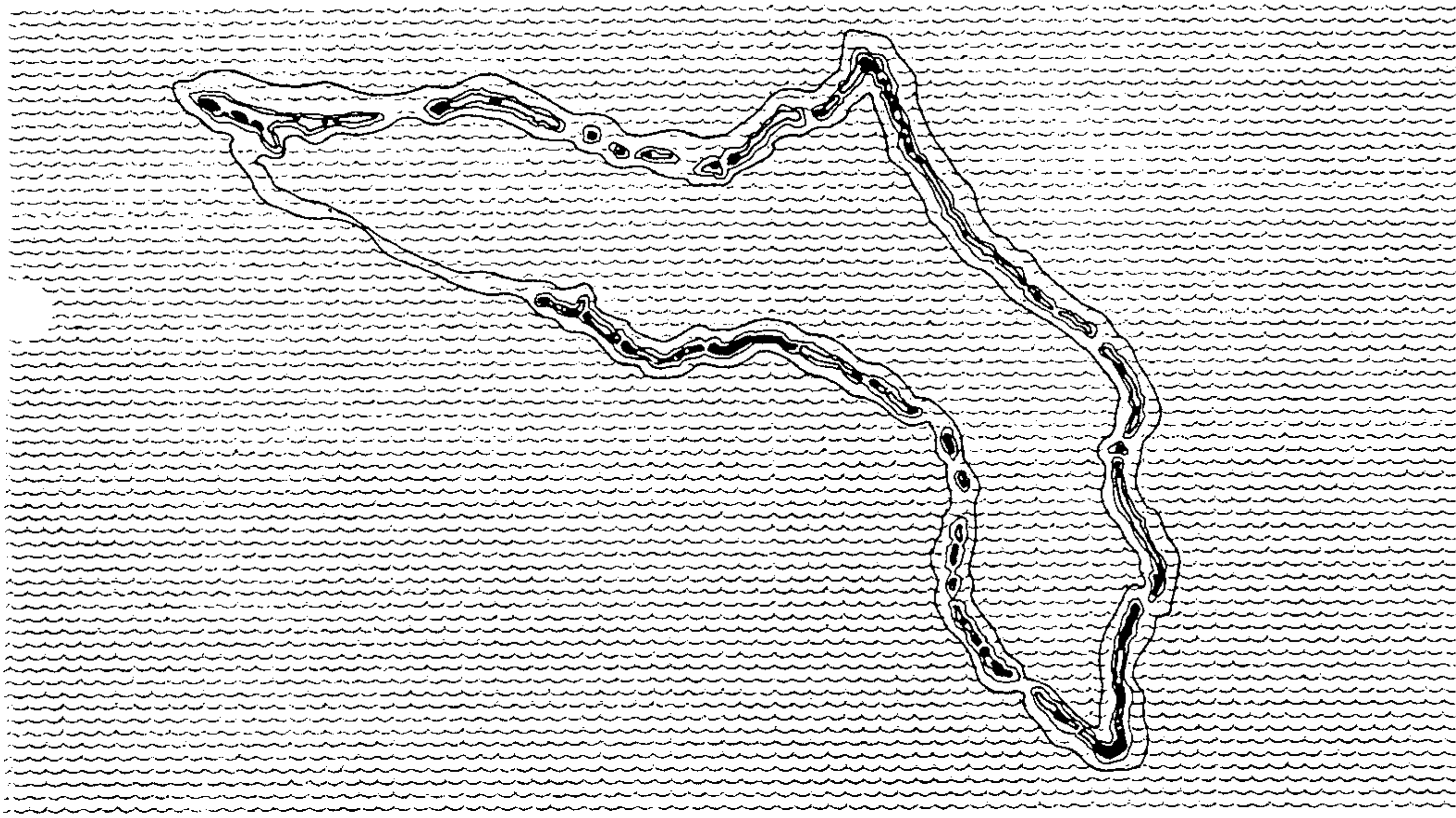
VOLUME I

Final Supplemental Environmental Impact Statement

Proposed Actions at

U.S. ARMY KWAJALEIN ATOLL



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THIS FINAL SUPPLEMENTAL IMPACT STATEMENT EVALUATES THE ENVIRONMENTAL IMPACTS OF TWO PROPOSED ACTIONS AT U.S. ARMY KWAJALEIN ATOLL (USAKA). THE FIRST PROPOSED ACTION IS THE TYPES AND LEVELS OF TEST ACTIVITIES, INCLUDING TEST FACILITIES AND SUPPORT SERVICES AT USAKA. THE SECOND PROPOSED ACTION IS THE ADOPTION OF NEW ENVIRONMENTAL STANDARDS AND PROCEDURES FOR U.S. GOVERNMENT ACTIVITIES AT USAKA.

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TITLE OF THE PROPOSED ACTIONS: Provide additional test range facilities and support services at U.S. Army Kwajalein Atoll (USAKA) in support of the Missile Defense Act of 1991 and adopt environmental standards and procedures that are appropriate to the unique environment and special circumstances at USAKA.

AFFECTED JURISDICTION: U.S. Army Kwajalein Atoll, Republic of the Marshall Islands

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ABSTRACT: Two Proposed Actions are examined. The purpose of the first is to provide additional testing facilities and support services at USAKA in support of the Missile Defense Act of 1991. The purpose of the second Proposed Action is to adopt environmental standards and procedures that are appropriate to the unique environment at USAKA and the special relationship between the U.S. and the Republic of the Marshall Islands, in accordance with the Compact of Free Association.

For the first Proposed Action, four alternatives are considered, each involving increasing levels of activity. The No-Action Alternative is the ongoing activity at USAKA. The Low, Intermediate, and High Level-of-Activity alternatives involve increased numbers of launches and levels of range support and base activities. The first Proposed Action is the Intermediate Level of Activity. For the second Proposed Action, two alternatives are considered. The No-Action Alternative is the continued application of U.S.-based environmental statutes and regulations. The Proposed Action is the adoption of USAKA Environmental Standards and Procedures.

The Final SEIS examines the environmental impacts of each alternative for the two Proposed Actions. Where impacts are found to be significant, mitigation measures are identified. Topics addressed by the Final SEIS include land and reef areas, water resources, air quality, noise, biological resources, cultural resources, socioeconomics, transportation, utilities, and range safety.

A Draft SEIS was issued for public comment on April 30, 1993. Written comments were accepted through July 1, 1993, and oral comments were taken at three hearings in the Republic of the Marshall Islands in May 1993. All comments received on the Draft SEIS have been addressed in the Final SEIS. All comments on the Draft SEIS and responses have been translated into Marshallese (see Volume III of this document).

In 1989, the U.S. Army Space and Strategic Defense Command (then known as the Strategic Defense Command) completed an environmental impact statement (EIS) for proposed actions at the U.S. Army Kwajalein Atoll (USAKA) that encompassed new and continuing research and development and operational missions, including planned Strategic Defense Initiative (SDI) activities. This Supplemental EIS (SEIS) responds to two related needs that require new environmental analyses.

The first need is for increased levels of ground and flight testing, facilities, and support activities to meet the goals of the Missile Defense Act (MDA) of 1991, as amended, within the framework of current Department of Defense (DoD) policy and guidance. The goals of the MDA are to develop a highly effective defense of the United States against limited attacks of ballistic missiles and highly effective theater missile defenses to protect U.S. armed forces deployed abroad and our allies and friends against the threat of missile attack. Current DoD direction in implementing the goals of the MDA gives first priority to the development and deployment of theater missile defense systems and second priority to national missile defense. Increased testing at USAKA is required to meet both theater and national missile defense needs.

The second need is to adopt and implement environmental standards and procedures that are appropriate for the particular environment and special circumstances at USAKA, replacing the U.S.-based standards that are currently in place.

The Compact of Free Association between the Republic of the Marshall Islands (RMI) and the United States declares that it is the policy of the two nations to "promote efforts to prevent or eliminate damage to the environment and biosphere and to enrich understanding of the natural resources of the Marshall Islands..." (Title One, Article VI, Section 161). Section 161 delineates a framework for development of environmental standards and procedures for U.S. actions at USAKA that reflects the particular environment of Kwajalein and the "special governmental relationship" between the two nations cited by the Compact.

In consultation with the natural resources and environmental protection agencies of the RMI and the United States, the U.S. government has developed a set of proposed USAKA Environmental Standards and Procedures (the Standards) to replace the existing statutes and regulations that govern U.S. actions at USAKA. The proposed Standards are similar to existing regulations in their standards for the protection of health and safety and the environment, but they simplify many of the procedural aspects of existing regulations as appropriate for the particular environment of USAKA and the special relationship between the two governments.

This SEIS, then, examines two categories of proposed actions. The first is an increased level of testing and related support activities that would occur at USAKA in response to the MDA. Four alternatives are considered in evaluating the first proposed action: No-Action, and Low, Intermediate, and High Levels of Activity. The second proposed action is adoption of new environmental standards and procedures for U.S. activities at USAKA.

The alternative levels of test activities compared in this SEIS encompass increased numbers of launches and levels of range support and base operations activities that could have impacts on the environment of the 11 USAKA islands. For the purposes of analysis in this SEIS, the rockets launched at USAKA are grouped into three categories. Meteorological rockets are single-stage, solid fuel rockets that are launched from Kwajalein, Omelek, and Roi-Namur. Sounding rockets are single- or multistage missiles that are used to test sensors. These rockets are currently launched from Roi-Namur, the Kauai Test Facility (KTF) in Hawaii, and Vandenberg Air Force Base (VAFB) in California. Strategic Launch Vehicles (SLVs) are larger, generally multistage missiles used at USAKA to launch payloads or to intercept payloads launched from KTF or VAFB. They include ballistic missiles using solid propellant fuel in the first and second stages and solid or liquid fuel in the third stage. For the purposes of analysis in this SEIS, SLVs include missiles used for testing theater missile defense components.

Existing conditions at USAKA were described in the 1989 EIS. Since that EIS was issued, the drinking water system has been upgraded at Kwajalein and a new power plant to support the increased level of activities evaluated in the EIS is on line. A number of environmental mitigation measures have been implemented at USAKA, in accordance with the 1989 EIS and Record of Decision.

In the No-Action Alternative, existing test programs and the technical and logistical activities that support them would continue, along with the activities that made up the proposed action of the 1989 EIS.

In the Low Level-of-Activity Alternative, the number of single-flight launches would increase to some extent, requiring the construction of a new launch complex on Meck Island to facilitate simple System Integration Tests (SITs). A major new sensor, the Ground-Based Radar Test (GBR-T) would be installed at Kwajalein. Some port improvements and shoreline protection would be added on other USAKA islands in connection with base operation construction projects. The nonindigenous population of USAKA would increase by approximately 575 compared with the No-Action Alternative.

In the Intermediate Level-of-Activity Alternative, which is the Proposed Action, the number of launches would be further increased, allowing more complex SITs. Complex SITs would involve multiple, near-concurrent launches of interceptors and sensors. Launches could be made from Meck, Omelek, and Illeginni islands. Other improvements with possible environmental impacts would be made, as described in

Chapter 2. This alternative would involve a significant increase in range support and base activities at USAKA, requiring quarrying and dredging for shoreline protection and new facilities at several islands. Meck Island would be expanded by approximately 15 acres to accommodate new launch activities. Illeginni launch facilities would be reconstructed. Some existing silos on Meck and Illeginni might be destroyed. Nonindigenous USAKA population would increase by an estimated 1,675 persons (or 52 percent) over that of the No-Action Alternative. This is comparable with the population levels in the early 1970s during the Safeguard testing program at USAKA.

The High Level-of-Activity Alternative bounds the maximum activity foreseen at USAKA. The frequency of launches would make full use of the capacity of each launch facility. Several of the islands that now have few facilities would be the sites of major new installations. New launch facilities and a new power plant would be built at Omelek. New sensors would be installed at Legan at a site not currently developed. A six-silo launch hill would be built on Eniwetak, requiring the clearing of forest that covers much of the island. Gellinam would be the site of sounding rocket launches. Gagan would be extensively developed with new sensing and tracking equipment. Shoreline protection and new construction would require more quarrying and dredging near the construction sites.

Since the release of the Draft SEIS, additional changes in the overall Missile Defense Program, coupled with changing budget priorities, have resulted in a planned Missile Defense Program that does not clearly match, element for element, the level-of-activity alternatives described above. However, it is still appropriate to continue to evaluate the environmental impacts of each level-of-activity alternative described in this SEIS and to define the proposed action as the Intermediate Level of Activity. In the Record of Decision, the decisionmaker, after reviewing current program needs, budget constraints, and the environmental impacts identified here, may select another level-of-activity alternative, or may select elements from more than one alternative. The environmental impacts of the elements composing the decision documented in the Record of Decision would still closely approximate those of the levels of activity defined in the Final SEIS.

In the second category of proposed actions, two alternatives are analyzed: the continued use of U.S. standards, which is the No-Action Alternative, and the adoption of new environmental standards and procedures, which is the Proposed Action.

The proposed Standards address seven areas of environmental concern: air, water quality and reef protection, drinking water, wildlife (including endangered species), ocean dumping, material and waste management, and cultural resources. The new procedures for administration stress simplification and uniformity, replacing the multiple different permitting requirements now in effect under U.S. regulations with a Document of Environmental Protection (DEP) process for compliance and conflict resolution.

How the proposed Standards derive from the U.S. environmental laws is described in Chapter 2 of this SEIS, Alternatives Considered.

Level-of-Activity Alternatives—Summary of Environmental Impacts and Mitigations

Figure ES-1 summarizes the significant impacts associated with implementing the level-of-activity alternatives. These impacts and their associated mitigations are discussed below. Because level-of-activity alternatives are cumulative, identified significant impacts are generally carried through the High Level-of-Activity Alternative.

Land and Sea Resources. The No-Action Alternative is not expected to have significant impacts on land and sea resource areas.

In the area of freshwater and marine water resources, the only significant impact that is likely to occur could result from an increased risk of untreated sewage discharges from the Kwajalein wastewater treatment plant. The capacity of this plant would be exceeded in the Intermediate and High Level-of-Activity alternatives, but the addition of a clarifier and operational changes could eliminate this risk. Addition of a wastewater treatment plant at Roi-Namur in the Low Level-of-Activity Alternative would have a significant beneficial effect.

Quarrying for material to enlarge Meck, and for shoreline protection at Kwajalein, Illeginni, and Ennugarret under the Intermediate Level-of-Activity Alternative, and Gellinam, Omelek, Legan, and Eniwetak under the High Level-of-Activity Alternative, could result in a significant impact by affecting the integrity of the islands and shoreline configurations if protective measures are not followed for sizing and siting quarries. Criteria for siting and sizing quarries to protect land forms are provided.

Air Quality. No significant air quality impacts were identified under any of the level-of-activity alternatives.

Noise. The proposed Explosive Ordnance Disposal (EOD) pit at Ennugarret under the Intermediate and High Level-of-Activity alternatives would have a significant impact on the hearing of Marshallese people who might be on the island. Because USAKA does not control the entire island, it is possible that Marshallese citizens could be on the island during an explosion. USAKA should consider obtaining control of the entire island by lease or restrictive easement if it proposes to use this island for EOD.

Biological Resources. The native flora and fauna at USAKA have been extensively altered by people. Nonetheless, some relatively undisturbed areas remain and there is a variety of plant and animal life. At Legan, extensive clearing of the island for sensors and the EOD pit under the Intermediate Level-of-Activity Alternative would

ENVIRONMENTAL RESOURCE	LEVEL OF ACTIVITY ALTERNATIVES							
	NO ACTION		LOW LEVEL		INTERMEDIATE LEVEL		HIGH LEVEL	
	Basis for Evaluation		Basis for Evaluation		Basis for Evaluation		Basis for Evaluation	
	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]
Land and Reefs								
Kwajalein, Meck, Illeginni, Ennugarret		N/A		N/A	●	N/A	●	N/A
Omelek, Legan, Gellinam, Eniwetak		N/A		N/A		N/A	●	N/A
Water Resources								
Kwajalein			●	●	●	●	●	●
Roi-Namur			○	○	○	○	○	○
Air Quality								
Noise								
Ennugarret		N/A		N/A	●	N/A	●	N/A
Island Plants and Animals								
Legan					●	●	●	●
Eniwetak							●	●
Marine Biological Resources								
Roi-Namur			○	○	○	○	○	○
Meck					●	●	●	●
Gellinam							●	●
Rare, Threatened and Endangered Species								
Broad Ocean Area			●	●	●	●	●	●
Illeginni					●	●	●	●
Cultural Resources								
Kwajalein	●	●	●	●	●	●	●	●
Roi-Namur	●	●	●	●	●	●	●	●
Meck	●	●	●	●	●	●	●	●
Legan					●	●	●	●
Illeginni					●	●	●	●
Ennugarret					●	●	●	●
Omelek							●	●
Eniwetak							●	●

LEGEND

○ Significant beneficial impact

● Significant adverse impact

Blank No or nonsignificant impact

N/A No USAKA Standard directly applicable

[1] ES = Significance of impacts determined from Existing Statutes and Regulations

[2] USAKA = Significance of impacts determined from Proposed USAKA Environmental Standards and Procedures

Note:
Entry in Resource row means impact is USAKA-wide.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Impacts – Level-of-Activity Alternatives

FIGURE ES-1
p.1

ENVIRONMENTAL RESOURCE	LEVEL OF ACTIVITY ALTERNATIVES							
	NO ACTION		LOW LEVEL		INTERMEDIATE LEVEL		HIGH LEVEL	
	Basis for Evaluation		Basis for Evaluation		Basis for Evaluation		Basis for Evaluation	
	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]
Housing								
Kwajalein	●	N/A	●	N/A	●	N/A	●	N/A
Roi-Namur	●	N/A	●	N/A	●	N/A	●	N/A
Land Use								
Kwajalein		N/A		N/A	●	N/A	●	N/A
Illeginni		N/A		N/A	●	N/A	●	N/A
Ennugarret		N/A		N/A		N/A	●	N/A
Omelek		N/A		N/A		N/A	●	N/A
Legan		N/A		N/A		N/A	●	N/A
Gellinam		N/A		N/A		N/A	●	N/A
Eniwetak								
Income and Fiscal Conditions	○	N/A	○	N/A	○	N/A	○	N/A
Recreation, Education and Public Health								
Kwajalein		N/A	●	N/A	●	N/A	●	N/A
Roi-Namur		N/A	●	N/A	●	N/A	●	N/A
Transportation		N/A		N/A		N/A		N/A
Water Supply								
Wastewater								
Kwajalein					●	●	●	●
Roi-Namur			○	○	○	○	○	○
Solid Waste	●				●	●	●	●
Hazardous Materials		●		●		●		●
Hazardous Waste								
Energy and Fuels		N/A		N/A		N/A		N/A
Aesthetics								
Kwajalein		N/A	●	N/A	●	N/A	●	N/A
Ennugarret		N/A		N/A	●	N/A	●	N/A
Range Safety								
Ennugarret		N/A		N/A	●	N/A	●	N/A
Electromagnetic Radiation		N/A		N/A		N/A		N/A

LEGEND

- ○ Significant beneficial impact
- ● Significant adverse impact
- Blank No or nonsignificant impact
- N/A No USAKA Standard directly applicable

[1] **ES** = Significance of impacts determined from Existing Statutes and Regulations

[2] **USAKA** = Significance of impacts determined from Proposed USAKA Environmental Standards and Procedures

Note:
Entry in Resource row means impact is USAKA-wide.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Impacts – Level-of-Activity Alternatives

FIGURE ES-1
p.2

result in a significant impact by removing a small area of habitat identified as valuable for seabird nesting and coconut crabs. Consideration should be given to moving the planned EOD pit on Legan to another previously disturbed area to avoid a significant impact. At Eniwetak, under the High Level of Activity, removal of *Pisonia* trees that are used by nesting seabirds would have a significant, unmitigable impact.

Two projects that would improve the environmental conditions under the Low Level-of-Activity Alternative are the construction of a wastewater treatment plant with an extension of an existing outfall to deeper water, and the conversion of an existing power plant cooling system to freshwater—both at Roi-Namur. Treated effluent from the treatment plant on Roi-Namur would be discharged deeper in the ocean than at present, and the freshwater conversion would reduce the potential for entrainment and impingement of marine species.

The extension of Meck Island under the Intermediate Level-of-Activity Alternative and a similar extension at Gellinam under the High Level-of-Activity Alternative would have a significant adverse effect on coral, fish, and invertebrates by covering some and destroying the habitat of others. Although the loss of habitat and individuals of some species cannot be avoided, the filling and island extension activities will be designed to allow lagoon flushing and promote coral growth.

An endangered species, the hawksbill turtle, could be harmed under the Intermediate and High Level-of-Activity alternatives if revetment covers a sandy beach at Illeginni. Although the hawksbill turtle has not been observed on Illeginni, comprehensive surveys have not been conducted. The sandy beach appears to be a likely nesting area for the opportunistic hawksbill turtles. If the facilities that need protection cannot be relocated, then USAKA should design alternatives to revetment protection so the beach is not covered.

In the Low Level-of-Activity Alternative, parachutes used to slow the descent of the GSTS payload could entangle protected marine mammals or sea turtles in the Broad Ocean Area as the parachutes sink slowly through upper layers of the ocean. Although the probability of this occurring is remote, the loss of any protected marine mammal or turtle would be a significant impact.

Cultural Resources. Cold War era resources at USAKA (e.g., Sprint and Spartan silos) have not been evaluated to determine if any would be eligible for National Historic Register listing. Construction projects proposed on Roi-Namur and Meck in the No-Action Alternative, and at Illeginni in the Intermediate Level-of-Activity Alternative could affect sites that date from the Cold War. These sites should be evaluated for their historic value. Historic World War II resources on Kwajalein, Roi-Namur, and possibly other islands, are deteriorating as a result of Kwajalein's harsh climate. Under the Low Level of Activity, construction would take place in areas on Kwajalein and Roi-Namur having the potential to contain subsurface cultural resources. Shoreline protection and other construction at Kwajalein and Roi-Namur in the Low Level-of-Activity Alternative and access road construction at Legan in the

Intermediate Level-of-Activity Alternative could affect both historic and prehistoric sites. Construction of the EOD pit on Ennugarret could result in a significant impact to a buried prehistoric site. Shoreline protection and construction of facilities for increased testing could affect historic and prehistoric sites at Legan, Omelek, and Eniwetak under the High Level-of-Activity Alternative. All the cultural impacts can be mitigated by determining if the site is of cultural importance through surveys and field testing. If culturally important sites cannot then be avoided, further investigation and data recovery should be initiated.

Income and Fiscal Conditions. Increased taxes on contractor personnel income paid to the RMI that would result from implementation of the Low through High Level-of-Activity alternatives would yield a significant beneficial impact.

Socioeconomic Conditions. Under the No-Action Alternative, there would be a deficit at Kwajalein of 14 units of family housing and 401 units of unaccompanied housing. At Roi-Namur, there would be a deficit of 49 units of unaccompanied housing. These deficits are considered significant impacts and would increase substantially with the increasing levels of activity. The impacts of the increased population on housing could be alleviated by building more housing using high-rise buildings, subject to height limitations for protection from electromagnetic radiation. USAKA could limit the number of workers with families, but this could adversely affect recruiting. The trailers at Kwajalein could be replaced with high-density apartments, saving valuable land space. Temporary housing such as hotel ships, open barracks, or tents could be used during peak mission periods. Additional recreation facilities may need to be constructed under the Low, Intermediate, and High Level-of-Activity alternatives to serve the larger USAKA population.

Land Use. The siting of a GEP communications facility on Kwajalein in the vicinity of Facility No. 845 could restrict beach use and is considered a significant impact. Consideration should be given to selecting one of the other two Kwajalein sites identified for this facility to avoid this impact.

The proposed fire station in the Intermediate Level-of-Activity Alternative at Illeginni is inconsistent with the use of the adjacent area as a reentry vehicle (RV) land impact zone and is considered a significant impact. Mitigation should include comprehensive analysis to optimize island utilization and to minimize impacts to existing and potential land uses, human activity, and the natural environment.

The existing EOD pit is incompatible with the increased mission activity at Illeginni under this alternative. One option under the Intermediate Level-of-Activity Alternative is to move the EOD activities to Ennugarret, which is also considered a significant impact. That island is only partially controlled by USAKA and has other associated problems with safety and noise that lessen its viability as an EOD site. Legan is also proposed as another option for EOD activities; however, the current use of Legan for sensors and other telemetry-gathering instruments makes it a poor candidate for EOD activities. If Ennugarret must be used, consideration should be given to expanding the area of control to encompass the entire island. If Legan is selected for EOD activities, then the sensor and telemetry facilities must be separated from the EOD pit.

Substantial increases in mission activities would occur under the High Level-of-Activity Alternative at Omelek, Gellinam, Eniwetak, and Legan, which would result in significant impacts. Saturating these islands with mission activities could cause a significant impact on the future uses of the land, especially given the scarcity of land surface available. Comprehensive evaluation of the optimal development of Illeginni, Ennugarret, Omelek, Gellinam, and Eniwetak should be accomplished as a mitigation under these alternatives.

Transportation and Utilities. The wastewater treatment plant at Kwajalein could exceed effluent limits because of increased loads under the Intermediate and High Level-of-Activity alternatives. These impacts could be avoided by adding an additional clarifier and/or an additional blend tank, using facilities aboard ships, or constructing a package wastewater treatment plant. At the High Level-of-Activity Alternative, USAKA should add a blend tank as an aeration basin to increase plant capacity to 1.0 million gallons (3.8 million liters) per day.

Currently, municipal solid waste is open-burned and/or open-dumped at Roi-Namur and Meck. None of these practices meet existing standards for management of solid waste. The practices will cease when the proposed solid waste incinerators are installed under the Low Level-of-Activity Alternative. Incinerators were installed on Kwajalein in October 1993.

Under the Intermediate and High Level-of-Activity alternatives, the management of construction and operations solid waste could become a problem because storing the excess wastes in these categories will occupy limited solid waste landfill space on Kwajalein. Mitigations for the impacts from construction and operations waste include continued waste minimization efforts, and finding alternative uses for scrap metal and used tires. USAKA could ship its solid waste to the mainland United States as a costly alternative.

If the proposed Standards are adopted, the current management of hazardous materials under the level-of-activity alternatives would be assessed as a significant negative impact because the existing hazardous material storage facilities would not meet the more stringent facility and other management controls that would be applied under the proposed Standards.

The current volumes of hazardous waste generated would increase substantially under the Intermediate and High Level-of-Activity Alternatives, but impacts are not predicted to be significant.

Aesthetics. Construction of family housing at Kwajalein under the Low Level-of-Activity Alternative would block the view of the ocean from residential areas to the west. USAKA should consider orienting the houses so a partial view is retained or adding landscaping to provide a new visual amenity. Extensive construction in forested areas at Ennugarret under the Intermediate Level-of-Activity Alternative would degrade the natural environment now enjoyed by Marshallese. The only mitigation for this action would be to site the facilities elsewhere.

Range Safety and Electromagnetic Radiation. Use of Ennugarret for EOD activities under the Low Level-of-Activity Alternative has the potential to affect human safety because USAKA controls only 6 of the 24 acres on the island. If the site of EOD activities cannot be changed, USAKA should obtain sufficient control over the island to preclude risk to Marshallese who may be visiting. There are no unmitigable impacts from electromagnetic radiation (EMR) predicted under any of the alternatives.

Proposed USAKA Standards—Summary of Environmental Impacts and Mitigation

Figure ES-2 summarizes the potential impacts associated with adopting the proposed Standards compared to the No-Action Alternative of retaining existing statutes and regulations for protection of human health and safety and the environment at USAKA. Discussion of these impacts and associated USAKA Environmental Standards and Procedures are described below by resource area.

Procedures. A single set of procedures applies to all sections of the Standards. The procedures establish a single mechanism (the Document of Environmental Protection) to replace the multitude of different permit processes under existing statutes and regulations. The procedures provide a framework for participation by appropriate U.S. agencies and the RMI Environmental Protection Authority (RMIEPA) in review of proposed USAKA activities that have the potential for significant effects on the environment. The procedures also provide oversight and conflict resolution processes involving the appropriate U.S. agencies and the RMIEPA.

Air Quality. The proposed Standards do not automatically require technology controls for emissions; instead, they limit increased emissions to the lower of 80 percent of the ambient air quality standard of a pollutant or 25 percent of the standard added to baseline conditions. By setting a lower limit on allowable concentrations of air pollutants than would be the case under existing statutes and regulations, the proposed Standards would provide a higher level of air quality protection in the long term.

Water Quality. Overall, the proposed Standards provide a higher level of protection of water quality because they incorporate the more stringent requirements of U.S. Trust Territory of the Pacific Islands and RMI regulations.

Endangered Species and Wildlife Resources. The proposed Standards are more protective of wildlife resources because more species are reviewed for potential

ENVIRONMENTAL RESOURCE	STANDARDS ALTERNATIVES	
	NO ACTION: EXISTING STATUTES AND REGULATIONS	PROPOSED ACTION: USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES
Land and Reef [1]		
Water Resources	No Impact	• Overall more protection
Air Quality	No Impact	• Short-term increase in pollutants possible • Long-term better protection because incremental increase is limited
Noise [1]		
Island Plants and Animals	No Impact	• More species are protected
Marine Biological Resources	No Impact	• More species are protected
Rare, Threatened and Endangered Species	No Impact	• DEP process establishes framework of consultation and coordination • Candidate species are protected
Cultural Resources	No Impact	• Similar
Land Use [1]		
Socioeconomic [1]		
Transportation [1]		
Water Supply	No Impact	• Overall more protection
Wastewater	No Impact	• Similar
Solid Waste	No Impact	• Overall more protection
Hazardous Materials	No Impact	•Overall more protection
Hazardous Waste	No Impact	• Overall more protection
Energy and Fuels [1]		
Aesthetics [1]		
Range Safety [1]		
Electromagnetic Radiation [1]		

[1] No USAKA Environmental Standard specifically addresses these resources; associated impacts are addressed by other sections of USAKA standards.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Alternatives – USAKA Environmental Standards And Procedures

FIGURE ES-2

impacts and RMI species are included. In addition to listed species, candidate species under the Endangered Species Act are afforded full protection under the Standards. The Standards provide for coordination with appropriate U.S. agencies and the RMIEPA for a number of other valuable species and habitats.

Cultural Resources. The cultural resources provisions of the proposed Standards are similar to existing requirements, and differences between the two sets of standards are all procedural.

Drinking Water Quality. The drinking water requirements contained in the proposed Standards provide better protection than those under existing standards because the type and frequency of monitoring is based on a population of 10,000 (as opposed to USAKA's population of approximately 3,000, which would require less frequent monitoring under existing U.S. statutes and regulations). In addition, requirements for protection of the lens well system are enhanced under the Materials and Waste Management chapter of the proposed Standards.

Ocean Dumping. The proposed Standards regulate ocean dumping in a manner similar to existing statutes and regulations.

Materials and Waste Management. Overall, the proposed Standards provide a higher level of protectiveness than existing statutes and regulations because more materials are managed and better protection of soil and water can be expected from the proposed Standards.

Contents

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Page

Tables

Contents
(Continued)

Page

Tables (continued)

Contents
(Continued)

Page

Tables (continued)

Contents
(Continued)

Page

Tables (continued)

Contents
(Continued)

Contents
(Continued)

Contents
(Continued)

Page

Figures (continued)

Purpose and Need for the Action

The purpose and need for two actions at USAKA are addressed in this chapter. The first action is to increase the level of testing facilities and support activities; the second action is to adopt and implement new environmental standards and procedures for United States activities there.

1.1 Background

U.S. Army Kwajalein Atoll (USAKA), a subordinate command of the U.S. Army Space and Strategic Defense Command (USASSDC), is located in the Republic of the Marshall Islands (RMI), approximately 2,000 nautical miles (3,706 kilometers) southwest of Hawaii (Figures 1.1-1 and 1.1-2). USAKA consists of all or portions of 11 of the 100 islands that enclose an 1,100-square-mile (2,849-square-kilometer) lagoon, the largest lagoon in the world (Figure 1.1-3).

Since the late 1950s, USAKA has served as a primary site for testing intercontinental ballistic missiles (ICBMs), sea-launched ballistic missiles (SLBMs), and antiballistic missiles (ABMs), and to support a variety of other Department of Defense (DoD) programs. USAKA is one of two national test ranges designated in the 1972 Anti-Ballistic Missile Treaty with the former Soviet Union for conducting field testing of ABM radars, launches, and missiles. The other site recognized in the treaty, White Sands Missile Range in New Mexico, has significant size and safety limitations; consequently, full-scale intercept and system integration testing has been conducted at USAKA and future testing is expected to take place there as well.

In 1983, President Reagan initiated a long-term research and development program to achieve a national goal of eliminating the threat of nuclear ballistic missiles. The Strategic Defense Initiative Organization (SDIO) was established in the Department of Defense for that purpose. Since then, SDIO (now the Ballistic Missile Defense Organization [BMDO]) has sponsored and managed a research and development program, including ground and flight testing facilities, and support activities at USAKA. In 1984, USAKA's mission was further expanded to include sensing and tracking other objects in space, including foreign launches.

In accordance with the National Environmental Policy Act (NEPA), in 1989 USASDC completed an environmental impact statement (EIS) (Draft EIS [DEIS], USASDC, 1989a; Final EIS [FEIS], USASDC, 1989b) to identify and document the impacts of Strategic Defense Initiative (SDI) flight tests and other ongoing activities at USAKA. On December 4, 1989, the Director, SDIO, signed a Record of Decision (ROD) to go forward with SDI tests at USAKA. On December 5, 1989, the Assistant Secretary of the Army for Installation, Logistics, and Environment, signed an ROD allowing the proposed USAKA activities to be implemented and adopting a mitigation plan for their environmental impacts.

1.2 Purpose and Need

Early in 1991, President Bush announced a refocusing of the SDI program, from its early emphasis on defending against mass nuclear attack from a single source, to protection against limited ballistic missile strikes regardless of their source. This program, known as Ballistic Missile Defense (BMD), is designed to protect the United States, its forces overseas, and its allies and friends abroad.

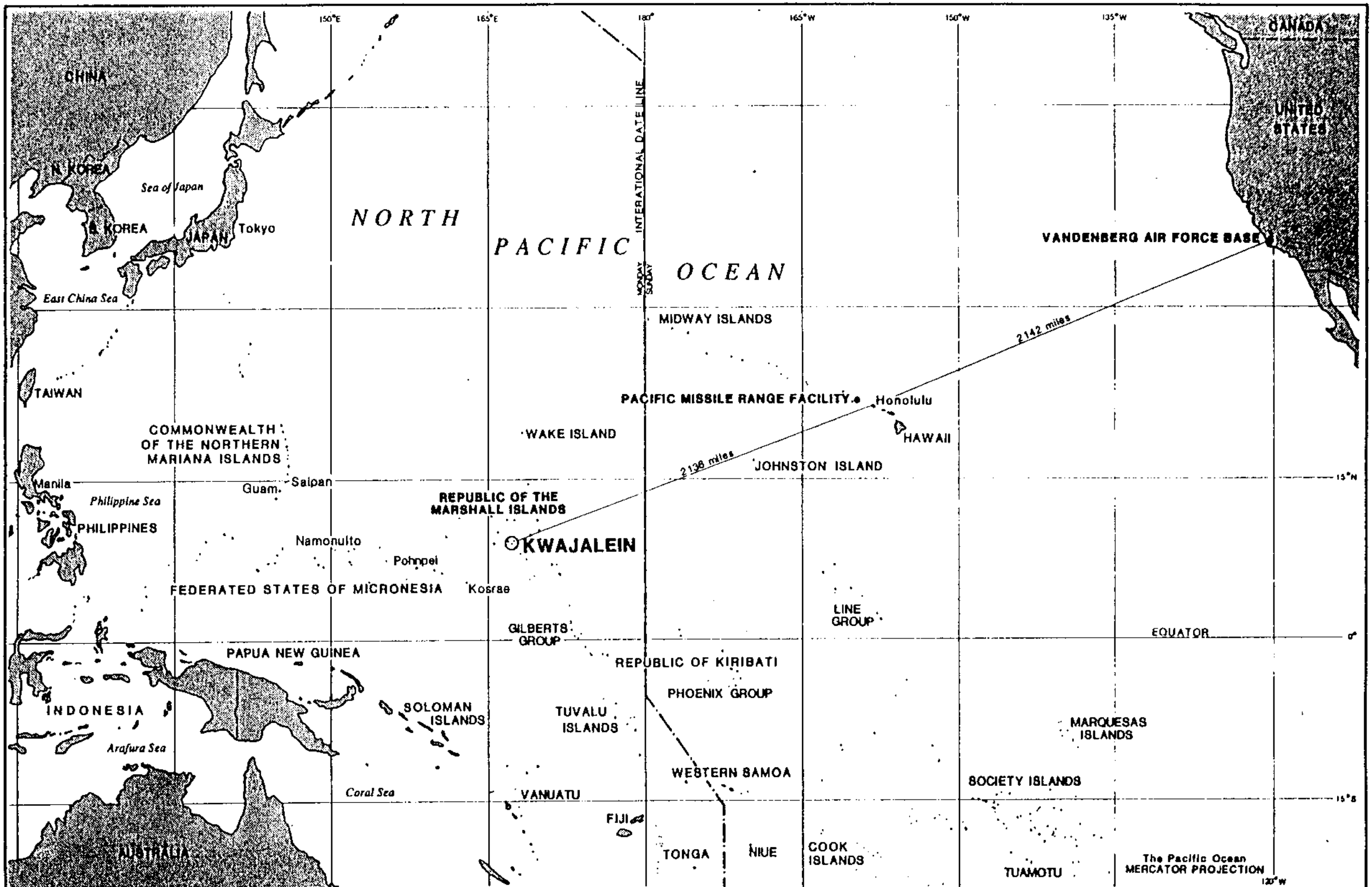
Together with the National Defense Authorization Act for Fiscal Years 1991 and 1992, Congress enacted the Missile Defense Act (MDA) of 1991. As amended in 1992, the MDA has the following goals:

> (1) comply with the ABM Treaty, including any protocol or amendment thereto, and not develop, test, or deploy any ballistic missile defense system, or component thereof, in violation of the treaty, as modified by any protocol or amendment thereto, while deploying an anti-ballistic missile system that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles;
>
> (2) maintain strategic stability; and
>
> (3) provide highly effective theater missile defenses (TMDs) to forward-deployed and expeditionary elements of the Armed Forces of the United States and to friends and allies of the United States.

