in Section 4.1.4, Water Resources.

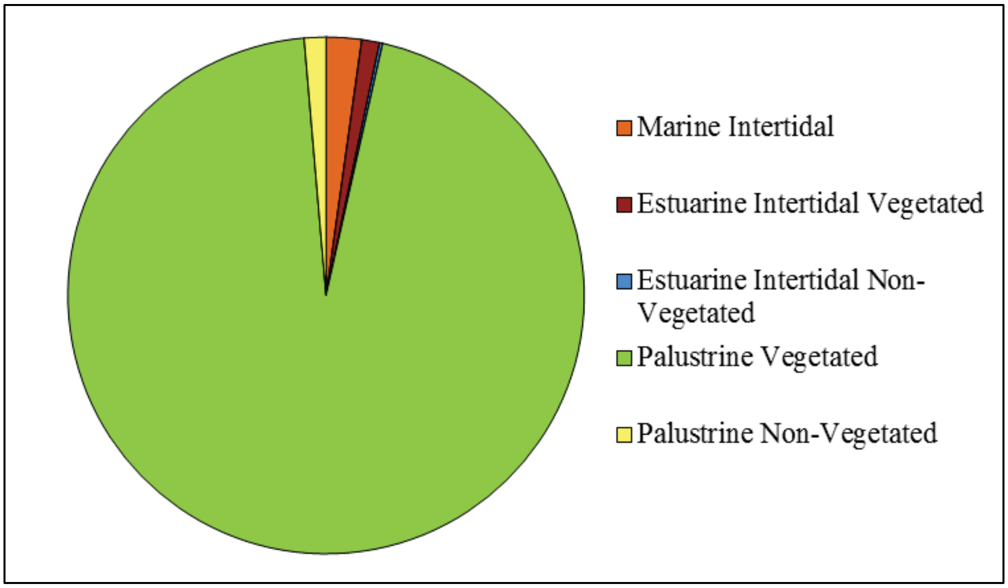
4.1.5.4. Wetland Characteristics

A total of approximately 153,186 acres of wetlands are mapped for Hawaii (*USFWS 2015a*), which represents 2.2 percent of the total area of the state, lower than the approximately 5.5 percent of total area comprised of wetlands in the contiguous U.S. as of 2009 (*Dahl 2011*) (see Table 4.1.5-1).

The large majority of Hawaii's wetlands are classified as palustrine (147,791 acres), followed by marine intertidal (3,382 acres) and estuarine intertidal (2,012 acres) (see Figure 4.1.5-1). Nearly all of the estuarine and palustrine wetlands are vegetated, with estuarine emergent, estuarine forested, and estuarine scrub/shrub wetlands being the least common vegetated wetland types on the island. Of the estuarine vegetated wetlands, the vast majority are estuarine scrub/shrub wetlands and estuarine forested (which includes non-native mangrove forests); estuarine emergent wetlands are far less common. For the palustrine vegetated wetlands, the majority are palustrine forested and palustrine scrub/shrub. Palustrine emergent wetlands are much less common, representing about 10 percent of the total palustrine vegetated wetlands (see Table 4.1.5-1) (*USFWS 2015a*). Montane bogs[7] are an example of unique palustrine wetlands on the Hawaiian Islands (*Mac et al. 1998*).

[3] Federal Geographic Data Committee standards web site: http://www.fgdc.gov/standards
[4] Palustrine wetlands: Includes all nontidal wetlands dominated by trees, shrubs, persistent emergent, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand.
[5] Marine intertidal: Areas of open ocean associated with high energy coastline where the substrate is exposed and flooded by tides (*Cowardin et al. 1979*).
[6] Estuarine intertidal: Coastal areas usually semi-enclosed by land but have open partially-obstructed access to open ocean. Water is partially diluted by freshwater runoff.
[7] Montane bogs occur in mountainous regions.

Anchialine pools[8] are an example of a unique type of estuarine wetland that forms in collapsed lava tubes where there is a subsurface connection to the ocean (*USGS 1996)*. See Figures 4.1.5-2, 4.1.5-3, and 4.1.5-4 for examples of wetland types in Hawaii.



Source: USFWS 2015a

Figure 4.1.5-1: Hawaii Wetland Types

Photo taken at Kaloko-Honokōhau National Historical Park on the island of Hawaii; source: USGS 2008

Figure 4.1.5-2: Marine Intertidal Wetland on Hawaii

[8] Anchialine pools are closed, landlocked waterbodies or ponds with an underground connection to both fresh and salt water.

Table 4.1.5-1: Acreages, Types, and Descriptions of Wetlands in Hawaii

System[a]	Subclass[a]	Veg/Non-Veg	Class[a]	Code[a]	Acres	Physical Description	Hydrology	Vegetation
Marine	Intertidal	NA	All M2 classes	All M2 codes	3,382.4	Areas of open ocean associated with high energy coastline where the substrate is exposed and flooded by tides	Substrate exposed and flooded by tides; includes the splash zone	Typically unvegetated, or with some intertidal vegetation; includes seagrasses (e.g., *Halophila hawaiiana*, *Ruppia maritima*), algae, and corals
		Total Marine Intertidal			**3,382.4**			
Estuarine	Intertidal	Non-Vegetated	Aquatic bed; unconsolidated bottom; unconsolidated shore; rocky shore	E2AB, E2UB, E2US, E2RS	293.5	Coastal areas usually semi-enclosed by land but have open partially-obstructed access to open ocean; water is partially diluted by freshwater runoff	Substrate exposed and flooded by tides; includes the splash zone	NA
		Vegetated	Emergent; scrub/shrub; forested	E2EM, E2SS, E2FO	1,718.2			Herbaceous emergent, scrub/shrub, or forested vegetation; includes mangrove and other trees, rushes, sedges, ferns, and grasses
		Total Estuarine Intertidal			**2,011.8**			
Palustrine	NA	Non-Vegetated	Unconsolidated shore	PUS	207.5	Unvegetated freshwater wetlands that 1) lack active wave-formed or bedrock shorelines (e.g., lakes), 2) are <20 acres, and 3) are <6 ft deep at low water; substrate includes rock, sand, other fine materials, or vegetation growing below the water surface; Includes ponds	Water <6 feet deep; hydrologic regime ranges from permanently flooded to seasonally/ intermittently flooded, to saturated	NA
			Open water	PUB	1,792.3			NA
			Aquatic beds	PAB	80.6			Vegetation, algae, or moss growing below the water surface
		Total Palustrine Non-Vegetated			**2,080.4**			
		Vegetated	Emergent	PEM	14,699.5	Vegetated freshwater wetlands that 1) lack active wave-formed or bedrock shorelines (e.g., lakes), and 2) are dominated by vegetation, regardless of size; includes bogs, fens, marshes, swamps, and prairies	Hydrologic regime ranges from permanently flooded to seasonally/ intermittently flooded, to saturated	Herbaceous vegetation growing above the water surface; includes agricultural plants such as taro and rice, as well as kalo (*Colocasia esculenta*), rushes, sedges, ferns, and grasses
			Scrub/shrub	PSS	60,239.8			Scrub/shrub vegetation adapted to brackish conditions; includes ferns (e.g., *Cyclosorus interruptus*), and other woody species
			Forested	PFO	70,771.7			Forested vegetation adapted to brackish conditions;
		Total Palustrine Vegetated			**145,711.0**			
		Total Palustrine			**147,791.4**			
Total Wetlands					**153,185.6**			

Sources: Acreage: USFWS 2015a. Descriptions: Cowardin et al. 1979. Vegetation info: USFWS 2015b; Hawaiian Native Plants 2015

NA= Not applicable
[a] System, subclass, class, and code are based on NWI (*Cowardin et al. 1979*), as follows:

- Marine intertidal: M2: marine intertidal;
- Estuarine intertidal: E2AB: estuarine intertidal aquatic bed; E2UB: estuarine intertidal unconsolidated bottom; E2US: estuarine intertidal unconsolidated shore; E2RS: estuarine intertidal rocky shore;
- Palustrine
  - Non-vegetated: PUS: palustrine unconsolidated shore; PUB: palustrine unconsolidated bottom; PAB: palustrine aquatic bed
  - Vegetated: PEM: palustrine emergent; PSS: palustrine scrub-shrub; PFO: palustrine forested

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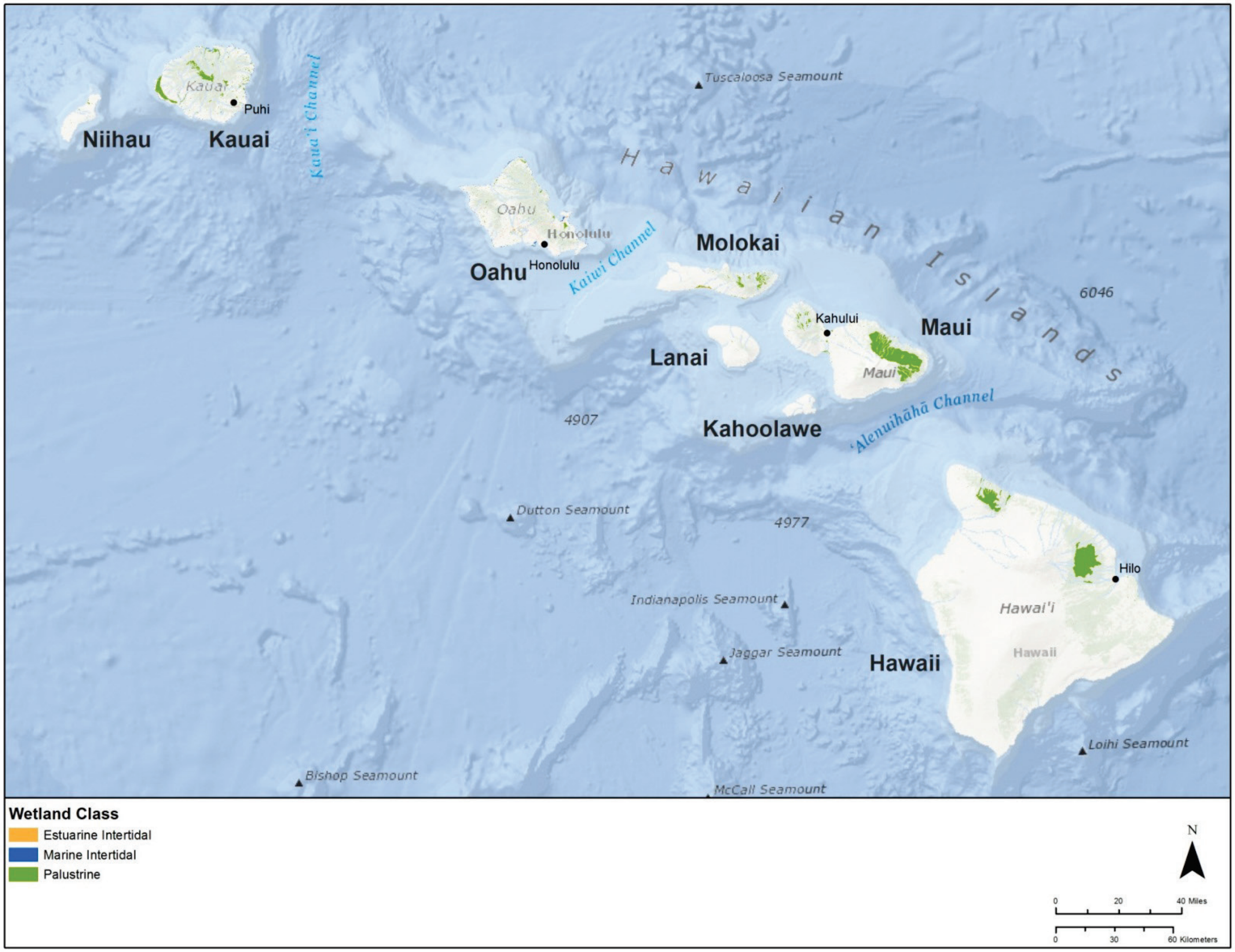
Photo taken on Hawaii at Pu'uhonua o Hōnaunau National Historic Park; source: NPS 2015

Figure 4.1.5-3: Anchialine Pool on Hawaii

Photo taken in Hawaii; source: USFWS 2015c

Figure 4.1.5-4: Estuarine Wetland Along Stream, With Invasive Mangroves on Hawaii

Figure 4.1.5-5 depicts the spatial distribution of wetland types on Hawaii. Hawaii's wetlands are semi-centrally located on the islands of Kauai and Oahu, and north/northeastern on Maui and the island of Hawaii.



Source: USFWS 2015a

Figure 4.1.5-5: Spatial Distribution of Hawaii Wetland Types

Hawaii's Coastal Nonpoint Pollution Control Program Management Plan (*HCZMP 1996)* provides a detailed discussion of several functions provided by Hawaii's wetlands. Those functions are:

- Flood conveyance;
- Protection from storm waves and erosion;
- Flood storage;
- Sediment control;
- Habitat for fish and shellfish;
- Habitat for waterfowl and other wildlife;
- Habitat for rare and endangered species;
- Recreation;
- Source of water supply;
- Natural products (e.g., timber and furs);
- Preservation of historic archaeological values;
- Education and research; and
- Source of open space and contribution to aesthetic values.

Primary anthropogenic stressors to Hawaii's wetlands include non-native and invasive species and filling and dredging of wetlands for resort development (*Hawaii Wetland Monitor 2007*). Coastal wetlands have been drained or filled for resorts, industrial, and residential developments (*SWS 2015*). Hawaii's wetlands are also being drained for agricultural water use, drinking water, and urban use (*HCZMP 1996*). Certain wetland types may be more sensitive to stressors than others, or may be more difficult to restore or rehabilitate structure and function after disturbance. For example, vegetated wetlands in Hawaii would be more difficult to restore than non-vegetated wetlands, with forested wetlands being the most difficult to restore (perhaps with the exception of non-native mangrove trees, which are invasive in Hawaii [*Allen 1998]*) given the time required for trees to grow, followed by scrub/shrub and emergent wetlands. For this same reason, wetlands that support coral reefs would also be more difficult to restore than marine wetlands that do not support coral reefs. Replacement of Hawaii's montane bogs would be considered particularly difficult, as the organic peat deposits in bogs take thousands of years to develop (*USEPA 2015*).

The National Oceanic and Atmospheric Administration has developed a national set of Environmental Sensitivity Index (ESI) maps that includes the Hawaiian Islands. The ESI maps present coastal area resources that may be at risk in the event of an oil spill. These maps provide a sensitivity index for areas considered to be "sensitive shorelines", including coastal wetlands, wetlands providing habitat for sensitive or special status plant and wildlife species, and coral reefs. For Hawaii, they also include the locations of anchialine ponds (*NOAA 2015)*. The ESI maps could therefore be used as a tool to determine potentially sensitive wetland habitats in coastal areas.[9]

Seven of Hawaii's 10 NWRs consist primarily of wetland habitats: Hawaiian Islands NWR (remote islands 800 miles off the Hawaii coast); Kakahai'a NWR (Molokai); Keālia Pond NWR (Maui); Pearl Harbor NWR (Oahu); Hanalei NWR (Kauai); Huleia NWR (Kauai); and James Campbell NWR (Oahu) (*USFWS 2015b*). These NWRs were designated to protect the habitat of endangered plant and animal species. Most of these refuges are off-limits to visitors to prevent disturbance of plant and animal life. The Keālia Pond NWR encompasses approximately 700 acres and is one of the few natural wetlands remaining in the Hawaiian Islands (*USFWS 2015b*). The James Campbell NWR provides habitat for endangered Hawaiian waterbirds, seabirds, endangered and native plant species, the endangered Hawaiian monk seal, and the threatened green sea turtle (*USFWS 2015b*). See Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, for more information on Hawaii's threatened and endangered species.

[9] ESI maps and downloadable data can be found at http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-sensitivity-index-esi-maps.html

4.1.6. Biological Resources

4.1.6.1. Introduction

Biological resources include 1) terrestrial vegetation, 2) wildlife, 3) fisheries and aquatic habitats, and 4) threatened and endangered species and communities and species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources.

This section discusses existing biological resources in Hawaii:

- Terrestrial vegetation, including vegetation types, vegetation communities of conservation concern, and invasive species.
- Wildlife, including wildlife habitat and seasonal characteristics. Species included in this section are terrestrial invertebrates; amphibians and reptiles; terrestrial mammals (game and non-game); marine mammals; and birds occurring in Hawaii and in Hawaii's offshore environment. Wildlife species and their habitat in Hawaii are generally discussed along with select principal species or those of particular interest.
- Fisheries and aquatic habitats, including fisheries features and characteristics. Species included in this section include freshwater and marine species of fish and shellfish occurring in Hawaii and in Hawaii's offshore environment.
- Threatened and endangered species and species of conservation concern. This analysis considers plant and animal species that are federally listed as threatened, endangered, candidate, proposed, or species of concern; species that are state-listed as endangered; and/or species that receive specific protection defined in federal or state legislation. This analysis considers species that are known to occur in Hawaii for all or part of their life cycle.

4.1.6.2. Specific Regulatory Considerations

Given the expected nature and extent of the Proposed Action, it is likely that a wide range of biological resources could be impacted to varying degrees. Therefore, there are many federal, state, and local laws and regulations as well as executive orders considered as part of this analysis. Each biological resource below contains a brief discussion of laws and regulations specific to its resource. Appendix C, *Environmental Laws and Regulations*, provides a comprehensive list of all applicable laws and regulations that were considered as part of the Proposed Action.

4.1.6.3. Terrestrial Vegetation

Introduction

This section discusses terrestrial vegetation resources in Hawaii. Information is presented regarding vegetation types and characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Specific Regulatory Considerations

Related to terrestrial vegetation, and as addressed in Appendix C, *Environmental Laws and Regulations*, Executive Order (EO) 13112 "directs federal agencies to prevent the introduction of invasive plant and other species, provide for their control, and minimize the economic, ecological, and human health impacts that invasive species can cause."

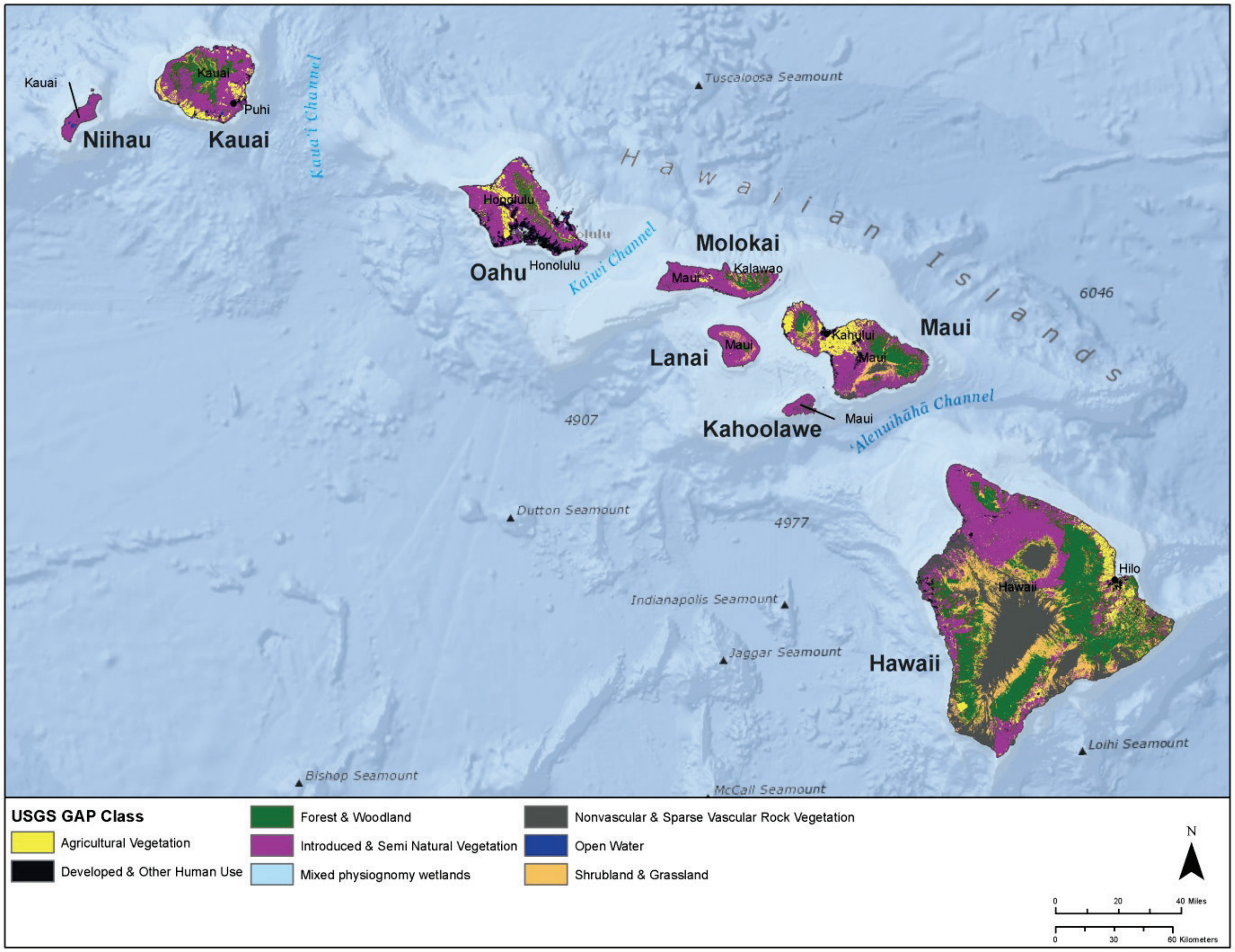
Environmental Setting

The general vegetation types and land cover classes present in Hawaii were identified, evaluated, and described using information gathered from the United States (U.S.) Geological Survey Gap Analysis Program *USGS GAP 2011*) and the Hawaii Department of Land and Natural Resources (*DLNR 2010*). Introduced, invasive, and noxious plant species are addressed in this section based on information from the U.S. Department of Agriculture Natural Resources Conservation Service PLANTS Database (*USDA NRCS 2003*).

Vegetation Types

Based on the vegetation data provided by Gap Analysis Program, eight general vegetation types or land cover classes were classified in Hawaii. Figure 4.1.6.3-1 depicts the distribution of these vegetation types or land cover classes, and Table 4.1.6.3-1 provides a description of each type and their general characteristics.

As shown in Figure 4.1.6.3-1, the majority of the Hawaiian Islands consists of forest and woodland as well as introduced and semi-natural vegetation. Major threats to vegetation in Hawaii include animal grazing, invasive weeds, climate change, land development, logging and other harmful land use practices, and wildfire.



Source: USGS GAP 2011

Figure 4.1.6.3-1: Vegetation Types and Land Cover Classes in Hawaii

Table 4.1.6.3-1: Vegetation Types/ Land Cover Classes in Hawaii

Vegetation Type or Land Cover Class Name	General Description	Vegetation Characteristics
Agricultural Vegetation	Consists of areas with vegetation used for food crops	Various food crops including macadamia, coconut, banana, guava, papaya, sugarcane, pineapple, coffee, vegetable crops, and fallow fields
Developed and Other Human Use	Includes developed open areas that are primarily herbaceous[a] such as golf courses, road sides, parks, or air fields as well as other low, medium, or high intensity developed areas with covered impervious surfaces	Various grasses, shrubs, or trees
Forest and Woodland	Mixture of non-native and native trees with closed or open canopies; understories commonly contain various mixed shrubs, grasses, or ferns.	Variable depending on location/elevation and other physical characteristics; species may include hala (*Pandanus tectorius*), koa (*Acacia koa*), mamane (*Sophora chrysophylla*), and others
Introduced and Semi Natural Vegetation	Includes non-native plants as well as semi-natural vegetation influenced by grazing or other land use practices including vegetation established in previously cultivated or otherwise disturbed areas	Various grasses, shrubs, or trees
Mixed Physiognomy Wetlands	Includes wetland grasses or grass-like vegetation, shrubs, or trees in wetland areas	Common vegetation types include oriental mangrove and American mangrove plants; in many locations degraded areas from invasive animals have been replaced by non-native plants
Nonvascular and Sparse Vascular Rock Vegetation[b]	Consists of sparse vegetation in rocky areas with minimal soil development	Nonvascular vegetation consists of various mosses; vascular vegetation includes shrubs and grasses
Open Water	Areas of open water including streams, rivers, ponds, and lakes with less than 25 percent cover of vegetation or soil	NA
Shrubland and Grassland	Consists of a combination of grasses and shrubs, ferns, and small trees	Primarily includes various grasses and shrubs including pukiawe (*Styphelia tameiameiae*), ‘a’ali’i (*Dodonaea viscosa*), Ma’o (*Gossypium tomentosum*), uluhe (*Dicranopteris linearis*), and others.

Source: USGS GAP 2011

NA = not applicable
[a] Herbaceous plants do not have woody stems.
[b] Vascular plants possess conducting tissues to transport nutrients and water throughout the plant. Nonvascular plants, such as mosses, liverworts, hornworts, and algae, do not have the same types of conducting tissues.

Vegetation Communities of Conservation Concern

Some vegetation communities or types have become of conservation concern because of declining abundance, sensitivity to disturbance, and/or due to the reliance of certain species on the habitat they create. There are currently a combined 351 federal or state-listed protected plant species in Hawaii (see Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern).

As further discussed in section 4.1.6.4, Wildlife, there are numerous protected areas in Hawaii designated to protect sensitive plant and animal species. These areas include national wildlife refuges, state-managed natural area reserves, wilderness preserves, and wildlife sanctuaries. Hawaii also has 17 Important Bird Areas which are designated for protecting birds and their habitats.

Invasive Species

EO 13112 defines an invasive species as a species not native to an area whose introduction causes or is likely to cause harm to the economy or the environment, or harms animal or human health. As mentioned above, the EO "directs federal agencies to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts that invasive species can cause."

According the PLANTS Database, there are 97 state-listed noxious weeds identified in Hawaii (*USDA NRCS 2003*). The following are some examples of problematic invasive plants in the state, some of which are more susceptible to becoming established in disturbed areas than others (*Hawaii Invasive Species Council 2015*):

- Miconia *(Miconia calvescens)* – native to South and Central America; produces shallow roots which, compared to native plants, does not allow for soil stabilization and may increase likelihood of erosion and landslides; thick stands shade out native plants and reduce rainwater infiltration (see Figure 4.1.6.3-2).

Source: NPS 2009

Figure 4.1.6.3-2: Miconia Invasive Plant

- Australian tree fern *(Cyathea cooperi)* – introduced to Hawaii as an ornamental, this plant is fast growing and out-competes native plants in the forest understory.
- Barbados gooseberry *(Pereskia aculeata)* – introduced as an ornamental or for its fruit, this plant forms dense thorny thickets that overgrow and replace other plants.
- Cattail *(Typha latifolia)* – wetland plant native in North America; takes over wetlands in Hawaii and crowds out native plants and destroys native bird habitat; threatens the taro industry (see Figure 4.1.6.3-3).

Source: Hagwood 2006

Figure 4.1.6.3-3: Cattail

- Fireweed *(Senecio madagasariensis)* – daisy-like herb native to Madagascar; toxic to livestock when eaten; invades pastures, disturbed areas, and roadsides.
- Himalayan blackberry *(Rubus discolor)* – native to Western Europe and introduced to Hawaii as an ornamental and food crop; found in disturbed areas, open fields, and around fresh water habitats; dense thickets outcompete native plant species and make access difficult for hikers and other forest visitors.

- Ivy gourd *(Coccina grandis)* – fast growing vine native to Africa and Asia; introduced to Hawaii as a food crop; vines smother vegetation and cover fences and power lines, threatening natural and managed areas (see Figure 4.1.6.3-4).

Source: NPS 2009

Figure 4.1.6.3-4: Ivy Gourd

- Pampas grass *(Cortaderia jubata, selloana)* – large grass native to South America and introduced as an ornamental; out-competes native plants and creates a fire hazard.
- Smoke bush *(Buddleja madagascariensis)* – viney shrub native to Madagascar; aggressively invades disturbed areas at mid to low elevations; forms dense stands that crowd out native plants.

4.1.6.4. Wildlife

Introduction

This section discusses the existing wildlife resources in Hawaii. Information is presented regarding wildlife habitat and seasonal characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Species discussed in this section include reptiles and amphibians, terrestrial invertebrates, terrestrial mammals (game and non-game), marine mammals, and birds occurring in Hawaii and in Hawaii's offshore environment. Species reviewed in this section, although not inclusive, represent the major taxonomic groups including reptiles and amphibians, terrestrial invertebrates, terrestrial mammals, marine mammals, and birds occurring in the Hawaiian Islands and in the Hawaiian Islands' offshore environment. For a list of injurious[1] species on Hawaii, see the State of Hawaii's Injurious Wildlife List.[2] For more information on subsistence use of wildlife and threatened and endangered wildlife species, see Section 4.1.9, Socioeconomics, and Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, respectively.

Specific Regulatory Considerations

Three primary agencies are responsible for wildlife management in Hawaii: U.S. Fish and Wildlife Service (USFWS), State of Hawaii Division of Forestry and Wildlife (DFW), and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS).

Reptiles, amphibians, and terrestrial mammals are managed by DFW, except for threatened and endangered species, which are managed by USFWS and are protected by the Endangered Species Act. Hawaii's marine mammals are managed by NMFS and are protected under the Marine Mammal Protection Act. Birds are managed by both DFW and USFWS, depending on their life history and human uses. Hawaii's bird species, both migratory and non-migratory are protected under the Migratory Bird Treaty Act (MBTA), except for game species of pheasant, frankolins, partridge, quail, grouse, dove, and wild turkey (*Hawaii DFW 2015*).

The DFW Native Ecosystems Protection and Management Division manages land use activities within Hawaii's Natural Area Reserves System, established by Chapter 195 Hawaii Revised Statutes, to "preserve and protect, in perpetuity, examples of Hawaii's unique terrestrial and aquatic natural resources, in order that present and future generations may be able to learn about and appreciate these natural assets" (*Hawaii DFW 1997*).

[1] Any species or subspecies of animal except game birds and game mammals that is known to be harmful to agriculture, aquaculture, indigenous wildlife or plants, or constitute a nuisance or health hazard and is listed in the exhibit entitled "Exhibit 5, Chapter 13-124, List of Species of Injurious Wildlife in Hawaii" (*DOFAW 2015*).

[2] Invasive and injurious species list: http://dlnr.hawaii.gov/wildlife/invasives/injurious-wildlife/

Subsistence and recreational hunting in Hawaii requires licenses and/or permits, which are distributed by DFW. Guidance on compliance with Hawaii government wildlife and habitat regulations can be found at the DFW and USFWS websites.[3]

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) affords specific legal protection to bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). Under this Act, it is a violation to "…take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof…." (*16 United States Code [USC] § 668*). The BGEPA defines "take" as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing (*16 USC § 668c*). "Disturb" is defined in regulation *50 CFR 22.3* as the following:

> "...[T]o agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." (*50 CFR 22.3*)

In fall 2009, USFWS implemented two rules (*50 CFR 22.26 and 22.27*) authorizing limited legal take of bald and golden eagles "when the take is associated with, but not the purpose of an otherwise lawful activity, and cannot practicably be avoided" (*USFWS 2011*).

Migratory Bird Treaty Act

A migratory bird is any individual species or family of birds that crosses international borders at some point during their annual life cycle to live or reproduce. The MBTA implements four treaties that prohibit take, possession, transportation, and importation of all migratory, native birds (plus their eggs and active nests) occurring in the wild in the U.S., except for house sparrow, European starling, rock pigeon, any recently listed unprotected species in the *Federal Register* (*70 Federal Register 12710*), and non-migratory upland game birds, except when specifically authorized by the USFWS. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird or any part, nest, or egg or any such bird unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. "Take" is defined in regulations as: "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (*16 USC § 1532(19)*). In total, more than 1,000 bird species are protected by the MBTA, 58 of which can be legally hunted with a permit as game birds. The MBTA addresses take of individual birds, not population-level impacts, habitat protection, or harassment. Failure to comply with the MBTA can result in criminal penalties. As authorized by the MBTA, the USFWS issues permits to qualified applicants for the following types of

[3] DFW: http://dlnr.hawaii.gov/dofaw/; USFWS: http://www.fws.gov/pacificislands/

activities: falconry, raptor propagation, scientific collecting, special purposes (rehabilitation, educational, migratory game bird propagation, and salvage), take of depredating birds, taxidermy, and waterfowl sale and disposal.

Marine Mammal Protection Act

The Marine Mammal Protection Act prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.[4] The act defines "take" to mean "to hunt, harass, capture, or kill" any marine mammal or attempt to do so. Exceptions to the moratorium can be made through permitting actions for take incidental to commercial fishing and other non-fishing activities; for scientific research; and for public display at licensed institutions such as aquaria and science centers.

Other federal regulations pertaining to wildlife resources are discussed in Chapter 1, Introduction, and Appendix C, *Environmental Laws and Regulations*.

Terrestrial Habitats and Wildlife (Invertebrates, Mammals, Reptiles and Amphibians)

The Hawaiian High Islands Ecoregion contains three major habitat types: Tropical Moist Broadleaf Forest, Tropical Dry Broadleaf Forest, and Tropical Grasslands, Savannas & Shrublands. The boundaries of the Hawaiian High Islands Ecoregion correspond to the collective sea-level island boundaries of the main Hawaiian Islands and immediately surrounding islets. There are no contiguous terrestrial ecoregions. Systematic analysis revealed that the vast majority of species and natural communities could be adequately nested under broadly defined ecological systems. For the purpose of this wildlife analysis, Hawaii is divided into six habitat systems: alpine/subalpine, montane (mountainous), lowland, coastal/marine, wet cliff, and dry cliff. These habitat systems and wildlife inhabiting those regions are discussed below. The descriptions of alpine/subalpine, montane, and lowland habitat types are summaries of the Hawaiian High Islands Ecoregions discussions developed by *The Nature Conservancy* (*2009*).

Habitat

Alpine/Subalpine

The alpine and subalpine habitat type is located above 6,000 feet elevation, which only occurs on Maui and the Island of Hawaii. The alpine habitats include alpine lake, aeolian[5] desert, and sparse shrubland. The subalpine habitat includes grasslands, shrublands, and forests. The biological diversity in this habitat is generally low, with few wildlife species uniquely adapted to live here (e.g., the endangered nene goose [*Branta sandvicensis*]). The Palila bird (*Loxioides baileui*, a honeycreekper), for example, requires specific subalpine dry forest habitat called

[4] U.S. persons and U.S. vessels within and outside the territorial limits of the U.S. The National Oceanic and Atmospheric Administration has consistently interpreted the Marine Mammal Protection Act as applicable to U.S. vessels and citizens throughout the high seas, including exclusive economic zones, as reflected in congressional and other correspondence and international agreements that rely upon jurisdiction over U.S. vessels and citizens in foreign exclusive economic zones (*16 USC §§ 1361-1423h*).

[5] Aeolian environments include those where wind is the major agent of sediment deposition.

māmane-naio for nesting and foraging on the fruit and seeds of these trees. Only the youngest and largest islands have alpine and subalpine habitat types with snow during the winter (*The Nature Conservancy 2009*).

Montane: Dry, Mesic, and Wet

The montane habitat type is located between 3,000 and 6,000 feet elevation. The dry areas of this habitat receive less than 50 inches of annual precipitation, mesic receives between 50 and 75 inches, and wet receives greater than 75 inches of annual precipitation. This area includes grasslands, shrublands, and forests in summit regions and plateaus. Biological diversity is moderate to high here. For example, there are four forest bird concentration areas on the island of Hawaii (*The Nature Conservancy 2009*). The largest concentration area occupies the montane wetland mesic system of the Ka'u-Kapapala Conservation Area (*The Nature Conservancy 2009*). In addition, specialized plants and animals thrive in this habitat type, including various specialized caterpillars that rely on plants unique to the elevation and precipitation.

Lowland: Dry, Mesic, and Wet

The lowland habitat type is located below 3,000 feet elevation. The dry areas of this habitat receive less than 50 inches of annual precipitation, mesic receives between 50 and 75 inches, and wet receives greater than 75 inches of annual precipitation. Grasslands, shrublands, and forests occur here and the habitat has a high biological diversity. Native birds in low elevations of Hawaii suffer from diseases such as avian malaria. As a result, native populations have moved to higher elevations, whereas birds and other wildlife resistant to the diseases prefer the stable climate leading to the high biological diversity of bird assemblages within this area (*Turner et al. 2006*).

Coastal and Marine

Coastal and marine habitats include beaches, rocky cliffs and shores, estuaries, coral reefs, and the offshore marine environment. Shallow water benthic habitats in the Hawaiian Islands are dominated by a variety of substrate types including mud, sand, basaltic boulder, coral rubble, and broad expanses of limestone pavement (*Battista et al. 2007*). Biological benthic cover is highly variable and can consist of seagrass, macroalgae, algal turf, coralline algae, and coral. Although not all nearshore marine bottom areas are structurally formed from coral material, the majority of open coastline and protected shoreline benthic habitats are coral-dominated.

Wet Cliff

The wet cliff system is found on the windward region of Hawaiʻi, Maui, Molokaʻi, Lānaʻi, Oʻahu, and Kauaʻi islands. This system is typically found adjacent to the lowland wet system or the montane wet system (*The Nature Conservancy 2009*). Although the slopes are too steep to support forests, the vegetative community is composed of grasslands and shrublands (*The Nature Conservancy 2009*). Wildlife diversity tends to be low to moderate in this system, as specialized native plants and ferns dominant the landscape and must endure the strong tradewinds. Due to these strong winds, most native birds of Hawaii have been displaced by wind-carried introduced avian species.

Dry Cliff

The dry cliff system occurs on the leeward, or direction downwind of the mountain. The dry cliff region is typically below or adjacent to either the lowland mesic system or the lowland dry system. The vegetation of dry cliffs tends to be grasslands, scrublands, and steep rocky cliffs. Although the cliffs are steep, introduced goats are commonly found in this system (*The Nature Conservancy 2009*).

Wildlife

Terrestrial Invertebrates

The native invertebrates of the Hawaiian Islands consist of some 6,000 arthropod species, 1,000 or more native land mollusks, and many undescribed species with little information known of life history characteristics (*Gagne and Christensen 1985*). The terrestrial invertebrates of Hawaii have a narrow geographical range and ecological limit. For example, alpine communities unique to the Hawaiian Islands support native terrestrial invertebrates such as the wekiu bug (*Nysius wekiuicola*), a candidate for federal listing, and a few spiders (*DLNR 2005*). According to the research by Gagne and Christensen (*1985*), terrestrial invertebrates of Hawaii evolved in geographical isolation, making these species vulnerable to invasion and resulting in the spread of non-native animal and plant species (*Gagne and Christensen 1985*). Although the introductions of invasive plants tend to be relatively low in Hawaii, the spread of the Argentine ant (*Linepithema humile*) is a growing problem (*DLNR 2005*). Some example species of conservation concern include the Blackburn's sphinx moth (*Manduca blackburni*), O'ahu tree snails (species in genus *Achatinella*), the Kaua'i cave wolf spider (*Adelocosa anops*), and Kaua'i cave amphipod (*Spelaeorchestia koloana*); these species and other threatened and endangered species are discussed further in Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Amphibians and Reptiles

Most of the reptiles and all of the amphibian species on Hawaii have been introduced and are not native (*Wildlife of Hawaii Undated*). For example, the brown tree snake (*Boiga irregularis*), cane toad (*Rhinella marina*), and coqui frog (*Eleutherodactylus coqui*) are invasive species and are considered injurious (*Hawaii DFW 2015*). The coqui frog was accidentally introduced to Hawaii from Puerto Rico, and with no natural predators or competition their populations grow uncontrollably (*Hawaii DFW 2015*). The coqui frog population eats massive quantities of insects, decreasing the food supply for birds and removing the pollinators from the ecosystem, disrupting the balance (*Hawaii DFW 2015*).

Amphibians require moist freshwater environments, so they are more commonly found in lowland and montane wet and mesic environments, and occasionally in coastal environments. Reptiles are less dependent on moisture, and several are saltwater tolerant. Hawaii's reptiles can be found in montane, lowland, and coastal/marine environments. The only native reptiles to Hawaii are saltwater species: the pelagic sea snake (*Pelamis platurus*) and five species of sea turtle (green [*Chelonia mydas*], hawksbill [*Eretmochelys imbricata*], loggerhead [*Caretta caretta*], olive-ridley [*Lepidochelys olivacea*], and leatherback [*Dermochelys coriacea*]) (*Starr Environmental Undated*).

Terrestrial Mammals

The terrestrial mammals of Hawaii include the only native species, the Hawaiian hoary bat (*Lasiurus cinereus semotus*), whereas the other 16 species (e.g., livestock, deer, wallaby, cat, dog, mongoose, rodents) were introduced either intentionally or accidentally (*Wildlife of Hawaii Undated*). A few of the introduced species are considered invasive and injurious, such as most feral livestock and the Indian mongoose (*Herpestes edwardsii*) (*Hawaii DFW 2015*). Common game and non-game mammals are discussed below.

Game Species

Feral pig, feral sheep, mouflon sheep (*Ovis orientalis orientalis*), axis deer (*Axis axis*), black-tailed deer (*Odocoileus hemionus*), and feral goats can be hunted on Hawaii, with restrictions via a hunter education program, hunting seasons, and specific hunting areas (*DWF 2015*). Brush-tailed wallabies (*Petrogale penicillata*) and feral cattle are considered game species, but are not permitted for hunting unless otherwise authorized by DFW (*Hawaii DFW 2015*).

All of these game species on Hawaii were introduced, and most are damaging to native species habitats. Feral livestock such as sheep, goats, and cattle trample vegetation and damage native forests (*Hawaii History 2015*). Feral pigs are especially harmful to native species, as they are omnivores and often consume ground-laying species' nests of eggs.

The introduced terrestrial mammal species on Hawaii are versatile, and can populate most of the lowland, montane, and coastal habitats on the Hawaiian Islands.

Non-Game Species

Introduced – Nonnative Species: Terrestrial mammals on Hawaii that are introduced non-game species include feral cat, feral dog, Indian mongoose, feral donkey, black rat (*Rattus rattus*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and the Polynesian rat (*Rattus exulans*) (*Wildlife of Hawaii Undated*). These animals are largely considered pests and are threats to native species habitats. Dogs, cats, mongoose, and rats frequently prey on native species, their young, and eggs. The Indian mongoose was introduced intentionally in 1883 to try and cull the population of rats in sugar cane fields (*Hawaii DWF 2015*). Since their release, the mongoose population has expanded to most of the islands and now threatens endangered ground egg-laying species, such as the nene goose and the hawksbill sea turtle (*Hawaii DFW 2015*).

The introduced terrestrial mammal species on Hawaii are versatile, and can populate most of the lowland, montane, and coastal habitats on the Hawaiian Islands.

Resident Species: The Hawaiian hoary bat is the only native terrestrial mammal on Hawaii; it is a common subspecies of the hoary bat, which is found throughout North and South America (*DOE 2014*). The Hawaiian hoary bat is listed as a federally endangered species (see Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern). For a list of native species, see the Hawaii Wildlife Center's Native Species List;[6] for a list of Hawaii's terrestrial and marine mammals, see the Mammals of the Hawaiian Islands list.[7]

Habitats and Marine Mammals

A total of 24 species of mammals have been observed in Hawaii's marine environment, including 22 cetaceans (e.g., whales and dolphins) and two pinnipeds (i.e., Hawaiian monk seal [*Monachus schauinslandi*] and the Northern elephant seal [*Mirounga angustirostris*]). Eighteen species of odontocetes (toothed whales) have been documented in Hawaiian waters (*Wildlife of Hawaii Undated*). Species observed most frequently in shallow (less than 164 feet) near-shore waters include bottlenose dolphins (*Tursiops* spp.), spinner dolphins (*Stenella longirostris*), and false killer whales (*Pseudorca crassidens*). Species found in very deep (e.g., greater than 10,000 feet) offshore waters include striped dolphins (*Stenella coeruleoalba*), sperm whales (*Physeter macrocephalus*), rough-toothed dolphins (*Steno bredanensis*), and pantropical spotted dolphins (*Stenella attenuata*). Special status species including the Hawaiian monk seal and the humpback whale (*Megaptera novaeangliae*) are discussed in Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Habitats and Birds

Because of their flight capability, birds were some of the first animals to successfully colonize the Hawaiian Islands. The Hawaii Wildlife Center (*HWC 2015*) assembled a list of Hawaii's native bird species, which includes 23 seabirds, 6 shorebirds, 14 waterbirds, 2 birds of prey, and 26 forest birds. However, researchers have estimated a 75 percent decline of these native Hawaiian bird species, which has resulted in extinction or an endangered status within the state (*Atkinson et al. 1995*). According to this study, major causes of decline include habitat destruction, competition with non-native species, and introduction of predators and avian diseases (*Atkinson et al.1995*). Approximately 170 bird species have been introduced to the islands (*DOE 2014*). In addition to resident species, Hawaii also seasonally hosts a variety of migratory species (*DOE 2014*).

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[6] Native species list: http://www.hawaiiwildlifecenter.org/native-species.html

[7] Mammal species list: http://wildlifeofhawaii.com/hawaii-mammals.html

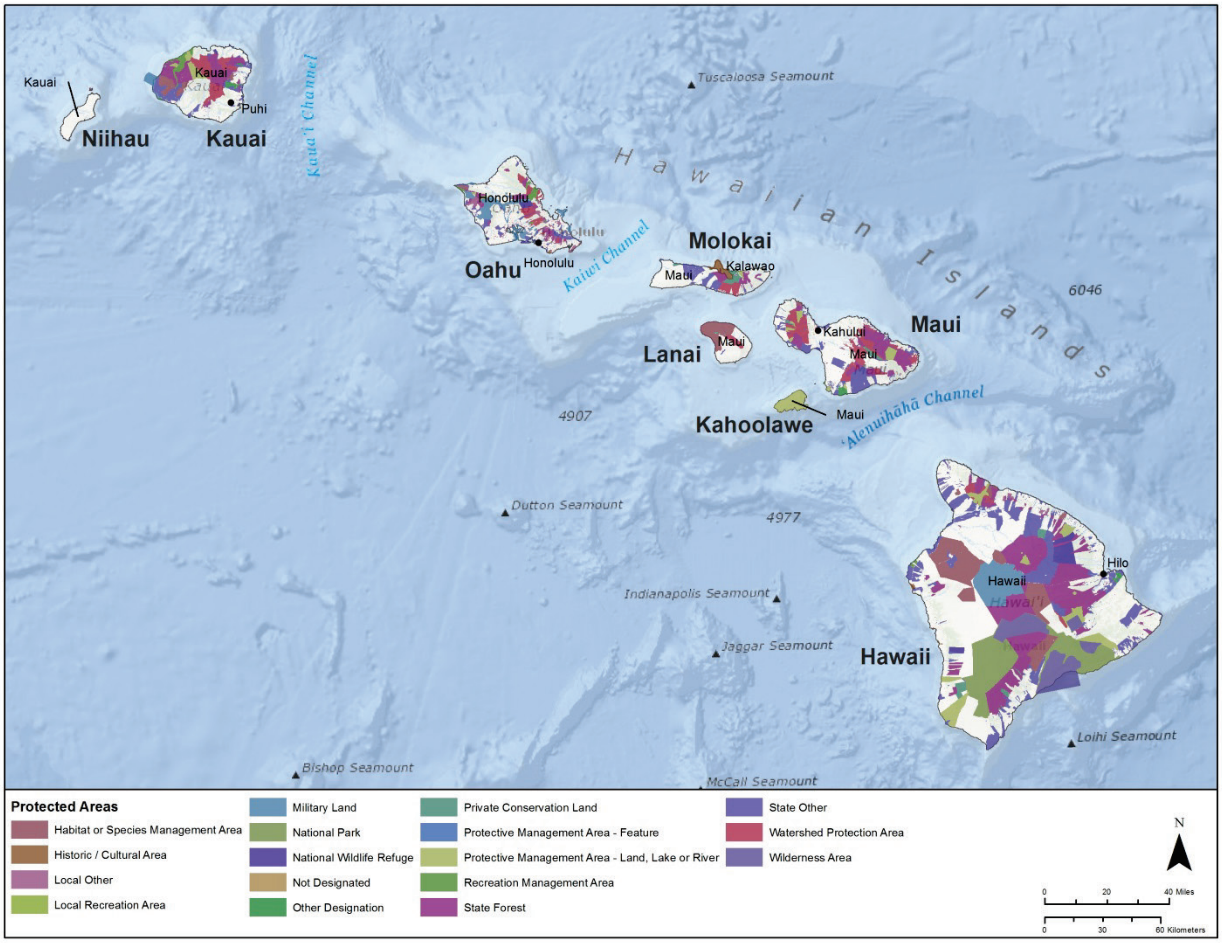
All of Hawaii is one established Bird Conservation Region. The North American Bird Conservation Initiative describes the Hawaiian Bird Conservation Region:

> "This chain of volcanic islands is the richest area for endemic landbirds in the United States. Because of significant disturbances from introduced species, including disease-bearing mosquitoes, and conversion of large areas to agriculture or other uses, Hawaii also has the nation's highest concentration of endangered species. About 12 forest birds in the chain became extinct during the 20th century, and many others are very close to that brink. The main island chain supports important seabird breeding populations, including the endangered dark-rumped petrel (*Pterodroma phaeopygia*) and Newell's shearwater (*Puffinus newelli*). The Leeward Islands host immense numbers of nesting seabirds, including important colonies of black-footed and Laysan albatrosses (*Phoebastria nigripes* and *Phoebastria immutabilis*); Bonin petrels (*Pterodroma hypoleuca*); boobies; frigatebirds; and gray-backed, sooty, and white terns (*Onychoprion lunatus*, *Onychoprion fuscatus*, and *Gygis alba*). Pelagic waters provide essential foraging sites for numerous shearwaters, petrels, terns, and other seabirds." (*NABCI 2000*)

There are 17 Important Bird Areas (IBA) designated along the Hawaiian Islands, all of which are globally-significant, totaling 90.6 million acres of habitat (*Audubon 2013*). This acreage total includes forests, uplands, marine habitats, and Wildlife Refuges in and surrounding Maui, Hawaii, Kauai, and Honolulu (*Audubon 2013*). The primarily marine Northwestern Hawaiian Islands IBA makes up about 99 percent of this area, however. The main Hawaiian Islands larger IBAs are the Kauai Forests and Uplands, Oahu Uplands, Haleakala (Maui), Hamakua Forests (Hawaii), Mauna Loa-Kilauea Forests (Hawaii), Kona Forests (Hawaii), and Kua Forest (Hawaii) (*Audubon 2013*). IBAs are designated as a first step in better protection for birds and habitats.

Important Habitat Areas

Hawaii has nine federally managed National Wildlife Refuges (NWR), distributed throughout the islands. These NWRs were designated as such to protect the habitat of sensitive plant and animal species. The James Campbell NWR on Oahu provides habitat for endangered Hawaiian waterbirds, seabirds, endangered and native plant species, the endangered Hawaiian monk seal, and the threatened green sea turtle (*USFWS 2015*). The Hakalau Forest NWR on the island of Hawaii consists of 32,733 acres of forest and alpine areas, and supports a great diversity of native upland birds and plants (*USFWS 2015*). The Kealia Pond NWR on Maui encompasses approximately 700 acres and is one of the few natural wetlands remaining in the Hawaiian Islands (*USFWS 2015*). Hawaii also has 21 state-managed Natural Area Reserves on the five main Hawaiian Islands, which have been set aside to protect native flora, fauna, and geological sites in unique habitats on the islands (*Hawaii DFW 2015*). Additionally, Hawaii has several wilderness preserves, wildlife sanctuaries, and marine conservation districts not mentioned above. Hawaii's protected lands are shown in Figure 4.1.6.4-1.



Source: USGS GAP 2012

Figure 4.1.6.4-1: Protected Areas of the Hawaiian Islands

The Hawaiian Islands Humpback Whale National Marine Sanctuary is 1,218 square nautical miles of marine habitat located between Maui, Moloka'i, and Lana'i, and additional sanctuary regions adjacent to Kaua'i, O'ahu, and the island of Hawaii. It is managed by NOAA and the State of Hawaii (*NOAA 2015*). The primary purpose of the sanctuary is to protect breeding and calving humpback whale habitat, but along with this protection, the surrounding ecosystems are also protected. NOAA is currently analyzing the possibility of expanding the focus of the sanctuary to include multiple marine species (*NOAA 2015*).

In 2014, NOAA selected a northwestern portion of the island of Hawaii as a habitat focus area (*NOAA 2014*). This area is known for its clear water, coral reefs, and wetland habitats, and several endangered or threatened species occur here, such as the Hawaiian monk seal, humpback whales, and green sea turtles (*NOAA 2014*).

Threats and Stressors

The primary threats to wildlife and their habitats in Hawaii are climate change, non-native species, habitat loss, and human disturbance. Many species of wildlife on Hawaii have been introduced, and many of these species are considered invasive and injurious.

Introduced species are a significant threat to native bird species, especially predators such as feral cats, mongoose, rats, and feral pigs. Cats were brought to the islands in the 1800s; at least 30 species of native forest birds either went extinct or were greatly reduced in numbers between 1870 and 1930, as a direct result of predation by cats (*USGS 2006*). The Indian mongoose preys on eggs and is a major threat to endangered nene geese and sea turtle populations.

Hawaiian hoary bats are negatively affected by habitat loss (deforestation), pesticides, predation, and disturbances to their roosts (*Mitchell et al. 2005*).

Humpback whales and other marine mammals can be injured by boat strikes and marine debris entanglement, underwater noise from sonar, vessel traffic, and harassment from ocean goers may affect their ability to communicate and use preferred habitat (*Mitchell et al. 2005*). The primary threats to the survival of the Hawaiian monk seal include conflicts with fishing gear (e.g. entanglement and hooking), entanglement in other marine debris, storms and climate change resulting in loss of pupping islands, disease (e.g., canine distemper, leptospirosis, and brucellosis), predation by sharks, human disturbance to mothers with calves, low pup survival, and low genetic variability (*Mitchell et al. 2005*).

4.1.6.5. Fisheries and Aquatic Habitats

Introduction

This section discusses fisheries resources in Hawaii. Information is presented regarding fisheries features and characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Species included in this section include freshwater and marine species of fish and shellfish, occurring on Hawaii and in Hawaii's offshore environment. Fish species and habitat in Hawaii are generally discussed in this section. For more information about water, see Section 4.1.4, Water Resources. Fisheries are defined as the human activities involved in harvesting fish or shellfish, or a group of fish species that share the same habitat (*NOAA 2015a*). The types of fisheries in Hawaii include commercial,[1] subsistence,[2] and recreational.[3] For more information on subsistence use and threatened and endangered species of fish, see Section 4.1.9, Socioeconomics, and Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, respectively.

Specific Regulatory Considerations

The Western Pacific Regional Fishery Management Council (WPRFMC) produced a Fishery Ecosystem Plan for the Hawaiian Archipelago, which outlines ecosystem approaches to management of the fisheries (*WPRFMC 2009*).

The State of Hawaii Division of Aquatic Resources (DAR) is responsible for the implementation of fisheries management within 3 miles of the shore of Hawaii (*WPRFMC 2009*).

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Pacific Islands Regional Office manages fisheries outside of the 3 mile offshore boundary around Hawaii (*WPRFMC 2009*).

Commercial fishermen are required to have commercial fishing licenses on Hawaii, obtained from the DAR office (*State of Hawaii DAR 2015b*). Marine recreational and subsistence fisheries on Hawaii are currently not regulated via licenses, but there are some fishing restrictions in marine protected areas, gear restrictions, and species restrictions (*State of Hawaii DAR 2015b*). A freshwater game license is required for fishing in freshwater systems (*State of Hawaii DAR 2015b*). The many protected areas in Hawaii include marine managed areas, marine life conservation districts, wildlife sanctuaries, natural area reserves, marine refuges, a national monument, as well as several fishery management areas in bays, canals, harbors, and wharfs (Figures 4.1.6.5-1 and 4.1.6.5-2) (*State of Hawaii DAR 2015b*). State and federal agencies, along with non-governmental agencies and private industry, have formed the Hawaii Fish Habitat Partnership, which is a statewide effort to prevent fish habitat degradation through aquatic habitat restoration programs (*USFWS 2012*).

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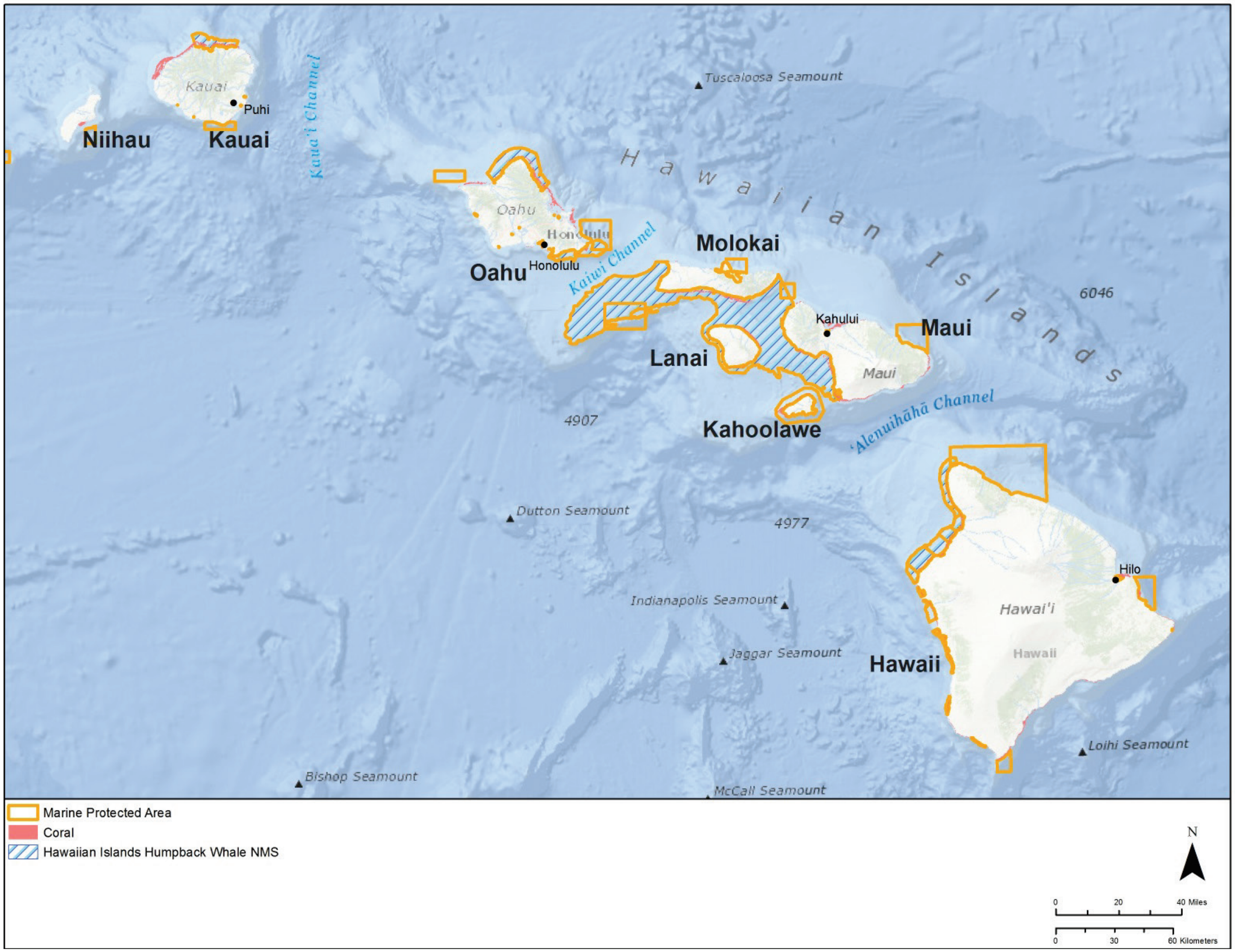
[1] The whole process of catching and marketing fish and shellfish for sale (*NOAA 2015a*)

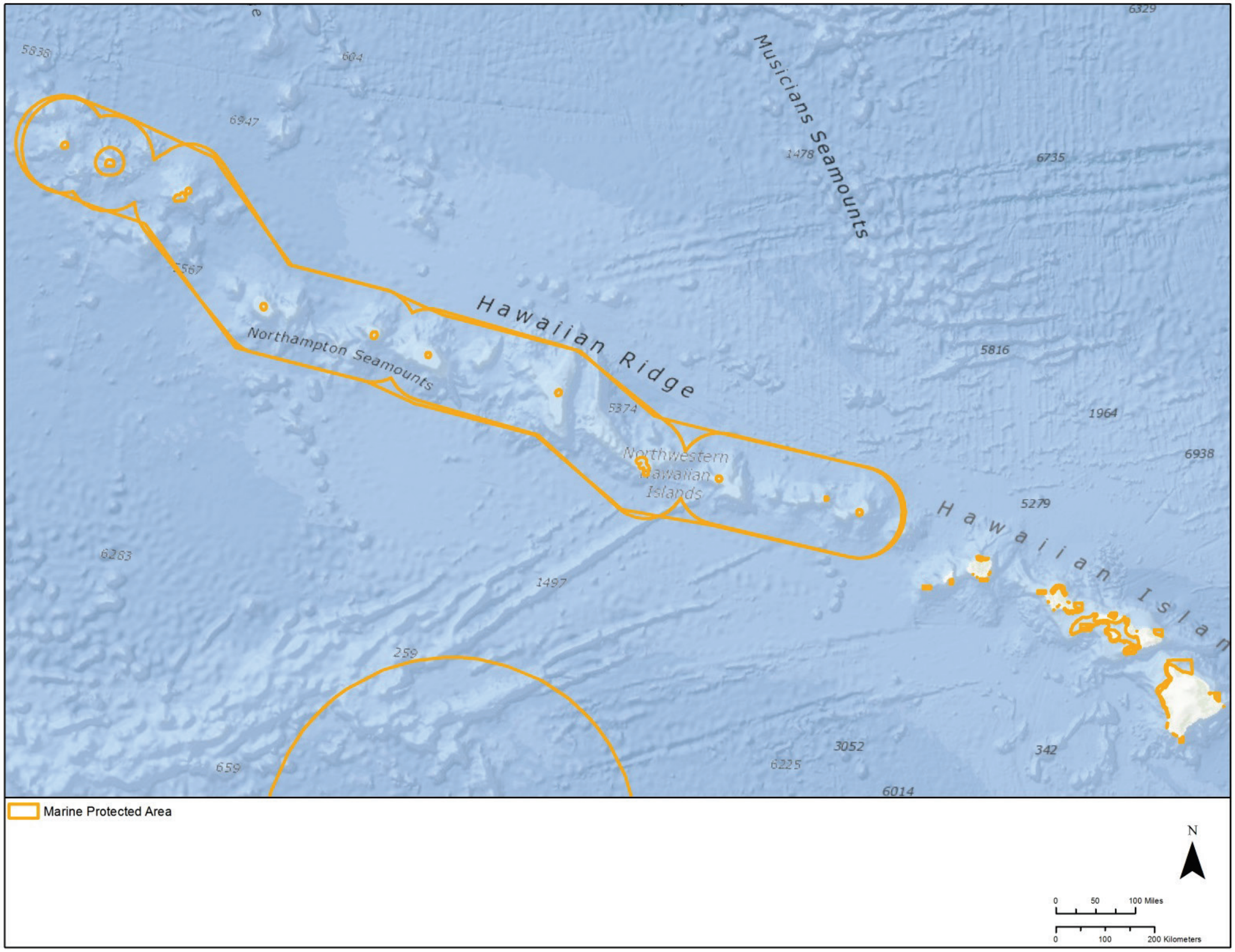
[2] The catch is shared and consumed directly by the families and kin of the fishermen, rather than being sold (*NOAA 2015a*).

[3] The catch is for personal use, pleasure, or competition (*NOAA 2015a*).



Source: State of Hawaii DAR 2015b; NOAA and USDOI 2014

Figure 4.1.6.5-1: Protected Marine Areas on Hawaii



Source: State of Hawaii DAR 2015b; NOAA and USDOI 2014

Figure 4.1.6.5-2: Expanded View of Protected Marine Areas on Hawaii

Guidance on compliance with Hawaiian fisheries management and regulations can be found on the State of Hawaii DAR[4] (*2015a*) and the NOAA Fisheries Pacific Islands Regional Office[5] (*NOAA 2015c*) websites.

Environmental Setting

The environmental settings for Hawaii's fisheries are freshwater lakes and streams and the surrounding marine environment. In general, marine environments are described as benthic/demersal (associated with the seafloor) and pelagic (the water column and open ocean) (*WPRFMC 2009*). Special vegetated fish habitat types also occur in brackish and intertidal waters and are described below.

Seagrass Beds

One native species of seagrass (*Halophila hawaiiana*) occurs on Hawaii and is found near shore below the tidal zone (*DOE 2015*). A second grass, widgeon-grass (*Ruppia maritima*), is commonly found amongst the seagrass (*DOE 2015*). Seagrass ecosystems are common off the inner reef flats of south Molokai and Kauai; it is rare elsewhere (*DOE 2015*). Seagrass communities prefer habitats where wave action is gentle, in sands and muds that are completely submerged, and commonly occur in fishponds (*DOE 2015*). Some of the common species that occur in seagrass communities are sea cucumbers, gastropods, clams, crabs, shrimps, mullets, and rudderfish (*DOE 2015*).

Estuaries

Estuaries occur along coastlines where fresh and saltwater meet, making a brackish environment (*DOE 2015*). This can occur where streams enter the ocean or where groundwater discharges offshore (*DOE 2015*). Estuaries typically have sediment covered bottoms and the fresh water brings nutrients, which stimulates productivity (*DOE 2015*). A diversity of vegetation and aquatic species occurs in estuaries including crustaceans,[6] mollusks, and fish (*DOE 2015*). Estuaries serve as important nursery areas for fish and shellfish species by providing habitat, nutrients, and protection (*DOE 2015*).

Mangrove Forests

The WPRFMC (*2009*) discusses the mangrove forest habitat on Hawaii:

> "Mangroves are terrestrial shrubs and trees that are able to live in the salty environment of the intertidal zone. In their native habitat, their prop roots form important substrate on which sessile organisms[7] can grow, and they provide shelter for fishes. Mangroves are believed to also provide

[4] http://dlnr.hawaii.gov/dar/fishing/fishing-regulations/

[5] http://www.fpir.noaa.gov/

[6] A group of freshwater and saltwater invertebrates with jointed legs and a hard shell of chitin; includes shrimps, crabs, lobsters, and crayfish (*NOAA 2006*)

[7] Sessile organisms are unable to move; attached to the substrate (*NOAA 2006*). Peneaeid shrimp are a family of marine crustacean that includes some of the most commercially valuable species (e.g., tiger prawn). Invasive species are introduced species that out-compete native species for space and resources (*NOAA 2006*).

> important nursery habitat for many juvenile reef fishes. Apart from the usefulness of the wood for building, charcoal, and tannin, mangrove forests can stabilize areas where sedimentation is occurring and may be important as nursery grounds for peneaeid shrimps and some inshore fish species. They may also provide a habitat for some commercially valuable crustaceans.
>
> The red mangrove (*Rhizophora mangle*) and the oriental mangrove (*Bruguiera gymnorrhiza*) were introduced into Hawaii and have become the dominant plant within a number of large protected bays and coastlines on both Oahu and Molokai. Mangroves are invasive species in Hawaii where they have become established on all the major Hawaiian Islands. Mangroves have colonized many different landforms including tidal flats, riverbanks, fishponds, canals, embayments, lagoons, and some reef areas that are protected from strong waves and currents."

Freshwater Environment

The State of Hawaii DAR (*State of Hawaii DAR 2015b*) describes freshwater fish habitat on Hawaii:

> "Streams on the leeward slopes of the islands are mostly intermittent. By contrast, the windward slopes are often characterized by cliffs and valleys with high annual rainfall and many perennial streams. Only five natural lakes, all very small, occur in Hawaiʻi, but 266 freshwater reservoirs ranging up to 400 surface acres in size have been created through impoundment of stream waters.
>
> Despite the abundance of fresh water and hundreds of streams, the only freshwater fishes native to Hawaiʻi are four gobies [members of family Gobiidae] and an eleotrid [a sleeper goby; member of family Eleotridae]. Two marine fishes, aholehole and mullet, are transient inhabitants of lower stream reaches.
>
> Various fish species from elsewhere in the world have been deliberately or accidentally introduced to Hawaiʻi. High-quality game fishes such as largemouth bass [*Micropterus salmoides]*, tucunare [*Cichla ocellaris*] and channel catfish [*Ictalurus punctatus*] are now widespread and well established in reservoir waters. Two game fishes, rainbow trout [*Oncorhynchus mykiss]* on Kauaʻi and smallmouth bass [*Micropterus dolomieu]* on Oʻahu and Kauaʻi, may be found in both streams and reservoirs. Panfish such as bluegill [*Lepomis macrochirus*] and tilapia [*Tilapia spp.*] are generally abundant in reservoirs statewide, and several tilapia species also occupy stream habitats."[8]

[8] "Leeward" is on the side sheltered from wind (downwind). A stream reach is any specified length of a stream.

Coral Reefs and Marine Environment

The WPRFMC (*2009*) discusses coral reef habitat on Hawaii:

> "Coral reefs are carbonate rock structures at or near sea level that support viable populations of reef-building corals. Apart from a few exceptions in the Pacific Ocean, coral reefs are confined to the warm tropical and subtropical waters lying between 30° N and 30° S. Coral reef ecosystems are some of the most diverse and complex ecosystems on Earth."

A highly diverse assemblage of fish and shellfish species occurs in the reef and marine environment around Hawaii. Marine invertebrate groups important to ecosystem function and energy transfer through the food web are corals, sponges, star fishes, anemones, crustaceans, and mollusks (*WPRFMC 2009*).

Fisheries Characteristics

Commercial

Pelagic waters, deep sea bottoms, and reefs are commercially fished in Hawaii. Common commercial harvest methods in the pelagic and deep sea environments include pole and line, longline, deep bottom hand line, tuna hand line, and trolling (*State of Hawaii DAR 2012*). Nets, traps, hook and line, and spears are used in reef fisheries (*WPRFMC Undated*).

Some of the most economically valuable fisheries include snapper, jacks, tuna, and Hawaiian grouper. The most sought-after fish species in Hawaii's bottomfishery are called the "Deep 7": pink snapper, scarlet/red snapper, Hawaiian grouper, squirrelfish snapper, Von Siebold's snapper, flower/Brigham's snapper, and ironjaw/silverjaw snapper (*WPRFMC 2010*). There are several restrictions for harvesting the Deep 7 (e.g., bag limits, restricted fishing areas, and closed seasons) (*WPRFMC 2010*).

The WPRFMC (*2009*) states that "the most commonly harvested species of coral reef associated organisms include the following: surgeonfishes (Acanthuridae), triggerfishes (Balistidae), jacks (Carangidae), parrotfishes (Scaridae), soldierfishes/squirrelfishes (Holocentridae), wrasses (Labridae), octopus (*Octopus cyanea*, *O. ornatus*), and goatfishes (Mullidae)."

Subsistence

Local Hawaiians use both freshwater and marine habitats to obtain fish and shellfish for consumption. Using throw nets and spearfishing are common practice for nearshore schooling reef species (e.g., surgeonfish, herrings, rabbitfish, and mullets) (*WPRFMC 2009*). Hook and line is often used for freshwater species. Game fishes such as largemouth bass, smallmouth bass, tucunare, rainbow trout, bluegill, tilapia, and channel catfish have been introduced to Hawaii and are now widespread and well established in reservoirs and streams throughout the state (*State of Hawaii DAR 2015b*). Crustaceans, mollusks, and octopus are caught in traps/pots or are hand collected in shallow waters (*Hawaii DAR 2015a*).

Recreational

Marine recreational fishing is not currently regulated with a permit system in Hawaii, with some exceptions in protected areas and gear and species restrictions. Freshwater fishing, however, does require a freshwater game permit (*State of Hawaii DAR 2015b*). Marine sport fishing is popular in Hawaii, especially for tourists. Charter boats take tourists out to fish with rods and lures for species such as blue marlin, yellowfin tuna, dolphin fish (mahi-mahi), striped marlin, black marlin, spearfish, and wahoo (*Magic Sport Fishing 2015*). Some commonly caught nearshore game fish species using hook and line include barracuda, bonefish, snapper, trevally, flagtail, goatfish, ladyfish, milkfish, peacock grouper, wrasse, rudderfish, squirrelfish, triggerfish, unicornfish, and sharks (*Lovic 2014*).

Areas of Importance

The Magnuson-Stevens Fishery Conservation and Management Act, commonly referred to as the Magnuson-Stevens Act, as amended by the 1996 Sustainable Fisheries Act, defines essential fish habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding or growth to maturity" of Management Unit Species *(WPRFMC 2009)*. EFH for the Hawaii Archipelago is designated by the Western Pacific Regional Fishery Management Council's Fishery Ecosystem Plan (*WPRFMC 2009*) for thousands of species represented by the following groups: bottomfish, seamount groundfish, crustaceans, precious corals, and coral reef ecosystems.

For descriptions of life history and habitat use of individual Hawaii EFH-designated fish species, see the EFH descriptions and maps contained in Supplements to Amendment 4, 6, and 10 to the Precious Corals, Bottomfish and Seamount Groundfish, and Crustaceans Fishery Management Plans respectively (*WPRFMC 2002*), and the Coral Reef Ecosystems Fishery management Plan (*WPRFMC 2001*).

There are many protected areas around Hawaii. These include marine managed areas, marine life conservation districts, wildlife sanctuaries, natural area reserves, marine refuges, a national monument, as well as several fishery management areas, bays, canals, harbors, and wharfs (Figures 4.1.6.5-1 and 4.1.6.5-2) (*State of Hawaii DAR 2015b*). Of the protected areas, the two largest sites are the Papahanaumokuakea National Marine Monument and the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS).

The Papahanaumokuakea National Marine Monument encompasses 139,797 square miles of marine habitat (*PMNM 2015*). The Monument, including the Hawaiian Islands National Wildlife Refuge, is designated a United Nations Educational, Scientific and Cultural Organization World Heritage Site and is co-managed by the Department of Commerce, Department of Interior, and the State of Hawaii (*USFWS 2014*).

Most of the HIHWNMS' area is located between Maui, Molokai, and Lanai, but there are also sanctuary regions on Kauai, Oahu, and the island of Hawaii. It is managed by NOAA and the State of Hawaii (*NOAA 2015b*). The primary purpose of the sanctuary is to protect breeding and calving humpback whale habitat, but along with this protection, the surrounding ecosystems are also protected. NOAA is currently analyzing the possibility of expanding the focus of the HIHWNMS to include multiple marine species (*NOAA 2015b*).

Threats and Stressors

Hawaii's coral reefs and marine environment are at risk from overfishing, sedimentation, land-based pollution, recreational overuse, and invasive species (*The Nature Conservancy 2015*). Hawaii's reefs have declined by 75 percent over the last century (*The Nature Conservancy 2015*).

Major sources of pollution into the marine environment from Hawaii include sources such as debris from boats and beaches, sewage, oils, lead acid batteries, and paint from vessel maintenance and cleaning (*State of Hawaii DLNR DBOR 2015*).

Overfishing occurs when fish are harvested at a rate faster than they can reproduce–a potentially devastating problem for fisheries worldwide (*Monterey Bay Aquarium 2015*). The Hawaiian Islands Archipelago Fishery Ecosystem Plan, mandated by the Magnuson-Stevens Act, strives to "achieve long-term sustainable yields from domestic fisheries while preventing overfishing" (*WPRFMC 2009*). Typically overfishing begins when fishermen target the largest individual fish in a population, for the greatest economic value. When the largest fish become depleted, the next largest fish size is targeted and the overfishing sequence continues until only the smallest size classes remain in the population. Larger fish are generally the ones that reproduce; when larger fish are removed, the population cannot sustain itself.

One of the WPRFMC's primary management objectives for the Hawaiian Islands Archipelago is "to minimize fishery bycatch and waste to the extent practicable" (*WPRFMC 2009*). NOAA (*2011*) describes the effects and importance of managing non-target species bycatch:[9]

> "Bycatch costs fishermen time and money, harms endangered and threatened species, affects marine and coastal ecosystems, and makes it more difficult for scientists to measure the effect of fishing on the stock's population, and for managers to set sustainable levels for fishing. Preventing and reducing bycatch is an important part of ensuring sustainable living marine resources and coastal communities. The 2006 reauthorization of the Magnuson Stevens Act, the nation's principal law for living marine resources, made bycatch reduction a priority, leading NOAA to establish a bycatch reduction program to develop technological devices and other conservation engineering solutions."

In most cases coral reef fisheries generate very little bycatch (*WPRFMC 2009*). Certain fish are discarded due to cultural taboos (e.g., surf perch) or known toxicity (*WPRFMC 2009*). Ciguatera toxin is a concern for several coral reef fish species caught in Hawaii (*WPRFMC 2009*).

There are other naturally occurring threats to fish habitat such as storm and hurricane action, which often devastates coastal ecosystems by damaging coral reefs, seagrasses, and mangroves.

[9] Unintentional capture/injury/entanglement of unwanted species during commercial fishing (e.g., a shark captured in a seine net targeting salmon)

4.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

Introduction

The threatened and endangered species analysis in this Draft Programmatic Environmental Impact Statement considers plant and animal species that are federally listed as threatened (likely to become endangered), endangered (at risk for extinction), candidate,[1] proposed,[2] or species of concern (species in need of conservation); and species that are state-listed as endangered or threatened. This analysis considers species that are known to occur in Hawaii for all or part of their life cycle.[3]

Specific Regulatory Considerations

Federal Regulations

<u>Endangered Species Act</u>

The Endangered Species Act (ESA) is administered by the United States (U.S.) Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). With some exceptions, Section 9 of the ESA prohibits unauthorized take[4] of any fish or wildlife species listed as endangered or threatened under the ESA. Subject to specified terms and conditions, Section 10 of the ESA allows for the incidental take of listed species by non-federal entities otherwise prohibited by Section 9. Pursuant to Section 10, an Incidental Take Permit[5] is issued through adoption of an USFWS-approved Habitat Conservation Plan[6] that demonstrates that take has been avoided, minimized, and mitigated (reduced severity) to the maximum extent practicable.

Section 7(a)(2) of the ESA states that each federal agency shall ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat. A federal action "means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas" (*50 Code of Federal Regulations 402.2*).

[1] Candidate species are plants and animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act.
[2] Proposed species are those that have been proposed in a *Federal Register* (FR) after the completion of a status review and consideration of other protective conservation measures.
[3] Life cycle is defined as the continuous sequence of development of an organism.
[4] Take is defined differently by various federal and state regulations, but the most commonly accepted definition is that of the U.S. Endangered Species Act (ESA). This act defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct." The act further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering," and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering."
[5] An Incidental Take Permit is issued under Section 10 of the ESA to private parties undertaking otherwise lawful projects that might result in the take of an endangered or threatened species (*USFWS 2015a*).
[6] A plan that outlines mitigation measures to enhance, maintain, and protect habitats of a particular species. The Plan is developed to help reduce impacts.

Actions of federal agencies that do not jeopardize the continued existence of listed species or result in destruction or adverse modification of their designated critical habitat, but that could result in a take, must be addressed by consulting with applicable resource agencies under Section 7. The Proposed Action is subject to the ESA because it is a proposed federal undertaking.

State Regulations

Hawaii's Administrative Rules, Revised Statutes (HRS) Division 1, Title 12, Subtitle 6, Chapter 195 (*HRS 195D 1-32*) establishes the state's legal framework related to endangered species and provides the regulations related to those species protected under the law within the state, including prohibiting take, possession, and export of such species. Under *HRS 195D 1-32*, the state's Department of Land and Natural Resources (DLNR) is responsible for determining and maintaining a list of threatened and endangered species in the state. This list was last updated in 2014 and includes 38 birds, 6 marine mammals, 2 marine turtles, and 68 species of invertebrates that are state-listed as endangered and 2 birds, 3 marine turtles, and 2 species of invertebrates that are state-listed as threatened (*DLNR 2014*). Most of these species are also federally listed under the ESA. No plants are included on the state list, but the DLNR considers any species (all taxa including plants) that is federally listed under the ESA to also be state-listed at the same status ranking as the federal listing, unless otherwise noted in the current state list. Conservation and management considerations for state-listed endangered and threatened species are incorporated into Hawaii's Comprehensive Wildlife Conservation Strategy, which is currently being updated (*DLNR 2005*).

Species Overview

As a result of the state's relatively small land area and isolation from other islands and continental land masses, many native plant and animal species in Hawaii are unique because they have evolved and adapted to the natural conditions that are specific to the state. Changes to the natural conditions that the species' have adapted to, such as changes in land use, urbanization, and the introduction of nonnative species, have negatively impacted these species. As a result in large part to these human activities and these species uniqueness, Hawaii has the highest number of threatened and endangered species in the nation (*USFWS 2012*).

There are 474 federally and/or state-listed species in Hawaii (*USFWS 2015b*; *DLNR 2014*). These include 351 plants, 41 birds, 9 mammals (all but 1 are marine), 5 reptiles (all marine), and 68 invertebrates. Of the 68 invertebrate species, there are 41 species of the Oahu tree snail (*Achatinella* spp.) and other instances where multiple related species have the same common name. There are no Federal Candidate Species or Federal Species of Concern. Table 4.1.6.6-1 lists the federally and state-listed species and summarizes their habitat preferences and geographic distribution in Hawaii.

Table 4.1.6.6-1: Federal- and State-listed Threatened and Endangered and Candidate Species Known to Occur in Hawaii

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Plants (351 species)									
See Appendix D, Threatened and Endangered Species, for the list of federal- and state-listed plants.									
Birds (41)									
Millerbird, Nihoa *(Acrocephalus familiaris kingi)*	FE, SE	Tiny land bird, prefers dense cover on the ground, particularly amongst shrubs. Nests between January and May.							Northwest Islands
Duck, Laysan *(Anas laysanensis)*	FE, SE	Medium-sized duck found in dense cover and terrestrial vegetation during the day, while during the evening and night, found in the central hypersaline lake on Laysan. Nests and rests in dense stands of shrubs and grasses from February through August.							Northwest Islands
Duck, Hawaiian; Koloa maoli *(Anas wyvilliana)*	FE, SE	Medium-sized duck that inhabits a broad range of wetland habitats from sea level up to 10,000 feet above sea level. Nests from February through August.	x	x			x	x	
Owl, Short-eared Hawaiian; Pueo *(Asio flammeus sandwichensis)*	FE, SE	Medium-sized owl that inhabits forests and grasslands; nests on the ground. Nests throughout the year.					x		
Goose, Hawaiian; Nēnē *(Branta sandvicensis)*	FE, SE	Large goose found in pastureland adjacent to natural shrubland. Nests from August to April.	x	x		x		x	
Hawk, Hawaiian; 'Io *(Buteo solitarius)*	FE, SE	Large hawk found in territorial forest habitat. Nests from March through September.	x						

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
'Elepaio, O'ahu *(Chasiempis sandwichensis ibidis)* (CH)	FE, SE	Small forest bird that occurs in closed-canopy mesic (habitat with moderate amounts of moisture) forest, generally in valleys and on slopes between 600 and 2,400 feet above mean sea level. Nests from January through June.					x		
Crow, Hawaiian; 'Alalā *(Corvus hawaiiensis)*	FE, SE	Medium-sized bird that inhabits native Hawaiian Ohia forests or Ohia and Koa mixed open forest. Nests from March through July.	x						
Coot, Hawaiian; 'Alae ke'oke'o *(Fulica alai)*	FE, SE	Medium-sized waterbird that is typically found in ponds and fresh and tidal marshes below 1,200 feet above mean sea level. Some birds inhabit pools above 6,000 feet above sea level. Nesting period varies based on climatic and hydrologic conditions.	x	x	x	x	x	x	
Moorhen, Common; Hawaiian gallinule; 'Alae 'ula *(Gallinula chloropus sandvicensis)*	FE, SE	Medium-sized waterbird that inhabits dense freshwater lowland wetland vegetation while feeding in the open, usually below 400 feet above sea level. Nests year round but most active nesting period occurs from March through August.	x	x		x	x	x	
Nuku pu'u, Maui *(Hemignathus lucidus affinis)*	FE, SE	Small forest bird that inhabits forests that are 4,000 feet or more in elevation. . Nests from January through June.		x					

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Nuku pu'u, Kaua'i *(Hemignathus lucidus hanapepe)*	FE, SE	Small forest bird that inhabits forests that are 4,000 feet or more in elevation. . Nests from January through June.						x	
Akia pōlā'au *(Hemignathus munroi)*	FE, SE	Small forest bird that inhabits high elevation ʻōhiʻa-koa forests. Nests from March through June.	x						
'Akia loa, Kaua'i *(Hemignathus procerus)*	FE, SE	Small forest bird that inhabits high elevation forests. Nests from March through June.						x	
'Akia loa, Kaua'I; 'Akia loa *(Hemignathus stejnegeri)*	FE, SE	Small forest bird that inhabits high elevation forests. Nests from March through June.	x	x	x	x	x	x	
'Amakihi, Maui; 'Amakihi *(Hemignathus virens wilsoni)*	FE, SE	Small forest bird that inhabits high elevation forests. Nests from March through June.			x				
Stilt, Black-necked; Hawaiian stilt; Ae'o *(Himantopus mexicanus knudseni)*	FE, SE	Medium-sized waterbird that occurs in fresh and tidal ponds, mashes, and mudflats below elevation of 450 feet above sea level. Nests from March through August.	x	x	x	x	x	x	Northwest. Islands
Palila *(Loxioides bailleui)* (CH)	FE, SE	Small forest bird that inhabits sub-alpine forest at altitudes above 6,000 feet mean sea level. Nests from February to September.	x						

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
'Ākepa, Kauai; Akekee *(Loxops caeruleirostris)* (CH)	FE, SE	Small forest bird found in forests above 4,500 feet above mean sea level containing large mature trees with naturally occurring cavities for nesting. Nesting occurs from March through September.						x	
'Ākepa, Hawai'i *(Loxops coccineus coccineus)*	FE, SE	Small forest bird found in forests having large mature trees with naturally occurring cavities for nesting between 4,000 and 6,000 feet above sea level. Nesting occurs from March through September.	x						
'Ākepa, Maui *(Loxops coccineus ochraceus)*	FE, SE	Small forest bird found in forests having large mature trees with naturally occurring cavities for nesting. Nesting occurs from March through September.		x					
Po'ouli *(Melamprosops phaeosoma)*	FE, SE	Small forest bird found in remote high elevation forests above 5,000 feet mean sea level. Nesting occurs from February to June.		x					
Ō'ō, Kaua'i; 'Ō'ō 'ā'ā *(Moho braccatus)*	FE, SE	Small forest bird found within mid-elevation dense, wet forest of the island of Kauai. Nesting occurs from March through June.						x	
Thrush, Moloka'i; Oloma'o *(Myadesxes lanaiensis ruxha)*	FE, SE	Small forest bird that inhabits wet ‘ōhi‘a forest containing dense understory at elevations above 3,000 feet mean sea level. Nesting period unknown.				x			

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Thrush, Large Kaua'i; Kāma'o *(Myadestes myadestinus)*	FE, SE	Small forest bird that inhabits dense montane forests. Nesting period unknown.						x	
Thrush, Small Kaua'i; Puaiohi *(Myadestes palmeri)*	FE, SE	Small forest bird that inhabits forested, steep-sided ravines and prefers to nest next to streams where ferns and mosses provide a high level of cover. Nesting period occurs from March through June.						x	
Storm-petrel, Band-rumped; 'Ake 'ake *(Oceanodroma castro)*	FE, SE	Small seabird species usually found far out at sea, feeding over deep, warm waters and rarely coming to land, except when breeding. Nests in burrows in cliffs. Breeding period is variable and some populations breed twice a year.	x	x	x	x	x	x	
Creeper, Kauai; Akikiki *(Oeromystis bairdi)* (CH)	FE, SE	Small forest bird found in high elevation forests where it feeds on invertebrates. Nesting occurs from March through June.						x	
Creeper, Hawai'i *(Loxops mana)*	FE, SE	Small forest bird occurring mainly in dry and wet tropical forests between 3,000 and 7,000 feet above sea level. Nesting occurs from March through June.	x						
Honeycreeper, Crested; *'Ākohekohe (Palmeria dolei)*	FE, SE	Small forest bird that occurs in mesic and hydric (very wet) forests between 3,300 and 7,000 feet above sea level. Nesting occurs from March through June.		x					

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Creeper, Moloka'i; *Kākāwahie (Paroreomyza flammea)*	FE, SE	Small insectivorous forest bird that occurs in wet forests above 1,500 feet mean sea level. Nesting occurs from March through June. Some reports indicate the species may now be extinct as it has not been observed in over 30 years.				x			
Albatross, Short-tailed *(Phoebastria albatrus)*	FE, SE	Large-bodied seabird that inhabits the open ocean most of the year, nests in bare ground surrounded by cliffs. Nesting period is poorly known but has been documented to occur from September through March.							Northwest Islands
Creeper, O'ahu; O'ahu 'Alauahio *(Paroreomyza maculata)*	FE, SE	Small forest bird that occurs in ʻōhiʻa-koa forests between 1,000 to 2,000 feet in elevation. The species biology is very poorly known and the nesting period has not been documented.					x		
Parrotbill, Maui *(Pseudonestor xanthophrys)*	FE, SE	Small forest bird that inhabits native, montane, tropical forest at altitudes between 3,600 and 7,500 feet above sea level. Its breeding biology and nesting period is undocumented.		x					
Ō'ū *(Psittirostra psittacea)*	FE, SE	Small forest bird found in wet to mesic forests between 2,400 and 6,000 feet above mean sea level. Nesting occurs from March through May.	x					x	

Common Name, Hawaiian Name, and Scientific Name	**Listing Status[a]**	**Habitat Description**	**Hawaii**	**Maui**	**Lanai**	**Molokai**	**Oahu**	**Kauai**	**Northwest Islands[b] or Oceanic**
Petrel, Dark-rumped; Hawaiian Petrel; 'Ua'u *(Pterodroma phaeopygia sandwichensis)*	FE, SE	Medium-sized seabird that is usually found far out at sea, feeding over deep waters and rarely coming to land, except when breeding. Nests in burrows in cliffs. Nests from March to October.	x	x	x			x	
Shearwater, Newell's *(Puffinus newelli)*	FT, ST	Medium-bodied seabirds, found north of the equator over waters deeper than 6,000 feet. Nests on steep, forested mountain slopes where it burrows under ferns. Has a long nesting period from April through November.	x				x	x	
Tern, White; Manu o ku *(Gygis alba)*	ST	Small- to-medium sized seabird that is mostly marine except when nesting, when it comes inland to nest in trees of parks and other maintained open space including downtown Honolulu. Nesting occurs from January to July.					x		
Finch, Laysan *(Telespyza cantans)*	FE, SE	Small grassland bird that inhabits lowland dry shrubland and grassland. Nesting occurs from February through May.							Northwest Islands
Finch, Nihoa *(Telespyza ultima)*	FE, SE	Small grassland bird that inhabits low shrubs and grasses and nests in cavities in cliffs, rock crevices, or in piles of loose rock. Nesting occurs from February through July.							Northwest Islands

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
'I 'iwi, 'I 'iwi *(Vestiaria coccinea)*	FE, SE	Small forest bird that occurs in wet or moderately wet forest above 6,600 feet mean sea level. Nesting occurs from January through June.			x	x	x		
Mammals (9)									
Bat, Hawaiian hoary; 'Ōpe'ape'a *(Lasiurus cinereus semotus)*	FE, SE	Roosts solitarily in dense vegetation at the edges of clearings, between 9 and 15 feet above the ground. Will also use tree cavities, rock crevices, and squirrel nests. Typically breeds in summer months (May-July) although the exact timing is variable based on climatic conditions and food availability.	x	x			x	x	
Hawaiian monk seal; 'Īlio-holo-i-ka-uaua, *(Monachus schauinslandi)* (CH)	FE, SE	Found on the coral atolls and rocky islands in tropical waters. Forage at depths of up to 300 feet below the ocean surface. Breeding occurs in the water during any month. Gestation takes 10-11 months. The most common months when pups are born are March and April	x	x	x	x	x	x	Oceanic and Northwest Islands
Whale, fin *(Balaenoptera physalus)*	SE	Generally concentrated along frontal boundaries or mixing zones between coastal and oceanic waters near 600 foot depth.							Oceanic
Whale, humpback; Koholā, *(Megaptera novaeangliae)*	FE, SE	Breeds in tropical waters and migrates to temperate and subpolar waters for feeding.	x	x	x	x	x	x	Oceanic

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Whale, sperm; Palaoa *(Physeter microcephalus)*	FE, SE	Occurs offshore in submarine canyons at the edge of the continental shelf or in waters deeper than 600 feet.							Oceanic
Whale, false killer *(Pseudorca crassidens)*	SE	Widespread throughout tropical and sub-tropical waters; most commonly found in open ocean waters but also frequents areas around oceanic islands.							Oceanic
Whale, blue *(Balaenoptera musculus)*	FE, SE	Circumglobal species that feeds on small, planktonic, shrimp-like krill (*Euphausia pacifica* and *Thysanoessa spinifera*) near the ocean's surface.							Oceanic
Whale, north pacific right *(Eubalaena japonica)*	FE, SE	Found in all the world's oceans from temperate to subpolar latitudes, primarily in coastal or shelf waters, although movements over deep waters are known.							Oceanic
Whale, sei *(Balaenoptera borealis)*	FE, SE	Distribution in open ocean highly variable and related to ocean currents. Strongly associated with ocean fronts and eddies. Rare in semi-enclosed seas or gulfs.							Oceanic
Reptiles (5)									
Loggerhead sea turtle *(Caretta caretta)*	FT, ST	Neritic (shallow, coastal) areas rich in sea grass/marine algae. Common in offshore waters, rare in nearshore waters. Does not nest in Hawaii.	x	x	x	x	x	x	Oceanic and Northwest Islands

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Green sea turtle; Honu *(Chelonia mydas)*	FT, ST	Coastal neritic areas rich in sea grass/marine algae. Most common sea turtle in Hawaiian waters. Common in near shore waters. Nests in northern Hawaiian Islands, with over 90% of nesting occurring on the French Frigate Shoals. Nesting season is November through April.	x	x	x	x	x	x	Oceanic and Northwest Islands
Leatherback sea turtle *(Dermochelys coriaceae)*	FE, SE	Coastal neritic areas rich in sea grass/marine algae. Common in offshore waters, rare in nearshore waters. Does not nest in Hawaii.	x	x	x	x	x	x	Oceanic and Northwest Islands
Hawksbill turtle; 'Ea *(Eretmochelys imbricate)*	FE, SE	Coastal neritic areas rich in sea grass/marine algae. Nest on the main Hawaiian islands, predominately on Hawaii and a few on Maui. Nesting season is May through December.	x	x	x	x	x	x	Oceanic and Northwest Islands
Olive ridley sea turtle *(Lepidochelys olivacea)*	FT, ST	Coastal neritic areas rich in sea grass/marine algae. Common in offshore waters, rare in nearshore waters. Does not nest in Hawaii.	x	x	x	x	x	x	Oceanic and Northwest Islands
Invertebrates (68)									
Snails									
Snail, O'ahu tree; Pupu kani oe *(Achatinella abbreviata)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella apexfulva)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Snail, O'ahu tree; Pupu kani oe *(Achatinella bellula)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella buddie)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella bulimoides)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella byronii)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella caesia)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella casta)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella cestus)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella concavospira)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella curta)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Snail, O'ahu tree; Pupu kani oe *(Achatinella decipiens)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella decora)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella dimorpha)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella elegans)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella fulgens)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella fuscobasis)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella juddii)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella juncea)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella lehuiensis)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Snail, O'ahu tree; Pupu kani oe *(Achatinella leucorrhaphe)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella lila)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella livida)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella lorata)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella mustelina)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella papyracea)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella phaeozona)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella pulcherrima)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella pupukanioe)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Snail, O'ahu tree; Pupu kani oe *(Achatinella rosea)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella sowerbyana)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella spaldingi)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella stewartii)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella swiftii)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella taeniolata)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella thaanumi)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella turgida)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella valida)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		

Common Name, Hawaiian Name, and Scientific Name	**Listing Status[a]**	**Habitat Description**	**Hawaii**	**Maui**	**Lanai**	**Molokai**	**Oahu**	**Kauai**	**Northwest Islands[b] or Oceanic**
Snail, O'ahu tree; Pupu kani oe *(Achatinella viridans)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella vittata)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Snail, O'ahu tree; Pupu kani oe *(Achatinella vulpina)*	FE, SE	Mountainous dry to moist forests and shrublands at elevations above 1,300 feet mean sea level.					x		
Tree Snail, Newcomb's *(Newcombia cumingi)*	SE	Lowland wet grasslands, shrublands, and forests from 3,000 feet above sea level to sea level on the windward sides of the main Hawaiian Islands that receive greater than 75 inches of annual precipitation. Feeds on fungi and algae that grow on the leaves and trunks of its host plant.	x	x	x	x	x	x	
Tree Snail, Lanai *(Partulina semicarinata)*	SE	Wet forests on the island of Lanai on tree trunks, stems, and leaves that have the fungi that snails eat.			x				
Tree Snail, Lanai *(Partulina variabilis)*	FE, SE	Wet forests on the island of Lanai on tree trunks, stems and leaves that have the fungi that snails eat.			x				
Snail, Newcomb's; Pupu wai lani *(Erinna newcombi)*(CH)	ST	Fast flowing perennial streams with stable overhanging rocks, springs, rock seeps, and waterfalls.						x	
Arthropods									

Common Name, Hawaiian Name, and Scientific Name	**Listing Status[a]**	**Habitat Description**	**Hawaii**	**Maui**	**Lanai**	**Molokai**	**Oahu**	**Kauai**	**Northwest Islands[b] or Oceanic**
Wolf spider, Kaua'i cave *(Adelocosa anops)* (CH)	FE, SE	Lava flow caves within a 4 square mile area in the Koloa-Po'ipu region.						x	
Moth, Blackburn's sphinx *(Manduca blackburni)* (CH)	FE, SE	Coastal mesic and dry forests at elevations from sea level to 5,000 feet above sea level.	x	x					Northwest Islands
Picture-wing fly, Oahu *(Drosophila Aglaia)* (CH)	FE, SE	Decomposing bark and stem of host plant, *Urera glabra*, in slopes and valley bottoms in mesic and wet forest habitat.					x		
Picture-wing fly, Kauai *(Drosophila attigua)* (CH)	FE, SE	Wet forest habitat between 3,000 and 4,000 feet on decomposing plant material from *Cheirodendron* and *Tetraplasandra.*						x	
Picture-wing fly, Molokai *(Drosophila differens)* (CH)	FE, SE	Mesic to wet forest from 3,650 – 4,500 feet above sea level on rotting bark and stems of *Clermontia* spp.				x			
Picture-wing fly, Hawaiian *(Drosophila digressa)* (CH)	FE, SE	Rain forest communities and is closely associated with *Charpentiera* stems as larval breeding substrate.	x	x	x	x	x	x	
Picture-wing fly, Oahu *(Drosophila hemipeza)* (CH)	FE, SE	Rain forest communities and is closely associated with *Urera* bark, *Cyanea* bark and stem, and Lobelia stem and other *lobeloids* as larval breeding substrate.					x		
Picture-wing fly, Hawaii *(Drosophila heteroneura)* (CH)	FE, SE	Rain forest communities and is closely associated with *Lobelia* bark, *Cheirodendron* bark, *Clermontia* bark, and *Delissea* stem.	x						

Common Name, Hawaiian Name, and Scientific Name	**Listing Status[a]**	**Habitat Description**	**Hawaii**	**Maui**	**Lanai**	**Molokai**	**Oahu**	**Kauai**	**Northwest Islands[b] or Oceanic**
Picture-wing fly, Oahu *(Drosophila montgomeryi)* (CH)	FE, SE	Mesic forest communities, and is closely associated with *Urera kaalae* as a larval breeding substrate.					x		
Picture-wing fly, Hawaii *(Drosophila mulli)* (CH)	FT, ST	Rain forest communities, and appears to be closely associated with *Pritchardia*, an endemic palm.	x						
Picture-wing fly, Kauai *(Drosophila musaphilia)* (CH)	FE, SE	Dry forest communities and is closely associated with *Acacia koa* as a larval breeding substrate.						x	
Picture-wing fly, Maui *(Drosophila neoclavisetae)* (CH)	FE, SE	Rain forest communities and is believed to be closely associated with lobelioid (especially *Cyanea*) species as its larval breeding substrate.		x					
Picture-wing fly, Oahu *(Drosophila obatai)* (CH)	FE, SE	Rain forest communities and is closely associated with *Dracaena aurea* as its larval breeding substrate.					x		
Picture-wing fly, Hawaii *(Drosophila ochrobasis)* (CH)	FE, SE	Semi-arid and humid forests, larvae of this species have been reported to feed within decomposing portions of three different host plant groups, *Myrsine* spp., *Clermontia* spp., and *Marattia douglasii.*	x						
Picture-wing fly, Oahu *(Drosophila substenoptera)* (CH)	FE, SE	Rain forest communities, associated with Cheirodendron and Tetraplasandra (decaying bark).					x		
Picture-wing fly, Oahu *(Drosophila tarphytrichia)* (CH)	FE, SE	Mesic forest community, closely associated with *Charpentiera* species as its larval breeding substrate.					x		

Common Name, Hawaiian Name, and Scientific Name	**Listing Status[a]**	**Habitat Description**	**Hawaii**	**Maui**	**Lanai**	**Molokai**	**Oahu**	**Kauai**	**Northwest Islands[b] or Oceanic**
Crimson Hawaiian damselfly *(Megalagrion leptodemas)*	FE, SE	Headwater stream pools in mountainous terrane.	x	x	x	x	x	x	
Flying earwig Hawaiian damselfly *(Megalagrion nesiotes)*	FE, SE	Upland ridges and wet forest.	x	x					
Blackline Hawaiian damselfly *(Megalagrion nigrohamatum nigrolineatum)*	FE, SE	Headwaters and midreaches of perennial rocky upland streams and along overflow channels and seep-fed side pools bordering streams.	x	x	x	x	x	x	
Oceanic Hawaiian damselfly *(Megalagrion oceanicum)*	FE, SE	Swift midreach sections of rocky upland streams in mountainous terrain,, usually amid rocks and gravel in stream riffles (stream sections with sufficient gradient to create small standing waves) and small cascades on waterfalls.	x	x	x	x	x	x	
Pacific Hawaiian damselfly *(Megalagrion pacificum)*	FE, SE	Seepage-fed side pools along mid and terminal reach overflow channels of rocky upland streams.	x	x	x	x	x	x	

Common Name, Hawaiian Name, and Scientific Name	Listing Status[a]	Habitat Description	Hawaii	Maui	Lanai	Molokai	Oahu	Kauai	Northwest Islands[b] or Oceanic
Amphipod, Kaua'i cave *(Spelaeorchestia koloana)* (CH)	FE, SE	Deep zone and stagnant air zone of lava tubes and intermediate-size voids (mesocaverns) in pahoehoe lava, as well as similar habitats in a limestone cave resting on top of the lava flow. Its lowland (0 to 100 feet above sea level) habitat is between 77 and 86 degrees Fahrenheit and always in damp to wet areas with calm, stagnant, water-saturated air, which sometimes contains more than three percent by volume carbon dioxide.						x	
Anchialine pool shrimp *(Vetericaris chaceorum)*	SE	Lagoon, subaquatic. Found in anchialine pools with deeper waters leading to a submerged lava tube. It has been collected in total darkness where the salinity was 30 parts per thousand.	x	x	x	x	x	x	

Sources: USFWS 2015a; DLNR 2014; NMFS 2015a; NMFS 2015b; IUCN 2015; and official species accounts or recovery plans published by USFWS.

[a] Species status: FE=Federally Endangered; FT=Federally Threatened; SE=State Endangered; ST=State Threatened; CH = Critical Habitat designated.
[b] Northwest Hawaiian islands include Frigate, Kure, Laysan, Midway, Necker, and Nihoa. Oceanic = Marine waters surrounding the Hawaiian Islands.

4.1.7. Land Use, Airspace, and Recreation

4.1.7.1. Introduction

This section provides a broad overview of land use, airspace, and recreational facilities and activities in Hawaii. This includes regulations, conditions, and activities that could potentially be affected by deployment and operation of the Proposed Action. The following summarizes major land uses, recreational venues, and airspace considerations, and characterizes existing, baseline conditions for use in evaluating the potential environmental consequences resulting from implementing the Proposed Action or Alternatives.

Land Use and Recreation

Land use is defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change, or maintain it" (*Di Gregorio and Jansen 1998*). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth's surface; land cover includes vegetation and manmade development (*USGS 2012b*).

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf and boating), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, beaches, caves, lakes, forests, beaches, recreational facilities, museums, historic sites, and other outdoor areas. Recreational resources are typically managed by state, county, or local governments.

Land uses are typically defined and managed by local governments, and the categories of land use can vary considerably from jurisdiction to jurisdiction. As a result, this Draft Programmatic Environmental Impact Statement refers to "land use/land cover," as defined in the National Land Cover Database (*USGS 2001*), a standardized set of 21 categories defined by the U.S. Geological Survey that incorporates both land use and land cover characteristics. Where appropriate, or important to convey local conditions, more general land use categories such as "forest," "agricultural," and "developed" are also used. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal, although other geographically-specific terms (such as "municipal") are used where appropriate. Descriptions of recreational opportunities are presented in a regional fashion, highlighting areas of recreational significance within 12 identified regions.

Airspace

Airspace is generally defined as the space lying above the earth, above a certain area of land or water, or above a nation and the territories that it controls, including territorial waters (*Merriam Webster Dictionary 2015*). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The FAA is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

The FAA operates a network of airport towers, air route traffic control centers, and flight service stations. The FAA also develops air traffic rules, assigns use of airspace, and controls air traffic in U.S. airspace. "The Air Traffic Organization (ATO) is the operational arm of the FAA responsible for providing safe and efficient air navigation services to approximately 30.2 million square miles of airspace. This represents more than 17 percent of the world's airspace and includes all of the U.S. and large portions of the Atlantic and Pacific Oceans and the Gulf of Mexico" (*FAA 2014*). The ATO is comprised of Service Units (organizations) that support the operational requirements.

The FAA Air Traffic Services Unit (the Unit) manages the National Airspace System and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices, Regional Offices & Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (*FAA 2015a*). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

4.1.7.2. Specific Regulatory Considerations

Land Use

Land use in Hawaii is guided by the Hawaii State Planning Act (the *Planning Act, Hawaii Revised Statues Chapter 226*). The Planning Act "sets forth the Hawaii state plan, which is a long-range comprehensive plan that includes an overall theme, goals, objectives, policies, priority guidelines, and implementation mechanisms" (*Hawaii Office of Planning 2015*). The "implementation mechanisms" portion of the state plan "establishes a statewide planning system to coordinate and guide all major state and county activities…The system implements the state plan through the development of functional plans and county general plans" (*Hawaii Office of Planning 2015*).

The State Land Use Commission (the Commission) is responsible for classifying land (and evaluating requests for amendment to existing classifications) in Hawaii as one of four districts (descriptions quoted from *Land Use Commission 2015*):

- **Urban:** "The Urban District includes lands characterized by 'city-like' concentrations of people, structures and services. This District also includes vacant areas for future development. Jurisdiction of this district lies primarily with the respective counties. Generally, lot sizes and uses permitted in the district area are established by the respective county through ordinances or rules."

- **Rural:** "Rural Districts are composed primarily of small farms intermixed with low-density residential lots with a minimum size of one-half acre. Jurisdiction over Rural Districts is shared by the Commission and county governments. Permitted uses include those relating or compatible to agricultural use and low-density residential lots."
- **Agricultural:** "The Agricultural District includes lands for the cultivation of crops, aquaculture, raising livestock, wind energy facility, timber cultivation, agriculture-support activities (i.e., mills, employee quarters, etc.) and land with significant potential for agriculture uses…Uses permitted in the highest productivity agricultural categories are governed by statute."[1]
- **Conservation:** "Conservation Districts are comprised primarily of lands in existing forest and water reserve zones and include areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. The conservation District also includes lands subject to flooding and soil erosion. Conservation Districts are administrated by the State Board of Land and Natural Resources and uses are governed by rules promulgated by the State Department of Land and Natural Resources."

Within these broad state policies, county governments determine specific land use categories, goals, policies, and implementation procedures through county general plans (the equivalent of comprehensive plans in other states) and zoning. Under the Planning Act, county plans and zoning must be generally consistent with the state plan and land classification system. Thus, for example, a county plan may not encourage a residential area on land designated as conservation by the state plan (*Hawaii Office of Planning 2015*).

Whereas general plans indicate the overall intent of the county's land use policy, zoning codifies that intent with specific requirements such as a list of permitted land uses, maximum residential density (e.g., number of dwelling units per acre), and maximum building height.

Aside from the City and County of Honolulu (which is evaluated here as a county), there are no incorporated cities in Hawaii (*Hawaii DBEDT 2010*).

In general, the zoning codes for Hawaii's counties regulate the location, height, and other characteristics of telecommunications equipment (especially, but not necessarily exclusively, aboveground facilities such as transmission towers). On federal lands, such regulations may be contained in each facility's relevant establishing legislation or other adopted management policies.

Airspace

The FAA has jurisdiction over air traffic in the United States (U.S.) and must be contacted for proposed construction or alteration of objects within navigable airspace that meet the following criteria (*14 Code of Federal Regulations 77, commonly known as Part 77 regulations*):

[1] The state classifies agricultural land according to land and soil productivity.

- Any construction or alteration that is more than 200 feet above ground level at the structure's proposed location (including buildings, wind turbines, communications towers, etc.); or
- Construction or alteration that exceeds certain imaginary surfaces extending outward and upward from an airport, seaplane base, or heliport. Imaginary surfaces are three-dimensional shapes surrounding aviation facilities within which development is limited or prohibited in order to ensure safe aviation and minimize the potential effects of crashes.

FAA review of proposed construction or alteration within the spaces listed above could result in denial of permission for construction/alteration, or approval of construction/alteration with or without additional marking or lighting (*FAA 2015b*). Section 4.1.8, Visual Resources, discusses FAA lighting regulations. Certain airspace in the U.S. reserved or intended for military use is managed jointly by the FAA and the Department of Defense (DOD). Military airspace in Hawaii includes Military Operations Areas, Military Training Routes, and various types of restricted or prohibited airspace.

Recreation

Hawaii contains a variety of federal, state, and local recreational lands, ranging from units of the National Park System and National Wildlife Refuges to city and county parks. Each of these facilities is administered according to the applicable federal, state, or local law, along with management documents prepared for that facility. For example, the National Park Service prepares a Superintendent's Compendium document for each of its units, enumerating park-specific restrictions, closures, permit requirements, and other regulations (*NPS 2015*).

4.1.7.3. Land Use and Ownership

Land Use/Land Cover

Land use/land cover refers to the use of land, as visible from the air (or satellites). Figure 4.1.7-1 and Table 4.1.7-1 show the distribution of land use/land cover in Hawaii. Statewide, forest and scrub/shrub—which includes shrubs and smaller trees (*MRLC 2014*)—account for more than half of land cover. As indicated in Table 4.1.7-1, developed land covers less than 10 percent of the state, ranging from 5 percent of the island of Hawaii and Kalawao counties to nearly 30 percent of Honolulu County (which includes the island of Oahu and several outlying islands). Barren land, primarily in the form of unvegetated volcanic peaks and lava fields, covers approximately 18 percent of Hawaii County (*USGS 2001*).

State Land Use Districts

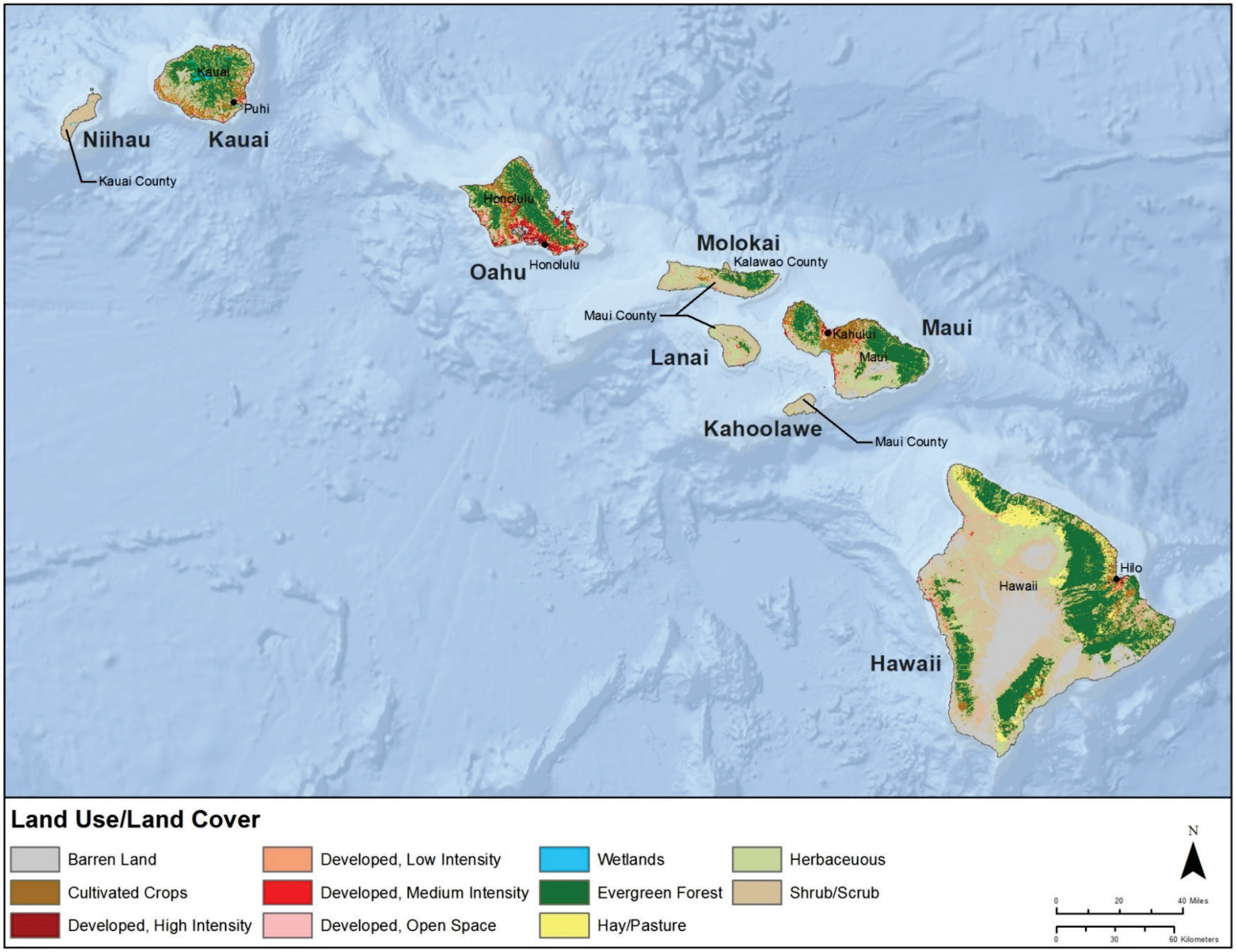
Whereas land use/land cover (see Figure 4.1.7-1) indicates the visible development pattern, the state land use districts are policy areas that provide guidance for local land use decisions and regulations, such as zoning. As described in Section 4.1.7.2, Specific Regulatory Considerations, land use in Hawaii is regulated via a state land use plan, which assigns all land to one of four districts. Figure 4.1.7-2 shows the distribution of state land use districts in Hawaii, while Table 4.1.7-2 shows the distribution of land by state land use district on each island.

As indicated in Table 4.1.7-2, nearly half of all state land is designated for conservation; another 46 percent is designated for agriculture, 5 percent for urban land, and less than 1 percent for rural development. Not all land conforms to state land use designations. For example, there are undeveloped parks (i.e., forested areas) within the urban districts, and pockets of developed land within conservation districts. As a result, the acreages of similar categories (i.e., developed land and the Urban District) in Table 4.1.7-1 and Table 4.1.7-2 may not match precisely.

Land Ownership

Table 4.1.7-3 lists major land owners in Hawaii. State government owns approximately 38 percent of land statewide, including nearly all of the island of Kahoolawe. Of that total, approximately 5 percent is owned by the state's Department of Hawaiian Homelands (DHHL), the agency that implements the Hawaiian Homelands Act of 1920 (*42 Stat. 108*). The Hawaiian Homelands Act sets aside land for homesteads for native Hawaiians.

The federal government owns approximately 13 percent of land in the state, most of which is on the islands of Hawaii and Oahu. Major federal lands in Hawaii include nine units of the National Park System, nine National Wildlife Refuges, and considerable DOD lands, particularly on Oahu. Hawaii Volcanoes National Park is the largest National Park and largest federal landholding in Hawaii. Major DOD landholdings include the 110,000-acre Pohakuloa Training Area on the island of Hawaii, as well as Joint Base Pearl Harbor-Hickam, Schofield Barracks, Fort Shafter, and Marine Corps Base Kaneohe, all on Oahu. In addition to being large landholdings, the Oahu DOD facilities are home to the headquarters function for the Pacific Fleet (U.S. Navy/Marine Corps), Pacific Air Forces (U.S. Air Force), and U.S. Army Pacific.



Source: USGS 2001

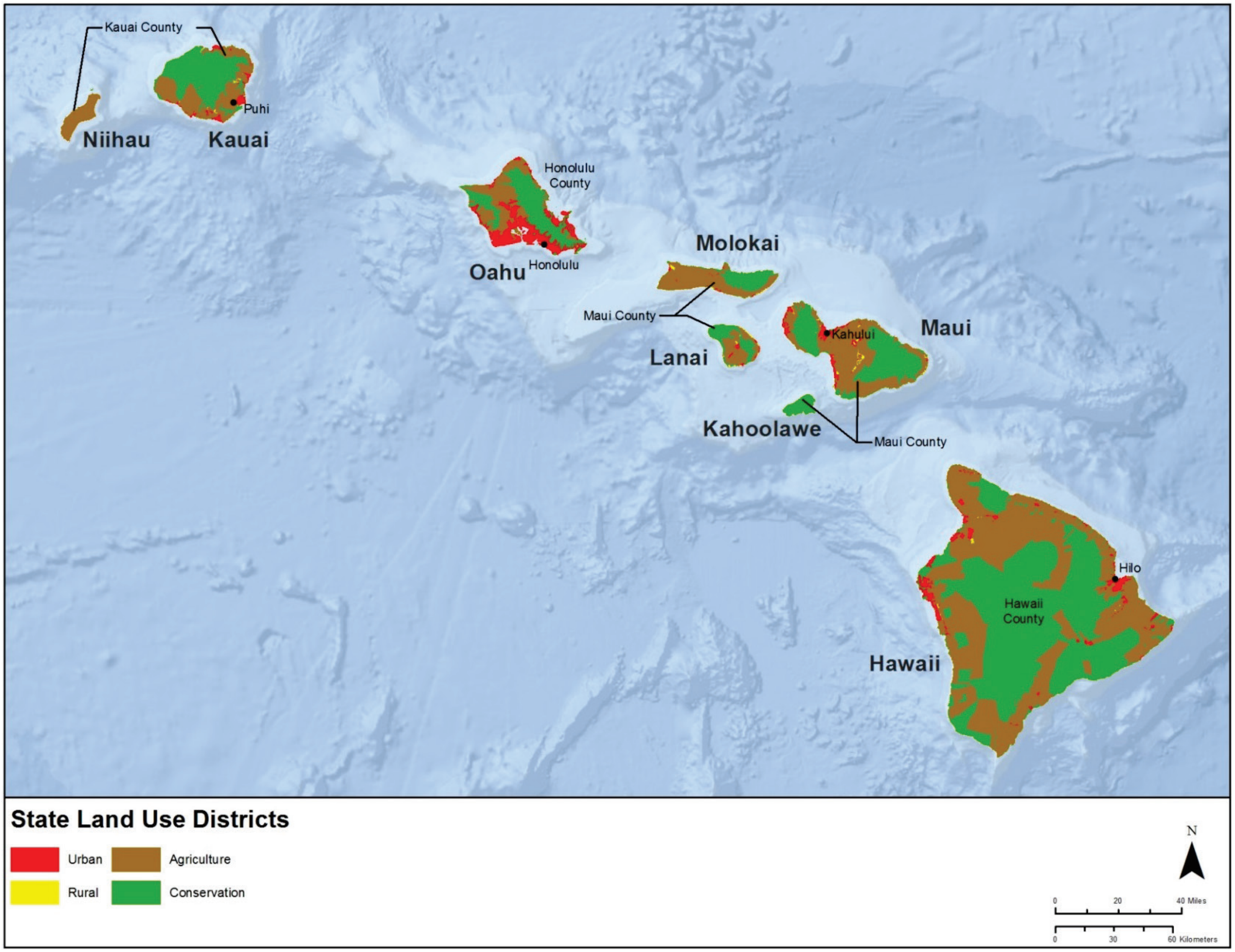
Figure 4.1.7-1: Land Use/Land Cover in Hawaii

Table 4.1.7-1: Land Use/Land Cover in Hawaii

	County											
	Hawaii		Honolulu		Kalawao		Kauai		Maui		Total[a,b]	
Land Use/Land Cover	**Acres**	**Pct[c]**	**Acres**	**Pct[c]**	**Acres**	**Pct[c]**	**Acres**	**Pct[c]**	**Acres**	**Pct[c]**	**Acres**	**Pct[c]**
Developed, Open Space[c]	69,141	2%	35,971	9%	293	3%	15,134	4%	42,050	6%	162,590	4%
Developed, Low Intensity	51,795	2%	25,527	7%	166	2%	22,377	6%	22,475	3%	122,342	3%
Developed, Medium Intensity	4,752	<1%	27,990	7%	10	<1%	2,346	1%	5,942	1%	41,041	1%
Developed, High Intensity	2,638	<1%	21,097	6%	0	0%	970	<1%	3,686	<1%	28,391	1%
Barren Land[d]	529,848	20%	1,744	<1%	59	1%	18,112	5%	35,516	5%	585,280	14%
Evergreen Forest	642,762	25%	169,557	44%	2,617	31%	146,782	37%	203,052	27%	1,164,771	28%
Scrub/Shrub	812,924	31%	49,744	13%	4,692	56%	118,413	30%	210,613	28%	1,196,388	29%
Grassland/Herbaceous[e,f]	327,870	13%	23,147	6%	574	7%	34,068	8%	163,458	22%	549,117	13%
Pasture/Hay	115,603	4%	0	0%	0	0%	393	<1%	0	0%	115,996	3%
Cultivated Crops	31,595	1%	23,713	6%	1	<1%	31,043	8%	52,076	7%	138,429	3%
Wetlands	171	<1%	2,727	1%	1	<1%	9,080	2%	2,021	<1%	14,000	<1%
Total[a,g]	**2,589,101**	**100%**	**381,217**	**100%**	**8,414**	**100%**	**398,718**	**100%**	**740,890**	**100%**	**4,118,344**	**100%**

Source: USGS 2001

[a] Totals may not match, due to rounding.
[b] Percent of the island's total land area within each land use/land cover.
[c] "Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses" (*MRLC 2014*).
[d] "Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material" (*MRLC 2014*).
[e] These areas may be used for grazing, but are not subject to active management, such as tilling (*MRLC 2014*).
[f] Herbaceous plants do not have woody stems.
[g] Excludes inland areas identified as "Open Water."



Source: Hawaii DBEDT 2014

Figure 4.1.7-2: State Land Use Districts

Table 4.1.7-2: State Land Use Districts

	County											
	Hawaii		Honolulu		Kalawao		Kauai		Maui		Total[a]	
Land Use/Land Cover	**Acres**	**Pct[a]**	**Acres**	**Pct[a]**	**Acres**	**Pct[a]**	**Acres**	**Pct[a]**	**Acres**	**Pct[a]**	**Acres**	**Pct[a]**
Agriculture	1,183,344	46%	120,790	31%	2,251	93%	190,362	47%	388,567	52%	1,885,315	46%
Conservation	1,343,131	52%	158,670	41%	0	0%	194,751	49%	325,791	43%	2,022,343	49%
Rural	1,618	0%	0	0%	0	0%	1,374	<1%	8,071	1%	11,063	<1%
Urban	56,348	2%	104,232	27%	178	7%	14,865	4%	28,076	4%	203,699	5%
Total[a,b]	**2,584,440**	**100%**	**383,692**	**100%**	**2,429**	**100%**	**401,352**	**100%**	**750,506**	**100%**	**4,122,419**	**100%**

Source: USGS 2001

[a] Totals may not match internally due to rounding.
[b] Percent of the island's total land area within each land use district.

Table 4.1.7-3: Major Land Owners in Hawaii

Island[a]	Land Ownership											
	Federal		State (Hawaiian Homelands)[b]		State (Other)[c]		County		Private/Other		Total	
	Acres	Pct[d]	Acres	Pct[d]	Acres	Pct[d]	Acres	Pct[d]	Acres	Pct[d]	Acres	Pct[d]
Hawaii	432,471	17%	117,261	5%	974,565	38%	6,633	0%	1,042,469.2	41%	2,573,401	100%
Maui	33,658	7%	31,337	7%	122,648	26%	7,678	2%	270,478.8	58%	465,800	100%
Kahoolawe	24	0%	0	0%	28,537	99%	0	0%	239.4	1%	28,800	100%
Lanai	8	0%	28	0%	513	1%	229	0%	89,721.4	99%	90,500	100%
Molokai	172	0%	25,120	15%	23,979	14%	258	0%	116,271.7	70%	165,800	100%
Oahu	60,081	16%	4,692	1%	81,213	21%	18,471	5%	221,731.2	57%	386,188	100%
Kauai	3,437	1%	19,492	6%	136,026	38%	873	0%	194,072.1	55%	353,900	100%
Niihau	272	1%	0	0%	127	0%	0	0%	45,301.2	99%	45,700	100%
Total[e]	530,123	13%	197,931	5%	1,367,607	33%	34,142	1%	1,980,285	48%	4,112,389	100%

Source: Hawaii DBEDT 2013

[a] The source data for this table are reported by island, rather than by county, and the data were not reported in a way that permitted compilation into county-level data.
[b] Land owned by the state DHHL, pursuant to the Hawaiian Homelands Commission Act (see Section 4.1.9.2, Specific Regulatory Considerations).
[c] Land owned by all state agencies and departments other than DHHL.
[d] Percentage of each island held by each ownership type.
[e] Data were not provided for Kaula, Lehua, and the Northwestern Hawaiian Islands, from Nihoa to Kure Atoll; therefore, total area does not match the totals in Table 4.1.7-1 or other tables. Totals may not match internally due to rounding.

County-owned lands comprise approximately 1 percent of land in the state, while private ownership accounts for the remaining 48 percent of land. Of that total, approximately 35,000 acres (approximately 8 percent of land in the state) is privately owned conservation land, held by The Nature Conservancy and other private landowners (*USGS 2012a*).

The entire island of Kahoolawe is owned by the State of Hawaii and managed by the Kaho'olawe Island Reserve Commission (KIRC), which is "responsible for the restoration and sustainable management of the island until it can be transferred to a Native Hawaiian entity to manage" (*KIRC 2015*). The island is uninhabited, and "access to the Reserve is permitted only with authorization of KIRC for specific purposes, such as restoration, education, and culture" (*KIRC 2015*). This restriction is due in large part to the presence of substantial amounts of unexploded ordinance—remnants of the U.S. Navy's use of the island as a bombing range until 1990 (*KIRC 2015*).

4.1.7.4. Airspace

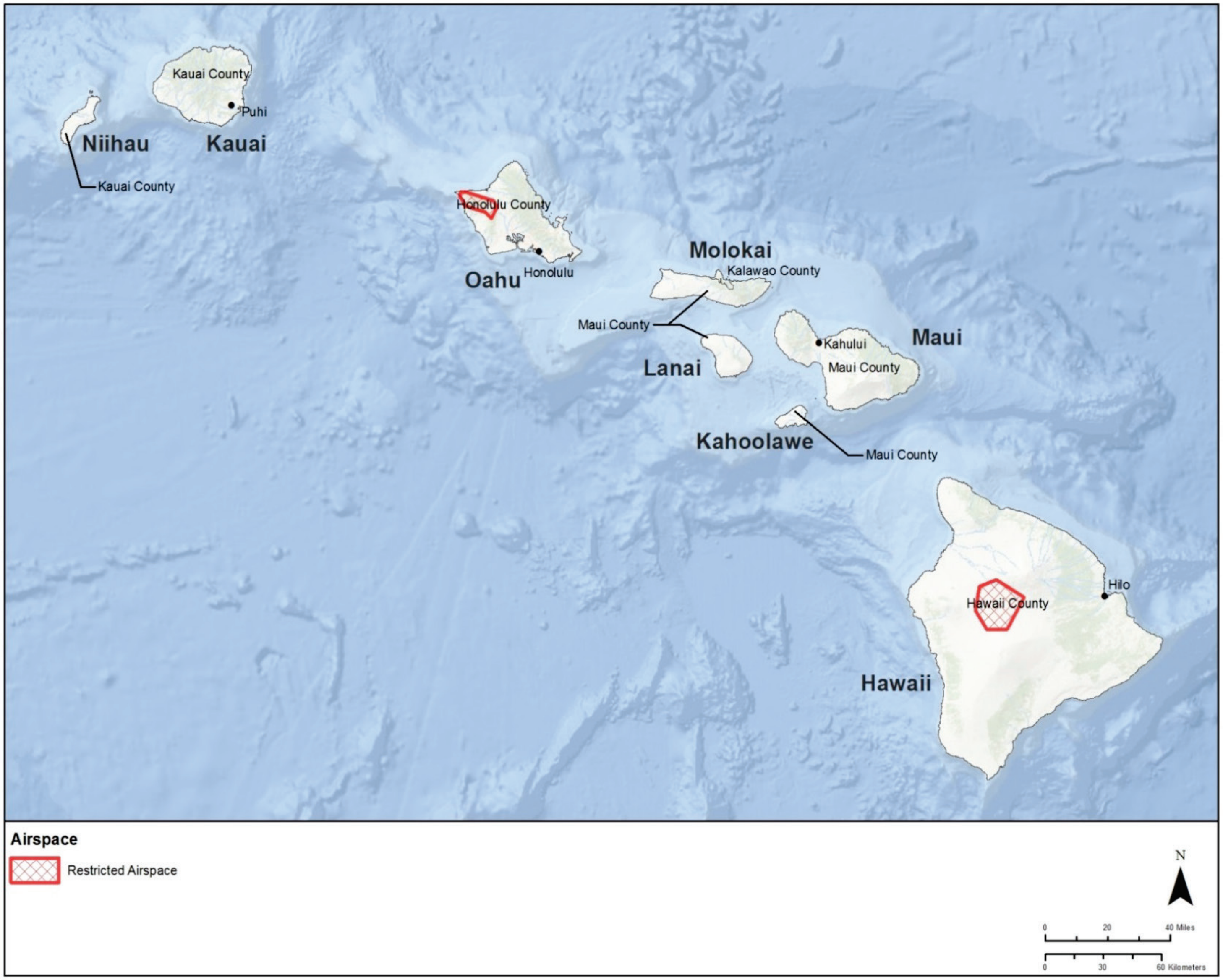
There are 15 civilian airports in Hawaii, including four on the island of Hawaii, three each on Oahu and Maui, two each on Kauai and Molokai, and one on Lanai (*HDOT 2015*). Eight of these airports are served by commercial airlines, including overseas (international or mainland U.S.) flights and inter-island commercial airlines. Honolulu International Airport on Oahu is the largest and busiest airport in the state, serving more than 20 million passengers per year (*HDOT 2015*).

In addition to civilian airports, there are three military-only airfields in Hawaii: Bradshaw Army Airfield on the island of Hawaii, and Wheeler Army Airfield and Marine Corps Air Station Kaneohe Bay (part of Marine Corps Base Kaneohe) on Oahu. The U.S. Air Force component of Joint Base Pearl Harbor-Hickam (formerly Hickam Air Force Base) uses the runways and airfields of Honolulu International Airport (*USGS 2012a*).

As described in Section 4.1.7.2, Specific Regulatory Considerations, airspace immediately surrounding airports is subject to Part 77 regulations, which generally govern the placement, height, and use of structures near airports and their runway approaches. There are two areas of restricted airspace in Hawaii not associated with the Part 77 airspace around airports, as shown in Figure 4.1.7.3 (*FAA 2015c*):

- Approximately 30,000 acres overlaying training areas associated with Schofield Barracks and the Makua Military Reservation on the island of Oahu; and
- Approximately 105,000 acres overlaying the Pohakuloa Training Area on the island of Hawaii.

Restricted airspace delineates areas that are off-limits for non-military pilots under most circumstances, but does not necessarily indicate restrictions on aboveground telecommunications facilities such as transmission towers (see *14 Code of Federal Regulations Part 73*). Other existing airspace obstructions include wind turbines (typically on higher ground on Oahu and the island of Hawaii) and existing communications antennas (*FAA 2015c*).



Source: FAA 2015c

Figure 4.1.7-3: Hawaii Airspace

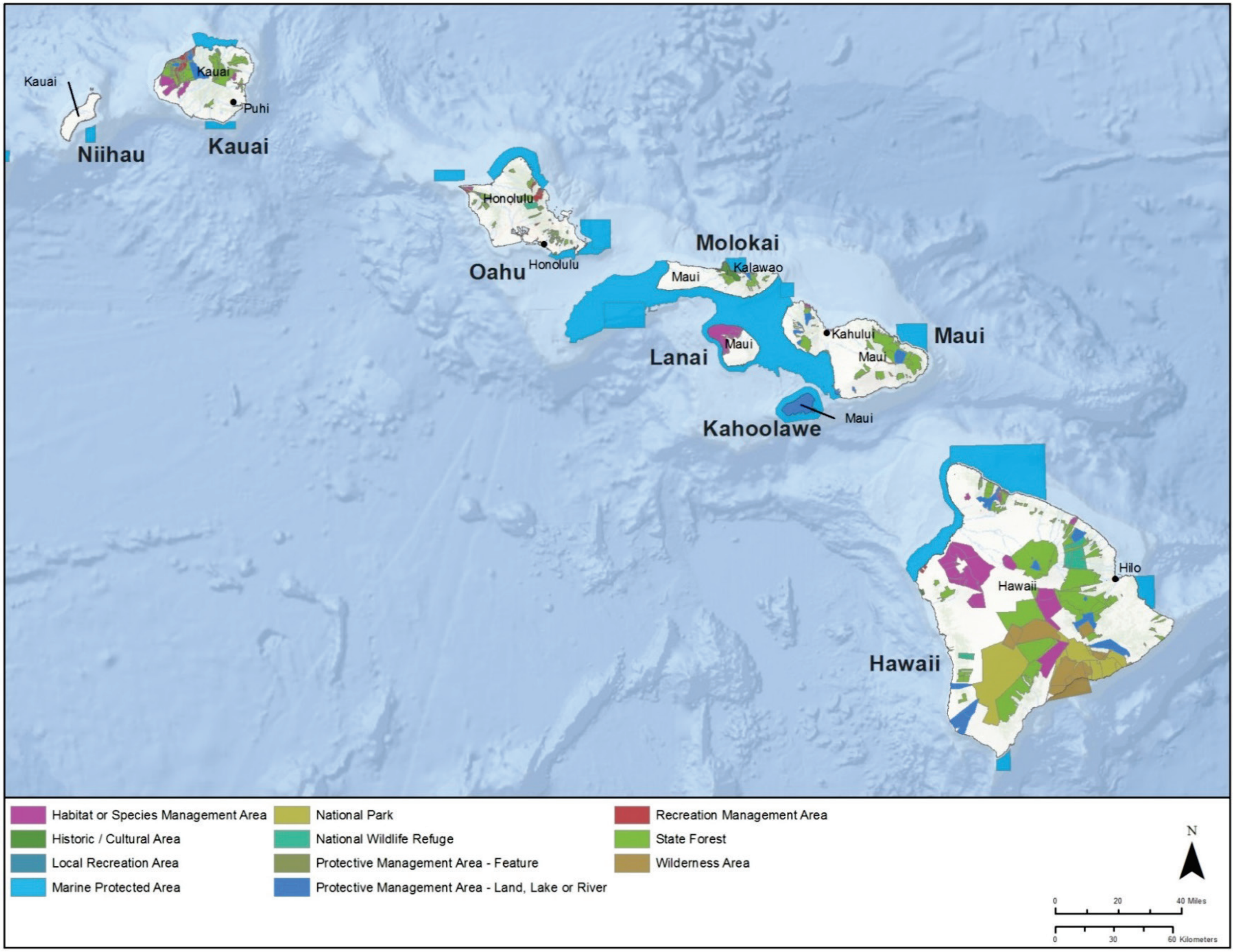
4.1.7.5. Recreation

Figure 4.1.7-4 shows federal, state, and locally owned or managed land and marine areas in Hawaii that are intended or generally available for public recreation. Such land areas generally include public parks and recreation facilities (including large athletic fields at public schools), forests, wildlife refuges, and other lands or marine areas the public might reasonably expect to be able to use for recreation.

Table 4.1.7-4 summarizes the acreage of recreation land by type; based on this data, approximately 36 percent of land in Hawaii is in areas designated, managed, or available for recreation. As shown in Table 4.1.7-4, state forests account for approximately 40 percent of recreational lands in the state, including more than half of recreational lands in Honolulu County. Units of the National Park System (National Parks, Wilderness Areas, National Historic Sites, etc.) comprise approximately 28 percent of recreation land in the state. Hawaii Volcanoes National Park and the Hawaii Volcanoes Wilderness Area (on the island of Hawaii) comprise more than 400,000 acres of land. The entirety of Kalawao County, on Molokai Island, is within Kalaupapa National Historic Park (*USGS 2012a*).

Hawaii offers a wide variety of offshore recreation for motorized and non-motorized vessels and activities. Section 4.1.6, Biological Resources, summarizes offshore ecological communities, including fisheries. Notable restrictions on ocean use include the following:

- The Hawaiian Islands Humpback Whale National Marine Sanctuary. The sanctuary includes more than 875,000 acres of ocean, including the area between the islands of Maui, Molokai, and Lanai, as well as areas near the coasts of the islands of Molokai, Hawaii, Oahu, and Kauai (*NOAA 2015b*).
- Restricted fishing areas. More than 500,000 acres of ocean, primarily in coastal areas, where fishing is restricted, in addition to general state fishing regulations (*DAR 2015*).
- Koho'olawe Island Reserve. Coastal areas surrounding the island of Kohoolawe, administered by the KIRC (along with the island itself) as part of the overall reserve (*KIRK 201*5).
- The Papahanaumokuakea Marine National Monument. Covering nearly 9 million acres of ocean, this monument extends more than 1,200 miles along the uninhabited islands to the west and north of Kauai (known as the Northwestern Hawaiian Islands). The monument is managed jointly by federal and state agencies and includes a restricted fishing area (*PMNM 2015*).



Source: USGS 2012a

Figure 4.1.7-4: Recreational Areas

Table 4.1.7-4: Acreage of Recreational Lands in Hawaii, by Type

Recreational Land Type	County											
	Hawaii		Honolulu		Kalawao		Kauai		Maui		Total[a]	
	Acres	Pct[b]	Acres	Pct[b]	Acres	Pct[b]	Acres	Pct[b]	Acres	Pct[b]	Acres	Pct[b]
National Park System	401,932	36%	22	<1%	10,330	100%	0	0%	2,289	1%	414,573	28%
National Wildlife Refuge	196,524	17%	2,285	4%	0	0%	19,927	17%	35,516	21%	254,253	17%
State Habitat or Species Management Area	37,833	3%	6,665	12%	0	0%	1,366	1%	749	<1%	46,612	3%
State Forest	409,446	36%	29,446	54%	0	0%	67,073	57%	83,452	49%	589,418	40%
State Natural Area Reserve	83,208	7%	1,756	3%	0	0%	15,053	13%	46,898	28%	146,915	10%
State Park/Historic Site	519	<1%	740	1%	0	0%	13	<1%	15	<1%	1,287	<1%
State Recreation Lands	2,238	<1%	8,657	16%	0	0%	13,704	12%	456	<1%	25,055	2%
Other State Lands	0	0%	17	<1%	0	0%	0	0%	0	0%	17	<1%
Local Park/Recreation Lands	342	<1%	4,659	9%	0	0%	378	<1%	449	<1%	5,829	<1%
Total [a]	**1,132,041**	**100%**	**54,248**	**100%**	**10,330**	**100%**	**117,514**	**100%**	**169,826**	**100%**	**1,483,958**	**100%**

Source: USGS 2012a

[a] Totals may not match due to rounding.
[b] Percent of the island's total recreational land area within each recreational land type.

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4.1.8. Visual Resources

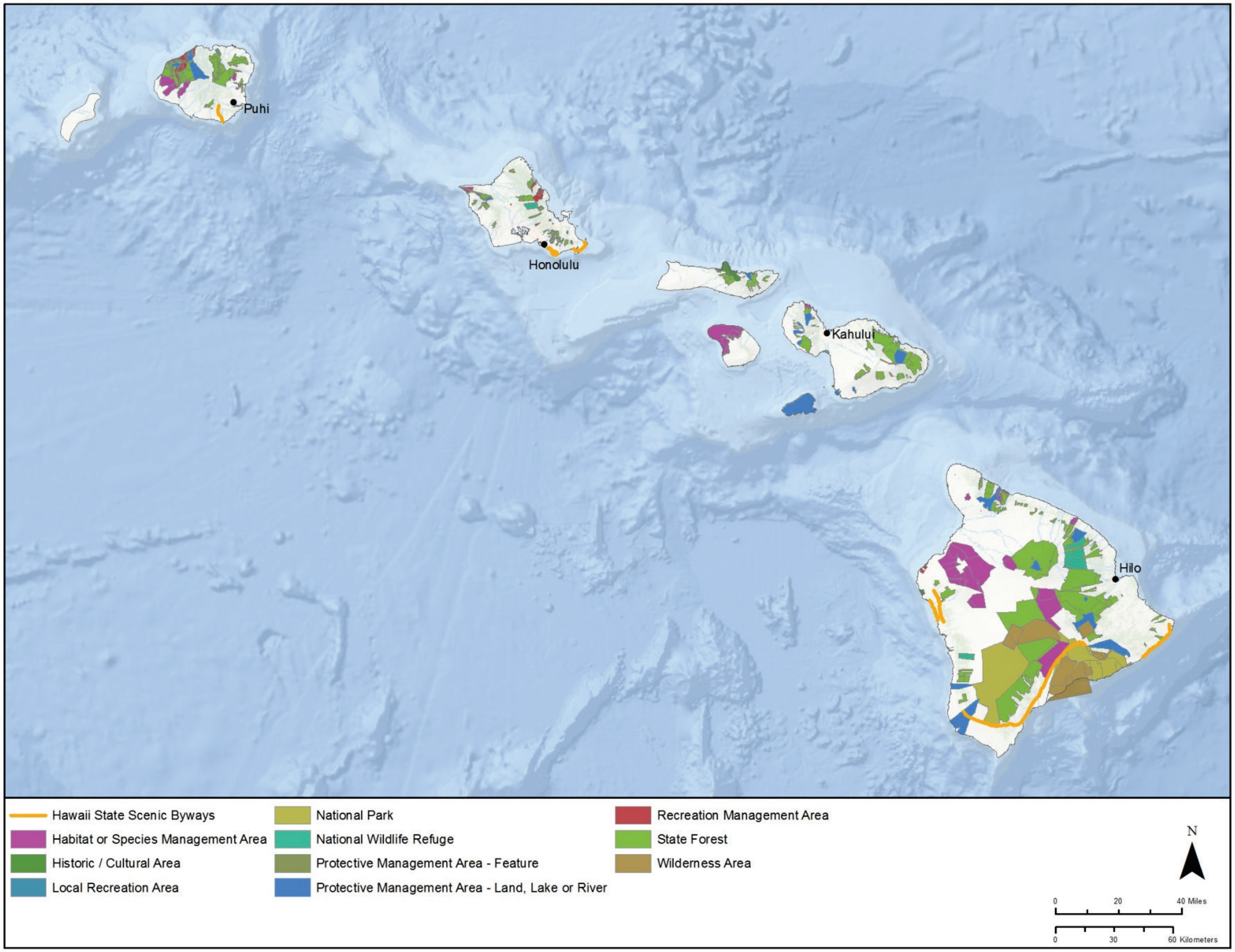
4.1.8.1. Introduction

Visual resources refer collectively to the natural and manmade features, landforms, structures, and other objects visible from a single location or a broader landscape. Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features (e.g., mountain ranges, city skylines, ocean views, unique geological formations, rivers) and constructed landmarks (e.g., bridges, memorials, cultural resources, or statues) are considered visual resources. For some, cityscapes are valued visual resources, whereas others prefer natural areas. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for National Environmental Policy Act and National Historic Preservation Act compliance. A general definition of visual resources used by the Bureau of Land Management is “the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)” (*BLM 1984*). This section provides a broad overview of visual resources in Hawaii. This includes regulations, conditions, and activities that could potentially be affected by deployment and operation of the Proposed Action.

4.1.8.2. Specific Regulatory Considerations

Federal Lands

As described in Section 4.1.7, Land Use, Airspace, and Recreation, the major federal landholders in Hawaii are the Department of Defense (DOD), National Park Service (NPS), and United States (U.S.) Fish and Wildlife Service (USFWS). DOD facilities are not evaluated here because any deployment on DOD lands will have to comply with DOD requirements associated with visual concerns. As DOD facilities are not open to the public, the likelihood of a visual impact beyond the perimeter of the facility is unlikely. Figure 4.1.8-1 shows federal and state lands (other than DOD lands) that are managed to address visual resources, while Section 4.1.7, Land Use, Airspace, and Recreation, describes these lands. Marine sanctuaries (also described in Section 4.1.7) are managed by the National Oceanic and Atmospheric Administration and are not discussed here because they are typically open ocean areas without land areas.



Source: USGS 2012

Figure 4.1.8-1: Areas in Hawaii Managed for Visual Resources

While agency-specific guidelines for complying with the National Environmental Policy Act typically require consideration of visual impacts, there is no overall federal regulation or methodology specifying how such impacts should be evaluated.

The most comprehensive federal agency visual impact methodologies are the U.S. Forest Service's Scenery Management System and the Bureau of Land Management's Visual Resource Management System. Neither of these agencies manages land in Hawaii; however, in practice, many Environmental Impact Statement documents use methodologies similar to the U.S. Forest Service and Bureau of Land Management. There are no agency-specific methodologies for evaluating visual impacts on NPS or USFWS lands, although relevant NPS guidance is described below.

National Park Service

- An NPS-authored guidance document for evaluating visual impacts associated with renewable energy projects (such as wind turbines) does provide an indication of the agency's approach to visual impact assessment. For NPS, visual impact assessment revolves primarily around the following concepts: Visual contrast: "the change in what is seen by the viewer" as a result of a new project such as a wind turbine (*Sullivan and Meyer 2014*); and
- Visual impact: "both the change to the visual qualities of the landscape resulting from the introduction of visual contrasts [i.e., a new wind turbine]…and the human response to that change" (*Sullivan and Meyer 2014*).

Visual impact assessments are incorporated into Environmental Impact Statements for units of the National Park System.

Federal Aviation Administration

Federal Aviation Administration (FAA) regulations in *14 Code of Federal Regulations 77* (commonly known as Part 77 regulations) require distinctive paint and lighting for structures with the potential to affect aerial navigation. Recommendations on marking and lighting structures may vary depending on terrain features, weather patterns, and geographic location. Guidance for implementing Part 77 regulations include (but are not limited to) the following (all citations from *FAA 2015*):

- Flashing or steady red lights (nighttime only) on structures up to 200 feet above ground level (AGL);
- Medium-intensity flashing white lights (daytime and twilight with automatically selected reduced intensity for nighttime) for structures greater than 200 feet AGL (other lighting and marking methods may be omitted for structures that do not exceed 700 feet AGL);
- Aviation orange and white paint for daytime marking on structures exceeding 700 feet AGL;
- High-intensity flashing white lights (daytime only with automatically selected reduced intensities for twilight and nighttime) for structures exceeding 700 feet AGL (other lighting and marking methods may be omitted if this system is used);

- Dual lighting including red lights for nighttime and high- or medium-intensity flashing white lights for daytime and twilight;
- Temporary high- or medium-intensity flashing white lights, as recommended in the determination, operated 24 hours a day during construction until all permanent lights are in operation;
- Red obstruction lights with painting or a medium-intensity dual system for structures 200 feet or more AGL in urban areas where there are numerous other white lights; and
- Steady red lighting for transmission wires (referred to in *FAA 2015* as "catenary wires" between transmission towers) near aviation facilities, canyons, and other areas.

In addition, USFWS has drafted revised guidelines related to communication towers, designed to protect migratory birds (*USFWS 2013*).[1] Regarding visual conditions, the USFWS guidelines recommend that, for new structures tall enough to require lighting under FAA Part 77 guidance

> "…the minimum amount of pilot warning and obstruction avoidance lighting required by the FAA should be used. Unless otherwise required by the FAA, only white strobe or red strobe lights (red preferable), or red flashing incandescent lights should be used at night, and these should be the minimum number, minimum intensity,…and minimum number of flashes per minute (i.e., longest duration between flashes/"dark phase") allowable by the FAA. The use of solid (non-flashing) warning lights at night should be avoided." (*USFWS 2013*)

State Lands

The Hawaii Environmental Policy Act (*Hawaii Revised Statutes, Chapter 343*) and Hawaii Administrative Rules (Chapter 11-200) require state-level Environmental Impact Statement documents to consider visual impacts. These regulations do not provide specific methodology for evaluating visual impacts.

There are no federally designated National Scenic Byways in Hawaii; although, there are eight state-designated scenic byways (see Figure 4.1.8-1):

- Mamalahoa Kona Heritage Corridor (island of Hawaii);
- Royal Footsteps Along the Kona Coast (island of Hawaii);
- Kau Scenic Byway – The Slopes of Mauna Loa (island of Hawaii);
- Diamond Head Scenic Byway (island of Oahu);
- Maunalua-Makapuu (island of Oahu);
- Waikiki – Kauhale O Hookipa (island of Oahu);
- Highway 137 – The Red Road (island of Hawaii); and
- Holo Holo Koloa Scenic Byway (island of Kauai).

[1] See Chapter 11, BMPs and Mitigation Measures, for additional information regarding USFWS and FAA guidelines.

Each state scenic byway in Hawaii has a Corridor Management Plan, a document that provides guidelines for the historic preservation and appearance of structures and landscapes along the byway. Byway designation makes the road and surrounding areas eligible for state funding to implement Corridor Management Plan projects. The state is responsible for maintaining the designated roads themselves, balancing the historic appearance of roads with safety and traffic flow considerations. The Corridor Management Plan architectural/historic guidelines are voluntary (*Mamalahoa Kona Heritage Corridor Local Byway Committee 2012*).

Local Regulations

Outside of federal lands, county land development (i.e., zoning) ordinances provide some regulation of visual resources in Hawaii. These ordinances typically govern the type, height, bulk (i.e., how much of the lot a building can occupy, along with setbacks from front, side, and rear property lines), and density/intensity (i.e., number of housing units per acre or non-residential floor area ratio) of development.

4.1.8.3. Existing Visual Resources

Taken as a whole, Hawaii is almost universally regarded for its high scenic quality, particularly scenery associated with beaches, mountains, forests, and natural areas (*Hawaii Tourism Authority 2015*). Section 4.1.9, Socioeconomics, discusses the importance of tourism in Hawaii, an industry that depends heavily on scenic resources. This section focuses on scenic resources that have been defined through the regulations and guidance described in Section 4.1.8.2, Specific Regulatory Considerations.

Federal Lands

Scenic resources on the federal lands in Hawaii are identified and managed by the host agency (in this case, the NPS or USFWS). For units of the National Park System (i.e., national parks, national monuments, etc.), the NPS uses a General Management Plan (GMP) to identify and manage all resources and impacts, including visual resources. Figure 4.1.8-1 shows these lands, while Section 4.1.7, Land Use, Airspace, and Recreation, lists them. A GMP typically divides a National Park System unit into management zones or areas, each of which has a defined purpose, along with a list of appropriate activities and management strategies.

Visual resources are typically a component of these strategies. Particularly scenic or historically important views are typically granted a greater degree of protection than views in other parts of the park. For example, in the Integrated Resource Management zone of Kalaupapa National Historical Park on Molokai, the GMP would allow “limited, small-scale telecommunications facilities and power facilities…if designed and sited to minimize visual impacts”, while no new telecommunications and power facilities would be allowed in the Wao Akua zone due to its historical and cultural significance (*NPS 2015*).

National Wildlife Refuges and other USFWS lands are managed according to Land Conservation Plans, Land Protection Plans, Monument Management Plans (for marine national monuments), or similar documents. While these documents may consider visual resources, they typically do not contain a visual impact assessment or policies specifically related to visual resources.

Other Areas

Hawaii has not identified any specific high-value visual resources. Height restrictions are often the de facto method for protecting views. County land ordinances include the following restrictions on the height of telecommunications towers and antennas:

- Honolulu County: 500 feet (*Revised Ordinances of Honolulu §21-4.60(c)(4)*);
- Maui County: 50 feet (*Maui County Code of Ordinances §19.02A.030*);
- Hawaii County: 500 feet (*Hawai'i County Code, §25-4-20*); and
- Kauai County: 20 feet higher than the maximum height allowed in the zoning district in which the antenna is constructed (*Kaua'i County Code, §8-1.4*).

Several Special Districts in Honolulu have tiered or stepped height limits to protect views to and from notable landmarks such as Diamond Head and the Punchbowl, two former volcanic craters (*Revised Ordinances of Honolulu §21-9*). Some development ordinances in Hawaii also require visual buffering or screening (i.e., with fencing or vegetation) for industrial or commercial uses.

4.1.9. Socioeconomics

4.1.9.1. Introduction

The National Environmental Policy Act of 1969 (NEPA; see Section 1.8, Overview of Relevant Federal Laws and Executive Orders) requires consideration of socioeconomics in NEPA analysis. Specifically, Section 102(A) of NEPA requires federal agencies to ensure "the integrated use of the natural and social sciences…in planning and in decision making" (*42 U.S.C. 4332(A)*). Socioeconomics refers to a broad, social-science-based approach to understanding a region's social and economic conditions. It typically includes population, demographic descriptors, cultural conditions, economic activity indicators, housing characteristics, property values, and public revenues and expenditures. When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet projects that could affect a region's socioeconomic conditions.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide a nationwide public safety broadband network (NPSBN) and interoperable emergency communications coverage. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, to give special attention to potential impacts on those populations per *Executive Order 12898* (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders). Certain demographic information including race, ethnicity, age, income, and poverty status is also relevant to evaluating potential environmental justice issues, as discussed in the Environmental Justice sections 4.1.10 and 4.2.10 (in the Affected Environment and Environmental Consequences sections, respectively).

This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use, airspace, and recreation (Sections 4.1.7 and 4.2.7), infrastructure (Sections 4.1.1 and 4.2.1), and visual resources (Sections 4.1.8 and 4.2.8).

The financial arrangements for deployment and operation of the FirstNet network have socioeconomic implications. Section 1.1, Overview and Background, frames some of the public expenditure and public revenue considerations specific to FirstNet. This socioeconomics section provides some additional broad context, including data and discussion of state and local government revenue sources that FirstNet could affect.

Wherever possible, this section draws on nationwide datasets from federal sources such as the United States Census Bureau (U.S. Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geographical location at the time of writing. At the county, state, region, and United States levels, the data is typically for 2013 or 2014. For smaller geographic areas, this section uses data from the U.S. Census Bureau's American Community Survey (ACS). The ACS is the U.S. Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that 5-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level. Where available, information is presented at the national, state, and county levels.

This section discusses existing socioeconomic conditions of Hawaii that could potentially be affected by deployment and operation of the Proposed Action, including the following subjects: regulatory considerations specific to socioeconomics in the state, communities and populations, economic activity, housing, property values, and taxes.

4.1.9.2. Specific Regulatory Considerations

Hawaiian Homes Commission Act

The federal Hawaiian Homes Commission Act of 1920 (HHCA; *42 Stat. 108*), as amended, recognizes the special socioeconomic status of Native Hawaiians. The HHCA defines 75 Hawaiian home lands and establishes a system of socioeconomic support to Native Hawaiian beneficiaries. This support system includes use of lands held in trust by the state for Native Hawaiian residential, agricultural, or pastoral purposes; the provision of water and infrastructure to these lands to ensure their productivity and accessibility; and financial and technical assistance to promote economic self-sufficiency and the preservation of native Hawaiian culture and quality of life.

While the HHCA may not directly apply to the proposed action, it is noted here given its overall effects on support of social and economic activity for approximately 10 percent of Hawaii's population (see Section 4.1.10, Environmental Justice, for more detailed information about race and ethnicity).

Subsistence

The Hawaii Code defines subsistence as "the customary and traditional native Hawaiian uses of renewable ocean resources for direct personal or family consumption or sharing" (*Title 12, §18-22.6*) and makes provisions for the establishment of community-based fishing subsistence areas. In 2014, the state Board of Land and Natural Resources adopted rules creating the first such area in Hāʻena, on the north shore of Kauai, although the rules have not yet been enacted by the governor (*Dawson 2015*).

4.1.9.3. Communities and Populations

Hawaii consists of five counties. Major population centers include the cities and surrounding areas of Honolulu, Hilo, Kailua, and Kahului (see Section 4.1.7, Land Use, Airspace, and Recreation). Table 4.1.9-1 presents population information for the state and its counties.

Population density varies considerably, from 1,587 persons per square mile in Honolulu County (which includes the island of Oahu and the City of Honolulu, the largest city in the state) to

8 persons per square mile in Kalawao County (a small peninsula of land and its surrounding waters along the north shore of the island of Molokai that is almost entirely comprised of Kalaupapa National Historical Park, and was the former quarantine site for Hawaiian citizens with Hansen's Disease, or leprosy). Statewide, approximately 6 percent of Hawaii can be characterized as urban (*U.S. Census Bureau 2015*)[1] as described by the U.S. Census Bureau. Approximately 92 percent of the state's population lives in these urban areas, as compared to approximately 81 percent of the national population (*Hawaii State Data Center 2013*). Table 4.1.9-1 provides select population, population density, and population growth rates at the state and county levels, compared with national data.

Table 4.1.9-1: National, State, and County Population, Population Density, and Growth Rates

	2000	2010	2014	2014 Population Density (persons/ square mile)	Annual Growth Rate, 2000-14 [a]
United States	281,421,906	308,745,538	318,857,056	90.3	1.0%
State of Hawaii	1,211,537	1,360,301	1,419,561	221.0	1.2%
Honolulu County	876,156	953,207	991,788	1,650.9	0.9%
Maui County	128,094	154,834	163,019	140.3	2.1%
Kauai County	58,463	67,091	70,475	113.7	1.5%
Hawaii County	148,677	185,079	194,190	48.2	2.4%
Kalawao County	147	90	89	7.4	-3.9%

Source: U.S. Census Bureau 2000, 2010a, 2014

[a] Calculated as the total change between 2000 and 2014, divided by the number of years between 2000 and 2014.

As illustrated in Table 4.1.9-1, annual population growth in the State of Hawaii since 2000 has occurred at a higher rate (1.2 percent) than in the nation as a whole (1 percent). At the county level, Honolulu County has grown slower than the state average, while the other populated counties (Maui, Kauai, and Hawaii County) have grown faster than the state average. Kalawao County has seen a decline in its already small population, due to the fact that no new permanent residents are allowed to move there because of its park status. The high population density in Honolulu County reflects the prominence of the City of Honolulu and surrounding areas.

Table 4.1.9-2 shows population projections for the State of Hawaii and the United States through 2040. Over this period of time, the State of Hawaii's projected population growth is slightly lower than for the nation as a whole.

Table 4.1.9-2: Population Projections

	2010	2020	2030	2040	Annual Growth Rate
State of Hawaii	1,360,301	1,489,774	1,612,574	1,716,417	0.9%
United States	308,745,538	335,605,444	360,978,449	382,152,234	0.8%

Source: UVA 2015

The analysis in Section 4.2.10, Environmental Justice, provides detailed race and ethnicity information for Hawaii and its census block groups.

[1] Urban is defined as "densely developed residential, commercial, and other non-residential areas."

4.1.9.4. Real Estate, Tax Revenues, Property Values, and Local Economic Activity

Economic Activity

Hawaii's economy is heavily tied to the tourism industry, which spans numerous economic sectors. The arts, entertainment, recreation, accommodation, and food service industry alone provides approximately 16 percent of all jobs. In 2014, tourism generated $1.6 billion in tax revenue and supported 165,000 jobs (*HTA 2015*). Other major employment sectors include education, health, and social services sector (approximately 19 percent); retail trade (approximately 12 percent); and professional, scientific, management, administrative, and waste management services (11 percent) (*State of Hawaii 2013*).

Fisheries in Hawaii contribute to the local economy and supply a valuable food source to the residents. The diverse marine environment in Hawaii also attracts eco-tourists such as divers, snorkelers, and underwater photographers. Other socioeconomic benefits related to these activities include recreational fishing guide operations, boat and SCUBA rentals, bait and tackle shops, lodging for tourists, and restaurants. Hawaii's coral reefs alone provide "food, recreation and income" valued at "more than $360 million annually to the state's economy" (*The Nature Conservancy 2015*).

Table 4.1.9-3 summarizes selected economic indicators for the State of Hawaii and the United States. At the state and county level, unemployment rates in the State of Hawaii range from approximately 6.1 percent to 10.8 percent, compared to the national average of 9.7 percent in 2013.

Table 4.1.9-3: Select Economic Indicators

	Per Capita Personal Income (2013)	Median Household Income (2013)	Unemployment Rate (Annual Average, 2013)
United States	$28,155	$53,046	9.7%
State of Hawaii	$29,305	$67,402	7.1%
Hawaii County	$24,635	$51,250	10.8%
Honolulu County	$30,361	$72,764	6.1%
Kalawao County	$45,515	$59,375	ND
Kauai County	$26,658	$62,052	7.2%
Maui County	$29,517	$63,512	8.5%

Source: U.S. Census Bureau 2013

ND = no data

Median household income in Hawaii is also above the national average of $52,250, with county averages ranging from a high in Honolulu County of $72,764 to a low of $51,250 in Hawaii County. At the same time, the City of Honolulu's cost of living index (a compilation of consumer prices intended to give a like-to-like comparison of common expenses in cities across the United States) was 165.7 in 2010 (the most recent year for which data were available). This indicates that Honolulu was approximately 66 percent more expensive to live in than the national average. Only New York City (Brooklyn and Manhattan) had higher cost of living indices (*U.S. Census Bureau 2010b*).

Housing

Table 4.1.9-4 provides information on housing units, occupancy, and tenure (owner vs. renter), while Table 4.1.9-5 provides information on housing costs. Between 2010 and 2013, the number of vacant homes in the State of Hawaii increased by 12.8 percent, compared to a 9.7 percent increase for the nation as a whole. During that period of time, home values generally decreased—as was the case in the United States as a whole (likely reflecting the ongoing results of the 2007 to 2008 recession). The median value of a single family home in the State of Hawaii was $502,200, ranging from $329,500 in Hawaii County to $548,900 in Honolulu County. Between 2010 and 2013, rental costs in the State of Hawaii and the United States increased. Monthly rental costs varied across Hawaii's counties, with the highest costs in Maui and Honolulu counties.

Table 4.1.9-4: Housing Units, Occupancy, and Tenure

	2010				2013				Change, 2010-2013			
	United States		State of Hawaii		United States		State of Hawaii		United States		State of Hawaii	
	Number	Pct.	Number	Pct.	Number	Pct.	Number	Pct.	Number	Pct.	Number	Pct.
Total	131,704,730	100%	519,508	100%	132,057,804	1.00%	522,164	1%	353,074	0.30%	2,656	0.5%
Occupied	116,716,292	89%	455,338	88%	115,610,216	88%	449,771	86%	-1,106,076	-0.9%	-5,567	-1.2%
Owner-occupied	75,986,074	58%	262,682	51%	75,075,700	57%	259,270	50%	-910,374	-1.2%	-3,412	-1.3%
Renter-occupied	40,730,218	31%	192,656	37%	40,534,516	31%	190,501	37%	-195,702	-0.5%	-2,155	-1.1%
Vacant	14,988,438	11%	64,170	13%	16,447,588	13%	72,393	14%	1,459,150	9.7%	8,223	12.8%

Source: U.S. Census Bureau 2013

Table 4.1.9-5: Housing Costs

	Median Home Value (Owner-Occupied)			Median Monthly Contract Rent (Renter-Occupied)		
	2010	2013	Change	2010	2013	Change
United States	$188,400	$176,100	-$12,300	$699	$752	$53
State of Hawaii	$537400	$502,200	-$35,200	$1,143	$1,220	$77
Hawaii County	$361,400	$329,500	-$31,900	$858	$884	$26
Honolulu County	$559,000	$548,900	-$10,100	$1,197	$1,331	$134
Kalawao County	ND	ND	ND	$245	$850	$605
Kauai County	$583,200	$483,900	-$99,300	$1,027	$1,067	$40
Maui County	$614,600	$533,700	-$80,900	$1,181	$1,155	-$26

Source: U.S. Census Bureau 2010a, 2013

ND = no data

Property Values and Tax Revenues

Table 4.1.9-6 illustrates the median value of owner-occupied, single family homes in 2013 as well as their distribution across a range of prices.

Table 4.1.9-6: Median Value of Owner Occupied Single Family Homes, 2009 to 2013 American Community Survey

	Less than $50,000	$50,000 to $99,999	$100,000 to $149,999	$150,000 to $199,999	$200,000 to $299,999	$300,000 to $499,999	$500,000 or more
State of Hawaii	0.80%	1.20%	1.70%	3.30%	11.80%	31.00%	50.30%
Hawaii County	1.20%	2.60%	5.30%	9.40%	24.90%	34.90%	21.60%
Honolulu County	0.70%	0.90%	0.80%	2.00%	10.00%	29.20%	56.40%
Kalawao County	ND	ND	ND	ND	ND	ND	ND
Kauai County	1.60%	0.60%	1.90%	1.30%	6.60%	41.60%	46.30%
Maui County	1.00%	1.20%	2.20%	3.20%	8.10%	31.50%	52.70%

Source: U.S. Census Bureau 2013

ND = no data

Changes in land value depend on factors such as the parcel size, proximity to public services, the parcel's current value and land use, and the value of nearby land parcels. Potential future buyers of land may also make decisions based on intended future use of land, as expressed in comprehensive land use plans or other local planning documents.

Prices in Honolulu, Kauai, and Maui counties are generally clustered in the higher-value brackets (see Table 4.1.9-6), while Hawaii County contains a larger number of more moderately-priced homes. In addition to the factors listed above, these home values may also reflect the availability of land; Hawaii County comprises the island of Hawaii, which has the largest land area and, as shown in Table 4.1.9-6, the lowest population density (except for the sparsely-populated Kalawao County).

Table 4.1.9-7 lists the real estate taxes for owner-occupied housing units in the State of Hawaii and its counties. Landowners are responsible for property taxes levied against parcels based on the appraised value of their property.

Table 4.1.9-7: Real Estate Taxes, Owner-Occupied Units with a Mortgage

	United States	Hawaii	Hawaii County	Honolulu County	Kalawao County	Kauai County	Maui County
Less than $800	13.2%	24.2%	42.4%	16.2%	ND	32.7%	43.3%
$800 to $1,499	18.4%	26.6%	26.1%	27.2%	ND	27.1%	23.4%
$1,500 or more	66.2%	44.9%	27.8%	52.4%	ND	34.5%	28.9%
No real estate taxes paid	2.2%	4.3%	3.7%	4.2%	ND	5.8%	4.4%
Median (dollars)	$2,382	$1,426	$975	$1,626	ND	$1,208	$915

Source: U.S. Census Bureau 2013

ND = no data

Subsistence

Subsistence activity in Hawaii is largely focused around fishing activities. The state does not record subsistence catch data; however, there are indications that subsistence catches in nearshore (coral reef) fisheries "could be as high as the reported commercial catch" (*WPRFMC 2015*). Overall, subsistence activities may account for as much as half of all food for some residents of Molokai, and 28 percent for all state residents (*USFS 2014*).

4.1.10. Environmental Justice

4.1.10.1. Introduction

This section presents select demographic data relevant to the assessment of environmental justice. The United States (U.S.) Environmental Protection Agency (USEPA) defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies" (*USEPA 2014*). Environmental justice issues arise when minority or low-income groups experience disproportionately adverse health or environmental effects. The Council on Environmental Quality's (CEQ) document titled *Environmental Justice: Guidance Under the National Environmental Policy Act* clarifies that environmental effects include ecological, cultural, human health, economic, and social impacts (*CEQ 1997*).

Potential environmental justice issues associated with the Proposed Action are most likely to occur within the confines of a particular place and at a local level. Therefore, the information in this section is presented at the U.S. Census block group level, the smallest geographic unit for which demographic data are readily available. The U.S. Census Bureau describes block groups as statistical divisions of census tracts, generally containing between 600 and 3,000 people, and typically covering a contiguous area. Block Groups do not cross state, county, or census tract boundaries, but may cross the boundaries of other geographic entities (*U.S. Census Bureau 2012*).

4.1.10.2. Specific Regulatory Considerations

Federal Regulatory Setting

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, is the basis for environmental justice analysis and is discussed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

The analysis of the potential impacts of the Proposed Action on environmental justice issues follows guidelines described in the *Environmental Justice: Guidance Under the National Environmental Policy Act* (*CEQ 1997*). The analysis method has three steps: 1) describe the geographic distribution of low-income and minority populations in the affected area; 2) assess whether the potential impacts of construction and operation would produce impacts that are high and adverse; and, 3) if impacts are high and adverse, determine whether these impacts disproportionately affect minority and low income populations (*CEQ 1997*).

A description of the geographic distribution of minority and low-income groups in Hawaii was based on U.S. Census Bureau demographic data. The following definitions provided by the *Environmental Justice: Guidance Under the National Environmental Policy Act* (*CEQ 1997*) were used to identify minority and low-income population groups:

- Minority populations consist of individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or, Hispanic; and
- Low-income populations consist of individuals living in poverty, as defined by the U.S. Census Bureau.