To implement these goals, the MDA directs the Secretary of Defense to:

> (1) develop advanced theater missile defense systems for deployment.
>
> (2) develop for deployment a cost-effective, operationally effective, and ABM Treaty-compliant antiballistic missile system at a single site as the initial step toward deployment of an antiballistic missile system. . . designed to protect the United States against limited ballistic missile threats, including accidental or unauthorized launches or Third World attacks. . .

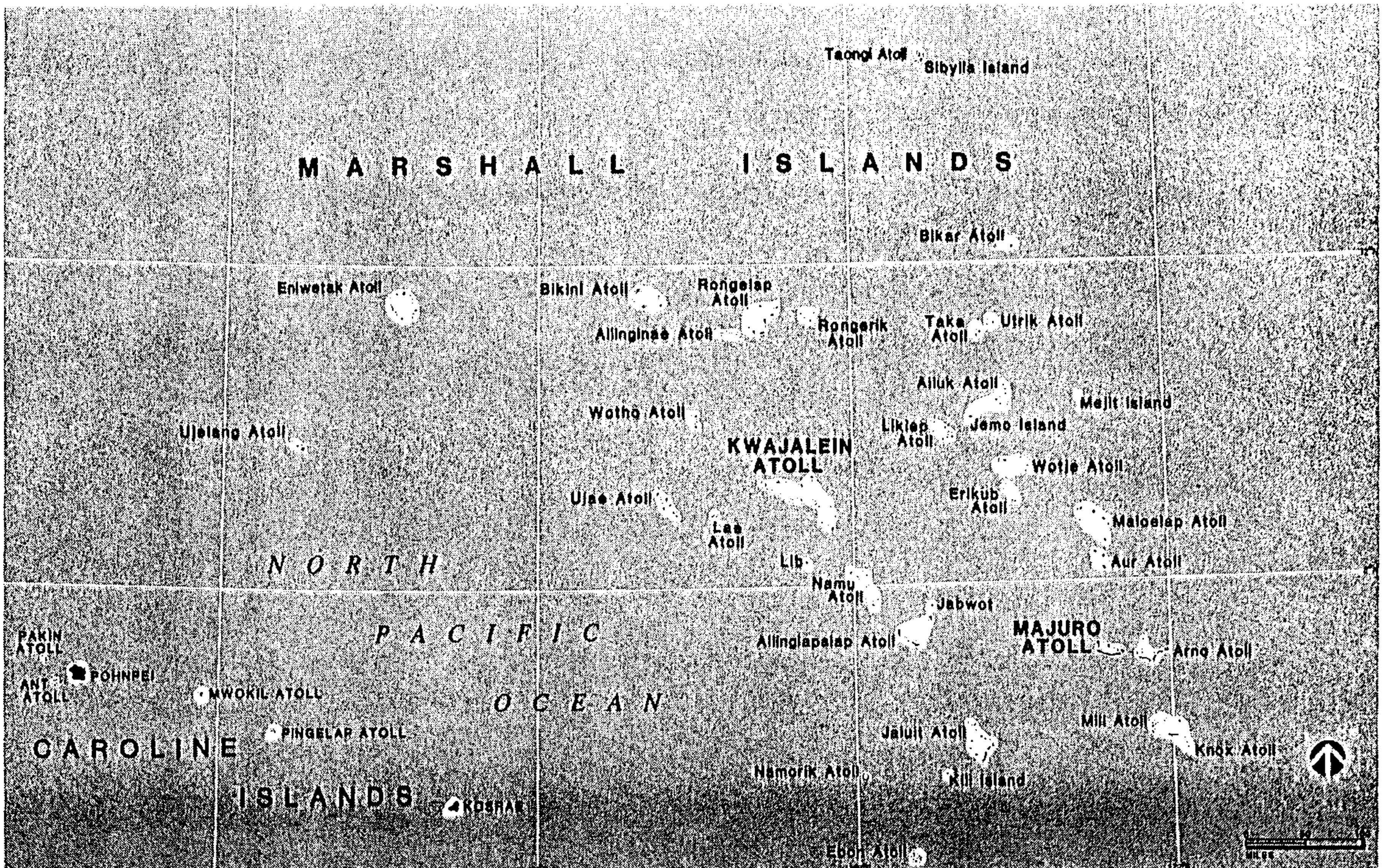
The FY 1993 Defense Authorization Conference Report stated that the development program should be structured with the objective of deploying "by the earliest date



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

North Pacific Ocean

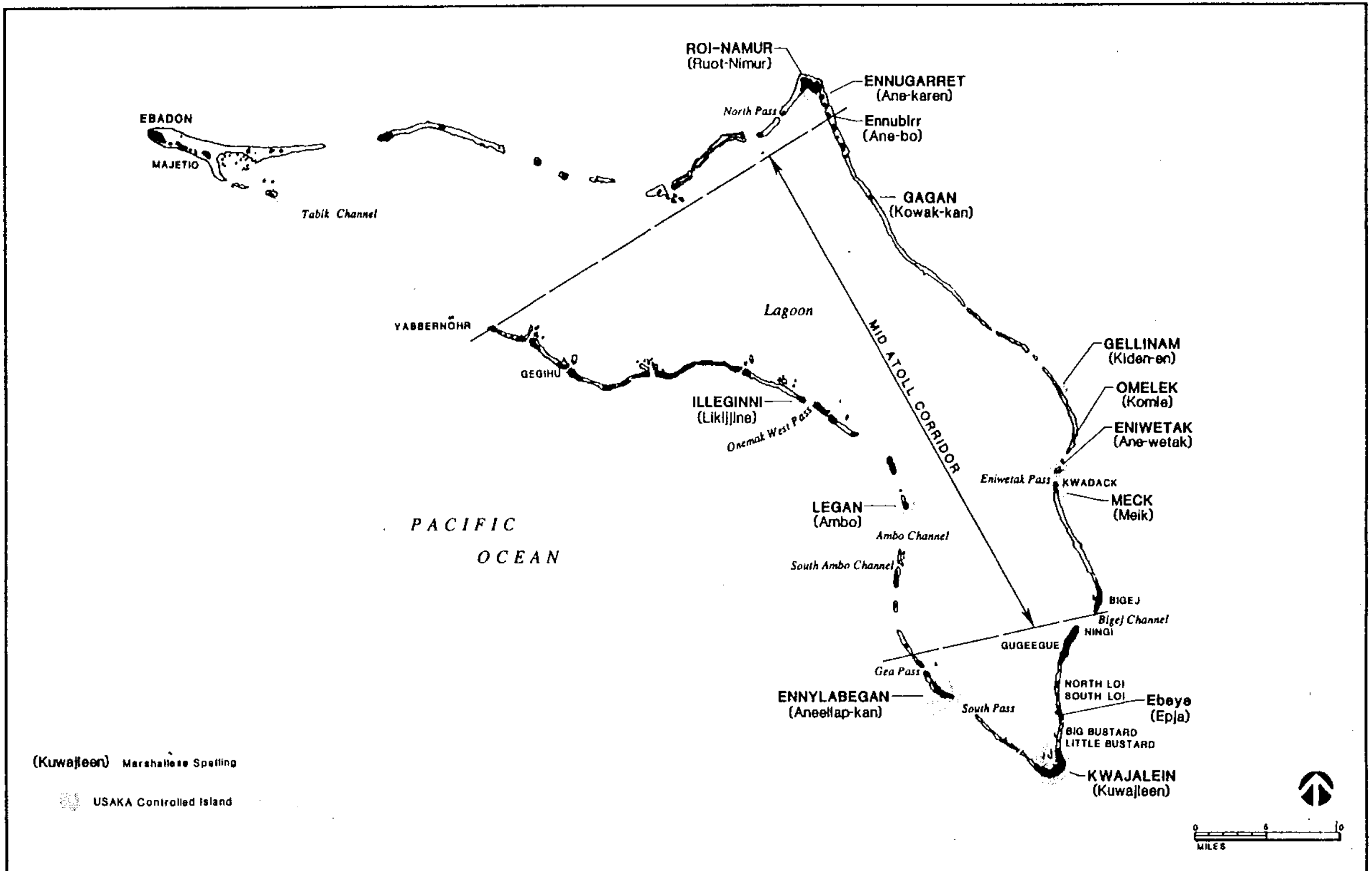
FIGURE 1.1-1



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Republic of the Marshall Islands

FIGURE 1.1-2



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Kwajalein Atoll

FIGURE 1.1-3

allowed by the availability of the appropriate technology and the completion of adequate integrated testing of all system components."

To validate the effectiveness of the technology being pursued for TMD and NMD, System Integration Tests (SITs) will be conducted. SITs are live launch tests to verify the capabilities of TMD and national missile defense (NMD) systems to detect, evaluate, track, and intercept ballistic missile launches. The SITs are essential to confirm the effectiveness of systems as they are developed and to demonstrate convincingly their readiness for deployment. Other tests involving launches from USAKA and/or incoming reentry vehicles will need to be conducted, bringing additional program and support personnel to USAKA.

A second proposed action is the adoption, implementation, and promulgation of environmental standards and procedures that are more appropriate to the particular environment at USAKA, replacing, in part, the U.S. environmental standards that currently apply at USAKA. This need was recognized in the Compact of Free Association (Compact) between the Republic of the Marshall Islands and the United States, which declares that it is the policy of the two nations to "promote efforts to prevent or eliminate damage to the environment and biosphere and to enrich understanding of the natural resources of the Marshall Islands...." (Title One, Article VI, Section 161). Section 161 delineates an environmental framework for adoption, implementation, and promulgation of standards for U.S. actions at USAKA. The Compact also directs that the standards reflect the "special governmental relationship" between the two nations.

In consultation with environmental agencies of the RMI and United States, the proposed USAKA Environmental Standards and Procedures (the Standards) were developed to replace U.S. statutes and regulations that govern U.S. actions at USAKA. The Standards protect human health and safety and the environment of USAKA and simplify many of the procedural aspects of existing statutes and regulations as appropriate to the particular environment of USAKA and the special relationship between the two governments.

In summary, this Supplemental EIS (SEIS) supplements the 1989 Draft and Final EIS by analyzing additional levels of testing and related activities that are proposed at USAKA, and assesses potential impacts from the adoption and implementation of the USAKA Environmental Standards and Procedures.

1.3 Scope of the SEIS

This SEIS examines the environmental effects of increasing the levels of testing and related activities and of implementing new environmental standards and procedures at USAKA (impacts at locations other than USAKA are addressed in other NEPA documents). The scope of this SEIS includes the impacts of continuing the current levels of testing and the current environmental standards as baseline conditions. It is a programmatic analysis of USAKA activities that addresses individual and cumulative impacts of many actions, some of which are known only in broad outline. In the ROD for this SEIS, the decision-maker, after reviewing program needs and the potential environmental impacts identified in this SEIS, may select elements from more than one alternative. For some actions that are evaluated in this SEIS, more detailed NEPA analyses may be required in the future to fulfill NEPA review requirements.

1.4 Changes in the Final SEIS

The Draft SEIS was released for public review on April 30, 1993. Comments received by letter or in the three public hearings held in the Marshall Islands were used to revise and update data and analyses in the Final SEIS. Comments and responses are included in Volume 2 of the Final SEIS.

The Final SEIS incorporates a few changes to the activities analyzed in the Draft SEIS that have occurred as program plans have developed in more detail. For example, the GEP communications facility is now proposed to be located on Kwajalein and Roi-Namur, rather than on Meck; the TMD-GBR portable radar would be used on several additional USAKA islands. In addition, the Final SEIS includes new information about shoreline protection alternatives, quarrying impacts, and commercial purchase of aggregate as an alternative to quarrying at Kwajalein (Section 4.2); additional analysis of lead emissions from launches of sounding rockets (Section 4.4); information about commercial fishing at Kwajalein (Sections 3.7 and 4.7); and expanded discussions of flight safety procedures (Section 4.15) and the GBR-T and TMD-GBR radars (Section 4.16). The analysis of wastewater requirements at Kwajalein (Section 4.13) has been revised based on new information about per capita wastewater flows at Kwajalein.

The Final SEIS also reflects revisions to the proposed USAKA Standards and Procedures developed by the Standards Project Team; these revisions principally affect the Procedures, Water Quality and Reef Protection, Endangered Species and Wildlife Protection, Cultural Resources, and Materials and Waste Management sections of the Standards.

1.5 Related Environmental Documentation

Previously completed NEPA documents, in addition to the 1989 USAKA EIS, include the following:

> *Environmental Assessment* and *Supplemental Environmental Assessment, Lightweight Exoatmospheric Projectile (LEAP) Test Program*

Alternatives Considered

Two Proposed Actions are addressed in this Supplemental Environmental Impact Statement (SEIS). The first Proposed Action would increase the level of testing activities at USAKA. Three alternative levels of increased activity are evaluated–low, intermediate, and high–in addition to No Action. The Proposed Action is the Intermediate Level of Activity. The No-Action Alternative consists of Ballistic Missile Defense (BMD) and other test activities that made up the Proposed Action of the 1989 USAKA EIS, as confirmed in the December 1989 Records of Decision (ROD).

The second Proposed Action is the adoption, implementation, and promulgation of new environmental standards and procedures for U.S. government activities at USAKA (*Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands* [the Standards]), as provided for by the Compact of Free Association (Compact) between the Republic of the Marshall Islands (RMI) and the United States. The No-Action Alternative to the second Proposed Action is the continuing application of the U.S. statutes and regulations to activities at USAKA.

2.1 Levels of Activity

The first Proposed Action involves the level of testing and related range support and base operations activities that would occur at USAKA in the future. For this SEIS, the Intermediate Level of Activity is the Proposed Action. The following alternatives are analyzed.

- No Action
- Low Level of Activity
- Proposed Action: Intermediate Level of Activity
- High Level of Activity

Each of these alternatives is discussed below and the principal elements of each are identified in Table 2.1-1 and in figures later in this chapter. In these figures, new facilities proposed under each alternative are shown in bold type; facilities constructed in preceding alternatives are shown in gray type.

Table 2.1-1
Summary of Level-of-Activity Alternatives

Feature	No Action	Low Level of Activity	Intermediate Level of Activity (Proposed Action)	High Level of Activity
Launches	**See Section 2.1.1.1** • ERIS Launch Program (Meck) • Meteorological rocket launches (primarily Kwajalein; Omelek and Roi-Namur also have meteorological rocket launch facilities) • Sounding rockets (Roi-Namur) • GSTS launch facility constructed (Omelek) • Up to 84 launches annually of all types (met rockets, sounding rockets, and strategic launch vehicles)	**See Section 2.1.2.1** • All of the No-Action Alternative launch programs • Construction of a new rail launch facility (Meck) • Single launch System Integration Tests (SITs) and other single launches (Meck, Omelek) • Up to 104 launches annually of all types	**See Section 2.1.3.1** • All of the No-Action Alternative launch programs • All of the Low Level-of-Activity Alternative launch programs • Expansion of Meck Island for new launch facilities, or extensive renovation of unused launch facilities and construction of new support facilities at Illeginni • Destruction of one existing unused silo on Meck or Illeginni for each new launcher constructed • Significant increase in launches to support multiple-launch SITs (Meck, Omelek, and Illeginni) with simultaneous tracking by multiple ground and/or space sensors, and for Theater Missile Defense (TMD) testing • Up to 140 launches annually of all types	**See Section 2.1.4.1** • All of the No-Action Alternative launch programs • All of the Low Level-of-Activity Alternative launch programs • All of the Intermediate Level-of-Activity Alternative launch programs (except Omelek rail-launch facility) • Construction of new launch facilities (Eniwetak and Omelek) • Installation of controls for remote launches (Meck) • Meteorological rocket launches and associated support facilities (Gellinam) • Complex multiple launch SITs (Illeginni, Eniwetak, Omelek, Meck) • Up to 172 launches annually of all types

Table 2.1-1
Summary of Level-of-Activity Alternatives

Feature	No Action	Low Level of Activity	Intermediate Level of Activity (Proposed Action)	High Level of Activity
Sensing and Tracking	**See Section 2.1.1.2** • Continued operation of: - KREMS (Roi-Namur) and other radars (Kwajalein, Gellinam, and Legan) - Optical sensors on eight islands - Telemetry equipment on five islands - Acoustic equipment on one island • Installation of GBR-X (Kwajalein) • Sensing and tracking activities in support of several RV test programs, including: AST; ARE; COBRA EYE; EDX; ERPA; HALO/IRIS; MSX; MM I, II, and III; PK-0T; TRIDENT, and STARS	**See Section 2.1.2.2** • All of the No-Action Alternative sensing and tracking programs • Installation of fiber optics communication system linking Ennylabegan and Meck • Construction and operation of the GBR-T on Building 1500 (in place of GBR-X) (Kwajalein)	**See Section 2.1.3.2** • All of the No-Action Alternative sensing and tracking programs • All of the Low Level-of-Activity Alternative sensing and tracking programs • Replacement/renovation of existing SDRs (Legan and Gellinam) • Construction and operation of a new SDR facility and replacement/renovation of existing HITS system (Gagan) • Deployment of USNS Redstone and USS Observation Island to Kwajalein with associated support facilities for docking, loading/unloading, and office space for liaison personnel • Construction and operation at Kwajalein of Command and Control Center • Construction and operation of Ground Entry Point communications facility (Kwajalein and/or Roi-Namur) • Portable TMD-GBR at Meck, Illeginni, Omelek, Gellinam, Gagan, and/or Legan	**See Section 2.1.4.2** • All of the No-Action Alternative sensing and tracking programs • All of the Low Level-of-Activity Alternative sensing and tracking programs • All of the Intermediate Level-of-Activity Alternative sensing and tracking programs • Installation of major new sensing and tracking equipment and associated support facilities (Gagan) • Installation of supplemental sensing and tracking equipment and associated support facilities (Ennylabegan, Legan, Meck, Gellinam, Eniwetak) • Installation of fiber optics communication system linking Kwajalein and Wake Island

Table 2.1-1
Summary of Level-of-Activity Alternatives

Feature	No Action	Low Level of Activity	Intermediate Level of Activity (Proposed Action)	High Level of Activity
Range Support and Base Operations	**See Section 2.1.1.3** • Intra-Atoll communications facilities linking 10 islands • Meteorological facilities (Kwajalein, Roi-Namur, and Omelek) • Range Safety Center (Kwajalein) • Reentry vehicle search and recovery capabilities are provided by scuba divers, a two-man submarine, and a remotely operated submersible • Other support facilities located on Kwajalein include: - Range operations control center - Photographic laboratory - Mobile frequency control and analysis unit - Calibration laboratory - Timing and range countdown system - Specialized computer facilities • Base operations include the following: - Transportation (air, marine, land) - Utilities (electricity, water, sewer, and sanitary solid waste)	**See Section 2.1.2.3** • All of the No-Action Alternative range support and base operations programs • Island facility construction, renovation, or installation as follows: - Kwajalein—Housing, physical security building, religious education facility, solid waste incinerator, corrosion prevention building, child development center, hospital addition/alteration, three warehouses, shoreline protection, hazardous materials storage building, and fuel tank containment upgrade - Roi-Namur—Power plant, fuel tank containment upgrade, saltwater intake, wastewater treatment plant and outfall, solid waste incinerator, and shoreline protection - Meck—Power plant expansion, fuel tank containment upgrade, fiber optics cable installation, solid waste incinerator, and shoreline protection - Ennylabegan—Fiber optics cable installation, fuel tank replacement, harbor dredging	**See Section 2.1.3.3** • All of the No-Action Alternative range support and base operations programs • All of the Low Level-of-Activity Alternative range support and base operations programs Illeginni facilities construction, renovation, or installation, as follows: - Building demolition, launch facilities, mess hall, physical security building, sand blast area/paint shed, fire station, power plant and power/fuel distribution upgrade, wastewater treatment system renovation or replacement, transportation terminal expansion, marine facilities upgrade • Evaluation of alternative locations for EOD activities: Illeginni, Legan, and Ennugarret • Construction of vehicle storage facility (Meck) • Quarrying and dredging as needed for shoreline protection and construction projects (Kwajalein, Meck, Legan, Illeginni, Gellinam, and Eniwetak, and potentially Ennugarret, Legan, and Ennylabegan)	**See Section 2.1.4.3** • All of the No-Action Alternative range support and base operations programs • All of the Low Level-of-Activity Alternative range support and base operations programs • All of the Intermediate Level-of-Activity Alternative range support and base operations programs • Island facility construction, renovation, or installation as follows: - Omelek—Power plant, fuel tank, harbor fuel ramp, and building demolition - Legan—Generator building and fuel tank and portable latrine - Gagan—Personnel shelter, generator building and fuel tank, portable latrine - Gellinam—Generator and fuel storage expansion, helicopter pad relocation, land surface expansion through fill operations

Table 2.1-1
Summary of Level-of-Activity Alternatives

Feature	No Action	Low Level of Activity	Intermediate Level of Activity (Proposed Action)	High Level of Activity
Range Support and Base Operations (continued)	- Housing - Community support - Fire protection - Security - Supplies and storage - Maintenance and repair • New Power Plant 1B and desalination plant; community support building; document control facility (Kwajalein)	- Legan—widen and deepen harbor; add breakwater and marine ramp; fuel tank containment upgrade - Illeginni—Fuel tank containment upgrade; widen harbor entrance - Omelek—Fuel tank containment upgrade; shoreline protection - Gellinam—Fuel tank containment upgrade; shoreline protection - Eniwetak—Fuel tank replacement, shoreline protection • Quarrying and dredging as needed for shoreline protection and construction projects (Kwajalein, Roi-Namur, Meck, Omelek, Gellinam, and Eniwetak)		- Eniwetak—Generator building and fuel tank, fuel ramp, potable water storage, sanitary sewage facilities, security fencing, warehouse, guardhouse, technical support building with mess hall • Quarrying and dredging as needed for shoreline protection and construction projects (Kwajalein, Roi-Namur, Meck, Omelek, Ennylabegan, Legan, Illeginni, Gagan, Gellinam, Eniwetak, and Ennugarret)
Employment and Population	• Peak-year USAKA nonindigenous population: Operations employees 1,725 Family members 1,375 Average visitor count 100 Subtotal 3,200 Construction workers 50 Total 3,250	• Peak-year USAKA nonindigenous population: Operations employees 2,100 Family members 1,600 Average visitor count 100 Subtotal 3,800 Construction workers 25 Total 3,825	• Peak-year USAKA nonindigenous population: Operations employees 3,100 Family members 1,600 Average visitor count 175 Subtotal 4,875 Construction workers 50 Total 4,925	• Peak-year USAKA nonindigenous population: Operations employees 3,400 Family members 1,600 Average visitor count 300 Subtotal 5,300 Construction workers 100 Total 5,400

It should be recognized that the Low, Intermediate, and High Levels of Activity are identified and analyzed to facilitate NEPA review. Given the number and range of individual elements of missile testing activities at USAKA, and related infrastructure and facility requirements, it would be impossible to meaningfully analyze each possible combination of these elements or to accurately assign each possible action at USAKA to a specific level of activity. This SEIS defines alternatives in terms of levels of activity to facilitate the analysis of a realistic range of activities and impacts, and to help both the decision-maker and the interested public to understand and evaluate potential new activities at USAKA.

Since the release of the Draft SEIS, additional changes in the overall Missile Defense Program, coupled with changing budget priorities, have resulted in a planned Missile Defense Program that does not clearly match, element for element, the level-of-activity alternatives described below. However, it is still appropriate to continue to evaluate the environmental impacts of each level-of-activity alternative described in this SEIS and to define the proposed action as the Intermediate Level of Activity. In the Record of Decision, the decisionmaker, after reviewing current program needs, budget constraints, and the environmental impacts identified here, may select another level-of-activity alternative, or may select elements from more than one alternative. The environmental impacts of the elements composing the decision documented in the Record of Decision would still closely approximate those of the levels of activity defined in the Final SEIS.

2.1.1 No-Action Alternative

This section supplements Section 2.2 of the 1989 USAKA Draft Environmental Impact Statement (DEIS). The No-Action Alternative is the continuation of existing test programs, and operation of the technical and logistical facilities and ongoing activities that support them, as summarized in Table 2.1-2. More specifically, this alternative encompasses the activities that were defined in the No-Action Alternative for the 1989 EIS and all the activities of the 1989 EIS Proposed Action. The No-Action Alternative evaluated in the 1989 EIS consisted of a lower level of activity than that proposed in the 1989 EIS and adopted in its Record of Decision. Therefore, the 1989 EIS evaluated a level of activity lower than that associated with current testing programs at USAKA. A reduced level-of-activity alternative is not reevaluated in this SEIS.

The Record of Decision on the 1989 USAKA EIS committed the Ballistic Missile Defense Organization (BMDO) and the U.S. Army to implement the mitigations incorporated into the ROD and the 1989 Final EIS (FEIS). These mitigations were described and a program for their implementation identified in the *USAKA Environmental Mitigation Plan* (USASDC, 1989c). Since 1989, most of the elements of the Mitigation Plan have been initiated and many have been completed. The status of the USAKA Environmental Mitigation Plan is described in Appendix A.

Table 2.1-2
Summary of Programs, Facilities, and Support Activities in the No-Action Alternative

Launches	Sensing and Tracking	Range Support
HAVE-JEEP sounding rockets; meteorological rockets; ERIS; GSTS; Aries I and II; Black Brant 9 and 10; Strypi IX; Talos-Aries I	Minuteman I, II, and III; Peacekeeper; ERPA; Trident; small ICBM; ARE; AST (formerly AOA); EDX; GBR-X; HALO/IRIS; MSX; OAMP; STARS	Missile transportation, storage, and assembly; range safety; KREMS complex; other radars; optical sensing; telemetry; HITS; communications; meteorological support; reentry vehicle search and recovery system; technical range support
Base Operations	**Construction**	**Population**
Air, water, ground transportation; electricity; water; sewer and sanitary facilities; solid waste; fire protection; security services; housing; community support; supplies and storage; maintenance and repair	Power Plant 1B; desalination plant; document control facility; GBR-X on Kwajalein; GSTS on Omelek; other minor construction/rehabilitation	Peak year nonindigenous population level related to testing activities: 3,250

The No-Action Alternative for this SEIS is based on continued implementation of the Mitigation Plan, except for those elements that are no longer considered necessary or applicable. Where activities under the Mitigation Plan have the potential to affect the environment significantly, the Mitigation Plan activity is described in the Low Level-of-Activity Alternative.

The following provides a summary description of the types of activities that would continue to occur at USAKA under the No-Action Alternative. Subsection 2.1.1.5 identifies specific facilities at each of the 11 USAKA islands, and also identifies the elements of the Proposed Action from the 1989 EIS that have been, or will be, completed in addition to those that are no longer planned. A detailed description of the No-Action Alternative is presented as the Proposed Action in the 1989 EIS.

2.1.1.1 Launch Programs

The following information updates and supplements Subsections 2.2.1 and 2.3.1 of the 1989 DEIS.

Three types of rockets are launched at USAKA—meteorological rockets, sounding rockets, and strategic launch vehicles (SLVs). For the purposes of analysis in this SEIS, SLVs also include missiles used for testing Theater Missile Defense programs. A fourth type of rocket, which is the largest—a heavy multistage launch vehicle—is not launched from USAKA; this class of rocket includes Titan, Atlas, and the Space Shuttle.

In the following section, the three types of rockets that are launched at USAKA are described generically. For each type of rocket, a number of representative flight test programs and rocket motors are described. However, these are only representative programs and motors, derived from activities performed at USAKA in the past, currently being performed, or reasonably anticipated in the future. If a future flight test program falls within the parameters described below and is subsequently analyzed in this SEIS, it would not require subsequent NEPA analysis and documentation. If a flight test program's performance, technical, or test characteristics lead to environmental impacts that fall outside the range of impacts described for rockets and test flights in this SEIS, it would require additional environmental analysis and documentation for compliance with NEPA.

Meteorological rockets ("met rockets"), which are launched from Kwajalein, Omelek, and Roi-Namur, are solid-fueled, single-stage rockets that carry a specially designed probe into the atmosphere to collect data on wind speeds and atmospheric weather conditions. There are up to 24 met rocket launches per year at each of the three sites. Sounding rockets are single or multistage vehicles that attain exoatmospheric heights but do not achieve orbital velocities or trajectories. They are used to test tracking sensors such as radars or infrared sensors and to conduct experiments in the vacuum or microgravity environments at the outer edges of the atmosphere. Sounding rockets are launched from Roi-Namur up to eight times per year.

A number of different rocket motors are used in combination as sounding rockets. Pertinent characteristics of rocket motors are shown in Table 2.1-3. Representative combinations are shown in Table 2.1-4.

SLVs are typically high-performance, multistage missiles used at USAKA to launch payloads for testing and evaluation or to intercept payloads launched from Vandenberg Air Force Base (VAFB), Pacific Missile Range Facility (PMRF), or Wake Island. SLVs are typically two-stage missiles that use solid propellant fuel in the first and second stage motors. The payload uses either solid or liquid propellants. The combinations of the rocket motors used in SLVs are shown in Table 2.1-5; pertinent characteristics of each rocket motor are described in Table 2.1-3.

Examples of programs that have launched SLVs from USAKA in the past include the Spartan and Sprint missiles launched from Meck and Illeginni in the 1960s and 1970s; the Homing Overlay Experiment Program missiles launched from Meck in the 1980s; and Exoatmospheric Reentry-Vehicle Interceptor Subsystem (ERIS), which launched missiles from Meck from 1990 through 1992. Another program that may launch SLVs from USAKA facilities is the Ground-Based Surveillance and Tracking System (GSTS). Other SLV launches such as the Ground-Based Interceptor (GBI), Light-weight Exoatmospheric Projectile (LEAP), Brilliant Pebbles (BP), and Exo-

Table 2.1-3
Characteristics of Representative Rocket Motors at USAKA

Page 1 of 3

Motor Name	Propellant Weight (lb)	Nominal Burn Time (sec)	Propellant Constituents	Major Exhaust Gas Constituents
SR-19[1]	54,100	56	Ammonium perchlorate Polyurethane binder Aluminum	CO_2, CO, H_2O, HCl, Al_2O_3, N_2, NO_x
M55A1	45,100	62	Ammonium perchlorate Polyurethane binder Aluminum	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
M56A1	10,371	61.3	Ammonium perchlorate Polyurethane binder Aluminum	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
Castor I	7,317	27.4	Ammonium perchlorate Polybutadiene binder Aluminum	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
M57A1	3,665	59	Ammonium perchlorate HMX Nitrocellulose Nitroglycerine Aluminum	CO_2, CO, H_2O, HCl, Al_2O_3, NO_x
Talos (X251C1)	2,803	5.4	Nitrocellulose Nitroglycerin	CO_2, CO, H_2O, H_2, N_2, Pb
Antares II	2,565	26.5	Ammonium perchlorate Nitrocellulose Nitroglycerine HMX Aluminum	CO_2, CO, N_2, H_2, HCl, Al_2O_3, NO_x

Table 2.1-3
Characteristics of Representative Rocket Motors at USAKA

Motor Name	Propellant Weight (lb)	Nominal Burn Time (sec)	Propellant Constituents	Major Exhaust Gas Constituents
Black Brant VB	2,198	32	Ammonium perchlorate Polyurethane binder Aluminum	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
Patriot	1,200	Less than 16 seconds	Aluminized hydroxyl terminated polybutadiene binder	CO_2, CO, H_2O, HCl, $N_2Al_2O_3$, NO_x
Terrier (X256A1)	1,200	4.4	Nitrocellulose Nitroglycerin Triacetin	CO_2, CO, H_2O, H_2, N_2, Al_2O_3, Pb, NO_x
THAAD	Less than 990	Less than 16 seconds	Hydroxyl terminated polybutadiene binder Aluminum Ammonium perchlorate	CO_2, CO, H_2O, HCl, N_2, NO_x
Orbus 1	912	39	Ammonium perchlorate Aluminum HMX Hydroxyl terminated polybutadiene binder	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
Nike Hercules M88/X216A2	750	3	Nitrocellulose Nitroglycerin	CO_2, CO, H_2O, H_2, N_2, Pb, NO_x
NIHKA	692	18.6	Ammonium perchlorate Aluminum Hydroxyl terminated polybutadiene binder	CO_2, CO, H_2O, HCl, N_2, Al_2O_3, NO_x
ERINT	360	N/A	Arcadene 451/452	Al_2O_3, CO, CO_2, HCl

Table 2.1-3
Characteristics of Representative Rocket Motors at USAKA

Motor Name	Propellant Weight (lb)	Nominal Burn Time (sec)	Propellant Constituents	Major Exhaust Gas Constituents
Viper III	57	2	Ammonium perchlorate Polysulfide binder Aluminum	CO_2, CO, H_2O, SO_2, HCl, N_2, Al_2O_3, NO_x
Super Loki	37.5	2	Ammonium perchlorate Polysulfide binder Aluminum	CO_2, CO, H_2O, SO_2, HCl, N_2, Al_2O_3, NO_x
Loki II	18.1	2	Ammonium perchlorate Polysulfide binder Aluminum	CO_2, CO, H_2O, SO_2, HCl, N_2, Al_2O_3, NO_x
Corps SAM	Unknown	Unknown	Solid fuel to be developed	Unknown
Liquid fuel motor	Variable	Variable	Nitrogen tetroxide Hydrazine Methyl hydrazine	H_2O, CO_2, CO, N_2, NO_x
Liquid propellant motor[1]	Variable	Variable	Chlorine pentafluoride Hydrazine Methyl hydrazine	HCl, HF, CO_2, CO, N_2, NO_x

[1]SR-19 and liquid motors using chlorine pentafluoride as an oxidizer have not been launched from USAKA and are assessed in the Low Level-of-Activity Alternative.
Source: SDIO/TNE, 1992
Chemical Propulsion Information Agency/Johns Hopkins University Applied Physics Laboratory, 1979.

Endoatmospheric Interceptor (E^2I) would be associated with Systems Integration Tests or other elements of testing for the Ballistic Missile Defense (BMD) program.

Table 2.1-4 Representative Sounding Rockets at USAKA			
Launch Vehicle	First-Stage Rocket Motor	Second-Stage Rocket Motor	Third-Stage Rocket Motor
Aries I/II	M56A1	(II only) M57A1	NA
Black Brant 9	Terrier	Black Brant VB	NA
Black Brant 10	Terrier	Black Brant VB	NIHKA
HAVE-JEEP	Hercules, Talos, or Sergeant	M56A1	M57A1
Strypi IX	Castor I	Antares II	NA
Talos-Aries I	Talos	M56A1	NA
Source: SDIO/TNE, 1992 Chemical Propulsion Information Agency, 1979			

Solid Propellants

The rocket motors that use solid propellants contain three basic types of mixtures to provide thrust to the launch vehicles. These are:

- Ammonium perchlorate (NH_4ClO_4) as the oxidizer, and aluminum metal and plastic binder as the fuel
- Nitrocellulose/nitroglycerine double-base propellant with the fuel and oxidizer combined (also used in small arms ammunition as the powder in cartridges)
- Mixtures of the substances listed above

When these motors are ignited, the oxidizer and the fuel react chemically to produce hot, light gases that are expelled from the nozzle(s) of the rocket causing the missile to accelerate.

The first two basic types of solid propellants have been blended in various mixtures to produce rocket propellants with specific properties of thrust, temperature, and burning rate to serve particular applications.

Liquid Propellants

Liquid propellants are also mixtures of oxidizers and fuel that react when combined and ignited to form light, hot gases that are then expelled through nozzles to accelerate the launch vehicles. The mixtures used at USAKA typically include nitrogen tetroxide (N_2O_4) (oxidizer) with hydrazine/methyl hydrazine (N_2H_4,(CH_3) N_2H_3) (fuel).

Table 2.1-5
Representative Strategic and Theater Missile Defense Launch Vehicles at USAKA

Launch Vehicle	First-Stage Rocket Motor	Second-Stage Rocket Motor	Payload
Aries II[1]	M56A1	M57A1	NA
ERIS[1]	M56A1	M57A1	NA
GSTS[1]	SR-19 or extended Pegasus (first stage)	N/A	NA
LEAP[2]	M56A1	M57A1	Liquid fuel (N_2O_4 or ClF_5 with N_2H_4/[(CH_3)N_2H_3]
GBI[2]	Not yet determined	Not yet determined	Liquid fuel (N_2O_4 or ClF_5 with N_2H_4/[(CH_3)N_2H_3]
BP[2]	M56A1	M57A1	Liquid fuel (N_2O_4 or ClF_5 with N_2H_4/[(CH_3)N_2H_3]
E[2]I[2]	Not yet determined	Not yet determined	Liquid fuel (N_2O_4 or ClF_5 with N_2H_4/[(CH_3)N_2H_3]
THAAD[3]	THAAD	None	Liquid fuel
Patriot[3]	Patriot	None	None
ERINT[3]	ERINT	None	None
Corps SAM[3]	Corps SAM	None	None

[1]Included in the No-Action Alternative.
[2]Included in the Low Level-of-Activity Alternative.
[3]Included in Intermediate Level of Activity.
Source: SDIO/TNE, 1992
Chemical Propulsion Information Agency, 1979.

The fuels and oxidizers are stored separately, loaded into separate tanks in the rocket motor, and then pumped together where they ignite in a combustión chamber in a controlled manner. Launch vehicles at USAKA use liquid propellants only in the payload stage of specific missiles. Exhaust gas constituents are shown in Table 2.1-3.

Chlorine-pentafluoride Handling

Chlorine-pentafluoride (ClF_5) is proposed to be used as part of the fuel system for payloads in missiles. The following discussion has been adapted from the *Supplemental Environmental Assessment, LEAP Test Program* (SDIO, 1992).