Since publication of the *Environmental Justice: Guidance Under the National Environmental Policy Act* (*CEQ 1997*), the U.S. Census Bureau has changed how it defines race and ethnicity. Ethnicity (Hispanic or not Hispanic) is now counted separately from race. As a result, this Draft Programmatic Environmental Impact Statement (PEIS) considers both race and ethnicity separately for the purpose of evaluating minority status.

In 2014, the USEPA issued the *Policy on Environmental Justice for Working with Federally Recognized Tribes and Indigenous Peoples*, which establishes principles to ensure that achieving environmental justice is part of the USEPA's work with federally recognized tribes and Indigenous Peoples in all areas of the U.S. and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands, and others living in Indian country. The policy, which is based on Executive Order 12898 as well as USEPA strategic plan and policy documents, contains 17 principles pertaining to the policy's four focus areas. These four focus areas are:

- Direct implementation of federal environmental programs in Indian country, and throughout the U.S.;
- Work with federally recognized tribes/tribal governments on environmental justice;
- Work with Indigenous Peoples (state recognized tribes, tribal members, etc.) on environmental justice; and
- Coordinate and collaborate with federal agencies and others on environmental justice issues of tribes, Indigenous Peoples, and others living in Indian country.

The policy includes accountability for the implementation of the policy, a definitions section, and an appendix that contains a list of implementation tools available.

State Regulatory Setting

Hawaii guidance on environmental justice adds specificity to federal regulations. In response to a 2006 law recognizing environmental justice environmental justice concerns in Hawaii, the state Environmental Council commissioned the development of the *Hawaii Environmental Justice Initiative Report* (the Report) in 2007 (*State of Hawai'i Environmental Council 2008*). This guidance document addresses environmental justice in all phases of the environmental review process with community collaboration. The report defines environmental justice as the following:

> "[T]he right of every person in Hawai`i to live in a clean and healthy environment, to be treated fairly, and to have meaningful involvement in decisions that affect their environment and health; with an emphasis on the responsibility of every person in Hawai`i to uphold traditional and customary Native Hawaiian practices that preserve, protect, and restore the `āina for present and future generations. Environmental justice in Hawai`i recognizes that no one segment of the population or geographic area should be disproportionately burdened with environmental and/or health impacts resulting from development, construction, operations and/or use of natural resources." [1] (*State of Hawai'i Environmental Council 2008*)

The report additionally provides specific guidance on segments of the population that may experience environmental justice:

> "[M]inority and low-income populations, with a special emphasis on the Native Hawaiian population, should be the target population for environmental justice efforts in Hawai`i. For purposes of the environmental justice guidance document, Native Hawaiian, minority, and low-income populations in Hawai`i will be termed "under-represented populations." (*State of Hawai'i Environmental Council 2008*)

While the Report is a guidance document rather than a formal regulatory instrument, its emphasis on the meaningful involvement of individuals in decision making, traditional and customary Native Hawaiian practices, and the inclusion of Native Hawaiians in environmental justice assessment is noteworthy for the purposes of this Draft PEIS.

4.1.10.3. Minority and Income Status

Table 4.1.10-1 shows the race and ethnicity of Hawaii residents. Respondents to the U.S. Census may identify themselves as White, Black or African American, Asian, Native Hawaiian and Other Pacific Islander, American Indian or Alaska Native, some other race alone,[2] or a combination of these primary races. In Hawaii, 25.0 percent of residents identify themselves as white and 38.3 percent identify themselves as Asian, compared to 74.0 percent and 4.9 percent, respectively, in the nation as a whole. Native Hawaiians and Pacific Islanders comprise nearly 10 percent of Hawaii's population, compared to less than 1 percent of the nation. Nearly 24 percent of Hawaiians identify themselves as being of more than one race, compared to less than 3 percent of the national population *(U.S. Census Bureau 2013)*.

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[1] `Āina is the Native Hawaiian word meaning "land" or "earth."

[2] This definition includes all respondents who did not identify themselves as either White, Black or African American, American Indian or Alaska Native, Asian, or Native Hawaiian or Other Pacific Islander race categories, or as an individual of multiple races.

In the U.S. Census, ethnicity refers to being of Hispanic origin. Ethnicity is independent of race; a Hispanic individual may identify themselves as being of one or multiple races. As shown in Table 4.1.10-1, approximately 9 percent of Hawaiians identify themselves as being Hispanic, compared to nearly 17 percent for the entire U.S.

Appendix E, *Environmental Justice Demographic Data*, provides demographic data characteristics for all block groups in Hawaii, including race, ethnicity, poverty status, and income. These data form the basis for the analysis of environmental consequences in Section 4.2.10, Environmental Justice.

Table 4.1.10-1: Race and Ethnicity

	Hawaii		United States	
Race	**Number**	**Percent**	**Number**	**Percent**
White	344,488	25.0%	230,592,579	74.0%
Black/African American	24,532	1.8%	39,167,010	12.6%
American Indian/Alaska Native	3,050	0.2%	2,540,309	0.8%
Asian	526,743	38.3%	15,231,962	4.9%
Native Hawaiian/Pacific Islander	134,733	9.8%	526,347	0.2%
Some other race alone	15,418	1.1%	14,746,054	4.7%
Multiple Races	327,334	23.8%	8,732,333	2.8%
Ethnicity				
Hispanic	128,171	9.3%	51,786,591	16.6%
Non-Hispanic	1,248,127	90.7%	259,750,003	83.4%
Total	**1,376,298**		**311,536,594**	

Source: U.S. Census Bureau 2013

4.1.10.4. Identification of Potential for Environmental Justice Impacts

Environmental justice impacts of the Proposed Action would most likely occur at a local level. For example, if adverse impacts from dust and noise exposure from construction of a communication tower, changes in property values, or effects from operation of communications equipment occur disproportionately in a specific environmental justice community (or communities), then these could constitute an environmental justice impact. Therefore, the environmental justice screening analysis in this Draft PEIS uses the smallest geographic unit for which socioeconomic data are readily available, the Census Block Group. The U.S. Census Bureau defines this unit as follows:

> "Block groups are statistical divisions of census tracts, [and] are generally defined to contain between 600 and 3,000 people …A block group usually covers a contiguous area…block groups never cross state, county, or census tract boundaries but may cross the boundaries of any other geographic entity." (*U.S. Census Bureau 2012*)

In dense urban areas, a block group may only encompass a few city blocks. In rural areas, a block group may cover many square miles.

Because the specific location and deployment options of the Proposed Action have not been determined, this Draft PEIS identifies locations in Hawaii where potential environmental justice impacts could be either more or less likely to occur. If the potential exists for environmental justice impacts from one or more aspects of the Proposed Action (such as noise, air quality, or visual impacts), additional analyses to identify environmental justice communities and assess specific impacts on those communities could be necessary as part of implementation.

The remainder of this section describes the methodology for making that determination.

The CEQ provides some basic guidance on the choice of metrics for classifying minority populations (i.e., environmental justice communities):

> "Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50% or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis." (*CEQ 1997*)

The CEQ also states that "low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the U.S. Census Bureau's Current Population Reports, Series P-60 on Income and Poverty" (*CEQ 1997*). Poverty thresholds are specific income levels that take into account factors such as family size. The federal government defines these levels annually for the nation. The U.S. Census Bureau defines a "poverty area" as an area (in this case, a block group) where more than 20 percent of the population is at or under the poverty level (*Bishaw 2014*).

Beyond this guidance, many aspects of environmental justice impacts are discretionary and are matters of precedent and best practice within particular agencies and among socioeconomic analysts. The CEQ also does not define "meaningfully greater," nor does it define the "appropriate unit of geographic analysis" (per the quote above).

For the purpose of evaluating potential environmental justice impacts, the Draft PEIS uses the state of Hawaii's total population as the comparison group (the "general population or other appropriate unit" described in the quote above), hereafter called the reference population. The Draft PEIS also defines a low-income household as one whose income is less than or equal to two times the federal poverty level. This approach aligns with the USEPA's approach to defining "low income" in its recently released EJSCREEN mapping tool (*USEPA 2015*).

The Draft PEIS evaluates the potential for environmental justice impacts along a spectrum, from low to high potential. The location along this spectrum is determined by the presence of one or more cases where the racial, ethnic, or low income characteristics of the block group's population is "meaningfully greater" than the reference population's characteristics.

The Draft PEIS defines "meaningfully greater" as meeting or exceeding one or more of the following thresholds:

1. An overall racial (non-white) or ethnic (Hispanic or Latino) minority population whose share of the block group's population is at least 20 percentage points greater than the reference population's minority percentage. This is the U.S. Department of Housing and Urban Development's definition of a "minority neighborhood" (*HUD Undated*).[3]
2. One or more individual racial or ethnic minority populations whose share of the block group's population is at least 20 percentage points greater than the reference population's comparable minority percentage.
3. An overall racial or ethnic minority population whose share of the block group's population is at least 120 percent of the reference population's minority population.
4. The share of low-income residents (those with a household income equal to or less than two times the federal poverty level) in the block group is at least 120 percent of the reference population's low income level. For example, if 25 percent of the reference population is low income, the threshold applied to each block group is 30 percent.

Approximately 75 percent of Hawaii's population identifies itself as a racial minority (i.e., a race other than White or Caucasian). The same is true in a large proportion of Hawaii's block groups. Accordingly, the 50 percent threshold for race and ethnicity recommended by CEQ guidelines has not been applied to Hawaii. Instead, the analysis of minority populations is based on the other thresholds described above.

The following combinations of the threshold characteristics listed above define three degrees of likelihood that a block group contains a potential environmental justice community:

- High Potential for Environmental Justice Communities
  - Greater than 20 percent of the block group's total population living in poverty; or
  - At least one minority population whose percentage of the block group's total population is at least 20 percentage points higher than that minority's share of the reference population; or
  - The combined minority share of the block group's overall population is at least 120 percent of the reference population's combined minority share.
- Moderate Potential for Environmental Justice Communities
  - Does not meet any of the above thresholds; and
  - At least one minority's share of the block group's overall population is at least 120 percent of that minority's share of the reference population; or
  - The low-income share of the block group's population is at least 120 percent of the reference population's low-income share.

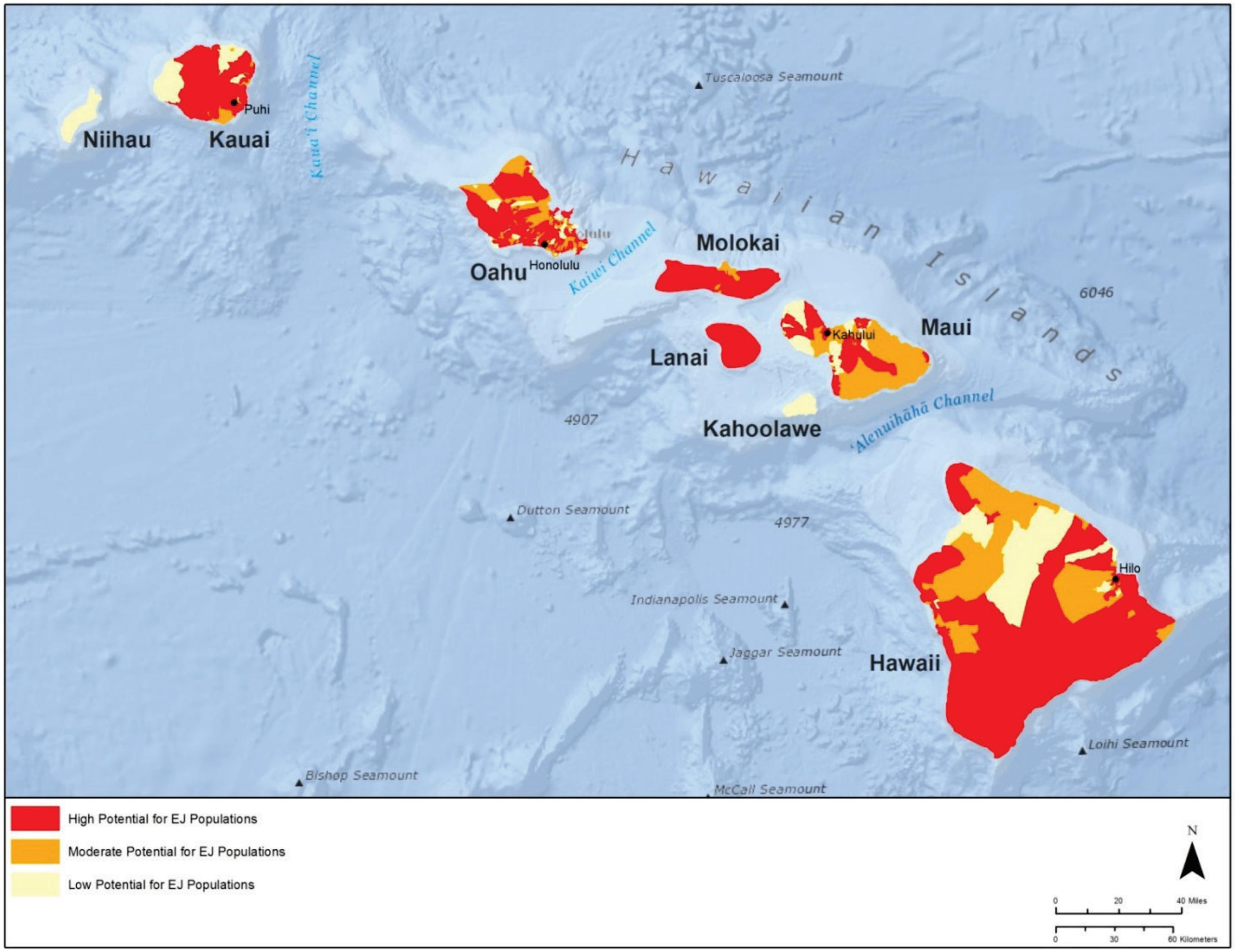
[3] Race (White, Black/African American, Asian, etc.) and ethnicity (Hispanic/Latino or not Hispanic/Latino) are separate categories, and are therefore considered separately.

- Low Potential for Environmental Justice Communities
  - Does not meet any of the above thresholds

This Draft PEIS applies this methodology to all block groups in the state.

Figure 4.1.10-1 displays the results of the screening analysis, and shows the potential presence of environmental justice communities. A substantial portion of Hawaii's block groups has a high potential for environmental justice communities, and therefore a high potential for impacts to those communities. These high potential areas are found on all of Hawaii's populated islands, [4] and cover all or nearly all of Kauai, Lanai, and Molokai. Moderate-potential block groups are found on the largest islands—Hawaii, Maui, Molokai, Oahu, and Kauai. There is no apparent correlation between major population centers and any specific level of potential environmental justice concerns.

[4] Including the islands of Hawaii, Maui, Molokai, Oahu, Kauai, and Lanai.



Source: U.S. Census Bureau 2013

Figure 4.1.10-1: Potential for Environmental Justice Populations

4.1.11. Cultural Resources

4.1.11.1. Introduction

This section discusses cultural resources that are known to exist in Hawaii. For the purposes of this Draft Programmatic Environmental Impact Statement (PEIS), cultural resources are defined as natural or manmade structures, objects, features, and locations with scientific, historic, and cultural value, including those with traditional religious or cultural importance, as well as any prehistoric or historic district, site, or building included in, or eligible for inclusion in, the National Register of Historic Places (NRHP).

This definition is consistent with how cultural resources are defined in:

- The statutory language and implementing regulations for Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), formerly *16 United States Code (USC) 470a(d)(6)(A)* (now *54 USC 306131(b)*) and *36 Code of Federal Regulations (CFR) 800.16(l)(1)*;
- The statutory language and implementing regulations for the Archaeological Resources Protection Act of 1979, 1*6 USC 470cc(c)* (now *54 USC 3203*) and *43 CFR 7.3(a)*;
- The statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act, *25 USC 3001(3)(D)* and *43 CFR 10.2(d)*; and
- National Park Service's guidance for evaluating and documenting traditional cultural properties (TCPs)[1] (*NPS 1998*).

Information is presented regarding cultural resources that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

4.1.11.2. Specific Regulatory Considerations

The Proposed Action is considered an undertaking as defined in *36 CFR 800*, the regulation implementing Section 106 of the NHPA. The intent of Section 106, as set forth in its attending regulations, is for federal agencies to take into account the effects of a proposed undertaking on historic properties,[2] which can include TCPs, and to consult with the Advisory Council on Historic Preservation, federally recognized American Indian tribes[3] and Native Hawaiian

[1] TCPs are defined as a place "eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (*NPS 1998*).

[2] A historic property is defined as any "prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on the National Register [of Historic Places (NRHP)], including artifacts, records, and material remains relating to the district, site, building, structure, or object" (54 *USC 300308*).

[3] NHPA defines "Indian tribe" as "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation or Village Corporation (as those terms are defined in section 3 of the Alaska Native Claims Settlement Act (*43 USC. 1602*)), that is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians" (54 *USC 300309*).

organizations,[4] State Historic Preservation Offices, local governments, applicants for federal assistance, permits, licenses, and other approvals, as well as any other interested parties with a demonstrated interest in the proposed undertaking and its potential effects on historic properties.

The Hawaii State Historic Preservation Division (SHPD) of the Department of Land and Natural Resources is the Hawaii State Historic Preservation Office (SHPO) and is responsible for the preservation and protection of cultural resources and consultation with the Advisory Council on Historic Preservation, federal and state agencies, Native Hawaiian organizations, and state residents regarding proposed undertakings under Section 106 and various other federal and state laws and regulations in Hawaii.

In addition to Section 106 and the various federal laws and regulations discussed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders, and Appendix C, *Environmental Laws and Regulations*, Hawaii has adopted a state review process to preserve and protect cultural resources as part of any proposed federal or state projects.

The value of historic and cultural property has been recognized by the constitution of the State of Hawaii. Hawaii Administrative Rules, Revised Statute (HRS) Chapter 6E was established to conserve and develop "the historic and cultural property within the State for the public good." The legislature declared that "the historic and cultural heritage of the State is among its important assets and the rapid and economic developments of contemporary society threaten the remaining vestiges of this heritage." As such, HRS Chapter 6E establishes "a comprehensive program of historic preservation at all levels of government to promote the use and conservation of such property for the education, inspiration, pleasure, and enrichment of its citizens." Among other things, the law establishes procedures for state agencies to follow when considering their own projects, plans, and programs, processes for designation of historic sites, landmarks, monuments, and districts as part of the Hawaii Register of Historic Places (HRHP), and establishment of standards, permit programs, and review procedures and authority for cultural resources survey, excavation, and handling of human remains.

Based on the federal and state laws and regulations discussed above, the Proposed Action requires FirstNet to seek the review, consultation, and concurrence of the SHPD prior to deployment.

Federal agencies are required to consult with Native Hawaiian organizations as part of Section 106 but also as part of other federal historic preservation laws[5] and HRS Chapter 6E. As stated

[4] NHPA defines a Native Hawaiian organization as any organization which "serves and represents the interests of Native Hawaiians; has as a primary and stated purpose the provision of services to Native Hawaiians; and has demonstrated expertise in aspects of historic preservation that are culturally significant to Native Hawaiians. In this division, the term 'Native Hawaiian organization' includes the Office of Hawaiian Affairs of Hawaii and Hui Malama I Na Kupuna O Hawai'i Nei, an organization incorporated under the laws of the State of Hawaii" (54 *USC 300314*). NHPA defines Native Hawaiian as "any individual who is a descendant of the aboriginal people who, prior to 1778, occupied and exercised sovereignty in the area that now constitutes Hawaii" (54 *USC 300313*).

in NHPA, the agency "shall make a reasonable and good faith effort to identify any [American] Indian tribes or Native Hawaiian organizations that might attach religious and cultural significance to historic properties in the area of potential effects and invite them to be consulting parties" for the individual project (*36 CFR 800.3(f)(2)*).

In accordance with the Council on Environmental Quality's guidance, entitled *NEPA and NHPA: A Handbook for Integrating NEPA and Section 106*, the NHPA Section 106 process is proceeding on a parallel path to the National Environmental Policy Act (NEPA) process. FirstNet has begun consultation with affected Native Hawaiian organizations as part of the NHPA and NEPA processes, and these consultations have informed the development of the cultural resources sections of this Draft PEIS.

4.1.11.3. Cultural Setting

As discussed above, cultural resources is a general term that can include a wide range of resources. Section 106 review commonly focuses on the identification of historic properties; however, historic properties are only a subset of cultural resources, and are but one aspect of the "human environment" defined by the NEPA regulations. The human environment, under NEPA, includes the natural and the physical (e.g., structures) environment, and the association of people to those environments. Therefore, a NEPA review must consider the cultural context in which the project effects would occur. The intent of this section is to describe the affected environment within this cultural context.

Cultural Context

The history of the Hawaiian Islands prior to European contact is based on a combination of ethnographic data, oral tradition, historical documentation, and analysis of archaeological material. There are two chronological frameworks within which this history can be placed: one based on traditional Hawaiian histories and royal genealogies, the other based on archaeological analysis, inclusive of radiocarbon dating. When it is possible, researchers attempt to integrate the two sources of dating.

Pre-Contact Period (ca. 100 CE [Common Era] to 1778)

The Hawaiian Islands were among the last places on Earth to be colonized by humans. Most researchers agree that voyaging Polynesians from the Marquesas Islands were the first people to colonize the Hawaiian Islands (*Wilmshurst et al. 2011*). However, the date of initial human habitation of the islands remains a highly contested topic. The two main positions on the matter have been labeled the *long count* and the *short count* (*Graves and Addison 1995*). Those

[5] Consultation with American Indian tribes and Native Hawaiian organizations is specifically addressed in the Native American Graves Protection and Repatriation Act of 1990 and American Indian Religious Freedom Act of 1978. Additionally, Executive Memorandum Government-to-Government Relationship with Tribal Governments, Executive Order 13007 Indian Sacred Sites, Executive 13175 Consultation and Coordination with Indian Tribal Governments, and the Archaeological Resources Protection Act all direct, to the extent practicable, that most federal agencies consult with and involve federally recognized American Indian tribes. However, these four policies and laws do not specifically mention Native Hawaiian organization, and though they do not require federal agencies to consult with Native Hawaiian organizations, many agencies, such as FirstNet, will consult with Native Hawaiian organizations consistent with the intentions of these policies and laws and maintain open, collaborative relationships with native peoples throughout their projects and programs.

supporting the *long count* argue for settlement as early as 100 to 300 CE, and those supporting the *short count* argue for settlement no earlier than 700 to 800 CE. Also highly contested is the manner in which the Hawaiian Islands were originally settled, some theorizing one voyage of colonization (*Cordy 2000*) and others theorizing numerous voyages (*Cachola-Abad 1993*).

Early settlement focused on the rich windward environments that supported horticultural and fishing activities with subsequent expansion into the drier leeward regions as populations grew and political complexities increased (*Tuggle 1979; Kirch 1985; Cordy 2000*). Radiocarbon data indicate intensive population growth and settlement expansion from 1150 to 1400 CE (*Dye and Komori 1992; Dye 1994*). This period of growth lead to the establishment of complex societies and resource production systems that supported a dense human population with complex sociopolitical systems (*Kirch 1985; Vitousek et al. 2004*). Traditional histories indicate that it was during this period of increasing social complexity that the founding of the powerful royal lineages occurred. Archaeological evidence indicates that this same period witnessed the advent of large temple construction, development of royal centers, and agricultural expansion and intensification (*Kolb 1991; Dye 1994; Cordy 1996, 2000*).

Population growth and agricultural expansion continued over the next several centuries. Population centers, royal centers, temples, and expansive agricultural systems that were observed at the time of European contact were clearly established by 1700 CE. The population growth and increased social complexities lead to periods of intensive warfare and political expansion in the century leading up to European contact in 1778. When the first Europeans arrived at the Hawaiian Islands, there were four competing kingdoms: the kingdoms of Hawai'i (the island of Hawai'i and a portion of Maui), Maui (Maui, Lanai, and Kahoolawe), Oahu (Oahu and Molokai), and Kauai and Niihau, which were ruled by Kalaniopuu, Kahekili, Peleioholani, and Kaneoneo, respectively (*Armstrong 1983; Tuggle 1979; Juvik and Juvik 1998*).

Post-Contact Period (1778 to Present)

Captain James Cook landed on Kauai in 1778, opening the Hawaiian Islands to the western world. Over the next 30 years the Hawaiian Islands incurred major changes. The political landscape of the Hawaiian Islands was transformed from island-based chiefdoms to a centralized government located out of Honolulu under the rule of King Kamehameha, who united warring factions on the island of Hawaii and by 1810 unified the islands into one royal kingdom. The introduction of western diseases resulted in epidemics that decimated Hawaiian populations. In 1819, less than a year after the death of King Kamehameha, his son Liholiho abolished the kapu system, a social hierarchy based on taboo. By 1820, American missionaries arrived and instituted a new set of religious order that filled the void left by the recently abolished kapu system (*Chamberlain 1957; Kuykendall 1938*).

The second half of the 19th century witnessed large-scale commercial agricultural development and associated waves of immigrant workers. Between the harvesting of sandalwood for its aromatic properties and firewood used to render blubber into oil as part of the growing whaling industry, the native forests of Hawaii were ravaged (*Chamberlain 1957; Kuykendall 1938*). Cattle and sheep, introduced in the late 1700s, were allowed to run wild and became a serious threat to the health of the Hawaiian Islands' environment. The cattle and sheep were systematically hunted to control the populations, and eventually the systematic hunting evolved into large scale ranching operations (*Ellis 1963; McEldowney 1979*).

As early as 1872 the U.S. Army was evaluating the defense possibilities of various Hawaiian ports. The Reciprocity Treaty of 1876 allowed the U.S. to develop Puuloa Lagoon into a harbor, and in 1887 the U.S. was granted exclusive use of the harbor that was to become known as Pearl Harbor. In 1893, Queen Lili'uokalani was deposed by a group of American residents. Despite reports denouncing the overthrow, Congress voted in 1898 to annex Hawaii as a U.S. territory and, as a strategically important location, it quickly became a hub of military development. The attack on Pearl Harbor by the Japanese in 1941 brought a large influx of military personnel, equipment, and development to the Hawaiian Islands. Hawaii became a state in 1959, further solidifying its status as a U.S. military stronghold. The military facilities located on the Hawaiian Islands, as well as the associated personnel and equipment, have continued to play a vital role in the defense of the U.S. on through the present (*Alvarez 1982*).

Economically, the Hawaiian Islands have relied on sugar and pineapple plantations, as well as tourism over the last century. Employment opportunities on plantations have encouraged an influx of immigrants from Japan, China, the Philippines, and Portugal, further diversifying the local population. Tourism has focused on the unique island environment, cultural history, and natural marvels. Kilauea National Park was proposed as early as 1903 and was fully realized as it is known today by 1920 (*Apple 1954*). The Hawaiian Islands continue to be an important strategic military location and military spending; the expenditures of military personnel stationed in Hawaii also contribute greatly to the local economy.

Archaeological and Historic Resources

The above sections provide a basis for understanding the identification and evaluation of cultural resources as it relates to the cultural context of Hawaii and the type of cultural resources that could exist within a project area of potential effect. Although site-specific information regarding cultural resources would need to be collected to define the affected environment of an individual project, the types of cultural resources that are currently listed on the HRHP and NRHP across Hawaii can provide an understanding of the types and range of potential archaeological and historic resources that should be considered and could be affected by the Proposed Action.

Table 4.1.11-1 provides a list of cultural resources that have been evaluated and designated significant to be listed on the NRHP. There are currently 388 cultural resources listed on the NRHP in Hawaii. The cultural resources consist of archaeological sites and features; historic buildings, bridges, and roads; military sites, features, and objects; cemeteries and burials; historic districts; traditional cultural properties; and cultural landscapes. In addition to the NRHP, the HRHP currently contains 890 listed cultural resources, containing all of the various types of cultural resources discussed above. Due to the extensive size of the HRHP, cultural resources listed on the HRHP are not provided here and are included in Appendix G, *Hawaii Register of Historic Places*. Figure 4.1.11-1 shows the locations of the cultural resources listed in Table 4.1.11-1.

Table 4.1.11-1: Cultural Resources Listed on the NRHP

Property Name	Property Type	Island	City
Kealakekua Bay Historical District	District	Hawaii	Captain Cook
Tong Wo Society Building	Building	Hawaii	Halawa
Ainahou Ranch	Building	Hawaii	Hawaii National Park
1790 Footprints	Site	Hawaii	Hawaii Volcanoes National Park
Mauna Loa Trail	Site	Hawaii	Hawaii Volcanoes National Park
Heiau in Kukuipahu	Site	Hawaii	Hawi
Hind, James M., House	Building	Hawaii	Hawi
Mookini Heiau	Structure	Hawaii	Hawi
Crater Rim Drive	District	Hawaii	Hilo
District Courthouse and Police Station	Building	Hawaii	Hilo
Guard, Thomas, House	Building	Hawaii	Hilo
Halaulani Place, 1917-1960	Building	Hawaii	Hilo
Hata, S., Building	Building	Hawaii	Hilo
Henderson, Walter Irving and Jean, House	Building	Hawaii	Hilo
Hilina Pali Road	District	Hawaii	Hilo
Hill, W.H., House	Building	Hawaii	Hilo
Hilo Masonic Lodge Hall-Bishop Trust Building	Building	Hawaii	Hilo
Kamehameha Hall	Building	Hawaii	Hilo
Kilauea Crater	Site	Hawaii	Hilo
Lyman, Levi and Netti, House	Building	Hawaii	Hilo
Lyman, Rev. D. B., House	Building	Hawaii	Hilo
Mauna Kea Adz Quarry	Site	Hawaii	Hilo
Mauna Loa Road	District	Hawaii	Hilo
McGuinness, Patrick and Ethel, House	Building	Hawaii	Hilo
Moses, Edward H. and Claire, House	Building	Hawaii	Hilo
Old Volcano House No. 42	Building	Hawaii	Hilo
Palace Theater	Building	Hawaii	Hilo
Parker, James and Catherine, House	Building	Hawaii	Hilo
Pua Akala Cabin	Building	Hawaii	Hilo
Shipman, W. H., House	Building	Hawaii	Hilo
Truslow, Herbert Austin, House	Building	Hawaii	Hilo
U.S. Post Office and Office Building	Building	Hawaii	Hilo
Volcano Block Building	Building	Hawaii	Hilo
Waiakea Mission Station-Hilo Station	Building	Hawaii	Hilo
Whitney Seismograph Vault No. 29	Building	Hawaii	Hilo
Wilkes Campsite	Site	Hawaii	Hilo
Williamson, A. J., House	Building	Hawaii	Hilo
Kahaluu Historic District	District	Hawaii	Holualoa

Property Name	Property Type	Island	City
Pua'a-2 Agricultural Fields Archeological District (50HA10229)	Site	Hawaii	Holualoa
Daifukuji Soto Zen Mission	Building	Hawaii	Honalo
St. Benedict's Catholic Church	Building	Hawaii	Honaunau
Chee Ying Society	District	Hawaii	Honokaa
Hale Halawai O Holualoa	Site	Hawaii	Kailua-Kona
Holualoa 4 Archeological District (State Site No. 50-10-37-23.661)	District	Hawaii	Kailua-Kona
Honokohau Settlement	District	Hawaii	Kailua-Kona
Hulihee Palace	Building	Hawaii	Kailua-Kona
Kalaoa Permanent House Site 10,205	Site	Hawaii	Kailua-Kona
Kamakahonu, Residence Of King Kamehameha I	Site	Hawaii	Kailua-Kona
Kamoa Point Complex	Site	Hawaii	Kailua-Kona
Kuamo'o Burials	Site	Hawaii	Kailua-Kona
Mokuaikaua Church	Building	Hawaii	Kailua-Kona
Pu'uhonua O Honaunau National Historical Park	District	Hawaii	Kailua-Kona
Kaloko-Honokohau National Historical Park	District	Hawaii	Kailua-Kona
Star of the Sea Church-Kalapana Painted Church	Building	Hawaii	Kaimu
Anna Ranch	District	Hawaii	Kamuela
Brown, Francis E. Ii, House	Building	Hawaii	Kamuela
Waimea Elementary School	Building	Hawaii	Kamuela
Bond District	District	Hawaii	Kapaau
Kohala District Courthouse	Building	Hawaii	Kapaau
Nanbu, A., Hotel-Holy's Bakery	Building	Hawaii	Kapaau
Pu'ukohola Heiau	Site	Hawaii	Kawaihae
Pu'ukohola Heiau National Historic Site	District	Hawaii	Kawaihae
Greenwell Store	Building	Hawaii	Kealakekua
Uchida Coffee Farm	Building	Hawaii	Kealakekua
Kamehameha III's Birthplace	Object	Hawaii	Keauhou
Keauhou Holua Slide	Structure	Hawaii	Keauhou
Lapakahi Complex	District	Hawaii	Mahukona
Ainapo Trail	Structure	Hawaii	Mauna Loa
Ahole Holua Complex	District	Hawaii	Milolii
South Point Complex	District	Hawaii	Naalehu
Mahana Archeological District	Site	Hawaii	Naalehu
Kahikolu Church	Building	Hawaii	Napoopoo
Ahu A Umi Heiau	Structure	Hawaii	North Kona
Paauhau Plantation House	Building	Hawaii	Paauhau
Puna-Ka'u Historic District	District	Hawaii	Pahala
Bobcat Trail Habitation Cave	Site	Hawaii	Pohakuluoa
Puako Petroglyph Archeological District	District	Hawaii	Puako
Ala Loa	Site	Hawaii	South Kohala
Hale-O-Aloha	Structure	Hawaii	Volcano
Imiola Church	Building	Hawaii	Waimea
Kii Petroglyphs	Site	Hawaii	Waiohinu

Property Name	Property Type	Island	City
Manuka Bay Petroglyphs	Site	Hawaii	Waiohinu
Hilina Pali Road	Structure	Hawaii	Hilo
Mauna Loa Road	Structure	Hawaii	Hilo
Haena Archeological Complex	District	Kauai	Hanalei
Hanalei Elementary School	Building	Kauai	Hanalei
Hanalei Pier	Structure	Kauai	Hanalei
Haraguchi Rice Mill	Structure	Kauai	Hanalei
Mahamoku	Site	Kauai	Hanalei
Na Pali Coast Archeological District	District	Kauai	Hanalei
Waioli Mission District	District	Kauai	Hanalei
Wilcox, Albert Spencer, Beach House	Building	Kauai	Hanalei
Hanapepe Town Lot No. 18	Building	Kauai	Hanapepe
Opaekaa Road Bridge	Structure	Kauai	Kapa'a
Seto Building	Building	Kauai	Kapa'a
Pu'u'opae Bridge	Structure	Kauai	Kapa'a
Kilauea Plantation Head Bookkeeper's House	Building	Kauai	Kilauea
Kilauea Plantation Head Luna's House	Building	Kauai	Kilauea
Kilauea Plantation Manager's House	Building	Kauai	Kilauea
Kilauea Plantation Stone Buildings	Building	Kauai	Kilauea
Kilauea Point Light Station	District	Kauai	Kilauea
Kilauea School	Building	Kauai	Kilauea
Kong Lung Store	Building	Kauai	Kilauea
Camp Sloggett	Building	Kauai	Koke'e
Civilian Conservation Corps Camp in Koke'e State Park	Building	Kauai	Koke'e
Old Sugar Mill of Koloa	Site	Kauai	Koloa
Grove Farm	District	Kauai	Lihue
Lihue Civic Center Historic District	District	Kauai	Lihue
Lihue Hongwanji Mission	Building	Kauai	Lihue
Menehune Fishpond	Site	Kauai	Lihue
US Post Office-Lihue	Building	Kauai	Lihue
Wilcox, Albert Spencer, Building	Building	Kauai	Lihue
Kaua'i Belt Road-North Shore section	District	Kauai	Princeville
Grove Farm Company Locomotives	Structure	Kauai	Puhi
Kukui Heiau	Site	Kauai	Wailua
Wailua Complex of Heiaus	District	Kauai	Wailua
Bishop National Bank of Hawaii	Building	Kauai	Waimea
Cook Landing Site	Site	Kauai	Waimea
Gay, Charles, House	Building	Kauai	Waimea
Gulick-Rowell House	Building	Kauai	Waimea
Kikiaola	Structure	Kauai	Waimea
Russian Fort	Structure	Kauai	Waimea
Waimea Hawaiian Church	Building	Kauai	Waimea
Yamase Building	Building	Kauai	Waimea

Property Name	Property Type	Island	City
Yamase Building	Building	Kauai	Waimea
Bank of Hawaii-Haiku Branch	Building	Maui	Haiku
Haiku Mill	Site	Maui	Haiku
Pauwela Point Light Station	Structure	Maui	Haiku
Hana District Police Station and Courthouse	Building	Maui	Hana
Honokalani Village	District	Maui	Hana
Piilanihale Heiau	Structure	Maui	Hana
Wananalua Congregational Church	Building	Maui	Hana
Kaho'olawe Island Archeological District	District	Maui	Kaho'olawe
Baldwin, Henry Perrine, High School	Building	Maui	Kahuli
Crater Historic District	District	Maui	Kahului
Meyer, R. W., Sugar Mill	Structure	Maui	Kalae
U.S. Coast Guard Molokai Light	Structure	Maui	Kalaupapa
Kaluaaha Church	Building	Maui	Kaluaaha
Hoapili Trail	Site	Maui	Kaupo
Kaupo School	Building	Maui	Kaupo
Loaloa Heiau	Site	Maui	Kaupo
Archeological Site (T-10) 50-60-04-702	Site	Maui	Kawela
Archeological Site (T-108) 50-60-03-713	Site	Maui	Kawela
Archeological Site (T-111-116; T-182) 50-60-04-710	Site	Maui	Kawela
Archeological Site (T-12) 50-60-04-704	Site	Maui	Kawela
Archeological Site (T-124) 50-60-04-711	Site	Maui	Kawela
Archeological Site (T-125-6; T-181) 50-60-03-714	Site	Maui	Kawela
Archeological Site (T-127) 50-60-04-711	Site	Maui	Kawela
Archeological Site (T-13) 50-60-04-703	Site	Maui	Kawela
Archeological Site (T-134) 5060-03-718	Site	Maui	Kawela
Archeological Site (T-135-6) 50-60-03-719	Site	Maui	Kawela
Archeological Site (T-144) 50-60-030-716	Site	Maui	Kawela
Archeological Site (T-145) 50-60-03-715	Site	Maui	Kawela
Archeological Site (T-155, -158) 50-60-03-721	Site	Maui	Kawela
Archeological Site (T-165-6) 50-60-03-727	Site	Maui	Kawela
Archeological Site (T-167) 50-60-03-728	Site	Maui	Kawela
Archeological Site (T-171) 50-60-03-729	Site	Maui	Kawela

Property Name	Property Type	Island	City
Archeological Site (T-180) 50-60-04-712	Site	Maui	Kawela
Archeological Site (T-19) 50-60-04-705	Site	Maui	Kawela
Archeological Site (T-22-4, T-90A&B) 50-60-04-709	Site	Maui	Kawela
Archeological Site (T-28) 50-60-04-701	Site	Maui	Kawela
Archeological Site (T-5, T-122, T-178) 50-60-04-142	Site	Maui	Kawela
Archeological Site (T-57) 50-60-03-720	Site	Maui	Kawela
Archeological Site (T-6 complex) 50-60-04-700	Site	Maui	Kawela
Archeological Site (T-70B) 50-60-03-722	Site	Maui	Kawela
Archeological Site (T-75) 50-60-03-725	Site	Maui	Kawela
Archeological Site (T-76) 50-60-03-724	Site	Maui	Kawela
Archeological Site (T-78) 50-60-03-723	Site	Maui	Kawela
Archeological Site (T-79) 50-60-03-726	Site	Maui	Kawela
Archeological Site (T-81, -100, -101, -105, -142) 50-60-03-717	Site	Maui	Kawela
Archeological Site (T-88) 50-60-04-707	Site	Maui	Kawela
Archeological Site (T-92) 50-60-04-708	Site	Maui	Kawela
Archeological Site 50-60-04-140	Site	Maui	Kawela
Archeological Site 50-60-04-144	Building	Maui	Kawela
Kamehameha V Wall, Archeological Site (T-20 and T-42-3) 50-60-04-706	Site	Maui	Kawela
Keanae School	Building	Maui	Keanae
Ket Hing Society Building	Building	Maui	Keokea
Kalepolepo Fishpond	Site	Maui	Kihei
Kipahulu Historic District	District	Maui	Kipahulu
Holy Ghost Catholic Church	Building	Maui	Kula
Kaluakini, William K., House	Building	Maui	Lahaina
King Kamehameha III's Royal Residential Complex	Site	Maui	Lahaina
Lahaina Historic District	District	Maui	Lahaina
Wo Hing Society Building	Building	Maui	Lahaina
Hale Pa'i	Building	Maui	Lahainaluna
Pu'upehe Platform	Site	Maui	Lanai City
Kaunolu Village Site	Site	Maui	Lanai City
Baldwin, Fred C., Memorial Home	Building	Maui	Makawao
Gomes, Frank and Theresa, House	Building	Maui	Makawao
Hana Belt Road	District	Maui	Makawao

Property Name	Property Type	Island	City
Hardy House	Building	Maui	Makawao
Southwest Moloka'i Archeological District	Site	Maui	Maunaloa
Makawao Union Church	Building	Maui	Paia
Maui High School Administration Building	Building	Maui	Paia
Paia School	Building	Maui	Paia
Puunene School	Building	Maui	Puunene
Hokukano-Ualapue Complex	District	Maui	Ualapue
Chinese Tong Houses of Maui Island	Building	Maui	Various
Maui Public Schools	Building	Maui	Various
Waihee Church	Building	Maui	Waihee
Chee Kung Tong Society Building	Building	Maui	Wailuku
Halekii-Pihana Heiau	Site	Maui	Wailuku
Iao Theater	Building	Maui	Wailuku
Ka'ahumanu Avenue-Naniloa Drive Overpass	Structure	Maui	Wailuku
Kaahumanu Church	Building	Maui	Wailuku
Ma'alaea General Store	Building	Maui	Wailuku
Maui Jinsha Mission	Building	Maui	Wailuku
Old Bailey House	Building	Maui	Wailuku
Wai'ale Drive Bridge	Structure	Maui	Wailuku
Wailuku Civic Center Historic District	District	Maui	Wailuku
Wailuku School	Building	Maui	Wailuku
Kalaupapa National Historical Park	District	Moloka'i	Kalaupapa
Aiea Sugar Mill	Building	Oahu	Aiea
Keaiwa Heiau	Site	Oahu	Aiea
`Ewa Sugar Plantation Villages	District	Oahu	Ewa
Kawailoa Ryusenji Temple	Building	Oahu	Haleiwa
Kupopolo Heiau	Site	Oahu	Haleiwa
Pohaku Lanai	Site	Oahu	Haleiwa
Pu'u o Mahuka Heiau	Structure	Oahu	Haleiwa
Waialua Fire Station	Building	Oahu	Haleiwa
Waialua School	Building	Oahu	Haleiwa
Alexander and Baldwin Building	Building	Oahu	Honolulu
Aliiolani Hale	Building	Oahu	Honolulu
Aloha Tower	Building	Oahu	Honolulu
Artillery District of Honolulu	District	Oahu	Honolulu
Battery Hasebrouck	Building	Oahu	Honolulu
Battery Hawkins	Structure	Oahu	Honolulu
Battery Hawkins Annex	Structure	Oahu	Honolulu
Battery Jackson	Structure	Oahu	Honolulu
Battery Randolph	Building	Oahu	Honolulu
Battery Selfridge	Building	Oahu	Honolulu
Bishop, Bernice P., Museum	Building	Oahu	Honolulu
Brewer, C., Building	Building	Oahu	Honolulu
Burningham, Thomas Alexander, House	Building	Oahu	Honolulu
Canavarro, Georges de S., House	Building	Oahu	Honolulu

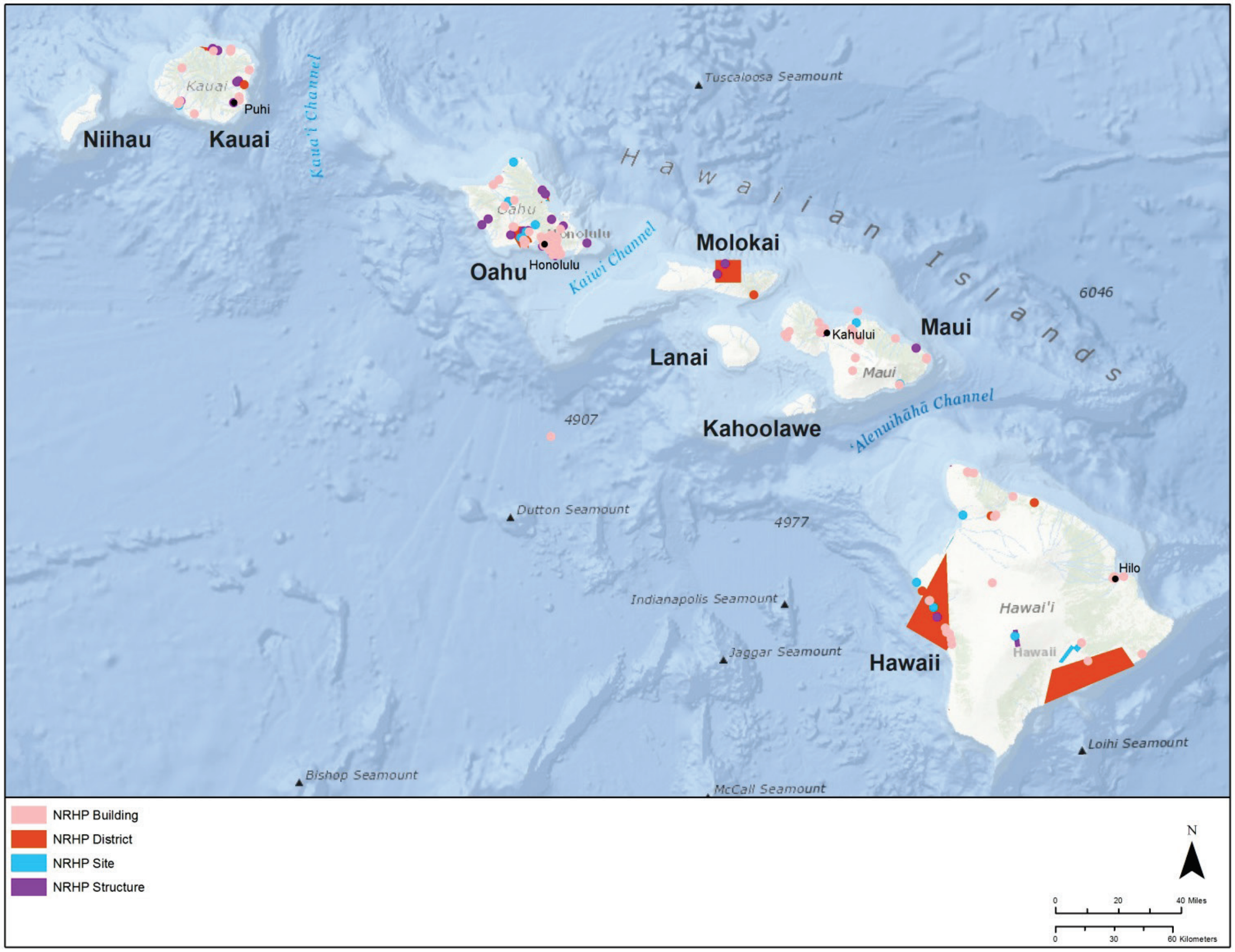
Property Name	**Property Type**	**Island**	**City**
Case, Lloyd, House	Building	Oahu	Honolulu
Central Fire Station	Building	Oahu	Honolulu
Central Intermediate School	Building	Oahu	Honolulu
Charlot, Jean, House	Building	Oahu	Honolulu
Chinatown Historic District	District	Oahu	Honolulu
Church of the Crossroads	Building	Oahu	Honolulu
Coke, James L., House	Building	Oahu	Honolulu
Cook, Grace, House	Building	Oahu	Honolulu
Cooke, Charles Montague, Jr., House	Building	Oahu	Honolulu
Cooke, Clarence H., House	Building	Oahu	Honolulu
Cooper, Bartlett, House	Building	Oahu	Honolulu
Dickey, C. W., House	Building	Oahu	Honolulu
Dillingham Transportation Building	Building	Oahu	Honolulu
Duhrsen, Carl H., House	Building	Oahu	Honolulu
East-West Center Complex	Building	Oahu	Honolulu
East-West Center Complex	District	Oahu	Honolulu
Eyman, Jessie-Judson, Wilma, House	Building	Oahu	Honolulu
FALLS OF CLYDE	Structure	Oahu	Honolulu
Faus, Dr. Robert, House	Building	Oahu	Honolulu
Fort Ruger Historic District	District	Oahu	Honolulu
Foster Botanic Garden	District	Oahu	Honolulu
Guild, John, House	Building	Oahu	Honolulu
Gump Building	Building	Oahu	Honolulu
Halekulani Hotel	Building	Oahu	Honolulu
Hawaii Capital Historic District	District	Oahu	Honolulu
Hawaii Shingon Mission	Building	Oahu	Honolulu
Hawaii Theatre	Building	Oahu	Honolulu
Henriques, Edgar and Lucy, House	Building	Oahu	Honolulu
Hibiscus Place	Building	Oahu	Honolulu
Hickam Field	District	Oahu	Honolulu
Hocking, Alfred, House	Building	Oahu	Honolulu
Holt, Lemon Wond, House	Building	Oahu	Honolulu
Honolulu Academy of Arts	Building	Oahu	Honolulu
Honolulu Tudor-French Norman Cottages	Building	Oahu	Honolulu
House at 3023 Kalakaua Avenue	Building	Oahu	Honolulu
House at 3023A Kalakaua Avenue	Building	Oahu	Honolulu
House at 3023B Kalakaua Avenue	Building	Oahu	Honolulu
House at 3027 Kalakaua Avenue	Building	Oahu	Honolulu
House at 3033 Kalakaua Avenue	Building	Oahu	Honolulu
House at 3033B Kalakaua Avenue	Building	Oahu	Honolulu
House at 4109 Black Point Road	Building	Oahu	Honolulu
Iolani Palace	Building	Oahu	Honolulu
Jones, Austin, Residence	Building	Oahu	Honolulu
Kaimuki Fire Station	Building	Oahu	Honolulu
Kakaako Fire Station	Building	Oahu	Honolulu

Property Name	Property Type	Island	City
Kakaako Pumping Station	Building	Oahu	Honolulu
Kalihi Fire Station	Building	Oahu	Honolulu
Kamehameha V Post Office	Building	Oahu	Honolulu
Kapuaiwa Building	Building	Oahu	Honolulu
Katsuki House	Building	Oahu	Honolulu
Kaumakapili Church	Building	Oahu	Honolulu
Kawaiahao Church and Mission Houses	Building	Oahu	Honolulu
Kelly, John and Kate, House	Building	Oahu	Honolulu
Kreye House	Building	Oahu	Honolulu
Kyoto Gardens of Honolulu Memorial Park	Building	Oahu	Honolulu
La Pietra	Building	Oahu	Honolulu
Lanihuli	Building	Oahu	Honolulu
Lihiwai	Building	Oahu	Honolulu
Liljestrand House	Building	Oahu	Honolulu
Linekona School	Building	Oahu	Honolulu
Linn, R. N., House	Building	Oahu	Honolulu
Lishman Building	Building	Oahu	Honolulu
Makiki Fire Station	Building	Oahu	Honolulu
MALIA (Hawaiian canoe)	Structure	Oahu	Honolulu
McKinley High School	Building	Oahu	Honolulu
Mendonca, J. P., House	Building	Oahu	Honolulu
Merchant Street Historic District	District	Oahu	Honolulu
Moana Hotel	Building	Oahu	Honolulu
Mother Waldron Playground	Structure	Oahu	Honolulu
National Memorial Cemetery of the Pacific	District	Oahu	Honolulu
Nuuanu Petroglyph Complex	District	Oahu	Honolulu
Oakley, George D., House	Building	Oahu	Honolulu
Ohrt, Frederick, House	Building	Oahu	Honolulu
Our Lady of Peace Cathedral	Building	Oahu	Honolulu
Palama Fire Station	Building	Oahu	Honolulu
Palm Circle Historic District	District	Oahu	Honolulu
Podmore, Joseph W., Building	Building	Oahu	Honolulu
Punahou School Campus	District	Oahu	Honolulu
Queen Emma's Summer Home	Building	Oahu	Honolulu
Royal Brewery	Building	Oahu	Honolulu
Royal Mausoleum	Building	Oahu	Honolulu
Sacred Heart Church	Building	Oahu	Honolulu
Salvation Army Waioli Tea Room	Building	Oahu	Honolulu
Shadinger, J. Alvin, House	Building	Oahu	Honolulu
Simpson, Charles A., House	Building	Oahu	Honolulu
Sinclair, Dr. Archibald Neil, House	Building	Oahu	Honolulu
Smyth, Mabel, Memorial Building	Building	Oahu	Honolulu
St. Andrew's Cathedral	Building	Oahu	Honolulu
Tantalus-Round Top Road	District	Oahu	Honolulu
Tavares, Frank, House	Building	Oahu	Honolulu
Thomas Square	Site	Oahu	Honolulu
Toyo Theatre	Building	Oahu	Honolulu

Property Name	Property Type	Island	City
U.S. Coast Guard Diamond Head Lighthouse	Structure	Oahu	Honolulu
U.S. Immigration Office	Building	Oahu	Honolulu
U.S. Post Office, Customhouse, and Courthouse	Building	Oahu	Honolulu
Uluhaimalama	Site	Oahu	Honolulu
USS ARIZONA Wreck	Structure	Oahu	Honolulu
USS BOWFIN	Structure	Oahu	Honolulu
USS UTAH Wreck	Structure	Oahu	Honolulu
Van Tassel, Ernest Shelton, House	Building	Oahu	Honolulu
Walker, H. Alexander, Residence	Building	Oahu	Honolulu
War Memorial Natatorium	Structure	Oahu	Honolulu
Washington Place	Building	Oahu	Honolulu
Withington House	Building	Oahu	Honolulu
Young, Alexander, Building	Building	Oahu	Honolulu
Small Heiau	Structure	Oahu	Kaaawa
Kahaluu Fish Pond	Site	Oahu	Kahaluu
Kahaluu Taro Lo'i	District	Oahu	Kahaluu
Burial Platform	Structure	Oahu	Kahuku
Kahuku Habitation Area	Site	Oahu	Kahuku
Marconi Wireless Telegraphy Station	Site	Oahu	Kahuku
Boettcher Estate	Building	Oahu	Kailua
Kaneohe Naval Air Station	District	Oahu	Kailua
Kaneohe Ranch Building	Building	Oahu	Kailua
Kukuipilau Heiau	Site	Oahu	Kailua
Pahukini Heiau	Structure	Oahu	Kailua
Ulu Po Heiau	Structure	Oahu	Kailua
Pohaku ka luahine	Object	Oahu	Kaneohe
Heeia Fishpond	Site	Oahu	Kaneohe
Huilua Fishpond	Structure	Oahu	Kaneohe
Kawaewae Heiau	Structure	Oahu	Kaneohe
Kualoa Ahupua'a Historical District	District	Oahu	Kaneohe
Leleahina Heiau	Structure	Oahu	Kaneohe
Mokapu Burial Area	District	Oahu	Kaneohe
Molii Fishpond	Site	Oahu	Kaneohe
Kapapa Island Complex	District	Oahu	Kapapa Island
Necker Island Archeological District	District	Oahu	Kauai
Nihoa Island Archeological District	District	Oahu	Kauai
Opana Radar Site	Site	Oahu	Kawela
Kunia Camp	Building	Oahu	Kunia Camp
Waialua Agricultural Company Engine No. 6	Structure	Oahu	Lualualei
Ukanipo Heiau	Site	Oahu	Makaha
Oahu Railway and Land Company Right-of-Way	Structure	Oahu	Nanakuli
Kaniakapupu	Site	Oahu	Nu'uanu
Pearl Harbor, U.S. Naval Base	District	Oahu	Pearl City
U.S.S. ARIZONA Memorial	Site	Oahu	Pearl City

Property Name	Property Type	Island	City
CINCPAC Headquarters	Building	Oahu	Pearl Harbor
Okiokilepe Pond	Site	Oahu	Pearl Harbor
Wheeler Field	District	Oahu	Schofield Barracks
Fire Stations of Oahu	Building	Oahu	Various
Kukaniloko Birth Site	Site	Oahu	Wahiawa
Schofield Barracks Historic District	District	Oahu	Wahiawa
Schofield Barracks Stockade	Building	Oahu	Wahiawa
Waianae District	District	Oahu	Waianae
Kea'au Talus Sites Archeological District	Site	Oahu	Waianae
Waikane Taro Flats	District	Oahu	Waikane
Bellows Field Archeological Area	District	Oahu	Waimanalo
U.S. Coast Guard Makapuu Point Light	Structure	Oahu	Waimanalo
Dole, James D., Homestead	Building	Oahu	Waipahu
Honouliuli Internment Camp	Site	Oahu	Waipahu
Marigold Building	Building	Oahu	Waipahu
Tsoong Nyee Society Cook House	Building	Oahu	Waipahu
Wakamiya Inari Shrine	Building	Oahu	Waipahu

Source: Stutts 2014



Sources: Stutts 2014

Notes: Spatial data for cultural resources only listed on the HRHP were not available and are not presented here. Some of the cultural resources listed in Table 4.1.11-1 have sensitive locations (e.g., archaeological sites) and are not shown here.

Figure 4.1.11-1: Cultural Resources Listed on the NRHP

In addition to those listed on the HRHP and NRHP, other known and unknown cultural resources exist across Hawaii that have yet to be identified or evaluated for their significance. A cultural resources survey would need to be conducted to identify specific cultural resources of an individual project; however, through previous surveys and a general understanding of the cultural context, archaeological sites and historic resources are more typically found in certain locations given their size, type, and function.

Archaeological site potential is largely based on an area's habitation suitability, proximity to natural resources, and/or locational prominence/importance. For instance, habitation sites, both prehistoric and historic, are typically found in naturally protected, upland landforms close to a significant and consistent fresh water source and within proximity to food resources. However, habitation sites can vary based on seasonal considerations or be temporal based on their use as specific resource extraction locations, recognizing that environmental conditions may have changed over time. Proximity to resources can vary according to a combination of environmental conditions such as the size and nature of the water source (perennial versus intermittent) and/or extent and location of food sources. Topographic prominence is also often indicative of archaeological potential. Topographically prominent locations were likely desirable locations as they provided vantage points for observation, which would be useful for tracking wildlife or recognizing potential threats to the habitation site. The presence of an extractive resource can also raise the potential for archaeological sites in a given location. Large outcrops of preferred stone resources, for example, are often the location of quarry sites; in another example, wood or other structural building resources would be expected in heavily forested areas. Likewise, topographic prominence could be an important component of ceremonial or spiritual sites or cultural landscapes.

In Hawaii, archaeological sites dating to the Early Pre-Contact Period are generally small and located along flat, elevated coastal areas (generally on low terraces above beaches), although later period sites have been identified in mountain environments as well. These locations seem to have been favored by the early inhabitants due to the great quantity of shellfish and reef fish (*Tuggle 1979; Kirch 1985, 1992; Cordy 2000*). However, intensive population growth in later periods pushed settlements into areas outside coastal environments and into inland and upland areas (*Dye and Komori 1992; Dye 1994*). Increasing populations and social complexity led to the advent of large temple construction, development of royal centers, and agricultural expansion and intensification, which pushed populations inland to expand throughout the islands and into areas not utilized as intensively in earlier period (*Kolb 1991; Dye 1994; Cordy 1995, 1996a, 1996b, 2000*). As a result, archaeological sites could be found in coastal or inland environments, in relatively flat areas or more remote locations such as those that could be used for ceremonial purposes.

Military sites and remnants and 19th century and later structures and archaeological sites are scattered across the island. Whereas military sites demonstrate the historical military presence and use of the islands, historic Hawaiian sites and structures represent the westernization of the islands and focus on developing economies, such as ranching or commercial agriculture. Similar to later period Pre-Contact sites, they are located throughout the islands, whether it be in urbanized settings or in rural areas (*Kirch 1998*).

Traditional Cultural Properties and Cultural Resources of Traditional Religious or Cultural Importance

Traditional cultural properties and other cultural resources of traditional religious or cultural importance can include a wide range of tangible and intangible resources (e.g., archaeological sites and funerary objects, ceremonial places, traditional wildlife and plant gathering areas, and cultural landscapes). Section 106 consultation would provide the means of identifying the affected environment of these types of resources for an individual project (*NPS 1998*).

It is often difficult, if not impossible, to place strict boundaries on locations of traditional significance. Another complicating factor is that even when boundaries might be defined, members of cultural groups may not be willing to disclose such information to those outside of their communities for a number of reasons. Therefore, cultural sensitivity is needed to ensure protection of these important places (ACHP 2008). Types of traditional resources may include, but are not limited to, archaeological sites, burial sites, ceremonial sites, traditional hunting, fish ponds, plant gathering areas, trails, certain prominent geological features that may have spiritual significance (i.e., cultural landscapes), and viewsheds to and/or from sacred locations (*NPS 1998*).

Whereas traditional cultural properties are historic properties (they are eligible for listing in the NRHP), other cultural resources of traditional religious or cultural importance need to be considered as they are important to a community's practices and beliefs and are necessary for maintaining the community's cultural identity. FirstNet plans to work with the SHPD and Native Hawaiian organizations as part of the NHPA and NEPA processes, and these consultations will inform the development of the cultural resources sections of the Final PEIS. Although specific locations of traditional cultural properties and other cultural resources of traditional religious or cultural importance in Hawaii are not currently known, FirstNet will maintain open, collaborative relationships with Native Hawaiian organizations throughout the NHPA consultation and NEPA public comment processes for all cultural groups.

4.1.11.4. Consultation

As discussed above, FirstNet has begun consultation with Native Hawaiian organizations as part of the NHPA and NEPA processes. FirstNet has engaged 15 Native Hawaiian organizations or organizations representing Native Hawaiian interests. These include:

- Hui Malama I Na Kupuna ‘O Hawai’i Nei
- Association of Hawaiian Civic Clubs
- Maui/Lana’i Islands Burial Council
- Molokai Island Burial Council
- Bernice Pauahi Bishop Museum

- Office of Hawaiian Affairs
- Aha Moku Advisory Committee
- Department of Land and Natural Resources, State Historic Preservation Division
- Historic Hawaii Foundation
- Kaua'i/Ni'ihau Islands Burial Council
- Hawaiian Homes Commission
- Molokai Museum and Cultural Center
- Hawai'i Island Burial Council
- Department of Land and Natural Resources, State Historic Preservation Division – History and Culture Branch
- Oahu Island Burial Council

FirstNet has yet to receive responses from any of the Native Hawaiian organizations regarding their initial invitation to consult under NHPA. Throughout the Environmental Impact Statement process, FirstNet will continue to maintain open and collaborative dialogue in order to inform the NHPA and NEPA processes.

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4.1.12. Air Quality

4.1.12.1. Introduction

This section discusses the existing air quality conditions in Hawaii. Information is presented regarding air quality characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action. Air quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography[1] of the area, and the prevailing weather and climate conditions. The levels of pollutants and pollutant concentrations in the atmosphere are typically expressed in units of parts per million (ppm)[2] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time. The U.S. Environmental Protection Agency (USEPA) designates areas within the United States as attainment,[3] nonattainment,[4] maintenance,[5] or unclassifiable[6] depending on the concentration of air pollution relative to ambient air quality standards.

4.1.12.2. Specific Regulatory Considerations

Air quality and emissions of atmospheric pollutants are regulated under the Clean Air Act (CAA). The CAA establishes limits on how much air pollution can exist in an area at any given time, based on local climatological factors. These limits are known as the National Ambient Air Quality standards (NAAQS). The USEPA has established NAAQS for six common pollutants, known as criteria pollutants. These include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter (PM), and sulfur dioxide (SO_2) (*USEPA 2013b*). Local air quality protection and permitting in Hawaii is jointly the responsibility of the Hawaii Department of Health, Clean Air Branch (DOH-CAB) and USEPA Region 9 (*USEPA 2014c* and *USEPA 2014b*). Hawaii enforces the federal NAAQS as well as several State Ambient Air Quality Standards (SAAQS). For each pollutant, the most stringent standard in Hawaii must be adhered to (throughout this section, the term AAQS [ambient air quality standards] is used to refer to the most stringent standard, inclusive of NAAQS and SAAQS). Table 4.1.12-1 below summarizes the NAAQS and SAAQS in Hawaii.

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[1] The unique features and shapes of the land (e.g., valleys and mountains).
[2] Equivalent to 1 milligram per liter.
[3] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (*USEPA 2015d*)
[4] Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant (*USEPA 2015d*).
[5] Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment (*40 Code of Federal Regulations 93.152*)
[6] Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant (*USEPA 2015d*)

Table 4.1.12-1: Ambient Air Quality Standards in Hawaii

Pollutant	Averaging Period	NAAQS (Primary Standard)[a]	NAAQS (Secondary Standard)[b]	SAAQS
Carbon monoxide	8-hour	9 ppm (10 mg/m^3)	None	4.4 ppm
	1-hour	35 ppm (40 mg/m^3)	None	9 ppm
Lead	3-month average	0.15 μg/m^3 (rolling 3-month)	Same as primary	1.5 μg/m^3 (calendar quarter)
Nitrogen dioxide	Annual	0.053 ppm (100 μg/m^3)	Same as primary	0.04 ppm
	1-hour	0.1 ppm (188 μg/m^3)	None	None
Ozone	8-hour	0.075 ppm	Same as primary	0.08 ppm
Particulate matter: PM_{10}	Annual	None (revoked)	None (revoked)	50 μg/m^3
	24-hour	150 μg/m^3	Same as primary	Same as NAAQS
Particulate matter: $PM_{2.5}$	Annual	12 μg/m^3	15 μg/m^3	None
	24-hour	35 μg/m^3	Same as primary	None
Sulfur dioxide	Annual	None (revoked)[c]	None	0.03 ppm
	24-hour	None (revoked)[c]	None	0.14 ppm
	3-hour	None	0.5 ppm (1,300 μg/m^3)	Same as NAAQS
	1-hour	0.075 ppm (196 μg/m^3)	None	None
Hydrogen sulfide	1-hour	None		0.025 ppm

Source: USEPA 2014a and Hawaii DOH-CAB 2013

μg/m^3= microgram(s) per cubic meter; mg/m^3 = milligram(s) per cubic meter; ppm = parts per million; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; PM_{10} = particulate matter up to 10 micrometers in diameter
[a] Primary standards are set to protect public health.
[b] Secondary standards are set to protect public welfare, including visibility and crops.
[c] Revoked means the previous pollutant standard has been retracted and no longer valid.

States and territories must establish enforceable plans, known as State Implementation Plans (SIPs), to achieve their AAQS. Regions that are not in compliance with AAQS (i.e., exceed the AAQS limits) are known as nonattainment areas. Those that are in compliance are known as attainment areas. Those without sufficient data are designated unclassifiable and generally have the same obligations as attainment areas. Regions that have previously exceeded the AAQS and subsequently improved air quality to become in compliance are re-designated as maintenance areas. Regions can be classified as in attainment for some criteria pollutants and nonattainment for others. SIPs must describe how the state or territory will maintain compliance in attainment and maintenance areas and will improve air quality in nonattainment areas (*USEPA 2013b*).

In addition to regulating ambient air quality, the CAA also establishes limits on the level of air pollution that can be emitted from both stationary (e.g., manufacturing facility) and non-stationary (e.g., motor vehicle) emission sources. For stationary sources, states and territories may implement more stringent standards than those set by the USEPA. For mobile sources, states or territories must adopt standards set by either USEPA or California (*USEPA 2013b*).

The key permitting programs for major stationary sources are Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NANSR). The PSD program ensures that clean air (in attainment, maintenance and unclassifiable areas) is not degraded by new or modified major sources. To obtain a PSD permit, proposed sources must:

- Be designed with best available control technology giving consideration to cost and other factors;
- Show that the added emissions will not cause or contribute to an air pollution increase in excess of the allowable increment, any NAAQS, or any other applicable CAA emissions standard; and
- Show that the added emissions will not have an adverse impact on air-quality related values in a Class I area[7] such as a national park or wilderness area (*USEPA 2013b*).

The NANSR program ensures that proposed major stationary sources will not further degrade air quality in locations where AAQS are not being met (i.e., nonattainment areas). To obtain an NANSR permit, proposed sources must:

- Be designed for the lowest achievable emission rate; and
- Obtain emission offsets (certified reductions in air pollution from existing facilities in the region) to provide a net air quality benefit (*USEPA 2013b*).

Stationary sources may also be subject to federal air quality regulations under the New Source Performance Standards or National Emission Standards for Hazardous Air Pollutants.

Air pollution from mobile sources is managed primarily through vehicle and fuel standards. Vehicle standards set limits for fuel efficiency and are the basis for state vehicle emissions inspection programs. Fuel standards regulate the amount of sulfur in gasoline and diesel fuels.

Other regulatory programs that may potentially be involved with deployment and operation of the Proposed Action include visibility protection and conformity. Haze[8] is one of the most basic forms of air pollution and it degrades visibility in many U.S. cities and scenic area (*USEPA 2015c*). National parks and scenic areas are protected from air pollution associated with both new and existing sources of air emissions due to visibility concerns from haze. Protection from new sources of air pollution occurs through the PSD program discussed above. Protection from existing sources occurs through the USEPA's 1999 Regional Haze Rule, which set goals of preventing future and remedying existing impairment in Class I Areas. States are required to adopt progress goals every 10 years, with the ultimate goal of achieving natural background conditions, or conditions which existed before manmade pollution, by 2064 (*USEPA 2010*).

[7] Class I areas are national parks and wilderness areas in attainment or unclassifiable areas that exceed 5,000 acres in size and were in existence on August 7, 1977.

[8] Haze is caused when sunlight encounters tiny pollution particles in the air. Some light is absorbed by particles; other light is scattered away before it reaches an observer. More pollutants mean more absorption and scattering of light, which reduce the clarity and color of what we see. Some types of particles such as sulfates, scatter more light, particularly during humid conditions.

Federal departments and agencies are prohibited from taking actions in nonattainment and maintenance areas without first demonstrating that the actions would conform to the state or territory's SIP. The CAA conformity requirements ensure that federal activities will not: 1) cause or contribute to new air quality violations; 2) worsen existing violations; or 3) delay attainment of AAQS. The transportation conformity requirements apply to projects funded by or requiring approval from the Federal Highway Administration or those related to a project funded under the Federal Transit Act, and thus would not apply to the Proposed Action. The general conformity requirements apply to other federal actions and may apply to the Proposed Action (*USEPA 2013b*).

4.1.12.3. Ambient Air Quality

One of the key indicators of current ambient air quality in a state or territory is the compliance status of each region compared to the AAQS (refer to Table 4.1.12-1 above). Compliance is typically evaluated by county or, in some cases, large cities. Based on the limited geographic size of Hawaii, the entire state is evaluated as a single air quality control region (AQCR): Hawaii AQCR 60 (*40 Code of Federal Regulations [CFR] Part 81, Appendix A*). Hawaii is not designated as nonattainment or maintenance status for any of the AAQS (*USEPA 2015a, USEPA 2015b*). However, the primary pollutants of concern are PM and SO_2, because they contribute to haze, among other environmental impacts (see discussion of Class I Areas below) (*Hawaii DOH-CAB 2015*).

Hawaii's DOH-CAB issues permits for proposed new or modified major stationary sources. The NANSR program is not currently applicable in Hawaii because the state is not designated as nonattainment for any of the AAQS. Therefore, all proposed major sources would be addressed under the PSD program (*40 CFR Part 52.21)*. Hawaii does not have a SIP-approved PSD program, so DOH-CAB issues permits in accordance with the federal PSD program. The DOH-CAB also implements minor source construction and operating permit programs (*USEPA 2014c* and *USEPA 2014b*). The type of permit required in Hawaii is primarily based on: 1) the type of proposed stationary source; and 2) the potential amount of air pollutants that could be emitted per year from the proposed source. PSD review is triggered for new sources if facility-wide potential emissions of any criteria pollutant exceed 250 tons per year. For modified stationary sources, the PSD thresholds vary by pollutant (*40 CFR 51.166* and *Hawaii Administrative Rules 11-60.1-132*). Minor source permitting thresholds also vary by pollutant.

As mentioned above, the entirety of Hawaii is evaluated as one AQCR. In implementing the federal PSD program, Hawaii DOH-CAB ensures that air quality throughout the state is not degraded by proposed major sources, specifically ensuring that a proposed major source would not cause ambient air concentrations to increase by more than allowable thresholds listed in Table 4.1.12-2.

Table 4.1.12-2: PSD Allowable Increase Increments

Pollutant	Averaging Period	PSD Increment (µg/m³)	
		Class I Area[a]	Class II Area[b]
Nitrogen dioxide	Annual	2.5	25
Particulate matter: PM_{10}	Annual	4	17
	24-hour	8	30
Particulate matter: $PM_{2.5}$	Annual	1	4
	24-hour	2	9
Sulfur dioxide	Annual	2	20
	24-hour	5	91
	3-hour	25	512

Source: 40 CFR 51.166(c)

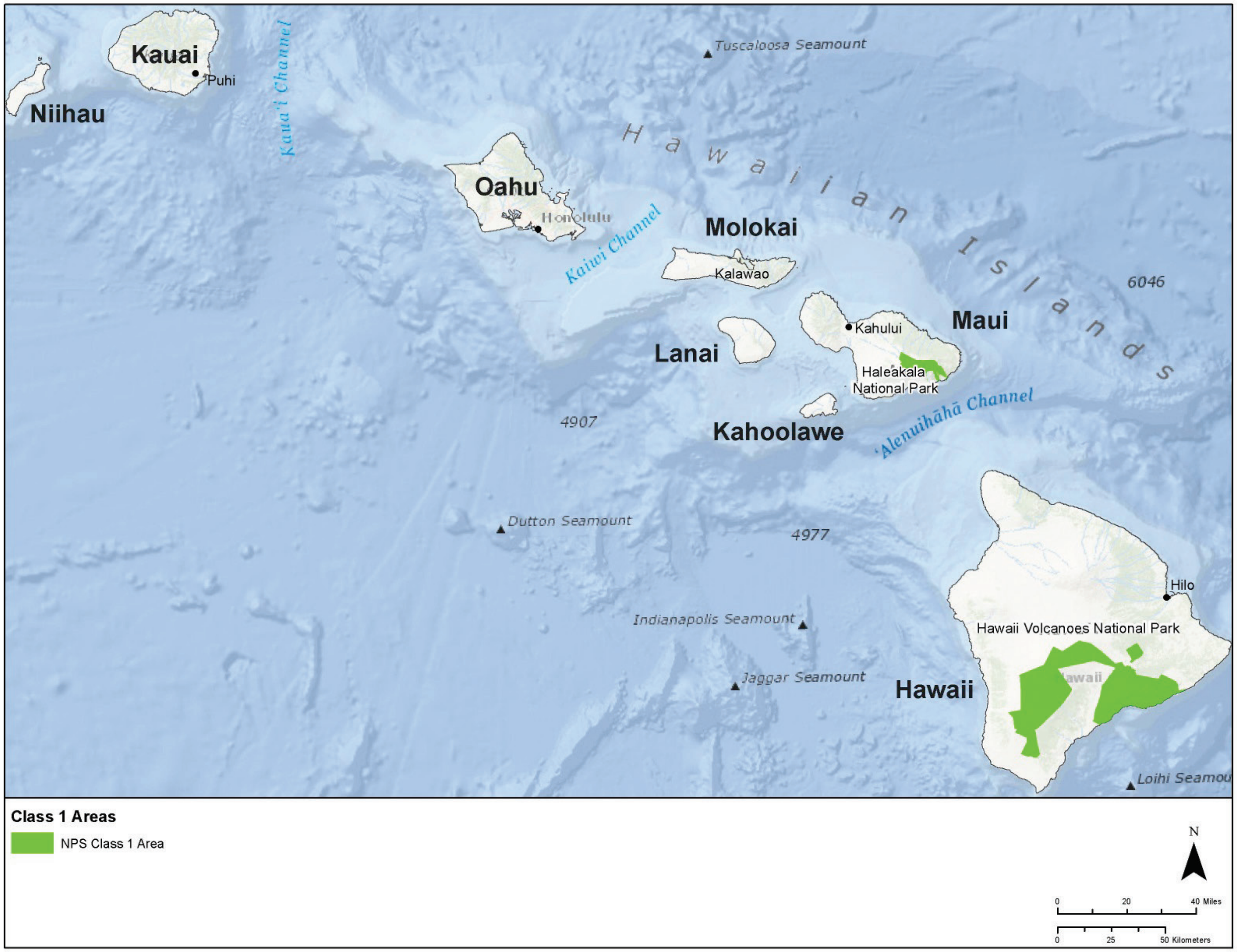
$\mu g/m^3$ = micrograms per cubic meter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; PM_{10} = particulate matter up to 10 micrometers in diameter
[a] Class I areas are national parks and wilderness areas in attainment or unclassifiable areas that exceed 5000 acres in size and were in existence on August 7, 1977
[b] Class II areas are all other attainment or unclassifiable areas outside Class I areas

Note that thresholds are lower for Class I Areas, which receive greater protection. Also note that a stationary source could impact a Class I Area that is nearby; in other words, proposed sources must consider how much their emissions will travel and impact any nearby Class I Areas. Hawaii's Class I Areas are shown below in Table 4.1.12-3 and Figure 4.1.12-1.

Table 4.1.12-3: Hawaii Class I Areas

Class I Area	Size (acres)	Federal Land Manager
Haleakala National Park	27,208	National Park Service
Hawaii Volcanoes National Park	217,029	National Park Service

Source: USEPA 2012b



Source: NPS 2007

Figure 4.1.12-1: Hawaii Class I Areas

Class I Areas are also protected through visibility protection programs, including the USEPA's 1999 Regional Haze Rule, which is discussed in Section 4.1.12.2, Specific Regulatory Considerations. Visibility is measured as the farthest distance a person can see in a given landscape. Air quality in Haleakala National Park is generally excellent, with few man-made sources of air pollution nearby. Hawaii Volcanoes National Park was first established as Hawaii National Park in 1916 to protect the volcanoes, Kilauea and Mauna Loa on Hawaii, and Haleakala on Maui.

By far, the largest source of air pollution for both of Hawaii's Class I Areas is Kilauea Volcano on the island of Hawaii. Currently the volcano emits between 1,000 and 2,000 tons of SO_2 each day. SO_2 reacts with sunlight, oxygen, dust particles, and water in the air to form a mixture known as volcanic smog or vog. Southeasterly kona winds[9] transport vog to Haleakala National Park. Locally, anthropogenic sources also affect visibility in both Class I Areas. To combat anthropogenic sources of visibility impairment, the USEPA has set SO_2 emission limits for three power plants on the island of Hawaii: Kanoelehua Hill, Shipman, and Puna. Future new or modified air emission sources will be evaluated through the PSD program (*USEPA 2012c, USEPA 2012d*).

While PSD and visibility programs are critical to air quality in attainment/unclassifiable and Class I Areas, respectively, conformity requirements are a key concern in nonattainment and maintenance areas. However, because the entire state of Hawaii is not currently designated as nonattainment or maintenance for any pollutants, conformity requirements are not currently applicable throughout the state.

In most U.S. states and territories, mobile source air pollution is managed primarily through vehicle maintenance and fuel standards. In Hawaii, vehicles must periodically complete safety inspections, but emissions-related inspections are optional (*DMV.org 2015*). USEPA has established fuel standards requiring all diesel-powered vehicles, including highway/on-road vehicles (e.g., trucks, vans) to use 15 ppm ultra-low sulfur diesel (*USEPA 2012a*). Other off-road engines, including those used in certain aircraft, are also regulated by USEPA in order to protect air quality (*USEPA 2013a*). Information on Hawaii's adherence to these fuel standards was not readily available for this assessment.

[9] Kona winds are stormy, rain-bearing winds that blow over the Hawaiian Islands from the southwest or south-southwest in the opposite direction of trade winds. The western, or leeward sides of the islands, then become windward in this case, as the predominant wind pattern is reversed. Kona winds occur when a low-pressure center is within 500 miles northwest of the islands. Although strong, Kona winds usually do not last for more than a day or so.

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4.1.13. Noise

4.1.13.1. Introduction

This section discusses noise conditions in Hawaii. Information is presented regarding noise characteristics that would be potentially sensitive to impacts from deployment and operation of the Proposed Action.

Noise is a form of sound caused by pressure variations that the human ear can detect and is often defined as unwanted sound (*USEPA 2012*). Noise is one of the most common environmental issues that can interfere with normal human activities and otherwise diminish the quality of the human environment. Typical sources of noise that result in this type of interference in both urban and suburban surroundings include interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

4.1.13.2. Specific Regulatory Considerations

In 1974, the U.S. Environmental Protection Agency determined that an exterior day-night average sound level (L_{dn}) of 55 A-weighted decibels (dBA) would not adversely affect public health and welfare by interfering with speech or other activities (*USEPA 1974*).

Per the Occupational Safety and Health Act of 1970, employees should not be exposed to more than 85 decibels (dB) for an 8-hour day, and if the noise level exceeds the 85 dB threshold, protective measures must be installed to reduce noise exposure (*29 Code of Federal Regulations 1910.95(c)(1)*).

Chapter 46 of Title 11 of the Hawaii Administrative Rules on Community Noise Control provides allowable noise levels per zoning districts (Table 4.1.13-1) (*NPC 2015a*). Honolulu is the only county in Hawaii that has numerical noise limits for land use. Section 21A-3.100-2 of the Revised Ordinance of Hawaii states that:

> "In I-2 intensive industrial and I-3 waterfront industrial districts, sound pressure levels from any use shall not exceed, at any point at or beyond the district boundary, the maximum number of decibels for each of the octave bands as set forth in [Table 4.1.13-2], provided, however, that where the I-2 intensive industrial or I-3 waterfront industrial district adjoins any district which permits residences, apartments or hotels, the maximum sound pressure levels at or beyond the I-2 intensive industrial or I-3 waterfront industrial district boundary shall be reduced seven decibels

> from levels indicated in [Table 4.1.13-2] for the hours between 8 a.m. and 6 p.m., and shall be reduced 10 decibels between 6 p.m. and 8 a.m." (*NPC 2015b*)

Table 4.1.13-1: Maximum Permissible Sound Levels (dBA) in Hawaii

Zone Districts	Time	Sound Level Limit (dBA)
Class A	7:00 a.m. – 10:00 p.m.	55
	10:00 p.m. – 7:00 a.m.	45
Class B	7:00 a.m. – 10:00 p.m.	60
	10:00 p.m. – 7:00 a.m.	50
Class C	7:00 a.m. – 10:00 p.m.	70
	10:00 p.m. – 7:00 a.m.	70

Source: NPC 2015a

Notes:
Class A zoning districts include all areas equivalent to lands zoned residential, conservation, preservation, public space, open space, or similar type.
Class B zoning districts include all areas equivalent to lands zoned for multi-family dwellings, apartment, business, commercial, hotel, resort, or similar type.
Class C zoning districts include all areas equivalent to lands zoned agriculture, country, industrial, or similar type.

Table 4.1.13-2: Maximum Permissible Sound Levels per Octave Band Center Frequency for Intensive Industrial and Waterfront Districts in Honolulu

Octave Band Center Frequency (Hertz)	Sound Pressure Level (Decibels)
31.5	79
63	79
125	74
250	66
500	59
1,000	53
2,000	47
4,000	41
8,000	39

4.1.13.3. Environmental Setting

Noise is generally defined as unwanted sound. Sound can be perceived as pleasant or annoying, and as loudness/intensity, in terms of dB. Sound measurement is refined by using a dBA scale that emphasizes the range between 1,000 and 8,000 cycles per second, which are the sound frequencies most audible to the human ear. The perceived increase in loudness of a sound does not correspond directly to numerical increase in dBA values. Typically, an increase of less than 3 dBA is barely noticeable, an increase of 5 dBA is noticeable, an increase of 10 dBA is perceived as a doubling in apparent loudness, and an increase of 20 dBA is perceived as a four-fold increase in apparent loudness. Table 4.1.13-3 shows typical noise levels generated by common indoor and outdoor activities, and provides possible human effects.

Table 4.1.13-3: Typical Noise Levels and Possible Human Effects

Common Noises[a]	Noise Level (dBA)	Effect
Rocket launching pad (no ear protection)	180	Irreversible hearing loss
Carrier deck jet operation	140	Painfully loud
Air raid siren		
Thunderclap	130	Painfully loud
Jet takeoff (200 feet)	120	Maximum vocal effort
Auto horn (3 feet)		
Pile driver	110	Extremely loud
Loud concert		
Garbage truck	100	Very loud
Firecrackers		
Heavy truck (50 feet)	90	Very Annoying
City traffic		Hearing damage (8 hours of exposure)
Alarm clock (2 feet)	80	Annoying
Hair dryer		
Noisy restaurant	70	Telephone use difficult
Freeway traffic		
Business office		
Air conditioning unit	60	Intrusive
Conversational speech		
Light auto traffic (100 feet)	50	Quiet
Living room	40	Quiet
Bedroom		
Quiet office		
Library/soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	Very quiet
Pin dropping	10	Just audible
Threshold of hearing	0	Hearing begins

Source: WSDOT 2015

dBA = A-weighted decibel
[a] No common 10 dBA source(s) was available, but expected noise effects for this decibel value were included.