ClF_5 is a clear, yellow-green, volatile liquid with a colorless gas. It has a sweet and irritating odor, and is suffocating when in concentrations above 10 parts per million (ppm). ClF_5 is extremely toxic, corrosive, and reacts vigorously with ice, water, and silicon-containing compounds (e.g., sand, glass, asbestos). It is incompatible with oil, grease, reducing agents, organic compounds, plastics, rubbers, fuels and combustibles, and many metals and metal oxides (especially if powdered).

Shipping of ClF_5 will be coordinated by Phillips Laboratory and its support contractor, Wyle Laboratories. Phillips will coordinate shipping from the continental U.S. to USAKA. Wyle Laboratories is fabricating the HOKE bottle overpack system that provides for safe transportation of the oxidizer.

The oxidizer will be shipped in 2.5-gallon (9.5-liter) stainless steel HOKE bottles (a Department of Transportation [DOT]-approved stainless steel handling and pressurization container that has been used for approximately 5 years to transport ClF_5 from Sacramento, California, to Edwards Air Force Base). The bottles will be filled with approximately 1 gallon (3.8 liters) of the product. The only pressure in the container is the vapor pressure of ClF_5, which follows almost directly the temperature of the product (i.e., on an 80°F [26.7°C] day, the vapor pressure will be approximately 80 pounds per square inch [psi] [6 kilograms per square centimeter (ksc)]). The shipping pressure will be well below the bottle design pressure of 1,800 psi (127 ksc).

Phillips Laboratory will be responsible for obtaining all necessary DOT permits and certifications. Matson, Incorporated, a commercial transportation contractor who routinely provides hazardous cargo shipment to USAKA, will deliver the ClF_5 to Kwajalein by surface transportation (i.e., barge sea transport).

Existing docks at Kwajalein Island, and landing craft utility (LCU) billets at other islands will be used during ClF_5 transportation. These facilities are in existence, no facility modifications will be required, and their current use is consistent with the proposed use for ClF_5 operations.

A Phillips Laboratory representative will meet the shipment upon its arrival at Kwajalein Island dockside, and direct the movement of the ClF_5. Handling of the containers will be performed by Launch Ordnance Personnel of DynCorp, Inc. The ClF_5 will be the first cargo off-loaded at the Kwajalein dock, and will immediately be placed on an LCU for surface transportation to the island where it will be used (Meck, Illeginni, Omelek, Gellinam, or Eniwetak). Interim storage of propellants on Kwajalein is being investigated for contingency purposes if rough seas delay immediate shipments. Two LCUs will be made available to minimize the possibility of temporary liquid fuel or oxidizer storage on Kwajalein in cases other than rough seas. USAKA will provide handling, security, and safety support on arrival, transportation to, and suitable storage on the islands (oxidizers and fuels must be transported and stored separately on the island).

Launches at USAKA

Launches that would occur as part of the No-Action Alternative include the ERIS launch program at Meck (described in the 1989 DEIS, Subsection 2.3.1.1, page 2-29), and ongoing sounding rocket and meteorological rocket launches from Kwajalein, Roi-Namur, and Omelek islands as described in the 1989 DEIS, Subsection 2.2.1, page 2-11, and in Table 2.1-6 of this document. Launches for the GSTS at Omelek, described as part of the Proposed Action of the 1989 EIS, have not yet been initiated but are included here as part of the No-Action Alternative.

2.1.1.2 Sensing and Tracking

The following information updates and supplements Subsections 2.2.2 and 2.3.2 of the 1989 DEIS. The sensing and tracking facilities at USAKA (Figure 2.1-1) are used for missions that involve reentry vehicles (RVs) and to track space objects. RVs are launched from PMRF at Barking Sands on the island of Kauai, Hawaii; and from the Western Space and Missile Center (WSMC), 30th Space Wing, at VAFB in California. RVs are currently targeted to one of three general areas:

- The Mid-Atoll Corridor within the lagoon
- A designated Broad Ocean Area (BOA), which refers to either USAKA North, an area to the north of Roi-Namur, or USAKA East, an area to the east of Roi-Namur
- A land target area on the north side of Illeginni Island

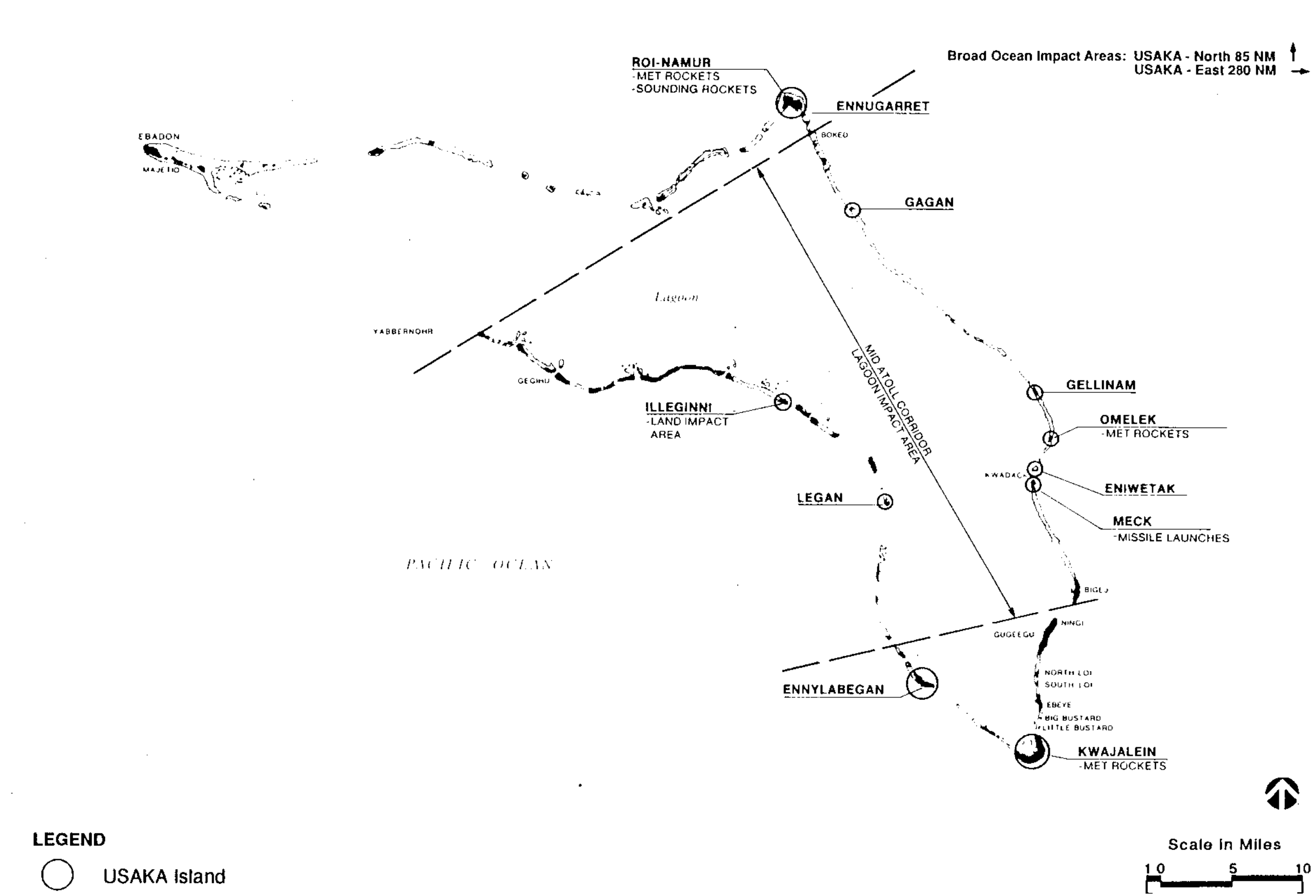
Most RVs contain payloads of sensing equipment, test materials, or decoys. RV payloads typically contain no toxic or hazardous materials. In most instances, portions of the RVs burn up on reentry into the atmosphere. Portions that survive reentry are either lost in the ocean or are recovered if they are targeted to the lagoon or to Illeginni. In the No-Action Alternative, tests that involve RVs would continue at a rate of approximately 12 per year.

USAKA supports these missions by providing tracking, sensing, RV recovery, and other technical and logistical support. Major sensing and tracking facilities include the Kiernan Reentry Measurements Site (KREMS) on Roi-Namur, and other radars located on Kwajalein, Gellinam, and Legan islands; optical sensors on eight of the USAKA islands, telemetry equipment on five islands, and acoustic equipment on one island. These facilities are identified below by island and are listed in Figure 2.1-2; they are described in pages 2-11 and 2-12 of the 1989 DEIS.

Table 2.1-6
Maximum Annual Launch Activity, by Alternative

Island/Launch Facility		Number of Launches Annually				
		1994	1995	1996	1997	1998
No Action						
Kwajalein:	Met rockets	24	24	24	24	24
Roi-Namur:	Sounding rockets	8	8	8	8	8
	Met rockets	24	24	24	24	24
Meck:	Strategic launch vehicles					
Omelek:	Strategic launch vehicles		4	4	4	4
	Met rockets	24	24	24	24	24
Total No-Action Alternative		**80**	**84**	**84**	**84**	**84**
Low Level of Activity						
Kwajalein:	Met rockets	24	24	24	24	24
Roi-Namur:	Sounding rockets	8	8	8	8	8
	Met rockets	24	24	24	24	24
Meck:	Strategic launch vehicles	4	4	8[a]	12[a]	12[a]
	Sounding rockets	4	8	8	8	8
Omelek:	Strategic launch vehicles			4*[a]	4*[a]	4*[a]
	Met rockets	24	24	24	24	24
Total Low Level-of-Activity Alternative		**88**	**92**	**100**	**104**	**104**
Intermediate Level of Activity						
Kwajalein:	Met rockets	24	24	24	24	24
Roi-Namur:	Sounding rockets	8	8	8	8	8
	Met rockets	24	24	24	24	24
Meck:	Strategic launch vehicles	4	14**	24**[b]	24**[b]	24**[b]
	Sounding rockets		4	12	12	12
Omelek:	Strategic launch vehicles			4*[a]	4*[a]	4*[a]
	Met rockets	24	24	24	24	24
Illeginni:	Strategic launch vehicles		10**	20**[b]	20**[b]	20**[b]
Total Intermediate Level-of-Activity Alternative		**84**	**108**	**140**	**140**	**140**
High Level of Activity						
Kwajalein:	Met rockets	36	36	24	24	24
Roi-Namur:	Sounding rockets	8	8	8	8	8
	Met rockets	24	24	24	24	24
Meck:	Strategic launch vehicles	4	14	24[b]	28[b]	28[b]
	Sounding rockets					
Omelek:	Strategic launch vehicles			8	8	8
	Met rockets					
Eniwetak:	Strategic launch vehicles			24[b]	24[b]	24[b]
Gellinam:	Met rockets		12	24	24	24
Illeginni:	Strategic launch vehicles		10[b]	24[b]	24[b]	24[b]
Total High Level-of-Activity Alternative		**84**	**108**	**168**	**172**	**172**

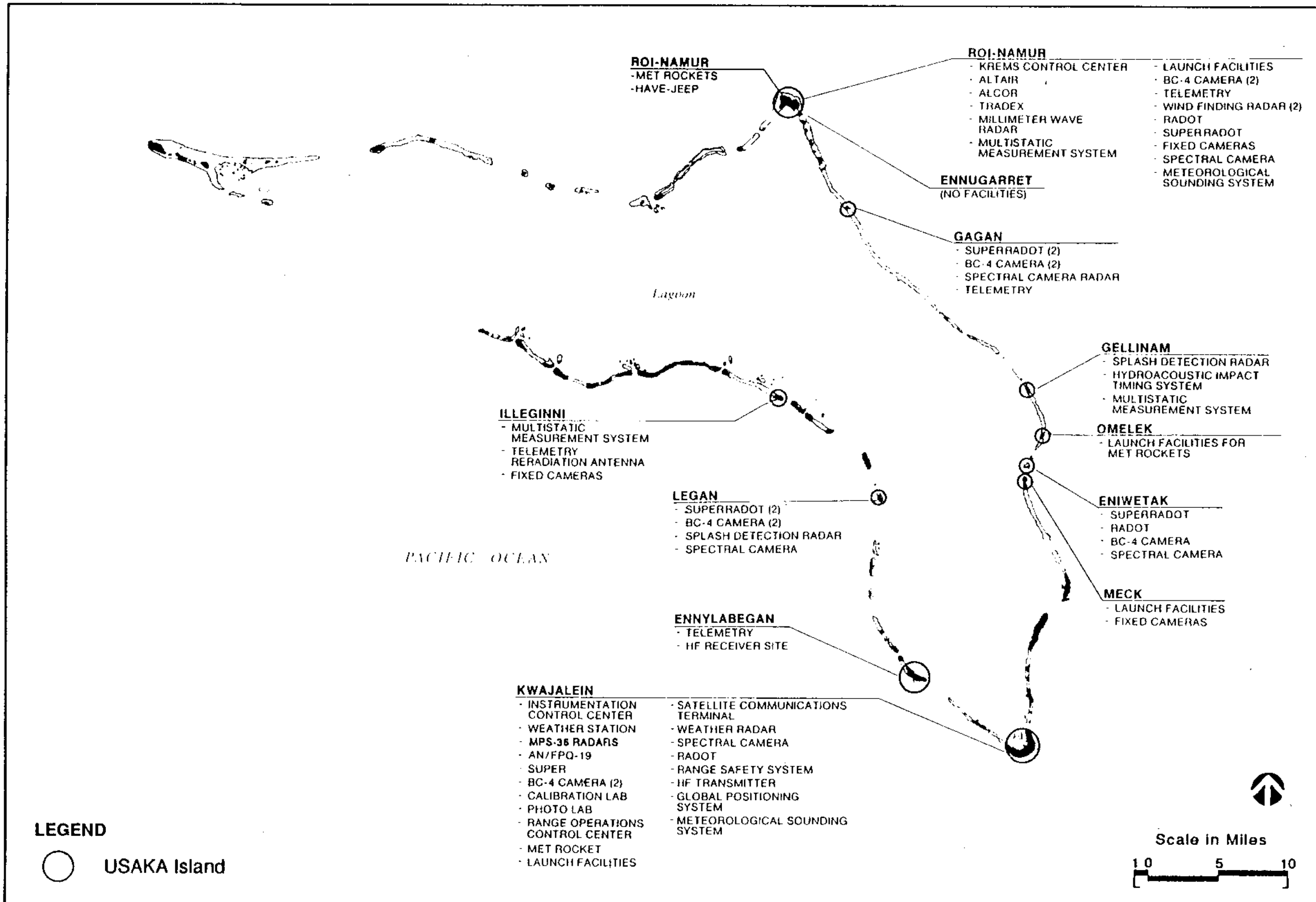
[a]May include single launch system integration tests.
[b]May include system integration tests with one, two, four, or six simultaneous launches from multiple launch facilities.
*New launch facilities would be constructed at Meck or at Omelek in this alternative, but not at both sites.
**New launch facilities would be constructed at Meck or at Illeginni in this alternative, but not at both sites.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Location of Launch Facilities and Reentry Vehicle Impact Areas

FIGURE 2.1-1



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

USAKA Range Support Facilities

FIGURE 2.1-2

Sensing and tracking programs are associated with RV testing, described in Subsection 2.3.2 of the 1989 DEIS, and are summarized in Table 2.1-7.

In addition to programs that use RVs, USAKA facilities monitor space objects and missile launches. The U.S. Space Command has a mission to detect, identify, catalog, and track orbiting objects in space. U.S. space activities, including the NASA space shuttle and other Department of Defense (DoD) missions, are supported by the sensing and tracking programs at USAKA. Information on space objects is provided to the United Nations; a catalog of more than 7,000 listings is maintained, which includes objects that range from space laboratories to an astronaut's lost glove. The space surveillance program began at USAKA in 1984 and now has a network of 27 links. The Space Objects Identification Catalog and Space Object Measurement project uses a combination of the TRADEX, ALCOR, and AN/FPQ-19 radars to assist NASA.

2.1.1.3 Range Support and Base Operations

The following information updates and supplements Subsections 2.2.3, 2.2.4, and 2.3.3 of the 1989 DEIS. The launch and sensing and tracking capabilities of USAKA are supported by a number of technical functions that are described in some detail in the 1989 DEIS, pages 2-17 through 2-19. These technical functions include communications, meteorological support, range safety, RV search and recovery, technical laboratories, computer facilities, a control center, and photographic facilities.

USAKA is a community that, in January 1992, had a population of 2,995 (JCWSI, 1992b). Base operations at USAKA include most of the municipal functions and community services found in towns of similar size in the mainland United States, with additional activities specific to Kwajalein's isolation and tropical climate. USAKA base operations are described in the 1989 DEIS, pages 2-19 through 2-25. Base operations include transportation (air, marine, and land), utilities (electricity, water supply, sewerage, and solid waste), housing, community support, fire protection, security, supplies and storage, and maintenance and repair. Specific base operations facilities on each island are described below in Subsection 2.1.1.5, and in Chapter 3 of this document.

The implementation of the *USAKA Environmental Mitigation Plan* (USASDC, 1989c) has led to changes in range support operations at USAKA. New procedures and facility modifications to support implementation of the Mitigation Plan are identified in Appendix A, and are further discussed in Chapter 3.

Shoreline Protection

The shorelines of all USAKA islands are exposed to high storm waves. To protect facilities and prevent shoreline erosion, shoreline improvements have been constructed along many sections of most of the USAKA islands. These shoreline

Table 2.1-7
Sensing and Tracking Experiments
No-Action Alternative

	Description	Frequency	Launch Point/ Operating Area	Target Area
Evader Replica Penetration Aid (ERPA)	Gather radar, optical signature, and dynamic performance data on RV penetration aid system	3 (1992-1993)	Vandenberg AFB, CA	BOA
Minuteman I	Three-stage booster used for experimental flights	15 (1992-1995)	Vandenberg AFB, CA	BOA
Minuteman II and III	Operational testing of three-stage ICBM with single and multiple simulated RVs	9 per year (1992-1999)	Vandenberg AFB, CA	Lagoon, BOA, Illeginni
Peacekeeper	Operational testing of three-stage ICBM with multiple simulated RVs	8 per year (1992-1999)	Vandenberg AFB, CA	Lagoon, BOA, Illeginni
HALO/IRIS	Learjet used to collect visible and infrared data on RVs and experiments	5-10 per year (1992-1999)	USAKA	N/A
Small ICBM	Single simulated RV ICBM	2 (1992)	Vandenberg AFB, CA	BOA
Trident	Submarine-launched multisimulated RV SLBM	1 or more per year (1992-1994)	Vandenberg AFB, CA	BOA
Airborne Surveillance Testbed (AST) (formerly Airborne Optical Adjunct)	Boeing 767 sensor platform aircraft	Several annually	Kwajalein	N/A
Mid-Course Space Experiment (formerly Mid-Course Sensor Experiment)	Satellite used to test BMD sensor components	1	Orbital	N/A
Exoatmospheric Experiment	Sensor experiment launched on an Aries rocket	10 (1994-1997)	Wake Island	BOA
Aerothermal Reentry Experiment	Monitor temperature and pressure on reentering payloads	4 (1993)	Vandenberg AFB, CA, and PMRF, HI	BOA
COBRA EYE (formerly Optical Aircraft Measurement Program)	Infrared sensor data collection system mounted on aircraft	As needed	USAKA	N/A
STARS	Three-stage solid propellant booster carrying multiple simulated RVs and equipment	4 per year (1992-2002)	PMRF, HI	BOA

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protection structures require periodic maintenance or improvement, and additional structures are identified for the various level-of-activity alternatives.

Quarrying and Dredging

Quarrying and dredging are the primary methods by which material is obtained for use as fill and aggregate for construction and shoreline protection (see pages 3-30 to 3-31 of the 1989 DEIS). In the No-Action Alternative, the shoreline protection projects described above and other construction associated with the No-Action Alternative would require quantities of armor rock and aggregate. Part of that requirement would be satisfied by quarry materials that have been stockpiled on Kwajalein; the remaining demand (which would require additional quarrying) is shown in Table 2.1-8.

Table 2.1-8
Requirements for Quarrying and Dredging
No-Action Alternative

Island	Quarried Armor Rock for Shoreline Protection (cubic yards)	Dredged Material for Construction Projects (cubic yards)
Kwajalein	0	1,100
Omelek	0	2,000
Ennylabegan	200	325
Total	200	3,425

Note: Dredged material for shoreline protection is not needed for the No-Action Alternative.

Quarrying at USAKA currently involves removal of the armor stone rock from the reef flats on the ocean side of the atoll. Armor stone from the reef flats generally comes from the first 2 feet (61 centimeters) of substrate and is loosened by blasting the reef with explosives. Armor stone is used to build shoreline protection and other structures requiring large blocks of stone (revetments and seawalls) placed along the island perimeters.

Dredging at USAKA is a followup procedure to quarrying. It removes the finer aggregate material (coral rock, smaller stones, rubble, and sand) underneath the armor rock to a depth of 10 feet (305 centimeters) or more below the reef flat substrate. Harbors are also dredged periodically (about once each decade for most USAKA islands). The finer material obtained from reef flat and harbor dredging is used as fill material and processed for concrete aggregate.

Quarrying and dredging usually require the construction of a causeway road at low tide to enable transport of a mobile hydraulic shovel and dump trucks to collect and transport the armor stone and dredged material. The selected reef flat quarry location is cored with explosives, which are detonated to loosen the armor stone. Excavated material is collected and transported off the reef flat. On Kwajalein Island, armor rock and aggregate are trucked to open storage piles on the west side of the island, where they are sorted and graded before use to build shoreline protection structures or as aggregate for landfill or concrete production.

2.1.1.4 Employment and Population

The following information updates and supplements Subsections 2.2.5 and 2.3.4 of the 1989 DEIS. Ongoing activities at USAKA are supported by a workforce of indigenous (Marshallese) and nonindigenous (primarily U.S.) personnel. In January 1992, the nonindigenous workforce and family members living on Kwajalein and Roi-Namur islands totaled 2,995 (JCWSI, 1992a). This level compares with a peak nonindigenous population of 4,756 in 1971 and 2,972 in 1988 (USASDC, 1989a).

Under the No-Action Alternative, USAKA's nonindigenous population would remain near its January 1992 level of 2,995. For the purpose of analysis, a total nonindigenous population of 3,250 (including 50 construction workers) is assumed to be the peak population (Table 2.1-9). This peak population would be reached in 1994.

An annual average daily visitor count of 100 is assumed for the No-Action Alternative. The actual daily peak visitor population could be up to twice the average annual number.

The nonindigenous employees and family members would continue to reside on Kwajalein and Roi-Namur Islands, as indicated in Table 2.1-9. From these islands, workers would commute by boat and aircraft to the other nine USAKA islands as indicated in Table 2.1-10. For other islands (those where a daily population of "two" is shown in Table 2.1-10), a two-person guard force commutes to each of these islands. In addition, periodic visits are made (by boat or helicopter) to maintain equipment or to perform other work. It is significant to note that there are no inhabited islands in the Mid-Atoll Corridor.

2.1.1.5 Facilities on USAKA Islands

Table 2.1-11 and Figures 2.1-3 through 2.1-6 summarize facilities, testing, and ongoing activities at each USAKA island. Please note that the Document Control Facility is under construction on Kwajalein. The 1989 EIS describes this project as being proposed for Roi-Namur, but it was subsequently relocated to Kwajalein. A Record of Environmental Consideration (REC) was issued in May 1993 (USAKA, 1993a) to document the evaluation of potential environmental impacts associated with this project's relocation to Kwajalein. The REC concluded that no significant impacts

Table 2.1-9 USAKA Peak-Year Nonindigenous Resident Population				
	Alternative (Peak Year)			
Island	No Action (1994)	Low Level (1996)	Intermediate Level (1996)	High Level (1996)
Kwajalein				
Workers/visitors	1,525	1,850	2,875	3,260
Family members	1,375	1,600	1,600	1,600
Subtotal	2,900	3,450	4,475	4,860
Construction workers	50	25	50	100
Roi-Namur	300	350	400	440
USAKA total	3,250	3,825	4,925	5,400

Table 2.1-10 USAKA Peak-Year Other Island Daily Population				
	Alternative (Peak Year)			
Island	No Action (1994)	Low Level (1996)	Intermediate Level (1996)	High Level (1996)
Meck	125	185	185	185
Omelek	2	2	2	70
Ennylabegan	2	2	2	2
Legan	2	2	2	35
Illeginni	2	2	215	215
Gagan	2	2	2	2
Gellinam	2	2	2	2
Eniwetak	2	2	2	75
Ennugarret	0	0	0	0

Table 2.1-11
Summary of Facilities and Activities
No-Action Alternative

Facility	Island										
	Kwajalein	Roi-Namur	Meck	Ennylabegan	Omelek	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennugarret
Launch	Meteorological rockets (twice monthly)	Sounding rocket; meteorological rockets (two per quarter)	ERIS; HEDI[1] (now E^2I); SBI[1] (now BP)	None	Meteorological rocket GSTS launch facility (three per year); rail launching; launch equipment; missile assembly building; blast berm	None	None	None	None	None	None
Sensing/tracking	AN/MPS-36 radars; AN/FPQ-19 radar; optical sensors; communications facilities; AST liquid nitrogen plant; GBR-X	KREMS complex; wind-finding radars; optical sensors; telemetry; communications	Cameras	Global positioning system; telemetry	Camera towers; fiber optics cable to Meck	Optical sensors; splash detection radar	Land impact area; Multistatic Measurement System; camera tower; telemetry	Optical sensors; telemetry	Splash detection radar; Hydro-acoustic Impact Timing System; Multistatic Measurement System	Optical sensors	None
Range support/ base operations	Headquarters; housing; community facilities; transportation; utilities; base operations, range support; desalination plant; Power Plant 1B	Housing; community facilities; utilities; transportation; range support; document control facility	Dining facilities; utilities; port facilities	Pier; helipad; water catchment and storage; power plant; septic system; seawall repair	Diesel generator; helipad; harbor; marine ramp; pier; port facilities; quarters for security personnel; road paving	Diesel generator; helipad; marine ramp; finger jetty	Power plant; helipad; unused launch facilities; explosive ordnance disposal (EOD) site	Diesel generator; helipad; marine ramp; small harbor	Diesel generator; helipad; marine ramp; small harbor	Diesel generator; helipad; marine ramp; small harbor	None

[1]E^2I and BP are now included in the Low Level-of-Activity Alternative.

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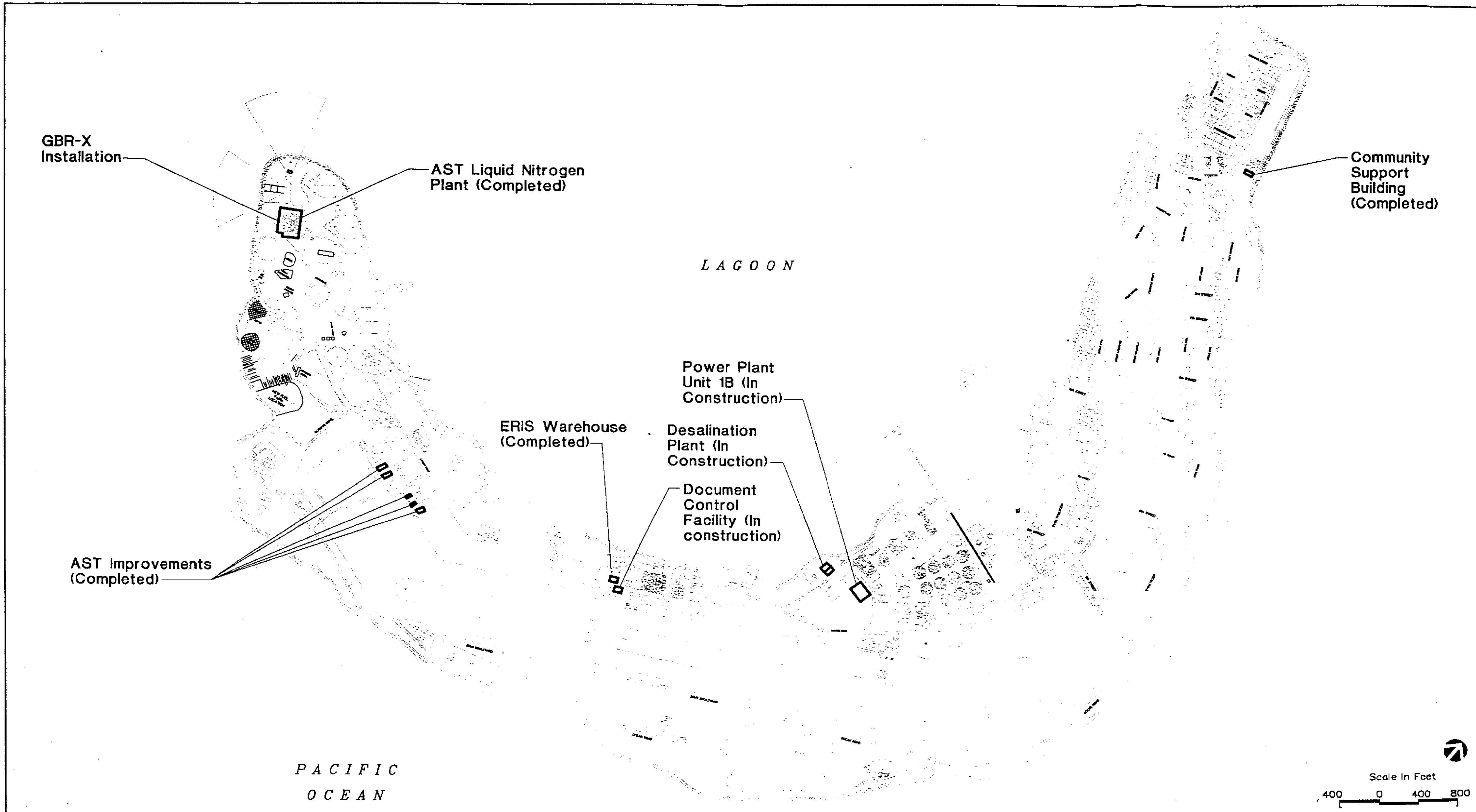
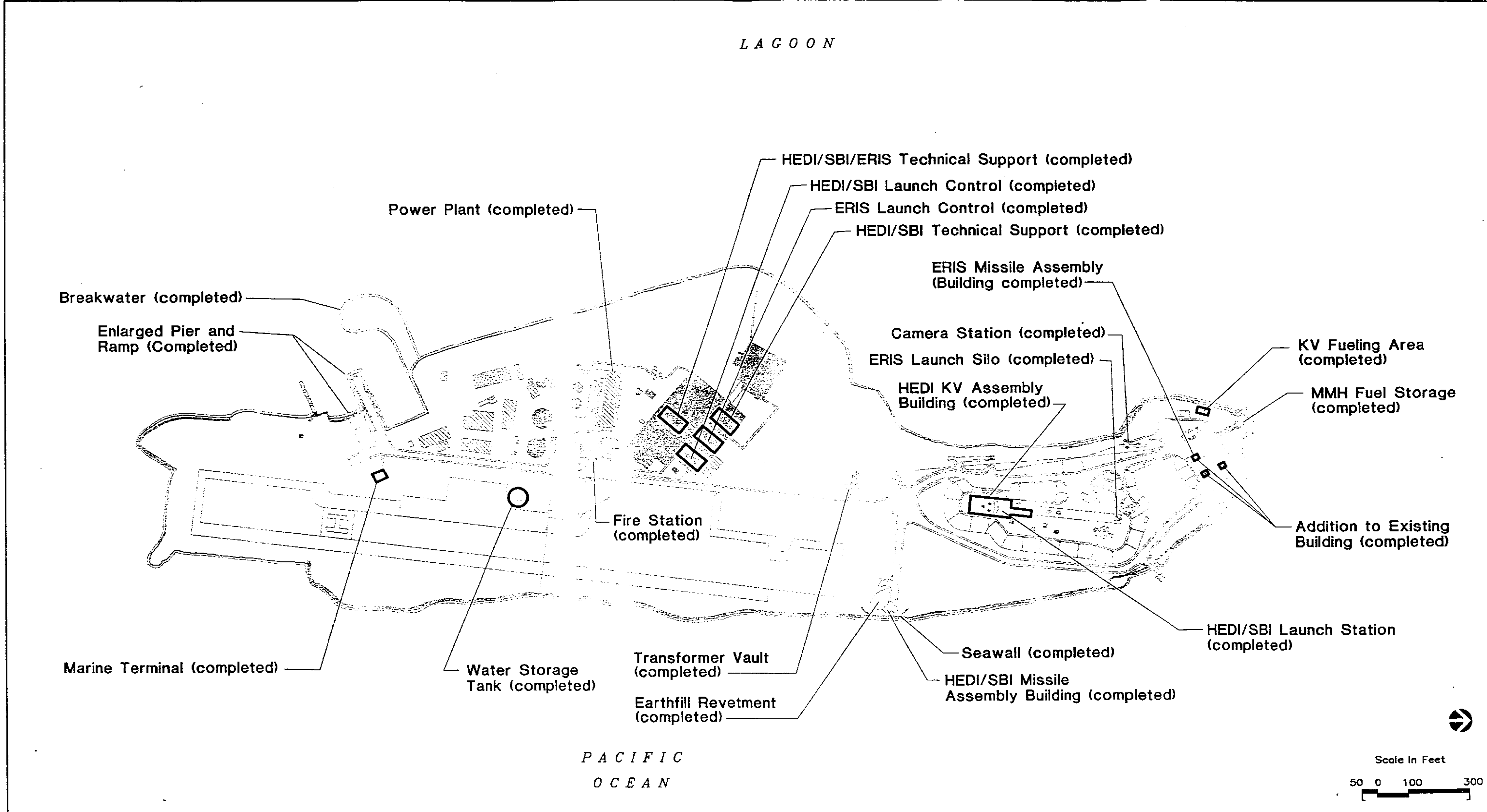


U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

No-Action Alternative
KWAJALEIN

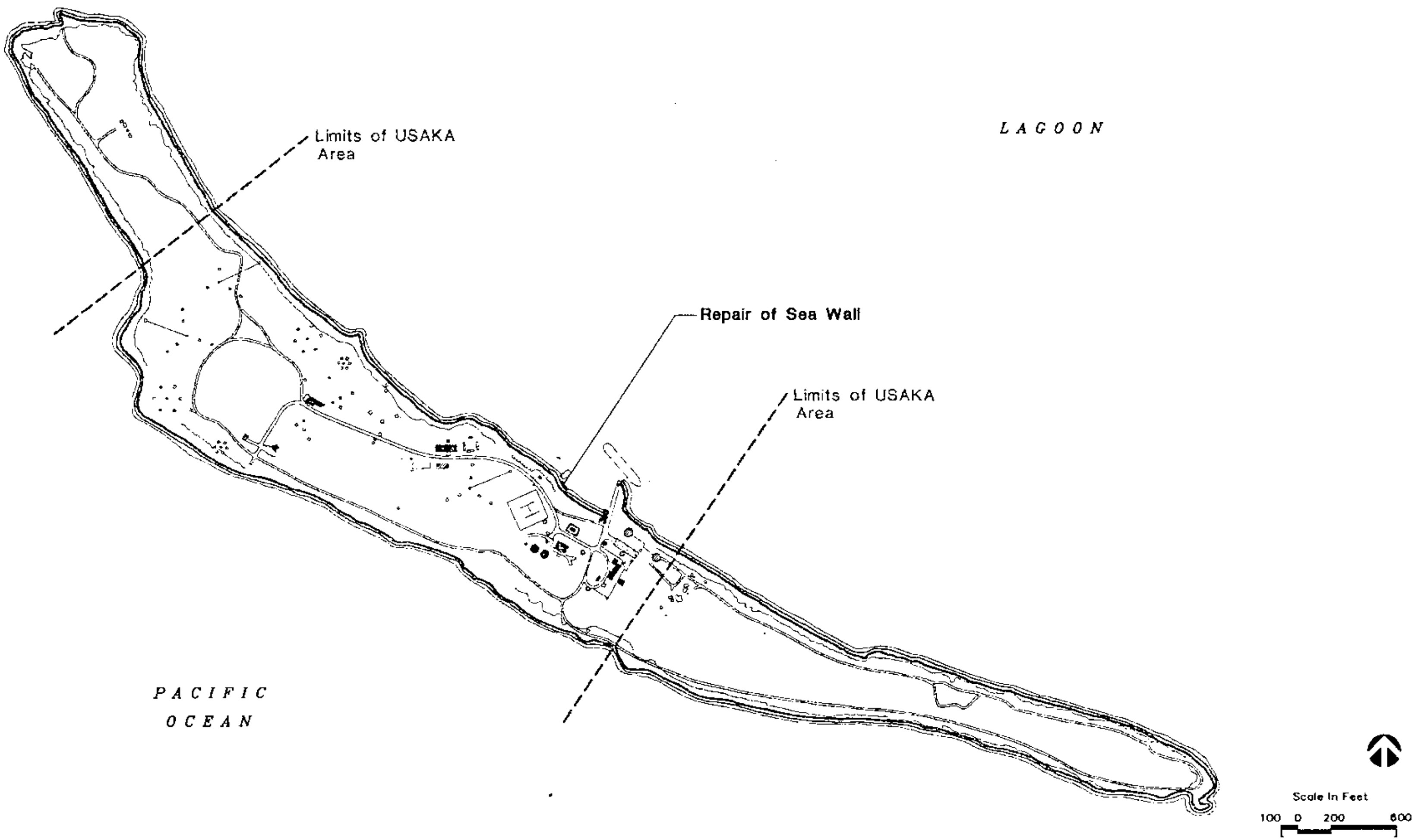
FIGURE 2.1-3



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

No-Action Alternative
MECK

FIGURE 2.1-4



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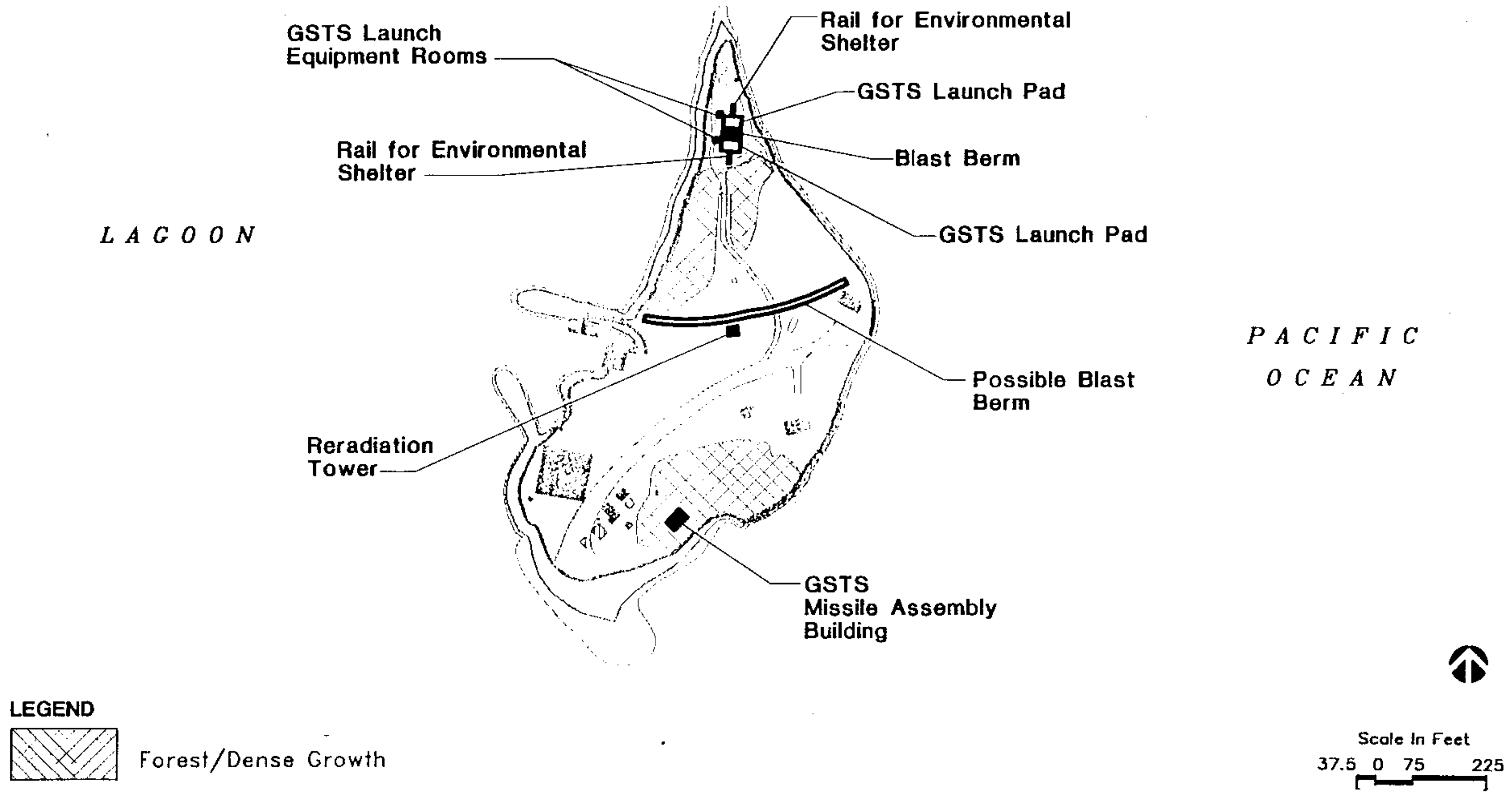
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

No-Action Alternative
ENNYLABEGAN

FIGURE 2.1-5



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

No-Action Alternative
OMELEK

FIGURE 2.1-6

associated with this project are anticipated. A REC issued in May 1992 (USAKA, 1992b) to document the evaluation of environmental impacts associated with the construction of a community support building also concluded that no significant impacts are expected.