In Hawaii, just like in any state or territory, noise can be generated from a variety of sources such as industries, railway and roadway vehicle traffic, aircraft, hunting, construction activities, and public gatherings, to name just a few.

In the absence of measured data, typical outdoor sound level by land use category is presented in Table 4.1.13-4. In Hawaii, forest and scrub/shrub account for more than half of land cover, and developed land covers less than 10 percent of the state (see Section 4.1.7.3, Land Use and Ownership). Ambient day-night noise levels in major cities such as Honolulu, Hilo, Kailua, Kaneohe, and Waipahu as well as areas with dense traffic or some commerce or industry are expected to range from 55 to 65 dBA. Ambient day-night noise levels in rural and suburban Hawaii towns (e.g., Pahoa) with infrequent traffic are expected to range from 40 to 45 dBA.

Units of the National Park System (National Parks, Wilderness Areas, National Historic Sites, etc.) comprise approximately 28 percent of recreation land in Hawaii (see Section 4.1.7.5, Recreation). Ambient day-night noise levels in the most sensitive areas in Hawaii, such as the Kalaupapa National Historic Park, are expected to be 35 dBA or less.

Table 4.1.13-4: Typical Outdoor Sound Levels by Land Use Category

Land Use Category	L_d (dBA)[a]	L_n (dBA)[b]	L_{dn} (dBA)[c]
Wilderness areas	35	25	35
Rural and outer suburban areas with negligible traffic	40	30	40
General suburban areas with infrequent traffic	45	35	45
General suburban areas with medium density traffic or suburban areas with some commerce or industry	50	40	50
Urban areas with dense traffic or some commerce or industry	55	45	55
City or commercial areas or residences bordering industrial areas or very dense traffic	60	50	60
Predominantly industrial areas or extremely dense traffic	65	55	65

Source: Cavanaugh and Tocci 1998; Bies and Hansen 2009

dBA = A-weighted decibel
[a] L_d, or daytime L_{eq}, is the average equivalent sound level for daytime (7 a.m. to 10 p.m.).
[b] L_n, or nighttime L_{eq}, is the average equivalent sound level for nighttime (10 p.m. to 7 a.m.).
[c] L_{dn}, or day-night average sound level, is the average equivalent A-weighted sound level during a 24-hour time period with a 10-dB weighting applied to equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m.

$$L_{dn} = 10log_{10}(\frac{15}{24}10^{L_d/10} + \frac{9}{24}10^{(L_n+10)/10})$$

4.1.14. Climate Change

4.1.14.1. Introduction

This section discusses the setting and context of global climate change effects in Hawaii. Information is presented regarding the historical and existing climate parameters including temperature, precipitation, and severe weather.

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (*IPCC 2007*)

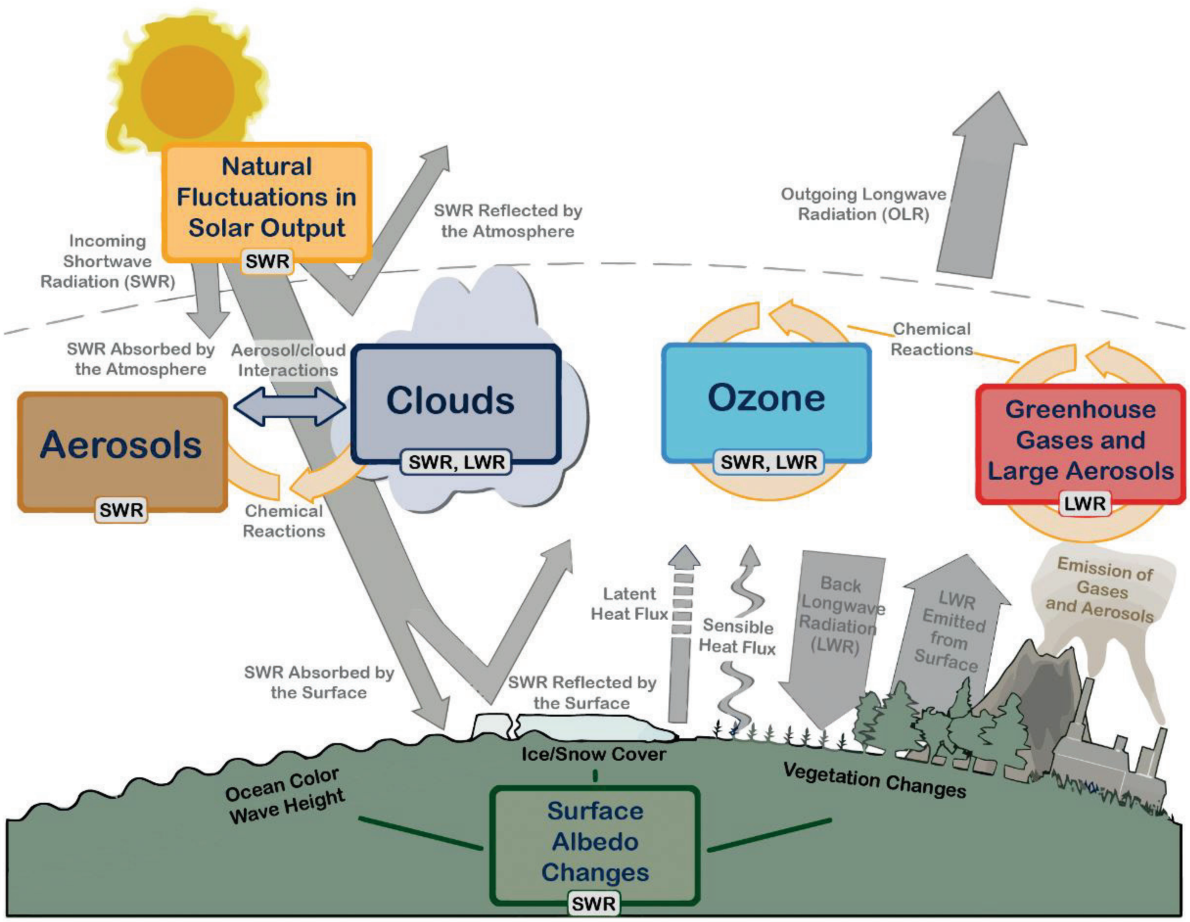
Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (*USEPA 2012*). The IPCC is now 95 percent certain that humans are the main cause of current global warming (*IPCC 2013a*). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (*IPCC 2007*). The common unit of measurement for GHGs is metric tons of CO_2-equivalent, which equalizes for the different global warming potential of each type of GHG.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" and that "atmospheric concentrations of CO_2 increased from 80 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005." (*IPCC 2007*) The atmospheric concentration of CH_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion to 1774 and 319 parts per billion, respectively, in 2005 (*IPCC 2007*). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (*IPCC 2007*).

Both the GHG emissions effects of the Proposed Action and Alternatives, as well as the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this Draft Programmatic Environmental Impact Statement (see Section 4.2, Environmental Consequences). Existing climate conditions in the Proposed Action area are described first by state/territory and sub-region, where appropriate, and then by future projected climate scenarios.

4.1.14.2. Context

Output from the sun powers the Earth's climate through solar radiation. The sun's energy in the form of light (including visible light or sunlight), which is electromagnetic radiation, and heat is reflected, transmitted or absorbed into the Earth's atmosphere. For the Earth's temperature and longer term climate to remain relatively constant, the incoming radiation from the sun must balance with outgoing radiation into space. Most of the outgoing radiation leaving the Earth's surface is longwave radiation, which is also referred to as infrared radiation (*IPCC 2013a*). Some of the infrared radiation that is emitted from the Earth's surface is absorbed by certain gases in the atmosphere, which also emit longwave radiation into all directions. The radiation downward back into the surface adds and traps heat into the earth's surface, creating the greenhouse gas effect. This effect is illustrated in Figure 4.1.14-1 below.



Source: IPCC 2013a

Figure 4.1.14-1: The Greenhouse Gas Effect

Gases including CO_2, CH_4, N_2O, water vapor, and ozone naturally occur in the atmosphere in addition to manufactured pollutants such as hydrofluorocarbons and chlorofluorocarbons. These gases have the ability to emit radiation and can trap outbound radiation within the Earth's atmosphere (*IPCC 2013a*). These gases are collectively called GHGs due to their ability to contribute to the greenhouse gas effect (*IPCC 2013a*). Some GHGs, such as CO_2, CH_4, N_2O, and water vapor, have been continuously released throughout Earth's geologic history through natural processes. Natural sinks[1] that absorb CO_2, such as vegetation and forests, counterbalance this cycle.

Since the industrial revolution, increasing GHG emissions from human activities (referred to as anthropogenic emissions and contrasting with emissions arising from natural processes) have increased the levels of GHGs in the atmosphere. Anthropogenic emissions enhance the greenhouse gas effect and result in a greater amount of heat that is trapped in the atmosphere (*IPCC 2013a*). Human activities that emit GHGs include the combustion of fossil fuel, industrial processes, land use changes, deforestation, and agricultural production.

The Fifth Assessment Report by the IPCC concludes that total radiative forcing, which is the difference between the visible light absorbed by Earth and the energy reflected, is positive. This leads to an increase in energy in the climate system (*IPCC 2013b*). The largest contributor to radiative forcing is caused by the increase of CO_2 in the atmosphere since 1750 (*IPCC 2013b*). Furthermore, according to climate models, continued GHG emission will cause further warming and changes in the climate system (*IPCC 2013b*).

4.1.14.3. Specific Regulatory Considerations

In 2007, the United States (U.S.) Supreme Court in *Massachusetts v EPA, 549 U.S. 497 (2007)* ruled that GHGs are air pollutants and can be regulated under the Clean Air Act. Since this ruling, there have been state and federal programs and initiatives that have been proposed and implemented that address GHG emissions in the U.S. The programs that are relevant to the Proposed Action are described below.

Revised Draft CEQ Guidance

The Council on Environmental Quality (CEQ) published revised draft guidance for GHG emissions and climate change impacts in December 2014. This guidance is applicable to all federal agency actions and is meant to facilitate compliance within legal requirements of the National Environmental Policy Act. The CEQ guidance describes how federal agency actions should evaluate GHG and climate change effects in their National Environmental Policy Act reviews. CEQ defines GHGs to include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with section 19(i) of Executive Order 13514. The CEQ guidance proposes that agencies should consider that a proposed action and its reasonable alternatives contribute, specifically, "(1) the potential effects of a proposed action on climate change as indicated by its GHG emissions; and (2) the implications of climate change for

[1] Carbon sinks occur when natural processes absorb more CO_2 than they release. Examples of natural processes that serve as carbon sinks include forests, soils, oceans, and vegetation.

the environmental effects of a proposed action." For GHG emissions, the guidance provides a reference point of 25,000 metric tons (tonnes) per year or more where a quantitative analysis would be warranted. CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action's potential climate change impacts. The analysis should assess direct and indirect climate change effects of the proposed action including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future.

State Regulations

The Global Warming Solutions Act of 2007 established Hawaii's policy and framework on GHG emissions. It established statewide GHG emissions limits to equal or below 1990 levels by 2020. The ruling also established a task force to prepare a work plan and regulatory scheme to meet the statewide goals. In 2009, the task force finalized work plans in accordance with Act 234. The first of these was the Hawaii Clean Energy initiative, which aims to promote efficiency and renewable energy development so that Hawaii can meet 100 percent of its energy needs by 2045. In May 2015, Hawaii's state legislature passed a bill that would require the state to have 100 percent electricity generation by renewables by 2045. The taskforce also established a GHG Program administered by the Department of Health. The program utilizes the air permit pollution control program to regulate GHG emissions statewide, focusing on large existing stationary sources. The legislation sets a 16 percent reduction in GHG from 2010 baseline year for large stationary sources with emissions equal to or above 100,000 tons per year (*HDOH 2015*).

4.1.14.4. Historical Climate

Air temperature in Hawaii has increased throughout the state in the last century. The temperature has increased by 0.07 degrees Fahrenheit (°F) per decade from 1919 to 2006; the rate of warming has increased to 0.11°F per decade in the last four decades (*Keener et al. 2013*). The rate of warming has been documented to be greater at higher elevations. However, most of the temperature variation prior to 1975 seems to be tightly coupled to the Pacific Decadal Oscillation (PDO) (*Keener et al. 2013*). PDO is a pattern of Pacific climate variability that varies over a much longer time scale; PDO can remain in the same phase for 20 to 30 years (*NC State Undated_a*). After 1975, the temperature has greatly diverged from the PDO (*Keener et al. 2013*). Variations in extreme events in Hawaii are affected by El Niño/Southern Oscillation (ENSO) (*Keener et al. 2012*). ENSO is a naturally occurring phenomenon that involves fluctuating ocean temperatures in the equatorial Pacific, and influences North America as it is a dominant force causing variations in regional climate patterns (*NC State Undated_b*). ENSO cycles typically only last 6 to 18 months (*NC State: Undated_a*). Regional sea level variation has amplitudes that are in the order of less than a foot per year and on the order of an inch on a decade-to-decade time scale. These variations are generally weak but can have a strong influence on sea level trend estimates on multi-year and decade-to-decade. Additionally, oscillations in regional sea level variations are associated with the ENSO (*Keener et al. 2012*). Historically, energetic[2] ENSO events can cause sea levels to rise 6 to 12 inches above mean conditions (*Keener et al. 2012*). Additionally, the average sea surface temperature in the Pacific has increased as much as 3.6°F since the 1950s (*USGCRP 2014*).

The Third National Climate Assessment, published in 2014, concludes that average precipitation in Hawaii has been on a decreasing trend for nearly a century (*USGCRP 2014*). This decline is consistent with increase in the frequency of occurrence of the trade wind inversion, decline in trade winds and higher rates of warming at high elevations (*Keener et al. 2012*).

Climate change projections in the National Climate Assessment (NCA) use a baseline period of 1971 to 2000 for temperature and precipitation. The historical annual average temperature in Hawaii during this time period is 74.1°F and precipitation is 127.5 inches (*NOAA 2015a).*

4.1.14.5. Existing Climate and Meteorology

Hawaii is comprised of eight large islands and 124 smaller islands with a total landmass of 6,425 square miles (*WorldMark Encyclopedia 2015*) and located between latitude 18 degrees north (°N) and 23°N and longitude 154 degrees west (°W) and 160°W within the Central North Pacific Ocean region (*Keener et al. 2013*).

Hawaii's weather is shaped by the Central North Pacific High and northeast Trade Winds (*NOAA 2012a*), which is a semi-permanent high-pressure area centered between 30°N to 40° N and 140°W to 150°W (off the eastern coast of Japan) (*Keener et al. 2013*). The trade winds occur between April and October with wind speeds of 10 to 20 miles per hour (mph) with accompanying rain showers (*Keener et al. 2013*). Hawaii's annual precipitation varies throughout the state and includes rainfall, fog, hail, and snow (Keener et al. *2013*). Hawaii's precipitation variability is affected by ENSO and PDO (*Keener et al. 2013*). Annual precipitation amounts vary throughout the state from 8 inches near the summit Mauna Kea to over 400 inches on the windward slope of Haleakala, Maui (*Giambelluca et al. 2013*).

General meteorological data for temperature, relative humidity, precipitation, and wind direction were extracted from historic climate information issued by the National Oceanic and Atmospheric Administration (NOAA); National Environmental Satellite, Data and Information Service, and National Climatic Data Center (NCDC) Comparative Climatic Data for the U.S. through 2012; and a NOAA National Environmental Satellite, Data and Information Service Technical Report in 2013.

Due to Hawaii's geographic location there is little seasonal variation, which translates to a minimal seasonal temperature range. August is Hawaii's warmest month with an average temperature of 78°F, while the lowest average temperature of 72°F occurs during the month of February (*Keener et al. 2013*). The air temperatures in Hawaii are tropical and range from 73°F

[2] Energetic refers to strength and amplification in oscillations.

to 81°F and on average the humidity ranges from 65 to 70 percent. Hawaii's dry season occurs from May to October, while the rainy season occurs between November and April (*Keener et al. 2013*). Average wind directions move in a northerly to northeasterly direction. Annual average meteorological data for Hawaii are shown on Table 4.1.14-1.

Table 4.1.14-1: Annual Average Temperature, Humidity, Precipitation, and Wind Speed Data for Hawaii

Parameter	Annual Average
Temperature (°F)	78
Relative Humidity (%)	<50
Precipitation: Rain (in)	47
Precipitation: snow/sleet (in.)	0
Wind speed (mph)	ND
Max (gust) wind speed	ND
Wind direction	NE

Source: NOAA 2012b

°F = degree Fahrenheit, % = percent, in = inches, mph = miles per hour, ND = no data, NE = northeast

There are several extreme weather system types that impact Hawaii. The types of weather systems and the time of year when they typically occur are summarized in Table 4.1.14-2.

Table 4.1.14-2: Hawaii Severe Weather System Characteristics

Parameter	Description	Typical Occurrence
Tropical Cyclones (Hurricanes)/Tropical Storms	Extreme storms generate strong winds, heavy rains, and high seas	June - October
Local "Kona" Storms (sub-tropical cyclones)	Generate widespread heavy rains accompanied by strong winds that last for days	October - May
Frontal Systems	Spotty/locally heavy showers and gusty winds	December - March
Upper Level Lows	Produce unstable conditions with heavy rainfall	December - March; can occur annually
Extra-Tropical Storm Surf	High seas caused by tropical cyclones and local storms	Caused by distant tropical cyclones and local storms
Extreme Tides	Relevant with respect to high seas	Winter and Summer Solstices

Source: NOAA 2012a

Severe weather data recorded over the last 18 years (1996 to 2014) within Hawaii include flooding, thunderstorm, tornado/funnel cloud, hurricane, tropical storm, and high wind (50-plus mph). Occurrence of such events during that time period is listed in Table 4.1.14-3. Thunderstorms and flooding are the most common severe weather phenomena within the territory.

Table 4.1.14-3: Severe Weather Data for Hawaii (1996-2014)

County	Number of Recorded Occurrences					
	Flooding[a]	Thunderstorm[b]	Tornado / Funnel Cloud	Hurricane/ Typhoon	Tropical Storm	High Wind (50+ mph)
Hawaii	156	316	17	0	8	68
Honolulu	153	334	54	0	0	109
Kauai	149	186	12	0	0	166
Maui	118	329	15	0	1	25
Total	**576**	**1,165**	**98**	**0**	**9**	**368**

Source: NOAA 2015b

mph = miles per hour
[a] Includes NCDC Event Type: Coastal Flood, Flash Flood, and Flood
[b] Includes NCDC Event Type: Marine Thunderstorm Wind, Thunderstorm Wind, Lightning, and Heavy Rain

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4.1.15. Human Health and Safety

4.1.15.1. Introduction

This section provides a health profile of the population of Hawaii where potential worker and community health and safety effects related to the deployment and operation of the Proposed Action could occur. The health profile includes a summary of basic population health indicators and a discussion of any key community health and safety issues, with a focus on those health issues that may be potentially sensitive to impacts from the Proposed Action.

This health profile is based a review of various secondary data sources, including the Centers for Disease Control and Prevention and the Hawaii Department of Health.

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the deployment, operation, and maintenance of towers, antennas, cables, utilities, and other equipment and infrastructure at existing and potential FirstNet telecommunication sites. There are two human populations of interest within the existing environment of health and safety, 1) telecommunication occupational workers and 2) the general public near telecommunication sites. Each of these populations could experience different degrees of exposure to hazards as a result of their relative access to FirstNet telecommunication sites and their function throughout the implementation of the FirstNet telecommunication network infrastructure.

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency radiation or vehicular traffic and transportation of hazardous materials and wastes. Radio frequency is evaluated in Section 2.4, Radio Frequency Emissions. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 4.1.1, Infrastructure.

4.1.15.2. Specific Regulatory Considerations

For worker health and safety, the Hawaii Occupational Safety and Health Division (HIOSH) has a state plan (certified April 26, 1978) that applies to all private and public sector places of employment in Hawaii, with the exception of federal government employees, who are covered under the Occupational Safety and Health Administration (OSHA) (*HIOSH 2015*). HIOSH has adopted the majority of United States (U.S.) Occupational Safety and Health Act of 1970 standards, whose purpose is to set and enforce protective standards to assure safe and healthful working conditions for all workers. HIOSH has also adopted two unique standards: Toxic Chemical and Handling Exposure; and Noise Exposure. HIOSH is responsible for the enforcement of HIOSH health and safety standards.

OSHA is the primary regulatory agency in charge of the enforcement of worker safety and health regulations; however, other regulations may play a role in if the project activities would include handling of hazardous waste.

The following four regulatory bodies deal with aspects of worker health in conjunction with OSHA:

- The main objective of the Resource Conservation and Recovery Act of 1976 is to "protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner" (*USEPA 2013a*);
- The Comprehensive Environmental Response, Compensation, and Liability Act or Superfund law was designed to help clean up hazardous waste sites and releases of pollutants or contaminants that may negatively affect public health (*USEPA 2015c*);
- The Toxic Substances Control Act regulates the introduction of new or existing chemicals that present a risk to human health or the environment (*USEPA 2015b*);
- The Emergency Planning and Community Right-to-Know Act of 1986 was designed to assist communities in planning for emergencies related to hazardous waste. The law also requires industry to inform federal, state, and local governments on the storage use and releases of hazardous chemicals (*USEPA 2015a*).

Other regulatory considerations that are applicable to worker and community health and safety are outlined in Section 2.4, Radio Frequency Emissions; Section 4.1.1, Infrastructure; Section 4.1.4, Water Resources; Section 4.1.10, Environmental Justice; Section 4.1.12, Air Quality; and Section 4.1.13, Noise.

4.1.15.3. Health Overview

Several measures of general health status, such as life expectancy (how long an individual from a certain population is expected to live), mortality rates, and disease prevalence are common indicators of the overall health status of a population. Table 4.1.15-1 summarizes some of the key health indicators for Hawaii compared to the averages for the U.S.

Table 4.1.15-1: Key Health Indicators for Hawaii

Health Outcome Indicator (data year)	Hawaii	United States
Age-adjusted death rate, per 100,000 population (2013)	590.8	731.9
Life expectancy at birth (2010)	Male: 78.0 years Female: 84.7 years	Male: 76.2 years Female: 81.0 years
Leading causes of death, % of total deaths (2013)	24.0% heart disease 22.2% - cancer 6.0% - cerebrovascular 4.5% - accidents 4.4% - pneumonia and influenza	23.5% - heart disease 22.5% - cancer 5.7% - chronic lower respiratory diseases 5.0% - accidents 5.0% - cerebrovascular
Infant mortality rate, per 1,000 live births (2013)	6.53	5.96

Source: CDC 2010, 2013b, 2013c; KFF 2010.

Hawaii, on at least some important health measures, compares well to the health status of the overall U.S. For example, Hawaii has a lower age-adjusted all-cause mortality rate and a higher life expectancy. However, the infant mortality rate is higher in Hawaii than in the U.S. overall.

These three measures are often used as indicators of health status in a population. With respect to causes of death, Hawaii is similar to the overall U.S. with heart disease and cancer as the leading causes, making up close to half of all deaths. Also similar to the U.S. in 2013, accidents (or unintentional injury) were the fourth leading cause of death.

4.1.15.4. Summary of Key Health and Safety Conditions for Hawaii

The following summarizes key health and safety conditions in Hawaii, with a focus on those conditions that could potentially be impacted by the activities and infrastructure associated with the Proposed Action, or potentially increase health risk to the Proposed Action workforce.

Accidents and injuries—The Hawaii Department of Health has identified accidents and injuries as a priority public health issue in Hawaii. Accidents are the leading cause of death among young adults and children, and the fourth leading cause of death among state residents of all ages. Motor vehicle-related accidents are the primary cause of unintentional injury-related death; however, there was a decreasing trend in deaths due to traffic accidents between 2007 and 2011. The most common contributing factor to fatal traffic accidents is speeding, noted for 41 percent of the drivers between 2007 and 2011. Substance use is also an important contributing factor, as 40 percent of the drivers involved in fatal car crashes tested positive for alcohol during that same period (*HDOH 2012*).

With regards to non-fatal occupational injuries/illnesses, Hawaii had a slightly higher rate compared to the U.S. in 2013 with 3.8 injuries per 100 full-time workers, compared to 3.5 nationally. There were a total of 11 fatal occupational injuries in Hawaii in 2013 (*BLS 2013*).

Substance abuse—Hawaii's rate of heavy alcohol consumption (defined as drinking five or more drinks on the same occasion on each of 5 or more days in the past 30 days) in persons aged 18 or older was higher than the national rate with 17.9 percent compared to the national mean of 15.1 percent in 2010 (*Xu et al. 2013*). Hawaii's heavy alcohol consumption rate is almost 3 times higher than the U.S. Department of Health and Human Services "Healthy People 2010[1]" objective of 6 percent (adults). Excessive alcohol use is a risk factor for many adverse health outcomes, such as: unintentional injuries (e.g., motor-vehicle accidents), violence, suicide, hypertension, and acute myocardial infarction (*CDC 2014*).

Mental health—With regards to mental wellbeing, mental health was identified as the number one health concern by public health officials in Hawaii; however, the rate of serious mental illness and death due to suicide were similar to or less than the national rates (*Lincoln 2013; SAMHSA 2013*)

Chronic diseases affected by air pollution—Common mobile source air emissions of health concern include nitrogen dioxide and particulate matter up to 2.5 micrometers in diameter ($PM_{2.5}$). Fossil fuel combustion associated with traffic and the use of heavy machinery and generators is the primary source of $PM_{2.5}$ and nitrogen oxides that could be generated by the Proposed Action. Baseline levels of air pollutants in Hawaii are addressed in Section 4.1.12, Air

[1] "Healthy People" is a program of nationwide health-promotion and disease-prevention goals set by the U.S. Department of Health and Human Services.

Quality. The focus of this section is on vulnerable groups that may be particularly sensitive to even short-term increases in $PM_{2.5}$ or nitrogen oxides.

Research to date has not revealed the existence of "No Observed Adverse Effects Level" thresholds for $PM_{2.5}$ or nitrogen oxides below which no health effects would be expected for sensitive populations (*HEI 2010; USEPA 2009, 2013a; Kelly and Fussell 2011; Levy et al. 2002; Nishimura et al. 2013; Patel and Miller 2009; O'Neill et al. 2005, 2007; Sarnat and Holguin 2007*). Sensitive populations for exposure to $PM_{2.5}$ and nitrogen dioxide are:

- Those with chronic respiratory diseases (asthma and chronic obstructive pulmonary disease), particularly children and the elderly;
- Those with acute respiratory infections, particularly children and the elderly;
- Those with chronic heart diseases; and
- Diabetics.

Compared to the U.S., Hawaii has a comparable but slightly higher prevalence of adult asthma, a lower percentage of deaths due to chronic lower respiratory illnesses, and a higher percentage of deaths due to infectious respiratory illnesses. Table 4.1.15-2 provides a summary of the prevalence of air-contaminant sensitive health conditions in Hawaii and the U.S.

Table 4.1.15-2: Health Conditions Affected by Air Pollution

Health Condition (data year)	Hawaii	United States
Adult asthma prevalence[a] (2013)	9.4%	9.0%
Chronic lower respiratory diseases, percentage of all deaths (2013)	2.7%	5.6%
Influenza and pneumonia, percentage of all deaths (2013)	4.4%	2.2%
Heart disease, percentage of all deaths (2013)	24.0%	23.5%
Diabetes prevalence[b] (2013)	8.4%	9.8%

Source: Xu et al. 2013; CDC 2013a ; CDC 2013b

[a] Defined as ever having been told by a doctor that you currently have asthma.
[b] Defined as ever having been told by a doctor that you have diabetes

Smoking is the primary behavioral health risk behavior for chronic illnesses that are affected by air pollution. Compared to the U.S., Hawaii has slightly better health behavior around smoking with 14.5 percent identified as smokers compared to 17.3 percent in the U.S. (*Xu et al. 2013*).

Hazardous waste/contaminated areas—Existing environmental contaminants in soil or water at a development site could potentially result in a worker or community health concern if such contaminants were not managed during development. Health effects from environmental contaminants can range from experiences of physical irritation/nuisance to acute illness to chronic disease outcomes. Existing areas of contamination can come from both existing industrial facilities and legacy contaminated sites.

Hawaii is lightly industrialized, with islands like Oahu that are more industrialized than others. According to the U.S. Environmental Protection Agency's Toxic Release Inventory (TRI), as of

2013 the Hawaii ranks 43 out of 56 states/territories nationwide[2] and has four TRI facilities with a total of 3,023,584 pounds of disposal or other releases (*USEPA 2013b*). The TRI database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). Additionally, according to *USEPA 2015*, Hawaii has three listed active Superfund sites (legacy contamination). These sites are listed in Table 4.1.15-3.

Table 4.1.15-3: Hawaii Active Superfund Sites

Site Name	City and Island	Cleanup Type / Description of
Pearl Harbor Naval Complex	Pearl Harbor, Oahu	NPL • Naval base • Soil, groundwater, and sediment are contaminated with metals, organic compounds as well as petroleum hydrocarbons
Del Monte Corp	Kunia, Oahu	NPL • Pineapple plantation that began in 1940 • Soil and shallow groundwater at the site have been contaminated with the fumigants EDB, DBCP, and DCP; the solvents trichloropropane and benzene; and the pesticide lindane • Deep groundwater is contaminated with EDB, DBCP, and trichloropropane
Naval Computer and Telecommunications Area Master Station Eastern Pacific	Oahu	• Site used for operating and maintaining facilities and equipment for the Navy's Defense Communications System. • Consists of facilities located throughout the Island of Oahu • PCBs have been detected in the soil surrounding electrical transformers at one of the facilities, in close proximity to a residential area.

Source: EPA 2015b

CAA = Clean Air Act; DBCP = 1,2-dibromo-3-chloropropane ; DCP = 1,2-dichloropropane ; EDB = ethylene dibromide; NPL= National Priorities Listing; RCRA = Resource Conservation and Recovery Act

Affected environment discussions for Radio Frequency, traffic, noise/vibration, and public safety services, all of which have the potential to influence community and worker health, are covered in Section 2.4, Radio Frequency Emissions; Section 4.1.1.3, Transportation; Section 4.1.13, Noise; and Section 4.1.1.4, Public Safety Services, respectively, in this Draft Programmatic Environmental Impact Statement.

[2] Ranking 1 represents the highest volume of releases.

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4.2. Environmental Consequences

This section describes the potential direct and indirect environmental impacts that could be caused by the deployment, operation, and maintenance of the Proposed Action and discusses best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts. Cumulative environmental impacts of the Proposed Action and other past, present, and reasonably foreseeable projects are described separately in Chapter 10, Cumulative Effects. In each of the resource area-specific sections that follow, a table is presented outlining each of the potential types of effects that could impact the given resource.

The levels of impacts for each resource area are defined as follows:

- *Potentially significant,* where there is substantial evidence that an effect may be significant;
- *Less than significant with best management practices (BMPs) and mitigation measures incorporated,* where the use of mitigation measures reduce an effect from a *potentially significant* impact to a *less than significant* impact;
- *Less than significant,* where the activity creates impacts but no significant impacts; or
- *No impact,* which applies where a project does not create an impact.

Characteristics of each type of effect, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact for each type of project activity associated with the Proposed Action. Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to the resources are presented as a range of possible impacts. BMPs and mitigation measures are described in Chapter 11.

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4.2.1. Infrastructure

4.2.1.1. Introduction

This section describes potential impacts to infrastructure in Hawaii, including transportation, communications and other utilities, associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.1.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on infrastructure, which includes public safety telecommunications systems, transportation safety and capacity, utility services, access to emergency services and commercial communications systems, were evaluated using the significance criteria presented in Table 4.2.1-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 4.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments)	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments)	No effect on traffic congestion or delay, or transportation incidents
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: persisting indefinitely		Short-term effects would be noticeable for up to the entire construction phase or a portion of the operational phase	NA
Strain on capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency health services or access is delayed due to the Proposed Action activities.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor delays to access to care and emergency services that do not impact health outcomes	No impacts on access to care or emergency services
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level	NA
	Duration or Frequency	Duration is constant during the construction and deployment phase.		Rare event during construction and deployment phase	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minimal change in the ability to communicate with and between public safety entities	No perceptible change in existing response times or the ability to communicate with and between public safety entities
	Geographic Extent	Local/city, county/region, or state/territory		Local/city, county/ region, or state/territory	Local/city, county/region, or state/territory
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level of service and communications capabilities	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor changes in level of service and communications while transitioning to the new system	No perceptible effect to level of service or communications while transitioning to the new system
	Geographic Extent	Local/city, county/region, or state/territory		Local/city, county/region, or state/territory	Local/city, county/region, or state/territory
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system ("brownouts"). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor disruptions to the delivery of electric power, water, and sewer services or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services	There would be no perceptible impacts to delivery of other utilities and no service disruptions
	Geographic Extent	Local/city, county/region, or state/territory		Local/city, county/region, or state/territory	Local/city, county/region, or state/territory
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase	NA

NA = not applicable

4.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

Deployment and operation of the Proposed Action could potential impact transportation system safety and capacity in Hawaii. The transport of heavy equipment required to support any clearance, drilling, and construction activities needed for network deployment could potentially have an impact on traffic congestion and transportation safety, particularly given the insular structure of the roadway and highway systems in Hawaii (*FHWA 2013*). Deployment activities including plowing, directional boring, and trenching necessary for the installation of fiber optic cable along the road and within the public road right-of-way (ROW) also have the potential to create temporary traffic congestion. The presence of deployable technologies such as Cell on Wheels, Cell on Light Truck, System on Wheels, and Deployable Aerial Communications Architecture could impact air and land-based traffic congestion and safety. However, potential impacts would likely be *less than significant* given that deployable technologies would typically be stationed in the more rural areas of Hawaii where there is less transportation system infrastructure that would be disrupted and where less permanent fixed infrastructure is likely to be erected.

Submarine deployment activities have the potential to increase boat traffic and congestion on a short-term basis. Submarine deployment activities likely to create potential impacts include the installation of sealed cables in limited nearshore waters and inland waterbodies and the construction of landings and facilities onshore to accept cables.

Each of the potential impacts to transportation capacity and safety discussed above would likely be short term, would be regionally based around the ongoing phase of construction, and would return to normal conditions after a few months or less.

Strain on Capacity of Local Health, Public Safety, and Emergency Response Services

Deployment activities involving plowing, directional boring, or trenching along the road during the installation of fiber optic cable or construction of wireless towers or other structures could have the potential to temporarily create minor road blockages or cause radio interference during the transition to the new system. Deployable technologies with cellular base stations and generators that could require connection to utility power cables have the potential to create temporary power outages or utility service interruptions that could have the potential to create temporary power outages or utility service interruptions While the potential impacts are not certain, these potential impacts would be localized, short-term and temporary, and the Proposed Action would likely improve overall access to health care and emergency health services during the operations phase. Deployable Technologies in particular would help to provide coverage in areas of Hawaii where fixed infrastructure cannot be erected due to a variety of factors.

The Hawaiian Islands are characterized by a diverse and rugged geography. On the island of Hawaii, for example, many of the communities are widely dispersed and undeveloped. Islands such as Kauai and Oahu are made up of mountainous regions and cliffs that are thousands of feet high and gorges that are thousands of feet deep. Some areas also lack commercial electricity.

All of these factors limit the availability of public safety telecommunications infrastructure on the Island (*Hawaii Tourism Authority 2015*). With successful completion of the Proposed Action, FirstNet would have established a nationwide broadband network allowing public safety officers and emergency responders to communicate with each other across agencies and jurisdictions, thus improving current conditions for first responders and impacted individuals in emergency situations.

Public Safety Communication Capabilities and Response Times

Currently, the Pacific Mobile Emergency Radio System Land Mobile Radio is the primary public safety interoperable communications system for the State of Hawaii and provides federal, state, local communications capabilities to emergency first responders and military personnel. Telecommunications coverage in Hawaii has the potential to be improved, especially in the more rural, less populated areas of Hawaii (*Radio Reference 2015*). Other public safety telecommunications systems in the state include the State of Hawaii Emergency Alert System, 911 Emergency and the Hawaii Department of Health two-way radio network, referred to as the MEDICOM radio network for emergency medical service, fire and police first responders. However, these systems are not fully interoperable and do not support communications across agencies and jurisdictions (*Radio Reference 2015*). The Proposed Action is needed to address existing deficiencies in public safety communications interoperability, durability, and resiliency that have been highlighted in recent years for the ways in which they have hindered response activities in high profile natural and man-made disasters.

As stated in Chapter 2, Description of the Proposed Action and Alternatives, FirstNet proposes to implement a nationwide public safety broadband network (NPSBN) that would involve high-speed fourth generation Long Term Evolution technology (as defined in Section 2.1.1, Characteristics of the NPSBN), a core network, and a radio access network. A wide range of new telecommunications infrastructure and deployable technologies would likely be implemented as a part of the core network, including fiber optic cable, towers, data centers, microwave technology, and others. The radio access network is necessary for the connection of user devices and includes infrastructure related to the radio base station, such as communication towers, cell site equipment, antennas, deployable mobile hotspots, and backhaul equipment required to enable wireless communications with devices using the public safety broadband spectrum.

The NPSBN intends to provide a backbone to allow for improved communications by carrying high-speed data, location information, images, and, eventually, streaming video. This capability could increase situational awareness during an emergency, thereby improving the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively. The backhaul, or intermediate links that carry user traffic, including voice, data and video, and signaling from radio base stations to the core network, would likely be accomplished through fiber optic and microwave technology, with an emphasis on redundancy that is intended to allow the network to continue to function in events of extreme demand. The NPSBN would also include, by statute, a variety of characteristics, one of which being substantial rural coverage. Hawaii has a complex geography and fragmented landscape and many parts of Hawaii are severely lacking in existing rural coverage (*Hawaii Tourism Authority 2015*). Implementation of the FirstNet public safety telecommunications infrastructure is intended to significantly improve public safety communications capabilities and response times in both urban and rural areas of Hawaii during operations.

Effects to Commercial Telecommunication Systems, Communications, or Level of Service

The capacity of local health, public safety, and emergency response services would experience negligible impacts during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders, local health officials, and public safety officials to communicate during emergency response situations. Based on the impact significance criteria presented in Table 4.2.1-1, such potential negative and positive impacts would be *less than significant*.

Effects to Utilities

Potential impacts to utilities, including electric power transmission facilities, could occur throughout the deployment/construction phase but would return to their original state during the operational phase. During deployment activities, to the extent practicable or feasible, FirstNet would work to implement wired projects using existing public road ROWs. These ROWs include existing utility corridors and other easements. As part of the Proposed Action, FirstNet could also install new fiber on existing poles in an effort to improve disaster resistance and resiliency. Pole replacement could be necessary as a part of project activities. Deployable technologies that contain generators could be connected to power utility cables, which could potentially result in temporary power outages. It is unlikely that these project activities would increase the load on the existing electrical utilities; however, the implementation of BMPs and mitigation measures (as discussed in Chapter 11, BMPs and Mitigation Measures) such as organizing scheduled coordination with other service providers while working within utility corridors and easements, would help to avoid or minimize the potential for overloading or interrupting the service. Once deployment activities have terminated, if there was any change in service or added burden to the system, electrical utilities would likely return to their original state.

Deployment of new submarine cable would involve the installation of specially sealed cables in nearshore waters and inland waterbodies. However, it is not likely that these project activities would impact offshore utilities.

4.2.1.4. *Potential Impacts of the Preferred Alternative*

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to public safety telecommunications systems, commercial communications, transportation capacity and safety, and utilities, and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to public safety telecommunications infrastructure, commercial communications, transportation capacity and safety, access to emergency services, and utilities under the conditions described below:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to infrastructure resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to telecommunications infrastructure as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of excavation, trenching, construction, or maintenance with public road

ROWs and utility corridors, collocation of network equipment on existing structures, transport or positioning of deployable technologies, construction of access roads, and installation of new fiber optic cables, poles, towers or ancillary structures. Potential impacts that could possibly result due to the deployment activities of the Preferred Alternative could include increased traffic congestion, current telecommunication system interruption, increased emergency response times, and utility interruptions. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to telecommunications infrastructure, commercial communications systems, transportation capacity and safety, utilities, and access to emergency facilities include the following:

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Deployment activities involving plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence,[1] huts, or other associated facilities or hand-holes along the utility corridor or within the public road ROW could potentially result in minor, temporary disruptions to some utility services. Construction along a utility corridor could require that certain utilities are shut down during construction. Temporary traffic congestion and limited access to emergency services could occur as a result of construction and the presence of heavy machinery and vehicles near public road ROWs. Public safety and commercial telecommunications systems could also be temporarily disturbed during construction due to potential short-term radio interference; however, during operation the buried fiber optic plant would likely improve coverage and telecommunications capabilities, as discussed below.
  - New Build–Aerial Fiber Optic Plant: Construction of new fiber optic cable involving installation of new poles and hanging cables on disturbed and undisturbed ROWs or easements could potentially impact some utility services. The presence of heavy equipment and vehicles during construction along ROWs could limit access to emergency services and result in increased traffic congestion. Depending on the availability of ROWs, the installation of new poles could involve the construction of access roads, which also has the potential to impact traffic flow. Temporary Disruptions to public safety telecommunications systems and current commercial communications systems could also occur as a result of the installation of new poles and hanging cables. As a large portion of the state lacks roadway infrastructure, public safety and commercial communication systems are likely to improve during operations given the new source of coverage that the NPSBN intends to provide. These positive impacts are discussed below.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles, installation of new fiber on existing poles, and structural hardening could cause some disruptions to current telecommunications infrastructure. These activities also have the potential to temporarily disrupt current commercial communications systems. If construction is

[1] Points of Presence are connections or access points between two different networks, or different components of one network.

required within utility corridors, current utility systems could be affected. The transport of heavy equipment use associated with these activities could result in increased traffic congestion and could potentially impact traffic safety conditions and limited access to emergency services. The collocation on existing aerial fiber optic plant would provide a new level of resiliency to current public safety telecommunications capabilities. Furthermore, pole replacement as a part of deployment activities could help to accommodate loads from new users. These positive impacts are discussed below.

  - New Build–Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would not impact land transportation systems, public safety telecommunications systems, commercial communications system, or land-based utility systems because there would be little to no terrestrial ground disturbance associated with this activity. Temporary impacts to telecommunications infrastructure could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require minimal construction, there would likely be no impact to infrastructure because there would be no disturbance to existing infrastructure. Fiber installation activities could require additional installation of equipment to enhance the digital signals traveling through the fiber, which could interfere with the existing telecommunication services. Installation of transmission equipment such as small boxes or huts is typically installed in the ROW of the utility corridor. Construction activities involving excavation could potentially impact utility services. Depending on the availability of a public ROW, construction of a new access road could be necessary, which has the potential to impact transportation capacity and safety. However, these potential impacts are expected to be minor and temporary.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current public safety telecommunications systems, commercial communications systems, or utility service during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. Transport of heavy equipment during these activities, construction that occurs within the public road ROW, and construction of new access roads could result in temporary impacts to transportation capacity and safety and could limit access to emergency services.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, installation of power units, and structural hardening on existing towers

and structures. These activities are not likely to impact transportation system capacity and safety or access to emergency services; however, there is a possibility that these activities could result in interruptions to the existing public safety telecommunications infrastructure, current communications systems, and electric power utilities. Collocation on existing wireless towers, structures, or buildings would improve disaster resistance and resiliency and increase the capacity of the system to accommodate the load from new users. These positive impacts are discussed below.

- Deployable Technologies
  - Deployable technologies including Cell on Wheels, Cell on Light Truck, and System on Wheels are comprised of cellular base stations (sometimes with expandable antenna masts) and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies would help to provide coverage in rural and urban areas of Hawaii where permanent, fixed infrastructure cannot be erected due to a variety of factors such as severe weather conditions and the rugged terrain (*Hawaii Tourism Authority 2015*). Positive impacts associated with operation of the Proposed Action are discussed below.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology have the potential to temporarily interfere with existing public safety telecommunications systems and current commercial communications systems. Given that construction activities would occur on existing structures, transportation capacity and safety and access to emergency services would not be impacted.

In general, the above-mentioned activities could potentially involve trenching or directional boring, construction of access roads, huts, and installation of equipment such as antennas or microwave dishes and specially sealed cables in nearshore waters and inland waterbodies, and heavy equipment movement. Potential impacts to telecommunications infrastructure associated with deployment of this infrastructure could include increased traffic congestion, interruptions to existing telecommunication systems, increased emergency response times, reductions in emergency levels of service, and utility interruptions. These potential impacts would generally be minor and temporary, and associated BMPs and mitigation measures to help avoid or reduce these impacts are described further in Chapter 11.

Potential Transportation System Capacity and Safety Impacts

Based on the analysis of the deployment activities described above, potential impacts to transportation system capacity and safety as a result of transport of heavy equipment, road blockages, and excavation activities are anticipated to be *less than significant* (see Table 4.2.1-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts to the Accessibility of Local Health, Public Safety, and Emergency Response Services

Based on the analysis of proposed activities described above, potential impacts to local health, public safety, and emergency response times are considered to be *less than significant* (see Table 4.2.1-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with infrastructure.

Potential Public Safety Telecommunication and Infrastructure Impacts

Based on the analysis of proposed activities described above, potential impacts to public safety telecommunications are considered to be *less than significant* (see Table 4.2.1-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Commercial Telecommunication System Level of Service Impacts

Based on the analysis of the proposed activities described above, potential impacts to the current commercial telecommunication system level of service are anticipated to be *less than significant* (see Table 4.2.1-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Utility Service Impacts

Based on the analysis of the proposed activities described above, potential impacts to utility services are anticipated to be *less than significant* (see Table 4.2.1-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no negative impacts to telecommunications infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads and utility ROWs used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could result as explained above, although these potential impacts would be expected to be minor and temporary.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Finally, the NPSBN would likely improve the much needed coverage in both rural and remote areas as well as the urban areas of Hawaii.

4.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to public safety telecommunications infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[2]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to telecommunications infrastructure as a result of implementation of this alternative could be as described below.

[2] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to telecommunications systems, commercial communications systems, and utilities if deployment occurs within public road and utility ROWs. Some staging or landing areas (depending on the type of technology) could require heavy equipment movement, excavation, or paving, which have the potential to impact transportation systems. The presence and transport of these mobile communication units could potentially increase traffic congestion and delays, increase transportation-related incidents, and limit access to emergency services. However, implementation of deployable technologies would result in positive impacts during operation, as discussed below.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no negative impacts to the existing telecommunications infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads and utility ROWs used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, *less than significant* impacts to transportation systems, utility services, emergency-level of service, emergency response times, and access to emergency facilities could occur.

As with operations associated with the Preferred Alternative, it is likely that the operation of the Deployable Technologies Alternative would result in improvements to public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in improvements in level of service and communications capabilities, but all these improvements would likely be temporary as opposed to the permanent beneficial impacts of the Preferred Alternative. Generally, these units would be deployed at times of an incident to the affected area for either planned or unplanned incidents or events. Many of the rural areas in Hawaii are lacking public safety telecommunications infrastructure and coverage given the complex geography and fragmented landscape (*Hawaii Tourism Authority 2015*). As explained above, under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure, which would likely temporarily improve coverage throughout Hawaii.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no negative impacts to telecommunications infrastructure as a result of construction and operation of the Proposed Action; however, none of the beneficial impacts associated with improved response times, redundancy, and resiliency of the system creating a more reliable emergency communication system would be realized. Environmental conditions would therefore be the same as those described in Section 4.1.1, Infrastructure.

4.2.2. Soils

4.2.2.1. Introduction

This section describes potential impacts to soil resources in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are discussed in Chapter 11, BMPs and Mitigation Measures.

4.2.2.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 4.2.2-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each potential impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

Table 4.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils; High likelihood of encountering prime or unique farmland	Effect that is *potentially significant*, but with mitigation is *less than significant*	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil suborders; low likelihood of encountering prime or unique farmland	No perceptible change in baseline conditions; *no impacts* to prime or unique farmland
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years		Isolated, temporary, or short-term erosion that that is reversed over few months or less	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers	Effect that is *potentially significant*, but with mitigation is *less than significant*	Minimal mixing of the topsoil and subsoil layers has occurred	No perceptible evidence that the topsoil and subsoil layers have been mixed
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline	Effect that is *potentially significant*, but with mitigation is *less than significant*	Perceptible compaction and rutting in comparison to baseline conditions	No perceptible change in baseline conditions
	Geographic Extent	State or territory		Region or county	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less	No perceptible change in baseline conditions

NA = not applicable

4.2.2.3. Description of Environmental Concerns

Soil Erosion

One of the primary environmental concerns during construction activities is soil erosion and sedimentation. Increased sedimentation in waterways, for example, could alter natural sediment transport processes which can impair water and habitat quality and potentially affect aquatic plants and animals. Potential impacts to soils from erosion could occur in areas where the slopes are steep and where the erosion potential is moderate to severe as indicated by soil characteristics. Soil suborders exist in Hawaii that have steep slopes (i.e., greater than 20 percent) and where the erosion potential is moderate to severe, particularly in the Udands, Ustands, Orthents, Psamments, Aquepts, Ustepts, Udox, Ustox, and Humults soil suborders (see Section 4.1.2, Soils).

According to Natural Resources Conservation Service data, a combined 200,000 acres of prime farmland (less than 5 percent of the state's total land area) exists on the islands of Hawaii, Maui, Oahu, and Kauai, so the likelihood of the Proposed Action impacting these soils is minimal.[1] FirstNet and/or their partners would work to avoid deployment/construction activities, as practicable or feasible, in areas with severe erosion potential and steep slopes (up to 90 percent). However, given that steep slopes are present throughout much of Hawaii, some limited amount of infrastructure could be built or deployed in these areas, in which case BMPs and mitigation measures (see Chapter 11) could help avoid or minimize the potential impacts. In addition, it is anticipated that any soil erosion would likely be isolated within those locations and would be short-term with stability achieved after a few months or less.

Topsoil Mixing

The potential for the loss of topsoil (i.e., organic and mineral topsoil layers) by mixing would be present during construction of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Although prime farmland soils identified in Hawaii make up only a small portion of the state's total landmass, topsoil mixing could result in the loss of soil productivity and fertility, as well as the loss of viable seeds and/or root mass present in surficial soil layers in non-prime farmland areas. It is possible that minimal topsoil mixing as a result of construction could potentially be perceptible at some buildout locations if BMPs and mitigation measures are not followed (see Chapter 11). However, it is anticipated that topsoil mixing would likely be minimal and isolated within those locations.

Soil Compaction and Rutting

The movement of heavy equipment required to support any clearance, drilling, and construction activities, as well as installation of equipment or modification of structures needed to support network deployment, could potentially impact soil resources by causing the compaction and rutting of susceptible soils. Soils suborders with the highest potential for compaction or rutting resulting from heavy equipment passage were identified by using the STATSGO2 Database

[1] See Section 4.1.7, Land Use, Airspace, and Recreation, for additional information related to prime farmland.

(see Section 4.1.2, Soils). Of the soil suborders identified in Hawaii, soils that are flood prone, poorly drained, or are unstable and subject to blowing and drifting likely have the greatest potential for compaction and rutting. These soils may be found within the Psamments, Aquepts, and Aquolls suborders. It is anticipated that soil compaction and rutting as a result of deployment of the Proposed Action would likely not be perceptible over a widespread area since flood prone, poorly drained, and unstable soils (with high potential for compaction and rutting) are present to varying degrees within only 3 of the 18 soil suborders present in Hawaii, as mentioned above. In addition, compaction would not likely be widespread within those locations and deployment activities would likely be temporary.[2] Implementation of BMPs and mitigation measures would further decrease the potential for impacts.

4.2.2.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to soil resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to soil resources because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to soil resources because there would be no ground disturbance.

[2] Although deployable technologies could be in place for a period of several years, potential impacts are still expected to range from *no impact* (if placed on a previously paved surface) to *less than significant*. See below.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact soil resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide, public safety broadband network (NPSBN); however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have *no impact* on soil resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to soil resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence[3], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to soil resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of points of presence, huts, or other associated facilities or hand-holes to access fiber could result in soil erosion, topsoil mixing, soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the installation of new poles could result in soil erosion and topsoil mixing. The use of heavy equipment during the installation of new poles and hanging of cables could result in soil compaction and rutting.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.

[3] Points of presence are connections or access points between two different networks, or different components of one network.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited near-shore or inland bodies of water would not impact soil resources because there would be no ground disturbance associated with this activity (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). However, impacts to soil resources could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Soil compaction and rutting could potentially occur due to heavy equipment use during these activities.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils. If installation of transmission equipment required grading or other ground disturbance to install small boxes, hunts, or access roads, there could potentially be impacts to soils. Such ground disturbance could result in soil erosion and topsoil mixing. Heavy equipment use could result in soil compaction and rutting.

• Wireless Projects

- New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils because there would be no ground disturbance associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact soil resources if this activity would not require ground disturbance. However, if structural hardening and physical security measures require ground disturbance, such as grading or excavation activities, impacts to soil resources could occur, including soul erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.

- Deployable Technologies
  - Where deployable technologies, both land-based and aerial, would be located on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, it is anticipated that there would be *no impacts* to soil resources because there would be no ground disturbance. However, implementation of deployable technologies could result in potential impacts to soil resources if deployment of land-based deployables occurs in unpaved areas, or if the implementation results in minor construction or paving of previously unpaved surfaces. In addition, potential impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging areas could require land/vegetation clearing, minor excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities could result in soil compaction and rutting. In addition, implementation of and activities associated with deployable technologies themselves, could also result in soil compaction and rutting if deployed in unpaved areas.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, and/or soil compaction and rutting. These potential impacts are described further below, and BMPs and mitigation measures to help avoid or reduce these potential impacts are discussed in Chapter 11.

Potential Soil Erosion Impacts

Based on the analysis of the deployment activities described above to soil resources, potential impacts as a result of erosion are anticipated to be *less than significant*. See Chapter 11 for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential soil erosion impacts.

Potential Topsoil Mixing Impacts

Based on the analysis of proposed activities described above, the minimal mixing of the topsoil with the subsoil layers could result in potentially *less than significant* impacts. See Chapter 11 for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential soil erosion impacts.

Potential Soil Compaction and Rutting Impacts

Based on the analysis of the proposed activities described above to soil resources, potential impacts to soil resources as a result of soil compaction and rutting are anticipated to be *less than significant*. See Chapter 11 for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential soil erosion impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, *less than significant* soil compaction and rutting impacts could potentially result as explained above.

4.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action alternative.[4]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile land-based and aerial communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Potential impacts to soil resources as a result of implementation of this alternative are described below.

Potential Deployment Impacts

As explained above, implementation of land-based deployable technologies could result in *less than significant* impacts to soil resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, potential impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging areas could require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities could result in soil compaction and rutting. In addition, implementation of and activities associated with deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas.

[4] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, *less than significant* soil compaction and rutting impacts could potentially result as previously explained above. Finally, if deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could result in soil erosion as it runs onto the soil below. However, it is anticipated that the soil erosion would not result in perceptible changes to baseline conditions.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no *impacts* to soil resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.2, Soils.

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4.2.3. Geology

4.2.3.1. Introduction

This section describes potential impacts to geologic resources in Hawaii associated with deployment and operation of the Proposed Action as well as the geologic hazards that could potentially affect the Proposed Action. Best management practices (BMPs) and mitigation measures that would help avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.3.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on geologic resources and the potential impacts to the Proposed Action from geologic hazards were evaluated using the significance criteria presented in Table 4.2.3-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geologic resources addressed in this section are presented as a range of possible impacts.

Table 4.2.3-1: Impact Significance Rating Criteria for Geology

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Surface geology, bedrock, topography, physiography, and geomorphology impacts	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor degradation or alteration of surface geology, bedrock, topography that does not result in measurable changes in physiographic characteristics or geomorphological processes	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes
	Geographic Extent	State or territory		State or territory	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes		Temporary degradation or alteration of resources that is limited to the construction and deployment phase	NA
Mineral and fossil fuel resource impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Limited impacts to mineral and/or fossil resources	No perceptible change in mineral and/or fossil fuel resources
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state or territory.		Mineral or fossil fuel extraction areas occur within the state or territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state or territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources		Temporary degradation or depletion of mineral and fossil fuel resources	NA
Paleontological resources impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than*	Limited impacts to paleontological and/or fossil resources	No perceptible change in baseline conditions

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state or territory.		Areas with known paleontological resources occur within the state or territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state or territory.
	Duration or Frequency	NA		NA	NA
Seismic hazards	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Low likelihood that a project activity could be located within an earthquake hazard zone or active fault	No likelihood of a project activity being located in an earthquake hazard zone or active fault
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state or territory.		Earthquake hazard zones or active faults occur within the state or territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state or territory
	Duration or Frequency	NA		NA	NA
Volcanic activity	Magnitude or Intensity	High likelihood that a project activity could be located near a volcano lava or mud flow area of influence	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Low likelihood that a project activity could be located near a volcanic ash area of influence	No likelihood of a project activity located within a volcano hazard zone
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state or territory.		Volcano ash areas of influence occur within the state or territory, but may be avoidable.	Volcano hazard zones do not occur within the state or territory.
	Duration or Frequency	NA		NA	NA
Landslides	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Low likelihood that a project activity could be located within a landslide area	No likelihood of a project activity located within a landslide hazard area
	Geographic Extent	Landslide areas are highly prevalent within the state or territory.		Landslide areas occur within the state or territory, but may be avoidable.	Landslide hazard areas do not occur within the state or territory.

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	NA		NA	NA
Land subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain, lava tubes, etc.)	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Low likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain, lava tubes, etc.)	Project activity located outside an area with a hazard for subsidence (e.g., karst terrain, lava tubes, etc.)
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain, lava tubes, etc.) are highly prevalent within the state or territory.		Areas with a high hazard for subsidence (e.g., karst terrain, lava tubes, etc.) occur within the state or territory, but may be avoidable.	Areas with a high hazard for subsidence (e.g., karst terrain, lava tubes, etc.) do not occur within the state or territory.
	Duration or Frequency	NA		NA	NA

NA = not applicable

4.2.3.3. Description of Environmental Concerns

Terms and concepts discussed in this section are further discussed and defined in the Affected Environment section (Section 4.1.3, Geology).

Potential Effects from the Proposed Action

Potential Surface Geology, Bedrock, Topography, Physiography, and Geomorphology Impacts

The potential for impacts to surface geology, bedrock, topography, physiography, and geomorphology could be present during deployment or construction of the proposed facilities/infrastructure, particularly during trenching, grading, and/or foundation excavation activities. For example, as discussed in and shown graphically in Section 4.1.2, Soils, there are numerous areas in Hawaii where shallow soils are present and bedrock is likely at or near the surface including, but not limited to, the Humid and Very Humid Organic Soils on Lava Flows, Sub-humid and Humid Intermediate and High Mountain Slopes, and Very Stony Land and Rock Land. Such shallow bedrock could be susceptible to potential impacts from rock ripping.[1] However, rock ripping would likely only occur in discrete locations where necessary and would not result in large-scale changes to Hawaii's geologic, topographic, or physiographic characteristics. In addition, to the extent practicable or feasible, FirstNet and/or their partners would work to avoid areas that commonly undergo significant geomorphological changes, such as active stream or river channels. Temporary degradation or alteration of surface geology, bedrock, topography, physiography, and geomorphology would primarily be limited to the construction/deployment phases and would be limited and localized in extent. Therefore, it is anticipated that potential impacts to surface geology, bedrock, topography, physiography, and geomorphology as a result of the anticipated project activities would be minor and would not result in measureable changes. Implementation of BMPs and mitigation measures would help further reduce potential impacts.[2]

Potential Mineral and Fossil Fuel Resource Impacts

In general, potential impacts to mineral and fossil fuel resources as a result of the Proposed Action would be more likely in states or territories with numerous extraction areas. Hawaii does not produce or have any proven recoverable reserves of petroleum, natural gas, or coal; and in 2011 the state ranked 47th among the 50 states for non-fuel mineral production (*USGS 2015; EIA 2014).*[3] Because of this, *no impacts* to fossil fuel resources could occur as a result of the Proposed Action. Any potential impacts would only be to mineral resources and are likely to be minor and temporary, and further reduced with implementation of BMPs and mitigation measures, as discussed in Chapter 11, BMPs and Mitigation Measures.

[1] Rock ripping refers to the breakup and removal of rock material with heavy equipment such as an excavator.
[2] See Chapter 11 for a discussion of specific required BMPs and mitigation measures.
[3] See Section 4.1.3, Geology, for a map showing the primary mineral production areas and a discussion of mineral and fossil fuel resources.

Potential Paleontological Resources[4] Impacts

The potential for impacts to paleontological resources could be present during deployment or construction of the proposed facilities/infrastructure, particularly during trenching, grading, and/or foundation excavation activities. As discussed in detail in Section 4.1.3, Geology, fossils known to exist in Hawaii include various reefs, corals and other sea animals, and birds. It is anticipated that potential impacts to specific areas with significant paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would likely be limited and localized. Implementation of the BMPs and mitigation measures as discussed in Chapter 11, BMPs and Mitigation Measures, would help further reduce potential impacts.

Potential Effects to the Proposed Action

Seismic Hazards

As discussed in Section 4.1.3, Geology, Hawaii's geology and its associated volcanic hotspot make the state susceptible to earthquakes, particularly within the island of Hawaii where seismic hazards are the highest. The Proposed Action is unlikely to affect seismic activity, but rather seismic hazards could have the potential to impact the Proposed Action. As discussed in Chapter 1, Introduction, the FirstNet network would be "hardened" from the physical layer, user access, and cyber security perspectives to be more resilient to potential impacts than typical telecommunications infrastructure. However, some potential impacts to the Proposed Action infrastructure could occur during significant earthquake events, and it is recommended that FirstNet and/or their partners attempt, as practicable or feasible, to design the network to reasonably withstand the seismic activity typical in the state of Hawaii, thereby limiting potential impacts. In addition, implementation of the BMPs and mitigation measures as discussed in Chapter 11, BMPs and Mitigation Measures, would help further reduce potential impacts.

Volcanic Activity

As described and shown graphically in Section 4.1.3, Geology, most volcanoes in Hawaii exist on the island of Hawaii. As with seismic hazards, the Proposed Action is unlikely to affect volcanic activity, but rather volcanic activity could have the potential to impact the Proposed Action. It is recommended that FirstNet and/or their partners work to avoid developing and deploying fixed telecommunications infrastructure near active volcanoes unless absolutely necessary. Implementation of the BMPs and mitigation measures as discussed in Chapter 11, BMPs and Mitigation Measures, would help further reduce potential impacts.

Landslides

In general, the Proposed Action is unlikely to affect landslide activity, but rather landslides in Hawaii have the potential to impact the Proposed Action. As discussed in Section 4.1.3, Geology, excessive rainfall, seismic activity, and volcanic activity can trigger local landslides, especially near areas with steep slopes and loose or unconsolidated material. As discussed in

[4] Paleontological resources, or fossils, are the physical remains of plants and animals that have mineralized into or left impressions in solid rock or sediment.

Section 4.1.2, Soils, slopes in Hawaii range from 0 to 90 percent, with steepest areas located in the mountainous regions and volcano areas including, but not limited to, the Humid and Very Humid Steep and Very Steep Mountain Slopes, Very Stony Land and Rock Land, and Lava Flows and Rock Outcrops.[5]

To the extent practicable or feasible, FirstNet and/or their partners would work to avoid developing and deploying telecommunications infrastructure in areas that are highly susceptible to landslides. Although some localized, limited potential impacts could occur as a result of landslides, widespread potential impacts are unlikely. Implementation of BMPs and mitigation measures discussed in Chapter 11, BMPs and Mitigation Measures, could further reduce potential impacts.

Land Subsidence

As discussed in Section 4.1.3, Geology, on all major islands in Hawaii, with the exception of Kaho'olawe and Hawaii, karst terrain can be found in some limestone rocks in small, island-fringing areas (*Weary and Doctor 2014*). Outside of these areas, land subsidence risk is likely much lower. To the extent practicable or feasible, FirstNet and/or their partners would work to avoid areas with a high hazard for subsidence during deployment and operation of the Proposed Action. Implementation of the BMPs and mitigation measures discussed in Chapter 11 would help avoid or further minimize potential impacts to the Proposed Action as a result of land subsidence.

4.2.3.4. Potential Impacts of, and to, the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities as well as potential geologic hazards to the Preferred Alternative.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to geologic resources and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Additionally, geologic hazards such as earthquakes, volcanic activity, landslides, and land subsidence that have the potential to impact the deployment of the Preferred Alternative are discussed below.

[5] See Section 4.1.2, Soils, for a map and descriptions of the physiographic characteristics of these areas.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to geologic resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to geologic resources because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to geologic resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to potentially impact geologic resources, it is anticipated that this activity would have *no impact* to geologic resources.

Activities and Geologic Hazards with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities including potential impacts to surface geology, bedrock, topography, physiography, and geomorphology; potential mineral impacts; and potential paleontological impacts. In addition, geologic hazards including seismic activity, volcanoes, landslides, and land subsidence have the potential to impact deployment of the Preferred Alternative. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or potential impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence[6], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources. Ground disturbance and heavy equipment use associated with plowing, trenching, directional boring, excavation activities, rock ripping, and landscape

[6] Points of presence are connections or access points between two different networks, or different components of one network.

grading associated with construction of points of presence, huts, or other associated facilities or hand-holes to access fiber could result in limited potential impacts to bedrock, topography, physiography, and geomorphology; potential mineral impacts; and potential paleontological impacts. Depending on its location, this development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility.

- New Build – Aerial Fiber Optic Plant: Depending on its location and deployment methods used, excavation and excavated material placement, trenching, grading, and rock ripping during the installation of new poles or construction of points of presence, huts, or other facilities could result in potential limited and localized impacts to bedrock, topography, physiography, and geomorphology; potential mineral impacts; and potential paleontological impacts. This development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence, if it occurs in areas of high susceptibility.
- Collocation on Existing Aerial Fiber Optic Plant: Depending on its location, excavation, grading, and rock ripping during the replacement of poles and structural hardening could result in localized potential impacts to bedrock, topography, physiography, and geomorphology; potential mineral impacts; and potential paleontological impacts. This development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence, depending on deployment location and its susceptibility to those hazards.
- New Build – Submarine Fiber Optic Plant: The installation of cables in near-shore or inland bodies of water would not impact geologic resources. However, potential impacts to geologic resources could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Grading, foundation excavation, rock ripping, or other ground disturbance activities could result in limited potential impacts to bedrock, topography, physiography, and geomorphology; potential mineral impacts; and potential paleontological impacts. Deployment of this development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to geologic resources. If installation of transmission equipment required grading, foundation excavation or other ground disturbance activities including rock ripping to install small boxes, hunts, or access roads, there could potentially be temporary impacts to geologic resources. Deployment of this development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to geologic resources. Excavation activities, landscape grading, rock ripping, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in localized potential impacts to bedrock, topography, physiography, and geomorphology; potential mineral and fossil fuel impacts; and potential paleontological impacts. Deployment of this development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to geologic resources because there would be no ground disturbance associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact geologic resources if this activity would not require ground disturbance. However, if structural hardening required ground disturbance, such as grading, excavation activities, or rock ripping, potential impacts to geological resources could occur. Deployment of this development scenario could also potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility.
- Deployable Technologies
  - Where deployable technologies (both land-based and aerial) would be located or deployed on existing paved surfaces, it is anticipated that there would be *no impacts* to geologic resources because there would be no new ground disturbance. However, Implementation of deployable technologies could result in potential impacts to geologic resources. These potential impacts could occur if deployment of land-based or aerial deployables occurs in unpaved areas, or if the implementation results in minor construction, paving of previously unpaved surfaces, grading, excavation, or rock ripping (e.g., for staging or launching/landing areas).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance nor any impact to the built or natural environment. However, where equipment is permanently installed in locations that are susceptible to specific geologic hazards, such as earthquakes, it is possible that they could be affected by that hazard.

In general, the abovementioned activities could potentially involve excavation, rock ripping, trenching or directional boring, and landscape grading. Potential impacts to geologic resources associated with deployment of this infrastructure could include potential localized and/or limited impacts to bedrock, topography, physiography, and geomorphology; mineral; and paleontological resources. Additionally, deployment of the abovementioned scenarios could potentially be impacted by geologic hazards including seismic activity, volcanoes, landslides, and/or land subsidence if it occurs in areas of high susceptibility. These potential impacts are described further below. BMPs and mitigation measures to help avoid or reduce these potential impacts are discussed in Chapter 11, BMPs and Mitigation Measures.

Potential Impacts from the Preferred Alternative

<u>Potential Surface Geology, Bedrock, Topography, Physiography, and Geomorphology Impacts</u>

Based on the analysis of the deployment activities described above to bedrock, topography, physiography, and geomorphology, potential impacts are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to these resources.

<u>Potential Mineral and Fossil Fuel Resource Impacts</u>

Based on the analysis of proposed activities described above to geologic resources, in general, potential mineral and fossil fuel resource impacts could result in potentially *less than significant* impacts; however, there would be no impacts to fossil fuel resources since Hawaii does not produce or have any proven recoverable reserves of petroleum, natural gas, or coal. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to mineral resources.

<u>Potential Paleontological Resources Impacts</u>

Based on the analysis of the proposed activities described above to geological resources, potential paleontological resources impacts are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to paleontological resources.

Potential Impacts to the Preferred Alternative

<u>Potential Seismic Hazard Impacts</u>

Based on the analysis of the proposed activities described above, potential impacts to the deployment of the Preferred Alternative as a result of seismic hazards are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with seismic hazards.

Potential Volcanic Activity Impacts

Based on the analysis of the proposed activities described above, potential impacts to the deployment of the Preferred Alternative as a result of volcanic activity are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with volcanic activity.

Potential Landslide Impacts

Based on the analysis of the proposed activities described above, potential impacts to the deployment of the Preferred Alternative as a result of landslides are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with landslide hazards.

Potential Land Subsidence Impacts

Based on the analysis of the proposed activities described above, potential impacts to the deployment of the Preferred Alternative as a result of land subsidence are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with land subsidence.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *no impacts* to geologic resources associated with routine inspections of the Preferred Alternative.

The operation of the Preferred Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant*, and even further reduced if BMPs and mitigation measures discussed in Chapter 11, BMPs and Mitigation Measures, are implemented.

4.2.3.5. Alternatives Impact Assessment

The following section assesses potential impacts to geologic resources associated with the Deployable Technologies Alternative and the No Action alternative.[7]

[7] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile land-based and aerial communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Potential impacts to geologic resources as a result of implementation of this alternative are described below.

Potential Deployment Impacts

As explained above, if deployment occurs on unpaved areas and/or if implementation results in paving of unpaved surfaces or if grading, excavation, or rock ripping is required for staging or launching/landing areas, implementation of deployable technologies (i.e., System on Wheels, Cell on Wheels, Cell on Light Truck, Unmanned Aerial Vehicle) would likely result in *less than significant* impacts to geologic resources. It is anticipated that the same BMPs and mitigation measures discussed for the Preferred Alternative would apply to the Deployable Technologies Alternative, to the extent practicable or feasible.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to geologic resources associated with routine inspections of the Deployable Technologies.

As with the Preferred Alternative, the operation of the Deployable Technologies Alternative could be affected due to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant*, especially given the BMPs and mitigation measures discussed in Chapter 11, BMPs and Mitigation Measures. It is anticipated that the same BMPs and mitigation measures discussed for the Preferred Alternative would apply to the Deployable Technologies Alternative, to the extent practicable or feasible.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to geologic resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.3, Geology.

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4.2.4. Water Resources

4.2.4.1. Introduction

This section describes potential impacts to water resources in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.4.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 4.2.4-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

Table 4.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: Clean Water Act, Safe Drinking Water Act	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions	No changes to water quality, sedimentation, water temperature, or the presence of water pollutants
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds		Watershed or subwatershed level[a]	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons		The impact is temporary, lasting no more than 6 months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Floodplain degradation*	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces or place structures that would impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. There is a low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds		Watershed or subwatershed level	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		The impact is temporary, lasting no more than 1 season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns
	Geographic Extent	Watershed level, and/or within multiple watersheds		Watershed or subwatershed level	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		The impact is temporary, lasting no more than 6 months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor or no consumptive use with negligible impact on discharge	Activities do not impact discharge or stage of waterbody.
	Geographic Extent	Watershed level, and/or within multiple watersheds		Watershed or subwatershed level	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than 6 months.	NA
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers
	Geographic Extent	Watershed level, and/or within multiple watersheds		Watershed or subwatershed level	NA
	Duration or Frequency	Impact is ongoing and permanent.		Potential impact is temporary, not lasting more than 6 months.	NA

Note: Because public safety infrastructure is considered a critical facility, Proposed Action activities should avoid the 500-year floodplain wherever practicable per the Executive Orders on Floodplain Management (*Executive Orders 11988 and 13690*).
NA = not applicable
[a] Definitions of U.S. Geological Survey (USGS) watershed and subwatershed: USGS watershed refers to the USGS 10 digit hydrologic unit code (HUC10), which averages approximately 230 square miles, depending on the region. USGS subwatershed refers to the USGS 12 digit hydrologic unit code (HUC12), which averages approximately 40 square miles, depending on the region. See *USGS and NRCS 2013* for an explanation of HUC codes.

4.2.4.3. Description of Environmental Concerns

Water Quality – Potential Impacts Associated with Sedimentation, Pollutants, or Water Temperature

One of the primary environmental concerns during deployment activities is minimizing potential impacts to water quality in Hawaii's 3,326 miles of rivers and streams, 37 square miles of bays and harbors, and 5 square miles of lakes and reservoirs (*HDOH 2014*) as well as its groundwater aquifers. Potential impacts to water quality could result from sedimentation or pollutants due to ground disturbance, disruption of streamside soils or vegetation, or spills of fluids from motorized equipment. Potential impacts to water quality due to deployment activities would be influenced by the timing of deployment, weather conditions, local topography, and the erosion and infiltration potential of soils.

Potential sedimentation impacts to streams or lakes, the near-shore ocean floor, or floodplains could be caused by ground disturbing construction activities such as trenching, pole installation, or road work. Increased sedimentation in waterways could impair water and habitat quality and potentially affect aquatic plants and animals. The pollutant that most frequently exceeds water quality standards in both fresh and marine waters in Hawaii is turbidity (*HDOH 2014*; see the Inland Surface Water Characteristics and Nearshore Marine Characteristics subsections in Section 4.1.4.3, Environmental Setting). Potential impacts to water quality from erosion and sedimentation are most likely in areas where:

- Ground disturbance occurs in or near waterbodies or floodplains;
- Riparian vegetation is cleared or disturbed; and/or
- Steep slopes with moderate to severe erosion potential are disturbed (see Section 4.1.2, Soils, and Section 4.1.3, Geology).

Other potential sources of sedimentation impacts include vehicle travel on dirt or gravel roads, or off-road construction activity. BMPs and mitigation measures could be implemented during deployment to adjust to local conditions and minimize soil erosion and storm water runoff.

During the dry season, the amount of sediment introduced to streams during ground disturbance and road work would be similar to natural erosion processes because there would be little or no flowing water on road surfaces or across disturbed areas.

Potential inputs of pollutants could occur if chemicals or petroleum products are spilled from equipment due to malfunction or refueling errors. Accidental spills of chemicals or petroleum products from motorized equipment during deployment could expose surface water resources to hazardous materials. Spills could also infiltrate the groundwater aquifer in areas with porous geology, such as limestone, if the spills are not contained. Any spills from vehicles or machinery used during deployment tend to be associated with refueling activities, and as such, would likely be a few gallons or less in volume and could easily be contained and cleaned.

Most wood poles used for utility or telephone lines are treated with a preservative called pentachlorophenol (PCP) to lessen wood rot and extend the life of the poles. Once constructed, new treated poles could potentially impact surface water (or groundwater) by leaching PCP. Because of the demonstrated tendency for PCP to adsorb to soils, the moderately rapid degradation of the compound in the environment, and the localized nature of the compound, it is unlikely that surface water (or groundwater) contamination would result from installation of the new wood poles. In addition, concentrations of PCP released during placement or replacement of poles are not expected to exceed United States Environmental Protection Agency levels of concern for human health.

Water temperature could be potentially impacted by reduced stream shading in any areas where riparian vegetation is cleared.

To the extent practicable or feasible, FirstNet and/or their partners would work to avoid stream crossings, and given that many streams in Hawaii are dry for a portion of the year, it could be possible to limit required stream crossings to times when streams are dry or have minimal flow. When crossing of perennial streams or streams that are flowing is required, potential impacts could be reduced by scheduling stream crossings for times of the year when stream flow is lowest. Further, to the extent practicable or feasible, limiting deployment in areas with severe erosion potential due to sensitivity and constructability limitations associated with steep slopes (up to 90 percent) could also reduce potential water quality impacts (see Section 4.2.2, Soils, and Section 4.2.3, Geology). However, because steep slopes are present throughout much of Hawaii, some limited amount of infrastructure could be built in these areas, in which case BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help avoid or minimize the potential impacts. If appropriate BMPs and mitigation measures are implemented, soil erosion could be isolated within those locations and would be short-term with stability achieved after a few months or less.

Sedimentation, whether due to storm water runoff or other deployment activity, could likely return to current levels once deployment is complete if vegetation is re-established in disturbed areas as a BMP. Additionally, creation of turbidity from installation of submarine infrastructure deployed in near-shore or inland bodies of water would be temporary and would likely return to background levels after deployment activities subside.

The U.S. Environmental Protection Agency requires review of activities within Hawaii's two sole source aquifers (SSAs) (Molokai Aquifer SSA and Southern Oahu Basin SSA) to ensure that ground water sources are not endangered (*USEPA Watershed Branch 2005*)

Floodplain Degradation

Floodplains can be degraded by construction of additional impervious surfaces or reduced ability to store floodwaters due to floodplain fill. Additionally, construction of structures in floodplains that cannot withstand flooding can cause residual effects for downstream areas where flood debris is transported. Soil compaction and removal of vegetation in the floodplain could contribute to erosion within the floodplain, lessen dissipation of water energy during floods, and impede floodplain permeability. In areas that are not permanently disturbed, these potential impacts could be reduced if these areas are restored by establishing new vegetation.

To the extent practicable or feasible, FirstNet and/or their partners would work to avoid deployment activities in floodplains, particularly in the floodway. The employment of BMPs and mitigation measures as described in Chapter 11 could also help avoid or minimize potential impacts in floodplain areas.

Drainage Pattern Alteration

Drainage patterns could be altered if Proposed Action activities involved alteration of a stream or a river course. This could be due to changes in stream geomorphological conditions, and/or a substantial or measureable increase in the amount of surface water or changes to the hydrologic regime of a surface waterbody. If in-stream construction activities such as trenching or road building were to involve rerouting of surface waters, this could result in drainage pattern alterations. Where surface disturbance associated with trenching and road building could be conducted when streams do not have flow, potential impacts are not anticipated to occur and surface waters would not need to be re-routed. When construction activities would cross perennial streams or during times that intermittent streams have flow, potential impacts to drainage patterns would be temporary and streams would be returned to their natural course after construction is complete.

Flow Alteration

Stream flow could be altered if Proposed Action activities involved withdrawal of surface water or diversion of surface water flows such that there is a measurable reduction in stream discharge. Withdrawal of surface water for water trucks (used in dust suppression for air quality mitigation) would be unlikely to result in a significant quantity of water being withdrawn, and therefore would not be likely to impact to stream flow patterns.

Changes in Groundwater or Aquifer Characteristics

Groundwater or aquifer characteristics could be potentially impacted if Proposed Action activities involved contamination of groundwater with petroleum, lubricants, or other fluids from heavy equipment. As discussed above, any concentrations of PCP released to groundwater during placement or replacement of poles are not expected to exceed United States Environmental Protection Agency levels of concern for human health and are likewise not anticipated to impact wildlife. Trenching for installation of Proposed Action features and pole placement could be deep enough to interact with shallow groundwater, but would not impact groundwater quality or aquifer characteristics, and any accidental spills of chemicals would likely be contained before they would reach groundwater; therefore, impacts to groundwater are not anticipated.

4.2.4.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities could result in potential impacts to water resources and others would not. In addition, and as explained in this section, the various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to water resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to water resources because the activities that would be conducted at these small entry and exit points are likely to be located in areas away from waterbodies, and are not likely to produce perceptible surface disturbances.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to water resources because there would be no ground disturbance.

Activities with the Potential to Have Impacts

Potential construction/deployment-related impacts to water resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including in-stream construction work, resulting primarily in sediments entering streams, but also potentially to near-shore or inland waters, as well as the potential for other impacts to water quality and floodplains. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs)[1], huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Ground disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities,

[1] POPs are connections or access points between two different networks, or different components of one network.

and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in stream sedimentation, construction of impervious surfaces and structures in floodplains, stream channel alteration, and accidental spills of fuels or lubricants to waterbodies. New Build – Buried Fiber Optic Plant projects could present a higher risk to water resources because of their relatively high degree of soil disturbance compared to the other types of projects.

- New Build – Aerial Fiber Optic Plant: Soil exposure from installation of new poles or construction of new roads, POPs, huts, or other facilities near waterbodies could result in ground disturbance, resulting in sediment deposition and increased turbidity in nearby waterbodies. The use of heavy equipment during the installation of new poles and cables could result in potential soil disturbance and the resulting potential sedimentation impacts to streams, disturbance of riparian vegetation, leaching of PCPs, and accidental spills of fuels or lubricants to waterbodies.
- Collocation on Existing Aerial Fiber Optic Plant: Lighting up of dark fiber would have *no impacts* to water resources. If required, and if done in existing huts or on existing poles with no ground disturbance, installation of new associated equipment would have *no impacts* to water resources. Ground disturbance during the replacement of poles and structural hardening could result in potential soil erosion and sedimentation impacts to streams, particularly where this work would be done in proximity to waterbodies. Collocation on Existing Aerial Fiber Optic Plant projects could present a lower risk to water resources because of their relatively low degree of soil disturbance compared to the other types of projects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in near-shore or inland bodies of water would potentially impact water quality due to disruption of sediments on the floor of the waterbody. Impacts to water resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Sediments entering limited near-shore or inland waterbodies could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Construction of facilities in floodplains could potentially impact floodplain functionality and drainage patterns.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to water resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes, huts, or access roads, there could potentially be impacts to water resources. The extent of these potential impacts would depend upon the proximity of the disturbance to waterbodies and floodplains.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation

lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to water resources. Ground disturbance and vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads completed in or near streams could result in sediments entering streams and physical disturbance of streams if crossings are required. Additionally, use of heavy equipment around streams could result in the accidental spill of fuel or other liquids from equipment that could potentially impact water quality. New Wireless Communication Tower projects could present a higher risk to water resources than some of the lower risk wired projects because of their relatively high degree of soil disturbance compared to the other projects.

- Co-location on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources because there would be no ground disturbance or in-water construction associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact water resources if this activity would not require ground disturbance or in-water construction. However, if the on-site delivery of additional power units, structural hardening, and physical security measures required travel through streams or ground disturbance, such as grading or excavation activities near streams, potential impacts to water resources could occur, including stream sedimentation and physical disturbance associated with heavy equipment use.

- Deployable Technologies
  - Where deployable technologies would be implemented on existing paved surfaces, away from streams, and outside of floodplains, it is anticipated that there would be *no impacts* to water resources because there would be no ground disturbance use of motorized equipment near streams. However, implementation of deployable technologies could result in potential impacts to water resources. These potential impacts could occur if deployment involves movement of equipment through streams, involves riparian or floodplain areas, or if the implementation results in minor construction, paving of previously unpaved surfaces in floodplains, or fuels leaking into surface or groundwater. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, minor excavation, and paving. These activities could result in erosion and sedimentation into streams. Heavy equipment use associated with these activities could result in stream sedimentation and physical disturbance of waterbodies if the equipment is used in or near streams. In addition, implementation of deployable technologies themselves could result in ground disturbance and related sediments entering waterbodies deployed in unpaved areas near streams.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use

satellite technology would not impact water resources because those activities would not require ground disturbance, construction in floodplains, or use of motorized equipment near streams.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide, public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have *no impact* to those resources.

In general, the abovementioned activities could potentially involve land/vegetation clearing, ground disturbance, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to water resources associated with deployment of this infrastructure could include soil erosion and the resulting sediments entering waterbodies; construction of structures and impervious surfaces near waterbodies and in floodplains; in-water construction related to trenching, road building, and construction of marine infrastructure; and spills of fuels, lubricants, or other materials from construction and maintenance equipment to waterbodies. These potential impacts and associated BMPs and mitigation measures to help mitigate or reduce these impacts are described in Chapter 11.

Potential Water Quality Impacts

Based on the analysis of the deployment activities described above to water resources, potential impacts to water quality are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts to water resources.

Potential Floodplain Degradation Impacts

Based on the analysis of proposed activities described above, the development of Proposed Action facilities in floodplains could result in potentially *less than significant* impacts (see Table 4.2.4-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts to water resources.