2.1.2 Low Level-of-Activity Alternative

Subsection 2.1.2 supplements Chapter 2 of the 1989 DEIS. Test activities in this alternative would consist of a continuation of SLV flight tests, but at a greater frequency than in the No-Action Alternative. Some of the test vehicle launches would be components of simple SITs.

SITs are live-launch tests planned by BMDO to verify the capabilities of the national missile defense (NMD) system to effectively detect, evaluate, track and intercept ballistic missile launches. In these tests, each element of NMD (sensors, interceptors, and command/control) would be evaluated in conjunction with all other elements.

The goal of the initial SITs would be to improve the interaction of each element of NMD, to verify the effectiveness of each component and the system as a whole. The later SITs (which would be part of the Intermediate and High Levels of Activity of this SEIS) would be fully operational tests designed to demonstrate convincingly the NMD component of the larger BMD program.

In a typical SIT (Figure 2.1-7), a set of sensors would be used to observe a launch region, detect a simulated intercontinental ballistic missile (ICBM) launch, and notify the Battle Management Command Control Communications (BMC^3) Center (which has been proposed to be located in Grand Forks, North Dakota). At the BMC^3 Center, military and civilian personnel would evaluate the launch. They would review data provided by launch detection sensors, which would deliver tracking data to boost phase, mid-course, and terminal sensors. In a full SIT, BMC^3 test managers would launch ground-based interceptors to destroy the incoming ICBM. Throughout their flights, the GBIs would be tracked by other sensors to confirm the accuracy and effectiveness of the interception. These would include sensors at USAKA, whose operators would be coordinated through a USAKA command control center. Independent test monitors would observe the entire SIT and evaluate the system's effectiveness.

In the Low Level-of-Activity Alternative, simple SITs would occur. These tests would employ single launches that would be tracked by ground-based and airborne trackers. The increased number of launches would occur primarily at Meck, as described below.

2.1.2.1 Launch Programs

A new rail launch complex for SLVs would be constructed on Meck. The new and existing facilities on Meck would be used in conjunction with the existing launch and support facilities on other islands to support launches for SITs and other test programs.

Illustrative launch programs are GSTS, E^2I, GBI, LEAP, Talos/Aries Sounding Rockets (TASRs), HAVE-JEEP IX sounding rockets, and BP, although other similar programs might also use USAKA facilities.

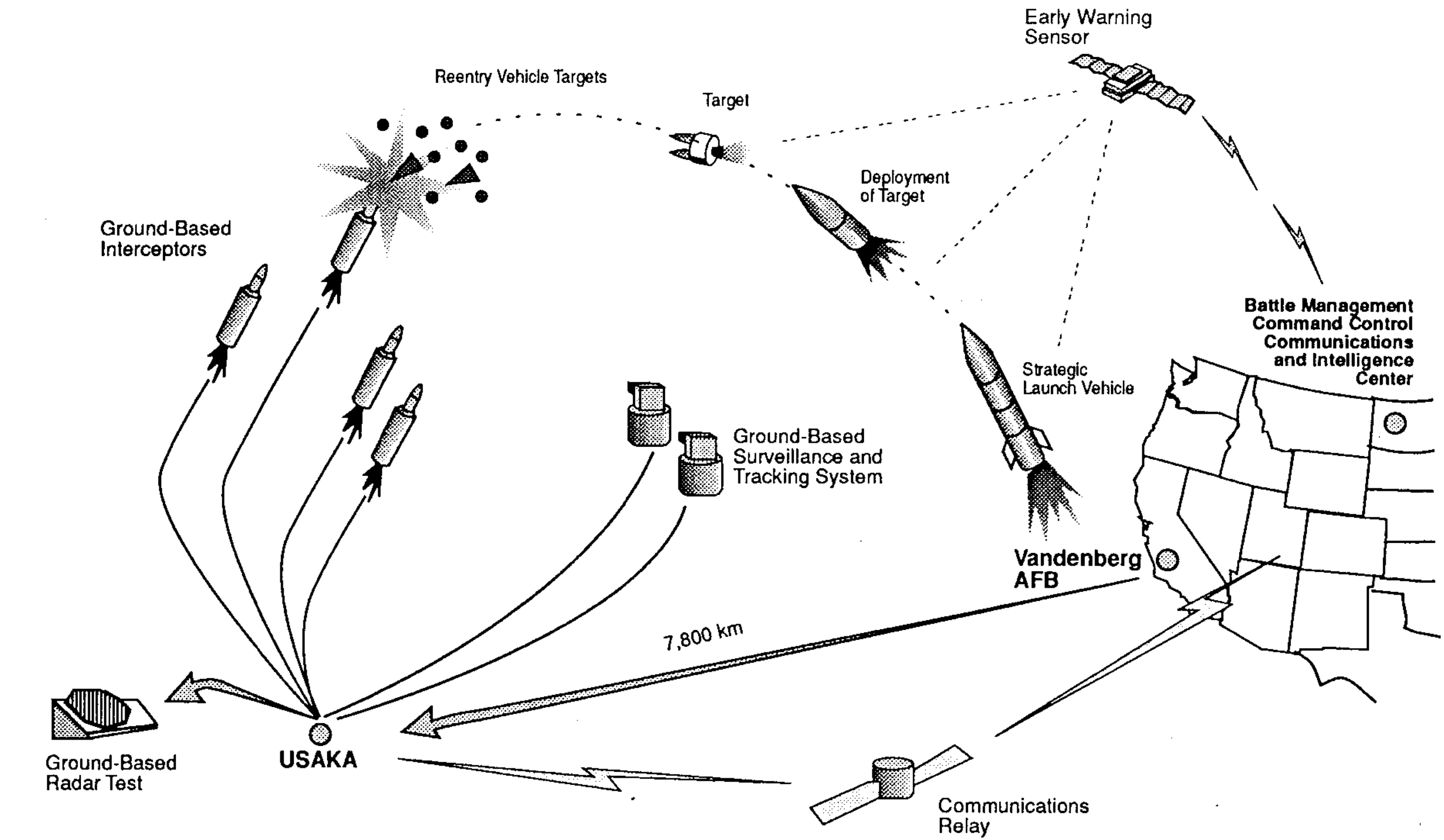
The following subsection briefly describes examples of launch programs that might use the USAKA launch facilities as part of the Low Level-of-Activity Alternative (in addition to those included in the No-Action Alternative); other programs might also use the facilities. Facilities specific to each island are described in detail below.

Ground-Based Surveillance and Tracking System. This program is a technology validation experiment using an exoatmospheric missile launched from Meck or Omelek, or (in the Intermediate Level-of-Activity Alternative) Illeginni. The payload is a long-wave infrared sensor that finds, identifies, and tracks RVs during the mid-course phase of their trajectory for a period of 10 minutes before the payload descends and is recovered from the BOA. The proposed payload launch vehicle is an SR-19, a single-stage rocket motor. An alternative for the launch vehicle is an extended Pegasus rocket motor. Payload propulsion uses pressurized helium; cryogenic (supercooled) helium is used for sensor cooling.

The GSTS payload's descent to the ocean would be slowed by parachute. Initially, a small (6 feet [2 meters] in diameter) pilot chute would be ejected. The pilot chute would extract a larger "drogue" parachute made of nylon ribbon with a diameter of 25 feet (8 meters). After a few seconds of descent, three main parachutes would open. Each main parachute is 75 feet (23 meters) in diameter with 75 feet of riser. The main parachute canopies are constructed of ripstop nylon; the parachute risers are constructed of a combination of nylon and Kevlar materials, and the ribbon parachutes are 90 percent Kevlar. Hardware attached to the parachutes (e.g., reefing line cutters and jettison components) are made primarily of steel, which would assist the parachutes in sinking after they are jettisoned from the payload. As many as 21 main parachutes, 7 drogue parachutes, and 7 pilot parachutes could be jettisoned in the Pacific Ocean from the launches that would occur in this alternative.

In the No-Action Alternative, the GSTS could be launched from Omelek; in this alternative, GSTS would also be launched from Meck. Over the period from 1996 through 1998, seven launches from Meck would occur, of which two would involve a dual launch of two GSTS vehicles.

Ground-Based Interceptor. The USAKA portion of the GBI is a flight test program that would consist of at least four developmental and two operational tests of



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Typical Systems Integration Test

FIGURE 2.1-7

exoatmospheric interceptors launched from Meck over the 1995 to 1998 period (in the Proposed Action for this EIS, GBI could also be launched from Illeginni). This program is the evolution of the ERIS program (described as part of the No-Action Alternative), which will be completed in 1993. Where ERIS used an Aries II payload launch vehicle (with a Minuteman I second stage and Minuteman I third stage), GBI is currently proposed to use a new smaller rocket with a propellant weight of approximately 8,300 pounds (3,765 kilograms). The payload would contain approximately 11 pounds (5 kilograms) of hypergolic oxidizer fuel loaded in prepackaged form.

Lightweight Exoatmospheric Projectile. LEAP is a test program of a lightweight payload vehicle that is proposed to be launched from Meck. The payload launch vehicle would be an Aries II rocket (second stage Minuteman I M56A1/third stage Minuteman I M57A1). Chlorine pentafluoride (ClF_5) may be used as a liquid oxidizer for the payload vehicle propellant. The target is a Castor IVA/ORBUS-1 rocket launched from Wake Island. Current plans include three launches.

Brilliant Pebbles. BP is a program that at USAKA would involve pre-full-scale development flight tests of a probe launched from Meck, which would track and intercept targets launched from Wake Island, VAFB, or PMRF. The target would be intercepted in mid-course flight. The probe is intended to test technology that could be deployed as a space-based interceptor. Ultimately, BP would provide a defense against ballistic missiles in their early phases of flight (boost and postboost) before they release their warheads. The BP payload launch vehicle is ultimately proposed to be an Aries II rocket (second stage Minuteman I M56A1 and a third stage Minuteman I M57A1). The payload would be propelled by gaseous nitrogen, monomethyl hydrazine, and nitrogen tetroxide. ClF_5 may be tested as a hypergolic fuel. Five launches are currently scheduled, from late 1993 through 1995.

Exo-Endoatmospheric Interceptor. E^2I would be an upgrade to the GBI program. E^2I is currently proposed to use a different payload vehicle with the GBI launch vehicle to add endoatmospheric interception capability to GBI (which is an exoatmospheric interceptor).

Talos/Aries Sounding Rockets. The TASR would be a rocket test flight project. Sounding rockets are used as objects for radar and optical tracking, testing, and calibration. Approximately two launches per year from Meck are currently proposed to occur during the period from 1993 through 1998.

HAVE-JEEP IX. This would be a flight test project of sounding rocket launches from the High Endoatmospheric Defense Interceptor (HEDI) launch pad on Meck. In the past, the HAVE-JEEP VII series was launched from Roi-Namur; in this alternative, the related HAVE-JEEP IX series would be launched from Meck.

2.1.2.2 Sensing and Tracking

Ground-Based Radar Test. A major new sensor, the Ground-Based Radar Test (GBR-T) would be installed at Kwajalein; the GBR-T is related to the Ground-Based Radar-Experimental (GBR-X) radar described as part of the Proposed Action of the 1989 EIS (and part of the No-Action Alternative of this SEIS), but the size and capabilities of the GBR-T are significantly greater than the GBR-X radar (see Kwajalein in Subsection 2.1.2.5). In addition, a fiber optics cable would be laid between Meck and Ennylabegan.

2.1.2.3 Range Support and Base Operations

Range support and infrastructure needed to support the level of activities described for this alternative are identified in Chapter 4. Several base operations-related construction projects specifically proposed as part of this alternative are identified by island in Subsection 2.1.2.5.

This alternative would require higher levels of shoreline protection, construction, and quarrying involving several of the islands; in addition, port improvements would be constructed at Ennylabegan, Illeginni, and Legan.

Port Improvements. In order to accommodate larger marine transport vessels (2000 class rather than the smaller 1500 class), port facilities at Ennylabegan, Illeginni, and Legan would be expanded, as described below for each island.

Shoreline Protection

Additional shoreline protection structures would be constructed to protect shorelines on several islands. Shoreline erosion caused by wave action can be reduced using a wide range of alternatives including:

- Wave energy absorbers or reflectors (or combinations)
- Rigid (static) or flexible (dynamic) structures
- Shore-attached or offshore structures

Some alternative approaches combine these categories; for example, a rock revetment is a rigid, shore-attached, energy absorber. The feasibility and effectiveness of each category of shoreline protection device at Kwajalein Atoll are described below.

Offshore Alternatives. Offshore alternatives include breakwaters, detached seawalls, dikes, and similar structures. This class of alternative was considered for shore protection at Kwajalein Atoll. However, such structures would be difficult, or impossible, to build in deep water. The morphology of the reef, with its very steep transition from shallow to deep water, would require construction on the reef flat. In addition, costs of offshore structures rise rapidly as water depth increases.

Construction of a breakwater large enough to protect against design storm waves would result in unavoidable and significant damage to the reef both during construction and by the physical covering of existing habitat. In addition, an offshore breakwater would eliminate or reduce wave action and water circulation between the structure and the shoreline. This would change the physical environment of the reef flat habitat and result in potentially significant impacts depending on the length of the structure. Overall, offshore alternatives do not appear reasonable for the particular environment of Kwajalein Atoll.

Flexible Alternatives. Flexible, shore-attached alternatives include beach nourishment with imported sand, dynamic revetments (for example, gravel or cobble beaches), and sacrificial dunes. All of these approaches require relatively large amounts of imported material and frequent maintenance, including periodic addition of more material. The necessary material would have to be mined locally or shipped to Kwajalein Atoll. The use of local material would result in an ongoing disturbance at the mining site and the costs of shipping large quantities of sand or gravel are prohibitive. In addition, ancillary structures such as groins and jetties are often required, which have the same disadvantages as the offshore structures discussed above. There have been some experimental uses of flexible offshore approaches (floating tire breakwaters, tethered float breakwaters), but performance of such approaches has been generally unsatisfactory. In addition, the high-energy wave climate and deep water are not compatible with such approaches. High maintenance requirements are also a concern. Flexible alternatives, both onshore and offshore, do not appear reasonable at Kwajalein Atoll.

Wave Reflectors. Almost every structure or approach involves both absorbing and reflecting wave energy. The classification is based on the most important of the two effects for a given structure. For example, a vertical seawall is a reflector (reflects waves back toward the sea), although some measurable energy decrease occurs. A low-slope beach generally induces energy degradation (waves break and dissipate energy in turbulence), although some reflection occurs even from very flat beaches. Seawalls and other massive reflecting structures would require shipping large quantities of bulk materials to Kwajalein Atoll. Such structures (wave reflectors) would change the nature of wave action over the reef flats and would result in a major modification in the characteristics of the shoreline. The existing conditions, on the reef and along the shoreline, would be more closely approximated by the use of rock revetments. Construction (short-term) impacts of revetments would be less than those for seawalls, as would impacts of future maintenance activities.

Shore-attached static rock revetments are the least environmentally disturbing, the most technically feasible, and among the most cost-effective approaches for shoreline erosion and backshore protection at Kwajalein Atoll. The use of native material would provide the best match with the existing habitat if such material can be acquired without unacceptable environmental impacts (see discussions on reef quarrying in Section 4.2).

Imported non-native rock could be used for shoreline protection structures, depending on purchase cost and transportation costs. Imported aggregate is being used by some construction contractors at USAKA. The aggregate is purchased on the open market (from Hawaii or elsewhere) and is sterilized before being transported by barge to Kwajalein Atoll. While using imported aggregate may be a cost-effective alternative to using native aggregate, importing armor rock is typically more expensive, because transporting blocks of stone is more expensive than transporting loose sand and aggregate.

Artificial armor units (cast reinforced concrete or tribar) in place of rocks are also feasible, but may involve higher shipping costs for materials and may require more maintenance because of the limited lifetime of the units.

Quarrying and Dredging. The shoreline protection and other construction activities identified as part of this alternative would require quarrying and dredging of additional quantities of armor rock, coral, aggregate, and sand (Table 2.1-12). Quarries would be created adjacent to the islands where construction projects are planned, or if adequate quarry area is not available adjacent to that island, quarry material would be transported from quarries adjacent to other USAKA islands. As an alternative, armor rock and aggregate could be purchased commercially from sources outside USAKA.

2.1.2.4 Employment and Population

Under this alternative, the total nonindigenous population of USAKA is projected to be approximately 3,825 (including 25 construction workers), or 575 higher than in the No-Action Alternative (see Table 2.1-9). The increase in population would include both operations employees (who would increase from 1,725 to 2,100) and family members (who would increase from 1,375 to 1,600). The average number of construction workers would drop from 50 to 25 in the peak total population year (1994), because the peak of construction activity would occur 1 to 2 years before the peak total population year.

2.1.2.5 New Facilities and Activities

New launch programs and facilities are described below by island. Table 2.1-13 contains an island-by-island comparison of new facilities for each level-of-activity alternative. Chapter 4 identifies infrastructure shortfalls and additional infrastructure required to support the level of population proposed for this alternative.

KWAJALEIN

Kwajalein Island would support a resident nonindigenous population of 3,450 (an increase of 550 people over the No-Action Alternative). A number of new range support and base operations facilities are proposed to be constructed; locations are indicated in Figure 2.1-8.

Table 2.1-12
Requirements for Quarrying and Dredging
Low Level of Activity
(cubic yards)

Island		Quarried Armor Rock for Shoreline Protection	Dredged Material: For Shoreline Protection	Dredged Material: For Construction Projects
Kwajalein	Increment[a]	35,280	16,560	5,600
	Total[b]	35,280	16,560	6,700
Roi-Namur	Increment[a]	12,000	24,800	700
	Total[b]	12,000	24,800	700
Meck	Increment[a]	7,000	9,400	1,000
	Total[b]	7,000	9,400	1,000
Omelek	Increment[a]	1,200	3,300	0
	Total[b]	1,200	3,300	2,000
Ennylabegan	Increment[a]	0	0	0
	Total[b]	200	0	325
Legan	Increment[a]	0	0	0
	Total[b]	0	0	0
Illeginni	Increment[a]	0	0	0
	Total[b]	0	0	0
Gagan	Increment[a]	0	0	0
	Total[b]	0	0	0
Gellinam	Increment[a]	2,500	3,500	0
	Total[b]	2,500	3,500	0
Eniwetak	Increment[a]	600	900	0
	Total[b]	600	900	0
Ennugarret	Increment[a]	0	0	0
	Total[b]	0	0	0
Total all islands	Increment[a]	58,580	58,460	7,300
	Total[b]	58,780	58,460	10,725

[a]Increment = additional material required for this alternative
[b]Total = total material required for this alternative

Table 2.1-13
Summary of New Facilities
Level-of-Activity Alternatives

	Island										
Level	Kwajalein	Roi-Namur	Meck	Ennylabegan	Omelek	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennugarret
No Action	Power Plant 1B; desalination plant; document control facility				GSTS launch facility						
Low	188 UPH units; 100 UPH units; 90 units family housing; air terminal receiving facilities; sea terminal physical security facilities; religious education facility; hazardous materials storage; solid waste incinerator; three storage warehouses; corrosion prevention facility; child development center; fuel tank containment upgrade; GBR-T testing facility; shoreline protection; hospital addition/alteration	Power plant; saltwater intake; wastewater treatment plant; fuel tank containment upgrade; shoreline protection	Payload assembly building; systems technology testing facility renovation; SLV launch complex with shelter; launch utility building; SLV rail launcher; climate control for HEDI fueling facility; power plant upgrade; fuel tank containment upgrade; fiber optics cable; shoreline protection	Fuel tank replacement; fiber optics cable; harbor area extension	Fuel tank containment upgrade; shoreline protection	Fuel tank containment upgrade; harbor dredging and blasting; marine ramp; fill for port improvements	Fuel tank containment upgrade; harbor dredging; widening; deepening		Fuel tank containment upgrade; shoreline protection; new revetment	Fuel tank replacement; new revetment	

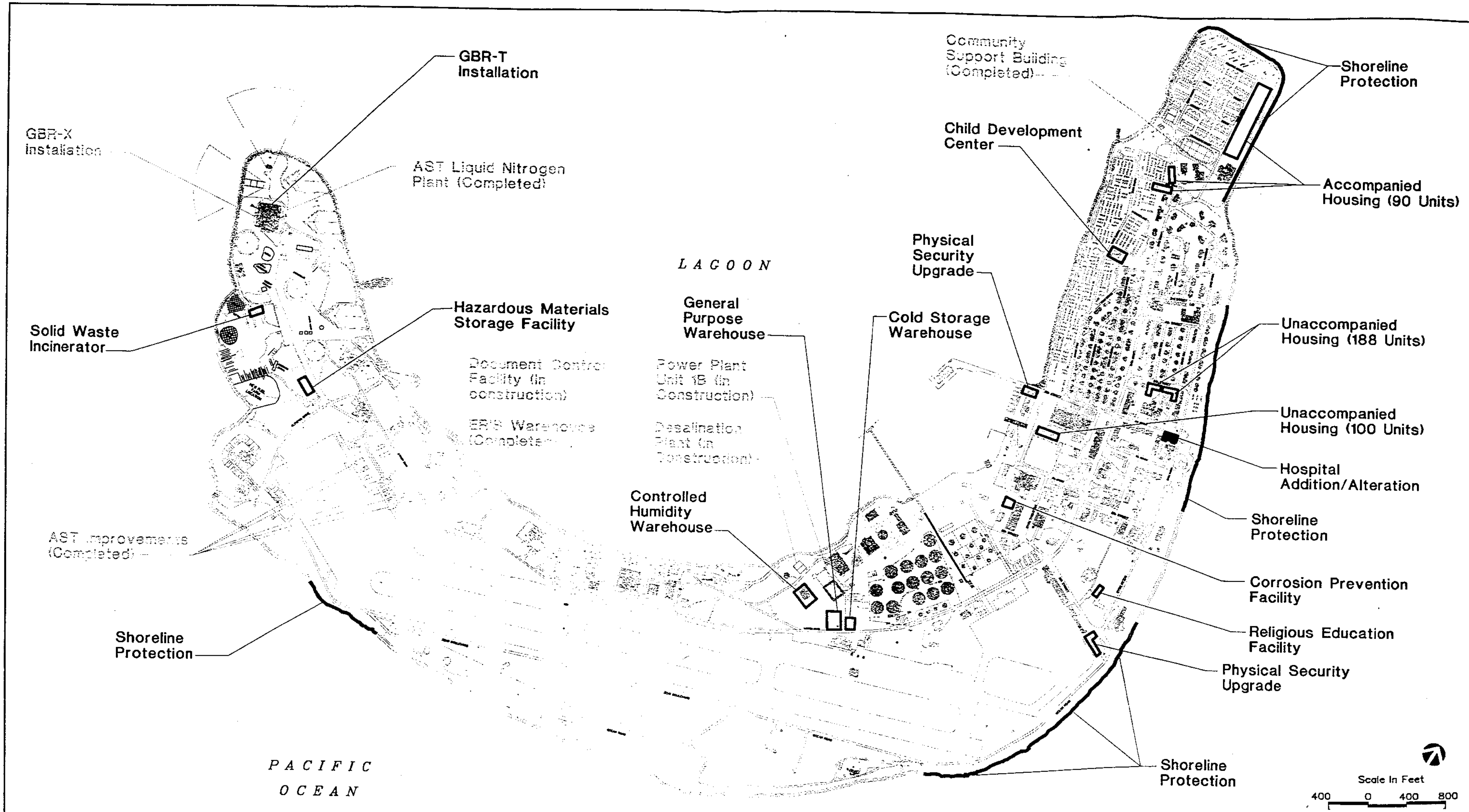
Table 2.1-13
Summary of New Facilities
Level-of-Activity Alternatives

	Island										
Level	Kwajalein	Roi-Namur	Meck	Ennylabegan	Omelek	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennugarret
Intermediate	Command control center; shoreline protection; possible location of Ground Entry Point communications facility	Shoreline protection; possible location of Ground Entry Point communications facility	1,100-foot (335-meter) island expansion; three launch facilities; renovation of existing silo; missile assembly building; payload assembly building; fuel storage; fueling facility; vehicle storage facility; camera shelter; quarrying and dredging; destruction of existing silos; portable TMD-GBR launcher*		Shoreline protection; portable TMD-GBR launcher*	Splash detection radar upgrade; possible EOD pit; road construction; portable TMD-GBR*	Six launch silos; launch control room; launch equipment; building renovation; missile/payload assembly building; liquid propellant storage; improve camera stations and communication facilities; physical security facility; sandblast area; paint shed; fire station; power plant and distribution upgrade; fuel storage upgrade; potable water renovation; wastewater system upgrade; harbor dredging; expand helipad; fuel and personnel pier; marine ramp; possible use for RV land impact; shoreline protection and revetment; destruction of existing silos; portable TMD-GBR launcher*	Splash detection radar; portable TMD-GBR*	Modernize splash detection radar and HITS facility; portable TMD-GBR*		Possible EOD; helicopter pad; road construction; marine ramp

Table 2.1-13
Summary of New Facilities
Level-of-Activity Alternatives

	Island										
Level	Kwajalein	Roi-Namur	Meck	Ennylabegan	Omelek	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennugarret
High	Fiber optics cable connecting Kwajalein with Wake Island		Controls for remote launches at Omelek and Eniwetak; shoreline protection	Nine-meter telemetry antenna; telemetry link antenna; shoreline protection	Two launch silos; 130-kW power plant; 50,000-gallon (189,267-liter) fuel tank; fuel ramp; demolish existing facilities; shoreline protection	Command control transmitters; two MPS-36 radars; SuperRadot camera facility; ballistic camera; spectral camera station; theodolite station; generator building with four 130-kW generators; 20,000-gallon (75,707-liter) diesel fuel tank; portable latrine; shoreline protection; possible EOD pit		Impact detection and timing system; fiber optics cable; large-aperture telemetry antenna; SuperRadot camera; ballistic camera; spectral camera station; theodolite station; personnel shelter; generator building with four 130-kW generators; 20,000-gallon (75,707-liter) diesel fuel tanks; portable latrine; shoreline protection	Two small met rocket launch facilities; extend ends of island; launch control facility; missile assembly building; equipment storage shelter; explosives storage building; personnel trailer; move sensors; fiber optics cable; two 130-kW generators; 20,000-gallon (75,707-liter) diesel fuel tank; new helipad; expand surface by 45,000 square feet (4,181 square meters); shoreline protection	Six-station launch complex; launch hill; four remote cameras; equipment room; launch equipment building; power plant with four 130-kW generators; 20,000-gallon (75,707-liter) fuel storage tank; fuel ramp; potable water facility; 20,000-square-foot (1,858-square-meter) water catchment; sewage facility; fencing; warehouse; guardhouse; technical support building; demolition of existing structures; shoreline protection; portable TMD-GBR radar* and portable TMD-GBR launcher*	

*Does not require construction of new facilities.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
KWAJALEIN

FIGURE 2.1-8

Unaccompanied Personnel Housing. One hundred and eighty-eight units of unaccompanied personnel housing (UPH) would be constructed in two projects located on the current site of the Surf Bachelor Quarters (Facility No. [FN] 501) on Fifth Street and Ocean Road. FN 501 would be demolished, so the increase in housing would be 188 minus 24, or 164 net. The construction of these UPH facilities was analyzed in the 1989 EIS, but the size and location of the project have changed substantially. Records of Environmental Consideration for these projects were prepared by USAKA in 1992, and the projects are included so that any cumulative impacts can be considered.

Another UPH project of 100 units would also be constructed immediately to the south of FN 602 in an area that is currently used for warehouses, but is planned in the long term to be within the Community Support/Bachelor Housing area for USAKA.

Family Housing. Ninety housing units for accompanied personnel would be built on the ocean side of Ocean Road, extending from the northern point of the island, past Corlett Recreation Center, to Nike Drive. The 1989 EIS identified housing for accompanied personnel as a proposed action; however, the location of these housing units has significantly changed (from the lagoon to the ocean side of the island) and, therefore, is included as a proposed action of this SEIS. Construction of this housing project close to the ocean shore would require improving approximately 2,000 feet (610 meters) of existing shoreline protection.

Physical Security Facilities Upgrade. Improvements to the physical security facilities consist of renovation and addition (6,174 square feet) to facilities at Air Terminal 901 and replacing facilities adjacent to the marine terminal at Echo Pier on the south side of Sixth Street. The facilities at the air terminal and at the dock are used for receiving and processing employees, family members, and visitors entering and leaving USAKA. The marine terminal facility will consist of a marine terminal, an external waiting area, a covered portico, and a sentry station, with a total of 8,170 square feet (759 square meters). Existing buildings on the site (the deteriorated Marine Passenger Terminal [FN 608, formerly FN 1733], Waiting Shelter [FN 618], and Guard Checkpoint [FN 788]) will be demolished and the existing bicycle racks relocated. An interim physical security facility will be built on the north side of Sixth Street, in a vacant area immediately to the north of Sixth Street, and will handle security functions while the permanent facility is being constructed. An *Environmental Assessment of the Physical Facility Marine Terminal* was prepared by USAKA (October 1992) and a Finding of No Significant Impact (FONSI) was issued in November 1992. A Record of Environmental Consideration for the air terminal project was issued in October 1992. The marine and air terminal physical security facilities are included in this SEIS so that any potential cumulative impacts can be considered.

Religious Education Facility. An 8,160-square-foot (758-square-meter) building adjacent to the existing chapel on Ocean Road and Ninth Street would be built. This building would be physically separate from the existing chapel, but would be constructed with roof and siding materials that would resemble or be compatible with the existing chapel (which dates to World War II). An *Environmental Assessment of the Religious Education Facility* was prepared in April 1993 and a FONSI was issued in June 1993 (USASSDC, 1993b). The Religious Education Facility is included in this SEIS so that any potential cumulative impacts can be considered.

Hazardous Materials Storage Facility. A Hazardous Materials Storage Facility would be constructed at the southern end of Kwajalein Island, between the Japanese Memorial Cemetery (FN 698) and the landfill. The building would have a gross floor area of 40,000 square feet (3,716 square meters). Facilities would include compartmented/ segregated areas, spill containment structures, office and laboratory facilities, and support infrastructure.

Solid Waste Incinerator. Existing air-curtain burn-pit operations at the Kwajalein Island Landfill would be replaced with three interim fixed-hearth incinerators beginning in late 1993. Three permanent incinerator units, each with a capacity of approximately 15 to 18 tons (14 to 16 metric tons) per day, are planned to replace the interim units. The new facility would have a capacity of about 45 to 54 tons (41 to 49 metric tons) per day, which would be twice the current burn-pit capacity.

Three Warehouses. Three warehouse structures would be constructed immediately north of Lagoon Road and south of Power Plants 1 and 1A. The **cold storage** warehouse would consist of a new 26,200-square-foot (2,434-square-meter) reinforced concrete structure capable of storing up to 1.6 million pounds (725,744 kg) of frozen and perishable goods, and of manufacturing ice. The **controlled humidity** warehouse would provide up to 69,905 square feet (6,494 square meters) of dehumidified storage space to accommodate up to 2 million pounds (907,180 kg) of humidity-sensitive commodities. This warehouse would use the existing Zeus Acquisition Radar (ZAR) Transmitter Building, which would be renovated and expanded. The **general purpose** warehouse would consist of 109,662 square feet (10,188 square meters) of storage space for general purpose USAKA range and facilities use. The three warehouses would replace a number of other warehouse facilities. Twelve other warehouse buildings would be demolished and five other warehouse buildings would be reused for other functions. Lens Well No. 5 at the cold storage warehouse site would be demolished. An active underground fuel pipeline passing directly beneath the site of the general purpose warehouse would be realigned around the site. The three warehouses were the subject of an Environmental Assessment (USASDC, 1992a) and FONSI (USASDC, 1992b), and are described here so that any cumulative impacts can be identified.

Corrosion Prevention Facility. A corrosion prevention facility (10,500 square feet [972 square meters]) would be constructed on Kwajalein Island, immediately north of Ninth Street and west of FN 808, to provide service for USAKA vehicles and heavy equipment. This facility was the subject of an Environmental Assessment and a FONSI in July 1993 and is included here so any cumulative impacts can be identified.

Hospital Addition/Alteration. The existing hospital building would be expanded by 11,440 square feet (1,063 square meters). The addition would provide six physician offices, a nurse station, six examination rooms, a triage room, a trauma room, a treatment room, and a special procedures room. The alteration would relocate the industrial hygiene and physical examination sections into the existing hospital from the two converted housing trailers in which they are now located.

Child Development Center. A Child Development Center (11,210 square feet [1,041 square meters]) would be constructed on Kwajalein on the site of existing trailer housing units (Nos. 715, 720, and 721 through 724) on the northeastern end of the island. Demolition/construction activities and associated environmental impacts were the subject of a REC prepared in February 1993 (USAKA, 1993b). The REC determined that construction of the Child Development Center would not result in any significant environmental impacts.

Marine Transport. The increased level of activity would require increased marine transportation services. Specific new activities include the need for one additional catamaran to serve Meck Island, and support for the GSTS program recovery ship. This ship is self-contained and would anchor off shore from Kwajalein Island; however, Kwajalein port facilities would handle the landing, loading, and unloading of the ship's launch, and Kwajalein Island facilities would be used for shore leave for the GSTS recovery ship crew.

Fuel Tank Containment Upgrade. The 1989 EIS identified the need for improved containment for abovegrade fuel tanks on most USAKA islands. Containment at existing tank 1016 (53,340 gallons [201,900 liters]) and three small tanks adjacent to Power Plant 2 would be upgraded by improving existing berms and adding flexible impermeable membrane liners, oil/water separators, and sumps. All work would occur within existing disturbed areas in and adjacent to the existing facilities. In follow-on projects, containment at other existing aboveground fuel tanks would be comparably improved.

Ground-Based Radar Test. The GBR-T is a major new radar facility that would provide search, tracking, and discrimination capabilities in support of the ground-based interceptors. In this alternative, the GBR-T would be constructed in the same location as the GBR-X radar in the No-Action Alternative (i.e., FN 1500 at the western end of Kwajalein Island), but as a more powerful radar with a higher electrical load. GBR-T would operate in the X-band (8 to 12 GHz) at less than 300-kW average radiated power. The radar would be installed within existing FN 1500.