Potential Drainage Pattern Alteration Impacts

Based on the analysis of the proposed activities described above to water resources, potential impacts to water resources as a result of drainage pattern alteration are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts to water resources.

Potential Flow Alteration Impacts

Based on the analysis of the proposed activities described above, *no impacts* to water resources as a result of drainage pattern alteration would occur as a result of the Proposed Action because activities would not impact the discharge or stage of waterbodies.

Potential Groundwater or Aquifer Impacts

Based on the analysis of the proposed activities described above, potential impacts to water resources as a result of groundwater or aquifer impacts are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts to water resources.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to water resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all refueling and vehicle maintenance BMPs and mitigation measures are followed. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies.

4.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action alternative.[2]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile and aerial communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger

[2] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to water resources if deployment of ground-based equipment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, potential impacts to water resources could occur if equipment maintenance and refueling standards are not followed, resulting in spills of petroleum products or other chemicals to surface waters. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, minor excavation, and paving. These activities could result in soil erosion and related sediments entering streams, drainage pattern alteration through the creation of cleared or impervious surfaces, and/or floodplain degradation if these activities occur in floodplains. Deployment and heavy equipment use associated with these activities could result in ground disturbance and sedimentation.

Potential Operation Impacts

As explained above, operation activities would consist of implementation and running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to water resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Site maintenance, including mowing or herbicides, may result in *less than significant* effects to water quality, depending on the location and amount of herbicides used. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could potentially result in soil erosion that could impact waterbodies if the deployables are located adjacent to waterbodies.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to water resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.4, Water Resources. It is anticipated that operation impacts on water quality would be *less than significant* due to the small scale of expected FirstNet activities in any one location.

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4.2.5. Wetlands

4.2.5.1. Introduction

This section describes potential impacts to wetland resources in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.5.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on wetland resources were evaluated using the significance criteria presented in Table 4.2.5-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each potential impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

As discussed in Section 4.1.5, Wetlands, wetlands are recognized as important for maintenance of watershed and environmental health due to their potential to perform various ecological, hydrologic, biogeochemical, and social functions, although not all wetlands perform these functions equally. Typical wetland functions on the Hawaiian Islands include shoreline and stream bank stabilization, flood mitigation, maintenance of water quality, maintenance of fish and wildlife habitat, sediment retention, groundwater discharge and recharge, and maintenance of nutrient retention and export. Their capacity or degree to which they perform individual functions depends on the wetland characteristics including soil type, substrate, type and percent cover of vegetation, water source, landscape position, location within a watershed, and location relative to populated areas (*USGS 1997*).

As part of mitigation planning (to avoid, minimize, and/or compensate for unavoidable impacts to wetlands) associated with Clean Water Act (CWA) Section 404 permitting, a wetland functional assessment is typically used to categorize wetlands into one of three categories, as defined by U.S. Army Corps of Engineers (USACE) (*USACE 2014*). Category 1 wetlands are the highest quality or functioning wetlands (or rare/unique); Category 2 wetlands are moderate to high functioning (or rare/unique); and Category 3 wetlands are lesser quality or lower functioning (or less rare/unique). Although these categories are useful for determining the significance of project-specific impacts to wetlands, given the programmatic nature of this environmental analysis, the magnitude of potential wetland impacts are discussed more broadly as part of the significance criteria presented in Table 4.2.5-1.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetland resources addressed in this section are presented as a range of possible impacts.

Table 4.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude[a] or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); Violations of Section 404 of the Clean Water Act	Effect that is *potentially significant*, but with mitigation is *less than significant*	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity)	No direct loss of wetlands.
	Geographic Extent	USGS watershed level (e.g., HUC10),[d] and/or within multiple watersheds		USGS watershed (HUC10)[d] or subwatershed (HUC12)[d] level	NA
	Duration or Frequency	Long-term or permanent loss, degradation, or conversion to non-wetland		Periodic and/or temporary loss reversed over one to two growing seasons with or without active restoration	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of high-quality wetlands impacting salinity, pollutants, nutrients, biodiversity (diversity of species present), ecological condition, or water quality; Introduction and establishment of invasive plant or animal species to high-quality wetlands	Effect that is *potentially significant*, but with mitigation is *less than significant*	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity (diversity of species present), ecological condition, or water quality; Introduction and establishment of invasive plant or animal species to high-quality wetlands	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	USGS watershed level (e.g., HUC10)[d], and/or within multiple watersheds		USGS watershed (HUC10)[d] or subwatershed (HUC12)[d] level	NA
	Duration or Frequency	Long-term or permanent alteration that is not restored within two growing seasons, or ever		Periodic and/or temporary loss reversed over one to two growing seasons with or without active restoration	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Indirect effects:[b] change in function(s),[c] change in wetland type	Magnitude or Intensity	Changes to the functions or type of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.)	Effect that is *potentially significant*, but with mitigation is *less than significant*	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity)	No changes in wetland function or type.
	Geographic Extent	USGS watershed level (e.g., HUC10)[d], and/or within multiple watersheds		USGS watershed (HUC10)[d] or subwatershed (HUC12)[d] level	NA
	Duration or Frequency	Long-term or permanent change in function or type that is not restored within two growing seasons, or ever		Periodic and/or temporary loss reversed over one to two growing seasons with or without active restoration	NA

NA= not applicable
[a] Magnitude is defined based on the type of wetland impacted, high or low quality.
[b] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time.
[c] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, threatened and endangered species habitat, biodiversity, recreational/social value.
[d] Definitions of USGS watershed and subwatershed: *USGS Watershed* refers to the USGS 10 digit hydrologic unit code (HUC10), which averages approximately 230 square miles, depending on the region. *USGS Subwatershed* refers to the USGS 12 digit hydrologic unit code (HUC12), which averages approximately 40 square miles, depending on the region. See *USGS and NRCS (2013)* for an explanation of HUC codes.

4.2.5.3. Description of Environmental Concerns

Table 4.2.5-1 presents three types of potential effects to wetlands that were evaluated: direct wetland loss, other direct effects, and indirect effects. *Direct wetland loss* includes the actual loss of wetland habitat due to fill or conversion to a non-wetland habitat, such as a dryer habitat (upland area), or a wetter habitat (e.g., lake or stream). *Other direct effects* includes any direct effects that cause impacts such that the area remains a wetland and is not lost or converted, but the impacts cause a change in the type of wetland or a decrease in wetland function. *Indirect effects* are effects that occur secondarily as a result of direct effects and, like direct effects, cause a change in the type of wetland or a decrease in wetland function.

Wetland Loss

Wetland loss is a primary environmental concern for wetlands during construction. Direct wetland loss can be caused by the placement of fill into wetlands, thereby converting the wetland to a developed area. Wetlands can also be lost due to impacts to hydrology that cause a wetland to convert to a non-wetlands either by draining (converting a wetland to an upland area), or by inundation (converting a wetland to a waterbody such as a lake). Hydrologic changes can occur due to several activities, including draining or damming of a wetland, or placing fill outside of, but up or down flow of, the wetland's primary hydrologic source (in turn causing drying or inundation of the wetland, respectively); replacing native soil with soil having different drainage rates; compacting or rutting soil; or increasing non-permeable surfaces. All of these activities can in turn alter wetland drainage patterns. Potential impacts to soils that could indirectly cause changes to hydrology are discussed in greater detail in Section 4.2.2, Soils. Potential impacts to water resources that could directly or indirectly impact wetland hydrology are discussed in Section 4.2.4, Water Resources.

To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high- and low-quality wetlands would be l*ess than significant* given the small amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures). With successful BMPs and mitigation measures, potential impacts associated with the loss of high-quality wetlands would be considered *less than significant*.

Other Direct Effects

For the purpose of this assessment, direct effects are defined as any effect that occurs in the same time and place as the impact, resulting from activities including vegetation clearing, ground disturbance, hydrologic alteration such as flooding or draining, changes to soils, or water quality degradation. Short of causing wetland loss, these construction and/or operation activities could potentially cause direct effects to wetlands, such as a change in the type of wetland (e.g., vegetation type), or a decrease or loss of one or all wetland functions performed by a given wetland. These activities can alter the wetland type by shifting vegetation structure, such as changing from a forested to a woody shrub or herbaceous vegetation type, due to vegetation clearing or changes in hydrology or soil drainage. Some or all wetland functions in a given wetland can be lost or decreased due to the activities described above. Effects to high- and low-quality wetlands would be *less than significant* given the small amount of land disturbance associated with the project locations (generally less than an acre), the short timeframe of deployment activities, and the application of federal, Commonwealth, or locally required wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures).

Indirect Effects

Indirect effects can result from the same activities that cause direct effects, but the effect occurs secondarily (e.g., in a different time or location) to the direct effects. In the same ways as direct effects, indirect effects can result in a change in wetland type or decrease in wetland function. In the case of wetlands, indirect effects can be the result of direct hydrologic alterations. For example, changes in hydrology caused by direct effects (e.g., fill placement) can result in a cascade of indirect effects, including changes in vegetation structure, changes in the type of wildlife habitat that is supported by the wetland, and changes to the functions that the wetland provides, including bank stability, filtering of pollutants for maintenance of water quality, and mitigation of flood flows. Indirect effects can also occur due to other activities such as vegetation clearing and ground disturbance, resulting in changes in wildlife habitat, weed infestation, and changes in wetland function, as described previously.

It is anticipated that indirect effects to high- and low-quality wetlands would be *less than significant* due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, state, or locally required wetlands regulations. Implementation of BMPs and mitigation measures (see Chapter 11) could further reduce these potential impacts. As with the direct effects category described above, the indirect effects category includes only effects that do not cause wetland loss or conversion to non-wetland, which are covered in the wetland loss category above.

4.2.5.4. Potential Impacts of the Preferred Alternative

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetland resources. In addition, and as explained in this section, the various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to wetland resources under the conditions described below:[1]

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to wetlands resources because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to wetlands resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact wetland resources because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wetlands resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetland resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of project construction activities. The following types of infrastructure development or deployment activities could cause wetland loss, conversion of wetlands to non-wetlands, or direct or indirect effects to wetlands as a result of wetland fill, vegetation clearing, landscape grading, soil compaction, and other various ground disturbance activities. Potential wetland impacts associated with each infrastructure development type are discussed below.

[1] A determination of *no impact* from these activities assumes that no heavy construction equipment would be required for deployment, or if heavy construction equipment were required, it would be deployed on a paved or non-paved gravel surface.

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of points of presence,[2] huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands from both construction equipment and the activity itself.
  - New Build – Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the installation of new poles could result in wetland loss, conversion, or direct or indirect effects. The use of heavy equipment during the installation of new poles and hanging of cables could result in direct or indirect effects to wetlands.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in wetland fill, conversion, or direct or indirect effects to wetlands.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited near-shore or inland bodies of water could potentially impact wetland resources if the water body was a flooded wetland. In addition, potential wetland impacts could occur as a result of the construction of landings and/or facilities on shore to accept submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to wetlands. However, if installation of transmission equipment required vegetation clearing, grading, or other ground disturbance to install small boxes, hunts, or access roads, wetland loss, conversion, or direct or indirect effects to wetlands could potentially occur.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to wetland resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in wetland loss, conversion, or direct or indirect effects to wetlands.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower or structure, which would have *no impacts* to wetlands because there would be no ground disturbance associated with this activity. The potential addition of power units, structural hardening, and physical security measures would also have *no impacts* on wetland resources if this activity would not require ground disturbance. However, if the onsite delivery of additional power units, structural hardening, and

[2] Points of presence are connections or access points between two different networks, or different components of one network.

physical security measures required ground disturbance, such as grading or excavation activities, direct or indirect effects to wetlands could occur.

- Deployable Technologies
  - Implementation of deployable aerial communications architecture (such as drones, balloons, or piloted aircraft) would not likely result in any potential impacts to wetlands, as there would not be any ground disturbance. Implementation of ground-based Cell on Wheels, Cell on Light Truck, and System on Wheels would not result in potential impacts to wetland resources if deployment occurs on paved or non-paved surfaces. However, implementation of the three land-based deployable technologies (Cell on Wheels, Cell on Light Truck, and System on Wheels) could result in potential impacts to wetland resources. These potential impacts could occur if deployment occurs in undeveloped areas, requiring minor construction, grading, filling, or paving of a surface to place a deployable technology. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, excavation, and paving.

Potential Wetland Impacts

Based on the analysis of the deployment activities described above to wetland resources, potential impacts as a result of Preferred Alternative activities are anticipated to be *less than significant*.

Wetlands comprise less than 3 percent of the area on the Hawaiian Islands (*USFWS 2015*) and are considered a rare, highly valued habitat type to be preserved (*HCZMP 2014*). In addition to their general uniqueness, most Hawaiian wetlands are considered high-quality habitats due to their provision of one or more important hydrologic, geomorphic, ecological, or social functions. Such functions specific to Hawaiian wetlands include maintenance of groundwater quality to protect drinking water resources; maintenance of surface water quality; coastal or inland waterbody bank stabilization; habitat for Hawaiian endemic,[3] threatened, endangered, or other species of concern; high-quality general wildlife habitat; and community water storage, flood mitigation, and/or coastal storm protection (*USGS 1996*). Loss of wetlands or direct or indirect potential impacts resulting in a decrease in any of these functions would be *less than significant* given the small amount of land disturbance associated with the project locations (generally less than an acre) and the short timeframe of deployment activities.

Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts can be further reduced by implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures). The *Hawaii Coastal and Estuarine Land Conservation Plan* (CELCP) developed by the Hawaii Coastal Zone Management Program (*HCZMP 2014*) lists several coastal sites that were prioritized for conservation due to important habitat and functions at the site, including wetlands: Waihee Coastal Dunes and Wetlands Reserve and Muolea Point on the island of Maui, Honuapo Estuary on the island of Hawaii, and Kilauea Bay on the island of Kauai. In addition, the

[3] Endemic species are only found in one area or region.

University of Hawaii published two reports that inventoried specific wetland areas on the islands of Oahu (*Miller et al. 1989 [Oahu])* and Maui (*Miller et al. 1989 [Maui])* that provide groundwater protection for drinking water resources and are vulnerable to contamination. The wetlands identified in the CELCP and in the University of Hawaii reports would be considered highly valuable with regards to the significance of potential impact of deployment activities.

In addition to a low relative abundance of wetlands in general, certain Hawaiian wetland types are also regionally rare or unique and would be considered high quality based on this characteristic alone. One example of rare wetlands on Hawaii is wetlands associated with anchialine ponds[4] (*HWJV 2007*). Other characteristics and/or wetland types other than those listed here can certainly be associated with high-quality wetlands. As described in Section 4.2.5.2, Impact Assessment Methodology and Significance Criteria, the quality or uniqueness of wetlands potentially impacted by deployment activities would require a formal assessment on a case by case basis as part of Proposed Action permitting.

To minimize potential impacts to wetlands, BMPs and mitigation measures could be implemented in compliance with any issued federal, state, and local permits. For example, loss of jurisdictional wetlands[5] resulting from the placement of dredged or fill material would require a CWA Section 404 permit, issued by the USACE and reviewed by the U.S. Environmental Protection Agency.

See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wetlands.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *no impacts* to wetland resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If heavy equipment is used as part of routine maintenance, if inspections occur off of established access roads or corridors, or if routine maintenance and application of herbicides is used to control vegetation, potential wetland impacts could be *less than significant* as explained above.

[4] Anchialine pools are enclosed, landlocked waterbodies or ponds with an underground connection to both fresh and salt water.
[5] Jurisdictional wetlands are wetlands that are found to be "waters of the U.S." per definitions presented in the CWA, and are thus under the jurisdiction of the USACE.

4.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to wetlands associated with the Deployable Technologies Alternative and the No Action alternative.[6]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of aerial and land-based mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetland resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

Implementation of the three land-based deployable technologies (Cell on Wheels, Cell on Light Truck, and System on Wheels) could result in *less than significant* impacts. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in wetland loss, conversion, or direct or indirect effects to wetlands. Heavy equipment use associated with these activities could result in soil compaction, resulting in direct or indirect potential impacts to wetlands. However, it is anticipated that impacts to wetlands would be *less than significant* due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, Commonwealth, or locally required wetlands regulations. Implementation of BMPs and mitigation measures (see Chapter 11) could further reduce these potential impacts.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there could be *less than significant* potential impacts to wetland resources associated with routine inspections and maintenance of the Preferred Alternative.

[6] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wetland resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.5, Wetlands.

4.2.6. Biological Resources

4.2.6.1. Introduction

This section describes potential impacts to biological resources in Hawaii associated with deployment and operation of the Proposed Action, and discusses best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts. These are the resources covered in this section:

- Terrestrial vegetation, including vegetation loss, fragmentation, and invasive species;
- Wildlife, including amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates occurring in both onshore and offshore environments;
- Fisheries and aquatic habitats, including both marine and freshwater species and habitats; and
- Threatened and endangered species and species of conservation concern, including federal-, state-, or agency-listed plant and animal species and designated critical habitat.

4.2.6.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on terrestrial vegetation, wildlife, and fisheries and aquatic habitat were evaluated using the significance criteria presented in Table 4.2.6.2-1 for direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; effects to migration or migratory patterns; reproductive effects; and invasive species effects. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*.

The potential impacts of the Proposed Action on threatened and endangered species and species of conservation concern were evaluated using the significance criteria presented in Table 4.2.6.6-1 in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern. The categories of impacts are defined as: *may affect, likely to adversely affect; may affect, not likely to adversely affect;* and *no effect*. These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* (*USFWS and NMFS 1998*).

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact. Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to biological resources addressed in this section are presented as a range of possible impacts.

Table 4.2.6.2-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, and Fisheries and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population[a] injury/mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics[b] or concentrations during breeding or migratory periods. Violation of various regulations including: MMPA, MBTA, and BGEPA.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant.*	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within each respective state or territory for at least one species. Anthropogenic[c] disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within 1 to 3 years.	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of said species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia,[d] or cover from weather or predators. Violation of various regulations including: MMPA, MBTA, and BGEPA.	Effect that is *potentially significant*, but with BMPs and mitigation is *less than significant.*	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from the Proposed Action would occur.
	Geographic Extent	Regional effects observed within each respective state or territory for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or subpopulation located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within 1 to 3 years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation or the avoidance or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MMPA, MBTA, and BGEPA.	Effect that is *potentially significant*, but with BMPs and mitigation is *less than significant*	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within each respective state or territory for at least one species; Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts,[e] resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within 1 to 3 years.	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MBTA, and BGEPA.	Effect that is *potentially significant*, but with BMPs and mitigation is *less than significant.*	Temporary loss of migratory rest stops due to anthropogenic activities takes place in important habitat that is widely distributed, and there are no cumulative effects from additional projects.	No alteration of migratory pathways and no stress or avoidance of migratory paths/patterns due to Proposed Action activities.
	Geographic Extent	Regional effects observed within each respective state or territory for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within 1 to 3 years.	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MBTA, and BGEPA.	Effect that is *potentially significant*, but with BMPs and mitigation is *less than significant.*	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within each respective state or territory for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning, or anthropogenic disturbances that lead to stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigations Measures Incorporated**	**Less than Significant**	**No Impact**
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is *potentially significant*, but with BMPs and mitigation is *less than significant.*	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to Proposed Action sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

BMPs = best management practices; BGEPA = Bald and Golden Eagle Protection Act; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; NA = not applicable; RF = Radio Frequency

[a] Interbreeding organisms occupying a certain space; the number of people or other living creatures in a designated area.

[b] Species that are only found in one area or region.

[c] Changes caused by humans.

[d] Areas of stable environmental conditions that protect wildlife and organisms from environmental change.

[e] Haulouts refers to periods are when seals and walrus come ashore (either land or ice) to rest, molt or breed.

4.2.6.3. Terrestrial Vegetation

Introduction

This section describes potential impacts to terrestrial vegetation resources in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are discussed in Chapter 11, BMPs and Mitigation Measures.

Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on terrestrial vegetation resources were evaluated using the significance criteria presented in Table 4.2.6.2-1 for vegetation and habitat loss, alteration, or fragmentation, and invasive species effects.[1] As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant, less than significant with BMPs and mitigation measures incorporated, less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation resources addressed in this section are presented as a range of possible impacts.

Description of Environmental Concerns

Terms and concepts discussed in this section are further discussed and defined in the Affected Environment section (Section 4.1.6.3, Terrestrial Vegetation).

Vegetation and Habitat Loss, Alteration, or Fragmentation[2]

With any construction project requiring ground disturbance, one of the main concerns during construction activities includes vegetation clearing. Not only could vegetation loss potentially result in wildlife habitat loss or fragmentation, as described in Section 4.2.6.4, Wildlife, it could also lead to accelerated erosion and increased sedimentation in waterways.[3] As explained in Section 4.2.2, Soils, soil erosion could alter natural sediment transport processes in streams and other surface waterbodies, which can impair water and habitat quality and potentially affect aquatic plants and animals. Soil suborders in Hawaii that have moderate to severe erosion

[1] Although direct and indirect injury/mortality, effects to migration or migratory patterns, and reproductive effects are types of effects presented in Table 4.2.6.2-1 that are applicable to other biological resources, these effects do not apply to terrestrial vegetation and are therefore not included in this section. For discussions of Wildlife, Fisheries and Aquatic Habitats, and Threatened and Endangered Species and Species of Conservation Concern, see Sections 4.2.6.4, 4.2.6.5, and 4.2.6.6, respectively. A discussion of potential wetland impacts is included in Section 4.2.5, Wetlands.

[2] Vegetation and habitat loss, alteration, or fragmentation effects related to wildlife are presented in Section 4.2.6.4, Wildlife.

[3] Keeping soil vegetated is often the most effective way to prevent erosion.

potential include the Udands, Ustands, Orthents, Psamments, Aquepts, Ustepts, Udox, Ustox, and Humults soil suborders (see Section 4.2.2, Soils, for descriptions of these soil types).

As described and shown graphically in Section 4.1.6.3, Terrestrial Vegetation, the majority of the Hawaiian Islands consists of forest and woodland as well as introduced and semi-natural vegetation. Potential impacts to terrestrial vegetation could occur in areas where construction activities require vegetation cutting, clearing, and/or removal. It is anticipated that for most types of facilities or infrastructure development scenarios, vegetation loss would likely be isolated within construction locations and/or would be short-term with stability achieved within several years, depending on the vegetation cover present in the area.[4] As discussed in Chapter 11, BMPs and mitigation measures would help avoid or minimize potential vegetation loss associated with ground disturbance activities.

Invasive Species Effects

Once a landscape has been cleared of vegetative cover and soil is disturbed, the re-establishment of native vegetation could be delayed or prevented if undesirable noxious weeds and/or invasive plants become established (*USFS Undated*). As discussed in Section 4.1.6.3, Terrestrial Vegetation, some invasive plants in Hawaii, such as the fireweed (*Senecio madagasariensis*), Himalayan blackberry (*Rubus discolor*), ivy gourd (*Coccina grandis*), and others, thrive in disturbed soil environments (*Hawaii Invasive Species Council 2015*). Once established, these invasive plants can displace native plants preferred by native animals. In addition, construction equipment or vehicles traveling from areas infested with invasive or noxious plants to areas free of those plants could disperse them if proper care is not taken or if BMPs and mitigation measures are not followed if they are deemed not practicable or feasible (see Chapter 11, BMPs and Mitigation Measures).

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities could result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impact* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

[4] Clearing of trees in forested and woodland areas (see Section 4.1.6.3, Terrestrial Vegetation, for an explanation of these vegetation types) could result in potential longer-term impacts given the length of time needed for these vegetation communities to mature to pre-disturbance conditions. Therefore, the duration of the potential impact would depend in part on the type of vegetation to be cleared. Grasses, for example, take less time to mature and become re-established than a stand of large trees.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to terrestrial vegetation resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to terrestrial vegetation resources because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to terrestrial vegetation resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact terrestrial vegetation resources because those activities would not require ground disturbance or vegetation clearing.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact vegetation, it is anticipated that this activity would have *no impact* to terrestrial vegetation resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to terrestrial vegetation resources in Hawaii as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including vegetation and habitat loss, alteration, or fragmentation, and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation resources include the following activities:

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence,[5] huts, or other associated facilities or hand-holes to access fiber would require ground disturbance that would likely

[5] Points of presence are connections or access points between two different networks, or different components of one network.

result in vegetation loss.[6] In addition, ground disturbance and heavy equipment use associated with excavation activities and landscape grading for constructing points of presence, huts, or other associated facilities or hand-holes to access fiber could also result in vegetation clearing or loss. Furthermore, in some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs[7] and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.

- New Build–Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the installation of new poles could result in ground disturbance and vegetation loss. Additionally, forested areas would likely need to be permanently converted to and maintained as shrub/grassland in the permanent right-of-way. In some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.
- Collocation on Existing Aerial Fiber Optic Plant: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *no impact* to terrestrial vegetation because there would be no ground disturbance or vegetation clearing associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact vegetation if these activities would not require ground disturbance or vegetation clearing. However, topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening (should that be required) could result in ground disturbance and vegetation loss. However, it is anticipated that in most cases there would generally be less soil disturbance compared to a new build project. If that is the case, there would likely be correspondingly fewer potential impacts to terrestrial vegetation. In some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.
- New Build–Submarine Fiber Optic Plant: The installation of cables in limited near-shore or inland bodies of water would have *no impact* terrestrial vegetation because there would be no ground disturbance associated with this activity (see Section 4.2.6.5, Fisheries and Aquatic Habitats, for a discussion of potential impacts to aquatic habitat).

[6] See Section 2.1.2, Proposed Action Infrastructure, for a description of the types of infrastructure to be potentially implemented and explanations of specific techniques and terms.
[7] BMPs and mitigation measures to minimize potential impacts to terrestrial vegetation resources are listed in Chapter 11, BMPs and Mitigation Measures.

However, potential impacts to vegetation could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Soil disturbance and vegetation loss could occur as a result of grading, foundation excavation, or other ground disturbance activities. Furthermore, in some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.

  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance or vegetation clearing, there would be *no impacts* to terrestrial vegetation. However, if installation of transmission equipment would require vegetation clearing, landscape grading, or other ground disturbance to install small boxes, huts, or access roads, there would be potential impacts to terrestrial vegetation. In some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to terrestrial vegetation resources. Excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads would likely result in vegetation loss. Furthermore, in some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance or resulted in vegetation loss, such as grading or excavation activities, potential impacts to vegetation resources would occur. It is anticipated that in most cases there would generally be less soil disturbance compared to a new build project. If that is the case, there would likely be correspondingly fewer potential impacts to terrestrial vegetation. Furthermore, in some build-out locations,

short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.

- Deployable Technologies
  - Where deployable technologies would be located on existing paved surfaces, it is anticipated that there would be *no impacts* to terrestrial vegetation resources because there would be no new ground disturbance or vegetation clearing required. However, implementation of deployable technologies could result in potential impacts to terrestrial vegetation if deployment of land-based or aerial deployables occurs in unpaved areas and results in vegetation loss. Some staging areas could require land clearing, excavation, and paving, which would result in vegetation loss. Furthermore, in some build-out locations, short-term and localized potential impacts to terrestrial vegetation could occur as a result of invasive or noxious weed establishment if local conditions and ground disturbance creates an environment conducive to their spreading. However, BMPs and mitigation measures to promptly and properly revegetate disturbed areas would help further reduce these potential impacts.

In general, the abovementioned activities could potentially involve land clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to terrestrial vegetation resources associated with deployment of this infrastructure could include vegetation loss and invasive species effects. These potential impacts are described further below and associated BMPs and mitigation measures to help mitigate or reduce these potential impacts are discussed in Chapter 11, BMPs and Mitigation Measures.

Potential Vegetation Loss Impacts

Based on the analysis of the deployment activities described above related to terrestrial vegetation resources, potential impacts as a result of vegetation loss are anticipated to be *less than significant* (see Table 4.2.6.2-1).[8] As mentioned previously, even if certain forested areas would be impacted that require more than several years to become re-established or would be permanently converted to a different cover type, the magnitude/intensity and geographic extent of the vegetation loss is anticipated to be *less than significant*, and further reduced with the implementation of BMPs and mitigation measures. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential vegetation loss impacts.

[8] Potential impacts to wildlife as a result of vegetation and habitat loss, alteration, or fragmentation as well as a listing of applicable BMPs and mitigation measures are discussed in Section 4.2.6.4, Wildlife, and Chapter 11, respectively.

Potential Invasive Species Impacts

Based on the analysis of proposed activities described above, invasive species effects could result in potentially *less than significant* impacts since it is anticipated that the proposed activities would not lead to measureable increases in invasive species populations, would be localized to individual build-out locations, and would result in changes that could be reversed over one or two growing seasons or less (see Table 4.2.6.2-1). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential invasive species impacts.

Potential Operation Impacts

As explained above, implementation of land-based deployable technologies could result in *no impacts* if the deployment occurs on paved or previously disturbed surfaces and *less than significant* impacts to terrestrial vegetation resources if deployment occurs in unpaved areas and results in vegetation loss, or if the implementation results in paving of previously unpaved vegetated surfaces. Potential impacts to vegetation could also occur if ground disturbance of the deployable vehicle(s) creates an environment conducive to invasive plant species and they become established, however, those potential impacts, as explained above, would also be *less than significant*. In addition, some staging or landing areas (depending on the type of technology) could require land clearing, minimal excavation, and paving, which could result in *less than significant* vegetation loss. BMPs and mitigation measures could help to minimize the spread of noxious and invasive weeds.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action alternative.[9]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile land-based and aerial communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Potential impacts to terrestrial vegetation resources as a result of implementation of this alternative are described below.

[9] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Potential Deployment Impacts

As explained above, implementation of land-based deployable technologies could result in *no impacts* if the deployment occurs on paved or previously disturbed surfaces and *less than significant* impacts to terrestrial vegetation resources if deployment occurs in unpaved areas and results in vegetation loss, or if the implementation results in paving of previously unpaved vegetated surfaces. Potential impacts to vegetation could also occur if ground disturbance of the deployable vehicle(s) creates an environment conducive to invasive plant species and they become established; however, those potential impacts, as explained above, would also be *less than significant*. In addition, some staging or landing areas (depending on the type of technology) could require land clearing, minimal excavation, and paving, which could result in less than significant vegetation loss. BMPs and mitigation measures could help to minimize the spread of noxious and invasive weeds. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential vegetation loss and/or invasive species impacts.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, there would be *no impacts* anticipated to terrestrial vegetation associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and results in ground disturbance or land clearing, vegetation loss and/or invasive species effects could result in *less than significant impacts* as previously explained above. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential vegetation loss and/or invasive species impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to terrestrial vegetation resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.6.3, Terrestrial Vegetation.

4.2.6.4. Wildlife

Introduction

This section describes potential impacts to wildlife resources in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures. Potential impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates occurring in Hawaii and Hawaii's offshore environments are discussed in this section.

Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on wildlife resources were evaluated using the significance criteria presented in Table 4.2.6.2-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wildlife resources addressed in this section are presented as a range of possible impacts.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. In general, the most common direct injuries from development projects are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals, like marine mammals, from disturbance events. Direct injury/mortality environmental concerns pertaining to Hawaii's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below.

<u>Amphibians and Reptiles</u>

Direct mortality to amphibians and reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals. Environmental consequences pertaining to Hawaii's protected reptiles (including sea turtles) are discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Mammals

Vehicle strikes are sources of direct mortality or injury to terrestrial mammals in Hawaii. Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur; however, these events are expected to be temporary and isolated, affecting only individual mammals.

Potential impacts of fences or other barriers on wildlife could be a source of mortality or injury to terrestrial mammals. Bats frequently incur injuries from collisions or entanglements in fences (*Amesbury 2007*). Fences or other barriers can also effectively corral wildlife on roadways where vehicular traffic increases strike mortality. Entanglement resulting from wildlife attempting to traverse under or over the barrier is also of concern, as animals can get appendages caught. Potential impacts of fences or other barriers would likely be isolated, individual events.

Marine Mammals

Underwater sound sources, if intense enough, could cause injury or death to marine mammals in the vicinity of the activity. However, given the limited amount of near-shore deployment activities, it is unlikely this would result in population-level impacts and would be isolated, individual events. BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to minimize potential impacts from underwater noise.

Direct mortality and injury to marine mammals as a result of vessel strikes could occur but are not likely to be widespread or affect populations of species as a whole. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further reduce potential impacts. Mitigation measures that are the result of consultations with the National Marine Fisheries Service would be followed, as required.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species, with some species covered under the Migratory Bird Treaty Act. Generally, collision events occur to “poor” fliers (such as ducks), heavy birds (such as swans and cranes), and birds that fly in flocks. Species susceptible to electrocution are birds of prey and thermal soarers[1] like great frigatebirds (*Fregata minor*) that typically have large wing spans. Avian mortalities or injuries can also result from vehicle strikes, although they typically occur as isolated events.

Direct mortality and injury to birds of Hawaii are not likely to be widespread or affect populations of species as a whole and would be further reduced by implementing BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures). Mitigation measures that are a result of consultations with the U.S. Fish and Wildlife Service regarding potential impacts to migratory birds will be implemented, as required.

[1] Soarers are birds that fly to a considerable altitude and maintain elevation without moving their wings by using ascending air currents. This is done because soaring is much more energy efficient than flapping their wings, and soarers generally hunt from the air and so spend a lot of time waiting for prey.

Terrestrial Invertebrates

Direct injury or mortality events to terrestrial invertebrates would be similar to those described above for amphibians and reptiles (i.e., vehicle strikes). The overall abundance of terrestrial invertebrate populations of the islands is not expected to be affected by direct mortality or injury events. Several invertebrate species are of particular concern as a result of habitat loss and degradation. Environmental consequences for these species are discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Potential habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Additionally, habitat loss can occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause isolated, temporary exclusion effects only in very special circumstances.

Potential effects of vegetation and habitat loss, alteration, or fragmentation are described for Hawaii's wildlife species below.

Amphibians and Reptiles

In general, amphibian species utilize aquatic habitats for some part of their life cycle. Amphibian species have a complex life cycle (i.e., having both larval and adult stages) and require aquatic habitats, such as vernal pools,[2] temporary ponds, and even streams for mating, egg laying, and larval growth. Aquatic habitats are naturally dynamic, often filling and drying on an annual basis. Amphibians associated with these habitat types are specifically adapted to such processes.

Filling or draining of wetland breeding habitat and alterations to ground or surface water flow associated with the Proposed Action could have effects on Hawaii's amphibian and reptile populations, although the Proposed Action is likely to only affect a small number of the overall population. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to minimize the potential impacts.

[2] Vernal pools are formed in basin depressions and are ponded only during the wetter part of the year, also known as ephemeral pools (*USEPA 2015*)

The activities associated with the Proposed Action (see below) would cause disturbance and result in temporary displacement of amphibians and reptiles. Some limited amount of infrastructure may be built in these sensitive areas that could permanently displace small numbers of individuals. Implementation of BMPs and mitigation measures could further help minimize potential impacts.

Terrestrial Mammals

The loss of suitable habitat is a major cause for declines in bat populations (*NRCS 2009*). The loss of tree cover (e.g., roost sites) may be the primary reason for the Hawaiian hoary bats' (*Lasirus cinereus semotus*) decline in Hawaii (*Mitchell et al. 2005*). Removal or loss of forest also decreases foraging habitat and would impact insect-eating bats like the Hawaiian hoary bat that are dependent on the forest for the diversity and numbers of flying insects.

Roost disturbances can also lead to exclusion of resources. Bats can abandon roost sites for less suitable habitat, and be exposed to unfamiliar territory and predators. Roost disturbance when the juvenile hoary bats are fledging (July through September) has the highest potential for impacts (*NRCS 2009*).

Habitat loss, fragmentation, or alteration effects would likely be temporary and/or isolated. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further reduce potential impacts.

Marine Mammals

The waters of the South Pacific serve as primary habitat for a range of critical activities including feeding, mating, and calving. Some marine mammals occupy a relatively well-defined habitat year-round or have a narrow feeding niche that restricts them to a particular kind of habitat (e.g., pinnipeds need access to beaches to haul out). Environmental consequences to protected marine mammals are discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Marine mammals may be temporarily excluded from a resource if they avoid it due to the increased noise associated with human activity. Depending on the duration of the activity, marine mammals could be excluded from their environment temporarily or could abandon the habitat entirely (*Richardson et al. 1995*). However, the degree to which habitat exclusion affects marine mammals depends on many factors. Marine mammals are mobile and generally use open water habitat; therefore, it is expected that sea-based activities from the Proposed Action, which would be limited to small boats in near-shore and inland waters, would not affect the ability of marine mammals to access important resources.

Birds

The removal and loss of vegetation can affect avian species directly by loss of nesting, foraging, and cover habitat. Displacement of migratory birds is of particular concern in Hawaii because the islands are important stopovers for resting and replenishing energy stores as well as wintering habitats. For example, the bristle-thighed curlew (*Numenius tahitiensis*), Pacific golden-plover (*Pluvialis fulva*), and wandering tattler (*Tringa incana*) spend the nonbreeding season on the islands within the Central Pacific Flyway (*PWNET 2015*).

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration could increase the likelihood that birds would avoid the area, possibly being excluded from essential resources.

The degree to which habitat exclusion affects birds depends on many factors. Exclusion from resources concentrated in a small migratory stop area during peak migration could have potential impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of birds. Potential impacts to birds could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

Terrestrial Invertebrates

Terrestrial invertebrates could be displaced or disturbed by activity associated with the Proposed Action on the island. Proposed Action activities that could affect terrestrial invertebrates are expected to be temporary and isolated, affecting only small numbers of terrestrial invertebrates. Potential impacts could be further reduced by the implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures). Several invertebrate species are of particular concern as a result of habitat loss and degradation. Environmental consequences for these species are discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Indirect Injury/Mortality

"Indirect effects" are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (*40 Code of Federal Regulations 1508.8[b]*). Indirect injury/mortality can include stress related to disturbance and disruption of life history patterns (such as migration and breeding) important for survival. A short-term stress response to an acute, temporary stressor initiates a "fight or flight" response that diverts energy (which would otherwise be used for reproduction and growth) to the immediate survival of the animal (*Reeder and Kramer 2005*). Most organisms are well adapted and recover quickly from these types of stressors. A chronic stress response to a persistent stressor, however, can be detrimental to the organism and result in cell death, compromised immune system, muscle wasting, reproductive suppression, and memory impairment (*Reeder and Kramer 2005*). Potential indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

Amphibians and Reptiles

In general, amphibian species utilize aquatic habitats for some part of their life cycle. Amphibian species have a complex life cycle (i.e., having both larval and adult stages) and require aquatic habitats, such as vernal pools, temporary ponds, and even streams for mating, laying eggs, and larval growth. Aquatic habitats are naturally dynamic, often filling and drying on an annual basis. Amphibians associated with these habitat types are specifically adapted to such processes. Changes in water quality and quantity and loss of wetlands and vernal pools, especially during the breeding seasons, reduce the number and density of breeding sites, leading to lower productivity and diminishing the capacity to maintain local and regional species populations (*Semlitsch 2000*). However, changes in water quality or quantity are expected to be temporary and isolated, affecting only a limited number of amphibians.

Reptiles are generally more hardy animals than amphibians, occupy more diverse habitats, and can tolerate longer periods without food and water. However, reptiles are still susceptible to stress from changes in their environment (*ScienceNordic 2012*).

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., maternity and weaning periods, inactivity) can reduce the overall fitness and productivity of young and adult terrestrial mammals. For example, bats are particularly vulnerable to disturbance during periods of torpor (when arousal affects their ability to conserve energy) and during the breeding season (when they are gathered in maternity colonies where disturbance may cause a decline in breeding success) (*Gannon et al. 2005*). Bats in poor body condition are more susceptible to disease (*Gannon et al. 2005*). Potential indirect injury or mortality to bat species as a result of the Proposed Action is discussed in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Marine Mammals

As discussed above, Hawaii's waters are primary habitat for feeding, calving, and mating marine mammals. Repeated disturbance, especially near calving or foraging areas, can cause behavioral changes such as alteration or cessation of feeding, nursing, or resting. These behavioral changes can increase an animal's energy expenditure or result in chronic levels of stress, which could have a negative effect on health (*Parsons 2012*). Additional behavioral changes observed in cetacean species in response to disturbance include changes in surfacing, acoustic, and swimming behavior and changes in direction, group size, and coordination, all of which can result in additional energetic cost (*Parsons 2012*). However, deployment activities would only take place in near-shore environments and are expected to be temporary and isolated, likely affecting only individual marine mammals.

Indirect effects from displacement or habitat damage could include lowered fitness as a result of increased energetic challenges, either as added travelling costs or reduced foraging opportunities. However, deployment activities would only take place in near-shore environments and are expected to be temporary and isolated, likely affecting only individual marine mammals. Indirect effects as a result of displacement and disturbance could be further minimized through the use of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

Birds

Nest abandonment and increased predation are two consequences resulting from human-induced disturbance during the breeding/nesting season. Disturbance during migration has been shown to negatively affect grazing geese, shorebirds, and lowland and upland waders (*Hockin et al. 1992*). Most waterfowl and shorebirds take to flight when disturbed; displacing them from preferred feeding or roosting areas (*Tuite et al. 1983; Bell and Austin 1985; Cryer et al. 1987*) or leading them to abandon areas completely (*Bell and Austin 1985; Korschgen et al. 1985; Burger 1986*). A shift from preferred to less preferred feeding areas is likely to affect feeding efficiency (*Burger 1988*).

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of birds. Potential impacts to birds could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

Terrestrial Invertebrates

Terrestrial invertebrates could experience chronic stress either by changes in habitat composition or competition for resources, resulting in lower productivity. However, the overall abundance of terrestrial invertebrate populations in Hawaii is not expected to be affected by indirect mortality or injury events.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Potential effects to migration patterns of Hawaii's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below.

Amphibians and Reptiles

Sea turtles are long-distance migrators, swimming long distances to their nesting home range of the tropic and subtropic regions. The leatherback turtle is the record holder, traveling an astounding 10,000 miles or more each year in search of jellyfish, crossing the entire Pacific Ocean from Asia to the West Coast of the U.S. to forage (*Oceanic Society 2015*). Potential effects to migratory patterns of protected species are described in Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Loss of stream functionality as dispersal corridors could have major potential impacts to reptile and amphibians that are reliant on the resource during critical migratory and reproductive periods. Restrictions or alterations of waterways are not expected to affect widely distributed populations as a whole. Other amphibian species in Hawaii that concentrate in smaller areas and are not widely distributed could potentially be impacted at the population level depending on the amount of resource altered. However, as deployment activities would be limited and temporary, it is likely that only individual amphibians would be impacted, rather than entire populations. BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to avoid or minimize potential impacts.

Terrestrial Mammals

Hawaii's terrestrial mammals do not have long-distance migratory patterns though some may exhibit short-distance dispersals. Potential impacts can vary depending on the species, time of year of construction/operation, and duration; however, as deployment activities are expected to be temporary and isolated, it is likely the short-distance dispersal of individual terrestrial mammals would be potentially impacted by the Proposed Action. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to avoid or minimize potential impacts. It is likely that the limited number of permanent structures such as towers or access roads would also have a minimal impact on migratory patterns.

Marine Mammals

Most species of large whales in the Southern Hemisphere migrate from the Pacific islands to the Antarctic Ocean each summer to feed and then return each winter to the Pacific islands to breed (*NZDC 2007*). Noise associated with the installation of cables in the near/offshore waters of the islands could potentially impact marine mammal migration patterns, though any potential impacts are likely to be short-term provided the noise sources are not wide ranging and below Level A and B sound exposure thresholds.[3] Behavioral changes observed in cetacean species in response to disturbance include changes in surfacing, acoustic, and swimming behavior and changes in direction, group size, and coordination, all of which can result in additional energetic cost (*Parsons 2012*). It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning. Additionally, as marine mammals have the capacity to divert from sound sources during migration, it is unlikely the Proposed Action would result in migratory impacts. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to avoid or minimize potential impacts.

[3] Level A (minimum exposure criterion for injury at the level at which a single exposure is estimated to cause onset of permanent hearing loss): 190 decibels (dB) referenced to 1 micro Pascal (μPa) (root mean square [rms]) for seals and 180 dB referenced to 1 μPa (rms) for whales, dolphins, and porpoises. Level B (defined as the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing): 160 dB referenced to 1 μPa (rms) (*Southall et al. 2007*).

Birds

Because many bird species have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. Hawaii is located along the Central Pacific Flyway between North American breeding sites and South Pacific wintering grounds. This flyway is crucial for the bristle-thighed curlew (*Numenius tahitiensis*), Pacific golden-plover (*Pluvialis fulva*), and wandering tattler (*Tringa incana*), which spend the nonbreeding season on the islands within this flyway (*PWNET 2015*). Many migratory routes are passed from one generation to the next. Potential impacts can vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration. It is unlikely that the limited amount of infrastructure and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to avoid or minimize potential impacts to migratory pathways.

Terrestrial Invertebrates

Very little is known about migratory behavior in Hawaii's terrestrial invertebrates. It is expected that the majority of terrestrial invertebrates are localized in their movements during their short life spans and as a result, no migratory effects to Hawaii's common terrestrial invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which can affect the overall population of individuals.

Amphibians and Reptiles

Reproductive effects to sub-populations of amphibians and reptiles could occur through the loss of habitat if deployment activities occur near breeding wetlands, alter water quality through sediment infiltration, or obstruction of natural water flow to pools. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize potential impacts.

Terrestrial Mammals

Disturbance during critical life phases (maternity and weaning periods) could affect reproductive success of bats in Hawaii, and could result in the abandonment of offspring, leading to reduced survival. It is, however, unlikely that the limited amount of infrastructure and the temporary nature of the deployment activities would impact the life phases of large numbers of bats. It is more likely that individual bats could be affected. Additionally, implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could reduce potential impacts.

Marine Mammals

Restricted access to important calving and nursing grounds has the potential to negatively affect body condition and reproductive success of many marine mammals. As described above, behavioral changes associated with disturbance could also affect mother-infant bonding, reducing survival success of offspring (*Parsons 2012*). Disturbances that could impair socialization (e.g., noise or displacement) can influence reproduction rates through reduced mating opportunities (*Lusseau and Bejder 2007*). As deployment activities are expected to take place only in limited near-shore environments and for a short duration, it is unlikely that marine mammals would experience reproductive impacts. Additionally, implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further reduce any reproductive impacts.

Birds

The Hawaiian Islands are important breeding areas for seabirds such as albatrosses and petrels (*Mitchell et al. 2005*). Potential impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) could displace birds into less suitable habitat and thus reduce survival and reproduction. The loss of important breeding habitats, such as preferred low coral and sand islands, could result in seabird displacement into marginal habitats, increased predation risks, and/or nest abandonment and chick mortality (*Mitchell et al. 2005*). Avian tolerance levels to disturbance can be species-specific. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in flushing birds from nesting areas; however, the temporary nature of the deployment activities would minimize these impacts. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further help to avoid or minimize potential impacts.

Terrestrial Invertebrates

Hawaii's terrestrial invertebrate species are highly diverse and prevalent. Currently, little is known on the status of species populations. It is expected that the majority of terrestrial invertebrates are widespread in Hawaii and as a result, no population-level reproductive effects to terrestrial invertebrates are expected as a result of the Proposed Action.

Invasive Species Effects

The introduction of non-native species is often the result of human activity. Invasive (non-native) species can have a dramatic effect on natural resources and native populations. Hawaii's wildlife populations have been affected by invasive species (*USFWS 2012*).

Non-native species that are introduced into an ecosystem in which they did not evolve often increase rapidly in number. Native species evolve together as a community and function within an ecosystem governed by many checks and balances. Balance evolves within the system that limits the population growth of any one species; for example predators, herbivores, diseases, parasites, and other organisms compete for the same resources under limiting environmental factors. A non-native species, when introduced into an ecosystem in which it did not evolve naturally, is often times not bound by those limits; its numbers can sometimes dramatically increase and have severe potential impacts on the native community and ecosystem. Invasive species are often times very capable of out-competing native species for food and habitats and sometimes may even be attributed to the extinction of native species or potentially impact the species richness in an ecosystem (*USFWS 2012*).

Potential invasive species effects to Hawaii's wildlife are described below.

Amphibians and Reptiles

There are no amphibians or terrestrial reptiles native to the Hawaiian Islands. However, the introduction of new species can lead to exploitation, competition, and displacement of established reptiles and amphibians, such as the coqui frog (*Eleutherodactylus coqui*) on Hawaii (*DLNR 2015*). The limited deployment of infrastructure and the short duration of construction activities are unlikely to result in new species being released. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further reduce potential impacts.

Terrestrial Mammals

Of the extinctions on islands in modern history, rats are estimated to have caused 50 to 81 percent of mammal extinctions (*Ceballos and Brown 1995*). Rats are a serious problem throughout the Pacific (*Buden 2000*; *Mitchell et al. 2005*). Invasive species related extinctions occur not only via direct predation, but also by eliminating common prey species used by other mammals. For example, besides eating seeds and small vertebrates, rats prey heavily on insects. This, in turn, can seriously reduce native populations of obligate[4] insect-eaters, such as bats. Other introduced species, such as the feral pig, have been implicated in destruction and degradation of key forest habitats for Hawaii's bat populations (*Mitchell et al. 2005*).

As the limited deployment of infrastructure and the short duration of construction activities are unlikely to result in any of the above named species being introduced or further exacerbated, it is unlikely that the Proposed Action would impact terrestrial mammals through the introduction of invasive species. Invasive species effects to terrestrial mammals could be further minimized following the BMPs and mitigation measures described in Chapter 11, BMPs and Mitigation Measures.

Marine Mammals

Invasive species are detrimental to native communities and ecosystem in that they compete for the same natural resources and life requirements (food, space, and shelter) as native species effectively displacing native fauna and flora communities. Displacement radically alters the nature of the habitats, resulting in the degradation of local ecologies, disrupting food chains, and finally causing the extinction of native species (*USFWS 2012*). Disruptions of food chains can potentially impact higher trophic (i.e., feeding) level species like marine mammals that are

[4] Obligate means "by necessity." The dictionary definition is: 1. Restricted to one particularly characteristic mode of life.

specialized feeders. However, the short duration of construction activities in limited near-shore locations are unlikely to result in the introduction or further exacerbation of invasive species to marine environments. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures) could further reduce the likelihood of effects to the marine ecosystem from invasive species.

Birds

Hawaii bird communities are vulnerable to introduced predators such as rats and feral cats. Seabird populations are particularly susceptible to invasive predators because of their unique life histories. Seabirds are long-lived and many species do not typically reproduce until attaining at least 2 to 3 years of age. Clutch sizes are typically small and young undergo long fledgling periods. These life history variables manifest in low annual productivity. Seabirds typically nest on the ground or in burrows or crevices and are absent for long periods on forage bouts (e.g., albatross and frigatebirds). Absence for long periods leaves the eggs and young vulnerable to predation (*Moors and Atkinson 1984; Major et al. 2006*).

Introduced mammals, invertebrates, and plants are known to degrade nesting habitat of many seabirds on the Hawaiian Islands (*Mitchell et al. 2005*). As the Proposed Action only involves temporary limited near-shore deployment activities, it is unlikely invasive species would be released by the construction activities that could threaten seabird populations. Additionally, due to the temporary and limited nature of terrestrial deployment activities, it is also unlikely that invasive species would be introduced or further exacerbated as a result of construction of the Proposed Action. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures), would further reduce potential impacts associated with invasive species.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that could change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation. Introduced predators, such as carnivorous snails and rats have been a major factor in the reduction of Hawaii's native snail populations (*Mitchell et al. 2005*). Additionally established populations of introduced ants, wasps, and parasites have negatively affected native invertebrates (*Mitchell et al. 2005*). Introduced invertebrates also compete directly for food and habitat with native species. As the Proposed Action involves temporary and limited deployment actions, it is unlikely that construction activities would result in population-level impacts as a result of the introduction or further exacerbation of invasive species. Implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures), would further reduce potential impacts associated with invasive species.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology,[5] and the nature and extent of the habitats affected.

<u>Activities Likely to Have No Impacts</u>

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to wildlife because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes. Additionally noise generated to install fiber would be infrequent and of short duration and unlikely to produce measureable changes in wildlife behavior.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to wildlife because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.

[5] Phenology is the seasonal changes in plant and animal life cycles, such as emergence of insects or migration of birds.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential construction/deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of points of presence (POPs),[6] huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles and amphibians, terrestrial invertebrates, and young), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).
  - New Build–Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public right-of-ways (ROWs) or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Potential impacts could vary depending on the number or individual poles installed, but could include direct injury/mortality as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to

[6] POPs are connections or access points between two different networks, or different components of one network.

wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects, indirect injury/mortality, and habitat loss if roost sites are abandoned. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).
- New Build–Submarine Fiber Optic Plant: The installation of cables in limited near-shore or inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources and Section 4.2.6.6, Threatened and Endangered Species and Species of Conservation Concern, for potential impacts to listed wildlife).[7] Effects could include direct injury/mortality; habitat loss, alteration, or fragmentation. If activities occurred during critical time periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to wildlife because no new infrastructure would be created and no disturbance to wildlife would incur. However, if installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality, of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns; indirect injury/mortality; and invasive species effects could occur as a result of construction and resulting disturbance. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

[7] Listed wildlife is any animal listed as threatened or endangered by federal or state agencies.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife if no additional disturbance is required to install the hardware on the tower. The potential addition of power units, structural hardening, tower replacement, and physical security measures such as lighting could potentially impact wildlife resources resulting in direct injury/mortality from disturbance activities that could occur during the installation of new equipment. However, deployment activities are expected to be temporary and isolated, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures). Refer to Section 2.4, Radio Frequency Emissions, for information on radio frequency concerns.
- Deployable Technologies
  - In general, some limited construction could be associated with the implementation of deployable technologies such as land clearing or paving for parking or staging areas. This could lead to vegetation and habitat loss, alteration, or fragmentation. Implementation of deployable technologies themselves, including Cell on Wheels, Cell on Light Truck, or System on Wheels, could result in direct injury/mortalities to wildlife on roadways as well as bird strike hazards to low flying species. If off-road deployment is required, the action would potentially impact habitat and result in indirect injury/mortality. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. Refer to Section 2.4, Radio Frequency Emissions, for information on radio frequency concerns. Although unlikely, deployment of drones, balloons, blimps, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from entanglement, collision, or ingestion and potential effects to migratory patterns and reproductive effects from disturbance and/or displacement. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary, likely affecting only a small number of wildlife. Potential impacts to wildlife could be further reduced by

implementation of BMPs and mitigation measures (described in Chapter 11, BMPs and Mitigation Measures).

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers and poles; installation of underwater cables in limited near-shore or inland bodies of water; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These potential impacts and are described further below.

Given the scope of the Proposed Action, while geographically enormous (in all 50 states, 5 territories, and the District of Columbia), the actual deployment in any one location is unlikely to be extensive and would likely involve a variety of deployment options (including an emphasis on collocations on existing facilities). The specific deployment activity and location would be determined based on location-specific conditions and the results of site-specific environmental reviews. These potential impacts associated with the Preferred Alternative, based on the deployment activity and the limited duration of construction activities, are described further below. BMPs and mitigation measures to help mitigate or reduce these potential impacts are described in Chapter 11, BMPs and Mitigation Measures.

Potential Impacts to Amphibians and Reptiles

Based on the analysis of the deployment activities described above to wildlife resources, potential impacts to Hawaii's amphibians and reptiles are anticipated to be *less than significant* due to the localized and short-term nature of the deployment activity. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Potential Impacts to Terrestrial Mammals

Based on the analysis of proposed activities described above to wildlife resources, potential impacts to Hawaii's terrestrial mammals are anticipated to be *less than significant* as deployment activities would be temporary and short in duration. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Potential Impacts to Marine Mammals

Based on the analysis of proposed activities described above to wildlife resources, potential impacts to Hawaii's marine mammals are anticipated to be *less than significant* as deployment activities would be temporary, short in duration, take place in near-shore and inland waters and not the open ocean, and avoid important haulout[8] and habitat areas. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Potential Impacts to Birds

Based on the analysis of proposed activities described above to wildlife resources, potential impacts to Hawaii's birds are anticipated to be *less than significant* as deployment activities would be temporary and short in duration. BMPs and mitigation measures could be required, as practicable or feasible, to further reduce potential impacts to migratory birds. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Potential Impacts to Terrestrial Invertebrates

Potential impacts to Hawaii's terrestrial invertebrates are expected to be *less than significant*. Some limited and localized impacts could result from Preferred Alternative effects such as habitat loss or invasive species. However, deployment activities are expected to be temporary, likely affecting only a small number of wildlife. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be *less than significant* impacts to wildlife resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance would be infrequent, including mowing or the limited use of herbicides. This could result in *less than significant* effects to

[8] Haulouts are areas of land where seals come ashore to rest, molt, or breed.

wildlife including direct injury/mortality to less mobile wildlife, as well as injury/mortality from exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. Light, odors, and noise associated with maintenance activities can delay or discourage bats from emergence, or potentially, cause site abandonment, but the infrequent and limited nature of the activity would also result in *less than significant* effects.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. As stated above, these impacts would likely be limited to individual wildlife species, and unlikely to cause population-level impacts.

Wildlife resources could be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. As stated above, these impacts would likely result in potential impacts to individuals rather than population-level impacts.

In addition, the presence of new access roads and transmission line ROWs could increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely result in potential impacts to individuals rather than population-level impacts.

While these impacts could occur, they are expected to be limited in magnitude and extent, primarily affecting individuals in isolated occurrences. As such, potential operational impacts to Hawaii's wildlife resources are expected to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with wildlife.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.[9]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger

[9] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

Activities associated with the set up and operation of deployable technologies for short time periods could result in *less than significant* impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Similar to potential impacts from the deployable elements of the Preferred Alternative, potential impacts under the Deployable Technologies Alternative could include potential noise or visual disturbances from aerial deployable equipment as well as bird strike hazards to low flying species; potential direct injury/mortalities to wildlife on roadways; potential habitat impacts and indirect injury/mortality from off-road deployment; and potential impacts to migratory wildlife patterns due to noise from external generators. Greater frequency and duration of deployments could change the magnitude of potential impacts depending on species, life history, and region of the state. However, deployment activities are expected to be temporary, likely affecting only a small number of wildlife. Potential impacts associated with the Deployable Technologies Alternative could be further reduced if the BMPs and mitigation measures mentioned in Chapter 11 are implemented.

Potential Operational Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts to wildlife resources associated with routine operations, management, and monitoring. To further reduce potential impacts, the BMPs and mitigation measures mentioned in Chapter 11 could be implemented. The potential impacts can vary greatly among species and geographic region and depend on the length and type of operation; potential impacts could result in indirect injury mortality or reproductive effects.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wildlife resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.6.4, Wildlife.

4.2.6.5. Fisheries and Aquatic Habitats

Introduction

This section describes potential impacts to fisheries resources in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on fisheries resources were evaluated using the significance criteria presented in Table 4.2.6-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to fisheries resources addressed in this section are presented as a range of possible impacts.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism that could result from interactions associated with the Proposed Action. The most common direct injuries from equipment deployment and operation events are entanglement, habitat degradation, accidental ingestion of marine debris, and disturbance incurred by sensitive tropical fishes. However, given that the Proposed Action is only envisioned to be deployed in limited near-shore and inland waters, it is unlikely to impact large populations of fish and any potential impacts would likely be localized, isolated, short-term, and limited to individual or small numbers of fish.

Indirect injury/mortality environmental concerns pertaining to Hawaii's fisheries are described below.

Coral Reefs and Seagrasses, Habitat Loss, Degradation, or Fragmentation

Hawaii provides highly productive coral habitats, submerged vegetation (i.e., seagrasses, seaweeds, algae), wetlands, rivers, and complex hardbottom substrates colonized in successional stages by aquatic faunal communities of marine and fresh water fishes, invertebrates, and mollusks (*Coral Reef Network 2005a*). The Hawaii Fish Habitat Partnership is a statewide effort to prevent fish habitat degradation through aquatic habitat restoration programs (*USFWS 2012a*).

Key threats to inland freshwater species of Hawaii include instream barriers, stream divisions, invasive species, polluted runoff, and sedimentation (*USFWS 2012a*). Threats to marine fish are heavily related to the health of coral reef systems. Although coral reefs cover less than 1 percent of the ocean floor, they support an estimated 25 percent of all marine life, with more than 4,000 species of fish alone (*NOAA 2015a*). However, as the proposed deployment activities are only envisioned to be performed in limited near-shore and inland waters, it is unlikely that deployment will result in impacts to coral reefs or seagrasses. Implementation of BMPS and mitigation measures could further reduce potential impacts.

Coral reefs provide habitat, spawning, and nursery grounds for half of all federally managed fisheries as well many subsistence, recreational, and aquaculture fish species important to Hawaii (*State of Hawaii 2010; NOAA 2015b*). Global concerns affecting corals include disease, ocean acidification affecting coral calcium carbonate skeletons, coral bleaching,[1] and increasing amounts of carbon dioxide in ocean water because of human development. Although it is unlikely the Proposed Action could contribute to these impacts, it is worth noting that the combination of these threats could inadvertently lead to high mortality of diverse resident and migratory fish found in and around Hawaii.

Habitat loss occurring through direct or indirect exclusion, either by physically preventing organisms from using a habitat or by causing fish to avoid a habitat, could potentially lead to temporary or long-term effects. Habitat exclusion could lead to the prevention of fish and invertebrates (e.g., shellfish, sea cucumbers) from accessing an optimal habitat for breeding, spawning, feeding, or cover. Coral reefs, seagrass meadows, and mangrove prop roots are all important habitats that support fish and would likely be avoided to the extent practicalbe or feasible. These productive zones provide food, shelter, and nursery areas for fish at various stages of their lives. Specific examples of fish displaced from habitat in Hawaii include species within groupers, jacks, and snappers families. All of these species have been impacted by habitat loss, pollution, and reductions in population and range (*Western Pacific Regional Fishery Management Council 2009*).

Prior to the 1900s, no mangroves were found on any of the Hawaiian Islands. The only mangrove found today is the red mangrove introduced in 1902 (*Allen 1998*). This species is now well established on all the major islands of Hawaii. The intentional introduction of this nonnative species was to help stabilize coastal mudflat communities. Red mangroves protect coastal waters and marine organisms by collecting and filtering rainwater runoff, as well as capturing sediment from eroding soil, which typically contains excess nutrients (*Allen 1998*). These systems serve as important habitats for breeding, rearing, and feeding grounds for fisheries. Therefore, mangrove degradation should be avoided as much as practicable or feasible in compliance with laws and regulations. Anchialine pools[2] should also be avoided as much as practicable; these unique ecosystems harbor diverse species of crustaceans (i.e., Hawaii's red shrimp), fish, and eels. Depending on the scope of individual proposed projects, regulations

[1] The stress response of corals releasing the photosynthetic plankton, known as Zooxanthellae, leading to coral bleaching.
[2] Anchialine pools are enclosed, landlocked waterbodies or ponds with an underground connection to both fresh and salt water (*NOAA 2006*).

specific to the mangroves of Hawaii may require consultation with the Army Corps of Engineers, Office of Conservation and Coastal Land, the Department of Health Clean Water Branch, and possibly a Special Management Area Permit for each project site (*State of Hawaii Office of Planning 2015*). Actions that can alter habitat or create physical barriers during equipment placement and operation should be avoided to the extent practicable to help minimize impacts associated with access to suitable habitat.

In Hawaii, there are two major types of Marine Protected Areas: Marine Life Conservation Districts and Fishery Management Areas. These areas should be avoided, as practicable and in compliance with all applicable laws and regulations, since they provide areas for conservation, management, and research. Laws and regulations that prohibit development in these areas are cited in the Hawaii Administrative Rules (*DLNR 2013*). Critical habitats include coral reefs, seagrass meadows, lagoons, mangroves, estuaries, wetlands, offshore keys, sandy beaches, and rocky shores (*Coral Reef Network 2005b*). To identify marine refuge boundaries, online mapping tools specific to Hawaii are available (*USFWS 2011*). The State of Hawaii, Division of Aquatic Resources, is the primary regulatory agency that protects Marine Protected Areas. Avoidance of critical habitat and refuges within Hawaii could prevent anthropogenic disturbance on these fishery resources. Installation and regular maintenance checks of equipment near protected areas should be monitored to prevent spills or fluid leaks or construction-related materials from reaching habitats, including but not limited to, Marine Protected Areas, Marine Life Conservation Districts, and Fishery Management Areas.

Disturbance to sea floor habitats could cause fishery-related stresses such as direct injury or mortality, loss of refuge or cover habitat, increase of suspended sediment, and disturbance or mortality of fish prey (e.g., algae, invertebrates). Land-based sediment and erosion can cause mortality in fish given the water clarity required by coral reef systems (*Rogers 1990*). Installation and operation on or near sea floor and near-shore or inland habitats can alter productivity and reduce survivorship by increased sedimentation and turbidity reaching nearby waterways utilized during fish passage. Fragmentation from construction and development can present major environmental concerns, including the loss of resident fish species and range reductions (*Pacific Fishery Management Council 2015a*). These potential impacts could also extend to many invertebrate and fish assemblages associated with habitat. However, as the Proposed Action is only envisioned to be deployed in limited near-shore and inland waters, it is unlikely to impact large populations of fish and potential impacts would likely be limited to individual or small numbers of fish. Sediment and erosion control would be implemented in accordance with federal, state, or local regulations. BMPS and mitigation measures would be required, as practicable or feasible, to further reduce potential sedimentation and turbidity (see Chapter 11, BMPs and Mitigation Measures).

Indirect Injury/Mortality

Indirect injury to aquatic habitat (e.g., coral reefs and seagrasses) that inadvertently affects fisheries includes changes in water quality, pH, and increased water turbidity (*USGS 2014*). Indirect injuries to individuals could be caused by underwater sound, poor water quality or changes in food availability. Underwater sound, such as noise created by motor boats laying cable or heavy equipment near the shoreline during operation and deployment of equipment, depending on magnitude and frequency, can physically damage aquatic organisms or disrupt movement and migration patterns (*USDOT 2011*). BMPs and mitigation measures to reduce the effects of underwater noise can be found in are addressed in Chapter 11, BMPs and Mitigation Measures. Indirect mortality and exclusion from resources could also result from degraded water quality or perturbation of physical habitat features. However, as deployment activities would likely be temporary and of short duration, it is anticipated that any impacts would be limited to individual fish and aquatic organisms. Potential indirect fisheries impacts associated with construction noise, installation, and increased human activity could include abandoned reproductive efforts, displacement, and avoidance of work areas, though these potential impacts would likely be temporary. Both direct and indirect potential impacts on fish and other marine life are expected to be short in duration and infrequent (limited to the period of activities). Mortality and injury of individual fish and aquatic organisms directly or indirectly linked to Proposed Action activities would likely be infrequent and could be minimized by maintaining access to habitats and avoiding critical, species-specific time periods (e.g., spawning and migration).

Effects to Migration or Migratory Patterns

In marine systems, highly migratory species are characterized as having vast geographical distributions with single stocks utilizing both national and international waters for feeding or reproduction (*Pacific Fishery Management Council 2015b*). Highly migratory species identified in the Magnuson-Stevens Act include tuna species, marlin (*Tetrapturus* spp. and *Makaira* spp.), oceanic sharks, sailfish (*Istiophorus* spp.), and swordfish (*Xiphias gladius*) (*NOAA 2007*). Many statutes and regulations have been implemented in Hawaii to minimize project activities on specific migratory fish-bearing waterbodies and migratory/anadromous[3] fish of Hawaii and are discussed in Section 4.1.6.5, Fisheries and Aquatic Habitats (*Pacific Fishery Management Council 2015a, Western Pacific Regional Fishery Management Council 2009*). Current efforts by the Fish Habitat Partnership have led to the Hawaii Statewide Fish Passage Barriers Inventory, a database collection of site-specific data on the types of barriers to upstream migratory fish and invertebrate passage into the Hawaiian streams (*USFWS 2012a*). It is possible that the Proposed Action could potentially impact migration or migratory patterns as a result of construction or if the duration of operation deterred suitable habitat use by fish, invertebrates, crustaceans, etc. However, it is anticipated that any interruption of migratory patterns would be minimal, or not likely to occur within the Project area. Areas used by migratory fish tend to be isolated within migration pathways, spawning grounds, rearing sites, and nursery areas of resident and anadromous fish.

[3] Anadromous fish are born in freshwater, migrate to the ocean to grow as adults, and then return to freshwater to spawn (*NOAA 2006*).

> *Fish produce sounds through three ways: drumming of the swim bladder with the sonic muscle, striking or rubbing together teeth or skeletal parts, and hydrodynamic sound production when fish quickly change speed and direction. The majority of sounds produced by fishes are of low frequency, typically less than 1000 Hz.*

Proposed Action related noise could mask communications by aquatic species and displace them entirely. Researchers have found that when fish are exposed to high noise levels, communication and auditory sensitivity were found to decline (*Ladich 2013, Codarin et al. 2009*). If continuous high levels of ambient noise persist in an area (e.g., from existing pedestrian traffic, highway noise, and other human activities in the area), the additional noise from installation, deployment, and operation could be negligible and species could acclimate. Otherwise, some species could become temporarily or permanently displaced due to noise. Physical noise displacement from the Proposed Action could cause fish and marine organisms to use an excess expenditure of energy to avoid the noise source or search for more suitable habitat. This, in turn, depletes energy reserves normally used for growth, migration, and/or reproduction. It is possible that the Proposed Action could potentially impact migratory patterns due to noise impacts, but it is likely that such impacts would be very localized (associated with limited near-shore and inland water deployment) and of a short duration. Therefore, it is anticipated that migratory patterns would be subject to minimal noise disturbance during construction and operation. Additionally, to further reduce potential impacts, suitable habitat availability in the vicinity of the Proposed Action could be considered to accommodate these species to the extent practicable. For specific noise BMPs and mitigation measures, see Chapter 11, BMPs and Mitigation Measures.

Reproductive Effects

The Magnuson-Stevens Fishery Conservation and Management Act (*16 USC 1801 et seq.*) established a management system for fishery resources in the United States. Identification of essential fish habitat includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (*NOAA 2007*).

Potential impacts to functional development of life stages (i.e., eggs and larvae), could be reduced by minimizing physical barriers. One example of temporary or long-term barriers is the underwater housing of cables that could potentially prevent the success of fish egg fertilization or invertebrate passage during construction or operation although unlikely due to the small size of underwater conduit that contain telecommunication cable. In addition, disruption of fish passage could influence reproductive timing, larval traits, and oceanographic features that act together, greatly reducing reproductive dispersal success between populations (*National Fish Habitat Partnership 2010*). Reproductive effects to fish and shellfish species are most prevalent through the direct loss of spawning habitat, slow recovery rates of habitat features, and the mortality of eggs and juveniles. Reproductive effects to fish and shellfish species are most prevalent through the direct loss of spawning habitat, slow recovery rates of habitat features, and the mortality of eggs and juveniles. However, the Proposed Action anticipates only minor disruption of the reproduction of fisheries and disturbance of their resources as individual projects will be small scale (generally less than an acre of disturbance) and deployment will be short term. During construction, activities such as minor removal of aquatic and terrestrial vegetation, in-stream trenching, and equipment installation could potentially result in the modification of aquatic habitats and thereby adversely affect fish reproduction. Other risks of vegetation clearing and soil compaction could potentially lead to an increase of runoff into coastal habitats (*Thrush et al. 2004*). Potential impacts could include increased sedimentation and turbidity (see Section 4.2.2, Soils), increased temperature, decreased dissolved oxygen concentrations, releases of existing chemical and nutrient pollutants from disturbed sediments, and introduction of chemical contaminants, such as fuel and lubricants, due to spills (see Section 4.2.4, Water Resources).

However, due to the scale of the individual projects (generally less than an acre of disturbance) and the short duration of deployment activities (in some cases, as little as a few hours at one location) it is unlikely that deployment activities will result in more than minor impacts to fish from removal of vegetation or increased sedimentation. Additionally all federal, state, and local regulatory requirements will be adhered to regarding erosion and sediment control. BMPs and mitigation measures could be implemented to further prevent sedimentation and other discussed hazards from reaching nearby surface waters (see Chapter 11, BMPs and Mitigation Measures). Measures such as time or area restrictions, avoidance of certain habitats, and mitigation could minimize adverse effects on reproductive habitat.

Invasive Species Effects

The introduction of nonnative species affects the structure and function of aquatic systems relied upon by fish. Invasive species can diminish the health of native fish communities through predation, disease introduction, habitat alteration, and competition for resources (e.g., food and space) (*USFWS 2012b*). The smothering of corals by invasive seaweeds (algae) is a major concern leading to coral mortality and habitat degradation (*DLNR 2015b*). Invasive seaweeds specific to Hawaii include gorilla ogo (*Gracilaria salicornia*), leather mudweed (*Avrainvillea-amadelpha*), hook weed (*Hypnea musciformis*), smothering seaweed (*Kappaphycus alvarezii*), and prickly seaweed (*Acanthophora spicifera*) (*DLNR 2015c*). Invasive seaweeds typically spread by fragmentation and have characteristics of high growth rates and lack of native predators. Seaweed fragmentation caused by deployment activities such as dropping submarine cables and installing machinery could potentially result in the displacement and degradation of habitat occupied by native fish and invertebrates (*DLNR 2015b*).

It is possible that the Proposed Action could potentially impact native species if previously deployed equipment is not cleaned and sterilized to prevent the spread of invasive algae, fish species, or other aquatic organisms. However, it is anticipated that the small scale of the individual projects (generally less than an acre) and the short duration of deployment activities would be unlikely to result in the spread of invasive species. Additionally, implementation of BMPs and mitigation measures (and recommended sanitation procedures) could further prevent the spread of invasive species and the alteration of fishery habitat.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative would result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries resources and others would not. In addition, and as explained in this section, the various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to fisheries resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to fisheries resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes and are likely not located in fish habitat. Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to fishery resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries resources because those activities would not require ground or waters disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential construction/deployment-related impacts to fisheries resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground or water disturbing activities, including plowing, trenching, boring, and filling in fish habitat. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries resources include the following:

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, excavating, filling, directional boring and the construction of points of presence,[4] including huts or other associated facilities or hand-holes to access fiber, could result in potential impacts to fisheries and fish habitat. Although potential impacts are usually temporary, buried fiber optic installation methods could potentially result in high-risk situations to fisheries resources by sedimentation from on-shore activities. Furthermore, these risks include the removal of productive habitat, blocked passage of streams used by anadromous fish during reproduction periods, and the introduction of excess sediment and turbidity into waterways during construction/deployment. Ground and water disturbance associated with vibratory plowing activities and excavation activities could also result in fish habitat loss and mortality of individuals due to ground-born sound transmission. Sound pressure waves pass through various media (soil, water, air) and can propagate long distances with little attenuation, especially when travelling through water (*Dahl et al. 2007*). Aquatic organisms' sensitivity to sound and vibrations varies greatly by species, with sharks and bony fish being particularly sensitive (*University of Maryland 2000*), thus sound and pressure waves can change fish behavior (*Hastings and Popper 2005*). Egg viability and embryoic development of aquatic species can be affected when exposed low frequency vibrations (*VanDerwalker 1964*; *Vandenberg et al. 2012*). It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, state, or locally required sediment and erosion control mechanisms.
  - New Build–Aerial Fiber Optic Plant: Ground and water disturbance and heavy equipment use associated with construction activities as well as land/vegetation clearing, and excavation activities associated with pole construction could result in fish habitat loss if activities occur near/in lakes, streams, rivers, coastlines, or wetlands. Noise and sedimentation associated with construction activities could stress fish, therefore potentially impacting their longevity and/or migratory patterns. It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the

[4] Points of presence are connections or access points between two different networks, or different components of one network.

application of federal, state, or locally required sediment and erosion control mechanisms.

- Collocation on Existing Aerial Fiber Optic Plant: Installation of cables using existing poles and structural hardening or reinforcement of equipment to improve disaster resistance and resiliency would have few potential impacts on fisheries habitat compared to new build construction, although some fish habitat loss could occur if activities were near/in lakes, streams, rivers, coastlines, or wetlands. It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, state, or locally required sediment and erosion control mechanisms. Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.
- New Build–Submarine Fiber Optic Plant: The installation and construction of sealed cables in limited near-shore or inland bodies of water and the construction of landings/facilities to accept a cable buried close to the shoreline could potentially impact fisheries resources. Although sensitive or vulnerable areas vary along Hawaii's shores, changes to aquatic communities that occupy the shoreline could disrupt fish development, sessile[5] invertebrates, alter community structure, and potentially change the fishery dynamics within the aquatic habitat (*NOAA 2008*). It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, state, or locally required sediment and erosion control mechanisms. Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts).
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground or water disturbance, there would be *no impacts* to fisheries. Ground and water disturbance during the installation of equipment to enhance the signals traveling through the fiber may involve the installation of concrete pads and potential construction of an access road, potentially leading to runoff, erosion, and sediment reaching nearby fishery habitats. These construction activities, which may include land/vegetation clearing and excavation, could potentially result in the loss of fishery habitat. If an access road is constructed, additional potential impacts to fish habitat resulting from stream crossing methods, culvert installations, and road runoff should be considered. It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre), the short duration of those activities, and the application of federal, state, or locally required sediment and erosion control mechanisms. Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.

[5] Unable to move, attached to the substrate (*NOAA 2006*).

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads constructed near aquatic habitats could potentially result in potential impacts to fish habitat and other fisheries resources (i.e., construction noise disturbance, light pollution, and spills from generator fluids). It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre) and the short duration of those activities. Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would result in less potential impact to fisheries than the construction of new wireless communication towers. However, if the onsite delivery of additional power units, structural hardening, and physical security measures were required, potential temporary impacts and disturbance to fishery habitat could potentially lead to species deterrence and loss of suitable habitat.
- Deployable Technologies

  Where deployable technologies (i.e., Cell on Wheels, Cell on Light Truck, System on Wheels, or aerial deployables such as piloted aircraft, balloons, or drones) would be implemented on existing paved and unpaved road surfaces, it is anticipated that there would be no impacts to fisheries resources because there would be no new ground or water disturbance. However, implementation of deployable technologies could result in potential impacts to fisheries resources if deployment occurs in off-road areas. Some construction of staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. Although unlikely, these activities could result in loss of fish habitat (e.g., wetlands, streams, or vegetation used as cover in these areas). In addition, while likely to only impact individual fish, implementation of aerial deployable Technologies could result in direct injury or death to fish or damage to fish habitat if a piece of equipment were to fall into an aquatic habitat. To retrieve a fallen piece of equipment, additional fish habitat damage could occur. It is anticipated that these potential impacts will be minimal due to the small footprint of deployment activities (generally less than an acre) and the short duration of those activities (as short as a few hours in some cases). Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.

In general, the abovementioned activities could potentially involve ground, waters, and near-shore sea floor disturbance by heavy equipment use associated with the construction activities, land/vegetation clearing, and excavation activities associated with construction. Potential impacts to fisheries resources associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and introduction of invasive species.

Given the scope of the project, while geographically enormous (50 states, 5 territories, and the District of Columbia), the actual deployment in any one location is unlikely to be extensive (generally less than an acre) and will likely involve a variety of deployment options (including an emphasis on collocations on existing facilities). The specific deployment activity, and where the deployment will take place, will be determined based on location-specific conditions and the results of site-specific environmental reviews. These potential impacts associated with the Proposed Action, based on the deployment activity and the limited duration of construction activities, are described further below. BMPs and mitigation measures to help mitigate or reduce these potential impacts are described in Chapter 11, BMPs and Mitigation Measures.

Potential Direct Injury/Mortality Impacts

Based on the analysis of the deployment activities described above to fisheries resources, potential impacts as a result of direct injury/mortality are anticipated to be *less than significant* since the proposed activities are only envisioned to be deployed in limited near-shore and inland waters, are unlikely to impact large populations of fish, and any potential impacts would likely be localized, isolated, short-term, and limited to individual or small numbers of fish. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Habitat Loss Impacts

Based on the analysis of the potential deployment effects to fisheries resources described above, potential impacts as a result of habitat loss are anticipated to be *less than significant*. It is anticipated that for most types of facilities or infrastructure development scenarios, loss of terrestrial vegetation would likely be isolated within construction locations and/or would be short-term with stability achieved within several years, depending on the vegetation cover present in the area. In addition, since the proposed deployment activities are only envisioned to be performed in limited near-shore and inland waters, it is unlikely that deployment will result in impacts to aquatic habitats. Implementation of BMPS and mitigation measures could further reduce potential impacts. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Indirect Injury/Mortality Impacts

Based on the analysis of the potential deployment effects to fisheries resources described above, potential impacts as a result of indirect injury/mortality are anticipated to be *less than significant* since deployment activities would likely be temporary, of short duration, and any impacts would likely be limited to individual fish and aquatic organisms. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Migration Impacts

Based on the analysis of the deployment activities described above to fisheries resources, potential migration impacts are anticipated to be *less than significant* since such impacts are anticipated to be localized, short term, and limited to near-shore and inland environments. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Reproductive Effects Impacts

Based on the analysis of the deployment activities described above to fisheries resources, potential impacts as a result of reproductive effects are anticipated to be *less than significant*. It is anticipated that project activities would result in only minor disruption to fisheries reproduction at the individual level, not the population level. Potential impacts to reproduction would also likely be short term and localized. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Invasive Species Impacts

Based on the analysis of the deployment activities described above to fisheries resources, potential of invasive species impacts are anticipated to be *less than significant*. It is anticipated that the small scale of the individual projects (generally less than an acre) and the short duration of deployment activities would be unlikely to result in the spread of invasive species. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with fisheries and aquatic habitats.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would likely result in potential impacts similar to the abovementioned potential deployment/construction impacts. It is anticipated that there would be few potential impacts to fisheries resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Although unlikely, limited used of herbicides and the potential release of other contaminants by runoff could present potential impacts to fish and their habitats. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, additional potential fish impacts could occur (e.g., stream bank erosion, sedimentation of streams). However, these impacts would likely be localized, limited to individual species, and unlikely to cause population-level impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to fisheries associated with the Deployable Technologies Alternative and the No Action Alternative.[6]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries resources as a result of implementation of this alternative could be as described below.

<u>Potential Deployment Impacts</u>

The implementation of deployable technologies is not anticipated to cause significant potential impacts to fisheries resources. Deployment and operation of cellular masts and antenna generated signals are anticipated to have minimal disturbance to fish. However, greater frequency and duration of deployments could change the magnitude of potential impacts depending on species, life history, and region of the state.

The main potential impact on fisheries would be the placement of deployable infrastructure near waterbodies. Generator stations that power this infrastructure are designed to be self-contained within a trailer. This would require fuel storage to be kept onsite with associated protection plans to prevent spills and contamination to fishery dependent waterways.

Tidal regimes, which may differ between the north and south coasts, should be taken into account when deploying equipment near coastal locations. This would prevent loss of equipment and marine debris in nearby coastal fish habitat. Resiliency in the design and construction of equipment to withstand natural environmental factors, (e.g., El Nino Southern Oscillation events, incidences of past Japanese tsunami debris, and hurricanes) would reduce detachment of equipment as free flowing marine debris (*DLNR 2015a*).

<u>Potential Operation Impacts</u>

As explained above, operation activities would consist of running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to fisheries resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If routine maintenance or inspections occur off of established access roads or

[6] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

corridors, or if the acceptable load capacity of the roads is exceeded, sediment laden run-off and increased stream bank erosion could occur. The utilization of buffer zones, temporary or permanent native seeding on disturbed ground, ground cover, plastic sheeting and matting would minimize sedimentation of aquatic systems. In addition, Stormwater Pollution Prevention Plans as required by the Clean Water Act should be implemented at Proposed Action sites where more than 1 acre of ground would be disturbed (*USEPA 2007*).

Coastal development can cause potential impacts to aquatic organisms from underwater sound, poor water quality or changes in food availability. Underwater sound during equipment operation, depending on magnitude and frequency, can physically damage fish or disrupt movement and migration patterns (*Popper and Hastings 2009, USDOT 2011*).

With the duration of operation lasting up to 2 years, it is recommended that deployment activities productive habitats such as coastal wetlands, inland waterways, EFH, seagrasses, and coral reefs should be avoided to the extent practicable. Adverse effects on these productive habitats could include many potential direct and indirect impacts in the form of physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, individuals, fisheries, benthic organisms, prey species and their habitat, and many other ecosystem components. However, it is anticipated that these potential impacts would be minimal due to the small footprint of deployment activities (generally less than an acre) and the short duration of those activities (as short as a few hours in some cases). Implementing BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce these potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to fisheries resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.6.5, Fisheries and Aquatic Habitats.

4.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

Introduction

This section describes potential impacts to federal or state-listed plant and animal species[1] (hereafter collectively referred to as listed species) and designated critical habitat associated with deployment and operation of the Proposed Action and alternatives, and discusses best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts.

Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on listed species were evaluated using the significance criteria presented in Table 4.2.6.6-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as: *may affect, likely to adversely affect; may affect, not likely to adversely affect;* and *no effect*. These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (*USFWS and NMFS 1998*):

- "*No effect*" means that no listed resources would be exposed to the action and its environmental consequences.
- "*May affect, not likely to adversely affect*" means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.
- "*May affect, likely to adversely affect*" means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

[1] Includes terrestrial, freshwater, and marine plant and animal species that are federally listed as threatened, endangered, candidate, proposed, or species of concern; species that are state-listed as critically endangered, endangered, threatened, or vulnerable; and/or species that receive specific protection defined in federal or state legislation.

Table 4.2.6.6-1: Impact Significance Rating Criteria for Listed Species and Critical Habitats

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Direct and Indirect Injury/Mortality of a Listed Species	Magnitude or Intensity	According to the U.S. Endangered Species Act, this impact threshold applies at the individual level so therefore applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under *likely to adversely affect* category); Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect; Includes permitted take	No measurable effects on listed species
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect; Typically applies to one or very few locations	No measurable effects on listed species
	Duration or Frequency	Any duration or frequency that could result in take of a listed species	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect; Typically applies to infrequent, temporary, and short-term effects	No measurable effects on listed species
Indirect Effects from Disturbance or Displacement Resulting in Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success or survivorship of offspring of a listed species	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success or survivorship of offspring	No measurable effects on listed species
	Geographic Extent	Reduced breeding success or survivorship of offspring of a listed species at any geographic extent	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success or survivorship of offspring of listed species; Typically applies to one or very few locations	No measurable effects on listed species
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success or survivorship of offspring of a listed species	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success or survivorship of offspring of a listed species within a breeding season	No measurable effects on listed species

Type of Effect	**Effect Characteristic**	**Impact Level**		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Indirect Effects From Disturbance or Displacement Resulting in Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species	Minor behavioral changes that would not result in take of a listed species	No measurable effects on listed species
	Geographic Extent	Any geographic extent that could result in take of a listed species	Changes in behavior at any geographic scale that are not expected to result in take of a listed species; Typically applies to one or very few locations	No measurable effects on listed species
	Duration or Frequency	Any duration or frequency that could result in take of a listed species	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species	No measurable effects on listed species
Direct or indirect effects on habitats (including designated critical habitats) that affect population size and long-term viability for listed species	Magnitude or Intensity	Effects to any of the essential features of listed species habitat that would diminish the value of the habitat for the survival and recovery of the listed species	Effects to listed species habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated	No measurable effects on listed species habitat
	Geographic Extent	Effects to listed species habitat at any geographic extent that would diminish the value of the habitat for listed species; Note that the *likely to adversely affect* threshold for geographic extent depends on the nature of the effect; Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species; Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for the listed species; Typically applies to one or few locations within a habitat known to be used by listed species	No measurable effects on listed species habitat
	Duration or Frequency	Any duration or frequency that could result in reduction in habitat function or value for a listed species	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated; Typically applies to Infrequent, temporary, or short-term changes	No measurable effects on listed species habitat

As discussed in Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, many listed species occur in Hawaii. Listed species are protected under federal and state regulations and, in most cases, a permit or other authorization is required for take[2] of a listed species. There are 474 federally and/or state-listed plant and animal species in Hawaii, including 351 plants, 41 birds, 9 mammals, 5 reptiles (all marine), and 68 invertebrates (snails and arthropods). There are no federal candidate species or species of concern. Federally listed species are under the jurisdiction of the United States (U.S.) Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) and state-listed species are under the jurisdiction of the Hawaii Department of Land and Natural Resources. Critical habitat has been designated in Hawaii for 23 species, including 4 birds, 1 mammal, and 18 invertebrates (*USFWS 2015; NMFS 2015b*). Table 4.2.6.6-2 provides key information about the federal and state-listed species, summarized by taxonomic group.[3]

As summarized in Table 4.2.6.6-2, most of the federally listed species fall under the endangered[4] category (452 of 468) and most of these are plants. Similarly, most of the state-listed species are endangered (116 of 123). Most of the state endangered species are invertebrates.

[2] Take is defined differently by various federal and state regulations but the most commonly accepted definition is that of the U.S. Endangered Species Act (ESA). This act defines take as “to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect, or attempt to engage in any such conduct.” The act further defines “harm” as “significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering,” and “harass” as “actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.”

[3] A taxonomic group is a group of biological organisms that have shared characteristics.

[4] According to the ESA, the term “endangered species” means any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary of the Interior to constitute a pest whose protection under the provisions of the ESA would present an overwhelming and overriding risk to man.

Table 4.2.6.6-2: Summary of Information on Federally and State-Listed Species in Hawaii

Taxonomic Group (Total Number of Species)	Listing Status and Number of Species in Each Listing Category[a]				
	Federally Endangered	Federally Threatened	State Endangered	State Threatened	Key Habitat
Plants (351)	340	11	0	0	Variety of forested, shrubland, meadow, coastal, and wetland habitats
Terrestrial Mammals (1)	1	0	1	0	Bat species that occurs in dense vegetation/tree cavities
Marine Mammals (8)	7	0	8	0	Seven of the species are whales that occur in the open marine environment (coastal pelagic) and one species is a seal that occurs on coral atolls and rocky islands.
Birds (41)	39	1	39	2	Variety of forest, shrubland, beach, marine and freshwater aquatic habitats
Reptiles (5)	2	3	2	3	All of the species are sea turtles that occur in marine and coastal habitats.
Invertebrates (68)	63	1	66	2	Snails: mountainous dry to moist forests and shrublands, wet forests, fast flowing water with overhanging rocks Arthropods: dry to moist forest and aquatic habitats
Total (474)	**452**	**16**	**116**	**7**	

Sources: USFWS 2015; NMFS 2015a; DLNR 2005 and 2014

[a] In Hawaii, 116 species are both federally and state-listed so the number of species summarized for the listing categories is greater (590) than the total number of listed species (474).

Listed species would be subject to the same potential impacts described for vegetation, wildlife, and fish (Section 4.2.6.3, Terrestrial Vegetation, Section 4.2.6.4, Wildlife, and Section 4.2.6.5, Fisheries and Aquatic Habitats). However, the magnitude of such impacts on listed species have the potential to be greater because of the reduced population size and/or limited geographic distribution of listed species and the importance of habitats known to support listed species for the maintenance of listed species populations. Potential impacts to endangered species would be more significant in terms of magnitude than impacts to species in the threatened or candidate categories.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to listed species discussed in this section are presented as a range of possible impacts to the major taxonomic groups that encompass the listed species in Hawaii (i.e., plants, terrestrial mammals, marine mammals, reptiles, birds, and invertebrates).

Description of Environmental Concerns

The following types of direct and indirect effects were considered in evaluating the potential impact of the Proposed Action and alternatives on listed species (see Table 4.2.6.6-1 for further details):

- Direct injury or mortality—includes the taking (removal or loss) of a listed species (individual or population) due to physical injuries, extreme stress, or death of an individual from interactions associated with the Proposed Action;
- Indirect effects from disturbance or displacement—includes changes in an individual or population's habitat use or life history pattern due to disturbance from increased noise and vibration, human activity, visual disturbance, and associated transportation activity; increased competition for resources or habitat due to displacement of individuals from the affected area into the territory of other animals; or other indirect effects that ultimately cause mortality, decreased fitness, or reduced breeding in the future population; and
- Direct or indirect effects on habitats for listed species that affect population size and long-term viability for listed species—direct habitat effects are primarily physical disturbances that result in alterations in the amount or quality of a habitat. Indirect habitat loss can occur through preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term.

Any of the listed species with individuals, populations, or habitat in the vicinity of activities related to the Proposed Action could be subject to one or more of the above potential impacts from the Proposed Action; however, implementation of BMPs and mitigation measures, as developed through consultation with the appropriate resource agency, would completely avoid potential impacts on some species and reduce potential impacts on others. The nature and extent of potential impacts to listed species would vary depending on many factors, including, but not limited to, the species, the location and extent of the Proposed Action activity, the time of year, and the duration of deployment.

The following sections define and describe each of these potential impacts according to the taxonomic groups encompassing the listed species in Hawaii.

Plants

In Hawaii, 351 species of federally and state-listed plants occur (*USFWS 2015; DLNR 2014*). The species occur throughout almost all the natural habitats known from Hawaii but more than half of the species occur in forest habitats (*USFWS 2015*). Potential impacts of Proposed Action activities on listed plants include direct mortality or injury, habitat loss, and habitat disturbance/degradation. The primary means of avoiding or minimizing potential impacts on listed plant species is to conduct expert and/or agency consultations to obtain more specific information on location and distribution of the listed plant species than is publicly available through desktop reviews. This consultation would be conducted prior to construction to ensure that the locations of listed plant species and their habitats are avoided to the maximum extent practicable. Where avoidance is not possible, consultation with USFWS and/or Hawaii Department of Land and Natural Resources would be conducted to identify suitable minimization and mitigation measures to ensure that the Proposed Action would not result in adverse effects to listed plants.

Terrestrial Mammals

One terrestrial mammal species is listed in Hawaii, the Hawaiian hoary bat (*Lasiurus cinereus semotus*) (*USFWS 2015*). The Hawaiian hoary bat is highly mobile so would likely move away from any Proposed Action activity, avoiding most direct injury or mortality. However, since this species is known to collide with manmade structures, there is a potential for collision with power lines, power poles, towers, or similar structures that could be installed as part of Proposed Action activities. Other potential impacts to this species would be related to disturbance, displacement, and/or habitat loss. The most notable of these potential impacts would be habitat loss, particularly loss of native forest. Displacement of individuals into other available and suitable habitats could result in increased energy expenditure and competition for resources in the newly occupied area, but these potential impacts would not be expected to cause mortality or have other adverse effects at the population level because the newly occupied habitats are not expected to be at carrying capacity and thus essential habitat elements should be available to displaced individuals. Potential impacts from the Proposed Action on this species would largely be avoidable through informed siting of Proposed Action features[5] outside native forests and other known bat use areas (e.g., known roost or maternity sites, the location of which could be obtained through agency consultation or field assessment), and by limiting any required forest clearing activities to outside the bat breeding season (e.g., summer months although the exact timing is variable based on climatic conditions and food availability).

Marine Mammals

Seven federally listed whale species occur in the offshore marine habitats of Hawaii (*NMFS 2015a*). FirstNet is unlikely to impact whales because deployment activities would only take place in nearshore or inland waters. Such activities would be conducted using small- to medium-sized vessels that are highly maneuverable and could, therefore, easily avoid interactions with any whales that could incidentally occur in nearshore waters.

A potential impact to listed whale species is disturbance from underwater noise. Noise associated with the installation of cables in the near/offshore waters of Hawaii could potentially impact whale behavior or migration patterns; however, the marine activities related to the Proposed Action are very limited in nature, so risks to listed marine species from marine noise are expected to be low. Whales could be temporarily excluded from a resource if they avoid it due to the increased presence of boats and associated noise. Greater human activity of longer duration would increase the likelihood that listed whale species would avoid affected areas, possibly being excluded from essential resources. The degree to which habitat exclusion could affect any of the listed whale species depends on many factors, including the context and duration of the noise exposure and the individual's experience, life stage, and conditioning. However, as stated above, the potential impacts associated with the Proposed Action are unlikely to impact whales; the likelihood of impacts could be further reduced with implementation of appropriate BMPs and mitigation measures if deemed necessary and defined in consultation with

[5] In this section, informed siting of Proposed Action features refers to the act of locating activities or features in areas that do not support listed species or their known habitats.

the appropriate resource agency. Potential impacts from the Proposed Action would likely be short-term, not wide ranging, and below sound exposure impact thresholds[6] and thus would not adversely affect listed whale species.

Since monk seals typically use offshore waters and forage on the sea floor, they are not highly vulnerable to vessel strike; however, individuals occurring in shallow waters near haulout sites or birthing areas would be vulnerable to vessel strike. The marine activities related to the Proposed Action are very limited in nature, so risks to listed marine species from vessel strike are expected to be low. Further, the vessels that would be used for deployment activities would be small- to medium-sized that are highly maneuverable and could, therefore, avoid collisions with monk seals in the water. Implementation of BMPs and mitigation measures related to vessel strike, if recommended by the USFWS and/or the Hawaii Department of Land and Natural Resources, would substantially reduce the potential for vessel strikes of monk seals.

Restricted monk seal access to important pupping grounds[7] due to disturbance from noise or human activity has the potential to negatively affect body condition and reproductive success of breeding monk seals. The displacement of females from preferred pupping habitats could reduce fitness and survival of pups, potentially affecting overall productivity. Prior to planning or conducting any activities related to the Proposed Action that could potentially impact monk seals, consultation with USFWS and Hawaii Department of Land and Natural Resources would occur to ensure that potential impacts to this species are avoided or minimized to the maximum extent possible. Implementation of BMPs and mitigation measures, as defined through consultation with the resource agencies, would aim to avoid or minimize the potential disturbance/displacement impacts and related reproductive effects to breeding monk seals.

Seals that are swimming or hauled out on sand, rock, or coral are sensitive to boats, aircraft, and human presence. Unexpected or abnormal noises, smells, sounds, and sights could elicit a flight reaction from individuals, particularly at haulout and pupping areas where many animals congregate, sometimes resulting in trampling injury or death to affected individuals. Aircraft or deployables overflights or boat activity could occur in relation to the Proposed Action, which could cause flight reactions at haulout and pupping sites. Implementation of BMPs and mitigation measures, as defined through consultation with the resource agencies, would avoid or minimize the potential disturbance impacts to monk seals. Underwater sound sources, if intense and frequent enough, could cause injury to monk seals in the vicinity of the activity. Implementation of BMPs and mitigation measures, as defined through consultation with the resource agencies, would avoid or minimize the potential impacts from underwater noise.

FirstNet does not expect to increase the disturbance to marine mammals associated with deployment over or on the marine environment. As such, potential impacts to marine mammals as a result of the Proposed Action would be highly unlikely.

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[6] Sound exposure impact thresholds developed by Southall et al. (2007) define specific sound levels above which measurable transient effects (Level B) or permanent effects (Level A) could occur on the hearing of marine mammal species. Level A and B thresholds have been established for seals (all species considered as one group) and for whales, dolphins, and porpoises (all species considered as one group) (Southall et al. 2007).

[7] Pupping grounds are the sites where marine mammals birth and rear their young.

Reptiles

Five species of threatened or endangered sea turtles occur in Hawaii. Two of the species are transients in Hawaiian waters so do not occur there regularly or nest there and three of the species nest there. Nesting sites for the three species of sea turtles that nest in Hawaii occur on many of the Hawaiian Islands and several protected areas have been established on these islands specifically for sea turtle protection (*USFWS 2015; DLNR 2005*).

Sea turtles typically return to the same sites to nest each year, so the nesting areas are well known by local sea turtle experts, including staff at the Hawaii Department of Land and Natural Resources, and consultation with these experts would facilitate avoidance of Proposed Action activities within or near sea turtle nesting beaches. As such, potential impacts to listed turtle species as a result of the Proposed Action would likely be primarily related to vessel strike during marine vessel-based deployment or maintenance activities; however, the marine activities related to the Proposed Action are very limited in nature and vessels used for deployment would be highly maneuverable so the risk to listed marine reptiles from vessel strike are expected to be low. Despite their low risk, there is a chance they could interact with proposed Action Activities. Marine-based activities related to the Proposed Action could displace individual turtles from the area around the work zones; however, this displacement would be temporary and would not significantly alter migratory routes or foraging behavior of individuals over the long term. Avoiding any activities within seagrass habitats, which marine turtles use for foraging, would significantly reduce the potential impacts to foraging turtles.

Any lighting erected or used along the coast for Proposed Action Activities could disrupt movement patterns and breeding behavior of sea turtles in the vicinity of the lit area. Artificial lighting placed at Project locations, either during deployment or operation, can discourage females from nesting and disorient hatchlings, attracting them towards land rather than the ocean, which makes them vulnerable to predation[8] and other sources of mortality (*Sea Turtle Conservancy 2015*). Minimization of coastal lighting, particularly within 500 feet of a known nesting beach, and use of turtle safe lighting instead of normal lights (low-pressure sodium-vapor lighting or red lights that emit a very narrow portion of the visible light spectrum) would minimize the potential impacts to nesting green turtles and hatchlings (*Sea Turtle Conservancy 2015*).

Birds

Forty-one species of federally and state-listed species of birds occur in Hawaii (*USFWS 2015; DLNR 2014*). Most of the listed bird species are federally and state-listed as endangered. These species occupy a variety of habitats but primarily occur in forest and coastal/beach/marine habitats. The most significant potential direct impacts to listed bird species from the Proposed Action would be injury or death of individuals from habitat loss (e.g., tree felling could crush birds or eggs) or equipment deployment (e.g., birds could strike or get entangled within

[8] Predation is the relationship between two organisms of unlike species in which one of them acts as predator that captures and feeds on the other organism that serves as the prey.

equipment such as antennas, cables, towers, and above-ground communication lines). Such potential impacts to adult birds would be unlikely given that they are highly mobile and would disperse from Proposed Action activities. Young birds or eggs would be most susceptible to direct or indirect mortality due to their immobility or limited mobility, but BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would significantly reduce the likelihood of such potential impacts.

The more likely direct and indirect effects of the Proposed Action on listed birds would include potential habitat loss and disturbance, and stress caused by noise, human activity (e.g., equipment deployment and human presence), and habitat degradation. The most significant of these potential impacts on listed bird species would be loss or degradation of important habitats, including breeding, migratory stopover, and overwintering sites, resulting in displacement and possibly reduced reproductive success or survival. The species of listed birds in Hawaii each have specific habitat preferences and are all susceptible, to varying degrees, to human disturbance and habitat alteration, particularly during the summer breeding season, migratory stopover, and overwintering periods. Disturbance from human activity e.g., equipment deployment and human presence), noise, vibration, and habitat degradation could cause abandonment of nesting sites, stopover, or overwintering areas resulting in adverse reproductive effects in breeding birds or reduced survivorship of migrating or overwintering birds. Disturbance-related potential impacts could be avoided or minimized by siting Proposed Action activities away from listed bird species habitats, timing them outside of critical breeding, migratory stopover, or overwintering periods, or if such avoidance measures are not feasible, limiting the duration of activities within or near potential and known listed species habitats. Consultation with the USFWS and Hawaii Department of Land and Natural Resources would identify other specific measures to reduce the potential impacts of the Proposed Action activities on listed birds.

There are several species of colonial waterbirds and seabirds in Hawaii, and these species are highly sensitive to disturbance, as are most colonial waterbirds and seabirds, and could abandon nests and/or young if Proposed Action activities (e.g., human presence, noise, aerial overflights) occurred during the breeding season at or within visual siting distance of a nest site (*Shreiber and Burger 2001*). Single disturbance events would have lower potential impacts on nesting birds (may not result in permanent abandonment) than repeated disturbances that are unpredictable in terms of the timing, type, or magnitude of the disturbance. Colonial waterbirds and seabirds nest in groups or colonies, so disturbance at or near a nest site during the breeding season could potentially impact many individuals simultaneously. If disturbance occurs late in the breeding season, individuals may not reattempt to nest following disturbance, resulting in the loss of a full breeding year for the affected individuals. If the disturbance occurs early in the breeding season, some individuals could reattempt to nest if suitable habitat exists and is not already occupied by other individuals. However, colonial waterbirds and seabirds are very habitat-specific in their nesting requirements and have strong fidelity to their nest sites, so some individuals may not attempt to re-nest at another site following disturbance (*Shreiber and Burger 2001*). For those individuals that do relocate elsewhere, if the new habitat is suboptimal, reduced adult and immature bird survivorship, reduced reproductive rates, or reduced offspring survivorship could occur. Colonial waterbird and seabird nesting sites are known by USFWS and Hawaii Department of Land and Natural Resources and are easily visible even in the non-breeding season, so potential impacts from the Proposed Action on nest sites and nesting individuals would be avoidable through informed siting of Proposed Action features away from nest sites and timing of any necessary activity in the non-breeding season.

Mortality or injury from collisions or electrocutions with manmade cables and wires are of concern for avian species. Birds that are at greatest risk of collision events include those that are not highly maneuverable (such as ducks), heavy birds (such as swans and cranes), and birds that fly in flocks (*APLIC 2012*). Certain bird species and species groups are more susceptible to electrocution than others based on their size and behavior that increases their risk of exposure to energized and/or grounded hardware. For example, the large wingspans of raptors such as bald eagles, red-tailed hawks (*Buteo jamaicensis*), osprey (*Pandion haliaetus*), and great horned owls (*Bubo virginianus*) enable them to simultaneously touch energized and/or grounded hardware parts. Tall birds such as herons and egrets are also at risk of electrocution where vertical spacing between lines is less than their height (*APLIC 2012; Brown et al. 1987*).

Several of the listed bird species in Hawaii are large-bodied and not highly maneuverable and/or are congregatory[9] so they would be susceptible to collision and electrocution from new power lines and related structures that could be associated with the Proposed Action. BMPs and mitigation measures related to design and siting of the nationwide public safety broadband network (NPSBN) facility would significantly reduce the likelihood of collision or electrocution by these or other bird species.

Invertebrates

The 68 invertebrate species known in Hawaii include many species of tree snails and insects, along with one spider, one shrimp, and one amphipod (a type of crustacean) (*USFWS 2015; DLNR 2014*). The tree snails are all strongly associated with forest habitats, so potential impacts of Proposed Action activities on these species could occur if forest habitat that supports these species is removed or degraded. The rest of the listed invertebrate species occupy a variety of habitats from open meadows to caves and freshwater streams. The primary means of avoiding or minimizing potential impacts on listed invertebrate species is to conduct reviews to gather information on them prior to construction to ensure that the locations of listed species and their habitats and/or key habitat features (e.g., host plants) are avoided to the maximum extent practicable. Where avoidance of potential impacts is not possible, consultation with USFWS and/or Hawaii Department of Land and Natural Resources would be conducted to identify suitable minimization and mitigation measures to ensure that the Proposed Action would not result in adverse effects to these species.

[9] Congregatory describes the behavior of gathering in groups.

Potential Impacts of the Preferred Alternative

This section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities could result in potential impacts to listed species and critical habitats and others would not. These potential impacts would vary considerably by species and would be significantly influenced by deployment scenario, potential impact area, species presence, and site-specific conditions. The species that would be affected would depend on the potential impact area, the species' phenology,[10] and the nature and extent of the habitats affected. As explained in this section, various types of Proposed Action infrastructure could result in a range of *no effect* to *may affect, but not likely to adversely affect* depending on the deployment scenario or site-specific conditions.

<u>Activities Likely to Have No Effect</u>

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no effect* to listed species under the conditions described below:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would have *no effect* to listed species because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened and endangered because those activities would not require ground disturbance.

[10] Phenology is the seasonal changes in plant and animal life cycles, such as insect emergence or bird migrations.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact threatened and endangered species, it is anticipated that this activity would have *no effect* on listed species.

The above activities are expected to have *no effect* to listed species because they involve collocation or shared use of existing facilities or do not require new ground disturbance or substantial construction activity. Should the above defined conditions not be met and activities require land disturbance, substantial construction activity, or implementation of physical security measures such as lighting, potential impacts to listed species would be similar to those described for new build activities below, although they would likely be lesser in magnitude due to the smaller scale of the activities required for collocation compared to new build scenarios.

<u>Activities with the Potential to Affect</u>

The infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and *may affect, but not likely to adversely affect* listed species include: 1) New Build Scenarios (Buried Fiber Optic Plant, Aerial Fiber Optic Plant, Submarine Fiber Optic Plant, or Installation of Optical Transmission or Centralized Transmission Equipment); 2) New Wireless Communication Towers, Collocation on Existing Aerial Fiber Optic Plant, or Collocation on Existing Wireless Tower, Structure, or Building; and 3) Deployable Technologies.

The actions related to these components that could cause potential impacts to listed species include 1) land/vegetation clearing; 2) excavation and trenching; 3) construction of access roads; 4) installation or restructuring of towers, poles, or underwater cables; 5) installation of security/safety lighting and fencing; and 6) deployment of aerial platforms. Potential impacts to listed species associated with deployment of this infrastructure and related actions are further described below and in the previous taxa-specific descriptions (see Description of Environmental Concerns section above).

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of points of presence (POPs),[11] huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to listed species. Land/vegetation clearing and excavation activities associated with construction of POPs, huts, or other associated facilities could result in temporary or permanent habitat loss and direct injury/mortalities of species that are not mobile enough to avoid deployment activities (e.g., slow moving species and young). Disturbance and habitat degradation from noise and human activity associated with the above activities could result in displacement of individuals, changes in use of important migration pathways or breeding/rearing sites, indirect injury/mortality, and reproductive effects if BMPs and mitigation measures, as

[11] POPs are connections or access points between two different networks, or different components of one network.

defined through consultation with the appropriate resource agency, are not implemented. In-water activities, although such activities would be minimal and limited to nearshore or inland waters, could cause vessel strike and/or auditory and potential disturbance impacts on listed sea turtles and/or marine mammals.

- New Build–Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to listed species. Potential impacts would vary depending on the number and location of individual poles or other facilities installed, but would primarily occur to terrestrial species as a result of habitat loss or degradation and/or disturbance from construction noise and human activity. Sea turtles could be adversely impacted by any lighting that is used or installed at or in the vicinity within 500 feet from turtle nesting beaches (*Sea Turtle Conservancy 2015*).
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
- New Build–Submarine Fiber Optic Plant: The installation of cables in limited nearshore marine or inland freshwater environments and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact listed species, particularly marine mammals and sea turtles. Effects could include direct or indirect injury/mortality; habitat loss or alteration; and disturbance/displacement from underwater noise and vibration. If activities occurred during critical time periods, effects to migratory patterns or reproduction could occur. However, the marine activities related to the Proposed Action are very limited in nature so risks to listed freshwater and marine species are expected to be low.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment occurs in existing boxes or huts, there would be *no effect* to listed species because there would be no ground disturbance and very limited human activity. However, if installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential impacts to terrestrial listed species. Land/vegetation clearing, excavation activities landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory or habitat use patterns. Security lighting could diminish habitat quality for listed species, particularly birds and sea turtles.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower or structure which would not result in impacts to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts would be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions and potential impacts, refer to Chapter 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - Implementation of deployable technologies including Cell on Wheels, Cell on Light Truck, or System on Wheels could result in direct injury/mortalities to terrestrial listed species on roadways. Construction of staging areas could cause potential aquatic habitat impacts if they were constructed near or in lakes, streams, rivers, coastlines, or wetlands. Implementation of Deployable Airborne Communications Architecture is not anticipated to impact threatened and endangered species or their habitat.

Potential Impacts to Listed Species

FirstNet is committed to avoidance of impacts to listed species and their known habitats to the maximum extent practicable. The key time to implement avoidance actions is during siting and deployment, prior to and during Preferred Alternative activities. To facilitate this commitment to impact avoidance, pre-siting or pre-deployment desktop reviews and expert and/or agency consultation to gather information on the location and distribution of listed species and their habitats in the vicinity of Proposed Action activities would be conducted for all proposed activities to ensure that informed siting and/or timing of Preferred Alternative activities would enable avoidance of impacts to listed species and their habitats to the maximum extent practicable.

For activities that could potentially affect listed species, FirstNet would enter into informal or formal consultation, as appropriate, with USFWS and/or NMFS, as well as Hawaii Department of Land and Natural Resources for state-listed species. These consultations would identify measures to be implemented to ensure potential impacts to listed species would not rise to the level of take or, should take be unavoidable, that it would be fully authorized through receipt of an Incidental Take Permit from USFWS or NMFS for federally listed species or authorization from Hawaii Department of Land and Natural Resources for state species FirstNet is committed to perform all required monitoring or mitigation activities associated with any federally or territorially-listed species.

In summary, with effective implementation of BMPs and mitigation measures, as needed and defined through consultation with the appropriate resource agency, the Preferred Alternative *may affect, but not likely to adversely affect* listed species. Site-specific analysis would likely be required to determine the potential impacts on listed species at specific proposed activity locations, once those locations are determined. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to these resources.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement conducted as part of ongoing system maintenance would result in potential impacts that are similar to the above mentioned deployment impacts. The species that would be affected and the nature and magnitude of potential impacts would depend on many factors including, but not limited to, the potential impact location related to listed species use areas, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that potential impacts to listed species *may affect, but not likely to adversely affect* with BMPs and mitigation measures (as defined through consultation with the appropriate resource agency) to listed species associated with routine inspections of the Preferred Alternative, assuming that the same access routes used for deployment are also used for inspections. This is because routine inspections would be short-term in nature, would not involve any new potential habitat impacts, and would not result in significant disturbance or displacement. Site maintenance activities, including mowing and application of herbicides *may affect, but not likely to adversely affect* listed species, as the activity would be infrequent and done in compliance with BMPS and mitigation measures (as defined through consultation with the appropriate resource agency).

During operations, direct injury/mortality of listed bird species could occur from collisions and/or entanglements with communication lines, towers, and aerial platforms. In addition, the presence of new access roads and communication line rights-of-way could increase human use of the surrounding areas, which could increase disturbance to or hunting or fishing of listed species or degradation of listed species habitats. If external generators were used, noise disturbance could potentially impact habitat use patterns or displacement of terrestrial listed species.

Deployable Aerial Communications Architecture, including deployment of drones, balloons, blimps, and piloted aircraft could potentially impact listed bird and bat species by direct or indirect injury/mortality and disturbance and/or displacement. The magnitude of these effects would depend on the location, timing, and frequency of deployments in relation to listed bird use areas. Other listed species would not be affected by deployable aerial communications equipment because, based on their habitat requirements, the likelihood of their interaction with aerial equipment is very low to nil. Aerial equipment could fall, resulting in injury or death of a listed species individual and/or habitat disturbance. If aerial equipment were to fly at low levels over marine mammal haulout sites or seabird nest locations, mass flight response could occur resulting in trampling death of individuals and/or abandonment of haulout or nest sites.

Such potential impacts *may affect, but not likely to adversely affect* listed species provided that any necessary federal and/or state authorizations regarding listed species are obtained. Implementation, as practicable or feasible, of the operational BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would further reduce the potential for impacts on listed species.

Table 4.2.6.6-3 summarizes the impact significance determinations for each taxonomic group as a result of deployment and operation of the Preferred Alternative. Potential impacts to listed species were considered significant (i.e., adverse effect) if listed species or their habitats could be adversely affected over relatively large areas; a large proportion of a listed species' population within a region could be adversely affected; or if disturbances related to the Preferred Alternative could cause significant reductions in population size or distribution of a listed species. The duration of a potential impact also affected its significance level: temporary impacts (e.g., noise associated with construction) were considered less significant than permanent impacts (e.g., land conversion). The impact ratings assume full and successful implementation of BMPs and mitigation measures, as defined through consultation with the appropriate resource agency. Additional BMPs and mitigation measures, as defined in Chapter 11, may be implemented as appropriate to further minimize potential impacts.

Table 4.2.6.6-3: Determination of Impact Significance for Listed Species as a Result of the Preferred Alternative

Taxa	Impact Determination	Rationale for Determination
Plants	*May affect, not likely to adversely affect*	The 351 listed plant species occur throughout almost all the natural habitats known from Hawaii but more than half occur in forest habitats. Prior to implementing Proposed Action activities, expert and/or agency consultation would be conducted to obtain more precise location and distribution information for the species than is publicly available and preconstruction surveys would be implemented if warranted based on the expert and agency consultation. These measures would enable avoidance to the extent possible and would reduce the potential for and extent of potential impacts to listed plants.
Terrestrial mammals	*May affect, not likely to adversely affect*	The one listed terrestrial mammal species is a bat that is highly mobile so it would likely move away from any Proposed Action activities avoiding most direct injury or mortality. Potential impacts from the Proposed Action on this species would largely be avoidable through informed siting of Proposed Action features outside native forests and other known bat use areas (e.g., known roost or maternity sites), and by limiting any required forest clearing activities to outside the bat breeding season (summer months, the exact timing is variable based on climatic conditions and food availability).
Marine mammals	*May affect, not likely to adversely affect*	The marine-based activities of the Preferred Alternative are not extensive and they are limited to nearshore and inland waters. They would be of short duration and spatial extent and they would avoid key listed species habitats and activity periods.
Birds	*May affect, not likely to adversely affect*	The 41 listed bird species occupy a variety of habitats in Hawaii, but most occur in forest and coastal/beach/marine habitats. The time period of greatest potential impact to listed birds is during the breeding season, which generally occurs between January and July. Further, each of the listed species has very specific nesting requirements so avoidance of breeding habitat is feasible, which makes it unlikely for significant adverse impacts from the Preferred Alternative on listed bird species.
Reptiles	*May affect, not likely to adversely affect*	Marine activities related to the Proposed Action are very limited in nature so risks to listed turtle species from vessel strike and marine noise are expected to be low.
Invertebrates	*May affect, not likely to adversely affect*	The 68 listed invertebrate species in Hawaii include tree snails and insects, along with one spider, one shrimp, and one amphipod. These species occur in a variety of habitats in Hawaii, so prior to implementing Proposed Action activities, expert and/or agency consultation would be conducted to obtain more precise location and distribution information for the species than is publicly available, and preconstruction surveys would be implemented if warranted based on the expert and agency consultation. These measures would enable avoidance where possible and reduce the potential for and extent of potential impacts to listed invertebrates.

Alternatives Impact Assessment

This section assesses potential impacts to listed species associated with the Deployable Technologies Alternative and the No Action Alternative.[12]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative (including land based and aerial technologies) would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. These increases could increase the magnitude of potential impacts to listed species compared with the Preferred Alternative, as further described below.

<u>Potential Deployment Impacts</u>

As explained above, implementation of deployable technologies could result in minor potential impacts from direct and indirect injury or mortality events, habitat loss, disturbance, or displacement. Greater frequency and duration of deployments could increase the magnitude of these potential impacts depending on the location of the deployments in relation to listed species use areas. However, even with the increased impact magnitude, potential impacts *may affect, but not likely to adversely affect* listed species or designated critical habitats if BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 11, may be implemented as appropriate to further minimize potential impacts.

<u>Potential Operation Impacts</u>

As explained above, operation activities would consist of implementation and running the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, potential impacts associated with routine operations, management, and monitoring would vary among species, season, and geographic region but may affect, but not likely to adversely affect any listed species of designated critical habitat with implementation of BMPs and mitigation measures, as defined through consultation with the appropriate resource agency. Such consultation would facilitate avoidance of known listed species use areas to the maximum extent possible. If complete avoidance of listed species use areas would be unavoidable, consultation with USFWS, NMFS, and Hawaii Department of Land and Natural Resources, as applicable, would identify appropriate impact minimization and mitigation actions that would

[12] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

reduce the potential impacts. As such, the Deployable Technologies Alternative *may affect*, *but is not likely to adversely affect* listed species.

The same BMPs and mitigation measures implemented for deployment and operation of the deployable technologies component of the Preferred Alternative would be applied to this alternative.

Table 4.2.6.6-4 summarizes the impact significance determinations for each taxonomic group under the Deployable Technologies Alternative. Deployment and operation of the Deployable Technologies Alternative *may affect, but not likely to adversely affect* any listed species with implementation of BMPs and mitigation measures, as defined through consultation with the appropriate resource agency. Additional BMPs and mitigation measures, as defined in Chapter 11, may be implemented as appropriate to further minimize potential impacts. *No effects* would occur to marine mammals, marine reptiles, or fish because of the lack of activities within the aquatic habitats of these species.

Table 4.2.6.6-4: Determination of Impact Significance for Listed Species as a Result of the Deployable Technologies Alternative

Taxa	Impact Determination	Rationale for Determination
Plants	*May affect, not likely to adversely affect*	Activities related to the Deployable Technologies Alternative would have very limited potential impacts on vegetation and habitats because minimal construction would occur. Expert or agency consultation would be conducted prior to any vegetation-impacting activities to minimize the potential for impacts to listed plants.
Terrestrial mammals	*May affect, not likely to adversely affect*	The one listed terrestrial mammal species is a bat that is highly mobile so it would likely move away from any activities related to the Deployable Technologies Alternative. Because habitat potential impacts associated with this alternative are expected to be minimal due to the lack of new construction, potential direct impacts to this species from this alternative are unlikely. Disturbance-related potential impacts could occur or bats could collide with deployable equipment if located near bat use areas. Avoidance of known use areas to the extent possible would minimize the potential impacts to this species.
Marine mammals	*No effect*	Deployment and operation of the Deployable Technologies Alternative would not occur in marine waters or coastal habitats and thus would have no effect on listed marine mammal species.
Birds	*May affect, not likely to adversely affect*	Potential habitat impacts associated with this alternative are expected to be minimal due to the lack of new construction; therefore, direct impacts to listed bird species from this alternative are expected to be minimal. Disturbance-related potential impacts could occur or birds could collide with deployable equipment if located near bird use areas. Avoidance of known use areas and the bird breeding season to the extent possible would minimize the potential impacts to listed bird species.

Taxa	Impact Determination	Rationale for Determination
Reptiles	*No effect*	Deployment and operation of the Deployable Technologies Alternative would not occur in marine waters or coastal habitats and thus would have no effect on listed marine reptile species.
Invertebrates	*May affect, not likely to adversely affect*	Potential habitat impacts associated with this alternative are expected to be minimal due to the lack of new construction; therefore, potential direct impacts to listed invertebrates from this alternative are expected to be minimal. Expert or agency consultation would be conducted prior to any vegetation-impacting activities occurring in areas where listed invertebrates could occur. This would minimize the potential for impacts to listed invertebrates.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure, satellites, and other technologies. As a result, there would be *no effects* to listed species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

4.2.7. Land Use, Airspace, and Recreation

4.2.7.1. Introduction

This section describes potential impacts to land use, airspace, and recreation in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.7.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on land use, airspace, and recreation were evaluated using the significance criteria presented in Table 4.2.7-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, airspace, and recreation addressed in this section are presented as a range of possible impacts.

Table 4.2.7-1: Impact Significance Rating Criteria for Land Use, Airspace, and Recreation

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct land use change (site of FirstNet facility installation or deployable base)	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Change in existing land use that is within permitted (by-right) uses.	No change in land use
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one location.	No measurable effects
	Duration or Frequency	Permanent: Land use altered indefinitely		Short-Term: Land use altered for as long as the entire deployment phase or a portion of the operations phase.	No measurable effect
Indirect land use change (site of FirstNet facility installation or deployable base)	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Adverse effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses	No measurable effects
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one location.	No measurable effects
	Duration or Frequency	Permanent: Land use altered indefinitely		Short-Term: Land use altered for as long as the entire deployment phase or a portion of the operations phase.	No measurable effect

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Use of airspace (at and near site of FirstNet facility installation or deployable base)	Magnitude or Intensity	Complete change in flight patterns and/or use of airspace	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Alteration to air space usage is minimal	No measurable effects
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one location.	No measurable effects
	Duration or Frequency	Permanent: Airspace altered indefinitely		Short-Term: Airspace altered for as long as the entire deployment phase or a portion of the operations phase.	No measurable effect
Loss of access to public or private recreation land	Magnitude or Intensity	Total loss of access to recreation land	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Minor restricted access to recreation land	No measurable effects
	Geographic Extent	Most or all recreational land/sites in a state or territory		One (or a small number of) recreational site	No measurable effects
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire deployment phase or a portion of the operations phase	No measurable effect
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment, resulting in avoidance of activity at one or more sites	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Small reductions in visitation or duration of recreational activity	No measurable effects
	Geographic Extent	Most or all recreational land/sites in a state or territory		One (or a small number of) recreational site	No measurable effects
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire deployment phase or a portion of the operations phase	No measurable effect

4.2.7.3. Description of Environmental Concerns

Direct and Indirect Land Use Change

Deployment and operation of new aboveground facilities associated with the Proposed Action, such as new towers, antennas, or other structures, could result in direct changes to land use where such deployment occurs on land not already used for telecommunications, industrial, or public utility activity.

As discussed in Section 4.2.9, Socioeconomics, the presence of permanent aboveground facilities could lead to reduced property values due to diminishment of aesthetic characteristics and the potential for perceived health impacts. Purchases of land for FirstNet buildout (as also discussed in Section 4.2.9) could also affect localized real estate market values. Such potential real estate impacts could indirectly impact the intensity or type of land use in residential or commercial neighborhoods near new FirstNet aboveground facilities.

Given the constrained nature of real estate in Hawaii and the state's high property values (see Section 4.1.7, Land Use, Airspace, and Recreation), such effects would likely be milder than in less land-constrained parts of the nation (i.e., residents are more likely to tolerate disturbances because their ability to relocate is more limited).

The location of new telecommunications equipment, particularly larger aboveground facilities such as antennas or towers with aerial fiber optic plant, would be affected by county zoning regulations, as discussed in Section 4.1.7.2, Specific Regulatory Considerations. FirstNet and/or their partners will consider existing zoning, likely giving preference to areas where appropriate zoning already exists to facilitate deployment. FirstNet and/or their partners may need to obtain zoning variances or other special permits to construct such facilities in some areas.

Use of Airspace

Deployment and operation of new aboveground facilities associated with the Proposed Action, particularly taller structures such as new towers and antennas, could add new obstructions to existing airspace. Use of Deployable Airborne Communications Architecture (DACA) could add the presence of new air traffic and/or aerial navigation hazards. Given the requirements of Federal Aviation Administration (FAA) Part 77 regulations (see Section 4.1.7.2, Specific Regulatory Considerations), such taller structures are unlikely to be built near airports.

Access to and Enjoyment of Recreation Land

Deployment of the Proposed Action could temporarily block or hinder access to recreation lands in Hawaii in cases where deployment activity occurs in the vicinity of the entrances to parks or other such lands. Access could also be affected in cases where construction vehicles must use or cross the access roads for recreation lands. Operation of the Proposed Action would not involve any routine or frequent closures of roads or trails; therefore, the Proposed Action is unlikely to prevent or hinder access to recreation lands.

As discussed above under Direct and Indirect Land Use Change and in Section 4.2.8, Visual Resources, the presence of new aboveground facilities or deployment activity could be perceived as a negative visual impact. Such negative perceptions are more likely to be experienced near areas in Hawaii that are managed for recreational uses, visual resources, and/or preservation of natural environmental conditions (see Section 4.1.7.5, Recreation, and Figure 4.1.7-4). Hawaii residents often choose to live near such lands—and, along with visitors, to visit those lands—because of their scenic beauty and environmental quality. Placement of new aboveground facilities within sight of such lands could create a perceived diminution of those aesthetic and environmental values in the eyes of Hawaii residents and visitors, thus reducing the enjoyment they derive from living near or visiting recreation lands and facilities.

4.2.7.4. Potential Impacts of the Preferred Alternative

The following section assesses potential land use, airspace, and recreation impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. As explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

The following types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative are likely to have *no impacts* to land use, airspace, or recreation in Hawaii:

- Wired Projects
  - Use of Existing Conduit–New Buried Fiber Optic Plant: Installation of a new buried fiber optic plant within an existing conduit would have *no impact* on the use of airspace and would have no direct effects on land use or land ownership in Hawaii. Visible evidence of deployment is unlikely to affect land use or ownership decisions. In general, such effects would be temporary, with blockages of recreation access lasting only as long as deployment. If the deployment activities take place on non-paved roads, the visual evidence of deployment would diminish as affected areas revegetate.
  - Collocation on Existing Aerial Fiber Optic Plant: This activity would involve no new towers or other structures, and thus would not directly affect land use, land ownership, or use of airspace in Hawaii. While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible, and thus would not affect land uses or the enjoyment of recreation lands. While deployment (specifically, the stringing of new aerial fiber optic plant) could cause temporary

blockage of recreation lands access roads or trails, such activity would likely be so spread out and of such a short duration as to be imperceptible to the vast majority of potential users.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: The use of existing fiber optic plant would involve no new aboveground facilities and no substantial new trenching. As a result, there would be no perceptible change in land use, land ownership, or use of airspace in Hawaii from this option. While deployment activity (particularly if a small amount of new buried fiber optic plant must be installed) could be visible, and could theoretically cause temporary blockage of recreation lands access roads or trails, such activity would likely be so spread out and of such short duration as to be imperceptible to the vast majority of potential users. If deployment activities take place on non-paved surfaces, the visual evidence of deployment would be temporary and diminish as affected areas revegetate.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: This activity would involve no new towers or other structures, and thus would not directly affect land use, land ownership, or use of airspace in Hawaii. While the addition of new satellite-enabled equipment to existing towers, structures, or buildings would likely be visible, the change associated with this option would be so small as to be essentially imperceptible, and thus would not affect land uses or the enjoyment of recreation lands. Deployment is unlikely to cause blockage of access routes for recreation lands due to the lack of substantial construction activity.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact land use, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use, airspace, and recreation include the following:

- Wired Projects:
  - New Build–Buried Fiber Optic Plant: Installation of a new buried fiber optic plant (i.e., new underground conduit) would have *no impact* on the use of airspace in Hawaii. Depending on the specific location, minor construction could be visible from existing residences, businesses, or recreation areas until revegetation was complete. Deployment could also temporarily block access to recreation areas. As discussed in Section 4.2.7.3, Description of Environmental Concerns, visible evidence of deployment could indirectly affect land use or ownership decisions because the visible presence of infrastructure may be unappealing to home owners and buyers; however, once the area over the buried

conduit has revegetated, there would likely be little visual evidence remaining. Similarly, the visible presence of infrastructure may diminish the enjoyment of recreation facilities and activities during deployment until revegetation has occurred—particularly in more rural recreation sites where the evidence of human activity is expected to be minimal. In general, such effects would be temporary, with blockages of recreation access lasting only as long as deployment; the visual evidence of deployment would diminish as affected areas revegetate. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could further reduce the potential impact of this scenario.

- New Build–Aerial Fiber Optic Plant: The installation of a new aerial fiber optic plant (i.e., new wires on existing or new poles) could involve the permanent placement of new poles. New-Build-Aerial Fiber Optic Plan would have *no impact* on airspace as utility poles are in average 40 feet in height and do not intrude into useable airspace. Depending on the existing ownership and land use, this scenario could constitute a potential permanent impact on land use and ownership (if an easement is required for new pole placement). In addition, new poles could potentially constitute a discernable change in visual conditions (see Section 4.2.8, Visual Resources), and thus could indirectly affect land use, land ownership, and/or enjoyment of recreation (as described under the New Build–Buried Fiber Optic Plant option). As discussed for other scenarios, deployment of this scenario could result in temporary blockages of access routes to recreational lands. As it is likely that deployment of new wires on either new or existing poles would take place in established rights of way, and it is unlikely this activity would be noticeable beyond the short time it would take to install the new poles or place the new wire on existing poles. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize potential impacts.
- New Build–Submarine Fiber Optic Plant: Installation of a new submarine fiber optic plant in nearshore or inland waters would have *no impact* on the use of airspace. Depending on the existing ownership and use of affected land (including land required for and immediately adjacent to the submarine plant's onshore landing site), this scenario could constitute a small but potentially permanent impact on land use and ownership. While onshore landing sites would be visible (see Section 4.2.8, Visual Resources), it is unlikely that they would constitute a change in visual conditions sufficient to indirectly affect use or ownership of land not directly affected by this scenario. Depending on the specific location of these landing sites, the change in visual conditions caused by the presence of onshore landing sites could decrease the enjoyment of nearby recreational facilities—particularly if new submarine cables and onshore landing sites are installed near one of Hawaii's many scenic beaches or shorelines. Offshore deployment of this scenario could limit access to nearshore recreation areas in the immediate vicinity of a new submarine fiber optic plant. Such effects would be more noticeable in nearshore areas or inland bodies of water designated or managed for recreational activity. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of new transmission equipment would have *no impact* on the use of airspace in Hawaii. Depending on their specific location, access roads associated with deployment of this scenario could temporarily affect land use or access to recreation in cases where access roads cross private property. The presence of deployment activity near recreational lands could temporarily diminish the enjoyment of recreation activities; however, as the deployment would be short-term (lasting several hours to several weeks), it is unlikely to cause any permanent impact. BMPs and mitigation measures (see Chapter 11) could further help to avoid or minimize potential impacts. While new transmission equipment in this scenario could be visible from private property and recreation areas in Hawaii, it is unlikely that their presence would noticeably affect land use or the enjoyment of recreational lands.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless communication towers would involve the permanent placement of new structures. Depending on the existing ownership and use of affected land (including land immediately adjacent to the towers), this scenario could constitute a potential permanent impact on land use and ownership. In addition, new structures could potentially constitute a discernable change in visual conditions (see Section 4.2.8, Visual Resources), and thus could indirectly affect land use, land ownership, and/or enjoyment of recreation. Depending on their specific height and proximity to one of Hawaii's airports, new structures could constitute a new obstruction to be managed by aviators. As discussed for other scenarios, deployment could result in temporary blockages of access routes to recreational lands. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building : There would be *no impacts* to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses. Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation. Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structural hardening, and physical security measures could result in impacts if located near airports.
- Deployable Technologies (all options)
  - The deployment of land-based deployable technologies (e.g., mobilizing vehicles) would have no direct effect on land use or ownership, and would have no permanent effects on the use of airspace or access to or enjoyment of recreation lands and activities in Hawaii. Implementation of DACA could result in temporary and intermittent potential impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near airports. Potential impacts to airspace (such as special use airspace and military training routes) may be possible

depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).

Potential Direct and Indirect Land Use and Land Ownership Impacts

Potential direct land use and land ownership impacts for the New Build–Aerial Fiber Optic Plant and Construction of New Wireless Communication Towers option would be *less than significant*. These options would require permanent dedication of land to new towers or other aboveground structures; however, new aboveground facilities would likely be constructed in locations where such structures are consistent with local land use regulations. Additionally, once deployment locations are known, the location would be subject to an environmental review to help ensure environmental concerns are identified. New communication tower projects would also be required to comply with all relevant federal, state, and local regulations.

Potential indirect land use and land ownership impacts associated with these two scenarios, along with for the New Build–Buried Fiber Optic Plant, New Build–Submarine Fiber Optic Plant, Installation of Optical Transmission or Centralized Transmission Equipment, and Deployable Technologies options would generally be *less than significant*. These options would result in temporary disruption associated with deployment, as well as the potential indirect land use and land ownership impacts associated with changing visual conditions (see Section 4.2.7.3, Description of Environmental Concerns); however, these activities would generally be consistent with local land use regulations and would not result in widespread changes in land use or land ownership patterns.

See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts associated with land use and land ownership.

Potential Airspace Impacts

The Construction of New Wireless Communication Towers could permanently affect the use of airspace by potentially creating new aerial navigation hazards, although restricted airspace would likely be avoided. New towers would be required to comply with all relevant federal, state, and local regulations regarding siting, lighting, and engineering. The DACA option would add the presence of new manned and unmanned air traffic and/or aerial navigation hazards (in the case of tethered balloons) in Hawaii; however, it is likely that only the piloted aircraft option would enter controlled airspace. Because DACA would primarily be used to address wide-scale loss of coverage after a major catastrophic event, such disruptions could be long-term in nature (up to 2 years depending on the emergency).

These effects would be *less than significant,* although BMPs and mitigation measures (see Chapter 11) could further minimize their potential impacts.

To minimize these effects, FirstNet and/or their partners would likely give preference to development options that do not involve new towers or other tall aboveground structures. For cases where new towers or tall aboveground structures are the preferred option, FirstNet and/or their partners would require, as practicable or feasible, implementation of BMPs and mitigation measures (see Chapter 11).

Other build options would have no airspace impacts because they would not involve aboveground facilities that would intrude into airspace.

Potential Recreational Access and Enjoyment Impacts

None of the FirstNet scenarios would permanently affect access to recreational lands. Deployment of the New Build–Buried Fiber Optic Plant, New Build–Aerial Fiber Optic Plant, New Build–Submarine Fiber Optic Plant, Installation of Optical Transmission or Centralized Transmission Equipment, and New Wireless Communication Towers options could result in temporary blockages of access routes to recreational lands. These blockages would not continue beyond deployment activity. Due to the temporary nature of these deployment scenarios, potential impacts would be *less than significant*, although BMPs and mitigation measures (see Chapter 11) could further minimize their potential impacts.

Potential impacts during deployment of the New Build–Aerial Fiber Optic Plant and New Wireless Communication Towers options could permanently change visual conditions in the vicinity of Hawaii's recreation lands. Because such changes could be perceived as adverse, and because adverse perceptions could affect the ability to enjoy recreational activities, deployment of these options could therefore have to some degree a permanent negative effect on the enjoyment of recreational lands. However, it is anticipated that only minimal or small reductions in visitation or duration of recreational activities would result (as opposed to total loss of enjoyment), if any at all. In addition, the geographic extent of this potential impact would likely be limited to a small number of recreational sites. For these reasons, potential impacts during deployment would be *less than significant.*

All of the development scenarios listed in this subsection, as well as Deployable Technologies, could cause temporary changes to the visual environment, due to the presence of vehicles, deployment activities, and construction "scars" where subsurface infrastructure is deployed. Such potential impacts would occur during deployment and until vegetation is able to reclaim affected areas. Accordingly, due to the temporary nature of the deployment activities, these effects would be *less than significant* and further reduced by implementation of BMPs and mitigation measures.

See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with recreation.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. There would be *no impacts* to land use, land ownership, use of airspace, access to recreation, or enjoyment of recreation lands associated with routine inspections of the Wired or Wireless options within the Preferred Alternative. However, as discussed above, there would be *less than significant* impacts for wireless projects that deployed new towers or aboveground structures. These impacts could be further minimized by implementation of the BMPs and mitigation measures detailed in Chapter 11.

Operation of the Deployable Technologies options of the Preferred Alternative would result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to 2 years in some cases. The degree of change in the visual environment (see Section 4.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. Nighttime lighting in isolated rural areas or if sited near a national park would be *less than significant with BMPs and mitigation measures incorporated* during operations. Additionally, FirstNet would work closely with the National Park Service to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a National Park Service unit. The use of DACA could temporarily add new air traffic or aerial navigation hazards, as discussed above. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. However, as operation of all of the Deployable Technology options are to address emergency situations on a temporary basis, the potential impacts are *less than significant.* BMPs and mitigation measures (see Chapter 11) could further help to avoid or minimize potential impacts.

4.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, airspace, and recreation associated with the Deployable Technologies Alternative and the No Action Alternative.[1]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to

[1] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

land use, airspace, and recreation as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to land use if deployment occurs in areas with compatible land uses. While a single deployable technology may have an imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected. Also, implementation of deployable technologies could result in *less than significant* impacts to airspace if deployment does trigger any obstruction criterion or result in changes to flight patterns and airspace restrictions.

Potential Operation Impacts

Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in Hawaii—all of which would potentially affect a larger number of properties and/or areas of airspace. It is anticipated that there would be *no impacts* to land use, recreational resources, or airspace associated with routine inspections assuming the same access roads used for deployment are also used for inspections. Overall these potential impacts would be *less than significant* due to the minimal footprint associated with the land-based deployable (generally the size of a utility truck). Aerial deployables (piloted aircraft, balloons, and drones) would likely use existing airports and facilities for launching and recovery. To further minimize these effects, FirstNet and/or their partners would require, as practicable or feasible, implementation of BMPs and mitigation measures similar to those described for the Preferred Alternative (see Chapter 11).

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to land use, airspace, and recreation as a result of deployment and operation of the Proposed Action. Land use, airspace, and recreation conditions would therefore be the same as those described in Section 4.1.7, Land Use, Airspace, and Recreation.

4.2.8. Visual Resources

4.2.8.1. Introduction

This section describes potential impacts to visual resources in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize potential negative impacts, and/or that would preserve or enhance potential positive impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.8.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 4.2.8-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each potential impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 4.2.8-1: Impact Significance Rating Criteria for Visual Resources

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Intermittently noticeable negative change in aesthetic character.	No visible effects
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or several locations, but not widespread.	NA
	Duration or Frequency	Persisting more than 1 year		Persisting 1 month or less	NA
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Adverse effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Lighting alters night-sky conditions to a degree that is noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or several locations, but not widespread.	NA
	Duration or Frequency	Persisting more than 1 year		Persisting 1 month or less	NA

NA = not applicable

4.2.8.3. Description of Environmental Concerns

Opinions of and reactions to changes in visual resources are inherently subjective, and are based on each observer's personal feelings about what they are seeing. This Draft Programmatic Environmental Impact Statement focuses on cases where changes in the aesthetic environment would occur in or affect lands in Hawaii where visual or scenic resources are the subject of adopted regulations or places where observers are likely to expect higher scenic quality. These lands are discussed in Section 4.1.8, Visual Resources.

Aesthetic Character

Construction and operation of new aboveground facilities, such as new towers, antennae, or other structures, could add new permanent elements to the visual landscape (what observers can readily see from a given vantage point), while construction of options other than aboveground facilities could create temporary changes to the landscape—such as construction scars or the presence of construction equipment.

Applicable federal and state policies and regulations would affect the type and location of new Proposed Action facilities on lands where visual resources are managed through specific policies (such as units of the National Park System) or laws (such as zoning ordinances). Observers are more likely to perceive Proposed Action facilities adversely in areas close to other public or recreational areas, such as local parks, historic neighborhoods, and coastlines. While such preferences are not necessarily codified in law or regulation, observers (especially in a state like Hawaii with a reputation for scenic quality) tend to prefer (if not demand) higher levels of scenic quality in such areas.

Proposed Action facilities (especially new towers) that extend above the horizon are also likely to be perceived more negatively than options that remain at or near ground level. In addition, as discussed in Section 4.1.8.2, Specific Regulatory Considerations, the Federal Aviation Administration (FAA) may require certain aboveground structures to be painted white and orange, and in some cases to include daytime lighting (*FAA 2015*). Even for structures that do not extend above the horizon, this paint scheme is likely to contrast with the predominant background, and could thus be perceived as a negative effect.

Finally, as discussed in Section 4.2.9.3, Description of Environmental Concerns, potential real estate purchasers (individuals who wish to purchase a home or property, investors, developers, etc.) and renters could see the presence of aboveground facilities as a negative aesthetic element—a perception that could affect property values. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing (looking at the impact of external factors effecting price), or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (*Bond et al. 2013*). Essentially, analysts compare the value of multiple properties while statistically controlling differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (*Bond et al. 2013*). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately 2 percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Nighttime Lighting

As discussed in Section 4.1.8.2, Specific Regulatory Considerations, the FAA requires lighting for a wide variety of aboveground structures, including communication towers over 199 feet above ground level (*FAA 2015*). Additionally, structures and facilities associated with the Proposed Action could include ground-level security and safety lighting, although such lighting is not specifically required by the FAA regulations. Although likely minimal, such lighting would not only constitute a new light source, but could also increase the overall diffusion of artificial light into the sky (commonly referred to as sky glow).

Aside from federal and state lands where visual resources are managed according to established policies or laws, new nighttime light sources are most likely to be perceived negatively in less developed areas of Hawaii (areas away from major cities such as Honolulu). In such cases, the new light source may not be able to blend with existing light sources, and would thus potentially be perceived as more distinct.

Nighttime sky glow depends on topography and weather conditions, as well as the number, type, and location of artificial lights. In general, sky glow is associated with larger concentrations of artificial lights (such as a city or neighborhood), rather than a single light source.

4.2.8.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. Potential visual impacts of each of the Preferred Alternative options are discussed as a statewide system—i.e., the potential collective visual impact of a series of new fiber optic towers, or the potential collective visual impact of a statewide system of new wireless receivers installed on existing structures, etc. While this approach could overestimate potential impacts, this is preferable to underestimating potential impacts, as could be the case if the options were evaluated on a structure-by-structure basis.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. As explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant with BMPs and mitigation measures incorporated*, depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

The following types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative are likely to have *no impacts* to visual resources:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of a new buried fiber optic plant within an existing conduit would create visible evidence of construction limited to minor "scars" in the earth at the entry and exit points of the existing conduit, and the presence of construction equipment. These impacts would be minor, temporary, and last only until the area was revegetated. This option would involve no new nighttime lighting.
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting, and pole replacement would be limited.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would not have any impacts to visual resources because there would be no ground disturbance. This option would involve no new nighttime lighting.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: While new satellite-compatible infrastructure on existing towers, structures, or buildings (where antennae are already placed) would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have *no impact* on those resources.

Activities with the Potential to Have Impacts

Given the scope of the Proposed Action, while geographically enormous (in all 50 states, 5 territories, and the District of Columbia), the actual deployment in any one location is unlikely to be extensive and would likely involve a variety of deployment options (including an emphasis on collocations on existing facilities). The specific deployment activity, and where the deployment would take place, would be determined based on location-specific conditions and the results of site-specific environmental reviews.

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would generally consist of the presence of new aboveground structures (where appropriate), as well as visual evidence of construction and the presence of construction equipment. Potential impacts associated with the Preferred Alternative, based on the deployment activity and the limited duration of construction activities, are described further below. The remainder of this section provides summary impact discussions for each development scenario or deployment activity.

The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects:
  - New Build – Buried Fiber Optic Plant: Installation of a new buried fiber optic plant (i.e., new underground conduit) would create visible evidence of construction, including a "scar" in the earth where the new fiber optic plant was installed, and the presence of construction equipment used for this installation. These "scars" would likely be temporary and last only until the area was revegetated. BMPs and mitigation measures could help to avoid or minimize the potential impacts. This option would involve no new nighttime lighting.
  - New Build – Aerial Fiber Optic Plant: The installation of a new aerial fiber optic plant (i.e., new wires on existing and/or new poles) could have a discernable change on aesthetic conditions. This option could add new elements (poles) to the visual environment, and would result in the temporary visible evidence of construction activity and equipment. As it is likely that any new pole placement would take place in established rights-of-way, any potential visual impacts associated with this activity would be temporary and generally unnoticed. BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Submarine Fiber Optic Plant: Installation of a new submarine fiber optic plant in nearshore or inland waters would affect visual resources in the vicinity of the onshore landings and any equipment boxes or huts associated with such a cable. Such facilities would represent a change in the visual condition of the shoreline, would create a temporary construction "scar" for the onshore portion of the fiber optic plant, and would involve the presence of construction equipment used for installation. The construction-related aspects of this activity would be temporary while any equipment boxes or huts would be permanent, although generally small in size. BMPs and mitigation measures could help to further avoid or minimize the potential impacts. This option would involve no new nighttime lighting.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of new transmission equipment could add a new element to the visual environment, in the form of a small box or hut. The construction aspects of this activity would be temporary and localized while the new boxes or huts would be permanent, although generally small in size. BMPs and mitigation measures could help to further avoid or minimize the potential impacts. This option would likely involve no new nighttime lighting.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless communication towers would have a discernable change on aesthetic conditions. This option would add new elements (towers) to the visual environment and would result in visible evidence of construction activity and equipment. Depending on specific design, the FAA could require high-visibility paint schemes and/or lighting on the new towers required for this option. BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: While new wireless elements added to existing towers, structures, or buildings (where antennae are already placed) would likely be visible, the change associated with this option is so small as to be essentially imperceptible. However, if the on-site delivery of additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies (all options)
  - Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, or results in vegetation removal, areas of surface disturbance, or additional nighttime lighting.

Potential Aesthetic Character Impacts

Potential visual impacts for the Construction of New Wireless Communication Towers and other build options are expected to be *less than significant*. FirstNet and/or their partners would require, as practicable or feasible, implementation of the BMPs and mitigation measures listed in Chapter 11 to further minimize potential visual impacts. BMPs and mitigation measures are particularly important if these project types are implemented in more than a few locations—and/or in locations that affect lands where visual resources are regulated—because these options would permanently change views for a variety of observers. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with visual resources.

Potential Nighttime Lighting Impacts

Depending on specific design, Construction of New Wireless Communication Towers or Installation of Optical Transmission or Centralized Transmission Equipment options could introduce new artificial lighting, due to FAA regulations or other security concerns. New lighting associated with FirstNet structures could contribute incrementally to sky glow. As a result of the temporary nature of deployment, these effects would be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that

FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with visual resources.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. Wired or wireless options within the Preferred Alternative would have *no impacts* to visual resources beyond those discussed under Potential Deployment Impacts, above. Nighttime lighting in isolated rural areas or if sited near a national park would be l*ess than significant with BMPs and mitigation measures incorporated* during operations. Additionally, FirstNet would work closely with the National Park Service to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a National Park Service unit.

Operation of the Deployable Technologies option of the Preferred Alternative would create no permanent changes to the aesthetic environment. Use of these technologies would result in the temporary presence of deployable vehicles and equipment, which would represent a change in existing conditions. The degree of change in the visual environment would be highly dependent on the specific vehicle parking location. Although the FAA would not likely require nighttime lighting for ground-based deployable technologies, some ground-based deployable technologies could include their own safety lighting, which would be visible in the vicinity of the deployable unit. The FAA would likely require nighttime lighting for airborne deployable technologies, such as balloons, blimps, drones, and piloted aircraft.

4.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomic resources associated with the Deployable Technologies Alternative and the No Action Alternative.[1]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to visual resources as a result of implementation of this alternative could be as described below. To

[1] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

minimize these effects, FirstNet and/or their partners would implement, as practicable or feasible, the BMPs and mitigation measures for the Proposed Action described in Chapter 11.

Potential Deployment Impacts

Deployment (i.e., purchase, initial testing, staffing, and mobilization) of deployable technologies would generally result in *less than significant* impacts to visual resources—including aesthetic conditions and nighttime lighting due to the temporary nature of deployment.

Potential Operation Impacts

The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be *less than significant.* These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to visual resources as a result of construction and operation of the Proposed Action. Visual conditions would therefore be the same as those described in Section 4.1.8, Visual Resources.

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4.2.9. Socioeconomics

4.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize potential negative impacts, and/or would preserve or enhance potential positive impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.9.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on socioeconomic resources were evaluated using the significance criteria presented in Table 4.2.9-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomic resources addressed in this section are presented as a range of possible impacts.

Table 4.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Impacts to real estate	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift	Effect that is *potentially significant*, but with mitigation is *less than significant*	Indiscernible impact to property values and/or rental fees	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized at one location	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	NA
Economic benefits or adverse impacts related to changes in tax revenues, wages, or direct spending (could be positive or negative)	Magnitude or Intensity	Economic change that constitutes a market shift	Adverse effect that is *potentially significant*, but with mitigation is *less than significant*	Discernible but not substantial economic change	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized in one city or town	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	NA
Employment	Magnitude or Intensity	High level of job loss or creation	Effect that is *potentially significant*, but with mitigation is *less than significant*	Low level of job creation	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized in one city or town	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	No perceptible change in baseline conditions

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased pressure on existing public services	Magnitude or Intensity	Access to or quality of public services severely constrained, potentially threatening public safety	Effect that is *potentially significant*, but with mitigation is *less than significant*	Access to or quality of public services constrained to a minimally perceptible degree	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized at one location	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	No perceptible change in baseline conditions
Diminished social cohesion/disruption related to influx	Magnitude or Intensity	Impacted individuals and communities cannot adapt to social disruption/ diminished social cohesion, or are not able to adapt fully, even with additional support	Effect that is *potentially significant*, but with mitigation is *less than significant*	Impacted individuals and communities are able to adapt to social disruption and/or diminished social cohesion without support	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized at one location	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	No perceptible change in baseline conditions

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Reduced opportunities for subsistence practices	Magnitude or Intensity	Impacted individuals and communities cannot adapt to reduced subsistence opportunities, or are not able to adapt fully, even with additional support	Effect that is *potentially significant*, but with mitigation is *less than significant*	Impacted individuals and communities are able to adapt to reduced subsistence opportunities without support	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized at one location	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	No perceptible change in baseline conditions

NA = not applicable

4.2.9.3. Description of Environmental Concerns

Real Estate

Construction and operation of new aboveground facilities, such as new towers, antennae, or other structures, could affect real estate values. Potential real estate purchasers (individuals who wish to purchase a home or property, investors, developers, etc.) and renters could see the presence of aboveground facilities as a negative aesthetic element, especially in a highly scenic state such as Hawaii (potential visual impacts are discussed in Section 4.2.8, Visual Resources). Purchasers and renters may also believe (regardless of factual information) that the presence of wireless facilities is a negative health impact (potential health impacts are discussed in Section 4.2.15, Human Health and Safety). Such negative perceptions of the Proposed Action could cause purchasers and renters to offer lower payments for affected properties than might otherwise be expected.

Should new land be required for FirstNet buildout (as opposed to installing additional equipment at existing telecommunications sites), such purchases could affect overall real estate markets by reducing the supply of available land. Given the constrained nature of real estate in the portions of Hawaii designated for development (see Section 4.1.7, Land Use, Airspace, and Recreation), and the state's high property values (see Section 4.1.9, Socioeconomics), such effects would likely be milder than in less land-constrained parts of the nation (i.e., residents are more likely to tolerate disturbances because their ability to relocate is more limited). Because of the limited housing supply, buyers and renters would be less likely to be disturbed by FirstNet buildout.

Improvements in telecommunications coverage for first responders in Hawaii's less developed areas could result in increased property value in those areas due to that increased connectivity. Overall effects on real estate would be limited to areas near FirstNet new-build projects.

Economic Effects (Positive and Negative)

FirstNet deployment and operation could affect the state's economy through changes in tax revenue, wages, and spending associated with FirstNet. Such effects could be direct, indirect, or induced. Direct effects could include (but are not limited to) taxes generated by FirstNet facilities, wages paid directly to FirstNet employees (deployment or operations), and FirstNet spending on raw materials. Indirect effects could include, for example, wages paid and materials purchased by FirstNet contractors and subcontractors. Induced effects are those that are not directly related to FirstNet, but that would not occur "but for" FirstNet, such as increased spending at restaurants near construction sites.

New projects such as FirstNet are typically associated with potential positive economic impacts. Potential negative impacts could occur if the presence of the Proposed Action were to prevent or diminish other existing or likely future economic activity, resulting in reduced taxes, wages, or spending. The same potential visual impacts that could affect real estate (see above) in Hawaii, could also negatively affect tourist activity in Hawaii, which is based at least in part on the state's visual characteristics.

Employment

FirstNet deployment and operations could create direct, indirect, and induced employment, through new jobs associated with FirstNet (direct), its contractors and subcontractors (indirect), and other businesses that serve FirstNet employees, contractors, or subcontractors (induced). As is the case for economic effects (discussed above), such potential impacts are typically positive, but could potentially be negative if FirstNet deployment or operation results in negative economic impacts.

The use of Hawaii-resident employees for FirstNet projects in Hawaii is an important consideration. Residents are more likely to spend their wages in the state, driving economic activity (discussed above) while reducing potential negative impacts on social cohesion (see below).

Increased Pressure on Public Services

The use of public services, such as first responders (police, fire, etc.), public utilities, and public schools, is typically tied to Proposed Action-related changes in residential population and employment. Increased population and/or employment typically results in increased demand for services. Increased demand for services could be offset by increased tax revenue (see Economic Effects subsection above, as well as Section 4.2.1, Infrastructure).

Diminished Social Cohesion and/or Disruption due to Influx

Construction projects such as FirstNet could result in the influx of construction and operations workers into the Proposed Action area. While this influx often results from a lack of appropriately skilled workers locally, social tension between existing residents and newly arrived workers may emerge. This tension could result from a variety of sources, such as dissatisfaction among existing residents who did not receive Proposed Action-related jobs, cultural differences between existing residents and new workers, and inappropriate or illegal behavior by incoming workers (e.g., alcohol and drug abuse, or solicitation of prostitution), many of whom are men without families, or whose families have not relocated with them. Hawaii's distance from the mainland United States (and other nations) reduces, but does not eliminate, the possibility of such influx.

Reduced Opportunities for Subsistence Practices

FirstNet's physical footprint and deployment activities could reduce the land available for subsistence activities, and/or could diminish the availability of subsistence species, either through diminishment of habitat or the interruption of migratory pathways. The cultural aspects of subsistence practices in Hawaii are discussed in Section 4.1.11, Cultural Resources.

4.2.9.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. As explained in this section, the various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following is likely to have *no impacts* to socioeconomics:

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomic resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to socioeconomic resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of new employment and/or economic activity, as well as potential effects on real estate, public services, subsistence, and social cohesion. The remainder of this section provides summary potential impact discussions for each development scenario or deployment activity.

The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to socioeconomics include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Installation of a new buried fiber optic plant (i.e., new underground conduit) would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety). There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but would be dependent on whether the workers are Hawaii residents or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of a new buried fiber optic plant within an existing conduit would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety). There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion

of a given area, but would be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. The effects described above would be similar to but less than the New Build – Buried Fiber Optic Plant option, because the Use of Existing Conduit – New Buried Fiber Optic Plant option would involve less ground disturbance, and therefore less labor and use of equipment.

- New Build – Aerial Fiber Optic Plant: The installation of a new aerial fiber optic plant (i.e., new wires on elevated structures) could potentially have a discernable change for factors that affect perceived property values (aesthetics, health, and safety). To the degree that such changes reduce property values, these effects could also reduce tax revenues, a negative economic effect. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but would be dependent on whether the workers are Hawaii residents or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts.
- Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant with existing fiber optic plant would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety) or subsistence resources. There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: The use of existing fiber optic plant would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety) or subsistence resources. There could be some potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. The effects described above would be similar to but less than those described for the Collocation on Existing Aerial Fiber Optic Plant option, and substantially less than the new build options.
- New Build – Submarine Fiber Optic Plant: Installation of a new submarine fiber optic plant in limited near-shore or inland waters would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety). There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of

a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of new transmission equipment could potentially have a discernable change in factors that affect perceived property values—particularly aesthetics due to new access roads. To the degree that such changes reduce property values, these effects could also reduce tax revenues, a negative economic effect. There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. The effects described above would be similar to but less than those described for the New Build – Buried Fiber Optic Plant because the Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable option would involve less ground disturbance, and therefore less labor and use of equipment.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless communication towers could potentially have a discernable change for factors that affect perceived property values (aesthetics, health, and safety). To the degree that such changes reduce property values, these effects could also reduce tax revenues, a negative economic effect. There could be potentially discernable benefits to the economy (income and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. In addition, and depending on location, installation of new wireless communication towers could affect terrestrial subsistence resources given FirstNet's physical footprint and deployment activities, either through diminishment of habitat or through the interruption of migratory pathways. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize these potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: The collocation of new wireless facilities on existing facilities would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety) or subsistence resources. There could be some potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. The effects described above would be similar to but less than those described for the Collocation on Existing Aerial Fiber Optic Plant option, and substantially less than the new build options.

- Deployable Technologies (all options)
  - The use of deployable technologies, including some limited construction associated with implementation, such as land clearing or paving for parking or staging areas, would create no permanent changes to factors that affect perceived property values (aesthetics, health, and safety). There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts.
- Satellite and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of new satellite-compatible infrastructure would create no permanent change in factors affecting perceived property values (aesthetics, health, and safety) or subsistence resources. There could be potentially discernable benefits to the economy (increased property, income, and sales tax revenues) and employment. The influx of new workers could affect the social cohesion of a given area, but could be dependent on whether the workers are Hawaiian or not. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to further minimize potential impacts. The effects described above would be similar to but less than those described for the Collocation on Existing Aerial Fiber Optic Plant option, and substantially less than the new build options. The use of satellite-compatible devices (e.g., mobile phones) absent the installation of new equipment would have *no impacts*.

Potential Real Estate Impacts

Potential real estate impacts for the New Build – Aerial Fiber Optic Plant and Construction of New Wireless Communication Towers option and the Installation of optical Transmission or centralized Transmission Equipment option would be *less than significant.* These options would permanently change views from private property and/or introduce new wireless infrastructure that property buyers or renters could perceive as having impacts; however, these potential impacts would be temporary and only as long as the construction period lasted. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing (looking at the impact of external factors effecting price), or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (*Bond et al. 2013)*. Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes in order to isolate the effect of a specific attribute, such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (*Bond et al. 2013*). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential real estate impacts.

Potential Economic Impacts

To the degree that the New Build – Aerial Fiber Optic Plant and Construction of New Wireless Communication Towers or Installation of Optical Transmission or Centralized Transmission Equipment options reduce property values and, although anticipated to be minor, these options could also reduce tax revenues. Other options would not reduce property values, and would therefore not affect tax revenues. Additionally, construction activity associated with FirstNet deployment would create additional wages, spending, and/or tax revenues. To further minimize these effects, FirstNet and/or their partners would require, as practicable or feasible, implementation of the BMPs and mitigation measures described in Chapter 11, BMPs and Mitigation Measures.

Overall, the potential economic impacts from Preferred Alternative development options would be positive and *less than significant*. BMPs and mitigation measures described in Chapter 11, BMPs and Mitigation Measures could maintain or enhance these positive economic impacts.

Potential Employment Impacts

The potential employment impacts from Preferred Alternative development options would be positive and *less than significant*. Construction activity associated with FirstNet deployment could create additional jobs (through new jobs directly associated with FirstNet, its contractors and subcontractors, and other business that serve FirstNet employees, contractors, or subcontractors). See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to enhance these benefits.

Potential Public Services Impacts

Potential impacts on demand for public services would be *less than significant*. As mentioned above, the use of public services is typically tied to changes in residential population and employment. Increases in population and/or employment typically results in increased demand for services, however, this demand is anticipated to be minimal. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further minimize potential public services impacts.

Potential Social Cohesion Impacts

Potential social cohesion impacts, due to the potential influx of workers into the project area, are anticipated to be *less than significant* for Preferred Alternative development options primarily due to the limited amount of construction activities in any one area. To further minimize potential social cohesion impacts, FirstNet and/or their partners would likely, as practicable or feasible, give preference to hiring workers who are residents of Hawaii, and ideally of the island on which construction activities would take place (see Chapter 11, BMPs and Mitigation Measures).

Potential Subsistence Impacts

There could be a potential to cause minor damage, remove access to, or cause the relocation of plant and animal species important for subsistence activities. However, given the limited amount of construction anticipated in any one area, it is anticipated that this potential impact would be minimal. Therefore, potential subsistence impacts are anticipated to be *less than significant* for the Preferred Alternative.

These minimal potential impacts could be further reduced by implementing the BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to subsistence harvesting (see Chapter 11, BMPs and Mitigation Measures).

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. There would be *less than significant* impacts to real estate public services, social cohesion, and subsistence resources, and minimal, positive, *less than significant* impacts to economic activity and employment associated with routine inspections of the Preferred Alternative.

4.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomic resources associated with the Deployable Technologies Alternative and the No Action Alternative.[1]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction. associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or

[1] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomic resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

Deployment (i.e., purchase and staffing) of deployable technologies would result in *no impacts* to real estate, public services, social cohesion, and subsistence, as well as *less than significant* positive impacts on economic activity and employment due to the employees who operate deployable equipment, the wages paid to them, and the expenditures on equipment, fuel, and other items.

Potential Operation Impacts

Operation of deployable technologies would result in *no impacts* to public services or social cohesion, and *less than significant* impacts to real estate and subsistence resources if deployment locations are in areas where subsistence resources are present, and if the same deployment locations are used repeatedly and frequently. Implementation of deployable technologies could have *less than significant* positive impacts on economic activity and employment due to the employees who operate deployable equipment, the wages paid to them, and the expenditures on equipment, fuel, and other items.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to socioeconomic resources as a result of construction and operation of the Proposed Action. Socioeconomic conditions would therefore be the same as those described in Section 4.1.9, Socioeconomics.

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4.2.10. Environmental Justice

4.2.10.1. Introduction

This section describes the potential impacts to environmental justice in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would help avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.10.2. Impact Assessment Methodology and Significance Criteria

Construction and operation of the Proposed Action in Hawaii could generate a potential environmental justice impact if high and adverse health and/or environmental impacts resulting from any phase of the Proposed Action's deployment or operation were to disproportionately affect a minority or low-income group (see below). If the impacts on the general population are not significant (in other words, are not high and adverse), there can be no disproportionate impacts on minority and low-income populations. For impacts determined to be significant, disproportionality would be determined based on the minority and low-income status of the population in the affected area. The significance of potential impacts of the Proposed Action on environmental justice was evaluated using the significance criteria presented in Table 4.2.10-1. As described in Section 4.2, Environmental Consequences, the categories of potential impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various areas, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 4.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects associated with other resource areas (e.g., cultural resources) that have environmental justice implications due to the affected parties (as defined by EO 12898)	Magnitude or Intensity	Direct and disproportionate effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated	Effect that is *potentially significant*, but with mitigation is *less than significant*	Direct effects on environmental justice communities (as defined by EO 12898) that do not require mitigation	No perceptible change in baseline conditions
	Geographic Extent	Regional impacts observed throughout the state or territory		Effects realized at one location	NA
	Duration or Frequency	Persists during or beyond the life of the Proposed Action		Persists for as long as the entire construction phase or a portion of the operations phase	NA

EO = Executive Order; NA = not applicable

4.2.10.3. Description of Environmental Concerns

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the location of the facility/infrastructure and the specific deployment requirements, some activities could result in potential impacts to environmental justice communities and others would not. As explained in this section, the same type of Proposed Action infrastructure could result in impacts ranging from *no impact* to *less than significant*, depending on the deployment scenario or site-specific conditions[1]. Section 4.1.10.4, Identification of Potential for Environmental Justice Impacts, shows areas in Hawaii with high, moderate, and low potential for environmental justice impacts.

4.2.10.4. Potential Impacts of Preferred Alternative

The following section assesses potential environmental justice impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

The determination of potential environmental justice impacts is dependent on both the specific location of deployment and operation as well as the magnitude of impacts to other resources and the types of resources affected. Environmental justice impacts are more likely to occur as a result of significant impacts to soils, water resources, land use, visual resources, socioeconomics, cultural resources, air quality, noise, and human health and safety, to the extent those impacts occur.

Activities Likely to Have No Impacts

The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and that are likely to have *no impact* on environmental justice include the following:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to environmental justice communities because the activities that would be conducted at these small entry and exit points are not likely to produce perceptible surface disturbances. Additionally, installation of a new buried fiber optic plant within an existing conduit could lead to minor positive economic and employment benefits.

[1] Since potential environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would be required to determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: The use of existing fiber optic plant would involve minimal aboveground activity in Alaska. While some socioeconomic impacts could occur (see Section 3.2.9, Socioeconomics), it is unlikely that any of these impacts would rise to the level of "high and adverse" necessary to create environmental justice effects.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of new satellite-compatible infrastructure could lead to economic benefits, and would create no permanent negative changes in factors that affect environmental justice (such as income, economic conditions, population distribution, and subsistence, among others). The use of satellite-compatible devices (e.g., mobile phones) absent the installation of new equipment would have *no impacts*. BMPs and mitigation measures could help to avoid or minimize the potential impacts.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice resources, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Given the scope of the project, while geographically enormous (in total 50 states, 5 territories, and the District of Columbia), the actual deployment in any one location is unlikely to be extensive and will likely involve a variety of deployment options (including an emphasis on collocations on existing facilities). The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

Except for the four infrastructure development activities described above, all development scenarios and deployment activities have at least some potential to create environmental justice impacts. Taking into account the limited duration of construction activities, the types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential environmental justice impacts are discussed below. In general, as described in Section 4.2.10.2, Impact Assessment Methodology and Significance Criteria, environmental justice impacts could occur as a result of other impacts (such as to air, water, or socioeconomics, etc.); the potential for environmental justice impacts shown in Figure 4.1.10-1 (in the Affected Environment section) indicates the degree to which such resource-specific impacts could disproportionately and adversely affect environmental justice communities. These potential impacts associated with the Proposed Action, based on the deployment activity and the limited duration of construction activities, are described further below.

- Wired Projects:
  - New Build – Buried Fiber Optic Plant: Installation of a new buried fiber optic plant (i.e., new underground conduit) could lead to economic and employment benefits, but could have adverse effects on land, air, water, community cohesion (due to worker influx), and other resources. BMPs and mitigation measures would help to avoid or minimize these potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of a new aerial fiber optic plant (i.e., new wires on elevated structures) could lead to economic and employment benefits, but could have adverse effects on land, air, community cohesion (due to worker influx), and other resources. BMPs and mitigation measures would help to avoid or minimize these potential impacts.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant with existing fiber optic plant could lead to economic and employment benefits, although these would be less than the New Build – Aerial Fiber Optic Plant option. While this option could affect land, air and water resources, such potential impacts are less likely than under the New Build – Aerial Fiber Optic Plant option because the Use of Existing Aerial Fiber Optic Plant option would involve less ground disturbance. BMPs and mitigation measures would help to further avoid or minimize these potential impacts.
  - New Build – Submarine Fiber Optic Plant: Installation of a new submarine fiber optic cable in limited near-shore or inland bodies of water could lead to economic and employment benefits, but could have adverse effects on land, air, water, community cohesion (due to worker influx), and other resources. BMPs and mitigation measures would help to avoid or minimize these potential impacts.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of new transmission equipment could lead to economic and employment benefits, but could have adverse effects on land, air, water, community cohesion (due to worker influx), and other resources, due in part to the need to create access roads. BMPs and mitigation measures would help to avoid or minimize these potential impacts. The effects described above would be similar to but less than those described for the New Build – Buried Fiber Optic Plant, because the Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable option would involve less ground disturbance, and therefore less labor and use of equipment.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless communication towers could lead to economic and employment benefits, but could have adverse effects on land, air, water, community cohesion (due to worker influx), and other resources. In addition, and depending on location, installation of new wireless communication towers could result in limited and isolated impacts to some terrestrial subsistence resources, either through diminishment of habitat or through the interruption of migratory pathways. However, given the relatively small footprint of this project type, potential impacts, if

any, would likely be localized (not widespread) and only persist during the construction phase, or a limited portion of the operations phase. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) would help to avoid or minimize these potential impacts.