FN 1500 is an existing facility that was originally designed to hold a large radar; currently, it is used for temporary storage. Installation of GBR components would require structural improvements to FN 1500, including the construction of an internal support tower and foundation to support the gravity, wind, dynamic, and seismic loads of the radar. Within the building, electrical power substations, power distribution equipment, air conditioning and ventilating units, and compressed air and fire protection equipment would be installed on various floors. Computer facilities, office space, a mission control room, and storage rooms would be constructed within the building, and an elevator would be added in a shaft extending through the existing roof to provide access to the radar unit.

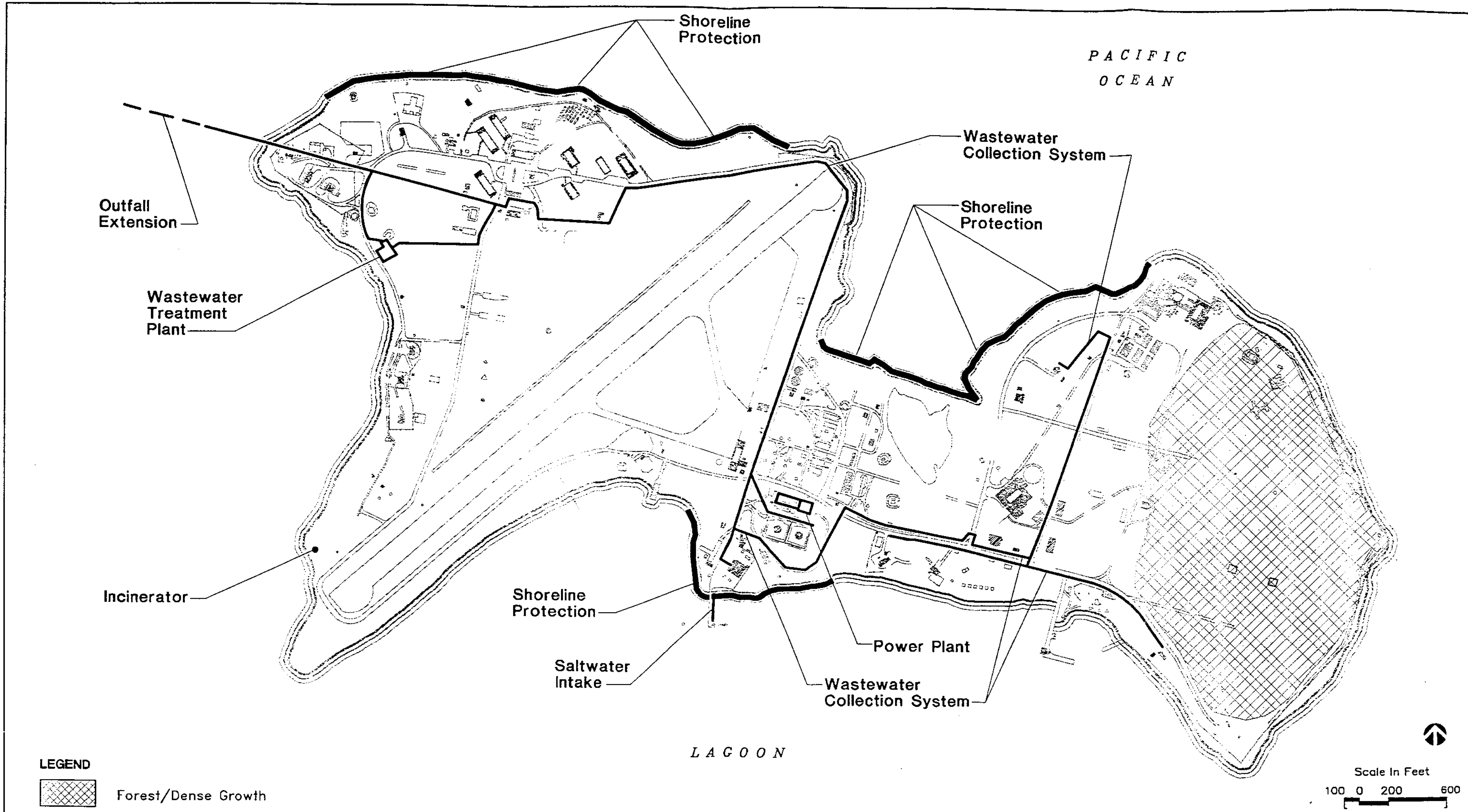
The radar would be connected to existing power and utility lines. This would involve adding a 1,100-foot (335-meter) potable water line to an existing line, adding a 2,300-foot (701-meter) nonpotable seawater line to an existing line, and placing 5,600 feet (1,707 meters) of underground electrical feeder lines. A 4,000-gallon underground septic holding tank would be installed at the north side of FN 1500. The tank would be double-walled, have a high-level alarm, and would be pumped into the Kwajalein wastewater treatment system at least every 4 days. Two new masonry buildings would be constructed, one next to FN 1500 to house fire pumps, and one next to FN 993 and near Power Plant 1B to house transformers. The majority of this construction would take place within areas previously disturbed by fill materials.

As part of an electromagnetic radiation (EMR) monitoring and safety system, a minimum of 10 EMR sensors would be sited at different locations at appropriate distances from the GBR-T. The exact location and number of sensors would be determined during radar installation and testing when actual low-level EMR measurements are taken. A *Ground-Based Radar (GBR) Family of Strategic and Theater Radars Environmental Assessment* and FONSI were issued by the U.S. Army Program Executive Office, Missile Defense, in June 1993. The GBR-T is included among the new facilities evaluated in this Supplemental EIS in order to ensure that any cumulative impacts associated with the GBR-T are addressed.

Shoreline Protection. Several reaches of shoreline would be fortified or reconstructed to protect existing facilities and facilities proposed to be constructed as part of this alternative (as shown in Figure 2.1-8). At the northeastern tip of the island, approximately 2,400 feet (732 meters) of shoreline protection would be upgraded to protect housing proposed to be built near the shoreline in that area. South along the shoreline adjacent to the housing and community center areas, approximately 2,400 feet (732 meters) of shoreline protection would be constructed. Farther south, one reach totaling approximately 2,900 feet (884 meters) would be protected near the air terminal and the east end of the airfield. Along the southwest ocean shoreline, approximately 450 feet (137 meters) of shoreline protection would be constructed near the southwest end of the airfield.

ROI-NAMUR

No new major programs or sensor facilities would be sited on Roi-Namur; however, the sensing and tracking facilities on this island would support increased levels of testing activities on other USAKA islands. The nonindigenous population resident at Roi-Namur would increase from 300 in the No-Action Alternative to 350 in this alternative. A number of base operations/infrastructure facilities would be built, as described below and identified in Figure 2.1-9.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
ROI-NAMUR

FIGURE 2.1-9

Power Plant. A new power plant (13.5 MW) is proposed to be built immediately east of the existing power plant (FN 8045), which would be demolished. The plant would have nine diesel engine generators, switchgear, controls, monitoring equipment, traveling crane, and a freshwater closed-loop cooling water system. Three buildings and one trailer would be demolished to accommodate the new plant, which would be housed in a 34,000-square-foot (3,159-square-meter) building.

Three existing fuel tanks (FN 8077, 8078, and 8079) would be replaced with new tanks with improved containment.

Alternatives to this power plant were considered but appear unreasonable. Previous studies at Kwajalein have shown that solar energy is not by itself a reliable source because of cloud cover; in addition, solar collectors require substantial land area, which is severely limited at Roi-Namur. Wind energy is also not fully reliable by itself, and, like solar energy, requires substantial land area. Energy conservation can reduce air-conditioning and other electrical loads but cannot eliminate the major electrical loads at Roi-Namur from radar and other sensor facilities. The proposed location was selected because construction of the power plant at other locations would require lengthier fuel pipelines (the proposed location is near the fuel pier). Location on the Namur side of Roi-Namur could place the power plant within the EMR exclusion zones in that area; construction in most other areas on the Roi side of the island could conflict with existing land uses (e.g., housing, recreation, and community services).

Solid Waste Incinerator. Existing air-curtain burn-pit operations at the Kwajalein Island Landfill would be replaced with one fixed-hearth incinerator with a capacity of 10 tons (9.07 metric tons) per day beginning in the fourth quarter of 1993. The new incinerator is expected to be operational in 1994.

Fuel Tank Containment Upgrade. Containment at two existing tanks (FN 8046 and 8047, each 336,000 gallons) would be upgraded by improving existing berms and adding flexible impermeable membrane liners, oil/water separators, and sumps. All work would occur within existing disturbed areas in and adjacent to the existing facilities. In follow-on projects, containment at two other existing aboveground fuel tanks (FN 8097 and 8098) would be comparably improved.

Saltwater Intake. Cooling water for radars and saltwater for fire protection and the sanitary sewer system are currently pumped from the lagoon by four 2,500-gallon-per-minute (gpm) (9,463-Liter-per-minute [Lpm]) pumps powered by 150-horsepower (hp) electric motors and one 2,500-gpm (9,463-Lpm) fire pump with a dual-drive 165-hp gasoline engine and a 150-hp electric motor. The saltwater intake would be moved to run alongside the eastern portion of the southwest pier. The new intake would be powered by five 3,000-gpm (11,356-Lpm) motors. A slightly lower capacity is required because the power plant has been switched to a closed-loop radiator freshwater cooling system.

A number of alternatives were assessed as possible alternatives to the cooling water intake but were determined to be infeasible at Roi-Namur. Alternatives to seawater cooling include the use of fresh or brackish water wells. Such a well would have to be constructed on the Roi side of the island and water would have to be piped to the power plant location because the Namur side of the island has no freshwater lens. The use of groundwater has the potential for long-term impacts on the limited freshwater supply for the island. Construction impacts would be associated with well drilling. An open-cycle cooling system (once-through cooling water) would require constant pumping from the groundwater. Even if the well were designed to provide brackish water, there would be an impact on the freshwater lens on Roi. Closed systems (i.e., cooling tower approach) would reduce the amount of water required, but would result in other construction impacts. Make-up water would still be needed: the effects of well withdrawal on the groundwater or lagoon disturbance for a seawater intake would still exist. Maintenance of a closed system would be higher (particularly for seawater). The construction impacts of a seawater intake would be short-term and would result overall in the least environmental disturbance.

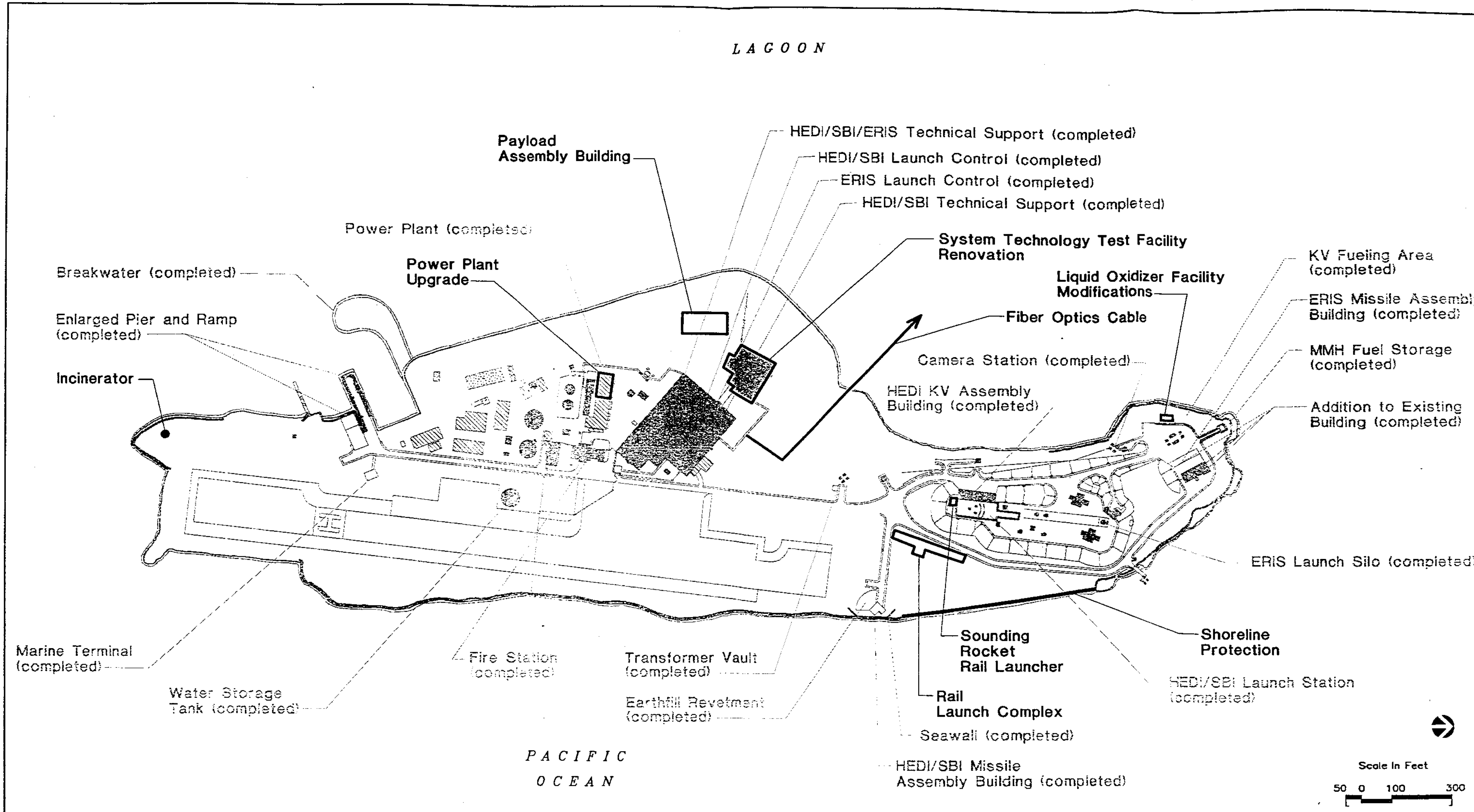
Wastewater Treatment Plant and Outfall. A wastewater treatment plant would be located on the northwestern shore of the island. It would consist of primary treatment (screening, primary clarification, aerobic digestion of primary sludge, a new effluent discharge pump station, and sludge drying beds) with a capacity of at least 70,000 gallons per day (gpd) (264,971 liters per day [Lpd]) and collection of wastewater from the Roi side of the island and the Enidrikdrik area of the Namur side of the island. The existing ocean side outfall, which discharges at an elevation of 0.4 foot (12 centimeters) below mean sea level, would be extended to a depth of 30 feet (9 meters). The outfall would be placed within a trench across the ocean side reef flat and, after placement, would be anchored with concrete anchors.

Shoreline Protection. Approximately 2,000 feet (610 meters) of new shoreline protection would be constructed on the ocean side of the island to protect existing facilities. Another 1,000 feet (305 meters) of shoreline protection wall on the ocean side of the island would be repaired (Figure 2.1-9). Approximately 600 feet (182 meters) of new revetment would be constructed west of the existing fuel pier to protect existing facilities (Figure 2.1-9). Another 700 feet (213 meters) of existing rubble revetment immediately to the east would be upgraded.

MECK

In this alternative, a new launch complex and a new rail launcher would be constructed at Meck Island (Figure 2.1-10), and launches to support expanded test programs would occur. Up to five launches per quarter would occur (two sounding rockets, two stool- or silo-launched SLVs, and one rail-launched SLV).

Although the only workers resident at Meck Island would be construction workers, there on a short-term basis, the increased level of test activities would involve a higher number of workers commuting from Kwajalein Island to work at Meck (an



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SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
MECK

FIGURE 2.1-10

increase of from 125 in the No-Action Alternative to 185 in this Low Level-of-Activity Alternative—see Table 2.1-10). The increase in activities at Meck would require improvements to the island's infrastructure.

Launch Complex. The flight test program on Meck Island would require significant construction activities. A new launch complex would be built southeast of the existing Meck Island Launch Hill (Figure 2.1-10). A new Payload Assembly Building (PAB) would be constructed west of the existing Meck Island Control Building (MICB), FN 5050. The Systems Technology Testing Facility (STTF), FN 5049, abandoned for more than a decade, would require extensive modification and renovations.

The new launch complex would consist of an erectable rail launcher with a 100,000-pound (45,359-kilogram) launch vehicle capacity, a rail-mounted launch shelter, a launch utility building, air conditioning units, and areas for parking various mobile maintenance vans and other vehicles in the area during pre-launch preparations.

The launch complex would consist primarily of a reinforced concrete slab of varying thicknesses constructed on grade. The pad under the launcher would be designed to resist loads associated with rocket assembly, erection, and launch. Another concrete slab, built as a northerly extension of the launch pad, would be provided with rails to support the retractable launch shelter. A concrete pad at the southwest end of the launch pad would be provided for the launch utility building. Bituminous pavements would also be constructed to provide parking areas for associated vehicles.

The payload sections of some launch vehicles require a separate facility area for preparation, testing, and other operations prior to being joined with the rocket motors at the launch complex. The PAB would be divided into two basic functional areas: payload technical operations and mechanical/electrical utility support equipment areas. Approximately 75 percent of the PAB would be devoted to technical payload operations, and 25 percent to utility equipment areas. The following functional areas would be accommodated in the PAB.

- A washdown bay, through which the recovered payload is cleaned with deionized water or solvent; this area opens onto the payload integration bay

- A payload integration bay that has a Class 100,000 clean environment, with sufficient area to prepare two separate payload sections simultaneously

- A technical support area to provide an office environment with observation windows into the payload integration bay and sensor room

- A payload auxiliary equipment room to house a cryogenic cart (containing liquid helium) and vacuum equipment

- A sensor-handling room with a Class 100 clean environment for testing of the sensor

- A tool and parts storage room
- Airlocks and vestibules for controlled access of equipment and personnel
- Facility support areas, personal amenities, and services and utilities, including mechanical and electrical equipment
- An equipment storage bay
- An aluminum-covered, secure walkway to link the PAB with the existing STTF for pedestrian use and mechanical equipment runs

Rail Launcher. A 20,000- or 50,000-pound (9,072- or 22,680-kilogram) launch vehicle capacity rail launcher will be installed at the HEDI launch pad and would be used to launch sounding rockets and other rockets. Sounding rocket launch ordnance and rocket motors would be transferred by barge from Kwajalein to the Roi-Namur Ordnance Storage Facility, processed and integrated at the existing Sounding Rocket Payload Assembly building on Roi-Namur, and then transported by barge to Meck Island for launch at the rail launch facility.

Some launch programs would require the renovation or modification of existing Meck Island facilities.

The existing STTF would be renovated and adapted to provide the following functional areas.

- Mission control area (room 115)
- Data processing area (room 120)
- Equipment storage and maintenance area (rooms 109 and 110)
- Engineering/administration areas (rooms 106 and 107)

Some launch programs may use liquid helium for cryogenic cooling; for example, the GSTS program anticipates a total life-cycle requirement of approximately 185,000 gallons (700,286 liters). The liquid helium would be used in the Payload Assembly Building and environmental shelter of the new Meck Island Launch Facility.

Other launch programs may use liquid fuels and/or oxidizers, such as ClF^5. The existing HEDI fueling facility (FN 5103) has been specifically sited, designed, and constructed for liquid propellant operations. Use for some programs could require modifications, including installation of a climate control shelter to protect payloads from the harsh wind, high humidity, and salt spray at Meck Island (SDIO, 1992).

In addition to these identified modifications to Meck facilities, other modifications and improvements would likely occur; these would be within the existing island perimeter and would not substantially change the functions or types of facilities that currently exist on this highly developed island.

Meck Power Plant Upgrade. The Meck Island Power Plant would be upgraded. The existing Meck Island Power Plant (FN 5030) generates electric power from five diesel generator units, each with 565-kW capacity; two additional 565-kW capacity diesel generators would be installed. The existing power plant structure has adequate space for the two additional diesel generator units with their related switchgear and air starting equipment. The existing foundations would support the skid-mounted engine-generators without modifications. Sufficient air intake openings exist for the increased cooling and combustion air requirements. The existing fuel tank and fuel delivery system is large enough to handle the additional requirements.

Fuel Tank Containment Upgrade. Containment at two existing diesel fuel tanks (FN 5032 and FN 5033, each 150,000 gallons [567,800 liters]) would be upgraded by improving existing berms and adding flexible impermeable membrane liners, oil/water separators, and sumps. All work would occur within existing disturbed areas in and adjacent to the existing facilities. In follow-on projects, containment at the remaining existing aboveground fuel tank (FN 5010, 1,500 gallons) would be comparably improved.

Solid Waste Incinerator. Existing air-curtain burn-pit operations at the Kwajalein Island Landfill would be replaced with one fixed-hearth incinerator with a capacity of 10 tons (9.07 metric tons) per day beginning in the fourth quarter of 1993. The new incinerator is expected to be operational in 1994.

Fiber Optics Cable. A data line (fiber optics cable) to Ennylabegan would be constructed, probably requiring trenching through Meck's lagoon reef. The cable would originate in FN 5050 and would be placed adjacent to the recently installed Submarine Fiber Optics Transmission System (SFOTS) (Environmental Consulting and Technology, Inc. [ECT], 1992), in order to minimize additional impacts to the reef and marine biological resources.

Shoreline Protection. At Meck Island, the construction of a 1,700-foot (518-meter) shoreline protection system is needed from the vicinity of the HEDI MAB facility (FN 5098) north along the ocean side of the island to approximately the vicinity of Camera Station Number Three (FN 5093).

ENNYLABEGAN

The existing fuel tank (FN 6006, 20,000 gallons [75,166 liters]), which is severely deteriorated, would be replaced with a new double-walled, self-contained, above-ground tank. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

A data link (fiber optics cable) to Meck would be installed, originating in FN 6015 and crossing the lagoon reef to the east. The cable would be placed adjacent to the recently installed SFOTS (ECT, 1992), in order to minimize additional impacts on the reef and marine biological resources.

The harbor area would be expanded by dredging to a width of 150 feet (46 meters) in order to accommodate 2000 class LCU vessels (Figure 2.1-11).

OMELEK

Containment at the existing fuel tank (FN 7424, 10,000 gallons [37,583 liters]) would be upgraded by providing a sump lining system. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

Approximately 660 feet (201 meters) of shoreline protection would be constructed along the northeastern and southeastern shore and 20 feet (6 meters) of existing damaged revetment would be replaced to protect existing facilities (Figure 2.1-12).

LEGAN

On Legan, containment at the existing tank (FN 7215, 10,000 gallons [37,583 liters]) would be upgraded by providing a sump lining system. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

The harbor area would be dredged and/or deepened by blasting to accommodate larger boats (LCU Class 2000 vessels as opposed to the smaller LCU Class 1500 vessels that can now dock at Legan). The material removed from the dredged area would be used to fill an area (5,000 to 10,000 square feet [465 to 929 square meters]) on the west side of the harbor to accommodate a new breakwater and marine ramp (Figure 2.1-13).

ILLEGINNI

On Illeginni, containment at the two existing fuel tanks (FN 9021 and FN 9022, each 15,000 gallons [56,780 liters]) would be upgraded by providing a sump lining system. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

The harbor area would be dredged to accommodate larger marine vessels. The mouth of the harbor would be widened and deepened (by means of blasting and/or dredging) to provide a 150-foot-wide (46-meter-wide) channel.

GAGAN

On Gagan, containment at the existing tank (FN 7513, 10,000 gallons) would be upgraded by providing a flexible impermeable membrane liner.

GELLINAM

On Gellinam, containment at the existing fuel tank (FN 7323, 10,000 gallons [37,583 liters]) would be upgraded by providing a sump lining system. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

Approximately 230 feet (70 meters) of new shoreline protection would be constructed along the southwestern portion of the island and 975 feet (297 meters) of new revetment on the northwest side of the island (Figure 2.1-14). Both of these shoreline protection measures would provide protection for existing facilities.

ENIWETAK

The existing fuel tank (FN 7113, 10,000 gallons [37,583 liters]) would be replaced with a new double-walled, self-contained, aboveground tank. All work would occur within existing disturbed areas in and adjacent to the existing facilities.

Approximately 140 feet (43 meters) of new revetment would be added at the northern end of the island to protect the existing Radot Camera Facility (Figure 2.1-15).

ENNUGARRET

No new facilities or functions are proposed in this alternative.

2.1.3 Proposed Action: Intermediate Level of Activity

Subsection 2.1.3 supplements Chapter 2 of the 1989 DEIS. The Proposed Action is an Intermediate Level of Activity, which includes all the activities of the Low Level-of-Activity Alternatives, plus more complex SITs than in the Low Level-of-Activity Alternative.

2.1.3.1 Launch Programs

In this alternative, additional activities to support SITs and other ballistic missile defense system testing (e.g., Theater Missile Defense) would occur. Some tests could involve all-range operational tests with up to six SLVs launched from USAKA and two targets (for example, one launched from PMRF at Kauai and one from VAFB in California), all launched within a period of a few minutes. In addition, Annual Service Practice (ASP) involving flight testing of SLVs would be performed for approximately four launches per year (one per quarter) (Table 2.1-6). Some of the launches for TMD testing could involve the launch of interceptors from Illeginni, Omelek, or Meck to intercept targets launched from ocean platforms (such as ships or barges) or from Wake Island (Figure 2.1-16).

In order to support this level of flight testing, Meck Island would be extended to accommodate new launch facilities or, alternatively, the currently unused launch facilities at Illeginni Island would be completely renovated and reactivated. Test program launches would take place at Meck, Omelek, and Illeginni islands; Roi-Namur and Kwajalein islands would continue to be used for meteorological and sounding rocket launches.

2.1.3.2 Destruction of Existing Silos

The United States is a party to the Antiballistic Missile (ABM) Treaty with the former Soviet Union. Under the treaty, each party is allowed a maximum of 15 ABM test launchers. The United States currently has 11 ABM test launchers—all at USAKA. The 11 launchers at USAKA include 10 that have been inactive for several years—4 Sprint and 2 Spartan launchers on Meck, and 2 Sprint and 2 Spartan silos on Illeginni.

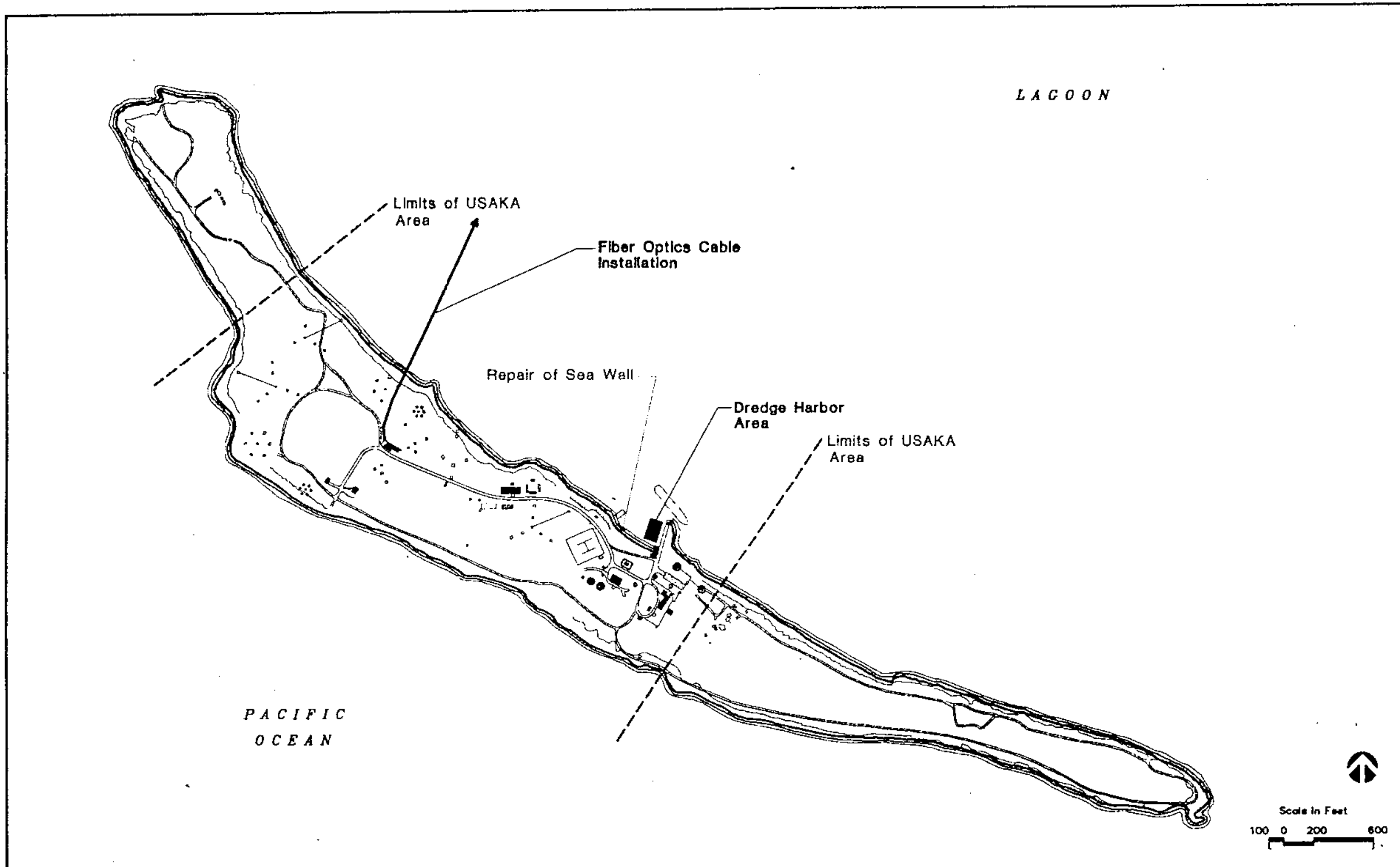
If more than four additional launchers are constructed at USAKA, existing silos would have to be destroyed in order for the total number of launchers to remain below the ABM Treaty ceiling of 15. This alternative would involve construction of new launchers on Meck and/or Illeginni. Because the construction of a new launcher on Meck in the Low Level-of-Activity Alternative (in addition to the construction of a new launcher on Omelek in the No-Action Alternative) would bring the total number of launchers at USAKA to 13, construction of more than 2 launchers in this alternative would require a one-for-one destruction of existing silos.

According to the ABM Treaty, destruction of an ABM silo requires the removal of aboveground structures, headworks, and launch rails. These actions must be completed within 90 days of initiating the destruction process. After 6 months, the silo can be filled with earth or debris and the surface covered or graded. Support buildings in the silo area can be left standing if they are stripped of all related equipment and are not used for their intended purposes.

2.1.3.3 Sensing and Tracking

Existing USAKA facilities would continue to be used for logistical support and tracking/sensing for a wide range of launch programs and incoming reentry vehicles, as in the No-Action and Low Level-of-Activity alternatives.

The reactivation of the Illeginni Island launch facilities could mean that land impact tests might no longer be performed at Illeginni, and that, instead, the number of tests aimed at the lagoon would increase. This in turn would probably require improvements to the lagoon impact instrumentation systems, the Splash Detection Radars (SDRs) and Hydroacoustic Impact Timing System (HITS). The SDRs are 30 years old. Their replacement would be a similar radar system, having significantly improved capabilities and reliability. The replacement of the SDR radars would call for some renovation and modernization of the current facilities on several USAKA



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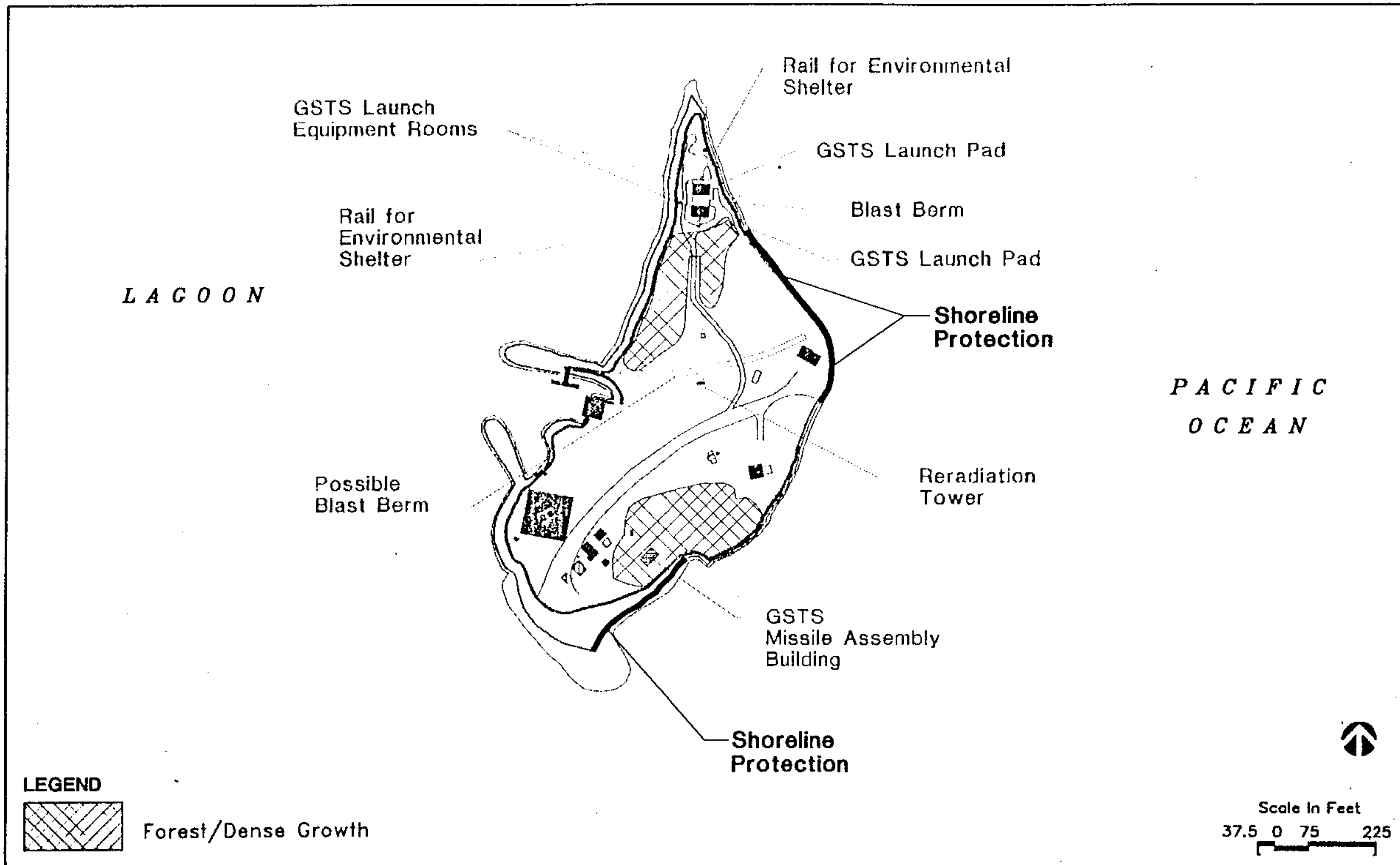
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
ENNYLABEGAN

FIGURE 2.1-11



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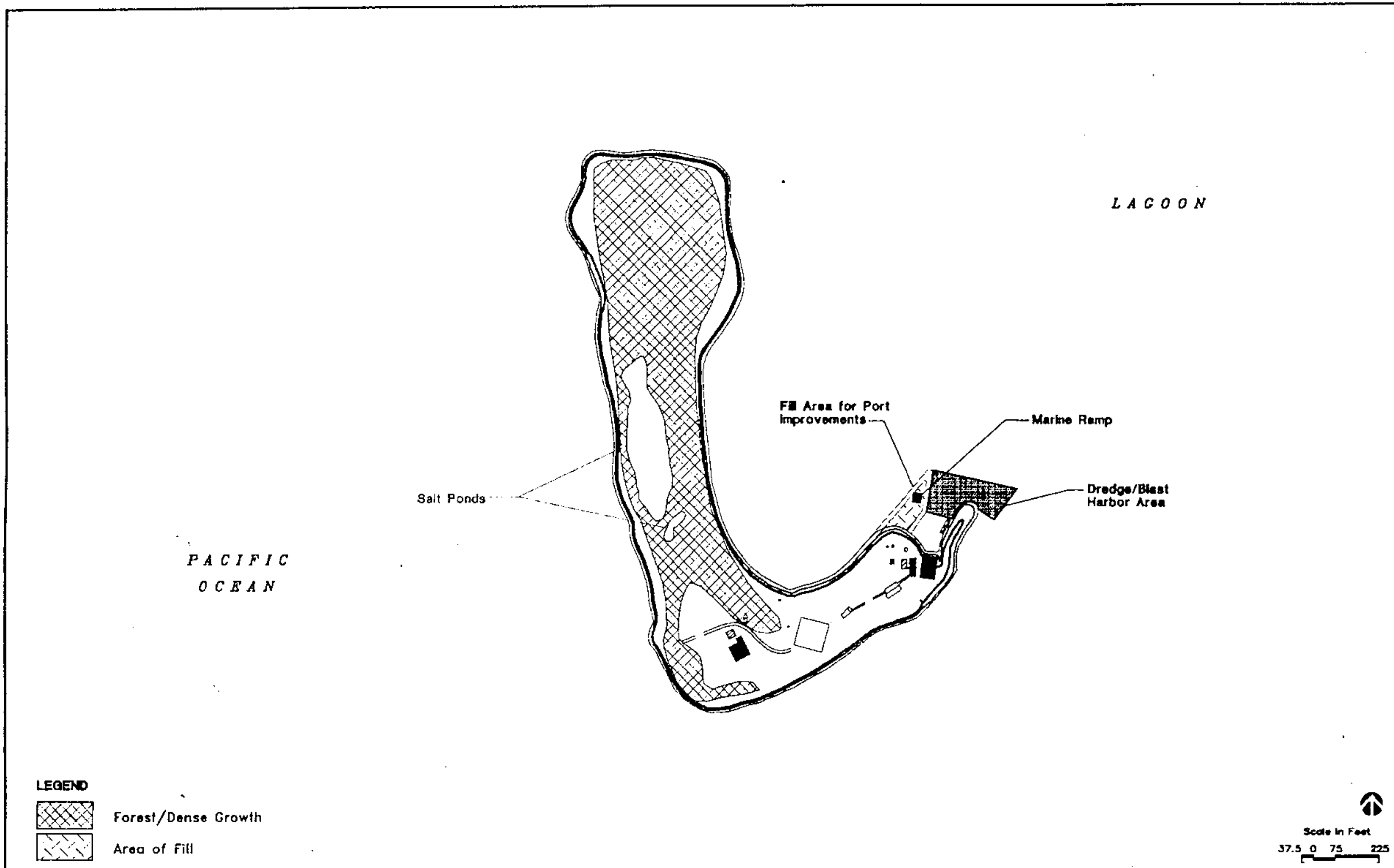
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
OMELEK