  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Deployable Technologies (all options)
  - Deployable Technologies: Cell on Wheels, Cell on Light Truck, System on Wheels, and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

As described in this Draft Programmatic Environmental Impact Statement, none of the development scenarios or deployment activities would result in significant impacts after mitigation. As a result, there would likely be no disproportionately high and adverse effects to environmental justice communities in Hawaii from any development scenario or deployment activity and even less impacts if BMPs and mitigation measures are followed.

Potential Environmental Justice Impact

Potential environmental justice impacts from all development scenarios and activities (except for the Use of Existing Conduit – New Buried Fiber Optic Plant, Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable, Satellite Enabled Devices and Equipment, or Deployment of Satellites options, which would have *no impacts*) would be *less than significant.* In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly for new towers. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help to determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with environmental justice.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative, which would consist of routine maintenance and inspection of the facilities, are anticipated to have *less than significant* impacts if the same roads are used to perform inspections and maintenance activities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the deployment impacts described above.

4.2.10.5. Alternatives Impact Assessment

This section discusses potential environmental justice impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. In general, some limited construction could be associated with the implementation of deployable technologies such as land clearing or paving for parking or staging areas. However, these construction activities would be minimal in comparison to the combination of project types associated with the Preferred Alternative as described above. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative, but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

The potential for environmental justice impacts shown in Figure 4.1.10-1 is applicable to this alternative.

Potential Deployment Impacts

As explained above, deployable technologies such as Cell on Wheels, Cell on Light Truck, System on Wheels, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise and dust could be generated temporarily, and traffic could be disrupted. These impacts are expected to be *less than significant*. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

Potential Operation Impacts

Operation of deployable technologies would result in effects similar in type to, but more frequent than, those described for the Preferred Alternative. As a result, this alternative would result in *less than significant* disproportionate impacts to environmental justice communities due to the impacts to air, water, land, and subsistence resources associated with the operation of deployable vehicles for up to 2 years at a time. The BMPs and mitigation measures described for the

Preferred Alternative would help to minimize these impacts. Implementation of deployable technologies could have *less than significant* positive impacts on environmental justice communities due to the employees who operate deployable equipment, the wages paid to them, and the expenditures on equipment, fuel, and other items (see Section 4.2.9, Socioeconomics).

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no impacts associated with construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. There would be no environmental justice impacts associated with the No Action Alternative.

4.2.11. Cultural Resources

4.2.11.1. Introduction

This section describes potential impacts to cultural resources in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would help avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.11.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 4.2.11-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as an *adverse effect; mitigated adverse effect; effect, but not adverse;* and *no effect*. These impact categories are comparable to those defined in *36 Code of Federal Regulations (CFR) 800*, *Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation* (*NPS 1983*), and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (*NPS 2002*). Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 4.2.11-1: Impact Significance Rating Criteria for Cultural Resources

<table>
<tr><th rowspan="2">Type of Effect</th><th rowspan="2">Effect Characteristic</th><th colspan="4">Impact Level</th></tr>
<tr><th>Adverse Effect</th><th>Mitigated Adverse Effect[a]</th><th>Effect, but not Adverse</th><th>No Effect</th></tr>
<tr><td rowspan="3">Direct effects to historic properties[b]</td><td>Magnitude or Intensity</td><td>Effects to a contributing portion of a single or many historic properties</td><td rowspan="3">Adverse effect that has been procedurally mitigated through Section 106 process</td><td>Effects to a non-contributing portion of a single or many historic properties</td><td>No direct effects to historic properties</td></tr>
<tr><td>Geographic Extent</td><td>Direct effects APE</td><td>Direct effects APE</td><td>Direct effects APE</td></tr>
<tr><td>Duration or Frequency</td><td>Permanent direct effects to a contributing portion of a single or many historic properties</td><td>Permanent direct effects to a non-contributing portion of a single or many historic properties</td><td>No direct effects to historic properties</td></tr>
<tr><td rowspan="3">Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)</td><td>Magnitude or Intensity</td><td>Effects to a contributing portion of a single or many historic properties</td><td rowspan="3">Adverse effect that has been procedurally mitigated through Section 106 process</td><td>Effects to a contributing or non-contributing portion of a single or many historic properties</td><td>No indirect effects to historic properties</td></tr>
<tr><td>Geographic Extent</td><td>Indirect effects APE</td><td>Indirect effects APE</td><td>Indirect effects APE</td></tr>
<tr><td>Duration or Frequency</td><td>Long-term or permanent indirect effects to a single or many historic properties</td><td>Infrequent, temporary, or short-term, indirect effects to a single or many historic properties</td><td>No indirect effects to historic properties</td></tr>
<tr><td rowspan="3">Loss of access to historic properties</td><td>Magnitude or Intensity</td><td>Effects to a contributing portion of a single or many historic properties</td><td rowspan="3">Adverse effect that has been procedurally mitigated through Section 106 process</td><td>Effects to a non-contributing portion of a single or many historic properties</td><td>No segregation or loss of access to historic properties</td></tr>
<tr><td>Geographic Extent</td><td>Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties</td><td>Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties</td><td>No segregation or loss of access to historic properties</td></tr>
<tr><td>Duration or Frequency</td><td>Long-term or permanent segregation or loss of access to a single or many historic properties</td><td>Infrequent, temporary, or short-term changes in access to a single or many historic properties</td><td>No segregation or loss of access to historic properties</td></tr>
</table>

APE = Area of Potential Effect

Notes:
[a] Whereas BMPs and mitigation measures for other resources discussed in this Draft Programmatic Environmental Impact Statement may be developed to achieve an impact that is *less than significant with BMPs and mitigation measures incorporated*, historic properties are considered to be "non-renewable resources" given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the National Historic Preservation Act (as codified in *Title 36 of the CFR Parts 800.6*), would require FirstNet to consult with the State Historic Preservation Office/Tribal Historic Preservation Office and other consulting parties, including American Indian tribes and Native Hawaiian organizations, to develop appropriate BMPs and mitigation measures.
[b] Per the National Historic Preservation Act, a historic property is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the National Register of Historic Places (NRHP). Cultural resources present within an individual project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian tribes and other consulting parties that, in consultation with the respective party or parties, may or may not be eligible for listing in the NRHP. These sites may also be considered traditional cultural property (TCPs). Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term "historic property" is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

Specific Regulatory Considerations

As discussed in Section 4.1.11, Cultural Resources, the Proposed Action is considered an undertaking as defined in *36 CFR 800*, the regulation implementing Section 106 of the National Historic Preservation Act. The intent of Section 106, as set forth in its attending regulations, is for federal agencies to take into account the effects of a proposed undertaking on historic properties, which can include traditional cultural properties (TCPs), and to consult with the Advisory Council on Historic Preservation (ACHP); State Historic Preservation Offices (SHPOs); federally recognized American Indian tribes and Native Hawaiian organizations; local governments; applicants for federal assistance, permits, licenses, and other approvals; and, any other interested parties with a demonstrated interest in the proposed undertaking and its potential effects on historic properties.

Section 106 establishes a process for the following:

- Identifying historic properties that may be affected by a proposed undertaking;
- Assessing the undertaking's effects on those resources; and
- Engaging in consultation that seeks ways to avoid, minimize, or mitigate adverse effects on properties that are either listed on, or considered eligible for listing on, the National Register of Historic Places (NRHP).

The area in which effects on resources are evaluated is known as the Area of Potential Effect (APE). The APE is defined as, "… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking" (*36 CFR § 800.16(d)*).

The APE would include potential effects areas for both direct and indirect effects. Direct effects physically alter the historic property in some way, and indirect effects are further removed in time or space and diminish some aspect of the historic property, but may not physically alter it. Direct and indirect effects are discussed in further detail below. Although an APE has not been identified for the Proposed Action due to the nature of this programmatic evaluation, an APE would need to be established to evaluate the potential site-specific effects to cultural resources for any individual project.

To be eligible for listing in the NRHP, a cultural resource must meet at least one of the four criteria for eligibility. The major criteria (*36 CFR 60.4(a–d)*) used to evaluate the significance of a cultural resource are as follows:

a) It is associated with events that have made a significant contribution to the broad patterns of history;

b) It is associated with the lives of past significant persons;

c) It embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d) It has yielded or may be likely to yield information important in history or prehistory.

Properties also need to exhibit integrity of location, materials, setting, design, association, workmanship, and feeling and commonly be at least 50 years old. However, under Criteria Consideration G, a property achieving significance within the past 50 years is eligible if it is of exceptional importance.

As discussed in Section 4.1.11, Cultural Resources, historic properties can also include properties of traditional religious and cultural significance to various populations; these properties are commonly referred to as TCPs. TCP is defined in National Register Bulletin 38 as a place "eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (*NPS 1998*). Because the cultural practices or beliefs that give a TCP its significance are typically still observed in some form at the time the property is evaluated, it is sometimes perceived that the intangible practices or beliefs themselves, not the tangible property, constitute the subject of evaluation. There is naturally a dynamic relationship between tangible and intangible. The beliefs or practices associated with a TCP are of central importance in defining its significance. However, it should be clearly recognized at the outset that the NRHP does not include intangible resources themselves. The entity evaluated must be a tangible property—i.e., a district, site, building, structure, or object. Notably, a property must meet several preconditions in order to meet the federal definition of TCP as articulated in National Register Bulletin 38. These conditions include the ongoing use of a property in spiritual practice or other traditional activities (*NPS 1998*). It is difficult to identify properties of traditional cultural significance because they are often kept secret due to sensitivity around use and location by the effected communities and the National Register discourages nominations of purely natural features "without sound documentation of their historical or cultural significance" (*NPS 1998*). It is through consultation with affected groups themselves that historic properties of religious and cultural significance can be properly identified and evaluated (*ACHP 2008*).

Local, state, tribal, and federal agencies would be consulted as appropriate in findings and determinations made during the Section 106 process, as specified in *36 CFR 800*. This includes any SHPO/Tribal Historic Preservation Office whose state would physically include any portion of the APE. In addition to the SHPO, the lead federal agencies have an obligation, as appropriate, to work with state and local governments as well as private organizations, applicants, or individuals with a demonstrated interest from initiation to completion of the review under Section 106 of the National Historic Preservation Act. Once the lead federal agency has identified the appropriate SHPO, *36 CFR 800.3(f)(2)* requires the federal agencies to identify American Indian tribes or Native Hawaiian organizations that may attach religious and cultural significance to historic properties within the APE and invite them to be consulting parties.

In consultation with the SHPO and other effected parties, FirstNet would apply the criteria of adverse effects to historic properties within the APE to evaluate the potential effect of the Proposed Action on the identified historic properties, as codified in *36 CFR 800.5*.

An *adverse effect* is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, as discussed above. Adverse effects may include reasonably foreseeable indirect effects that occur later in time, are farther removed, or are cumulative.

FirstNet would confer with consulting parties to determine the undertaking's effects on historic properties, to resolve adverse effects, and to develop BMPs and mitigation measures as necessary. As presented in Table 4.2.11-1, effects determinations have the following three possible outcomes:

1. Finding of *no effect* to historic properties – The Proposed Action does not have the potential to cause effects on historic properties that may be present.
2. Finding of *effect, but not adverse* – The historic property would be affected; however, the effects of an undertaking do not meet the criteria of adverse effect, or measures have been taken to avoid or minimize adverse effects.
3. Finding of *adverse effect/mitigated adverse effect* – The undertaking may affect the integrity, which would alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP. If an *adverse effect* is found, the federal lead agency shall consult further to resolve the adverse effect.

Except as described later, if an historic property could be affected, FirstNet would follow the provisions of *36 CFR 800.5* to determine whether the effects were adverse. If an effect were adverse, FirstNet would consult with the parties identified above to identify practicable and feasible ways to avoid, minimize, or mitigate any potential effects of the Proposed Action pursuant to *36 CFR 800.6*. Additionally, the ACHP would be notified of the adverse effects and invited to participate in the resolution of adverse effects process. If adverse effects are unavoidable, then the following are potential BMPs and mitigation measures that could be taken to resolve adverse effects:

- Minimization, which would reduce the effects on the resource through partial avoidance, but would not completely eliminate the effects; and
- Mitigation, which would offset that effect through some of the following means:
  - Protection of a similar resource nearby;
  - Detailed documentation of the resource through data recovery (e.g., excavations, in the case of archaeological sites, or Historic American Buildings Survey/Historic American Engineering Record documentation, in the case of historic structures);
  - Contributions to the preservation of cultural heritage in the affected community;

- Interpretative exhibits highlighting information gained about cultural resources through the Proposed Action; or
- Some combination of these strategies.

If adverse effects are unavoidable, FirstNet would be required to develop appropriate BMPs and mitigation measures, in consultation with some combination of the ACHP, SHPO, a Tribal Historic Preservation Office, and other interested parties, and execute a Memorandum of Agreement (MOA) or Programmatic Agreement (PA), depending on the size and length of the individual project or program and the number of parties involved.

The MOA or PA would establish a process for ongoing consultation, review, and compliance with federal and state historic preservation laws, and describe the actions that would be taken by the parties to meet their cultural resources compliance responsibilities. The MOA or PA would ensure the resolution of adverse effects and that consultation and BMPs and mitigation procedures are followed. The MOA or PA would also include an Unanticipated Discovery Plan, which would detail the procedures taken if unanticipated cultural materials or human remains were encountered during the deployment phase of the Proposed Action. The MOA or PA would be used as a tool to ensure that Section 106 and other applicable state and federal cultural resource laws and regulations, such as the Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act, and American Indian Religious Freedom Act, are complied with and implemented accordingly.

Additionally, FirstNet is permitted under a 2015 Program Comment approved by the ACHP—that renewed and amended an existing 2009 Program Comment—to use its alternative procedures to comply with Section 106 for any potential effects resulting from any proposed construction and modification undertakings that would be subject to review by the Federal Communications Commission under either an existing 2001 or 2004 nationwide PA for telecommunications and collocations. This permits FirstNet to avoid duplicative reviews and complying separately with Section 106 in evaluating any proposed undertaking, when it has already undergone or will undergo, or is exempt from, a review by the Federal Communications Commission under either the 2001 or 2004 PA (*ACHP 2015*).

4.2.11.3. Description of Environmental Concerns

Direct Effects to Historic Properties

The primary cultural resource concern during deployment and operation activities is physical damage to and/or destruction of historic properties. Direct effects typically occur to historic properties located within or in close proximity to deployment areas. Impacts caused by deployment or operation are restricted to any historic properties, known or unidentified, within the area of physical disturbance.

Any deployment-related ground disturbing activities, such as grading, excavation, vegetation clearing, or even merely driving equipment off-road has the potential to damage, disturb, or remove known or previously unidentified cultural resources, particularly archaeological sites. Since archaeological sites and the scientific data that can be gathered from them are based on their undisturbed context, the integrity and undisturbed nature of an archaeological site is of utmost importance. Ground-disturbing activities are likely to occur during deployment of Proposed Action facilities and associated infrastructure, both on land and in water, and in the future during operation phase maintenance that could involve unanticipated find events.

An influx of non-local workers into an area could subject known historic properties to an increase in visitors who may not be aware of a resource's local, regional, or national cultural value. Resources could be damaged due to intentional or unintentional looting or vandalism. If previously unidentified cultural resources are identified during deployment or operation, individual project-related personnel collecting artifacts as souvenirs could also impact resources.

Based on the impact significance criteria presented in Table 4.2.11-1, physical damage to and/or destruction of historic properties could be adverse if FirstNet's deployment locations or activities would cause permanent direct effects to a contributing portion of a single or multiple historic properties. As discussed in the affected environment Section 4.1.11, Cultural Resources, known and unidentified cultural resources can occur throughout Hawaii. Although parts of the state have been systematically surveyed, not all areas or cultural resources have been evaluated for their eligibility, and historic properties have been listed on the National Register of Historic Places, there is the potential for unidentified cultural resources to exist and/or known historic properties to be adversely effected by the Proposed Action. Because prehistoric sites in Hawaii are known to occur near coastal areas where populated areas and infrastructure are prevalent, historic properties such as Pre- through Post-Contact Period archaeological sites, near-shore shipwrecks, and military facilities would be most susceptible to near-coastal adverse effects. Additionally, prehistoric and historic period archaeological sites and historic structures are commonly located in more level, inland areas where individual project activities could occur. Unmarked human burial sites, however, have been found throughout the Hawaiian Islands and in a variety of geographic locations. Topographically prominent locations suited for telecommunication infrastructure could also be located near or on sites of religious and/or cultural significance, Pre- through Post-Contact Period sites, or within cultural landscapes.

Prior to deployment, FirstNet would identify and evaluate cultural resources through systematic survey and apply the criteria of adverse effects to historic properties within the individual project APE to determine the potential effect of the Proposed Action on any identified historic properties. To the extent practicable, FirstNet does not expect to raze any historic structures or adversely affect any known historic properties as part of siting the Proposed Action. If the proposed deployment activities would have the potential to adversely affect historic properties, FirstNet would apply BMPs and mitigation measures and/or consult with appropriate federal, state, Native Hawaiian organizations, and other interested parties to apply appropriate mitigation measures to resolve adverse effects. If after initial surveys unanticipated cultural resources were identified during deployment or operation, procedures established within the MOA or PA would be followed to appropriately consult, evaluate, and resolve potential adverse effects to any historic properties. If unmarked human burial remains are encountered, then work in the area of the find must cease immediately and the State Historic Preservation Division and the county sheriff must be contacted before further ground-disturbing activity could occur at the discovery site.

Indirect Effects to Historic Properties

Indirect effects to historic properties could include changes to the views to and from a resource (viewshed impacts); increased noise levels at a resource; vibration; and/or visual or atmospheric effects due to dust, emissions, or pollutants. These types of indirect effects may not only affect a historic property's sense of setting, feeling, or association, but could also indirectly affect the physical characteristics of a historic property.

Indirect effects are typically caused by spatially removed activities due to visual, auditory, vibratory, or atmospheric impacts that occur beyond the physical area of disturbance, but are typically restricted to the immediate area around the emitting source, especially in the case of noise, vibration, dust, or emissions. The size of the area impacted by the indirect effects is determined by a combination of variables including the frequency, duration, intensity, and magnitude of the impacts.

Proposed Action activities that could result in these types of impacts include deployment-related ground disturbance; vegetation clearance; increased noise, vibration, dust, pollutants, and emissions associated with vehicle traffic; and placement of individual project components within viewsheds. The accumulation of dust due to vehicular traffic or deployment activities on historic properties could impact their cultural value to a site user, although they would tend to be minor or limited in extent. The accumulation of other pollutants could have a similar effect as dust and could contribute to physical damage to historic properties from chemical reactions between pollutant and resource materials, although the effects would generally be required to be long-term to cause significant damage.

Historic structures and prehistoric ruins or sensitive features are prone to vibration-related impacts. Vibrations are measured in terms of peak particle velocity. The Swiss Association of Standardization Vibration Damage Criteria states that structures highly sensitive to vibration will sustain damage if continuous vibration activities generate peak particle velocity in the underlying soil of 3.048 millimeters per second (mm/s) or higher (*Jones & Stokes 2004*). A British Museum study found that continuous vibrations of 2.5 mm/s or 5.0 mm/s from intermittent vibrations will damage historic buildings (*Higgitt 2010*). The use of heavy equipment during deployment and increased vehicular traffic along established or new access roads during deployment and operation-phase activities could generate localized vibrations sufficient to damage historic properties. The Proposed Action, however, would likely not possess the amount or frequency of vehicular traffic needed to cause significant effects.

Based on the impact significance criteria presented in Table 4.2.11-1, indirect effects to historic properties could be adverse if FirstNet's deployment or operation activities would cause permanent indirect effects to a contributing portion of a single or many historic properties. As discussed in the affected environment Section 4.1.11, Cultural Resources, known and previously unidentified cultural resources can occur throughout Hawaii. Although parts of the islands have been systematically surveyed, cultural resources have been evaluated for their eligibility, and historic properties have been listed on the National Register of Historic Places, the potential remains for unidentified cultural resources to exist and/or known historic properties to be adversely effected by the Proposed Action. Additionally, in the case of TCPs and cultural resources of religious and/or cultural significance, sites may be difficult to identify, boundaries may not be able to be defined, and the affected cultural groups may not be willing to share information about the sites. Historic properties such as those related to natural features, such as many of the beach sites, cemeteries, or even traditional hunting, fishing, or plant gathering sites, could be adversely affected by effects from views, noise, or emissions. Topographically prominent locations suited for telecommunication infrastructure could also be located within the viewshed of TCPs or other sites of religious and/or cultural significance. Historic properties containing structural components (i.e., Pu'u'opae Bridge) or sensitive or fragile features, such as Kea'au Talus Sites Archeological District or the Manuka Bay Petroglyphs, could be susceptible to damage due to vibrations.

As discussed above, FirstNet would identify, evaluate, and apply the criteria of adverse effects to historic properties within the individual project APE to determine the potential effect of the Proposed Action on any identified historic properties. To the extent practicable, FirstNet does not expect to adversely affect any known historic properties as part of siting the Proposed Action. If the proposed deployment activities would have the potential to adversely affect historic properties, FirstNet would apply BMPs and mitigation measures and/or consult with appropriate federal, state, Native Hawaiian organizations, and other interested parties to apply appropriate mitigation measures to resolve adverse effects.

Loss of Access to Historic Properties

The goal of historic preservation is not only to preserve and protect historic properties, but also to provide access to cultural resources, especially to those who value them. This is fundamental to all historic properties, primarily to historic properties that are considered TCPs and other sites of religious and/or cultural significance (*NPS 1998*). Effects would be considered adverse if long-term or permanent segregation or loss of access was caused by individual project activities to a single or many historic properties.

Historic resources, especially TCPs, hunting, fishing, or plant gathering sites, graves or cemeteries, and areas of particular religious or traditional importance, can lose their integrity, and thus their potential eligibility for the NRHP when they become degraded as a result of natural or human disturbance processes. Additionally, loss of integrity can occur when the groups, such as Native Hawaiian organizations, who value these places, can no longer access them, thus, losing their ability to use the sites in a traditional way and the cultural connection to the site or place over time.[1]

The cause of the loss of access can be direct or indirect. A historic property such as a cemetery or religious place—Kaluaaha or Kaumakapili Churches, or the Royal Mausoleum, for example—could be physically segregated, excluding public use of the place. However, limitations on access could also be indirect, whereas the use associated with the cultural landscape or traditional gathering area is affected be visual or audible effects long-term or permanently so as

[1] In some instances, such as in the legislation creating the Kaloko-Honokōhau National Historical Park on the Island of Hawaii, native subsistence fishing and shoreline food gathering is authorized by law, so long as it is not incompatible with conservation of park resource management (*16 USC 396d(d)(3)*).

practitioners cannot perform traditional uses. Many TCPs are used for practical purposes by those who value them and the resources gathered are vital to continuing cultural and traditional practices.

As discussed above, FirstNet would consult with the appropriate state agencies and interested Native Hawaiian organizations to identify, evaluate, and apply the criteria of adverse effects to historic properties within the project APE to determine the potential effect of the Proposed Action on any identified historic properties. To the extent practicable, FirstNet does not expect to adversely affect access to any known historic properties as part of siting the Proposed Action. If the proposed deployment or operation activities would have the potential to adversely affect historic properties, FirstNet would apply BMPs and mitigation measures and/or consult with appropriate federal, state, Native Hawaiian organizations, and other interested parties to apply appropriate mitigation measures to resolve adverse effects.

4.2.11.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Effects

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no effects* to cultural resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no direct or indirect effects to cultural resources because the activities that would be conducted at these small entry and exit points are within previously disturbed areas and any indirect effect or effects to access would be short-term.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no effects* to cultural resources because there would be no ground disturbance.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of new satellite-compatible infrastructure on existing towers, structures, or buildings (where antennae are already placed) would likely be visible. It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create new perceptible visual effects. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize potential impacts.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle is very unlikely to impact cultural resources, it is anticipated that this activity would have *no effect* on cultural resources.

Activities with the Potential to Have Effects

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur as a result of ground disturbance activities, vehicular traffic, the presence of new aboveground structures or components, visual evidence of construction, and the presence of construction equipment. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential effects to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence[2], huts, or other associated facilities or hand-holes to access fiber could result in potential direct and indirect effects or access effects to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of points of presence, huts, or other associated facilities or hand-holes to access fiber could result in direct and indirect effects or access effects to cultural resources. Installation of a new buried fiber optic plant would create visible evidence of construction, including a narrow, impermanent "scar" in the earth where the new fiber optic plant was installed, and the presence of construction equipment used for this installation. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize the potential impacts.
  - New Build – Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the installation of new poles could result in potential direct and indirect effects or access effects to cultural resources. The use of heavy equipment during the installation

[2] Points of presence are connections or access points between two different networks, or different components of one network.

of new poles and hanging of cables could also result in potential direct and indirect effects to cultural resources or access effects to cultural resources. The installation of a new aerial fiber optic plant (i.e., new wires on new transmission towers) would have a discernable change on visual conditions. Except if replacing existing infrastructure, this option would add new elements (towers) to a viewshed, and would result in visible evidence of construction activity and equipment. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize potential impacts.

- Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.
- New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water could have direct and indirect impacts to submerged cultural resources. Direct and indirect effects as well as access effects to cultural resources could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable or the impact of cable placement on submerged resources. Direct and indirect effects to terrestrial cultural resources could potentially occur as result of grading, foundation excavation, or other ground disturbance activities as well as heavy equipment use during these activities. Installation of new associated huts or equipment, however, would create aboveground features and the presence of construction equipment and create visible aboveground components. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize the potential impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance (collocations), there would be *no effects* to cultural resources. However, if installation of transmission equipment required grading or other ground disturbance to install small boxes, hunts, or access roads, there could potentially be direct and indirect impacts to cultural resources, although access effects would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources. Installation of new transmission equipment would add a new element to the viewshed, in the form of a small box or hut. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize the potential impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in direct and indirect effects or access effects to cultural resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities

during the installation of new wireless towers and associated structures or access roads and heavy equipment use could result in direct and indirect effects. Installation of new wireless communication towers would add new elements (towers) to the viewshed and would result in visible evidence of construction activity and equipment. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize potential impacts.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. Although the change associated with this option is small, it could cause cumulative visual effects to historic properties within its viewshed. If the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, such as grading or excavation activities, direct and indirect effects to cultural resources could occur, although access effects would be short-term. The use of heavy equipment could also have direct and indirect effects. BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) could help to avoid or minimize potential impacts.

- Deployable Technologies
  - Implementation of deployable technologies could result in potential direct and indirect effects to cultural resources if deployment of land-based deployables occurs in unpaved areas, or if the implementation results in minor construction or paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, minor excavation, and paving. These activities could result in direct and indirect effect to cultural resources, although access effects would be unlikely. Heavy equipment use associated with these activities and implementation of deployable technologies themselves could result in direct and indirect effects if deployed in unpaved areas. It is anticipated that there would be *no effects* to access or the viewshed during deployment of the deployable technologies.

In general, the abovementioned activities could potentially involve land/vegetation clearing, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, heavy equipment movement, and installation of aboveground components. Potential effects to cultural resources associated with deployment of this infrastructure could include direct and indirect effects or access effects to cultural resources. These effects and associated BMPs and mitigation measures to help mitigate or reduce these impacts are described further below.

Direct Effects to Historic Properties

Based on the analysis of the deployment activities described above to cultural resources, impacts as a result of direct effects are anticipated to be *effect, but not adverse*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to these resources.

FirstNet is committed to avoidance of direct effects to historic properties to the maximum extent practicable. The key time to implement avoidance actions is during siting and deployment, prior to and during Preferred Alternative activities. To facilitate this commitment to effect avoidance, pre-siting or pre-deployment surveys for cultural resources would be conducted for all proposed activities not covered by the Program Comment to ensure that informed siting of Preferred Alternative activities would enable avoidance of adverse effects to historic properties to the maximum extent practicable.

Further, the establishment of an unanticipated discovery plan during deployment and operation would be implemented to ensure that procedures are followed if unanticipated cultural materials or human remains were encountered during the deployment and operation of the Preferred Alternative, and that BMPs and mitigation measures are fully and effectively implemented and unanticipated effects to historic properties are not occurring. For activities that could adversely affect historic properties, FirstNet would enter into formal consultation with federal, state, Native Hawaiian organizations, and other interested parties to execute a MOA or PA to establish a process for ongoing consultation, review, and compliance with federal and state historic preservation laws, and describe the actions that would be taken by the parties in order to meet their cultural resources compliance responsibilities. The MOA or PA would ensure the resolution of adverse effects and that consultation and mitigation procedures are followed. The MOA or PA would be used as a tool to ensure that Section 106 and other applicable state and federal cultural resource laws and regulations, such as the Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act, American Indian Religious Freedom Act, and state laws, are complied with and implemented accordingly.

Potential Indirect Effects to Historic Properties

Based on the analysis of the deployment activities described above to cultural resources, indirect effects are anticipated to be *effect, but not adverse*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to these resources.

Potential Loss of Access to Historic Properties

Based on the analysis of the deployment activities described above to cultural resources, impacts as a result of effects to access are anticipated to be *effect, but not adverse*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential impacts to these resources.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no effects* to historic properties associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections and the activities are infrequent and temporary. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, direct and indirect effects or temporary access effects could result as explained above.

4.2.11.5. Alternatives Impact Assessment

The following section assesses potential impacts to historic properties associated with the Deployable Technologies Alternative and the No Action Alternative.[3]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of land-based and aerial mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Potential effects to historic properties as a result of implementation of this alternative are described below.

Deployment Impacts

As explained above, implementation of land-based deployable technologies could result in *effects, but not adverse* to historic properties if deployment of land-based deployables occurs in unpaved areas or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect effect to cultural resources, although access effects would be unlikely. Heavy equipment use associated with these activities and implementation of deployable technologies themselves could result in direct and indirect effects if deployed in unpaved areas. It is anticipated that there would be *no effects* to access or the viewshed during deployment of the deployable technologies.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be *effects, but not adverse* to historic properties associated with implementation/running of the deployable technology because effects to access or the viewshed could occur, depending on the length of deployment. Assuming that the same

[3] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

access roads used for deployment are also used for inspections, it is anticipated that there would be *no effects* to historic properties due to inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, *effects, but not adverse* to historic properties could result as previously explained above.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated deployment or operation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effects* to historic properties as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.11, Cultural Resources.

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4.2.12. Air Quality

4.2.12.1. Introduction

This section describes potential impacts to air quality in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are discussed in Chapter 11, BMPs and Mitigation Measures.

4.2.12.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on air quality were evaluated using the significance criteria presented in Table 4.2.12-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of the potential air quality impact, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to air quality addressed in this section are presented as a range of possible impacts.

Table 4.2.12-1: Impact Significance Rating Criteria for Air Quality

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased air emissions	Magnitude or Intensity	Emissions would prevent progress toward meeting one or more NAAQS in nonattainment areas. Emissions in attainment or maintenance areas would cause an exceedance for any NAAQS. Emissions exceed one or more major source permitting thresholds. Projects do not conform to SIP.	Effect that is *potentially significant*, but with mitigation is *less than significant*	Negligible emissions would occur for any pollutant within an attainment area, but would not cause a NAAQS exceedance and would not trigger major source permitting.	Emission increases would be infrequent or absent, mostly immeasurable. Projects conform to SIP.
	Geographic Extent	NA		NA	NA
	Duration or Frequency	Permanent or long-term		Short-term	Temporary

NAAQS = National Ambient Air Quality Standards; NA = not applicable; SIP = State Implementation Plan

4.2.12.3. Description of Environmental Concerns

Increased air emissions could result in potentially negative impacts to human health, wildlife, vegetation, and visibility. Emissions could result from stationary or mobile equipment that is powered by fossil fuels such as excavators, backhoes, frontend loaders, graders, pavers, dump trucks, etc. required to support any clearance, drilling, and construction activities associated with network deployment. In addition, the use of power generators, first responder on-road vehicles (large towable trailers, commercial trucks, standard sport utility vehicles), and aerial platforms (unmanned aircraft such as drones and piloted aircraft such as airplanes, balloons, and blimps) associated with the implementation of deployable technologies could also increase air emissions, both from fossil fuel combustion and, in some cases, from stirring up dust on unpaved roads. Helicopters, if needed, would likely only be used during deployment of one of the above technologies to potentially move people or equipment to remote areas. As the use of helicopters would be infrequent, if at all, potential impacts associated with the use of helicopters are not evaluated here.

Potential impacts from increased air emissions could occur in any location; however, the most affected areas are nonattainment areas (where air quality is not meeting local standards), maintenance areas (where air quality has improved but historically did not meet local standards), and designated Class I Areas (areas of special national or cultural significance including certain national parks, wilderness areas, and national monuments). Nonattainment and maintenance areas are sensitive to increased air pollution because of their existing air quality concerns; Class I Areas are sensitive because of the expectation for pristine air quality and visibility in these areas (see Section 4.1.12, Air Quality).

Currently, Hawaii is not designated as nonattainment or maintenance status for any pollutants throughout the state. However, because there are two Class I Areas (Haleakala National Park and Hawaii Volcanoes National Park), infrastructure could be deployed in these areas, BMPs and mitigation measures (see Chapter 11) would help avoid or minimize potential air quality impacts. In addition, it is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year, and could be as short as a few hours or days for some activities such as pole construction).

4.2.12.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. Estimated emissions associated with the Proposed Action are compared to the permitting thresholds for new major stationary sources in order to evaluate the significance of potential air quality impacts. Because the air emissions associated with most of the construction/deployment activities (excluding use of mobile power generators for deployment technologies if on-site for 12 consecutive months or more) are solely from mobile construction equipment/vehicles, these non-stationary sources or activities would not be subject to state air quality requirements that would require consultation or permitting actions. Emissions from the non-stationary sources (and sources not covered by a New Source

Review permit) are subject to the general conformity requirements, if such emissions are generated in areas designated as nonattainment or maintenance for any criteria pollutant or its pre-cursor.

As noted in Section 4.1.12, Air Quality, there are no nonattainment areas in Hawaii, so the applicable threshold is 250 tons per year (tpy) for each criteria pollutant emitted by a stationary source. However, as also mentioned in Section 4.1.12, particulate matter (PM) and sulfur dioxide (SO_2) are pollutants of particular concern in Hawaii because they contribute to local haze issues. The major stationary source permitting thresholds are lower for modifications (rather than new sources); however, these thresholds are based on an increase in emissions compared to the existing source. It is anticipated that any modifications associated with the Proposed Action (e.g., replacement of an existing diesel generator) would involve equipment of the same size with emissions performance equal to or better than the existing equipment. Therefore, only new emission sources are quantitatively evaluated to determine significance. Additionally, lead emissions were not quantified in the following assessment because all fuels are anticipated to be unleaded and no measurable amount of lead emissions are expected as a result of the Proposed Action. Hawaii also enforces a State Ambient Air Quality Standard for hydrogen sulfide (H_2S). However, diesel engines produce minimal H_2S emissions, so measureable amounts of H_2S emissions are also not expected as a result of the Proposed Action.

Furthermore, within the United States and its territories, there are no air quality permitting programs, and thus no thresholds, for mobile sources such as construction equipment/activities, motor vehicles, small boats, airplanes, and drones.[1] As noted in Section 4.1.12, Air Quality, emissions from each of these mobile sources are regulated through fuel standards and inspection/maintenance programs. The proposed BMPs and mitigation measures (see Chapter 11) would help avoid or minimize potential air quality impacts associated with these mobile emission sources. Nonetheless, to provide additional context, emissions from construction equipment/activities and motor vehicles are estimated below and compared to the 250-tpy major source permitting threshold, although this threshold would not apply to such emissions for permitting purposes.

Finally, the following analyses consider pollutant emission rates only. Changes to ambient air pollutant concentrations through air dispersion modeling (which accounts for emission rates, source parameters, meteorological conditions, building wake effects, and terrain effects) and associated potential impacts relative to local ambient air quality standards, are not evaluated. More detailed Proposed Action information would be needed to model potential air emission impacts relative to local ambient air quality standards.

[1] The Clean Air Act (CAA), as amended through the 1990 Clean Air Act Amendments, defines “stationary source” in *Title III*, *General Provisions*, Section 302, Definitions, paragraph (z) [*CAA §302(z)*] such that any source of air emissions resulting directly from a non-road engine is not regulated as a stationary source under the CAA and are therefore, exempt from federal stationary source permitting requirements. The definition of a non-road engine in *Title II, Emission Standards for Moving Sources*, Section 216, Definitions of the CAA is codified in *40 CFR Parts 89.2* and *40 CFR Parts 90.3*. As defined in these parts, internal combustion engines that are mobile (i.e., portable or transportable) engines are considered non-road engines. Therefore, internal combustion engines such as portable generators, air compressors, welders, etc. that do not stay at any single site at a building, structure, facility or installation for 12 consecutive months or more, are considered non-road engines.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of potential impacts (*no impacts* to *less than significant*) depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to air quality under the conditions described below:

- Wired Projects:
  - Use of Existing Conduit-New Buried Fiber Optic Plant: Although existing conduits would be used, these projects could involve construction equipment for cable pulling, blowing. However due to the temporary and intermittent need for such machinery, there would be no perceptible increase in air emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would have *no impacts* to air quality because it would not create any sources of air emissions. It is expected that no heavy equipment would be used and that transportation activities would be temporary, producing a negligible quantity of air pollution.
- Satellites and Other Technologies:
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, unless this decision changes, it is anticipated that this activity would have *no impact*.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to air quality as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of fossil fuel combustion associated with on-road and off-road engines, and as a result of motor vehicles or heavy equipment stirring up dust on unpaved roads. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following activities.

Wired Projects

For buried wired projects, construction activities could include plowing (including vibratory plowing), trenching, or directional boring, depending on the nature of the terrain, geology, and environmental conditions. These activities could result in potential impacts to air quality as a result of associated fuel-burning equipment (combustion emissions) and ground disturbance (fugitive dust). This section excludes air emissions associated with trenching and horizontal boring activities as these are expected to be lower or similar to plowing activities (i.e., only one of the three options would likely occur at a particular location depending on the nature of the terrain, geology, and environmental conditions). For aerial wired projects, construction activities could include new wiring and poles that require use of auger trucks, boom trucks, and bucket lifts, as well as excavation and grading for new or modified rights-of-way or easements.

Additional activities associated with installation of new, or modifications to existing, wired systems (buried and aerial) and the construction of points of presence,[2] huts, or other associated facilities could result in air emissions from cable blowing, pulling, and vault placement. In other cases, new structures could be required without the need for new or modified wired systems. The deployment of marine vessels to lay submarine cable is unlikely; however, small work boats (with engines similar to recreational vehicle engines) may be required to transport and lay small wired cable in limited near-shore or inland bodies of water, but emissions from these small marine sources are expected to be negligible and were not quantified. Associated combustion emissions estimates for the anticipated fuel-burning equipment are presented in Table 4.2.12-2 through Table 4.2.12-4.

Furthermore, deployment of wired projects could potentially impact air quality as a result of associated excavation/filling and grading/earth moving activities. Associated fugitive dust emissions estimates are presented in Table 4.2.12-5.

Wired project deployment would also involve other on-road vehicle use, including employee transportation to and from work sites. However, these ancillary activities would be temporary and would produce a negligible quantity of air pollution. Therefore, emissions associated with these ancillary activities were not quantified.

[2] Points of presence are connections or access points between two different networks, or different components of one network.

Table 4.2.12-2: Combustion Emission Estimates (Monthly) from New Buried Wired Project Deployment[a]

Emission Source[b,c]	Estimated Emissions (tons/month)[d,e,f]					
	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
Vibratory Plow	0.329	0.110	0.015	0.002	0.001	0.0004
Backhoe	0.328	0.108	0.015	0.001	0.001	0.0004
Dozer	0.330	0.114	0.015	0.002	0.002	0.0004
Flat-bed Truck	0.333	0.124	0.016	0.002	0.002	0.0004
Pick-up Truck	0.333	0.124	0.016	0.002	0.002	0.0004
Trench Roller	0.330	0.112	0.015	0.002	0.002	0.0004
Air Compressor	0.329	0.110	0.015	0.002	0.001	0.0004
Cable Puller/Blower	0.327	0.103	0.015	0.001	0.001	0.0004
Concrete Mixer	0.328	0.105	0.015	0.001	0.001	0.0004
Grader	0.330	0.115	0.015	0.002	0.002	0.0004
Roller	0.330	0.112	0.015	0.002	0.002	0.0004
Total	**3.63**	**1.24**	**0.166**	**0.018**	**0.017**	**0.004**

NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compound; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; SO_2 = sulfur dioxide

[a] Deployment activities are assumed to include plowing, wire installation, and construction of points of presence and fiber huts.

[b] Emissions are based on one unit of typical equipment. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.

[c] Each equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.

[d] Emissions are estimated using methodology from *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, Equations 1 to 7, NR-009d, July 2010* (*USEPA 2010a*). Typical equation values were obtained from *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, EPA-420-R-10-016, NR-005d, July 2010* (*USEPA 2010b*).

[e] Emissions (tons) per month assume 240 hours (24 days, 10 hours/day) of construction activity per month. If construction lasts for 4 months, estimated air pollutant emissions would be expected to be four times as large as the values listed here.

[f] Fuel is assumed to be ultra-low sulfur diesel with a maximum sulfur content of 15 parts per million.

Table 4.2.12-3: Combustion Emission Estimates (Monthly) from New Aerial Wired Project Deployment[a]

Emission Source[b,c]	Estimated Emissions (tons/month)[d,e,f]					
	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
Grader	0.330	0.115	0.015	0.002	0.002	0.0004
Suction Excavator	0.331	0.117	0.015	0.002	0.002	0.0004
Auger Truck	0.328	0.107	0.015	0.001	0.001	0.0004
Boom Truck	0.330	0.112	0.015	0.002	0.002	0.0004
Cable Puller/ Blower	0.327	0.103	0.015	0.001	0.001	0.0004
Bucket Lift	0.327	0.104	0.015	0.001	0.001	0.0004
Flat-bed Truck	0.333	0.124	0.016	0.002	0.002	0.0004
Total	**2.31**	**0.781**	**0.106**	**0.011**	**0.011**	**0.003**

NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compound; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; SO_2 = sulfur dioxide

[a] Deployment activities are assumed to include excavation, grading, and pole delivery and installation.

[b] Emissions are based on one unit of typical equipment. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.

[c] Each equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.

[d] Emissions are estimated using methodology from *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, Equations 1 to 7, NR-009d, July 2010* (*USEPA 2010a*). Typical equation values were obtained from *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, EPA-420-R-10-016, NR-005d, July 2010* (*USEPA 2010b*).

[e] Emissions (tons) per month assume 240 hours (24 days, 10 hours/day) of construction activity per month. If construction lasts for 4 months, estimated air pollutant emissions would be expected to be four times as large as the values listed here.

[f] Fuel is assumed to be ultra-low sulfur diesel with a maximum sulfur content of 15 parts per million.

Table 4.2.12-4: Combustion Emission Estimates (Monthly) from Tower, Structure, and Transmission Equipment Delivery and Installation

Emission Source[a,b]	Estimated Emissions (tons/month)[c,d,e]					
	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
Concrete Mixer	0.328	0.105	0.015	0.001	0.001	0.0004
Flat-bed Truck	0.333	0.124	0.016	0.002	0.002	0.0004
Grader	0.330	0.115	0.015	0.002	0.002	0.0004
Paver	0.330	0.113	0.015	0.002	0.002	0.0004
Roller	0.330	0.112	0.015	0.002	0.002	0.0004
Truck-mounted Crane	0.330	0.112	0.015	0.002	0.002	0.0004
Total	**1.98**	**0.681**	**0.091**	**0.010**	**0.010**	**0.002**

NOx = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compound; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; SO_2 = sulfur dioxide

[a] Emissions are based on one unit of typical equipment. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.

[b] Each equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.

[c] Emissions are estimated using methodology from *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, Equations 1 to 7, NR-009d, July 2010* (*USEPA 2010a*). Typical equation values were obtained from *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, EPA-420-R-10-016, NR-005d, July 2010* (*USEPA 2010b*).

[d] Emissions (tons) per month assume 240 hours (24 days, 10 hours/day) of construction activity per month. If construction lasts for 4 months, estimated air pollutant emissions would be expected to be four times as large as the values listed here.

[e] Fuel is assumed to be ultra-low sulfur diesel with a maximum sulfur content of 15 parts per million.

Table 4.2.12-5: Dust Emission Estimates (Monthly) from Excavation/Filling and Grading/Earth Moving Activities

Emission Source	Estimated Level of Activity	Estimated Emissions (tons/month)[a,b,c]		
		PM	**PM_{10}**	**$PM_{2.5}$**
Excavation and Filling	100,000 tons of material transferred [d]	0.306	0.145	0.022
Grading and Earth Moving	1,200 vehicle miles traveled per month [e]	1.34	0.459	0.042
Total		**1.65**	**0.604**	**0.063**

PM = particulate matter; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter

[a] Emissions are estimated using methodology from AP-42, *Compilation of Air Pollutant Emission Factors*.

[b] Excavation and filling emissions are based on *Section 13.2.4, Aggregate Handling and Storage Piles - Equation (1)* (*USEPA 2006*). Mean wind speed is assumed to be 10 meters per second (22.4 miles per hour); wind speed data was not readily available for Hawaii. Moisture content is assumed to be the median value (2.525%) listed in AP-42. Control efficiency is assumed to be zero (worst-case scenario).

[c] Grading and earth moving emissions are based on *Section 11.9, Western Surface Coal Mining - Table 11.9-1* (*USEPA 1998*). Mean speed for construction vehicles is assumed to be 5 miles per hour. Emissions (tons) per month assume 240 hours (24 days, 10 hours/day) of construction activity per month. Emission estimates could be scaled proportionally based on the number of months required for grading and earth moving activities.

[d] Excavation and filling emissions assume 100,000 tons of material transferred per month. Emissions estimates could be scaled proportionally based on actual monthly estimates for material transfer (e.g., if monthly material transfer is to be 200,000 tons, associated PM emissions would be 0.480 tons).

[e] Vehicle miles traveled is based on average speed (5 miles per hour) and operating time per month (240 hours) (see note c above). Emission estimates cannot be directly scaled based on an increase/decrease in vehicle miles traveled – refer to equations in AP-42, Table 11.9-1.

Potential air quality impacts associated with each type of wired project are discussed below:

- New Build–Buried Fiber Optic Plant: These projects could involve plowing (including vibratory plowing), trenching, or directional boring (depending on the nature of the terrain, geology, and environmental conditions), as well as the construction of points of presence, huts, or other associated facilities or hand-holes to access fiber. The associated fuel-burning emissions are estimated in Table 4.2.12-2; the associated dust emissions are estimated in Table 4.2.12-5. For example, monthly nitrogen dioxides (NOx) emissions are the highest of all criteria pollutant emissions, at approximately 3.6 tons (based on the assumptions noted in each table); annual NOx emissions, if construction lasted for at least 1 year, would be approximately 44 tons. Additionally, annual emissions of PM_{10}, $PM_{2.5}$, and SO_2 would be expected to be approximately 7.5 tons, 0.96 tons, and 0.05 tons, respectively. The annual estimate for each criteria pollutant is less than the major source permitting threshold of 250 tons. Even if additional equipment, beyond the equipment assumed in these calculations, was needed, it is still unlikely that emissions would reach the major source permitting threshold.
- New Build–Aerial Fiber Optic Plant: These projects would not require plowing, trenching, or directional boring. However, they could require construction of new wiring and poles, as well as excavation and grading for new or modified right-of-ways or easements. The associated fuel-burning emissions are estimated in Table 4.2.12-3; the associated dust emissions are estimated in Table 4.2.12-5. These emissions are smaller in magnitude than the total emissions associated with New Build–Buried Fiber Optic Plant projects. Even if

additional equipment, beyond the equipment assumed in these calculations, was needed, it is still unlikely that emissions would reach the major source permitting threshold.

- Collocation on Existing Aerial Fiber Optic Plant: These projects could require replacement of existing wiring and poles. These emissions are expected to be smaller in magnitude than the total emissions associated with New Build–Aerial Fiber Optic Plant projects.
- New Build–Submarine Fiber Optic Plant: The deployment of large marine vessels to lay submarine cable is unlikely; however, small work boats (with engines similar to recreational vehicle engines) may be required to transport and lay small wired cables in limited near-shore or inland bodies of water, but emissions from these small marine sources would be negligible.
- Installation of Optical Transmission or Centralized Transmission Equipment: These projects could involve installation of boxes, huts, or other structures. Equipment delivery could require large trucks/trailers and installation could require cranes or skylifts. These projects could also require excavation and grading for new equipment and/or access roads. Therefore, emissions could include the sum of the emission estimates in Tables 4.2.12-4 and 4.2.12-5. Assuming at least 1 year of activity, these emissions are also below the 250-tpy threshold.

Wireless Projects

Wireless projects would involve similar, but fewer, air emission sources than the previously discussed wired projects. Emissions associated with installation of towers and other structures are comparable to the estimates in Table 4.2.12-4. Potential air quality impacts associated with each type of wireless project are discussed below:

- New Wireless Communication Towers: These projects could involve installation of new wireless towers and associated structures (backup power generators and equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads). Installation emissions are expected to correspond to those listed in Table 4.2.12-4 (emissions associated with backup power generators are discussed in the Potential Operation Impacts section below). For example, monthly NOx emissions are the highest of all criteria pollutant emissions, at approximately 1.98 tons (based on the assumptions noted in Table 4.2.12-4); total NOx emissions for one tower, if construction lasted for a maximum of four months, would be approximately 8 tons. The annual estimate for each criteria pollutant is less than the major source permitting threshold of 250 tons. Based on the assumptions stated in Table 4.2.12-4, at least 32 such simultaneous tower installations would be needed for any criteria pollutant (based on the worst-case pollutant, NOx) to trigger the major source permitting threshold of 250 tons. Even if additional equipment, beyond the equipment assumed in these calculations, was needed, it is still unlikely that emissions would reach the major source permitting threshold. As noted in Section 4.2.12.4, Potential Impacts of the Preferred Alternative, the mobile sources (non-road engines) are not subject to major source permitting requirements and general conformity requirements do not apply in Hawaii.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. Delivery and installation of equipment could require trucks and cranes that would generate air emissions. Additionally, these projects could require some work on structure foundations and thus concrete mixing equipment. Because these projects would not involve installation of new wireless towers and associated structures, air emissions are expected to be smaller in magnitude than the total emissions associated with New Wireless Communication Towers projects.

Deployable Technologies

Deployable technologies could potentially impact air quality because of their use of fuel-burning equipment, including first responder on-road vehicles, mobile power generators (diesel power generators are assumed as most likely fossil fuel technology; although gasoline-fueled and hydrogen-fueled generators could be an option), and aerial vehicles such as drones, airplanes, and blimps. In addition, some limited construction could be associated with the implementation of deployable technologies such as land clearing or paving for parking or staging areas.

During deployment, on-road vehicles could include light-duty trucks for Cell on Light Truck projects or heavy-duty trucks for Cell on Wheels and System on Wheels projects. Vehicle emissions are estimated in Tables 4.2.12-6 and 4.2.12-7; diesel generator emissions are discussed in the Potential Operation Impacts section. This deployment phase is expected to occur over a few days. Potential air quality impacts of the long-term implementation of the deployment technologies at deployment locations (some months to a year or more) are discussed in the Potential Operation Impacts section. Potential air quality impacts associated with each type of deployable technology project are discussed below.

Table 4.2.12-6: Combustion Emission Estimates from Heavy-Duty Vehicles

Pollutant	Emission Factor[a,b]	Estimated Emissions[c]	
	g/hp-hr	lb/day	tons/year
NO_x[b]	2.28	22.1	0.022
CO	15.5	150	0.150
$PM/PM_{10}/PM_{2.5}$	0.1	0.970	0.001
VOC[b]	0.12	1.16	0.001

g/hp-hr = grams per horsepower-hour; lb/day = pounds per day; NOx = nitrogen oxides; CO = carbon monoxide; PM = particulate matter; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; VOC = volatile organic compound

[a] Emission factors taken from *40 Code of Federal Regulations 86.004-11(a)(1)* (*Emission Standards for 2004 and Later Model Year Diesel Heavy-Duty Engines and Vehicle)*. Emission factors for PM, PM_{10}, and $PM_{2.5}$ were assumed to be the same. SO_2 emission factors were not provided for heavy-duty trucks but these are expected to be negligible due to the likely use of fuels with low sulfur content.

[b] NMHC/NOx (non-methane hydrocarbon compounds/nitrogen oxides) emission factor was split 5%/95% for VOC (assumed equal to NMHC) and NOx, respectively (based on California guidance [*CARB 2008*]).

[c] Emissions are estimated assuming one vehicle operates 8 hours per day, 2 days per year (one day for driving to location, one day for departing from location). Vehicle engine size was assumed to be 550 horsepower (typical tractor trailer engine specifications [*Caterpillar 2006*]). Driving emissions are larger than idling emissions; therefore, all operation was assumed to be driving at full capacity.

Table 4.2.12-7: Combustion Emission Estimates from Light-Duty Trucks

Pollutant	Emission Factor[a]	Estimated Emissions[b]	
	g/mi	lb/day	tons/year
NOx	0.9	0.794	0.001
CO	7.3	6.44	0.006
$PM/PM_{10}/PM_{2.5}$	0.12	0.106	0.0001
VOC[c]	0.28	0.247	0.0002

g/mi = grams per mile; lb/day = pounds per day; NOx = nitrogen oxides; CO = carbon monoxide; PM = particulate matter; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; VOC = volatile organic compound

[a] Emission factors taken from *40 Code of Federal Regulations 86.1811-04*, Table S04-1 (*Emission Standards for Light-Duty Vehicles, Light-Duty Trucks and Medium-Duty Passenger Vehicles*); emission limits were used as worst-case emission factors. Bin 11 vehicles were selected as worst-case scenario. Emission factors for PM, PM_{10}, and $PM_{2.5}$ were assume to be the same. SO_2 emission factors were not provided for light-duty trucks but these are expected to be negligible due to the likely use of fuels with low sulfur content.

[b] Emissions are estimated assuming one vehicle operates 8 hours per day, 2 days per year (one day for driving to location, one day for departing from location). Driving emissions are larger than idling emissions; therefore, all operation was assumed to be driving, with an average speed of 50 miles per hour.

[c] VOC emission factor assumed equal to non-methane organic compounds emission factor.

- Cell on Wheels: These projects could include a heavy-duty vehicle (large trailer) and mobile diesel generator. During deployment the vehicle engines would power the vehicle while in motion on roadways (the diesel power generators are assumed to be off while the vehicle is in motion). Associated combustion emission estimates during the short-term deployment period (i.e., a few days) are presented in in Table 4.2.12-6. If deployment (i.e., mobilization, setting up, and demobilization) lasted for 2 days per year (assume 8 hours per day), NOx emissions (as the worst-case pollutant) from a single Cell on Wheels/heavy-duty vehicle would be approximately 0.022 ton. Additionally, annual PM_{10} and $PM_{2.5}$ emissions per unit of heavy-duty vehicle would be approximately 0.001 ton and 0.001 ton, respectively. Based on the assumptions stated in Table 4.2.12-6, the project would need to involve over 11,300 Cell on Wheels systems deploying for 2 days per year, for NOx emissions to exceed the 250-tpy major source permitting threshold. Should this amount of equipment be required during deployment (which is very unlikely), emissions could exceed the major source permitting threshold. As noted in Section 4.2.12.4, Potential Impacts of the Preferred Alternative, the mobile heavy-duty vehicles are not subject to major source permitting requirements and general conformity requirements do not apply in Hawaii.
- Cell on Light Truck: These projects could include a light-duty truck and diesel power generator. Associated combustion emission estimates during the short-term deployment period (i.e., a few days) are presented in Table 4.2.12-7. If deployment (i.e., mobilization, setting up, and demobilization) lasted for 2 days per year (assume 8 hours per day), NOx emissions (as the worst-case pollutant) would be less than 0.001 ton from the mobile light-duty vehicle. Annual PM_{10} and $PM_{2.5}$ emissions would be approximately 0.0001 and 0.0001 ton, respectively. Based on the assumptions stated in Table 4.2.12-7, the project would need to involve approximately 315,000 Cell on Light Truck systems deploying for 2 days per year, for NOx emissions to exceed the 250-tpy major source permitting threshold. Should this amount of equipment be required during deployment (which is very unlikely), emissions could exceed the major source permitting thresholds. As noted in Section 4.2.12.4,

Potential Impacts of the Preferred Alternative, the mobile light-duty vehicles are not subject to major source permitting requirements and general conformity requirements do not apply in Hawaii.

- System on Wheels: These projects could include a heavy-duty vehicle (large trailer) and diesel power generator. Therefore, potential air quality impacts are expected to be similar to those for Cell on Wheels projects.
- Deployable Aerial Communications Architecture: These projects could involve mobilizing and demobilizing aerial vehicles including, but not limited to, unmanned aircraft such as drones and piloted aircraft such as airplanes, balloons, and blimps. As indicated above, the deployment phase is only expected to occur over a few days. Potential air quality impacts of the long-term implementation of the Deployable Aerial Communications Architecture at the deployment location (some months to a year or more) are discussed in the Potential Operation Impacts section. These projects could involve fossil fuel combustion (e.g., drone, airplane, and blimp engines), but the associated combustion emissions would not be comparable to stationary source permitting thresholds. More detailed project information would be needed to model potential air emission impacts relative to local ambient air quality standards. However, most of the aerial vehicle emissions would occur at or above a few thousand feet above ground and are expected to dissipate before reaching ground level.

<u>Satellites and Other Technologies</u>

- Satellite-Enabled Devices and Equipment: Although it is expected that existing structures would be used, these projects could involve delivery and installation of equipment. The associated emissions can be estimated from the values in Table 4.2.12-4, although less equipment would likely be required, so emission estimates would likely be less than those values.

In general, the abovementioned activities could potentially involve fuel-burning construction equipment, dust from unpaved roads, first responder on-road vehicles, aerial platforms, and fossil fuel power generators. Increased air emissions associated with deployment of this infrastructure could potentially impact the surrounding community. However, increases in air emissions are not expected to exceed applicable major source permitting thresholds for the projects and potential air quality impacts are expected to be *less than significant* and could be further minimized with BMPs and mitigation measures incorporated. In addition, it is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year and could be as short as a few hours or days for some activities). BMPs and mitigation measures to help reduce these potential impacts are described in Chapter 11.

Potential Impacts for Increased Air Emissions

Based on the analysis of the deployment activities described above, impacts as a result of increased air emissions are anticipated to be *less than significant* and can be further minimized with BMPs and mitigation measures incorporated for the deployment scenarios. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize the potential air quality impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *less than significant* impacts to air quality associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections (i.e., air emissions would be infrequent and/or immeasurable). If use of heavy equipment or vehicles, outside of established access roads or corridors, occurs as part of routine maintenance or inspections, potential air quality impacts could result as explained above.

Operation activities associated with the Preferred Alternative could also involve the short-term (e.g., few weeks per year) operation of a fossil fuel-powered backup generator for wireless projects (e.g., to power a deployed antenna during upset conditions when commercial power is interrupted and during normal routine maintenance) as well as long-term (e.g., some months up to a year or more) operation of power generators (embedded in on-road vehicles) for land-based deployable technologies while stationed on-site. The types of infrastructure operation scenarios or activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following activities.

Wireless Projects

- New Wireless Communication Towers: Operation of these projects could involve the use of backup power generators, including those that operate by burning fossil fuels. Diesel-fueled backup power generators were assumed for this analysis; however, gasoline and hydrogen-fueled generators could be an option. The backup power generators would only operate during upset conditions when commercial power is interrupted and during normal routine maintenance (assumed a maximum of 500 hours per year for both upset conditions and normal routine maintenance). The diesel-fueled backup power generator emissions are provided in Table 4.2.12-8. Based on the assumptions stated in the table, these projects would need to involve at least 480 diesel generators rated at 67 horsepower and running 500 hours per year, for any pollutant emissions (NOx) to exceed the 250-tpy major source permitting threshold. Should this amount of equipment be required (which is very unlikely), emissions could exceed the major source permitting threshold for the diesel backup power generators.
- Collocation on Existing Wireless Tower, Structure, or Building: Operation of these projects would likely not involve the use of additional backup power generators during operations unless the existing backup generator power rating is not large enough for the collocation project. If additional backup power generator is required at the existing site, the potential

operation impacts for these projects are expected to be similar to those associated with the New Wireless Communication Towers project (see Table 4.2.12-8).

Table 4.2.12-8: Combustion Emission Estimates from Diesel Backup Power Generators at Wireless Communication Towers

Pollutant	Emission Factor[a]	Estimated Emissions[b]	
	lb/hp-hr	lb/year	tons/year
NOx	0.031	1,039	0.52
CO	0.00668	224	0.11
SOx	0.00205	68.7	0.034
PM/PM_{10}/$PM_{2.5}$	0.00220	73.7	0.037
VOC[c]	0.00251	84.2	0.042

lb/hp-hr = pounds per horsepower-hour; lb/year = pounds per day; NOx = nitrogen oxides; CO = carbon monoxide; SOx = sulfur oxides; PM = particulate matter; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; VOC = volatile organic compound

[a] Emission factors taken from AP-42, *Compilation of Air Pollutant Emission Factors*, Section 3.3, Gasoline and Diesel Industrial Engines, Table 3.3-1 (diesel engines) (*USEPA 1996*). Emission factors for PM, PM10, and PM2.5 were assume to be the same.

[b] Emissions are estimated assuming one, 67-horsepower diesel engine operates for 500 hours per year when commercial power is interrupted and during normal routine maintenance. Estimates can be directly scaled based on actual equipment size and operating schedule.

[c] VOC emissions are assumed equal to total organic compound emissions.

Deployable Technologies

Operation of land-based deployable technologies while stationed on-site could involve the use of power generators embedded on heavy-duty vehicles (Cell on Wheels and System on Wheels) and/or light-duty trucks (Cell on Light Truck). During operations, the generators would power the cell unit while the vehicle is on-site and stationary (vehicle engines would likely be turned off on-site). Associated combustion emission estimates during the long-term operation period (i.e., some months up to a year or more) are presented in Table 4.2.12-9. If operation of the land-based deployment technologies lasted for 363 days per year (assumes 24-hour continuous operation excluding 2 days a year for mobilization, setting up, and demobilization as discussed in the Potential Deployment Impacts section), NOx emissions (as the worst-case pollutant) from a single power generator embedded in each land-based deployment technology (Cell on Wheels, Cell on Light Truck, or System on Wheels) would be approximately 4.32 tons. Additionally, annual SOx, CO, PM_{10}, and $PM_{2.5}$ emissions per unit of heavy-duty vehicle would be approximately 0.29, 0.93, 0.31, and 0.31 ton, respectively. The Proposed Action would need to involve at least 58 land-based deployable technology systems operating continuously and simultaneously for 363 days per year for NOx emissions to exceed the 250-tpy major source permitting threshold. Should these amounts of equipment be required during operations (which is very unlikely), emissions could exceed the regulatory thresholds. As noted in Section 4.2.12.4, Potential Impacts of the Preferred Alternative, the mobile heavy-duty vehicles are not subject to major source permitting requirements and general conformity requirements do not apply in Hawaii.

Table 4.2.12-9: Combustion Emission Estimates from Diesel Generators on On-Road Vehicles Stationed On-site

Pollutant	Emission Factor[a]	Estimated Emissions[b]	
	lb/hp-hr	lb/day	tons/year
NOx	0.031	23.8	4.32
CO	0.00668	5.1	0.93
SOx	0.00205	1.6	0.29
$PM/PM_{10}/PM_{2.5}$	0.00220	1.7	0.31
VOC[c]	0.00251	1.9	0.35

lb/hp-hr = pounds per horsepower-hour; lb/day = pounds per day; NOx = nitrogen oxides; CO = carbon monoxide; SOx = sulfur oxides; PM = particulate matter; PM_{10} = particulate matter up to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter up to 2.5 micrometers in diameter; VOC = volatile organic compound

[a] Emission factors taken from AP-42, *Compilation of Air Pollutant Emission Factors*, Section 3.3, Gasoline and Diesel Industrial Engines, Table 3.3-1 (diesel engines) (*USEPA 1996*). Emission factors for PM, PM_{10}, and $PM_{2.5}$ were assumed to be the same.

[b] Emissions are estimated assuming one, 32-horsepower diesel engine operates continuously (24 hours per day), 363 days per year (all year except for two travel days–see previous two tables). Estimates can be directly scaled based on actual equipment size and operating schedule.

[c] VOC emissions are assumed equal to total organic compound emissions.

Operation of aerial vehicles such as drones, airplanes, balloons, and blimps could involve fossil fuel combustion (e.g., from their engines), but the associated combustion emissions would not be comparable to stationary source permitting thresholds. Helicopters are not expected to be used for operations activities. More detailed information on the Proposed Action would be needed to model potential air emission impacts relative to local ambient air quality standards. However, most of the aerial vehicle emissions would occur at or above a few thousand feet above ground and are expected to dissipate before reaching ground level.

In general, the abovementioned activities could potentially involve dust from unpaved roads and combustion emissions from first responder on-road vehicles, aerial platforms, and fossil fuel power generators. Increased air emissions associated with operation of this infrastructure could potentially impact the surrounding community. However, increases in air emissions are not expected to exceed applicable major source permitting thresholds for most deployment scenarios and potential air quality impacts are expected to be *less than significant* and can be further minimized with BMPs and mitigation measures incorporated.

Based on the analysis of the operation activities described above, potential impacts as a result of increased air emissions are anticipated to be *less than significant* and can be further minimized with BMPs and mitigation measures incorporated. To minimize the effects of the Preferred Alternative on air quality, FirstNet and/or their partners would require, as practicable or feasible, implementation of the same BMPs and mitigation measures as those required for potential deployment impacts (see Chapter 11).

4.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.[3]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to air quality as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil fuel-powered generators, first responder on-road vehicles, and/or aerial platforms. Some staging or landing areas (depending on the type of technology) could require excavation and grading. In the event that a limited number of equipment units are needed (consistent with the assumptions described above for the potential deployment impacts), these projects are expected to be *less than significant* and can be further minimized with BMPs and mitigation measures incorporated. However, should greater numbers of equipment or larger equipment be needed, potential impacts could become significant. These impacts would still be reduced through implementation of the BMPs and mitigation measures described in Chapter 11.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts to air quality associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections; use of fossil fuel-powered generators would result in *less than significant* impacts and can be further minimized with BMPs and mitigation measures incorporated. If greater numbers of equipment or larger equipment are needed, potential impacts could become significant. Potential impacts could be reduced through implementation of BMPs and mitigation measures described in Chapter 11. If use of heavy equipment or vehicles outside of established access roads or corridors occurs as part of routine maintenance or inspections, additional potential air quality impacts could result as explained

[3] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

above. This alternative could also involve deploying aerial vehicles including, but not limited to, drones, blimps, and piloted aircraft, which could involve fossil fuel combustion. More information would be required regarding the number, type, and flight duration of the vehicles deployed to determine emissions from these technologies. However, most of the aerial vehicle emissions would occur at or above a few thousand feet above ground and are expected to dissipate before reaching ground level.

No Action Alternative

Under the No Action Alternative, the nationwide public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to air quality because there would be no deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.12, Air Quality.

4.2.13. Noise

4.2.13.1. Introduction

This section describes potential impacts from noise in Hawaii associated with deployment and operation of the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures. Unless otherwise stated, all references to noise in this section are airborne noise, specifically potential airborne noise impacts on humans. Potential airborne noise impacts on wildlife and underwater noise impacts on marine mammals and fish are discussed in Section 4.2.6, Biological Resources.

4.2.13.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on noise were evaluated using the significance criteria presented in Table 4.2.13-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of the potential noise impact, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to noise addressed in this section are presented as a range of possible impacts.

Table 4.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	**Effect Characteristic**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state/ territory noise limits. Noise levels plus baseline noise levels would exceed 10 dBA increase from baseline noise levels (i.e., louder).	Effect that is *potentially significant*, but with mitigation and/or BMPs is *less than significant*	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent	County or local		County or local	County or local
	Duration or Frequency	Permanent or long-term		Short-term	Temporary

dBA = A-weighted decibel(s)

4.2.13.3. Description of Environmental Concerns

Potential impacts to the community from increased noise levels could occur in a range of areas:

- Wilderness areas or pristine environments (including wildlife refuges, historic sites, ecological preserve areas, etc.) where natural quiet is expected;
- Rural and outer suburban areas with negligible traffic;
- General suburban areas with infrequent traffic, general suburban areas with medium density traffic; and
- Suburban areas with some commerce or industry.

These areas are most sensitive to increased noise levels because of their low to medium baseline day-night average noise levels, which typically range from 35 to 50 A-weighted decibels (dBA) (see Table 4.1.13-1). Urban areas are less susceptible to increased noise levels because of their higher average ambient noise levels.

Increased noise levels could result in community annoyance by interfering with speech and other human-related activities. Noise emissions associated with network deployment could potentially impact sensitive receptors (residences, hotels/motels/inns, hospitals, places of worship, schools, and recreational areas). The use of the following land-based and aerial deployable technologies could potentially impact such sensitive receptors:

- Wired and wireless technologies using heavy equipment such as excavators, backhoes, trenchers, graders, pavers, rollers, dump trucks, cranes, etc. required to support any construction/deployment activities;
- Land-based deployable technologies using power generators and first responder on-road vehicles (heavy-duty and light-duty trucks or vans); and
- Aerial deployable technologies, such as unmanned aircraft (e.g., drones) and piloted aircraft (e.g., airplanes, balloons, and blimps). Helicopters, if needed, would likely only be used during deployment to potentially move people or equipment to remote areas. As the use of helicopters would be infrequent, if at all, potential impacts associated with the use of helicopters are not evaluated here.

Because sensitive areas such as wilderness and pristine environments (e.g., Haleakala and Hawaii Volcanoes National Parks), rural areas, and suburban areas are present in Hawaii, infrastructure could be built near these areas, in which case BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) would help avoid or minimize the potential impacts. In addition, it is anticipated that any potential noise increase due to deployment would likely be isolated within those locations and would be short-term with pre-existing noise levels generally achieved after some months (typically less than a year and could be as short as a few hours or days for some activities such as pole construction).

4.2.13.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to noise and others would not. In addition, and as explained in this section, various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are Likely to have *no impacts* to noise under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Although existing conduits would be used, these projects could involve equipment used for cable pulling and blowing. Noise associated with this equipment would be infrequent and of a short duration and is not expected to produce perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to noise. It is expected that no heavy equipment would be used and no new structure would be installed or erected as most activities would be conducted in existing huts.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to noise as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur from on-road and off-road engines of heavy equipment during ground disturbance and installation activities. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to noise include the following:

Wired Projects

For buried wired projects, construction activities could include plowing (including vibratory plowing), trenching, or directional boring, depending on the nature of the terrain, geology, and environmental conditions. These activities could result in potential impacts to noise as a result of heavy equipment use during earth-work and material handling activities. Additional activities associated with buried wired projects include the installation of new or modified wired systems and the construction points of presence[1], huts, or other associated facilities could result in noise increases. Limiting distances for maximum noise levels associated with these buried wired project-related activities under hard[2] and soft[3] ground conditions are presented in Table 4.2.13-2.

For aerial wired projects, construction activities could include new wiring and poles that require use of auger trucks, boom trucks, and bucket lifts, as well as excavation and grading for new or modified right-of-ways or easements. Similar to buried wired projects, additional activities associated with aerial wired projects include the installation of new or modifications to existing wired systems and the construction points of presence, huts, or other associated facilities could result in noise increases. Limiting distances for maximum noise levels associated with these aerial wired project-related activities under hard and soft ground conditions are presented in Table 4.2.13-3.

In other cases, new buildings or structures could be required without the need for new or modified wired systems. In such cases, construction activities associated with the installation of transmission equipment would be required. Limiting distances[4] for maximum noise levels associated with transmission equipment installation under hard and soft ground conditions are presented in Table 4.2.13-4.

[1] Points of presence are connections or access points between two different networks, or different components of one network.

[2] A hard site exists where noise travels away from the source over a generally flat, hard surface such as water, concrete, hard-packed soil, or other ground surfaces having a low porosity. These are examples of reflective ground, where the ground does not provide any attenuation. The standard attenuation rate for hard site conditions is 6 dBA per doubling of distance for point source noise (e.g., power generators, most construction activities, etc.) and 3 dBA per doubling of distance for line sources (e.g., highway traffic, conveyor belt, etc.) (*WSDOT 2015*).

[3] A soft site exist where noise travels away from the source over porous ground or normal unpacked earth capable of absorbing noise energy such as grass, trees, or other ground surfaces suitable for the growth of vegetation, such as farmland. An absorptive ground results in an additional 1.5 dBA reduction per doubling of distance at it spreads from the source. Added to the standard reduction rate for soft site conditions, point source noise attenuates at a rate of 7.5 dBA per doubling of distance, and line source noise decreases at a rate of 4.5 dBA per doubling of distance (*WSDOT 2015*).

[4] Limiting distances are distances beyond which an adverse effect would not occur.

Table 4.2.13-2: Limiting Distances for Maximum Noise Levels Associated with New Buried Wired Activities such as Plowing, Wire Installation, and Construction of Points of Presence and Fiber Huts

Noise Source[a,b]	Actual Measured Average Lmax at 50 Feet (dBA)[a]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[c]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[c]
Vibratory Plow[d]	80.0	889	500
Backhoe	78.0	706	416
Dozer	82.0	1,119	601
Flat-bed Truck	74.0	446	288
Pick-up Truck	75.0	500	315
Trench Roller[e]	80.0	889	500
Air Compressor	78.0	706	416
Cable Puller/Blower[f]	80.0	889	500
Concrete Mixer	79.0	792	456
Grader	89.0	2,506	1,145
Roller	80.0	889	500
Warning Horn	83.0	1,256	659
Total	**92.6**	**3,788**	**1,594**

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel
[a] Source: *WSDOT 2015*
[b] Maximum noise levels are based on operating one unit of typical equipment. It is not likely that more than one piece of each equipment type would be used at the same time. It is also unlikely that individual units of each equipment type listed in the table would be used concurrently; therefore, maximum noise levels and associated limiting distances presented in the table are conservative.
[c] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in *WSDOT 2015*. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.
[d] Lmax data for slurry trenching machine were assumed for vibratory plow.
[e] Lmax data for roller were assumed for trench roller.
[f] Lmax data for ventilation fan were assumed for cable puller/blower.

Table 4.2.13-3: Limiting Distances for Maximum Noise Levels Associated with New Aerial Wired Activities such as Excavation, Grading, and Pole Delivery and Installation

Noise Source[a,b]	Actual Measured Average Lmax at 50 Feet (dBA)[a]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[c]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[c]
Grader	89.0	2,506	1,145
Suction Excavator	81.0	998	548
Auger Truck[d]	84.0	1,409	723
Boom Truck[e]	81.0	998	548
Cable Puller/Blower[f]	80.0	889	500
Bucket Lift[e]	81.0	998	548
Flat-bed Truck	74.0	446	288
Warning Horn	83.0	1,256	659
Total	**92.4**	**3,717**	**1,570**

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel
[a] Source: *WSDOT 2015*
[b] Maximum noise levels are based on operating one unit of typical equipment. It is not likely that more than one piece of each equipment type would be used at the same time. It is also unlikely that individual units of each equipment type listed in the table would be used concurrently; therefore, maximum noise levels and associated limiting distances presented in the table are conservative.
[c] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in *WSDOT 2015*. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.
[d] Lmax data for auger drill rig were assumed for auger truck.
[e] Lmax data for truck mounted crane were assumed for boom truck and bucket lift.
[f] Lmax data for ventilation fan were assumed for cable blower.

Table 4.2.13-4: Limiting Distances for Maximum Noise Levels Associated with Tower, Structure, and Transmission Equipment Delivery and Installation

Noise Source[a,b]	Actual Measured Average Lmax at 50 Feet (dBA)[a]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[c]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[c]
Concrete Mixer	79.0	792	456
Flat-bed Truck	74.0	446	288
Grader	89.0	2,506	1,145
Paver	77.0	629	379
Roller	80.0	889	500
Truck Mounted Crane	81.0	998	548
Warning Horn	83.0	1,256	659
Total	**91.4**	**3,296**	**1,426**

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel
[a] Source: *WSDOT 2015*
[b] Maximum noise levels are based on operating one unit of typical equipment. It is not likely that more than one piece of each equipment type would be used at the same time. It is also unlikely that individual units of each equipment type listed in the table would be used concurrently; therefore, maximum noise levels and associated limiting distances presented in the table are conservative.
[c] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in *WSDOT 2015*. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.

Wired project deployment would also involve other on-road vehicle use, including worker transportation to and from work sites. However, these ancillary activities would be temporary and would produce negligible noise pollution. Potential noise impacts associated with each type of wired project are discussed below:

- New Build – Buried Fiber Optic Plant: These projects could result in increased noise levels due to use of heavy equipment for plowing (including vibratory plowing), trenching, or directional boring, as well as the construction of points of presence, huts, or other associated facilities or hand-holes to access fiber. The limiting distances for maximum noise levels associated with new buried wired activities are presented in Table 4.2.13-2. The table excludes noise associated with trenching and horizontal boring activities as these are expected to be lower or similar to plowing activities (i.e., only one of the three options could occur at a particular location depending on the nature of the terrain, geology, and environmental conditions). As indicated in Table 4.2.13-2, a maximum noise level of 93 dBA at 50 feet could be expected from New Build – Buried Fiber Optic Plant projects and residences or other sensitive receptors within 3,788 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 1,594 feet of these sources could be exposed to noise in excess of the 55 dBA criterion. Without BMPs and mitigation measures and/or if a wired project is situated in an area with low background sound levels such as wilderness area, pristine environments, rural areas, or suburban areas with infrequent traffic (see Table 4.1.13-1), the predicted maximum noise levels could substantially increase above background levels (i.e., 10 dBA or more above background levels) and residences and other sensitive receptors within these limiting distances could experience potential negative noise impacts. To minimize the potential short-term noise impacts to residences and other sensitive receptors within these limiting distances, BMPs and mitigation measures should be implemented for New Build – Buried Fiber Optic Plant projects and other similar wired projects.
- New Build – Aerial Fiber Optic Plant: These projects would not require plowing, trenching, or directional boring. However, they could require construction of new wiring and poles, as well as excavation and grading for new or modified right-of-ways or easements. The limiting distances for maximum noise levels associated with new buried wired activities are presented in Table 4.2.13-3. As indicated in the table, a maximum noise level of 92 dBA at 50 feet could be expected from New Build – Aerial Fiber Optic Plant projects and residences or other sensitive receptors within 3,717 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 1,570 feet of these sources could be exposed to noise in excess of the 55 dBA criterion. These noise increases are similar but slightly smaller in magnitude than those associated with the New Build - Buried Fiber Optic Plant projects.

- Collocation on Existing Aerial Fiber Optic Plant: These projects would not require plowing, trenching, or directional boring. However, they could require replacement of existing wiring and poles (i.e., equipment installation). The maximum noise increases for these projects would be smaller in magnitude than those associated with the New Build - Aerial Fiber Optic Plant projects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited near-shore or inland bodies of water could potentially impact aquatic and/marine resources (fish and marine mammals) due to increased underwater noise from small marine vessels (similar to recreational vessels). Potential impacts to airborne noise could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cable. Increased airborne and underwater noise is expected to result in similar potential noise impacts to the other New Build projects. Additional information on potential underwater noise impacts on marine mammals and fish is discussed in Section 4.2.6, Biological Resources.
- Installation of Optical Transmission or Centralized Transmission Equipment: These projects could involve installation of boxes, huts, or other structures. Equipment delivery could require large trucks/trailers and installation could require cranes or skylifts. These projects could also require excavation and grading for new equipment and/or access roads. The limiting distances for maximum noise levels associated with installation of transmission equipment are presented in Table 4.2.13-4. As indicated in the table, a maximum noise level of 92 dBA at 50 feet could be expected from these projects and residences or other sensitive receptors within 3,656 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 1,549 feet of these sources could be exposed to noise in excess of the 55 dBA criterion. These noise increases are similar to those for the New Build – Aerial Fiber Optic Plant projects.

<u>Wireless Projects</u>

Wireless projects would involve similar, but fewer, noise sources than the previously discussed wired projects. Noise increases associated with installation of towers and other structures are comparable to the estimates in Table 4.2.13-4. Potential noise impacts associated with each type of wireless project are discussed below:

- New Wireless Communication Towers: These projects could involve installation of new wireless towers and associated structures (power generator and equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads). Installation noise levels are expected to correspond to those listed in Table 4.2.13-4. Therefore, a maximum noise level of 91 dBA at 50 feet could be expected from these projects and residences or other sensitive receptors within 3,296 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 1,426 feet of these sources could be exposed to noise in excess of the 55 dBA criterion.

Without BMPs and mitigation measures and/or if a wireless project is situated in an area with low background sound levels such as wilderness area, pristine environments, rural areas, or suburban areas with infrequent traffic (see Table 4.1.13-1), the predicted maximum noise levels could substantially increase above background levels (i.e., 10 dBA or more above background levels) and residences and other sensitive receptors within these limiting distances could experience potential negative noise impacts. BMPs and mitigation measures could be implemented for New Wireless Communication Towers projects and other similar wireless projects to further reduce potential impacts.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. Delivery and installation of equipment could require trucks and cranes that would generate noise. Additionally, these projects could require some work on structure foundations and thus concrete mixing equipment. Because these projects would not involve installation of new wireless towers and associated structures, expected maximum noise increases and limiting distances to the 55 dBA criterion would be smaller in magnitude than those for the New Wireless Communication Towers project. Table 4.2.13-5 shows that a maximum noise level of 86 dBA at 50 feet could be expected from these projects, and residences or other sensitive receptors within 1,844 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 896 feet of these sources could be exposed to noise in excess of the 55 dBA criterion.

Table 4.2.13-5: Limiting Distances for Maximum Noise Levels Associated with Collocation on Existing Wireless Tower, Structure, or Building

Noise Source[a,b]	Actual Measured Average Lmax at 50 Feet (dBA)[a]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[c]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[c]
Concrete Mixer	79.0	792	456
Flat-bed Truck	74.0	446	288
Truck Mounted Crane	81.0	998	548
Warning Horn	83.0	1,256	659
Total	**86.3**	**1,844**	**896**

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel
[a] Source: *WSDOT 2015*
[b] Maximum noise levels are based on operating one unit of typical equipment. It is not likely than more than one piece of each equipment type would be used at the same time. It is also unlikely that all individual units of each equipment type listed in the table would be used concurrently; therefore, maximum noise levels and associated limiting distances presented in the table are conservative.
[c] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in WSDOT 2015. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.

Deployable Technologies:

Implementation of deployable technologies could result in potential impacts to noise from use of power generators and first responder on-road vehicles and aerial platforms. On-road vehicles could include light-duty trucks for Cell on Light Truck projects or heavy-duty trucks for Cell on Wheels and System on Wheels projects. Aerial platforms could include drones, airplanes, balloons, and blimps. In addition, some limited construction could be associated with the implementation of deployable technologies such as land clearing or paving for parking or staging areas. Noise levels associated with deployable technologies during deployment (including mobilization to the destination site, setting up, and demobilization) are estimated in Table 4.2.13-6.

Table 4.2.13-6: Limiting Distances for Maximum Noise Levels Associated with Deployable Technologies Implementation – Short-Term

Noise Source[a,b,c]	Actual Measured Average Lmax at 50 Feet (dBA)[a,b]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[d]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[d]
Cell on Wheels or System on Wheels			
Heavy-duty Vehicle or Large Trailer (1 Unit)[e]	76.0	561	346
Heavy-duty Vehicle or Large Trailer (2 Units)[e]	79.0	793	456
Heavy-duty Vehicle or Large Trailer (3 Units)[e]	80.8	792	537
Heavy-duty Vehicle or Large Trailer (4 Units)[e]	82.0	1,122	602
Heavy-duty Vehicle or Large Trailer (5 Units)[e]	83.0	1,254	659
Cell on Light Truck			
Light-duty Truck (1 Unit)[f]	75.0	500	315
Light-duty Truck (2 Units)[f]	78.0	707	416
Light-duty Truck (3 Units)[f]	79.8	866	490
Light-duty Truck (4 Units)[f]	81.0	1,000	549
Light-duty Truck (5 Units)[f]	82.0	1,118	601
Deployable Aerial Communication Architecture			
Unmanned Aircraft - Drone Takeoff or Landing (1 Unit)[g, h]	82.0	1,125	603
Unmanned Aircraft - Drone Take-off or Landing (2 Units)[g, h]	85.1	1,591	796
Unmanned Aircraft - Drone Take-off or Landing (3 Units)[g, h]	86.8	1,948	936
Unmanned Aircraft - Drone Take-off or Landing (4 Units)[g, h]	88.1	2,249	1,051
Unmanned Aircraft - Drone Take-off or Landing (5 Units)[g, h]	89.0	2,515	1,149
Piloted Aircraft - Plane Flyover (1 Unit)[i]	114.0	44,668	11,476
Piloted Aircraft - Plane Flyover (2 Units)[i]	117.0	63,171	15,143

Noise Source[a,b,c]	**Actual Measured Average Lmax at 50 Feet (dBA)[a,b]**	**Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[d]**	**Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[d]**
Piloted Aircraft - Plane Flyover (3 Units)[i]	118.8	77,368	17,809
Piloted Aircraft - Plane Flyover (4 Units)[i]	120.0	89,337	19,981
Piloted Aircraft - Plane Flyover (5 Units)[i]	121.0	99,881	21,847
Piloted Aircraft - Blimps (1 Unit)[j]	85.6	1,687	835
Piloted Aircraft - Blimps (2 Units)[j]	88.6	2,386	1,101
Piloted Aircraft - Blimps (3 Units)[j]	90.3	2,922	1,295
Piloted Aircraft - Blimps (4 Units)[j]	91.6	3,374	1,453
Piloted Aircraft - Blimps (5 Units)[j]	92.6	3,772	1,589

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel; NA = not applicable
[a] Source of Lmax data for Cell on Wheels, Cell on Light Truck, and System on Wheels: *WSDOT 2015*
[b] Source of Lmax data for Deployable Aerial Communication Architecture: *Hodgson et al. 201*3 and *WSDOT 2015*
[c] Maximum noise levels for deployable technologies are based on operating one to five units of vehicle type, depending on the size of the coverage area.
[d] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in *WSDOT 2015*. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.
[e] Lmax data for dump truck were assumed for heavy-duty vehicle (large trailer).
[f] Lmax data for pick-up truck were assumed for light-duty truck.
[g] Lmax data for drone take-off were based on noise levels of a ScanEagle Unmanned Aerial Vehicle (85 to 90 dBA) at 6 meters (20 feet) (*Hodgson et al. 2013*). The 90 dBA maximum level at 20 feet was assumed for this analysis. The noise level at 20 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.
[h] Lmax data for drone landing were assumed to equal to that for drone take-off.
[i] Lmax data for airplane flyover (120 dBA) at 1,000 feet were taken from *Purdue University 2015*. The noise level at 1,000 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.
[j] Lmax data for blimps were based on noise levels of a Goodyear blimp with two 210-horsepower engines with a total of 110 dBA just outside of a gondola (assume 3 feet away) (Goodyear Blimp 2015). A gondola is a passenger compartment suspended beneath a balloon or airship. The 110 dBA maximum level at 3 feet was assumed for this analysis. The noise level at 3 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.

This deployment phase is expected to occur over a few days. Potential noise impacts of the long-term implementation of this technology at the deployment location (some months to a year or more) are discussed in the operation impact section. Potential noise impacts associated with each type of deployable technology project are discussed below.

- Cell on Wheels: These projects could include noise sources such as a heavy-duty vehicle (with large trailer) and power generators. During deployment, the vehicle engines would power the vehicle while in motion on roadways (the power generators are assumed to be off while the vehicle is in motion). The limiting distances for maximum noise levels associated with Cell on Wheels projects during the short-term deployment period (i.e., a few days) are presented in Table 4.2.13-6. As indicated in the table, a maximum noise level of 76 dBA at 50 feet could be expected per unit of heavy-duty vehicle and residences or other sensitive receptors within 561 feet of each heavy-duty vehicle could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 346 feet of each heavy-duty vehicle could be exposed to noise in excess of the 55 dBA criterion. Without BMPs and mitigation measures and/or if a deployable technologies project is situated in an area with low background sound levels such as wilderness area, pristine environments, rural areas, or suburban areas with infrequent traffic (see Table 4.1.13-3), the predicted maximum noise levels could substantially increase above background levels (i.e., 10 dBA or more above background levels) and residences and other sensitive receptors within these limiting distances could experience potential negative noise impacts. The expected maximum noise levels and limiting distances to the 55 dBA criterion during the short-term deployment period (i.e., a few days) is dependent on the type of deployed technology and the number of deployed units per affected area. For example, if Cell on Wheels technology were to be deployed in a rural area such as Pahoa Town (2.161 square miles) in Hawaii and assuming the Cell on Wheel technology can provide 10-mile diameter coverage, it would require only one heavy-duty vehicle or large trailer to cover the entire town. The maximum noise level associated with this land-based deployment technology (i.e., one heavy-duty vehicle) in Pahoa Town would be approximately 76 dBA at 50 feet. Because the ground conditions in rural areas are typically soft (farmland, grasses, trees, etc.), Pahoe residences or other sensitive receptors within 346 feet of the heavy-duty vehicle could be exposed to noise in excess of the 55 dBA criterion. To minimize the potential noise impacts to residences and other sensitive receptors within these limiting distances, BMPs and mitigation measures could be implemented for Cell on Wheels projects and other similar deployable technology projects.

- Cell on Light Truck: These projects could include a light-duty truck and power generator. As indicated above, generator noise is discussed in the operation impact section. The expected maximum noise levels and limiting distances to the 55 dBA criterion during the short-term deployment period (i.e., a few days) is dependent on the type of deployed technology and the number of deployed units per affected area (Table 4.2.13-6). For example, if Cell on Light Truck technology were to be deployed in a rural area such as Pahoe Town (2.161 square miles) in Hawaii and assuming the Cell on Light Truck technology can provide 2-mile diameter coverage, it would require only one light-duty truck to cover the entire town. The maximum noise level associated with this land-based deployment technology (i.e., one light-duty truck) in Pahoe Town would range from 85.8 to 86.1 dBA at 50 feet. Because the ground conditions in rural areas are typically soft (farmland, grasses, trees, etc.), Pahoe residences or other sensitive receptors within 315 feet of the light-duty truck could be exposed to noise in excess of the 55 dBA criterion.
- System on Wheels: These projects could include a heavy-duty vehicle (large trailer) and power generator (i.e., same noise sources as Cell on Wheels technology). As indicated above, the generator noise is discussed in the operation impact section. Therefore, expected maximum noise levels and limiting distances to the 55 dBA criterion would be similar to those for the Cell on Wheels projects (Table 4.2.13-6).
- Deployable Aerial Communications Architecture: These projects could involve mobilizing and demobilizing aerial vehicles, including, but not limited to, drones, airplanes, balloons, and blimps. As indicated above, the deployment phase is only expected to occur over a few days. Potential noise impacts of the long-term implementation of the Deployable Aerial Communications Architecture at the deployment location are discussed in the operation

impact section. The aerial vehicles typically generate loud noises during take-off and landing operations. During the short-term deployment period (i.e., a few days), the maximum noise levels for a single aerial vehicle take-off or landing is expected to range from 82 dBA at 50 feet for a drone to 114 dBA at 50 feet for an airplane. As such, residences or other sensitive receptors within 1,125 to 44,668 feet (0.21 to 8.5 miles) of these aerial vehicles could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 603 to 11,476 feet (0.11 to 2.2 miles) of these aerial vehicles could be exposed to noise in excess of the 55 dBA criterion (Table 4.2.13-6). It is unlikely that take-off or landing of aerial vehicles would occur concurrently at the same location; however, if this were to occur, total noise increases and limiting distances to the 55 dBA criterion would increase as well (Table 4.2.13-6). For overflight operations, most of the noise would occur at a few thousand feet above ground level and could be perceived by sensitive receptors on the ground but for a short-term/intermittent period.

The short-term and intermittent noise increases associated with the aerial vehicles take-off and landings would be higher than those for the Cell on Wheels, Cell on Light Truck, and System on Wheels projects. The expected maximum noise levels and limiting distances for the 55 dBA criterion during the short-term deployment period (i.e., few days) is dependent on the type of deployed aerial technology and the number of deployed units per affected area. For example, if an unmanned aircraft such as a drone were to be deployed in or near Kalaupapa National Historic Park on the island of Molokai (24.45 square miles) and assuming the drone can provide 15-mile diameter coverage, it would require only one drone to cover the entire park.

The maximum noise level associated with this Deployable Aerial Communication Architecture (i.e., the single drone taking off or landing) in or near Kalaupapa National Historic Park would be approximately 82 dBA at 50 feet. Because the ground conditions at national historic parks and wilderness areas are typically soft (grasses, trees, etc.), sensitive receptors within 603 feet (0.11 mile) of the single drone take-off or landing could be exposed to noise in excess of the 55 dBA criterion. If piloted aircraft are used, the corresponding noise levels would be higher and sensitive receptors at larger distances from the source (piloted aircraft) would be exposed to noise above 55 dBA For example, if a piloted aircraft such as a two-engine airplane were to be deployed in or near Kalaupapa National Historic Park on the island of Molokai (24.45 square miles) and assuming the two-engine airplane can also provide 15-mile diameter coverage, it would require only a single two-engine airplane to cover the entire historic national park. The maximum noise level associated with this Deployable Aerial Communication Architecture (i.e., the single two-engine airplane taking off or landing) in or near Kalaupapa National Historic Park would be approximately 114 dBA at 50 feet. Because the ground conditions at national historic parks and wilderness areas are typically soft (grasses, trees, etc.), sensitive receptors within 11,476 feet (2.2 miles) of the single two-engine airplane take-off or landing could be exposed to noise in excess of the 55 dBA criterion.

<u>Satellites and Other Technologies</u>

- Satellite-Enabled Devices and Equipment: Although it is expected that existing structures would be used, these projects could involve delivery and installation of equipment. The associated noise increases can be estimated from the values in Table 4.2.13-4 above, although less equipment would likely be required, so noise increases and limiting distances to the 55 dBA criterion under hard and soft ground conditions would likely be less than those values.

Increased Noise Levels during Deployment

In general, the abovementioned activities could potentially involve heavy equipment movement associated with ground disturbance, equipment delivery, and installation, as well as operation of power generators, and first responder on-road vehicles, and aerial platforms. Increased noise levels associated with deployment of this infrastructure could potentially impact the surrounding community. BMPs and mitigation measures could help reduce these potential impacts during deployment activities. Based on the analysis of the deployment activities described above, potential impacts as a result of increased noise levels are anticipated to be *less than significant* since these potential impacts would generally be temporary and limited to areas near deployment locations. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential noise impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be minimal potential impacts to noise associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections (i.e., noise from pick-up truck driven by inspector would be infrequent and/or immeasurable). If use of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, potential noise impacts could result as explained above.

Operation activities associated with the Preferred Alternative could also involve prolonged operation of a fossil fuel-powered generator (e.g., to power a deployed antenna), aerial vehicles (drones, airplanes, balloons, and blimps), and other support equipment such as ventilation fans associated with heating, ventilation, and air cooling at fiber huts or central offices. Helicopters are not expected to be used for operations activities. Such operation would result in increased noise levels over extended periods. The types of infrastructure operation scenarios or activities that could be part of the Preferred Alternative and result in potential impacts to noise include the following:

Wireless Projects

- New Wireless Communication Towers: Operation of these projects could involve the use of power generators and ventilation fans at fiber huts or central offices. Table 4.2.13-7 indicates a maximum noise level of 83 dBA at 50 feet could be expected from extended use of power generators and ventilation fans and as such, residences or other sensitive receptors within 1,274 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 667 feet of these sources could be exposed to noise in excess of the 55 dBA criterion. Without BMPs and mitigation measures and/or if a wireless project is situated in an area with low background sound levels such as wilderness areas, pristine environments, rural areas, or suburban areas with minimum traffic (see Table 4.1.13-3), the predicted maximum noise levels could substantially increase above background levels (i.e., 10 dBA or more above background levels) and residences and other sensitive receptors within these limiting distances could experience potential negative noise impacts. To minimize the potential long-term noise impacts to residences and other sensitive receptors within these limiting distances, BMPs and mitigation measures should be implemented, as practicable or feasible, for New Wireless Communication Towers projects and other similar wireless projects.
- Collocation on Existing Wireless Tower, Structure, or Building: In the event that additional onsite backup power is required, for reasons of FirstNet's requirements for resiliency and redundancy, operation of these projects could involve the use of power generators (Table 4.2.13-7). If additional power generators are required, the potential operation impacts for these projects are expected to be similar but slightly less than those associated with the New Wireless Communication Towers project. If additional power generators are not required, the potential operation noise impact for these projects would be negligible.

Table 4.2.13-7: Limiting Distances for Maximum Noise Levels Associated with Power Generators and Ventilation Fans at Fiber Huts or Central Offices

Noise Source[a,b]	Actual Measured Average Lmax at 50 Feet (dBA)[a]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[c]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[c]
Power Generator	81.0	998	548
Ventilation Fan	79.0	792	456
Total	**83.1**	**1,274**	**667**

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel
[a] Source: *WSDOT 2015*
[b] Maximum noise levels are based on operating one unit of typical equipment. It is not likely that more than one piece of each equipment type would be used at the same time. It is also unlikely that individual units of each equipment type listed in the table would be used concurrently; therefore, maximum noise levels and associated limiting distances presented in the table are conservative.
[c] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in WSDOT 2015. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.

Deployable Technologies

Operation of land-based deployable technologies while stationed on-site could involve the use of power generators embedded on heavy-duty vehicles (Cell on Wheels and System on Wheels) and/or light duty trucks (Cell on Light Truck) (Table 4.2.13-8). As indicated in the table, a maximum noise level of approximately 61 dBA at 50 feet could be expected per unit of power generator, and residences or other sensitive receptors within 103 feet of these sources could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 89 feet of each power generator could be exposed to noise in excess of the 55 dBA criterion.

The expected maximum noise levels and limiting distances to the 55 dBA criterion during the long-term deployment period (i.e., some months to a year or more) is dependent on the type of deployed land-based technology and the number of deployed units per affected area. For example, if Cell on Wheels technology were to be deployed in a rural area such as Pahoa Town (2.161 square miles) in Hawaii and assuming the Cell on Wheel technology can provide 10-mile diameter coverage, it would require only one power generator (embedded in a heavy-duty vehicle or large trailer) to cover the entire town. The maximum noise level associated with this land-based deployment technology (i.e., one power generator) in Pahoe Town would be approximately 61 dBA at 50 feet. Because the ground conditions in rural areas are typically soft (farmland, grasses, trees, etc.), Pahoe residences or other sensitive receptors within 89 feet of the power generator could be exposed to noise in excess of the 55 dBA criterion.

These projects could involve aerial vehicles, including, but not limited to, drones, airplanes, balloons, and blimps. Aerial vehicle take-off and landing operations typically generate loud noises. The magnitude of noise generated by these aerial vehicles would be similar to those described in the short-term deployment phase but would occur over a longer period (i.e., some months to a year or more). During the long-term deployment period, the maximum noise level is expected to range from approximately 82 dBA at 50 feet for a drone take-off or landing to 114 dBA at 50 feet for an airplane. As such, residences or other sensitive receptors within 1,125 and 44,668 feet (0.21 to 8.5 miles) of each aerial vehicle take-off or landing could be exposed to noise in excess of the 55 dBA criterion under hard ground conditions. Similarly, under soft ground conditions, residences or other sensitive receptors within 603 to 11,476 feet (0.11 to 2.2 miles) of each aerial vehicle operation could be exposed to noise in excess of the 55 dBA criterion (Table 4.2.13-8). It is unlikely that take-off and landing of aerial vehicles would occur concurrently at the same location; however, if this were to occur, total noise increases and limiting distances to the 55 dBA criterion would increase as well (Table 4.2.13-8). For overflight operations, most of the aerial vehicle noise would occur at a few thousand feet above ground level and could be perceived by sensitive receptors on the ground but for a short-term/intermittent period. The short-term and intermittent noise increases associated with the aerial vehicle take-off and landing would be higher than those for the land-based deployment technologies.

Table 4.2.13-8: Limiting Distances for Maximum Noise Levels Associated with Deployable Technologies Implementation – Long-Term

Noise Source[a,b,c]	Actual Measured Average Lmax at 50 Feet (dBA)[a,b]	Threshold Distance to 55 dBA Noise Criterion Under Hard Ground Conditions (Feet)[d]	Threshold Distance to 55 dBA Noise Criterion Under Soft Ground Conditions (Feet)[d]
Cell on Wheels, Cell on Light Truck, or System on Wheels			
Power Generator (1 Unit)	61.3	103	89
Power Generator (2 Units)	64.3	145	117
Power Generator (3 Units)	66.0	178	138
Power Generator (4 Units)	67.3	205	155
Power Generator (5 Units)	68.2	230	169
Deployable Aerial Communication Architecture			
Unmanned Aircraft - Drone Takeoff or Landing (1 Unit)[e,f]	82.0	1,125	603
Unmanned Aircraft - Drone Takeoff or Landing (2 Units)[e,f]	85.1	1,591	796
Unmanned Aircraft - Drone Takeoff or Landing (3 Units)[e,f]	86.8	1,948	936
Unmanned Aircraft - Drone Takeoff or Landing (4 Units)[e,f]	88.1	2,249	1,051
Unmanned Aircraft - Drone Takeoff or Landing (5 Units)[e,f]	89.0	2,515	1,149
Piloted Aircraft - Plane Flyover (1 Unit)[g]	114.0	44,668	11,476
Piloted Aircraft - Plane Flyover (2 Units)[g]	117.0	63,171	15,143
Piloted Aircraft - Plane Flyover (3 Units)[g]	118.8	77,368	17,809
Piloted Aircraft - Plane Flyover (4 Units)[g]	120.0	89,337	19,981
Piloted Aircraft - Plane Flyover (5 Units)[g]	121.0	99,881	21,847
Piloted Aircraft - Blimps (1 Unit)[h]	85.6	1,687	835
Piloted Aircraft - Blimps (2 Units)[h]	88.6	2,386	1,101
Piloted Aircraft - Blimps (3 Units)[h]	90.3	2,922	1,295
Piloted Aircraft - Blimps (4 Units)[h]	91.6	3,374	1,453
Piloted Aircraft - Blimps (5 Units)[h]	92.6	3,772	1,589

Lmax = maximum value of a noise level that occurs during a single event; dBA = A-weighted decibel; NA = not applicable

[a] Source of Lmax data for Cell on Wheels, Cell on Light Truck, and System on Wheels: *WSDOT 2015*

[b] Source of Lmax data for Deployable Aerial Communication Architecture: *Hodgson et al. 2013* and *WSDOT 2015*

[c] Maximum noise levels for deployable technologies are based on operating one to five units of vehicle type, depending on the size of the coverage area.

[d] Threshold distances to 55 dBA noise criterion were calculated in accordance with the equation and methodology (accounting for hard and soft ground conditions) described in *WSDOT 2015*. The calculations do not include the effects, if any, of atmospheric absorption, screening obstacles/barriers (e.g., earthen berm, buildings), or foliage that could reduce sound levels and limiting distances further.

[e] Lmax data for drone take-off were based on noise levels of a ScanEagle Unmanned Aerial Vehicle (85 to 90 dBA) at 6 meters (20 feet) (*Hodgson et al. 2013*). The 90 dBA maximum level at 20 feet was assumed for this analysis. The noise level at 20 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.

[f] Lmax data for drone landing were assumed to equal to that for drone take-off.

[g] Lmax data for airplane flyover (120 dBA) at 1,000 feet were taken from *Purdue University 2015*. The noise level at 1,000 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.

[h] Lmax data for blimps were based on noise levels of a Goodyear blimp with two 210-horsepower engines with a total of 110 dBA just outside of a gondola (assume 3 feet away) (*Goodyear Blimp 2015*). A gondola is a passenger compartment suspended beneath a balloon or airship. The 110 dBA maximum level at 3 feet was assumed for this analysis. The noise level at 3 feet was converted using typical logarithmic equations to reference noise levels at 50 feet.

The expected maximum noise levels and limiting distances to the 55 dBA criterion during the long-term deployment period (i.e., some months to a year or more) is dependent on the type of deployed aerial technology and the number of deployed units per affected area. For example, if an unmanned aircraft such as a drone were to be deployed in or near Kalaupapa National Historic Park on the island of Molokai (24.45 square miles) and assuming the drone can provide 15-mile diameter coverage, it would require only one drone to cover the entire national historic park. The maximum noise level associated with this Deployable Aerial Communication Architecture (i.e., the one drone taking off or landing) in or near Kalaupapa National Historic Park would be approximately 82 dBA at 50 feet. Because the ground conditions at national historic parks and wilderness areas are typically soft (grasses, trees, etc.), sensitive receptors within 603 feet (0.11 mile) of the drone could be exposed to noise in excess of the 55 dBA criterion. If piloted aircraft are used, the corresponding noise levels would be higher and sensitive receptors at larger distances from the source (piloted aircraft) would be exposed to noise above 55 dBA. For example, if a piloted aircraft such as a two-engine airplane were to be deployed in or near Kalaupapa National Historic Park on the island of Molokai (24.45 square miles) and assuming the two-engine airplane can also provide 15-mile diameter coverage, it would require only a single two-engine airplane to cover the entire park. The maximum noise level associated with this Deployable Aerial Communication Architecture (i.e., the single two-engine airplane taking off or landing) in or near Kalaupapa National Historic Park would be approximately 114 dBA at 50 feet. Because the ground conditions at national historic parks and wilderness areas are typically soft (grasses, trees, etc.), sensitive receptors within 11,476 feet (2.2 miles) of the single two-engine airplane take-off or landing could be exposed to noise in excess of the 55 dBA criterion.

Increased Noise Levels during Operations

In general, the abovementioned activities could potentially generate noise from extended use of power generators, and aerial vehicles. Increased noise levels associated with operation of this infrastructure could potentially impact the surrounding community. BMPs and mitigation measures could help reduce these potential impacts during operation activities.

Based on the analysis of the operation activities described above, potential impacts as a result of increased noise levels are anticipated to be *less than significant.* To minimize the effects of the Preferred Alternative on noise during operation activities, FirstNet and/or their partners would require, as practicable or feasible, implementation of BMPs and mitigation measures described in Chapter 11.

4.2.13.5. Alternatives Impact Assessment

The following section assesses potential impacts to noise associated with the Deployable Technologies Alternative and the No Action alternative.[5]

[5] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts from noise as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* potential impacts to noise if deployment requires use of heavy equipment, power generators, first responder on-road vehicles, and/or aerial platforms. Some staging or landing areas (depending on the type of technology) could require land/vegetation clearing, minimal excavation, and paving. In comparison to the Deployable Technologies Alternative implemented as part of the Preferred Alternative (Table 4.2.13-6), these activities would likely be implemented in greater number over a larger geographic extent, and used in greater frequency and duration. Therefore, the maximum noise increases and limiting distances to sensitive receptors for this alternative are expected to be greater in magnitude than those listed in Table 4.2.13-6. These activities would result in increased noise levels as well, but again these potential impacts are expected to be *less than significant*.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that potential noise impacts associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and the use of power generators, aerial vehicles, and ventilation fans on fiber huts or central offices are expected to be *less than significant*. If use of heavy equipment or vehicles outside of established access roads or corridors occurs as part of routine maintenance or inspections, potential noise impact could result as explained above.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to noise as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 4.1.13, Noise.

4.2.14. Climate Change

4.2.14.1. Introduction

This section presents future climate change projections for temperature, precipitation, and sea-level rise (SLR). It also describes potential greenhouse gas (GHG) emissions arising from deployment and operation of the Proposed Action and alternatives, the effects of climate change in Hawaii on the Proposed Action and alternatives. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.14.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of climate change on the Proposed Action were evaluated using the significance criteria presented in Table 4.2.14-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of the potential climate change effects, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts of climate change on the Proposed Action and the potential GHG emissions arising from the Proposed Action are addressed in this section as a range of possible impacts.

Table 4.2.14-1: Impact Significance Rating Criteria for Climate Change

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000[a] metric tons of CO_2e/year, and global level effects observed.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Only slight change observed.	There would be no increase in GHG emissions or related changes to the climate as a result of the Proposed Action activities.
	Geographic Extent	NA		NA	NA
	Duration or Frequency	NA		NA	NA
Effect of climate change on Proposed Action-related impacts	Magnitude or Intensity	Local impacts from global climate change effects are observed in air temperature rise, precipitation increases (severe storm events), and/or sea level.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	Only slight change observed.	There would be no measurable changes in global average temperature, precipitation events including severe storms, or sea-level rise.
	Geographic Extent	Local impacts from global climate change effects are observed.		Local impacts from global climate change effects are observed.	NA
	Duration or Frequency	Long-term changes; changes cannot be reversed in a short term		Long-term changes; changes cannot be reversed in a short term	NA

GHG = greenhouse gas; CO_2e = carbon dioxide equivalents; NA = not applicable

[a] Twenty-five thousand (25,000) metric tons per annum is the threshold set by Draft Council on Environmental Quality Guidance for a quantitative analysis.

4.2.14.3. Global Climate Change

Global climate change due to increasing GHG emissions is projected to produce a range of effects, including changes in temperature and precipitation on a seasonal and annual basis and in sea level compared to historical trends. Additional effects could include intensity and frequency of weather events such as storms, tornados, and droughts. Climate change projections are developed by simulating different future emission scenarios with a variety of models that are calibrated using historical trends plus the influence of varying radiative forcing[1] index due to increase in concentration of GHGs in the atmosphere. Global circulation models are frequently used to make global high level projections of temperature, precipitation, and other parameters. These models can be downscaled to produce regional climate models. Downscaling refers to disaggregating and refining future predictions from global to regional levels.

As part of this Draft Programmatic Environmental Impact Statement, an analysis was conducted to evaluate potential effects of overall climate change in Hawaii. The potential climate change impacts on the effects of the Proposed Action are evaluated in Section 4.2.14.6, Potential Impacts of the Preferred Alternative. The analysis identified relevant and credible sources for climate change projections in the region potentially affected by the Proposed Action. The projections analyzed were downscaled from global general circulation models. Due to the broad geography of the Proposed Action, four studies were reviewed as part of this analysis:

- *Fifth Assessment Report, International Panel on Climate Change:* the fifth assessment report provides global and regional climate change projections and sector specific climate risks.
- *Third National Climate Assessment, United States Global Change Research Program:* The third National Climate Assessment (NCA) provides downscaled climate change projections and impacts covering the U.S. and its territories.
- *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment Part 8 – Climate of the Pacific Islands, US National Oceanic and Atmospheric Administration*: The regional climate trends report for Hawaii and the Pacific Islands is a key input into the NCA. It provides climate change projections for temperature, precipitation, and SLR for Hawaii using 15 coupled atmosphere-ocean general circulation models. These models were downscaled to a resolution of approximately190 miles latitude and 60 to110 miles longitude for multi-model mean maps (*Keener et al. 2013*).
- *Climate Change and Pacific Islands: Indicators and Impacts, Pacific Island Regional Climate Assessment:* This report served as the primary basis for the Regional Climate Trends and Scenarios for the NCA. The report provides climate change projections for temperature, precipitation, extreme heat, and SLR for Hawaii and Pacific Islands.

Further information on the models used in this Draft Programmatic Environmental Impact Statement can be found in Appendix F, *Climate Change Sources and Models*.

[1] Radiative forcing is the difference between the radiation absorbed by Earth and the energy reflected back to space.

The projections prepared and presented in the NCA are the most recent and relevant to the U.S. and its territories. Since the Proposed Action has an undetermined timeline, outputs have been provided for 2035, 2055, and 2085, which are the half way points in the following time periods: 2021 to 2050, 2041 to 2070, and 2070 to 2099. The NCA provides climate projections using A2 (high emissions) and B1 (low emission) scenarios, which cover a significant range of potential future human impacts on the climate system. Additionally, many available literature sources use these two scenarios to evaluate potential impacts as well as mitigation and adaptation measures.

4.2.14.4. Global and Regional Climate Change Projections

Temperature and Precipitation

Climate projections show average temperatures in Hawaii continuously increasing throughout the end of the century. Temperatures are higher in the A2 high emission scenario compared to the baseline of 1971 to 2000 with little or no spatial variation (*Keener et al. 2012*). Table 4.2.14-2 below illustrates the temperature changes in high (A2) and low (B1) emissions scenarios through 2100. Additionally, sea temperature in the Pacific is expected to increase by 1.1 degrees Fahrenheit (°F) by 2030, 1.8°F by 2055 and 2.5°F by 2090 compared to 1990 levels under the high emission scenario (*USGCRP 2014*).

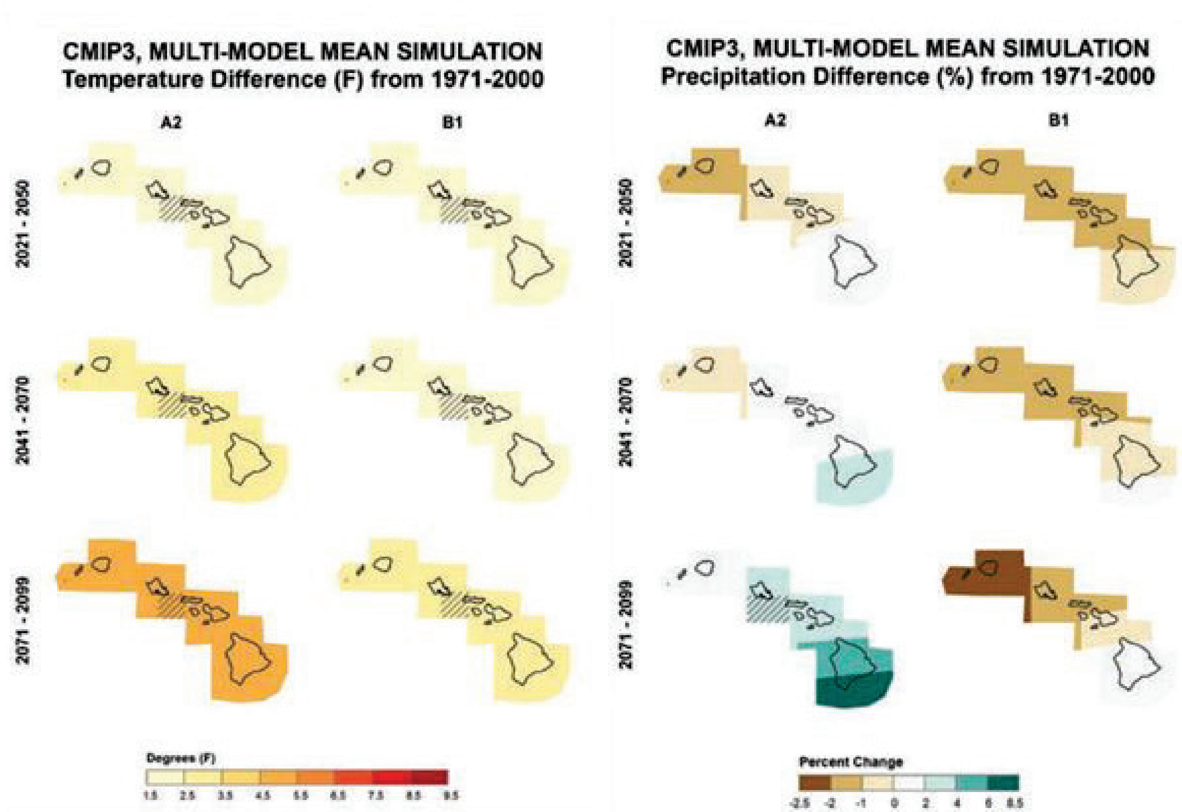
Table 4.2.14-2: Projected Temperature Changes

Scenario	Timeline	Temperature (°F)
	Baseline (1971-2000)[a]	74.1
A2	2035[b]	1.5 to 2
	2055[c]	3 to 3.5
	2085[d]	4.5 to 5
B1	2035[b]	1 to 2
	2055[c]	1.5 to 2.5
	2085[d]	2.5 to 3

Source: Keener et al. 2012

[a] Temperature from *NOAA 2015*
[b] 2035 is the mean year for the time period 2021 -2050.
[c] 2055 is the mean year for the time period 2041-2070.
[d] 2085 is the mean year for the time period 2070-2099.

Precipitation trends throughout the century show gradient changes in the northern and southern parts of Hawaii (*Keener et al. 2012*). Southern Hawaii in both scenarios shows a large increase in precipitation while precipitation in northern Hawaii is expected to decrease (*Keener et al. 2012*. The north-south gradient change increases in magnitude throughout the century (*Keener et al. 2012)*. The largest difference is observed in the A2 emission scenario in 2085 with a decrease of 7.5 percent in precipitation on the Big Island and a decrease of 3.5 percent in Kauai from the baseline of 127.5 inches from 1971 to 2000 (*Keener et al. 2012*). The smallest difference in gradient occurs in the B1 scenario in 2035 with decreases of 0.5 percent to 2.5 percent below the baseline (*Keener et al. 2012*). Figure 4.2.14-1 below illustrates the multi model mean simulation of both temperature and precipitation for A2 and B1 emission scenarios.



Source: Keener et al., 2013

Figure 4.2.14-1: Projected Temperature and Precipitation Changes for Hawaii

Global Sea Level Rise

Global sea level is expected to rise throughout the century. The National Oceanic and Atmospheric Administration's report on global sea level scenarios supporting the NCA concludes with high confidence (greater than 9 in 10 chance) that the global mean sea level will rise at least 8 inches and no more than 6.6 feet by 2100 (*Parris et al. 2012*). SLR is primarily attributed to ocean thermal expansion and ice sheet loss. However, recent studies by The National Research Council based on satellite measurements indicate that the ice sheet loss has greater contribution to global SLR than thermal expansion in the period from 1993 to 2008 (*Parris et al. 2012*). Global SLR projections use four scenarios:

- High, which should be considered for situations with low tolerance for risk;
- Intermediate high, which is based on an average of the high-end global SLR projections;
- Intermediate low, which is based on the upper global SLR projections using B1 emissions scenarios from Intergovernmental Panel on Climate Change's Fourth Assessment Report; and
- Lowest scenarios, which are based on linear extrapolation of historical SLR from tide gauge records since 1900. This scenario should be considered where there is great tolerance for risk (*Parris et al. 2012*).

Global SLR projections are highly uncertain. There is low confidence in the future prediction of wind patterns and their influence on regional sea level (*Keener et al. 2012*). It is uncertain how the tropical Pacific atmospheric circulation will respond to future projected global climate change (*Keener et al. 2012*). However, many models have concluded that there will be a trend toward a more El Niño background state (*Keener et al. 2012*). Table 4.2.14-3 below illustrates projected global sea level rise using the four scenarios relative to mean sea level in 1992.

Table 4.2.14-3: Projected Global Sea Level Rise Relative to 1992

Scenario	**Sea Level Rise (SLR) by 2100 (feet)[a]**
Highest	6.6
Intermediate high	3.9
Intermediate low	1.6
Lowest	0.7

Source: Parris et al. 2012

[a] Relative to mean sea level in 1992

4.2.14.5. Description of Environmental Concerns

Greenhouse Gas Emissions

Since the industrial revolution, increasing GHG emissions from human activities (referred to as anthropogenic emissions and contrasting with emissions arising from natural processes) have increased the levels of GHGs in the atmosphere. Anthropogenic emissions enhance the greenhouse gas effect and result in a greater amount of heat that is trapped in the atmosphere (*IPCC 2013*). Human activities that emit GHGs include the combustion of fossil fuel, industrial processes, land use changes, deforestation, and agricultural production GHG emissions cumulatively contribute to climate change globally. There is no causal connection between GHG emissions arising from the deployment of the Proposed Action and the potential local impacts from global climate change.

Climate Change

Climate changes due to increasing global GHG emissions are projected to produce a range of effects, including changes in temperature, precipitation, and sea level as well as changes in frequency and intensity of weather events when compared to historical trends. These climate change effects can exacerbate, lessen, or have a positive effect on the potential impacts on environmental resources from operations associated with the Proposed Action, as identified in Section 4.2, Environmental Consequences.

Climate change projections have been presented for the A2 (high emissions) and B1 (low emission) scenarios. However, this analysis took a precautionary approach by using and discussing the worst case scenario (high emission A2) to ensure future potential impacts and outcomes are not underestimated. In an A2 scenario, temperature in Hawaii is expected to increase by 5°F by the end of the century compared to a baseline of 1971 to 2000. Precipitation will vary greatly in northern and southern Hawaii; increases in precipitation are projected in southern Hawaii while decreases in precipitation are projected in northern Hawaii compared to this baseline.

As a result of these changes, potential impacts on water resources in the Pacific Islands would vary due to island size and relative isolation. Availability of freshwater supplies in many Pacific Islands could potentially be impacted by climate change due to warmer and drier conditions as temperatures increase. Additionally, sea-level rise could increase the salinity of groundwater resources (*Keener et al. 2012*). Rising sea levels would increase likelihood of coastal flooding and erosion (*Keener et al. 2012*).

Transportation infrastructure would be impacted by storm surges or sea-level rise, which could lead to increased cost to repair or replace infrastructure that could be impacted by climate change effects (*Keener et al. 2012*). Sea level rise would likely increase vulnerability of coastal structures and properties; however, impacts would vary with location depending on regional sea level variability coupled with an increasing global average sea level. Increasing mean global sea levels would have an impact on extreme events in the Pacific Island region (*Keener et al. 2012*). A study conducted by Hunter (*2012*) that focused on Australian sea-level stations estimated that a 4-inche increase in sea level corresponded to an average of a threefold increase in the frequency of extreme weather (*Keener et al. 2012*).

Climate change could have potential impacts on human health by increasing incidences of various infectious diseases such as dengue (*Keener et al. 2012*).[2] Increased flooding from sea-level rise could overflow sewer systems and therefore potentially impact public sanitation (*Keener et al. 2012*)

An increase in temperature could increase stress in vegetation and wildlife species potentially impacted by the Proposed Action. Additionally, drier conditions could increase soil contraction, potentially impacting foundations of infrastructure. Changes in precipitation and increases in extreme weather events could exacerbate potential impacts due to soil erosion and top soil mixing. Foundations for infrastructure and infrastructure near coastal areas could be particularly vulnerable to increased soil erosion. Additionally, precipitation increase, particularly in storm events, could exacerbate potential impacts from flooding, particularly infrastructure near coastal areas and in flood zones. Furthermore, changes in temperature and precipitation and increases in extreme weather could increase stress on wetlands and biodiversity.

[2] Studies show a correlation between climate and diseases with various transmission with the strongest link shown between climate and mosquito-borne diseases (*Morin and Comrie 2013*). The Fifth Assessment report by the Intergovernmental Panel on Climate Change summarizes the link between temperature and infectious diseases. The influence of temperature on malaria is vector specific (*IPCC 2014*). Temperature affects mosquito vector development rates, mortality, and behavior and controls viral replication *(Morin and Comrie 2013*). New studies show that increasing temperatures studied over a long period of time (30 years) correspond to increased transmission of malaria *(IPCC 2014*). This indicates that even modest warming may drive up increases of malaria transmission. Studies have established transmission of dengue with seasons; the highest cases of dengue fever were recorded during the wet season in Trinidad (*IPCC 2014*). Precipitation provides suitable habitat for mosquitos particularly to create and maintain breeding sites (*Morin and Comrie 2013*).

4.2.14.6. Potential Impacts of the Preferred Alternative

The following sections assess potential impacts associated with implementation of the Preferred Alternative, including deployment and operational activities. Potential climate change impacts associated with the Proposed Action include potential impacts from the Proposed Action on climate change, in terms of an increase in GHG emissions, as well as the opposite: climate change effects on the Proposed Action.

GHG emissions would arise from combustion of fossil fuel in stationary or mobile equipment, clearing of vegetation, use of generators, and changes in land use during construction and operation. The types of stationary and mobile equipment that would be used include excavators, backhoes, frontend loaders, graders, pavers, and dump trucks. Additionally, combustion of fuel used in power generators, first responder on-road vehicles, and aerial platforms such as drones and piloted aircraft would contribute to GHG emissions. GHGs are characterized in terms of their global warming potential (GWP). The GWP is a measure of how much energy the emission of 1 tonne[3] of gas will absorb over a period of time, relative to the emission of 1 tonne of carbon dioxide (CO_2). This metric is normalized in terms of carbon dioxide equivalents (CO_2e) and expressed with a time horizon. The most commonly used time horizon is 100 years, where 1 unit of CO_2 will have a 100-year GWP of 1; an equivalent amount of methane will have a 100-year GWP of 25, and an equivalent amount of nitrous oxide will have a 100-year GWP of 298. GHG emissions would be emitted locally but have a global effect as explained in Section 4.1.14.2, Context. The GWP values are revised from time to time and should be updated accordingly based on the Intergovernmental Panel on Climate Change Assessment Reports. Current values derive from the Fourth Assessment Report (*IPCC 2007*).

GHG emissions associated with the Proposed Action are estimated and compared against a threshold limit of 25,000 metric tons per year as defined by the Council on Environmental Quality (CEQ) Revised Draft GHG and Climate Change Guidance (*CEQ 2014*). GHG emissions arise from combustion of fossil fuel in stationary or mobile equipment, use of generators, clearing of vegetation and changes in land use during construction and operation. GHG emissions from loss of vegetation and soil disturbance are expected to be minimal and therefore will not be estimated in this analysis.[4] As described in Section 4.1.14.3, Specific Regulatory Considerations, the Revised Draft CEQ Guidance requires that projects provide a quantitative analysis for emissions greater than 25,000 metric tons of CO_2e annually.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the facility infrastructure and specific deployment requirements, climate change effects would result in potential impacts from some activities in the Preferred Alternative in

[3] One tonne is a unit of measure in the International System of Units that is equivalent to 1 metric ton and equivalent to 1.1023 U.S. tons, which are also known as short tons.
[4] Emissions from vegetation loss are not significant in the evaluation of the Proposed Action. The greatest source of GHG emissions comes from loss of forest. Approximately 230 hectares of forest would need to be cleared to generate 25,000 metric tons.

terms of GHG emissions. Climate change effects from deployment of the Preferred Alternative could range from *less than significant* to *no impacts* depending on the project types deployed.

In addition to potential effects from the Proposed Action on climate change, potential climate change effects on the Proposed Action were assessed. If deployment activities occur in the next 10 years, as is anticipated, climate conditions in that period would not differ much from current conditions even in the worst case emission scenario. Therefore, climate change effects on the various deployment activities would likely be minimal and are expected to have *no impacts*.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, climate change effects are likely to have *no impacts* to the following facilities under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Existing conduits would be used in the installation of new fiber optic cable, which could require construction equipment for cable blowing or pulling. The emissions associated with the use of existing conduit would arise from use of similar equipment as those listed in Table 4.2.14-4 below. The short duration and intermittent use of heavy equipment would not produce perceptible changes to climate change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: These projects involve lighting up dark fiber and installation of new equipment in existing huts. The use of heavy construction equipment is not expected and movement of equipment by light truck or cars would produce a minimal amount of GHGs in the context of this Proposed Action. Therefore, no significant GHG emissions are expected to arise from these activities. As mentioned above, GHG emissions from ground disturbance and vegetation loss are expected to be minimal.

Table 4.2.14-4: GHG Emission Estimates from Buried Wired Project Deployment[a]

Emission Source[b,c]	Estimated Emissions[d,e,f]	
	CO_2e (tons/year)	CO_2e (metric tons/year)
Vibratory Plow, Backhoe, Dozer, Flat-bed Truck, Pick-up Truck, Trench Roller, Air Compressor, Cable Blower, Concrete Mixer, Grader, Roller	1,403	1,273

CO_2e = carbon dioxide equivalent
[a] Deployment activities are assumed to include excavation, grading, and pole delivery and installation.
[b] Emissions are based on one unit of typical equipment. One unit consists of one each of the equipment listed in the table, operating simultaneously. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.
[c] Each equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.
[d] Emissions are estimated using methodology from *USEPA 2010a*. Typical equation values were obtained from *USEPA 2010b*.
[e] Emissions (tons) assume 240 hours (24 days, 10 hours/day) of construction activity per month. Construction was assumed to last for 3 months in a year. If construction lasts for more than 3 months, emissions would be greater than the values listed here.
[f] Fuel is assumed to be ultra-low sulfur diesel.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: These projects would include installing permanent equipment on existing structures. GHG emissions would arise from fuel combustion from delivery and installation of equipment, however the use of satellite enabled devices and equipment would not create any perceptible changes in GHG emissions.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Land use emissions occur as a result of soil disturbance and loss of vegetation. GHG emissions from loss of vegetation and soil disturbance are expected to be minimal and therefore are not estimated. The types of deployment activities that would create GHG emissions are discussed below.

Wired Projects

GHG emissions would arise from combustion of fuel from the equipment used for plowing, trenching (including vibratory plowing), or directional boring during construction for buried wired projects. The worst-case emissions are expected to result from plowing techniques. For aerial wired projects, construction activities could include new wiring and poles that require use of auger trucks, boom truck, and bucket lifts, as well as excavation and grading equipment that use fossil fuels. Other activities associated with installation of new or modification of existing wired systems and associated infrastructure, including points of presence[5] (POPs) and huts, could result in GHG emissions during cable blowing, pulling, and vault placement. For some deployment activities, new structures could be required without the need for new or modified wired systems. GHG emissions from fuel combustion due to construction of deployment of wired projects have been estimated and are presented in Tables 4.2.14-4 and 4.2.14-5. Emission calculations assume that all construction equipment use diesel fuel and would have the same emissions. Therefore, each table shows a summation of the estimated emissions for the construction equipment required for each deployment activity.

[5] Points of presence are connections or access points between two different networks, or different components of one network.

Table 4.2.14-5: GHG Emission Estimates from New Aerial Wired Project Deployment[a]

Emission Source[b,c]	Estimated Emissions[c,d,e,f]	
	CO_2e (tons/year)	CO_2e (metric tons/year)
Grader, Suction Excavator, Auger Truck, Boom Truck, Cable Blower, Bucket Lift, Flat-bed Truck	893	810

CO2e = carbon dioxide equivalent
[a] Deployment activities are assumed to include excavation, grading, and pole delivery and installation.
[b] Emissions are based on one unit of typical equipment. One unit consists of one each of the equipment listed in the table, operating simultaneously. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.
[c] Each equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.
[d] Emissions are estimated using methodology from *USEPA 2010a*. Typical equation values were obtained from *USEPA 2010b*.
[e] Emissions (tons assume 240 hours (24 days, 10 hours/day) of construction activity per month. Construction was assumed to last for 3 months in a year. If construction lasts for more than 3 months, emissions would be greater than the values listed here.
[f] Fuel is assumed to be ultra-low sulfur diesel.

Potential GHG impacts associated with each type of wired project are discussed below:

- New Build –Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. The emissions associated from fuel use from these activities are estimated in Table 4.2.14-4. These annual CO_2e emissions resulting from deployment of buried fiber for one unit of equipment, operating for a total of 3 months within a given year, are equivalent to 1,403 tons (1,273 metric tons), which is less than the 25,000 metric ton threshold. It would require 20 or more buried fiber optic cable projects to be deployed simultaneously for 1 year or more for the threshold to be met and/or exceeded, which is unlikely.
- New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. The GHG emissions from burning fuel for one unit of equipment, operating for a total of 3 months within a given year, are estimated in Table 4.2.14-5. The total emissions are estimated at 893 tons (810 metric tons) per year, which is less than the 25,000 metric ton threshold. It would require 31 or more aerial fiber optic plant projects to be deployed simultaneously for 1 year or more to meet and/or exceed the threshold for quantification, which is unlikely.
- Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of less equipment than those listed in Table 4.2.14-5. As a result, these emissions have not been estimated separately but are expected to be fewer than the total emissions from New Build Aerial Fiber Optic Plant projects analyzed above.
- New Build – Submarine Fiber Optic Plant: The deployment of marine vessels that are capable of laying underwater cables that would be required for these types of projects is unlikely. However, small work boats (with engines similar to recreational vehicle engines)

may be required to transport and lay small wired cable. The emissions from these small marine sources would be negligible.

- Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment and additional cranes or sky lifts for installation. GHG emissions for one unit of equipment, operating for a total of 3 months within a given year, correspond to those emissions from Table 4.2.14-6. These emissions are estimated at 766 tons (695 metric tons). For the threshold for quantification to be met and/or exceeded, it would require 36 or more optical transmission or transmission equipment projects to be deployed simultaneously for 1 year or more, which is unlikely.

Table 4.2.14-6: GHG Emissions Estimates from Tower, Structure, and Transmission Equipment Delivery and Installation[a]

Emission Source[b,c]	Estimated Emissions (tons/month)[c,d,e]	
	CO_2e (tons/year)	CO_2e (metric tons/year)
Concrete Mixer, Flat-bed Truck, Grader, Paver, Roller, Truck-mounted Crane	766	695

CO_2e = carbon dioxide equivalent
[a] Emissions are based on one unit of typical equipment. One unit consists of one each of the equipment listed in the table, operating simultaneously. If additional equipment is required, equipment-specific emission estimates should be multiplied by the number of equipment units.
[b] Equipment is assumed to have a maximum rated capacity of 300 horsepower and to be 10 years old (equipment age). If new equipment is used, emissions would be lower.
[c] Emissions are estimated using methodology from *USEPA 2010a*. Typical equation values were obtained from *USEPA 2010b*.
[d] Emissions (tons assume 240 hours (24 days, 10 hours/day) of construction activity per month. Construction was assumed to last for 3 months in a year. If construction lasts for more than 3 months, emissions would be greater than the values listed here.
[e] Fuel is assumed to be ultra-low sulfur diesel.

Wireless Projects

Wireless projects would involve similar but fewer GHG emissions than wired projects. Emissions associated with installation of structures are similar to those found in Table 4.2.14-6 above. GHG emissions associated with each type of wireless project are discussed below:

- New Wireless Communication Towers: These projects would involve installation of new towers as well as associated structure including generators, equipment sheds, fencing, security lighting, aviation lights, and electrical feeds. Emissions from installation of new towers are estimated in Table 4.2.14-6. The annual emissions from these tower structure delivery and installation projects, assuming one unit of equipment operating for a total of 3 months within a given year, are estimated at 766 (695 metric tons) per year. For the threshold for quantification to be met and/or exceeded, 36 or more new towers deployed simultaneously would be required, which is unlikely.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would require mounting and installation of equipment on an existing tower. GHG emissions could arise from combustion of fuel from trucks required for the delivery and installation of equipment and from the equipment used for excavation and grading. GHG emissions for these projects are expected to be fewer than the total emissions associated with New Wireless

Communication Towers projects (which are estimated in Table 4.2.14-6) because there would be no new towers.

Deployable Technologies

GHG emissions would arise from use of Deployable Technologies from combustion of fuel from on-road vehicles and mobile power generators. It is assumed that diesel generators are the most likely fuel technology although gasoline and hydrogen-fueled generators could be an option. On road vehicles could include light-duty trucks for Cell on Light Truck projects or heavy-duty trucks for Cell on Wheels and System on Wheels. Emissions from diesel-power generator are estimated in Table 4.2.14-7.

Table 4.2.14-7: GHG Emissions Estimates from Heavy and Light Duty Vehicles[a]

Vehicle Type	Emission Factors[b,c]			Emissions	
	CO_2	CH_4	N_2O	Ton CO_2e/year	Metric tons CO_2e/year
	kg/gal	g/mi	g/mi		
Light Truck	10.21	0.0009	0.0014	1.80	1.63
Heavy-Duty Vehicles	10.21	0.0051	0.0048	1.80	1.63

CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; kg/gal = kilograms per gallon; g/mi = grams per mile
[a] Emissions are estimated assuming one vehicle operates 8 hours per day, 2 days per year (one day for driving to location, one day for departing from location). Driving emissions are larger than idling emissions; therefore, all operation was assumed to be driving, with an average speed of 50 miles per hour
[b] Emission factors taken from *Climate Registry 2015*, *Default Emission Factors 2014* Table 13.1 and 13.4.
[c] Fuel efficiency for light and heavy trucks taken from *Understanding Tractor-Trailer Performance* (*Caterpillar 2006*).

GHG emissions associated with each type of deployable technology are discussed below:

- Cell on Wheels: These projects consist of a cellular base station on a trailer, which is a heavy-duty vehicle. The generators would power the cell unit while the vehicle is on-site and stationary and the vehicle engines would power the vehicle when it is traveling to and from the site. The GHG emissions from the use of heavy-duty vehicles are presented in Table 4.2.14-7. This estimation assumed that one vehicle operates for 2 days a year twice a year, traveling to and from the site for deployment (operating emissions are calculated separately, below). In order for the threshold for quantification to be met and/or exceeded, 15,338 trucks or more would have to be deployed within a given year, an unlikely event.
- Cell on Light Truck: GHG emissions would arise from the combustion of fuel from light-duty truck and diesel generator for powering the cellular base station. Similar to Cell on Wheels, the generators would power the cell unit while the vehicle is onsite and stationary; however, the vehicle engines would power the vehicle while traveling to the site. The GHG emissions from use of a light-duty truck are presented in Table 4.2.14-7. This estimation assumed that one vehicle operates for 2 days a year twice a year, traveling to and from the site for deployment (operating emissions are calculated separately, below). In order for the threshold for quantification to be met and/or exceeded, 15,338 trucks or more would have to be deployed simultaneously, which is an unlikely event.

- System on Wheels: These projects include a full base station and controller on a large towable trailer or truck. These trailers or trucks are similar to the heavy duty vehicle and diesel-power generator associated with the Cell on Wheels technology. As such, GHG emissions from these projects are expected to be similar to those for Cell on Wheels and are listed in Table 4.2.14-7. This estimation assumed that one vehicle operates for 2 days a year twice a year, again for deployment only. In order for the threshold for quantification to be met and/or exceeded, 15,338 trucks or more would have to be deployed simultaneously, which is an unlikely event.
- Deployable Aerial Communication Architecture: These projects consist of deploying, but not operating, aerial vehicles such as drones, balloons, blimps, and piloted aircraft to staging areas. GHG emissions would arise from fuel combustion from this staging activity. These emissions have not been estimated but would likely be less than those used in installation and delivery of tower, structure, and transmission equipment (which are estimated in Table 4.2.14-6).

It is likely that the Preferred Alternative would use one or more or a combination of the above mentioned activities. Although each individual project might not meet the GHG emissions threshold for quantification in accordance to CEQ, it is possible that a combination of these activities could result in emissions that meet or exceed the requirement for a qualitative assessment. For example, if a combination of new build buried fiber optic plant, new build aerial fiber optic, new build submarine fiber optic, and the installation of optical transmission equipment occurred simultaneously, the threshold for quantification would be exceeded if nine sets of these operating units were deployed in a given year. The use of BMPs and mitigation measures help reduce these emissions. Operational emissions are described further below.

GHG Emissions during Deployment

Based on the analysis of deployment activities described above, GHG emissions are anticipated to be *less than significant* based on a reasonable assumption that the number of simultaneously deployed units would be less than the number required to reach the quantification threshold of 25,000 metric tons per project. It is unlikely that more units would be used or that a combination of projects would be deployed in sufficient numbers to exceed the threshold. In addition, BMPs and mitigation measures presented in Chapter 11, BMPs and Mitigation Measures, would further reduce potential GHG impacts.

Potential Operation Impacts

GHG Emissions

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in similar potential impacts to the abovementioned potential deployment impacts. There would be GHG emissions from combustion of trucks and other equipment used for routine inspection of the Preferred Alternative. However, these emissions would be far fewer than those associated with deployment activities. It is anticipated that there would be no GHG emissions associated with soil disturbance and vegetation loss from routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are used for inspection.

Operational activities associated with the Preferred Alternative could involve operation of fossil fuel power generators in Wireless Projects and Deployable Technologies. This analysis assumed that these power generators would use diesel fuel; however, gasoline- and hydrogen-fueled generators could be options. Power generators would be used as backup generators and operated while onsite for wireless projects during upset conditions where commercial power is interrupted and during routine maintenance; as a result, they would be expected to operate for only a short period of time. For deployable technologies, power generators would be utilized as the primary power source. The deployable technologies would operate onsite for as long as needed. The types of deployment activities that GHG emissions would arise from include the following:

- Wireless Projects
  - New Wireless Communication Towers: GHG emissions would arise from use of power generators including those that operate by combustion of fossil fuels. Backup power generators would only operate for a short period of time during upset conditions when commercial power supply has been interrupted or during routine maintenance. This analysis assumed a maximum of 500 hours per year for both upset conditions and routine maintenance. These emissions have been estimated and are presented in Table 4.2.14-8 below. The annual emissions for backup power generators are 19.3 tons (17.5 metric tons) of CO_2e for one unit, which is less than the 25,000 metric tons threshold. For the threshold to be met and/or exceeded, 1,429 or more units of the above mentioned equipment, operating simultaneously, would be needed, which is unlikely.
  - Collocation on Existing Wireless Tower, Structure or Building: These projects could involve the use of backup power generators such as diesel-power generators. The emissions from combustion of fuel for power generators are comparable to New Wireless Communication towers and are presented in Table 4.2.14-8 below.

Table 4.2.14-8: GHG Emissions from Back-up Diesel Power Generators for Wireless Projects

Emission Source	Estimated Emissions[a,b]	
	CO_2e (tons/year)	CO_2e (metric tons/year)
Diesel Generators	19.3	17.5

CO_2e = carbon dioxide equivalent
[a] Emission factors taken from *AP-42, Compilation of Air Pollutant Emission Factors*, Section 3.3, Gasoline and Diesel Industrial Engines, Table 3.3-1 (diesel engines) (*USEPA 1996*)
[b] Emissions are estimated assuming one, 67-horsepower diesel engine operates for 500 hours per year when commercial power is interrupted and during normal routine maintenance. Estimates can be directly scaled based on actual equipment size and operating schedule.

- Deployable Technologies
  - Operation of land-based deployable technologies would involve use of power generators such as diesel-power generators to power the cell unit. This analysis assumed power generators operating continuously for 24 hours a day and for 363 days a year (deployment to and from the site would require 2 additional days, as discussed above). The emissions from combustion of fuel for power generators are presented in Table 4.2.14-9 below. The annual emissions for power generators for deployable technologies are 160 tons (145 metric tons) of CO_2e for one unit, which is less than the 25,000 metric tons threshold. It would require 173 or more units of the above mentioned equipment operating simultaneously for the threshold to be met and/or exceeded, which is unlikely. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. These emissions would not be similar to any of the other technologies presented here. More information would be required regarding the number, type, and flight duration of the vehicles deployed to determine emissions from these technologies.

Table 4.2.14-9: GHG Emissions from Power Generators for Deployable Technologies

Emission Source	Estimated Emissions[a,b]	
	CO_2e (tons/year)	**CO_2e (metric tons/year)**
Diesel Generators	160	145

CO_2e = carbon dioxide equivalent
[a] Emission factors taken from *AP-42, Compilation of Air Pollutant Emission Factors*, Section 3.3, Gasoline and Diesel Industrial Engines, Table 3.3-1 (diesel engines) (*USEPA 1996*).
[b] Emissions are estimated assuming one, 32-horsepower diesel engine operates continuously (24 hours per day), 363 days per year (all year except for two travel days – see Tables 4.2.14-7 and 4.2.14-8). Estimates can be directly scaled based on actual equipment size and operating schedule.

Based on the analysis of operations activities described above, GHG emissions are anticipated to be *less than significant*. It is likely that emissions could be *potentially significant* only if 1,429 or more backup generators for wireless projects or 173 or more deployable units are used at the same time, an unlikely event. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to avoid or minimize potential impacts associated with GHG emissions.

Potential Climate Change Impacts on the Preferred Alternative

Climate change effects such as changes in temperature, precipitation, and sea-level rise during operations could potentially impact the infrastructure of the Preferred Alternative. Section 4.2.14.4, Global and Regional Climate Change Projections, presents climate change effects projected for Hawaii through the end of the 21st century. The potential impacts on the Preferred Alternative from climate change effects include the following:

- Projections indicate increasing average annual temperatures through the end of the century. These increases could lead to potential impacts associated with heat stress and wildfire risk, particularly for aboveground infrastructure. These would include towers, antennas, POPs, huts, poles, and microwave dishes.

- Precipitation varies greatly between the northern and southern parts of Hawaii. Increases in precipitation are projected in southern Hawaii. These increases could result in increased periods of soil saturation. Additionally, any heavy precipitation events could result in flooding, increased runoff, and erosion. These effects could potentially impact aboveground infrastructure such as towers, antennas, POPs, huts, poles, and microwave dishes. Northern Hawaii is expected to have decreases in precipitation. Potential impacts could include higher evapotranspiration rates, leading to heat stress and wildfire risks. These effects would potentially impact aboveground infrastructure.
- Projections indicate that the global mean sea level would rise through the end of the century. Sea level rise increases the likelihood for coastal flooding and erosion. Additionally, sea-level rise would potentially impact extreme events in the Pacific, likely increasing their frequency. Sea level rise, soil and coastal erosion, and flooding could pose potential significant impacts to infrastructure near or on the coast such as huts for buried aerial fiber optic or submarine fiber optic. Additionally, other aboveground infrastructure such as antennas, POPs, and poles could potentially be impacted during extreme events.

Adaptation to Climate Change Effects during Operation

Based on the analysis of the operational activities described above, climate change effects on the Preferred Alternative could be *potentially significant* to *less than significant with BMPs and mitigation measures incorporated* because climate change effects such as changes in temperature, precipitation, and sea-level rise during operations could potentially impact the infrastructure of the Preferred Alternative. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting from the Project, while adaptation refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to minimize climate change effects on the Preferred Alternative.

4.2.14.7. Alternatives Impact Assessment

The following section assesses potential impacts of climate change on the Deployable Technologies Alternative and the No Action Alternative.[6]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater

[6] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

frequency and duration. Therefore, potential impacts of climate change on the implementation of this alternative are described below. As with the Preferred Alternative, the effects of this alternative on climate change (in terms of GHG emissions) were examined as well as the other way around, in other words, the effects of climate change on the alternative.

Potential Deployment Impacts

The potential impacts on climate change from this alternative were assessed in terms of its potential to generate GHG emissions. As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be *less than significant* if 15,338 units or fewer of either light trucks or heavy-duty trucks were deployed, or if a combination of the light trucks or heavy duty trucks amounting to 15,338 units or fewer were deployed simultaneously, which is unlikely; these potential impacts would be further reduced by implementation of BMP and mitigation measures. In addition, GHG emissions would arise from fuel combustion from staging of aerial vehicles. These emissions have not been estimated; more information would be required regarding the number, type, and staging locations of the vehicles deployed to determine emissions from these technologies.

In addition to potential impacts on climate change from this alternative, the potential impacts from climate change on this alternative were assessed. Climate change effects on this alternative during deployment would be similar to such effects on the Preferred Alternative. If deployment activities occur in the next 10 years, as is anticipated, climate conditions in that period would not differ much from current conditions even in the worst case emission scenario. Therefore, climate change effects on the various deployment activities would likely have little to *no impact*. See the section below for more discussion on potential climate change effects during operation.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be few GHG emissions associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Emissions would arise from use of power generators as the main power source. Emissions from the use of one fossil-fuel-powered generator would not be significant. It would require more than 173 power generators working simultaneously for GHG emissions to be *potentially significant*. These potential impacts could still be reduced through implementation of BMP and mitigation measures. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. These emissions would not be similar to any of the other technologies presented here. More information would be required regarding the number, type, and flight duration of the vehicles deployed to determine emissions from these technologies.

Climate change effects on this alternative would have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to *no impact* on the deployed technology if the technologies are deployed within a short period of time (less than a decade). If there are no permanent structures, particularly near coastal areas, there would be little to *no impacts* as a result of sea-level rise. However, if these technologies are deployed continuously (at the required location) for a time period greater than a decade, climate change effects on infrastructure could be similar to the Proposed Action, as explained above.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no GHG impacts from the No Action Alternative. However, GHG emissions would be emitted from the current technologies used in Hawaii for first responders. Climate change effects such as changes in temperature and precipitation, extreme weather and sea-level rise would still occur globally and regionally but have *no impact* in the No Action alternative since there would be no associated infrastructure.

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4.2.15. Human Health and Safety

4.2.15.1. Introduction

This section describes potential impacts to human health and safety in Hawaii associated with deployment and operation of the Proposed Action. Best management practices (BMPs) and mitigation measures that would avoid or minimize those potential impacts are addressed in Chapter 11, BMPs and Mitigation Measures.

4.2.15.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 4.2.15-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with BMPs and mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various geographic and social settings, the potential impacts to health and safety addressed in this section are presented as a range of possible impacts. Potential impacts to human health and safety are assessed for both the workers and/or the general public, where applicable.

Environmental Consequences assessments for traffic, noise, water quality, and air quality, all of which have the potential to influence community and worker health, are covered in this Programmatic Environmental Impact Statement (see Section 4.2.1, Infrastructure; Section 4.2.13, Noise; Section 4.2.4, Water Resources; and Section 4.2.12, Air Quality, respectively). Applicable information from those assessments is referenced in this section if the potential impacts to those resources could result in impacts to community and/or worker health.

Other areas that directly or indirectly relate to health and safety but are not included in this section given the discussion in the respective resource sections include: radio frequency emissions (see Section 2.4, Radio Frequency Emissions); access to health and emergency services (see Section 4.2.1, Infrastructure); environmental justice issues that could result in decreased health (see Section 4.2.10, Environmental Justice); community cohesion and sense of safety (see Section 4.2.9, Socioeconomics).

Table 4.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Decrease in human health and safety (resulting from potential exposure to hazardous materials [including emissions, spills, and potential exposures via disturbance of historical contaminated sites]; accidents and injuries; exposure to noise; unsafe working conditions, and other recognized workplace safety hazards; and transmission of infectious diseases)	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public; a net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity; and probable regulatory violations; site contamination conditions could preclude development of sites for the proposed use; exposure to recognized workplace safety hazards; violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant*	No exposure to chemicals above health-protective screening levels; hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks; no exposure to unsafe working conditions or other workplace safety hazards	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state)		Impacts only at a local/neighborhood level	NA
	Duration or Frequency	Occasional frequency during the life of the Proposed Action		Rare event	NA

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; EPCRA = Emergency Planning and Community Right-to-Know Act; NA = not applicable; OSHA = Occupational Safety and Health Administration; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act

4.2.15.3. Description of Environmental Concerns

Exposure to Hazardous Materials

Health effects from human exposure to contaminants can range from experiences of physical irritation/nuisance to acute illness, to chronic disease outcomes, depending on the type of contaminant and level of exposure. The following are potential pathways for human exposure to contaminants in Hawaii associated with the Proposed Action.

Existing Contaminants in Soil or Water

The construction of the proposed facilities/infrastructure, trenching, and/or foundation excavation could expose soil containing contaminants from either existing industrial facilities or from legacy industrial activities. The disturbed soil could pose a health risk to workers and communities if there is direct contact with the soil or surface water runoff containing soil chemicals from the construction site. As outlined in the Affected Environment Health and Safety Section 4.1.15, Hawaii has three active Superfund sites that have ongoing cleanup action around soil and ground water contamination, including volatile organic compounds (VOCs) such as benzene (a known carcinogen) and the pesticide lindane; polychlorinated biphenyls; and heavy metals (*USEPA 2015b*). Other existing sources of soil and water contamination that could potentially pose a risk to workers and communities include pesticides used primarily in agricultural areas on the islands (*USEPA 2015a*). The implementation, as practicable or feasible, of water quality and soil erosion BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures) would help ensure contaminated soil and water are safely and adequately managed in accordance with all applicable regulations and policies, and exposure risks are minimized.

Potential Spills of Pollutants into Surface Water

Section 4.2.4.3, Description of Environmental Concerns, discusses the potential for water quality impacts that could occur from petroleum products accidentally spilled during refueling, or from potential pentachlorophenol associated with treated utility poles leaching into surface water, although concentrations of pentachlorophenol released during placement or replacement of poles are not expected to exceed United States (U.S.) Environmental Protection Agency levels of concern for human health (see Section 4.2.4.3, Description of Environmental Concerns). Health risks posed to workers and community members who could potentially come into contact with these chemicals range from acute to chronic illnesses, including increased risk of cancer (*USEPA 2000*).

In Hawaii, water used for human consumption is sourced from groundwater, surface water, and rainwater catchments (*HDOH 2014*). Therefore, surface water contamination could potentially impact catchment potable water systems. FirstNet will attempt, to the extent practicable or feasible, to avoid buildout/deployment locations are in or adjacent to waterbodies or that involve in-stream construction. In the event of a larger spill that goes unnoticed, shallow groundwater wells used for potable water could also potentially be impacted. The implementation of spill management BMPs and mitigation measures outlined in Section 11.4, Water Resources, could help to further ensure contaminated soil and water are safely and adequately managed in accordance with all applicable regulations and policies, and exposure risks are minimized.

Air Emissions from Mobile Sources

Section 4.2.12, Air Quality, discusses the potential impacts to air quality associated with the Proposed Action, which include emissions from stationary and mobile sources during deployment. Emissions could result from stationary or mobile equipment that is powered by fossil fuels, such as excavators or backhoes, required to support any clearance, drilling, and construction activities associated with network deployment. In addition, the use of power generators, first responder on-road vehicles (large towable trailers, commercial trucks, standard sport utility vehicles), and aerial platforms (aircraft such as drones and piloted aircraft) associated with the implementation of deployable technologies could also increase air emissions, both from fossil fuel combustion and, in some cases, from stirring up dust on unpaved roads. The emissions of health concern to both workers and communities are primarily particulate matter up to 2.5 micrometers in diameter ($PM_{2.5}$) and nitrogen dioxide (NO_2), both of which are produced by fossil fuel combustion associated with vehicle, heavy machinery, and generator use.

There is a substantial body of scientific literature linking both short-term and long-term adverse health impacts to various types of air pollution (*HEI 2010; Sarnat and Holguin 2007; Nishimura et al. 2013; Patel and Miller 2009; USEPA 2009; Levy et al. 2002*). NO_2 has been linked to short-term respiratory and cardiovascular effects (*USEPA 2008*). $PM_{2.5}$ has been linked to both short-term and long-term health effects. Specific health effects for $PM_{2.5}$ exposures include adverse cardiovascular effects, increase in cardiovascular and respiratory mortality, and adverse respiratory effects, including lung cancer (*USEPA 2009*).

Research to date has not revealed the existence of concentration thresholds for $PM_{2.5}$ and nitrogen oxides below which no health effects would be expected for sensitive populations.[1] Because a no-effect level has not been defined, the increase in emissions from deployment activities could potentially increase the risk of short-term and long-term effects to sensitive populations within the workforce or nearby communities (*HEI 2010; USEPA 2009, 2013; Kelly and Fussell 2011; Levy et al. 2002; Nishimura et al. 2013; Patel and Miller 2009; O'Neill et al. 2005, 2007; Sarnat and Holguin 2007*). Sensitive populations for exposure to $PM_{2.5}$ and NO_2 are listed below:

- Those with chronic respiratory diseases (asthma and chronic obstructive pulmonary disease), particularly children and the elderly;
- Those with acute respiratory infections, particularly children and the elderly;
- Those with chronic heart diseases; and
- Diabetics.

[1] If health-based air quality standards are being met, the health of the general population is unlikely to be adversely affected.

With regards to sensitive populations in Hawaii, the prevalence of deaths from chronic lower respiratory disease is lower than in the overall U.S.; however, adult asthma prevalence and deaths from infectious respiratory diseases are higher than in the U.S. Diabetes prevalence is lower in Hawaii relative to the U.S., while the rate of heart disease death is comparable but slightly higher (*CDC 2013a; CDC 2013b*). Overall, the percentage of the Hawaiian population that could be considered sensitive is likely comparable to the national percentage.

It is important to note that there are multiple causes of the diseases associated with particulate exposures. Although it is possible that some cases of cardiovascular problems, respiratory problems, and lung cancer could be related to or result from or be worsened by $PM_{2.5}$; most cases of these health problems are associated with other causes, such as smoking (*American Lung Association 2015; Heart and Stroke Foundation 2015*).

According to Section 4.2.12, Air Quality, potential impacts to air quality associated with the Preferred Alternative activities could range from *no impacts* to *less than significant with BMPs and mitigation measures incorporated,* depending on the deployment or operation scenario, or the site-specific conditions. It is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year). The implementation of appropriate air quality BMPs and mitigation measures outlined in Section 11.12, Air Quality, and below would further help reduce human exposure to air contaminants and minimize the potential risk of health effects.

Accidents and Injuries

Workplace and Construction Site Accidents and Injuries

The Preferred Alternative construction activities, including excavation, drilling, buried, or aerial installations and transportation to and from work sites could increase the risk of accidents and injuries to both workers and communities. For communities, inadequate safety signage at construction and other work sites, as well as poor public awareness regarding construction risks, can increase the risk of injuries and accidents for community members living or working in proximity to those sites. For the workforce, workplace hazards such as work at heights and work involving the use of heavy machinery increase the risk of slips, trips, falls, and other accidents. The Hawaii Occupational Safety and Health Division and the U.S. Occupational Safety and Health Administration (OSHA) maintain authority over all federal and private sector workplaces in Hawaii; therefore, although accidents and injuries are considered an employee workplace hazard, FirstNet and/or their partners could implement appropriate measures, such as Job Hazard Analyses, to assure a safe and healthful workplace in compliance with Hawaii Occupational Safety and Health Division/OSHA standards.

Road Traffic Accidents and Injuries

In addition to worksite accidents and injuries, temporary traffic congestion on public roads as discussed in Section 4.2.1, Infrastructure, during deployment could increase the risk of road traffic-related accidents and injuries for both workers and community members.

Those most at risk for traffic-related accidents are often local citizens whose daily activities occur at the same time or in the same vicinity as the Proposed Action activities. The degree of health risk to the local communities and workers relates to the forms of local community traffic that exist on the same roads used by the Proposed Action (e.g., mixed-use traffic involving pedestrian, motorcycle, animals, etc.), the integrity of local road infrastructure, and driver behavior. Key risk factors for road traffic accidents that should be taken into consideration and mitigated in the deployment and operation phases of the Proposed Action include: alcohol-impaired driving, distracted driving due to the use of handheld devices, speeding, low seat belt usage, and high incidence of motorcycle and moped accidents (*HDOT 2013*).

Adherence to OSHA workplace standards, the implementation of the appropriate traffic congestion BMPs and mitigation measures in Section 11.1, Infrastructure, and the implementation of human health and safety BMPs and mitigation measures outlined in Section 11.15 could reduce the risk of road traffic-related accidents and injuries to both communities and workers.

Potential Noise-Related Health Impacts

Noise is measured in A-weighted decibels (dBA). Human exposure to long-term noise levels above 80 dBA is associated with an increased risk of hearing loss, and lower levels of noise exposure may be associated with non-auditory health effects, including sleep disturbance, increase in blood pressure, and increase in stress (*Evans et al. 2001; Babisch 2011; WHO 1999*). Sources of noise during deployment above ambient background noise and threshold distances are discussed in Section 4.2.13, Noise.

Worker health effects managed by OSHA are designed to prevent hearing impairment. If worker noise exposure is equal to or greater than 85 dBA for an 8 hour exposure, a hearing conservation program must be implemented (*OSHA 2015*). During deployment, construction activities that involve the use of heavy machinery could exceed 85 dBA (refer to Section 4.2.13, Noise).

For communities, a 5 dBA increase in noise above the ambient background is used to assess whether an impact is considered to be potentially significant (*IFC 2007; USDOT 2005; WHO 1999*). "Significant" in this context means the level of sound that a community is likely to perceive as an annoyance (*USDOT 2005*). The minimum increase in sound levels that most people can perceive is 3 dBA (*Bies and Hansen 1996*), which equates to a doubling of the sound power (sound is measured on a logarithmic scale). Use of a 5 dBA increase to assess whether a community might perceive a noise annoyance may not be accurate if noise levels in the community are already relatively high (e.g., above 65 dBA) (*USDOT 2005)*. In general, the "noisier" existing conditions are, the less additional noise is tolerated by the community (*USDOT 2006*). Higher noise levels and larger increases above existing noise levels are associated with increasing levels of stress responses. Noise-related disturbance and stress are subjective factors, and therefore there is no defined threshold at which a noise disturbance is considered to result in stress levels representing a measurable health effect. Best practice guidance suggests assessment of community noise based on perception rather than measured health outcomes (*USDOT 2005*), and on examining increases above baseline conditions (*IFC 2007*).

Providing further complication, the potential impacts of increased sound depend not just on the numerical increase in sound levels, but also on the intensity of the sound, the duration of the sound, and the sound setting (*WHO 1999*). Unexpected, short duration, high intensity sounds can have a worse effect than relatively steady sounds. Research suggests that humans appear to have capacity for adaptive response to typical sound levels in their environment; once adaptation has occurred, sleep patterns are not affected (*Stansfeld and Matheson 2003*).

Adherence to OSHA workplace standards, the implementation of the appropriate noise and human health and safety BMPs and mitigation measures outlined in Chapter 11 could minimize the risk of human exposure to noise levels above health-protective levels.

Communicable Diseases

Communicable, or infectious, diseases are illnesses that result typically from infection by biologic agents (most commonly viruses, bacteria, and parasites) in a human or animal host. In Hawaii, human cases of the mosquito-borne diseases chikungunya and dengue have been reported in recent years. To date, all chikungunya cases and the majority of dengue cases have been imported (*USEPA 2015a*); however, the disease-vector mosquitos[2] that transmit the virus are present in the state and therefore local transmission is possible (*Remadna 2015*). Community members and workers are both at risk for infection, particularly during the rainy season when mosquito vectors are more prevalent. Construction activities considered under the Preferred Alternative that include land clearing and excavation could inadvertently create new bodies of standing water that can become mosquito vector-breeding sites, which could increase the risk of transmission of mosquito-borne illnesses to workers and community members.

With the implementation of the appropriate soil erosion control and human health and safety BMPs and mitigation measures in Chapter 11, the risk of transmission of communicable diseases would be significantly minimized.

4.2.15.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the various types of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

[2] A vector is an organism that carries and transmits an infectious pathogen to another living organism. There are six species of mosquitos in Hawaii that are possible disease vectors: *Aedes albopictus* (Asian Tiger Mosquito), *Aedes aegypti* (Yellow Fever Mosquito), *Aedes japonicus*, *Wyeomyia mitchelli* (Bromeliad Mosquito), *Culex quinquefasciatus* (Southern House Mosquito), and *Aedes vexans* (*Hawaii DOH 2011*).

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to human health and safety under the condition described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: The pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Hazardous materials needed for this work would include fiber optic cable lubricants or mechanical oil/grease, although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury, chemical exposure, or surface disturbances since work would be limited to existing entry and exist points, would be temporary, and intermittent. It is anticipated there would be *no impacts* to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to health resources because there would be no ground disturbance or heavy equipment used to accomplish the task.
- Satellite and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact health and safety, it is anticipated that this activity would have *no impact* to those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of the Preferred Alternative implementation would encompass a range of potential impacts that could occur as a result of exposure to hazardous materials in the air, water, or soil; potential workplace or road traffic accidents that result in injury; potential health effects from exposure to noise and increased infectious diseases transmission. The remainder of this section provides summary impact discussions for each development scenario or deployment activity.

- Wired Projects
  - New Build–Buried Fiber Optic Plant: Installation of a new buried fiber optic plant (i.e., new underground conduit) would include plowing, trenching, or directional boring and the construction of points of presence,[3] huts, or other associated facilities or hand-holes to access fiber could result in disturbed soil and the potential for exposure to legacy contaminants in the ground, and the possibility for spills and soil and water contamination that could affect human health. Additionally, the use of heavy machinery

[3] Points of presence are connections or access points between two different networks, or different components of one network.

and other vehicles around the construction area and on access roads would potentially impact human health through increases in air emissions and noise, as well as increased risk of workplace and road traffic accidents. Land clearing and any open areas that could cause rainwater to collect could increase the risk of transmission of mosquito-borne infections, in particular during the rainy season. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.

- New Build–Aerial Fiber Optic Plant: The build of an aerial fiber optic plant would require less soil disturbance and therefore the potential for exposure to legacy contaminants would be less than for a buried fiber optic plant. The use of heavy machinery still presents the possibility for spills and soil and water contamination, and air and noise emissions that could potentially impact human health, as well as possible workplace and road traffic accidents that could result in injury. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.
- Collocation on Existing Aerial Fiber Optic Plant: Collocation of an existing aerial fiber optic plant is not expected to cause a sufficient level of soil disturbance that would result in the potential for exposure to legacy contaminants in the ground. The use of heavy machinery, while expected to be less than for new build, still presents the possibility for spills, soil and water contamination, and air and noise emissions that could potentially impact human health, as well as possible workplace and road traffic accidents that could result in injury. BMPs and mitigation measures (see Chapter 11) could help avoid or minimize the potential impacts. No land clearing would be expected; therefore, the propagation of mosquito-vectors due to Proposed Action activities is not a concern. Transmission of mosquito-borne infections could still be a possible concern for workers given the presence of mosquito vector species for chikungunya and dengue in Hawaii. BMPs and mitigation measures (see Chapter 11) could help avoid or minimize the potential impacts.
- New Build – Submarine Fiber Optic Plant: The build of a submarine fiber optic plant would require less soil disturbance and therefore the potential for exposure to legacy contaminants would be less than for a buried fiber optic plant. The use of heavy machinery still presents the possibility for spills and soil and water contamination, and air and noise emissions that could potentially impact human health, as well as possible workplace and road traffic accidents that could result in injury. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes, hunts, or access roads, there could be soil disturbance and the potential for exposure to legacy contaminants in the ground, and the possibility for spills and soil and water contamination that could affect human health. Additionally, the use of heavy machinery and other vehicles around the construction area and on access roads would potentially impact human health through increases in air emissions and noise, as well an increased risk of workplace and road traffic accidents. Land clearing and the

creation of any areas where water could collect could increase the risk of transmission of mosquito-borne infections. Given Hawaii is an endemic area for mosquito-borne diseases, transmission to workers is a concern even if Proposed Action activities such as land clearing do not increase mosquito propagation at the site. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in soil disturbance and potential for exposure to legacy contaminants in the ground. The use of heavy machinery and generators presents the possibility for spills and soil and water contamination, and air and noise emissions that could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Land/vegetation clearing, excavation activities, landscape grading could increase the risk of transmission of mosquito-borne infections. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in soil disturbance, however the use of heavy machinery and generators presents the possibility for spills and soil and water contamination, and air and noise emissions that could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Given no land clearing would be expected, the risk of transmission of mosquito-borne infections would be less although still a possibility for workers given the presence of chikungunya and dengue mosquito vector species in Hawaii. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.
- Deployable Technologies
  - Cell on Wheels, Cell on Light Truck, System on Wheels, Deployable Aerial Communications Architecture: The use of deployable technologies could result in soil disturbance if land-based deployables occur in unpaved areas, or if the implementation results in minor construction or paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and air and noise emissions that could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment, and when not in use, the aerial vehicles could require preventive maintenance. Workers responsible for these activities may handle hazardous materials

not limited to fuel, solvents, and adhesives. BMPs and mitigation measures (see Chapter 11) could help to avoid or minimize the potential impacts.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would have *no impact* on impact soil, water, air or noise resources (refer to Sections 3.2.2 Soils, 3.2.4 Water Resources, 3.2.12 Air Quality, and 3.2.13 Noise), therefore the only potential human health and safety impacts considered are those associated with worksite or traffic-related congestion, which are anticipated to be minor and insignificant. Any use of satellite-enabled devices and equipment would be within current regulated ranges/standards. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

In general, the abovementioned activities could potentially involve trenching and/or foundation excavation, which could expose soil containing contaminants either from existing industrial facilities or from legacy industrial activities and could potentially affect human health. In addition, the possibility for spills that result in soil and water contamination exists and could also potentially affect human health. The use of heavy machinery and other vehicles around construction areas and on access roads could potentially impact human health through increases in air emissions and noise, as well as increased risk of workplace and road traffic accidents that could result in injury. Potential human health and safety impacts are described further below, and BMPs and mitigation measures to help avoid or reduce these potential impacts are discussed in Chapter 11.

Potential Exposure to Hazardous Materials Impacts

Based on the analysis of deployment activities, and assuming the adherence to OSHA workplace standards, potential health effects as a result of exposure to environmental hazardous materials are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential human health and safety impacts.

Potential Accident and Injury Impacts

Based on the analysis of deployment activities, and assuming the adherence to OSHA workplace health and safety standards, the risk of construction site, road, and other accidents and injuries to workers and communities is considered *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential human health and safety impacts.

Potential Noise-Related Health Impacts

Based on the analysis of deployment activities, and assuming the adherence to OSHA workplace health and safety standards, potential health effects as a result of exposure to noise are anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential human health and safety impacts.

Potential Communicable Disease Impacts

Based on the analysis of deployment activities, the risk of transmission of infectious diseases for the workforce and community members is anticipated to be *less than significant*. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential human health and safety impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *less than significant* impacts associated with human exposure to environmental hazardous materials, impacts to human health and safety associated with the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission. See Chapter 11, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential human health and safety impacts.

4.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action alternative.[4]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile land-based and aerial communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and no new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Potential impacts to health and safety resources as a result of implementation of this alternative are described below.

[4] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Potential Deployment Impacts

As explained above, implementation of land-based deployable technologies could result in *less than significant* impacts to health and safety resources if deployment occurs within public roads and some staging and land/vegetation clearing, excavation, or paving are required. These activities could result in the potential of on-site or road traffic related accidents involving workers and community members; disturbed soil and the potential for exposure to legacy contaminants in the ground; and air and noise emissions that could potentially impact human health; however, it is anticipated that the activities associated with the Deployables Alternative would have *less than significant* potential impacts because they would not result in exposure to chemicals, including hazardous or toxic materials, above health screening levels and those materials would be handled and disposed of in accordance with prevailing laws and regulations. If land clearing is required, depending on the area and time of year (rainy season) the risk of transmission of mosquito-borne infections could be a concern for workers given the local presence of chikungunya and dengue mosquito vector species.

Potential Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil resources, the risk of road traffic, workplace accidents and injuries, noise, and risk of infectious disease transmission would be *less than significant* because of the small scale of likely FirstNet activities. These potential impacts could be further reduced by implementation, as practicable or feasible, of BMPs and mitigation measures (see Chapter 11, BMPs and Mitigation Measures).

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in the Affected Environment Section 4.1.15, Human Health and Safety.

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4.3. References

4.3.1. Introduction

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