FIGURE 2.1-12



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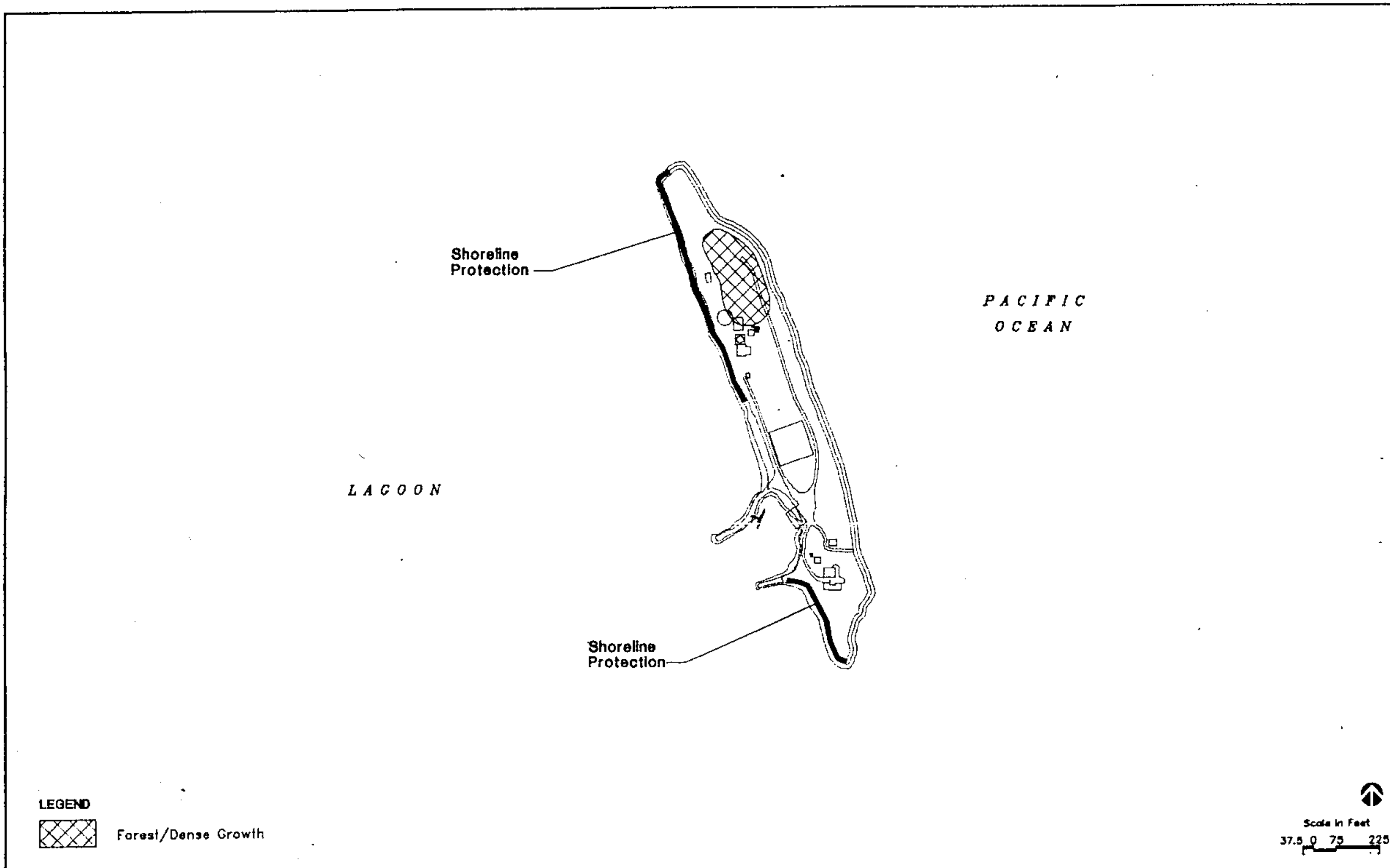
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
LEGAN

FIGURE 2.1-13



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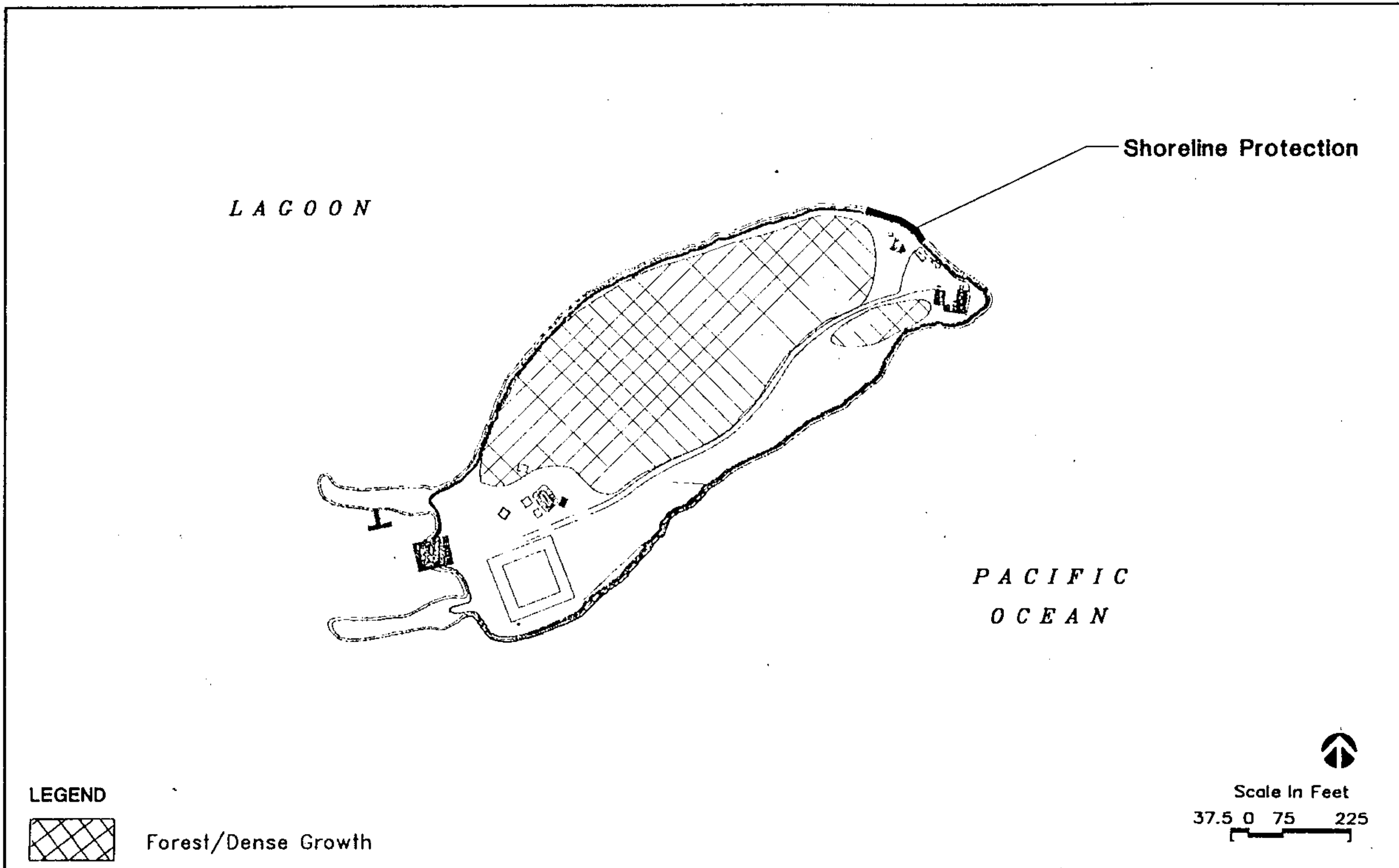
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
GELLINAM

FIGURE 2.1-14



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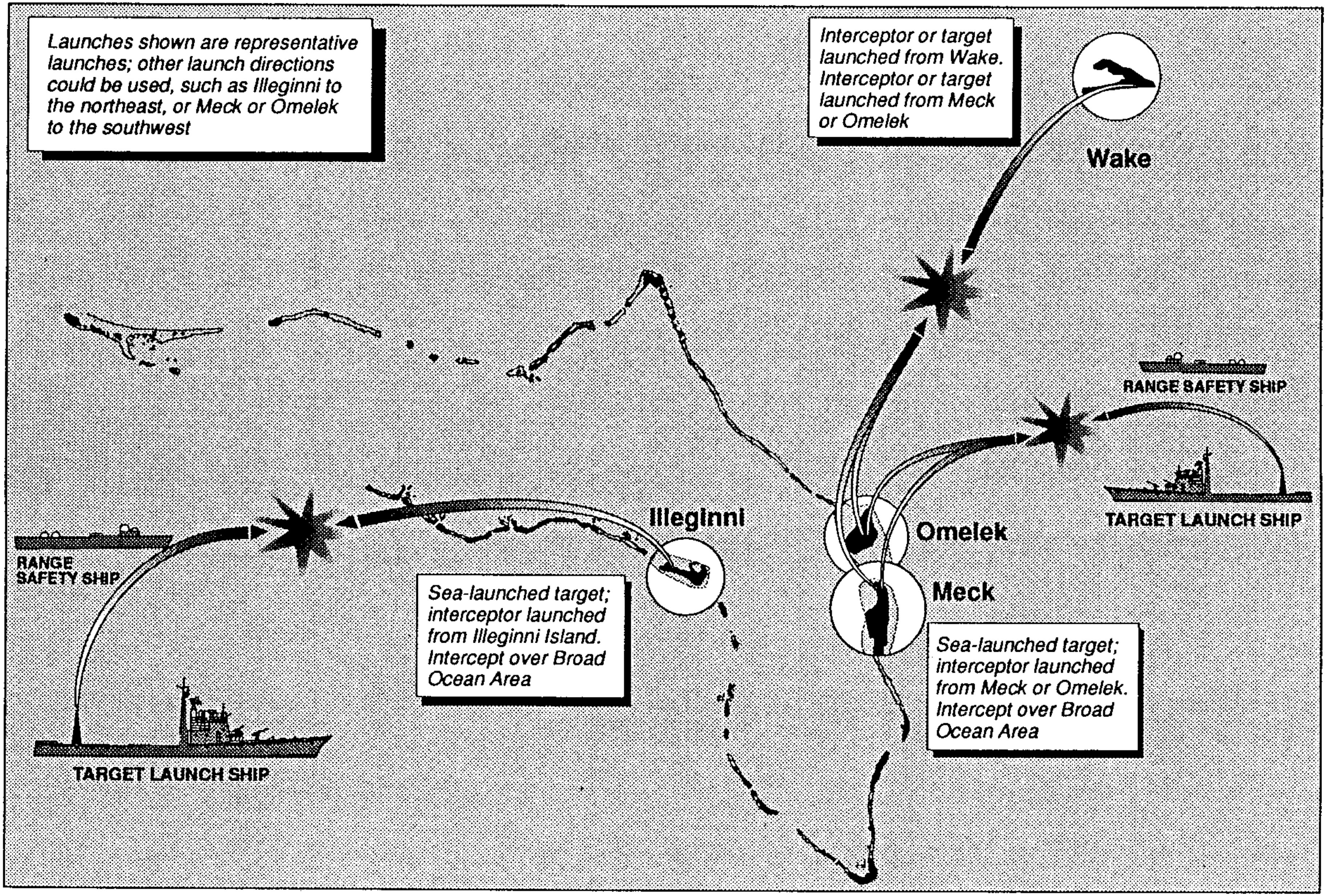
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Low Level-of-Activity Alternative
ENIWETAK

FIGURE 2.1-15



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Theater Missile Defense Testing at USAKA

FIGURE 2.1-16

islands. Additionally, a third SDR site would be added on Gagan Island. The HITS would also require renovation, but no significant new facilities would be required.

A command control center would be installed at Kwajalein; observation ships would be deployed to USAKA to observe specific tests.

A new communications facility, the Ground Entry Point (GEP), would be constructed on Roi-Namur and Kwajalein. The GEP would consist of an antenna, pedestal, and associated electronic equipment mounted within a radome. The GEP would receive and process data from a command center and would communicate with interceptors and other elements of SITs. It would send data at a frequency of approximately 44 GHz and would receive data at approximately 20 GHz. Two GEPs spatially separated by at least 40 kilometers would be needed at USAKA in order to ensure communications during heavy rainstorms. The preferred locations would be the central lagoon side of Kwajalein and the western half of Roi-Namur. Although the specific Kwajalein location is currently unknown, Figure 2.1-17 shows three potential sites. Figure 2.1-18 shows the preferred location of the Roi-Namur GEP.

Theater Missile Defense Ground-Based Radar (TMD-GBR). The TMD-GBR is a portable single-faced, phased-array radar that would support testing of TMD interceptors. At USAKA, the TMD-GBR could be temporarily deployed at Meck, Omelek, Illeginni, Gagan, Gellinam, and/or Legan to track interceptors launched from Meck, Omelek, or Illeginni. The TMD-GBR would be housed on a truck or trailer that can be transported by barge or aircraft. It would be made up of five units: an antenna equipment unit, electronic equipment unit, operators' control unit, cooling equipment unit, and prime power unit. The antenna would operate in the X-band (8 to 12 gigahertz) and would be mechanically adjustable in elevations between 10 and 60 degrees; however, during operation (transmitting), the elevation would be fixed. The TMD-GBR would be transported from Kwajalein to the island at which it is to be used and would be set up within existing cleared areas (i.e., there would be no construction or clearing associated with use of the TMD-GBR at any of the islands). A *Ground-Based Radar (GBR) Family of Strategic and Theater Radars Environmental Assessment* and FONSI were issued by the U.S. Army Program Executive Office, Missile Defense, in June 1993. The TMD-GBR is evaluated in this SEIS in order to ensure that any cumulative impacts associated with the TMD-GBR are addressed.

2.1.3.4 Range Support and Base Operations

This alternative would involve a significant increase in activities at USAKA, which would require a corresponding increase in range support and base operations. Infrastructure to support the level of activities described for this alternative is identified in Chapter 4 of this SEIS. Specific facilities that have been identified as integral to the alternative are listed by island in Subsection 2.1.3.6. Shoreline protection projects to protect new and existing facilities are identified.

Quarrying and Dredging. The shoreline protection and other construction activities identified as part of this alternative would require quarrying and dredging of additional quantities of armor rock, coral, aggregate, and sand (Table 2.1-14). Quarries would be constructed on the ocean side reef flat or the interisland reef flat adjacent to the islands where construction projects are planned to occur, or, if adequate quarry area is not available adjacent to that island, quarry material would be transported from quarries adjacent to other USAKA islands. As an alternative, armor rock and aggregate could be purchased commercially from sources outside USAKA.

2.1.3.5 Employment and Population

In this alternative, the peak nonindigenous population at USAKA would be approximately 4,925 (including 50 construction workers) (see Table 2.1-9). This represents 1,100 more people than the Low Level-of-Activity Alternative, or 1,675 more than the No-Action Alternative. This level of population is comparable with the population levels experienced at USAKA in the early 1970s, during the Safeguard testing program at USAKA.

2.1.3.6 New Facilities and Activities on Each Island

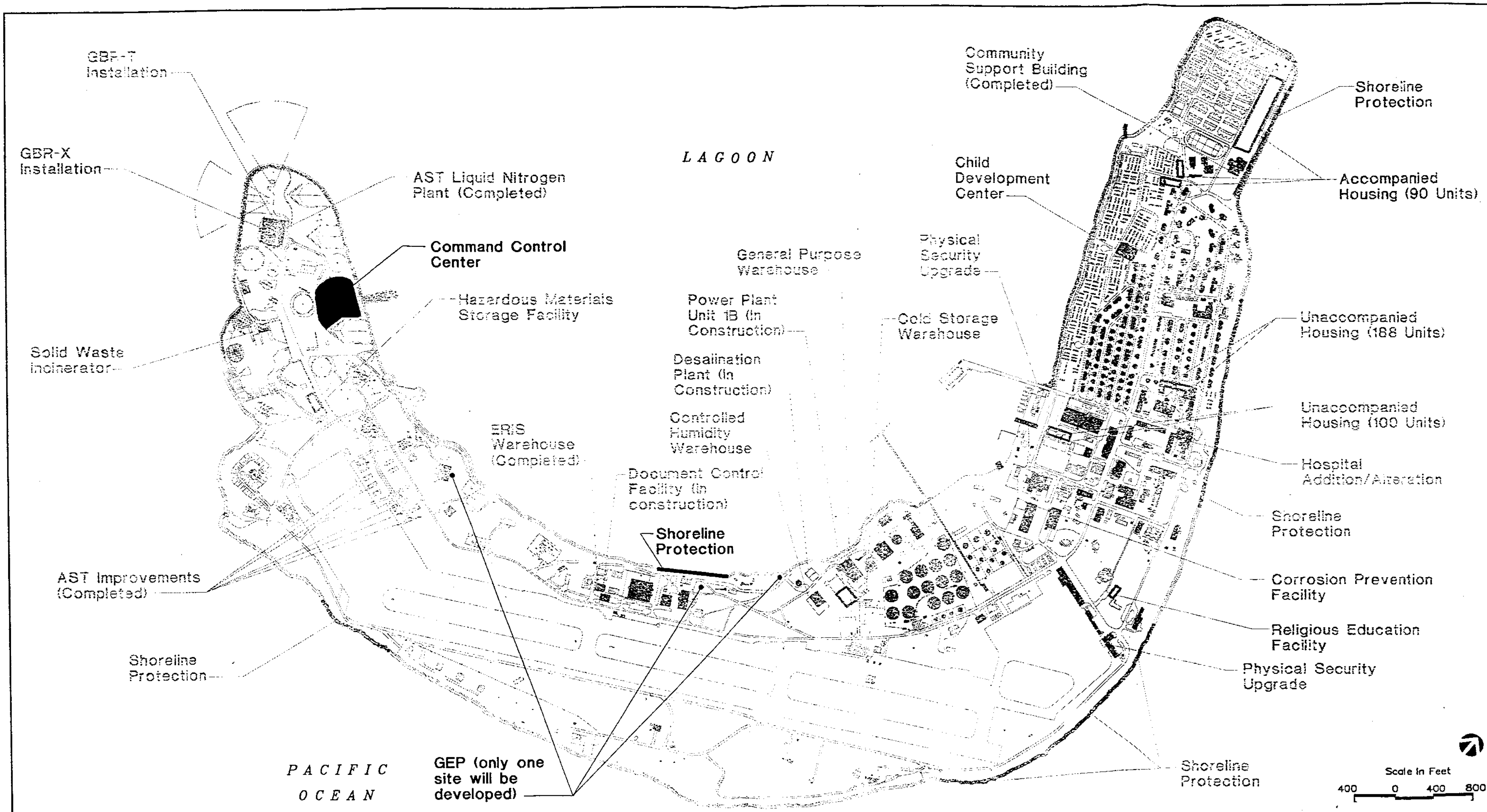
New facilities and launches to support the level of activities proposed for this alternative are described below by island.

KWAJALEIN

The primary new facility under this alternative would involve the construction of a command control center.

USAKA Command Control Center. A USAKA command control center would be established to coordinate sensing and tracking operations at USAKA and to communicate with the BMC^3 center, proposed to be established at Grand Forks, North Dakota. The USAKA command control center is currently envisioned as being constructed in an open area at the west end of the island, which is currently one of several areas used as storage areas for aggregate and dredged materials (Figure 2.1-17). Other sites within areas currently used for research and development or communications operations on Kwajalein might also be used.

Plans for the command control center are very preliminary at this time. The command control center would monitor and coordinate sensing and tracking by other sensors at USAKA or installed in airborne sensors or satellites, and transmit data to other control centers, such as the BMC^3 center. There would be no new radars or sensors directly associated with the command control center. A variety of computer, data processing, and communications equipment would be installed at the command control center. It would be linked to sensors elsewhere on Kwajalein and into SFOTS by fiber optics cable, and it would probably have microwave and radio-frequency



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
KWAJALEIN

FIGURE 2.1-17

Table 2.1-14
Requirements for Quarrying and Dredging
Intermediate Level of Activity
(cubic yards)

Island		Quarried Armor Rock for Shoreline Protection	Dredged Material	
			For Shoreline Protection	For Construction Projects
Kwajalein	Increment[a]	11,600	4,700	250
	Total[b]	46,880	21,260	6,950
Roi-Namur	Increment[a]	0	0	250
	Total[b]	12,000	24,800	950
Meck	Increment I[a]	74,500	0	438,000
	Total I[b]	81,500	9,400	439,000
	Increment II[c]	54,700	0	275,000
	Total II[d]	61,700	9,400	276,000
Omelek	Increment[a]	0	0	0
	Total[b]	1,200	3,300	2,000
Ennylabegan	Increment[a]	0	0	0
	Total[b]	200	0	325
Legan	Increment[a]	0	0	400
	Total[b]	0	0	400
Illeginni	Increment[a]	15,500	22,000	200
	Total[b]	15,500	22,000	200
Gagan	Increment[a]	0	0	0
	Total[b]	0	0	0
Gellinam	Increment[a]	0	0	0
	Total[b]	2,500	3,500	0
Eniwetak	Increment[a]	0	0	0
	Total[b]	600	900	0
Ennugarret	Increment[a]	3,000	0	16,000
	Total[b]	3,000	0	16,000
All islands	Increment I[a]	104,600	26,700	455,100
	Total I[b]	163,380	85,160	465,825
	Increment II[c]	84,800	26,700	292,100
	Total II[d]	143,580	85,160	302,825

[a] Increment = additional material required for this alternative
[b] Total = total material required for this alternative
[c] Increment = additional material required for this alternative assuming that tribar structures will be used to protect the Meck Island extension
[d] Total = total material required for this alternative assuming that tribar structures will be used to protect the Meck Island extension

transmitters and receivers that are broadly comparable with existing facilities on Kwajalein.

Kwajalein Island's range support and base operations facilities would support increased levels of testing activities at other USAKA islands. Infrastructure shortfalls and new facilities required to support a peak nonindigenous population of 4,475 residents at Kwajalein Island are identified in the analysis in Chapter 4.

Kwajalein airport would be used for more frequent visits of technical flights, such as the AST, HALO/IRIS, Argus, and COBRA EYE. The USNS Redstone and USS Observation Island, two ships equipped with specialized sensing equipment, would be deployed to USAKA. Both ships are essentially self-sufficient, carry their own fuels and lubricants, and provide adequate living quarters for their crews; however, USAKA would be required to provide shore leave for personnel; support for docking, loading, and unloading the 30-foot (9-meter) launches both ships use for transporting passengers and cargo between ship and shore; and office space for liaison personnel temporarily stationed at USAKA.

Ground Entry Point. As described in Subsection 2.1.3.3, three GEP communications facility locations are being considered (Figure 2.1-17). The specific location of the facility has not been determined.

Shoreline Protection. Along the central lagoon shoreline, approximately 850 feet (259 meters) of shoreline protection would be constructed in an area where the existing shoreline is eroded and deteriorating (Figure 2.1-17).

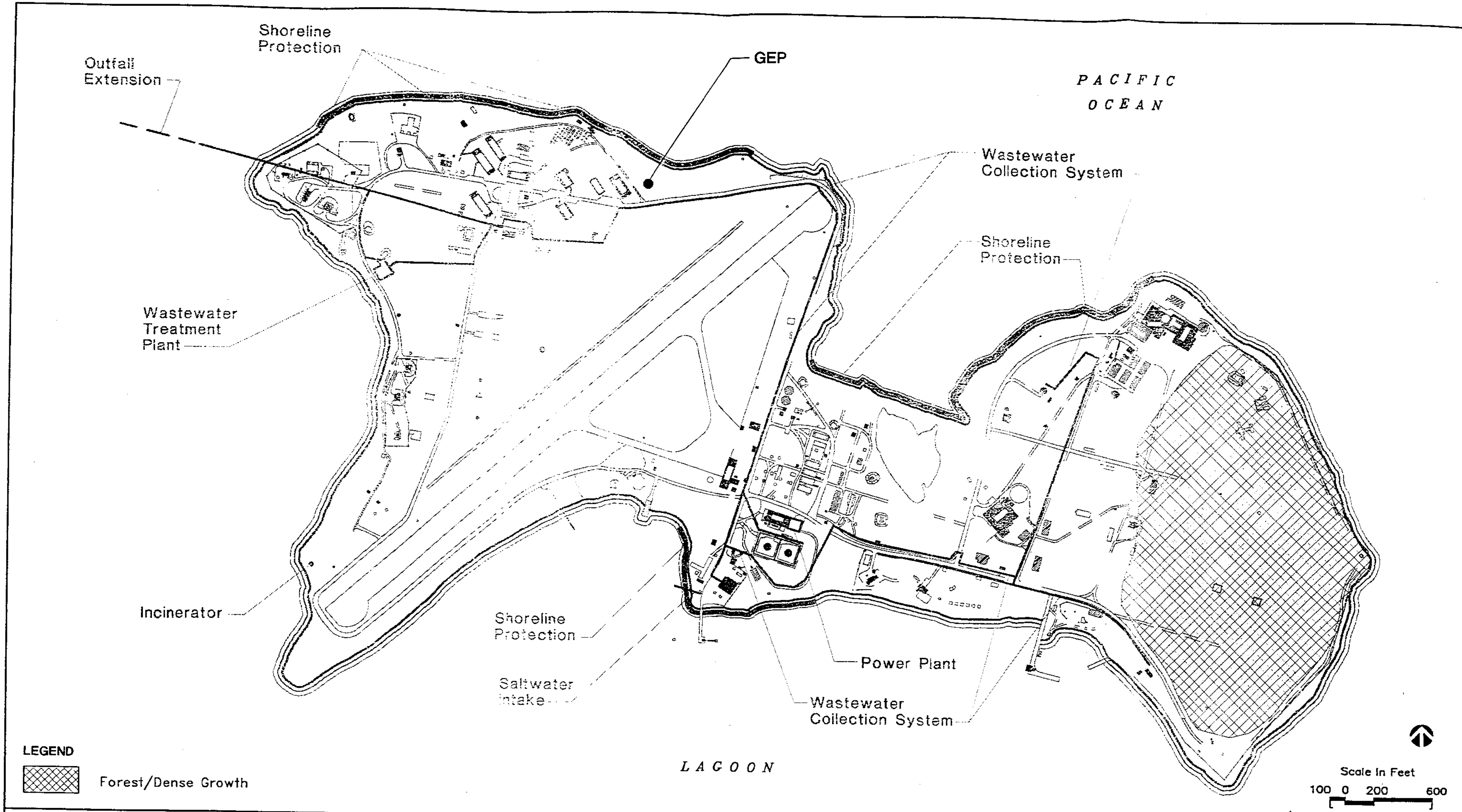
ROI-NAMUR

The number of workers residing on Roi-Namur would increase from 350 in the Low Level-of-Activity Alternative to 400 in this alternative (see Table 2.1-9). These workers would be housed in existing facilities at Roi-Namur; however, accommodating this number of workers might require "doubling up" of personnel.

Ground Entry Point. As described in Subsection 2.1.3.3, a GEP communications facility is planned for construction on the western half of Roi-Namur Island. Figure 2.1-18 shows the location of this planned facility north of Pandanus Road and directly east of FN 8115.

MECK

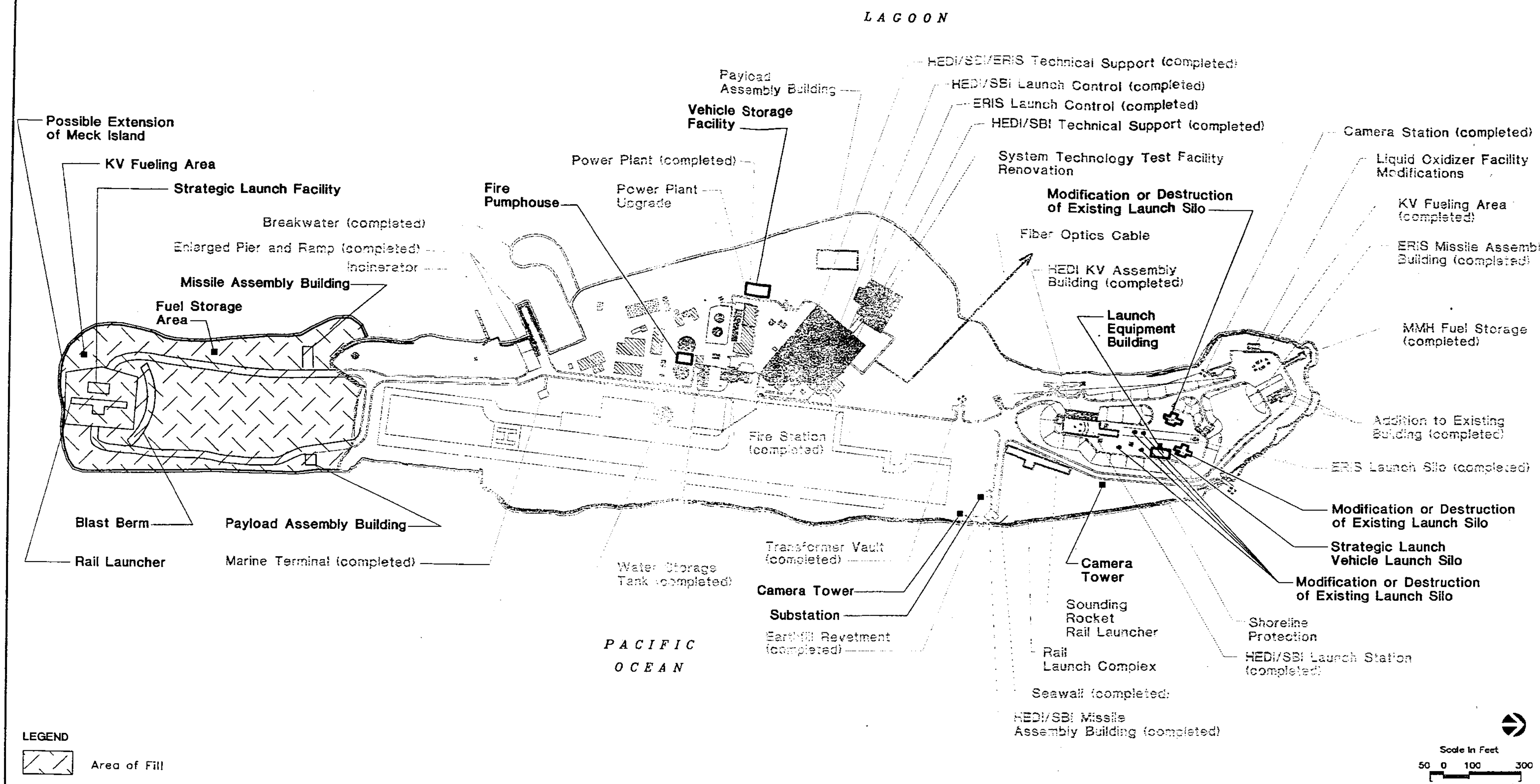
In this alternative, Meck Island would be the location of new launch facilities. An existing Spartan silo on the launch hill area would be renovated to accommodate launches of up to four SLVs at a time (Figure 2.1-19). Another new silo would also be built on the launch hill or another existing Spartan silo modified to accommodate up to four launches of SLVs. These two launch facilities would use existing launch



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
ROI-NAMUR

FIGURE 2.1-18



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
MECK

FIGURE 2.1-19

support facilities (e.g., missile assembly building, payload assembly, and fueling facilities). A new vehicle storage facility, fire pumphouse, and a new launch equipment building would also be constructed.

In addition, there could be other minor construction or modification of launch facilities to support new types of rocket launches (e.g., new suborbital launches for the Theater High Altitude Air Defense System–THAAD). The TMD-GBR, a portable radar, would be used at Meck in conjunction with TMD tests.

Meck Island Extension. New launch facilities would also be constructed at the south end of the island. As shown in Figure 2.1-19, Meck would be expanded to the south by approximately 1,100 feet (335 meters), for a total expansion of approximately 15 acres (6 hectares). The extension would accommodate a rail launch facility for SLVs, a launch stool/pad for sounding rockets, a missile assembly building, a payload assembly building, fuel storage and containment, and fueling facilities. The launch facilities would be used for launching SLVs for a number of programs and there might be simultaneous launches from these facilities with launches from other islands.

The Meck Island expansion would require quarrying and dredging of the surrounding reef flat. The new island area would be protected by revetment. Two options are available for the revetment—armor stone quarried from the reef flat or reinforced concrete, which would require less quarrying but would be more expensive and would require sand, cement, and rebar and the use of an area for casting revetment sections. Extensive quarrying of the reef flats adjacent to Meck Island and/or the interisland reef flat would be required to provide material for fill and for construction. In this alternative, up to six strategic launches could occur quarterly from Meck from a total of five strategic launch facilities (one existing in the No-Action Alternative, one added in the Low Level-of-Activity Alternative, and three added in this alternative).

Destruction of Existing Silos. Construction of the proposed launch facilities at USAKA could require the destruction of some or all of Meck's four existing unused Sprint launch silos and/or modification of two existing unused Spartan silos. As described earlier, ABM silo destruction requires removal of launch rails, headworks, and any aboveground structures required to launch missiles. All of the Sprint and Spartan silos on Meck have their launch rails and electronic equipment intact, and two Sprint silos on Meck have been partially covered with a concrete skirting from a new unused pad. Silo covers have rusted shut, preventing the inspection of silos for asbestos, which has been observed at similar silos on Illeginni. Silo destruction would require asbestos inspection and removal if necessary, and the removal of equipment as specified in the ABM Treaty.

ENNYLABEGAN

No significant new facilities or functions would be developed at Ennylabegan in this alternative.

OMELEK

Theater Missile Defense-Ground-Based Radar. A portable TMD-GBR might be used at Omelek in conjunction with TMD intercept tests. It would be transported to Omelek by barge and set up within already cleared areas. No new construction would be required.

LEGAN

Splash Detection Radar Renovations. The existing SDR facilities at Legan could be renovated and upgraded. All construction would occur on or adjacent to existing structures.

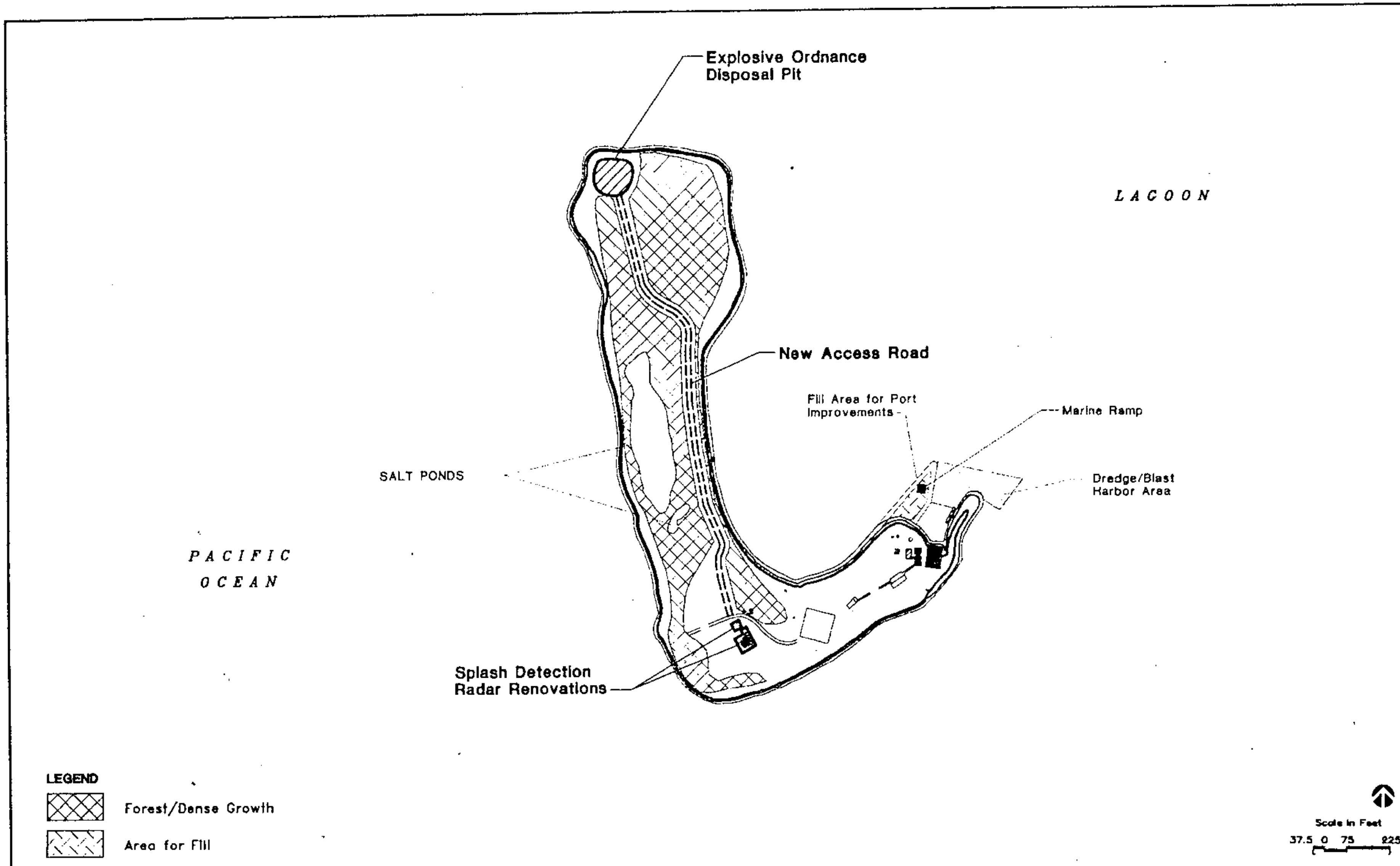
Theater Missile Defense-Ground-Based Radar. A portable TMD-GBR might be used at Legan in conjunction with TMD intercept tests. It would be transported to Legan by barge and set up within already cleared areas. No new construction would be required.

Explosive Ordnance Disposal (EOD) Activities. Explosive ordnance dating to World War II is regularly discovered during construction or other excavation on Kwajalein, Roi-Namur, and other USAKA islands. When ordnance is uncovered, it is examined by trained ordnance disposal specialists and then transferred to explosive ordnance bunkers at Kwajalein or Roi-Namur. Approximately once per quarter, accumulated ordnance is transferred to Illeginni and detonated in an EOD pit on the western tip of the island. EOD technicians conduct a survey of the Illeginni site and rake the EOD pit after detonation to look for debris and explosives not fully consumed in the detonation.

In this alternative, launch facilities at Illeginni Island would be reactivated. In the event that Illeginni Island could not continue to be used for EOD because of launch activities, EOD activities would be analyzed as an option to be moved to Legan or Ennugarret Island. Alternatives to Illeginni are analyzed in this EIS; however, only one site would be selected. Moving EOD activities to Legan would require construction of an EOD pit and a new 2,000-foot (610-meter) road to access the area located at the northern end of the island in order to separate the EOD pit from the existing SuperRadot camera facility and Splash Detection Radar Building by at least 1,250 feet (381 meters) (Figure 2.1-20). The road would be constructed along an existing cleared but somewhat overgrown road in order to reduce its impacts.

ILLEGINNI

Illeginni may be an alternative site for some or all of the launches described above for Meck; therefore, renovation of abandoned Illeginni facilities and the construction of new facilities to accommodate these flights are analyzed as part of this alternative. It is likely, however, that either the extension of Meck Island described previously or the Illeginni development described here would take place, but not both.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
LEGAN

FIGURE 2.1-20

If Illeginni were developed, its launch facilities, unused for several years, would be reconstructed and used for new launch programs involving launches of SLVs. The most intensive launch activities would involve the concurrent (i.e., within 1 hour) launch of up to six rockets. The new facilities would be constructed in previously disturbed areas and would use the foundations of abandoned facilities where economical (Figure 2.1-21). Although no workers would reside at Illeginni (except for temporary construction workers), an average of 215 workers would commute to Illeginni by boat on a daily basis (see Table 2.1-10).

Construction projects on Illeginni include the following:

- Construction of up to six launch silos in the same location as existing silos (on the launch hill).
- Construction of launch control rooms adjacent to the launch hill or at the site of the abandoned operations building (FN 9030).
- Extensive renovation of the existing launch equipment building (FN 9034).
- New missile assembly/payload assembly building constructed on the site of the existing remote launch equipment building (FN 9033).
- Transporter/erector storage and maintenance facility to be constructed on the site of the decommissioned power plant (FN 9020).
- Liquid propellant storage for oxidizer and fuel (two facilities); these would be small facilities (each approximately 75 square feet [7 square meters]) with containment, constructed in previously disturbed areas on either side of the launch hill.
- Improved sensing, communications, and telemetry, requiring renovation of existing camera stations and communications facilities.
- Renovation and modernization of the existing mess hall facility (FN 9010). Part of the building would be used as a dining facility; another area would be a technical support area.
- Construction of a physical security facility on the existing large concrete slab west of FN 9015.
- Construction of a sandblast area/paint shed on the existing large concrete slab north of FN 9017.
- Construction of a fire station at the site of the abandoned civilian dormitory.

- Renovation and modernization of the power plant and island distribution system, substation, and fuel tanks. The existing power plant (three 130-kW diesel units) would be expanded by the addition of three additional 130-kW capacity units. Diesel fuel marine (DFM) storage would be increased from 30,000 to 50,000 gallons (113,560 to 189,267 liters).

- Renovation and modernization of the potable water system, including renovation of an existing 200,000-gallon (757,066-liter) water tank and construction of an additional 275,000-gallon (1,040,966-liter) water tank and pump station, renovation of the water catchment area on the helipad, construction of a freshwater pumphouse, and renovation of the existing water treatment facility.

- Renovation of the island wastewater system. Illeginni Island wastewater is collected and transported to Kwajalein for treatment; in this alternative the existing system at Illeginni would be renovated, or an alternative septic or treatment system would be installed.

- Dredging of the harbor area.

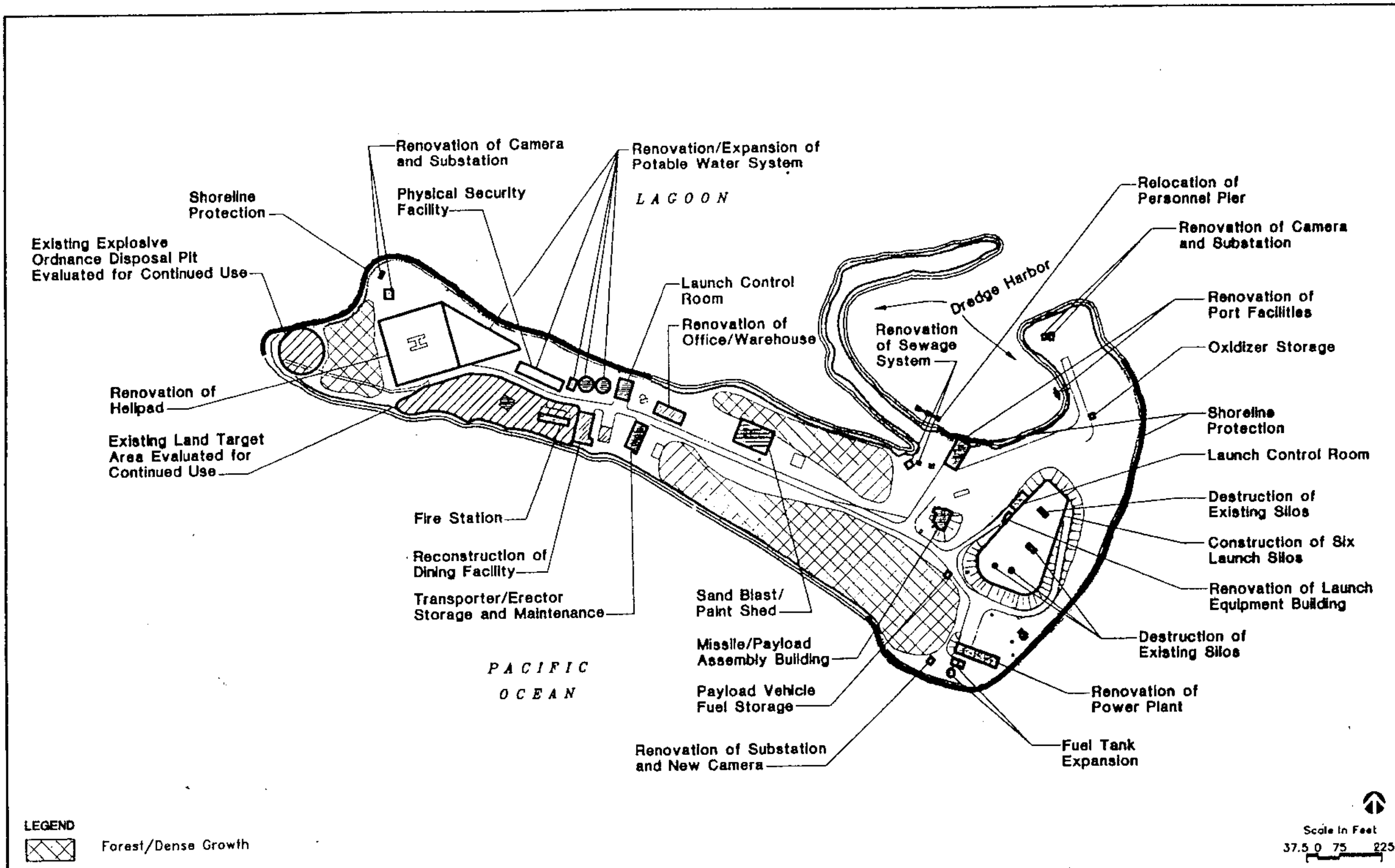
- Modernization and expansion of transportation terminals (helicopter pad, fuel and personnel piers, marine ramp).

- Two new catamarans would be required to transport personnel from Kwajalein to Illeginni; their introduction to Illeginni might require expansion or upgrading of existing marine facilities.

- Possible use of a portable TMD-GBR radar in association with TMD testing.

Construction of the proposed launch facilities at USAKA could require the destruction of some or all of Illeginni's two existing unused Sprint launch silos and two existing unused Spartan silos. As described earlier, ABM silo destruction requires removal of launch rails, headworks, and any aboveground structures required to launch missiles. Silos on Illeginni have been stripped of most of their internal components and silo covers have rusted in place. Recent inspections have identified an asbestos hazard—rooms in the base of the silos have friable asbestos insulation on the elbows and valves of exposed duct and pipe work—but the number of fittings present within each silo is unknown. Silo destruction would require asbestos inspection and removal, and the removal of remaining equipment as specified in the ABM Treaty.

The continued use of the existing EOD site at the west tip of Illeginni Island is proposed in this alternative; however, potential safety concerns related to the EOD activities occurring on the same island as launches would have to be addressed. If these concerns cannot be addressed at Illeginni, other sites at Legan and Ennugarret would be evaluated for possible use for EOD.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
ILLEGINNI

FIGURE 2.1-21

The continued use of Illeginni for land targets would be evaluated in this alternative. Any buildings that cannot be reused would be demolished and any asbestos-containing materials discovered during construction would be removed and disposed of.

Some of the launches from Illeginni would be in support of the TMD program. Launches could occur from Illeginni to the open ocean to the southwest. These Illeginni TMD test launches would intercept a target missile launched from a fixed platform (such as a barge) located up to 310 miles (500 kilometers) to the southwest or the northeast. Target and interceptor debris would fall in open ocean areas southwest or northeast of Kwajalein Atoll.

Shoreline Protection. Shoreline protection along 3,800 feet (1,158 meters) of the shoreline would be completed to protect new facilities, as would the repair of 100 feet (31 meters) of existing damaged revetment at the south end of the island.

GAGAN

A new SDR with a 100-square-foot (9-square-meter) building and 111.6-foot (34-meter) tower base would be constructed on the site of the abandoned SDR tower (FN 7515) (Figure 2.1-22).

Theater Missile Defense-Ground-Based Radar. A portable TMD-GBR might be used at Gagan in conjunction with TMD intercept tests. It would be transported to Gagan by barge and set up within already cleared areas. No new construction would be required.

GELLINAM

Existing sensing and tracking equipment on Gellinam (e.g., SDR and HITS facilities) would be modernized (Figure 2.1-23).

Theater Missile Defense-Ground-Based Radar. A portable TMD-GBR might be used at Gellinam in conjunction with TMD intercept tests. It would be transported to Gellinam by barge and set up within already cleared areas. No new construction would be required.

ENIWETAK

No new facilities or activities are proposed at Eniwetak for this alternative.

ENNUGARRET

Explosive Ordnance Disposal Activities. If EOD activities could not be continued on Illeginni Island (see above, Illeginni and Legan), transferring EOD activities from Illeginni to Ennugarret or Legan would be analyzed as an option in this alternative. EOD activities occur approximately once per quarter (between disposal actions, ordnance is stored in bunkers at Kwajalein and Roi-Namur). EOD technicians conduct a survey of the Illeginni site and rake the EOD pit after detonation to look for debris and explosives not fully consumed in the detonation. Moving EOD activities to Ennugarret would require construction of an EOD pit, a new road to access the area, a helicopter pad, and a marine ramp (Figure 2.1-24). USAKA leases only 6 of Ennugarret's 24 acres (2 of 10 hectares). Use of this island for EOD would require an evaluation of whether the safety distances required for EOD activities could be accommodated within the USAKA island area. If there is insufficient space within the leased area for the EOD activities and required safety distances, USAKA would have to negotiate a modification to the lease agreement with the RMI government or consider another location for EOD.

2.1.4 High Level-of-Activity Alternative

This alternative includes all of the activities of the Low Level-of-Activity and Intermediate Level-of-Activity Alternatives, plus significant new test activities, which would bound the maximum range of activities that could be conducted at USAKA. SITs, more complex than those in the Intermediate Level Alternative, would be conducted at USAKA, involving multiple, near-concurrent launches of interceptors and ground-based tracking system launch vehicles, with data collection and tracking that would involve the full complement of USAKA facilities. In addition to specific, identified SITs, other launches would take place at a frequency that would use the full capacity of each launch facility (see Table 2.1-6). The uses of several of the USAKA islands would change substantially; islands that currently house few facilities (e.g., Eniwetak, Legan, Gagan, and Gellinam) would be the sites of major new facilities.

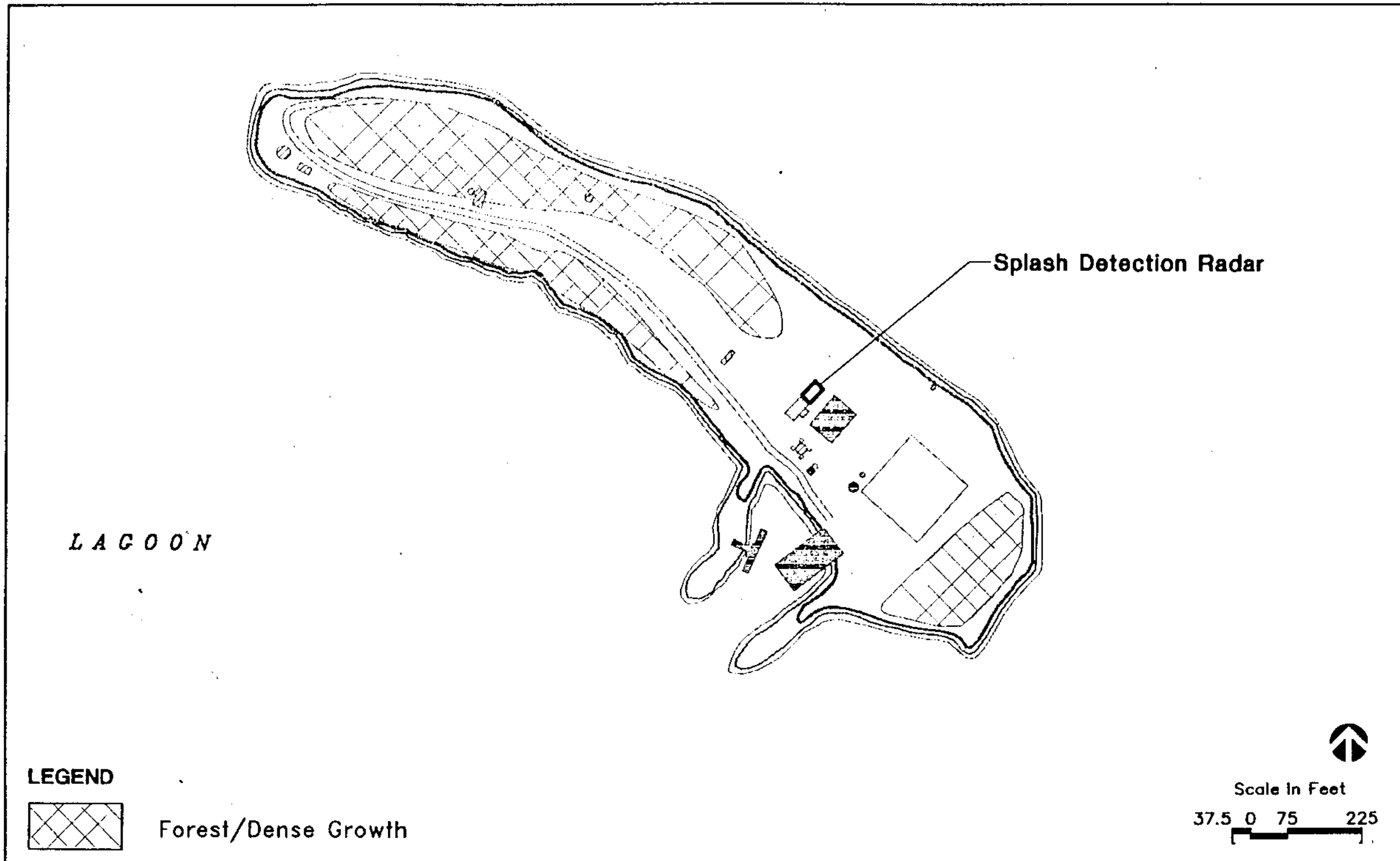
2.1.4.1 Launch Programs

This alternative would include all the launch programs of the other alternatives, plus a higher number of launches from facilities at Meck and Omelek, launches from new facilities at Eniwetak and Omelek, and meteorological rocket launches from new facilities at Gellinam (see Table 2.1-6).

SITs involving near-concurrent launches of multiple sensors and interceptors would occur in this alternative. In the most intensive tests, as many as six interceptors and two ground-based tracking system launch vehicles would be launched in conjunction with several target vehicles.

2.1.4.2 Sensing and Tracking

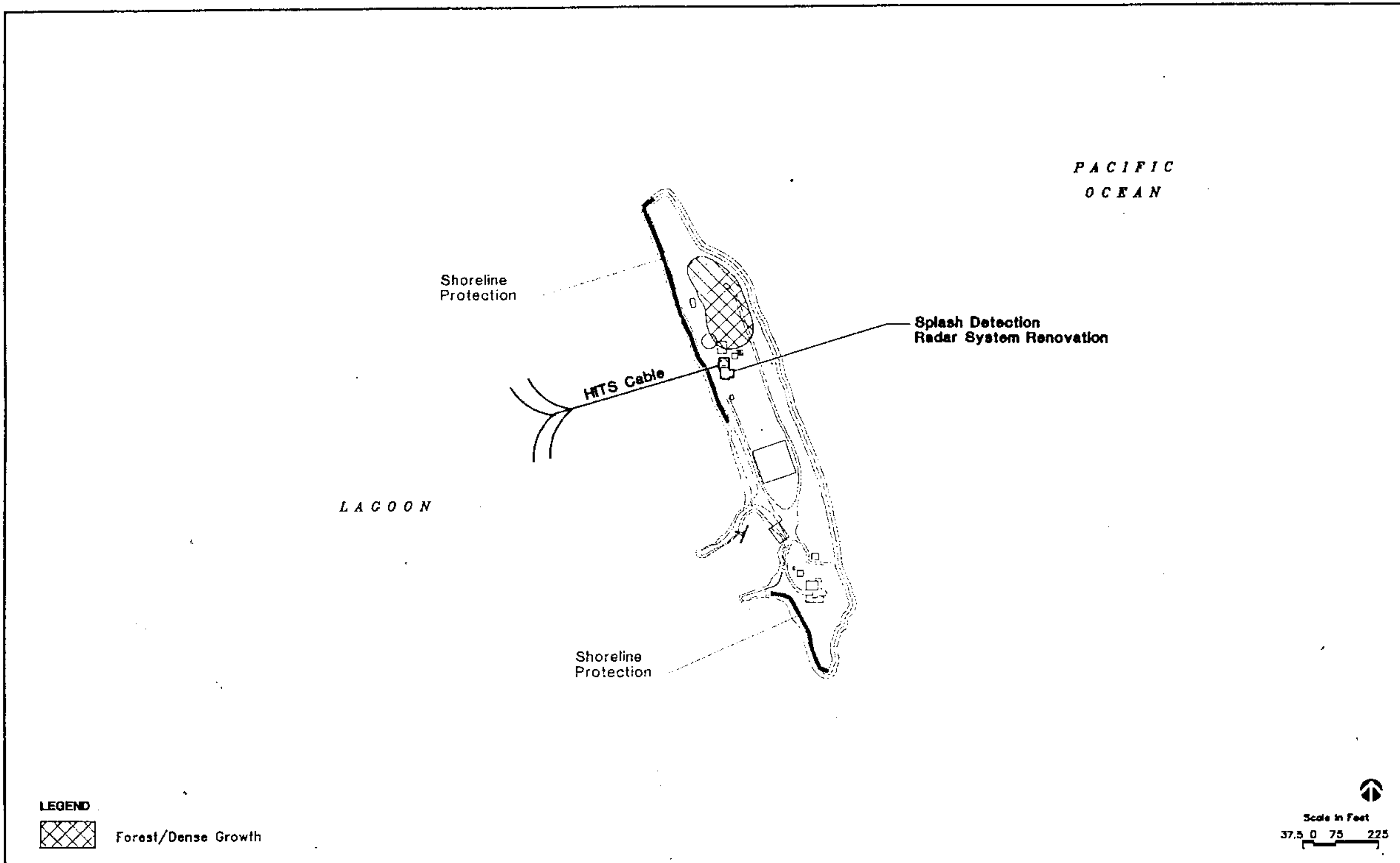
Major new sensing and tracking equipment would be added at Gagan, and additional equipment would supplement existing facilities on several other islands. A fiber optics communications system would be installed, linking Kwajalein Island with Wake Island. A portable TMD-GBR radar might be used in support of TMD test launches.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
GAGAN

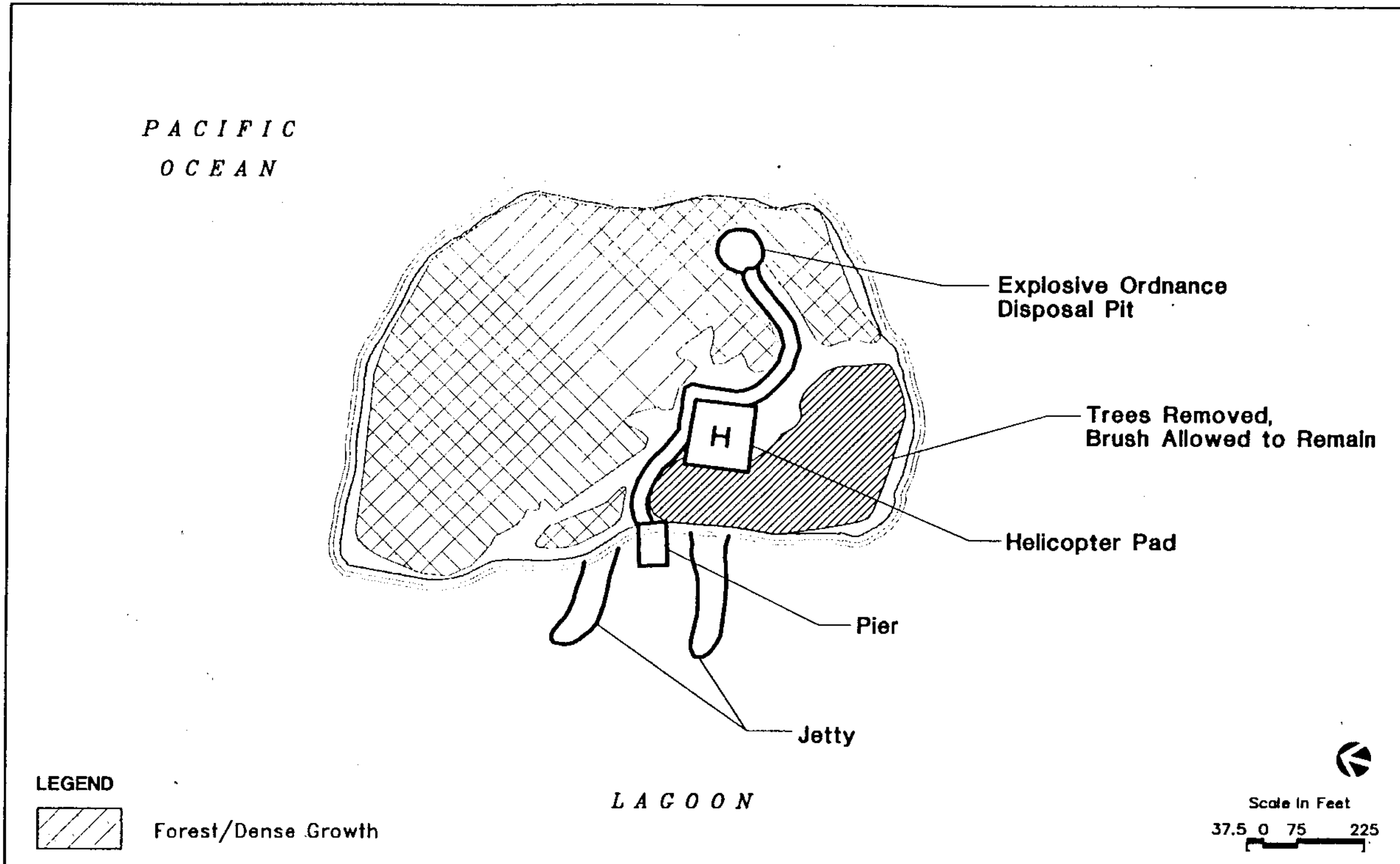
FIGURE 2.1-22



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
GELLINAM

FIGURE 2.1-23



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action
Intermediate Level-of-Activity Alternative
ENNUGARRET

FIGURE 2.1-24

2.1.4.3 Range Support and Base Operations

This alternative, because it would bound the maximum extent of testing activities that could occur at USAKA, would require substantial increases in support activities. Infrastructure shortfalls and additional infrastructure requirements to support the level of activities described for this alternative are identified in Chapter 4. Specific facilities that are integral to this alternative are listed by island in Subsection 2.1.5.

Shoreline Protection. In this alternative, shoreline protection structures would be constructed to protect specific new and existing facilities located close to shorelines identified as at risk for overtopping and/or erosion, as identified below by island.

Quarrying and Dredging. Shoreline protection and other construction activities identified as part of this alternative would require quarrying and dredging of additional quantities of armor rock, coral, aggregate, and sand (Table 2.1-15). Quarries would be created on the ocean side reef flat or the interisland reef flat adjacent to the islands where construction projects are planned to occur, or if adequate quarry area is not available adjacent to that island, quarry material would be transported from quarries adjacent to other USAKA islands. As an alternative, armor rock and aggregate could be purchased commercially from sources outside USAKA.

2.1.4.4 Employment and Population

Under this alternative, the peak nonindigenous population of USAKA would be approximately 5,400 (see Table 2.1-9), which would be reached in 1996 and continue for several years. This level of population is 2,150 higher than the No-Action Alternative, and 475 higher than the Proposed (Intermediate) Action.

2.1.4.5 New Facilities and Activities

KWAJALEIN

Base operations activities would increase in response to the increase in population at Kwajalein (to a total of 4,860—see Table 2.1-9) and the increase in testing activities at USAKA. Infrastructure required to support this level of activities is identified in Chapter 4.

Fiber Optics Cable. A fiber optics communications cable linking Kwajalein Island with Wake Island would be installed. This cable would probably be trenched and laid across the ocean or lagoon reef flat of Kwajalein Island. It would use the same landing as the existing SFOTS, which terminates at FN 1010 (the Range Control Center).

Table 2.1-15
Requirements for Quarrying and Dredging
High Level of Activity
(cubic yards)

Island		Quarried Armor Rock for Shoreline Protection	Dredged Material	
			For Shoreline Protection	For Construction Projects
Kwajalein	Increment[a]	0	0	0
	Total[b]	46,880	21,260	6,950
Roi-Namur	Increment[a]	0	0	0
	Total[b]	12,000	24,800	950
Meck	Increment[a]	2,000	2,800	0
	Total I[b]	83,500	12,200	439,000
	Increment[c]	2,000	2,800	0
	Total II[d]	63,700	12,200	276,000
Omelek	Increment[a]	4,100	6,500	150,000
	Total[b]	5,300	9,800	152,000
Ennylabegan	Increment[a]	400	500	0
	Total[b]	600	500	325
Legan	Increment[a]	4,100	6,500	200
	Total[b]	6,600	6,500	600
Illeginni	Increment[a]	0	0	0
	Total[b]	15,500	22,000	200
Gagan	Increment[a]	1,300	4,000	0
	Total[b]	1,300	4,000	0
Gellinam	Increment[a]	4,100	6,500	16,000
	Total[b]	6,600	10,000	16,000
Eniwetak	Increment[a]	0	1,000	150,000
	Total[b]	600	1,900	150,000
Ennugarret	Increment[a]	0	0	0
	Total[b]	3,000	0	16,000
All islands	Increment I[a]	16,000	27,800	316,200
	Total I[b]	179,380	112,960	782,025
	Increment II[c]	16,000	27,800	316,200
	Total II[d]	159,580	112,960	619,025

[a]Increment = additional material required for this alternative.
[b]Total = total material required for this alternative.
[c]Increment = additional material required for this alternative assuming that tribar structures will be used to protect the Meck Island extension.
[d]Total = total material required for this alternative assuming tribar structures will be used to protect the Meck Island extension.

ROI-NAMUR

No new facilities are proposed at Roi-Namur as part of this alternative; however, the number of workers resident at Roi-Namur would increase from 400 in the Intermediate Level-of-Activity Alternative to 440 in this alternative (see Table 2.1-9). These workers would be housed in existing facilities at Roi-Namur.

MECK

In this alternative, the launch facilities at Meck would be used for a variety of rocket launches. Up to six launches per quarter could occur at Meck in this alternative (two sounding rockets and four strategic vehicles) as indicated in Table 2.1-6. Controls for remote launches at Omelek and Eniwetak would be installed at Meck.

Shoreline Protection. Approximately 475 feet (145 meters) of new shoreline protection would be constructed and 350 feet (107 meters) of existing damaged revetment would be repaired to prevent further erosion and to protect existing facilities (Figure 2.1-25).

ENNYLABEGAN

Additional sensing and tracking equipment would be installed at Ennylabegan (Figure 2.1-26). Representative equipment would include:

- 30-foot (9-meter) telemetry antenna
- Small telemetry link antenna

Shoreline Protection. Approximately 50 feet (15 meters) of existing damaged revetment would be repaired and provided with flank protection, and another 50-foot (15-meter) break in existing shoreline protection would be repaired.

OMELEK

In this alternative, the rail launch facilities at Omelek (to be developed under the No-Action Alternative) would be replaced by a launch hill similar to those on Meck and Illeginni Islands (Figure 2.1-27). The launch hill would have two launch silos; up to two launches of an SLV could occur per quarter (one per quarter from each silo).

Because of the small size of Omelek Island, the launch facility would be primarily supported by existing technical support facilities at Meck Island; rockets may be remote-launched from Meck Island. The launch facility would accommodate a range of SLVs, including self-contained TMD test launches. Up to one pair of concurrent launches per quarter may occur. Remote cameras, an underground equipment room, and a remote launch building may be located in the immediate vicinity of the launch hill.

Related infrastructure improvements would include:

- A new power plant with six 130-kW generators and a 50,000-gallon (189,267-liter) fuel tank.

- A fuel ramp at the harbor.

- All existing facilities on Omelek would be demolished, with the exception of the helicopter pad, marine ramp, and pier. All but approximately 8,000 square feet (743 square meters) of vegetation on the island would be removed.

- Approximately 1,050 feet (320 meters) of new shoreline protection would be constructed.

LEGAN

In this alternative, new sensors would be installed at the northern end of Legan Island, an area of the island not currently developed (Figure 2.1-28). A new road (approximately 3,000 feet [914 meters]) would be constructed to serve this area. Representative facilities could include:

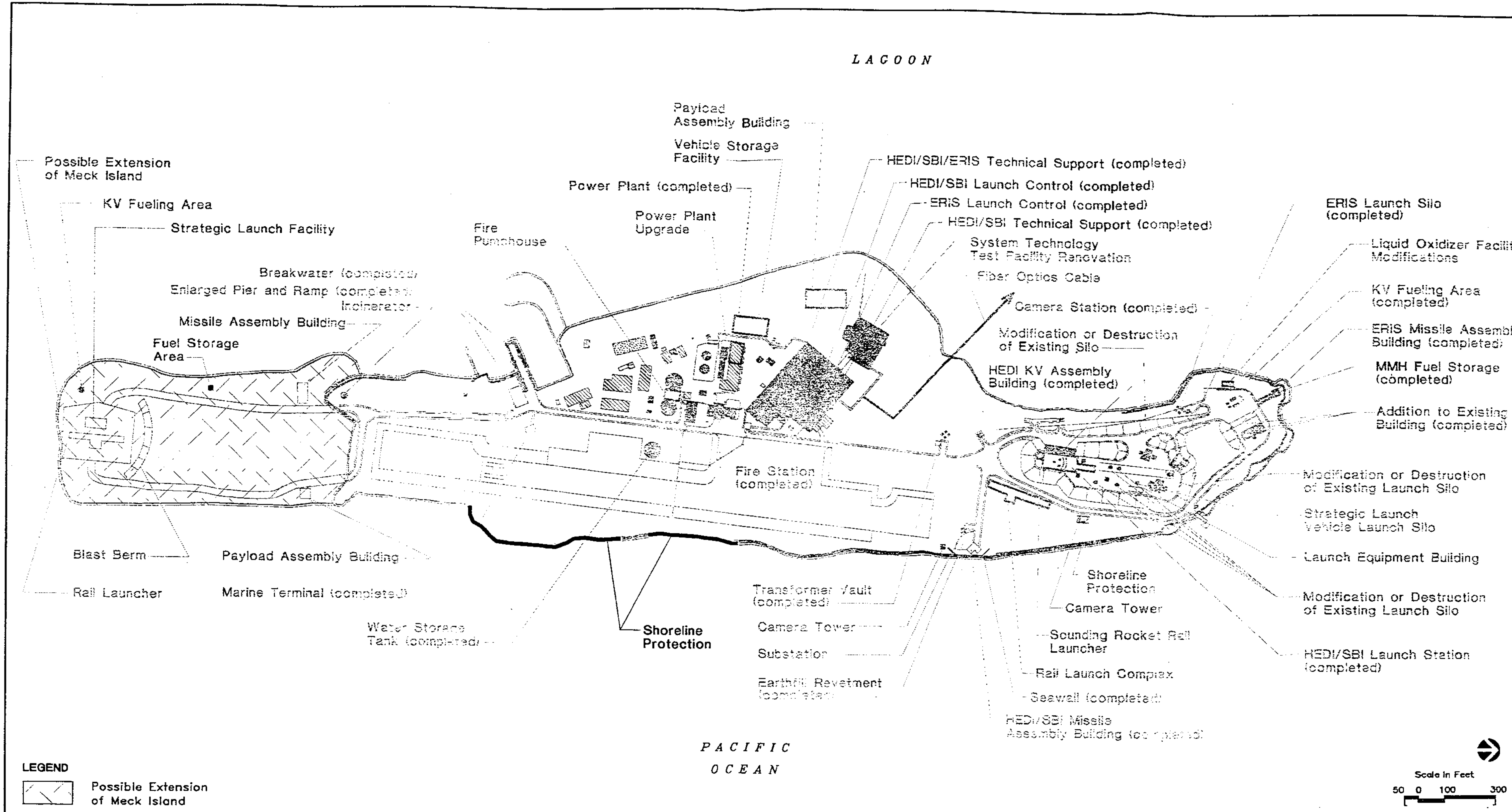
- Command/control transmitters
- MPS-36 Radar Complex (two radars)
- SuperRadot camera facility
- Ballistic camera
- Spectral camera station
- Theodolite station
- New generator building, housing four 130-kW generators
- Diesel fuel tank (20,000 gallons [75,707 liters])
- Composting latrine

Shoreline Protection. Approximately 50 feet (15 meters) of revetment near the harbor would be repaired. Approximately 975 feet (297 meters) of new shoreline protection would be constructed along the south side of the island.

Explosive Ordnance Disposal Activities. The use of Legan for EOD activities (proposed in the Intermediate Level-of-Activity Alternative) would be evaluated in relation to the sensors and other facilities proposed for construction on the island in this alternative.

ILLEGINNI

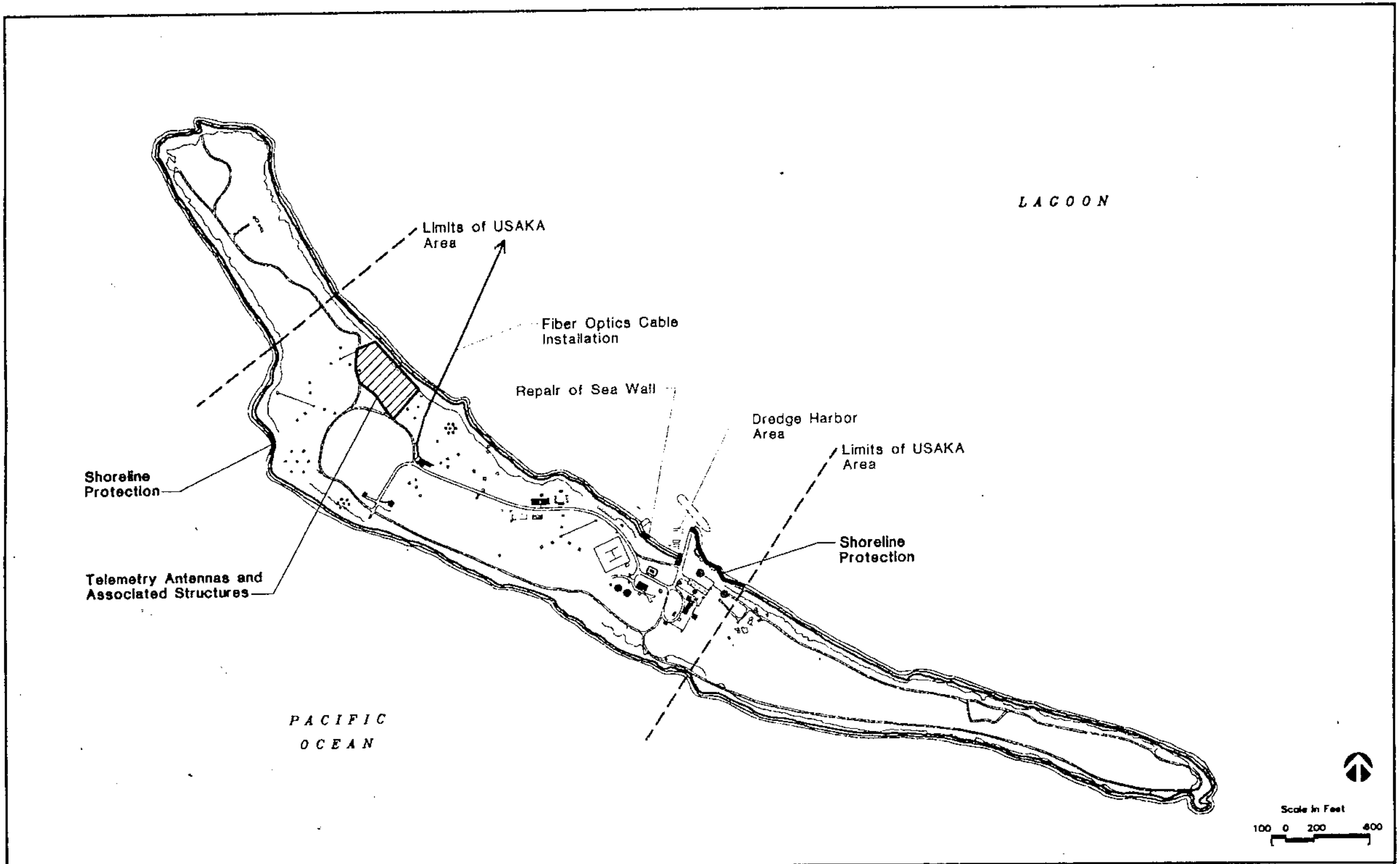
In the Intermediate Level-of-Activity Alternative, the new facilities at either Meck or Illeginni would be constructed, but not both. However, in the High Level-of-Activity Alternative, both islands would be developed with the facilities described in the Intermediate Level-of-Activity Alternative (see Subsection 2.1.3.6).



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
MECK

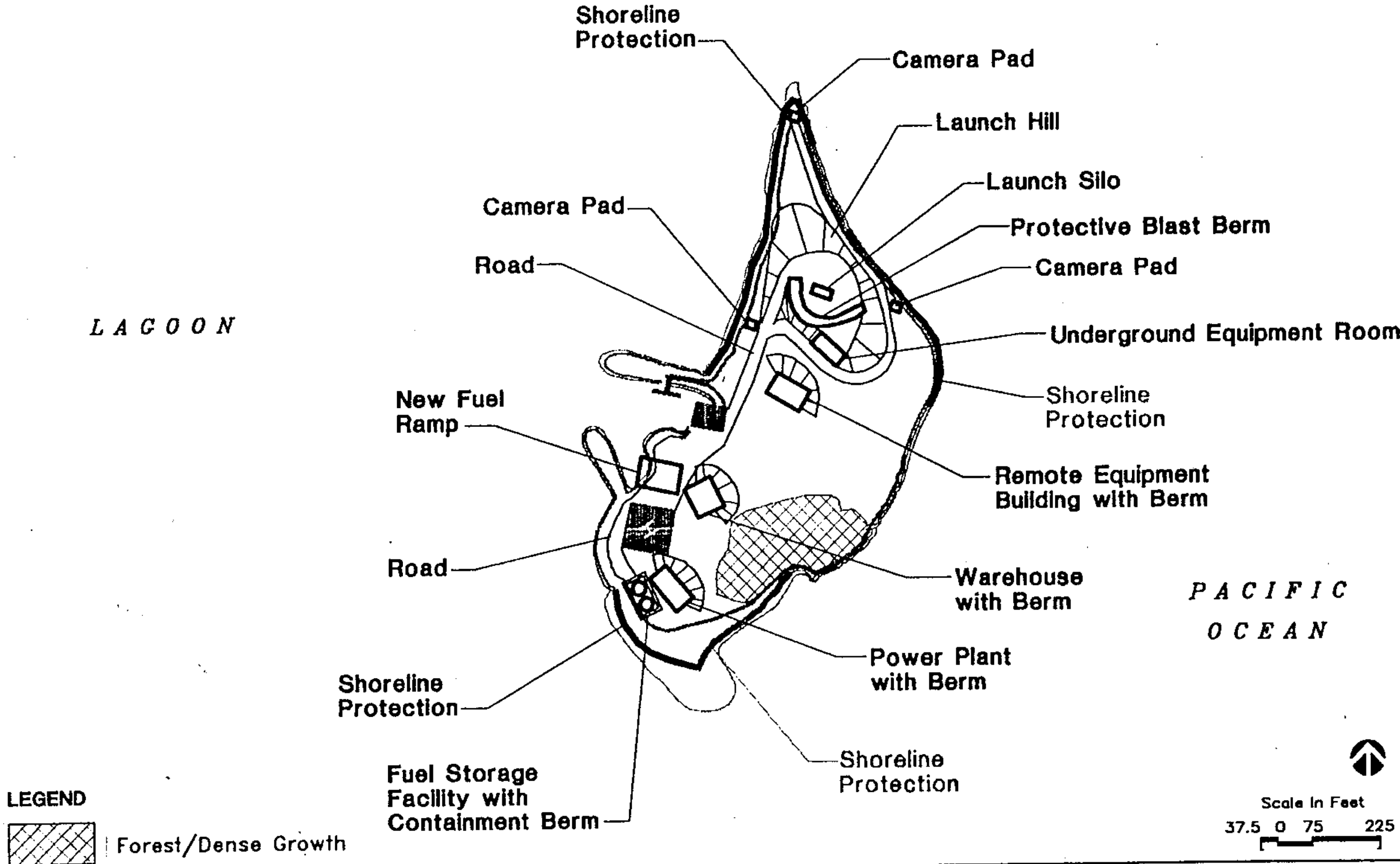
FIGURE 2.1-25



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
ENNYLABEGAN

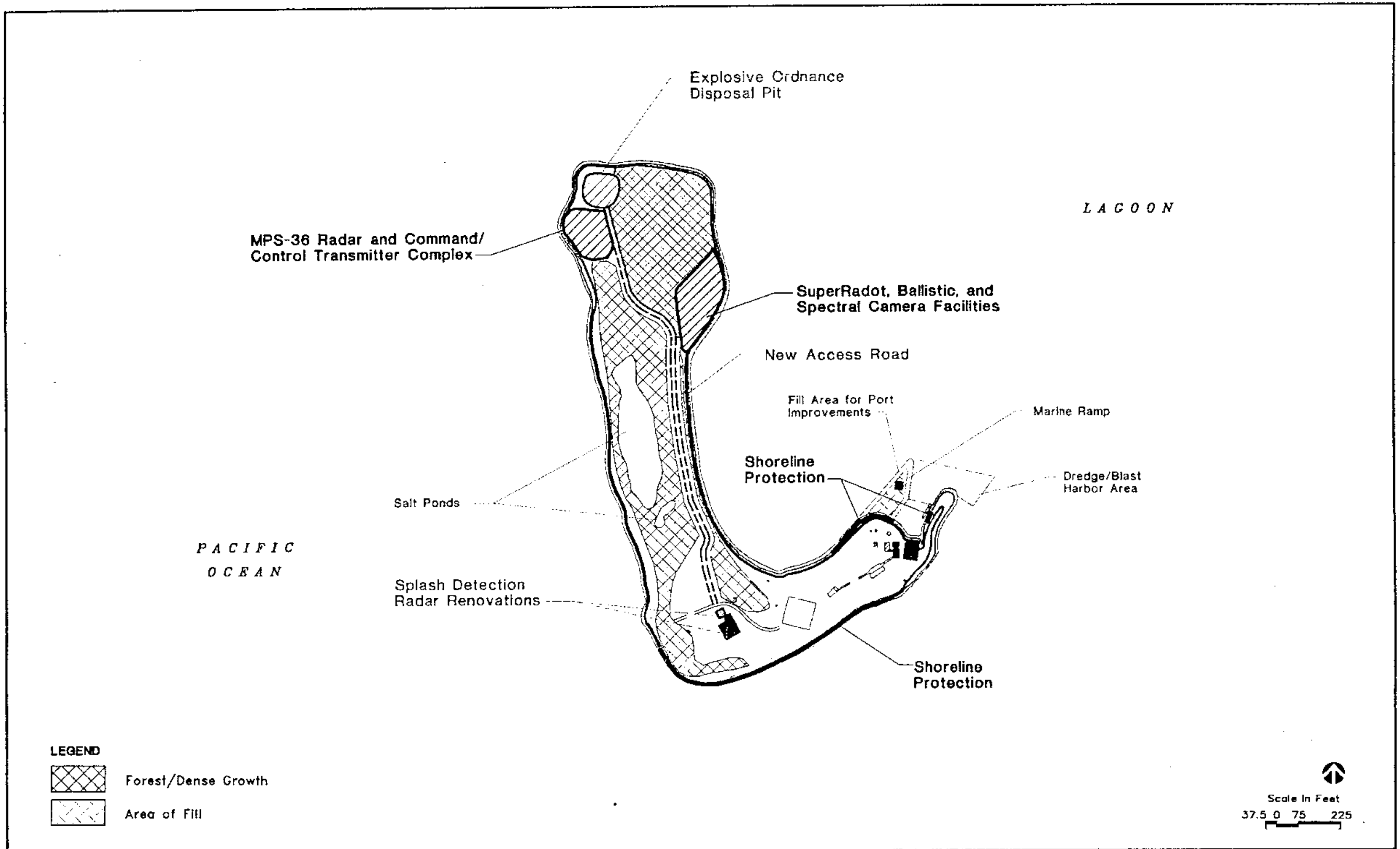
FIGURE 2.1-26



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
OMELEK

FIGURE 2.1-27



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
LEGAN

FIGURE 2.1-28

GAGAN

In this alternative, Gagan would be extensively developed with sensing and tracking equipment, which would require the removal of all vegetation except at the northwestern and southeastern ends of the island (Figure 2.1-29). This development would occur in part to replace optical sensor facilities removed from Eniwetak Island because of that island's development with launch facilities in this alternative.

Representative sensing and tracking equipment and supporting infrastructure could include:

- Impact Detection and Timing System, oriented toward the BOA. This facility would require the installation of fiber optics cables across the ocean reef flat. A small (800-square-foot [74-square-meter]) control building would be built.
- Large-aperture telemetry antenna on a 30-foot (9-meter) base
- SuperRadot camera facility
- Ballistic camera
- Spectral camera station
- Theodolite station
- Personnel shelter
- Generator building housing four 130-kW generators
- Diesel fuel tank (20,000 gallons [75,707 liters])
- Composting latrine

Shoreline Protection. Three hundred feet (91 meters) of new protection would be constructed at the south end of the island. Approximately 180 feet (55 meters) of existing damaged revetment at the south end of the island and the heads of both jetties would be repaired.

GELLINAM

In this alternative, Gellinam would house small-scale launch facilities such as for meteorological rockets, which would be launched at a rate of up to two per month. Areas of fill would be added at either end of the island to accommodate the new launch facilities (Figure 2.1-30).

For the purposes of analysis, it is assumed that the following new meteorological rocket facilities would be constructed:

- Launch control building
- Two met-launch pads
- Missile assembly building
- Equipment storage shelter
- Explosive storage building
- Personnel trailer

Existing sensors on Gellinam would be moved to the middle of the island just south of the current location of the helipad. Approximately 500 feet (152 meters) of fiber optics cable would be installed for HITS. This cable would link existing HITS sensors (located offshore in the lagoon) to a new terminus in the SDR Building, which would be relocated to the vicinity of the existing helipad. The new fiber optics cable would be installed within a trench along the lagoon shore of the island.

The existing generator, installed in 1967 and consisting of two 130-kW units, would be expanded by the addition of two more 130-kW units. The existing fuel tank would be replaced by a 20,000-gallon (75,707-liter) tank. The existing helicopter pad would be moved from its current location to the newly created land surface at the southern end of the island.

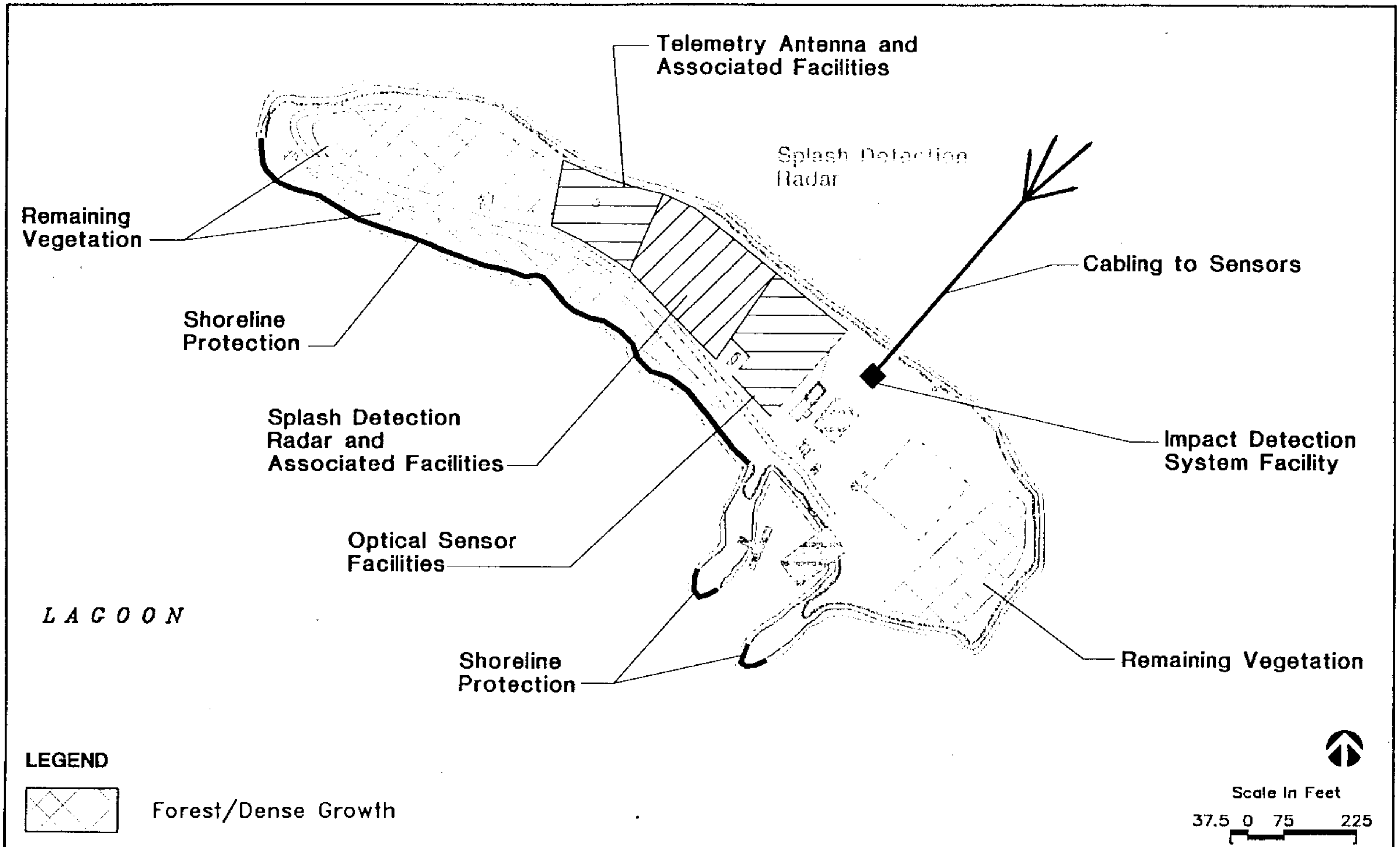
In order to accommodate the facilities proposed for Gellinam Island without violating the explosive hazard safety arcs associated with the rocket launches, the land surface of the island would be expanded. At the northern end of the island, an additional 18,000 square feet (1,672 square meters) of land area would be added; at the southern end of the island, an additional 27,000 square feet (2,508 square meters) would be added. Shoreline protection (approximately 1,000 feet [93 square meters]) would be constructed to protect new land surfaces, and the tip of the south jetty would be repaired.

ENIWETAK

In this alternative, a six-station launch hill would be constructed at Eniwetak (Figure 2.1-31) that would be used to launch SLVs. As many as six SLVs might be launched per quarter, many of these launches nearly concurrent with launches from Omelek or Meck islands. Because of the limited size of the island, launches would be primarily supported from nearby Meck Island. Most of the vegetation on the island would be removed. The following construction would occur at Eniwetak:

- Six-station launch facility, requiring construction of a launch hill; launches would be remotely controlled from Meck

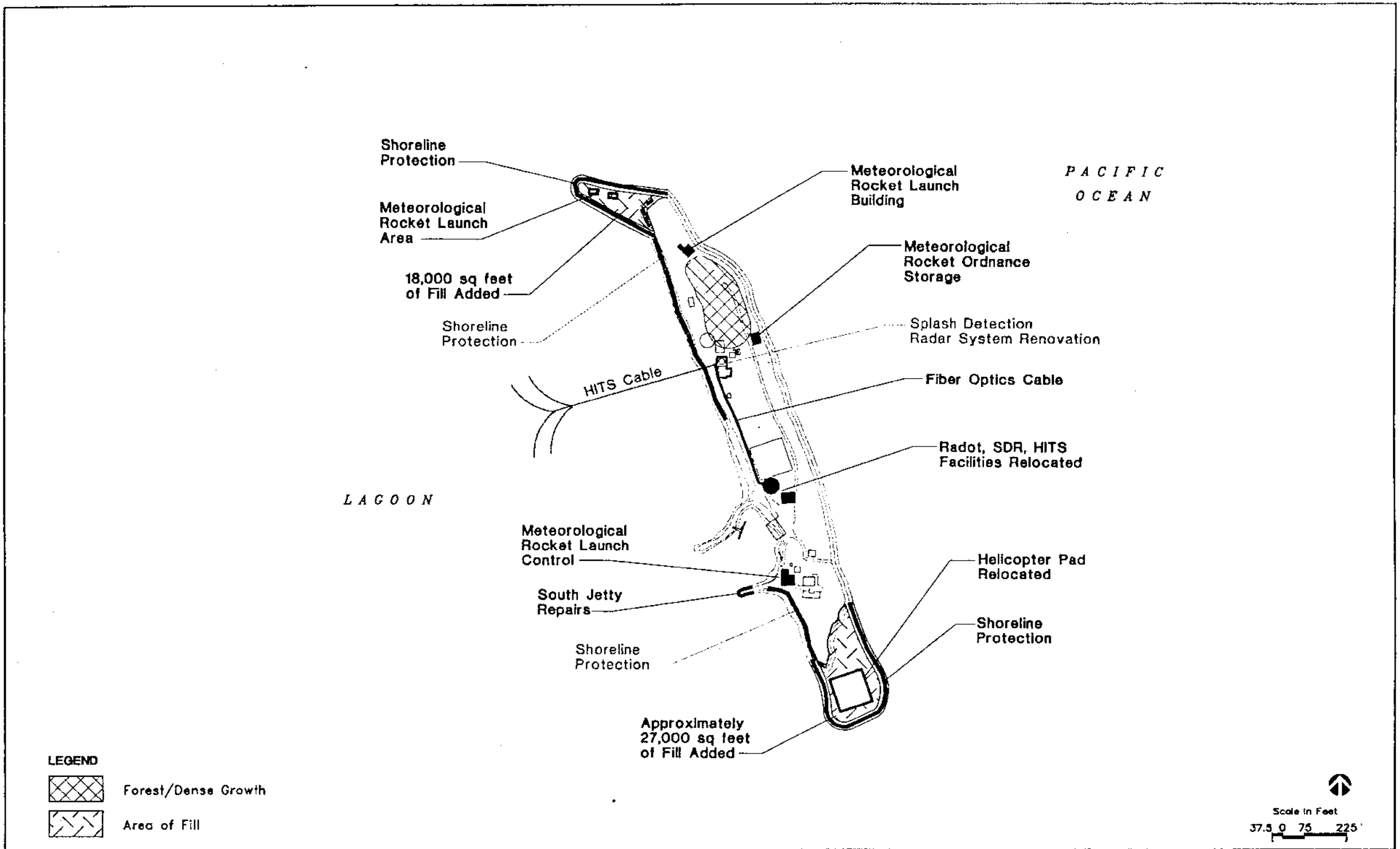
- Four remote cameras, underground equipment room, remote launch equipment building near the launch hill



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
GAGAN

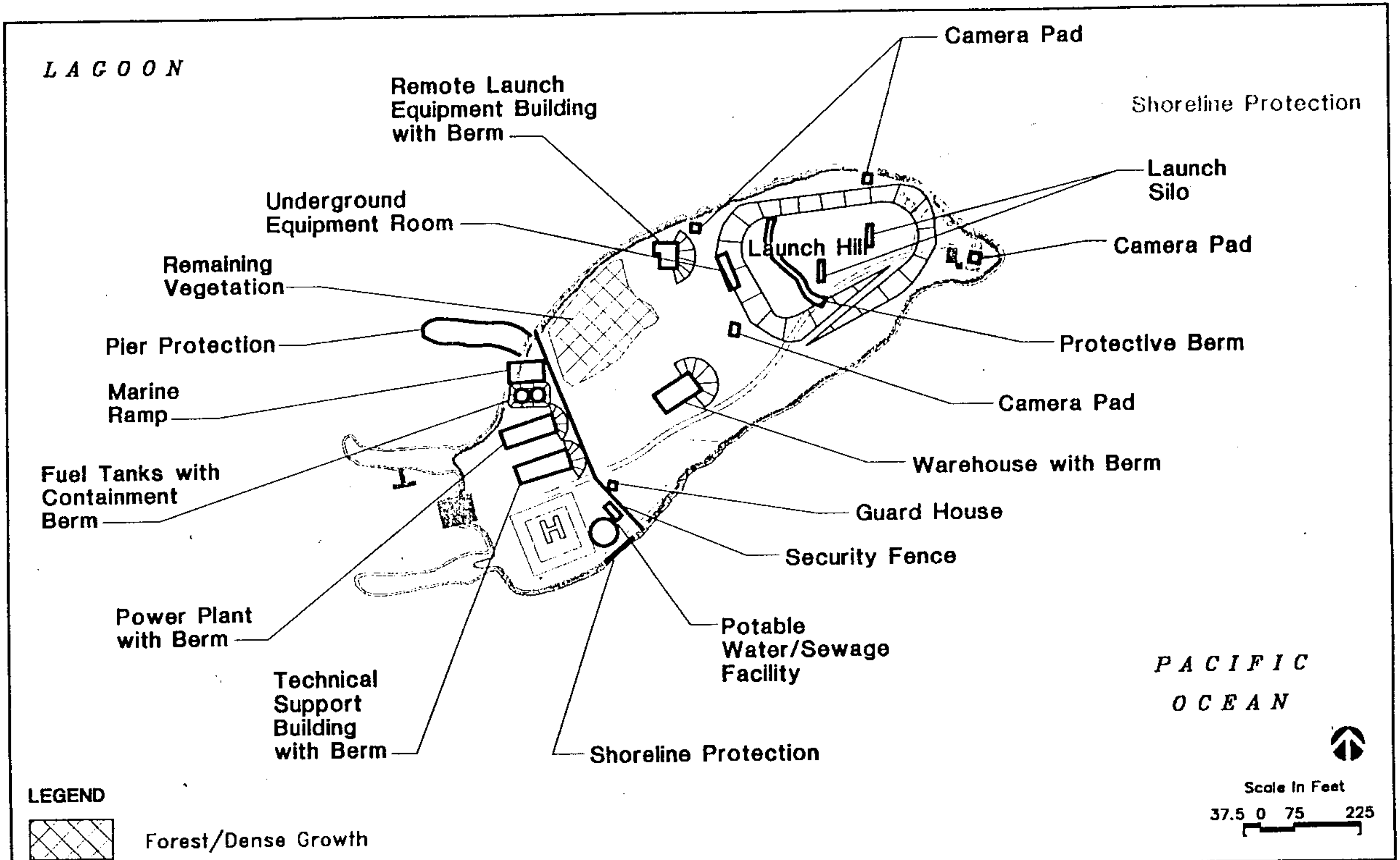
FIGURE 2.1-29



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
GELLINAM

FIGURE 2.1-30



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

High Level-of-Activity Alternative
ENIWETAK

FIGURE 2.1-31

- Power plant (four 130-kW generators) and 20,000 gallons (75,707 liters) of fuel storage

- Fuel ramp and associated fuel ramp protection (use of the existing fuel ramp would continue also)

- Potable water facility with 2,000 square feet (186 square meters) of water catchment

- Sewage facility (septic system or portable toilet)

- Fencing (600 feet [183 meters]), warehouse, guardhouse, technical support building with limited mess facilities

- Destruction of all existing facilities except the pier, ramp, and helicopter pad

- Removal of all vegetation except approximately 6,000 square feet (557 square meters)

Shoreline Protection. Upgrading of 100 feet (31 meters) of existing revetment would take place.

ENNUGARRET

There would be no changes at Ennugarret in this alternative in addition to those described for the Intermediate Level of Activity.

2.2 Proposed USAKA Environmental Standards and Procedures

The Compact between the RMI and the U.S. (Public Law 99-239) provides at Section 161 that environmental standards and procedures be developed for U.S. activities at USAKA, taking into account the particular environment at USAKA. The Compact also declares that it is the policy of the U.S. and the RMI "to promote efforts to prevent or eliminate damage to the environment and biosphere and to enrich understanding of the natural resources of the Marshall Islands . . . ."

USASSDC and U.S. EPA, Region IX, co-chaired a team that developed environmental standards and procedures as provided in the Compact. Other agencies on the project team were U.S. Fish and Wildlife Service (USFWS); BMDO; U.S. Army Engineer Division Pacific Ocean (USAEDPO); USAKA; and RMI Environmental Protection Authority (RMIEPA). The team received technical and legal advice from the U.S. Army Environmental Hygiene Agency (USAEHA), U.S. National Marine Fisheries Service (USNMFS), and the U.S. Army Corps of Engineers (USACOE).

The Standards were developed with a goal of preparing an integrated set of standards and procedures that would provide protection of human health, safety, and the environment, as envisioned by Section 161 of the Compact. In some respects, the Standards provide additional protection for the fragile and limited environmental resources of RMI. In other respects, because USAKA is not operating in an industrial setting, the Standards are procedurally less complex than those that would usually be applied within the United States.

The proposed Standards provide the opportunity for the appropriate U.S. federal resource agencies and the RMI government to be involved in the review of all proposed USAKA activities with the potential to affect the environment.

In developing the proposed Standards, the team relied on the statutes used for the 1989 SEIS (Table 2.2-1) and reviewed appropriate statutes and regulations of the RMI. The Noise Control Act was adopted by the team. The team added the Fish and Wildlife Coordination Act (FWCA), the Migratory Bird Conservation Act (MBCA), and the Marine Mammal Protection Act (MMPA). Provisions of the U.S. regulations that are not substantively or procedurally applicable to the circumstances at USAKA were determined and eliminated from further review. Health-based standards of the U.S. regulations were adopted unmodified. Other standards, such as technology-based standards, were modified or eliminated if their underlying environmental protection objective is attained by the Standards as a whole.

Table 2.2-1
Environmental Laws of the United States Applicable to USAKA Activities

7 U.S.C. 136	Federal Insecticide, Fungicide, and Rodenticide Act
15 U.S.C. 2601	Toxic Substances Control Act
16 U.S.C. 470	National Historic Preservation Act
16 U.S.C. 469	Archaeological and Historic Preservation Act
16 U.S.C. 1531	Endangered Species Act of 1973
33 U.S.C. 1251	Clean Water Act
33 U.S.C. 1401-1445	Ocean Dumping Act
42 U.S.C. 300f-300j	Safe Drinking Water Act
42 U.S.C. 4901-4918	Noise Control Act
42 U.S.C. 6901-6992k	Resource Conservation and Recovery Act/Solid Waste Disposal Act
42 U.S.C. 7401	Clean Air Act
42 U.S.C. 9601-9675	Comprehensive Environmental Response, Compensation, and Liability Act
42 U.S.C. 1801	Hazardous Material Transportation Act

2.2.1 No-Action Alternative

In the No-Action Alternative, the proposed Standards would not be implemented, and U.S. statutes and regulations would continue to apply to activities of the U.S. government at USAKA.

2.2.1.1 The Compact of Free Association

Effective October 21, 1986, the controlling U.S. statute that governs environmental restrictions imposed upon federal activities within RMI is Public Law 99-239, dated January 14, 1985. Specific provisions are contained in Title One, Article VI, Sections 161-163, "Environmental Protection."

The introductory paragraph to Article VI of the Compact declares a mutual policy to promote efforts to prevent or eliminate damage to the environment and biosphere and to enrich the understanding of the natural resources of the Marshall Islands. More specifically, under Section 161(a), the United States agreed to the following:

- Section 161(a)(1)—Apply pre-Compact environmental controls to its continuing activities.
- Section 161(a)(2)—Apply the National Environmental Policy Act of 1969 (NEPA) to its activities under the Compact as if the RMI were the United States.
- Section 161(a)(3)—Comply with standards substantively similar to those required by six enumerated U.S. environmental laws to any of its activities requiring the preparation of an EIS under NEPA:
  - Endangered Species Act, 16 U.S.C. 1531, *et seq.*
  - Clean Air Act, 42 U.S.C. Supp. 7401, *et seq.*
  - Clean Water Act, 33 U.S.C. 1251, *et seq.*
  - Marine Protection, Research, and Sanctuaries Act, Title I of which is the Ocean Dumping Act, 33 U.S.C. 1401, *et seq.*
  - Toxic Substances Control Act, 15 U.S.C. 2601, *et seq.*
  - Resources Conservation and Recovery Act and Solid Waste Disposal Act, 42 U.S.C. 6901, *et seq.*
  - Such other environmental protection laws of the United States as may be mutually agreed upon from time to time with the government of the Marshall Islands or the Federated States of Micronesia
- Section 161(a)(4)–Develop appropriate mechanisms, including regulations or other judicially reviewable standards and procedures to regulate its activities in the RMI in participation with federal agencies designated to administer those laws.

Section 161(c) recognizes the right of the respective governments to modify or supersede such standards or procedures by mutual agreement. Section 161(e) allows the President of the United States to exempt activities from environmental standards or procedures only if in the paramount interests of the United States to do so.

Also relevant is the Military Use and Operating Rights Agreement (MUORA) of the Government of the United States in the Marshall Islands, an attendant agreement to the Compact in which, among other things, the United States reaffirmed its commitment to the RMI to use its best efforts to minimize damage to the terrain and to reef areas; avoid harm to the environment, including water areas; and avoid activities that would adversely affect the well-being of the residents of the Marshall Islands.

2.2.1.2 Environmental Controls Applied to the 1989 USAKA EIS

The environmental controls in U.S. environmental laws that applied to the 1989 USAKA EIS were identified using a three-step process. First, U.S. environmental laws that applied to USAKA when the RMI was a Trust Territory were reviewed to identify which ones would be applied to continuing activities, as required by Section 161(a)(1) of the Compact. Second, the environmental laws in Sections 162(a)(2) and (3) of the Compact were reviewed to determine which ones would be applied to new activities after the Trusteeship was terminated for the RMI on October 21, 1986. Third, all the environmental controls of the statutes identified in the first two steps were analyzed to ensure the protection of public health and safety and the environment at USAKA.

Initially, the Army attempted to distinguish between the controls applicable to continuing activities requiring an EIS [Section 161(a)(1)] and new activities [Section 161(a)(3)].

The Army concluded, however, that such a distinction was impractical because ongoing and planned activities at USAKA are inextricably linked. To ensure that the environmental laws eventually identified would be applicable to USAKA activities and the RMI environment, the Army applied the controls of the U.S. environmental laws in Table 2.2.1 to its analyses of USAKA activities in the 1989 SEIS.

2.2.2 Proposed Action

Under the Proposed Action, the proposed Standards would apply to U.S. activities at USAKA instead of standards and procedures derived from statutes delineated in the Compact.

The proposed Standards are grouped in seven environmental categories, with a single set of administrative procedures applicable to all categories. These environmental categories are: air quality, water quality and reef protection, drinking water quality, endangered species and wildlife resources, ocean dumping, materials and waste management, and cultural resources. The environmental controls of the following environmental laws and regulations were reviewed in developing the Standards:

U.S. Statutes

- Archaeological and Historic Preservation Act
- Clean Air Act
- Clean Water Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Endangered Species Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Fish and Wildlife Coordination Act
- Hazardous Materials Transportation Act
- Marine Protection, Research, and Sanctuaries Act, Title I of which is the Ocean Dumping Act
- Marine Mammal Protection Act
- Migratory Bird Conservation Act
- National Historic Preservation Act
- Noise Control Act
- Resource Conservation and Recovery Act/Solid Waste Disposal Act
- Safe Drinking Water Act
- Toxic Substances Control Act

RMI Statutes and Regulations

- Coast Conservation Act of 1988
- Endangered Species Act of 1975
- Historic Preservation Act of 1991
- Littering Act of 1982
- Marine Mammal Protection Act of 1990
- Marine Resources Act
- Marine Resources (Trochus) Act of 1983
- Marine Zones (Declaration) Act of 1984
- Marshall Islands Marine Resources Authority Act of 1988
- Marshall Islands Marine Resources Authority (Amendment) Act of 1989
- RMIEPA National Environmental Protection Act of 1984
  - RMIEPA Clean Air Regulations (Draft)
  - RMIEPA Earthmoving Regulations
  - RMIEPA Marine Water Quality Regulations
  - RMIEPA Pesticides Regulations (Draft)
  - RMIEPA Solid Waste Regulations
  - RMIEPA Toilet Facilities and Sewage Disposal Regulations

- Public Health, Safety, and Welfare Act
- Public Lands and Resources Act
- Trust Territory Marine and Fresh Water Quality Standard Regulations (retained as law pursuant to NEPA 1984, Section 66)
- Trust Territory Public Water Supply Systems Regulations (retained as law pursuant to NEPA 1984, Section 66)

International Agreements

- Compact of Free Association Between the United States of America and the Republic of the Marshall Islands (Compact)
- Convention for the Protection of the Natural Resources and Environment of the South Pacific and Related Protocols (MARPOL, 73/78)
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1990
- Convention on the Continental Shelf, 1958
- Convention on the Law of the Sea, 1982
- Convention on the Territorial Sea and Contiguous Zone, 1958
- Convention on International Trade in Endangered Species (CITES)
- London Dumping Convention

2.2.2.1 Summary of USAKA Environmental Standards and Procedures

The proposed Standards were developed with the intent of establishing protection for the environment of the RMI, which could be affected by activities at USAKA, taking into consideration the particular environment of USAKA and the special relationship between the RMI and the United States.

Generally, U.S. regulations that address grant programs, implementation by state or local governments, or topics not applicable to USAKA (such as provisions for Indian tribes) have not been adopted. Specific requirements of U.S. regulations that have been promulgated on the basis of human health considerations have been adopted unchanged into the Standards. Many protocols for sampling, testing, and analyzing also have been adopted through incorporation by reference. Other provisions of U.S. regulations have been made either more or less stringent in the proposed Standards, according to the need to protect the particular environment at USAKA. Finally, a set of procedural requirements was developed to streamline administration and compliance.

Procedures

The procedures defined in Part 2 of the proposed Standards were drafted to ensure that environmental activities at USAKA are fully disclosed to all appropriate environmental agencies and that each such agency has an opportunity to review and comment on environmental activities. The procedures replace a wide variety of requirements in more than a dozen U.S. environmental statutes and regulations.

Additionally, the procedures delineate the mechanism under which appropriate U.S. resource agencies and RMIEPA would participate in reviewing and commenting on environmental information. The procedures apply without exception to all facilities at USAKA and to all the environmental categories in the Standards (Part 3).

The procedures require USAKA to produce reports on existing or potential environmental conditions, such as reports on the results of drinking water sampling or reports on the generation and disposal of hazardous waste. USAKA also must develop and maintain studies and plans (discussed throughout Part 3 and cited in 2-6.2 and 2-9.2 of the Standards) that are subject to periodic review to ensure accuracy and completeness.

Several sections of the procedures differ from the U.S. regulations from which they derive. The USAKA procedures contain provisions designed to address both the special relationship between the U.S. and RMI governments and the seven environmental categories that make up the Standards in Part 3. These procedural requirements, which include auditing (Section 2-16 of the Standards), conflict resolution (Section 2-19), and submittal of Documents of Environmental Protection (DEP–Subsection 2-17.3), were designed to facilitate compliance with the Standards.

USAKA is required to conduct internal audits every 2 years of the facilities and programs that have the potential to affect public health and safety and the environment. The audits (Subsection 2-16.1 of the Standards) are intended to ensure compliance with environmental standards by instituting self-inspection programs. Reports on the status of compliance must reveal all identified problems and must present recommendations and schedules for corrective action. In addition to the internal audits, USAKA's program must be audited (Subsection 2-16.2) by a U.S. agency independent of USASSDC (e.g., USAEHA) at least once every 4 years.

A DEP (Subsection 2-17.3 of the Standards) is a procedural mechanism that provides a forum for USAKA, U.S. agencies, and RMIEPA to coordinate and review activities proposed by USAKA that have the potential to affect the USAKA environment. Activities requiring a DEP and the agencies having jurisdiction for an environmental category are specified in Subsection 2-17.3.1. Before submitting a DEP, USAKA must provide to the appropriate agencies sufficient information on the potential effects of the project on the environment. If the appropriate agencies find that the submittal is incomplete, USAKA may furnish additional data to the reviewing agencies.

The DEP must include, at a minimum, documentation of the review process; descriptions of the proposed activity and the associated potential environmental effects of the activity; and applicable procedures for monitoring, notification, and reporting. All parties to the review must sign the DEP. If disputes arise about the mitigation measures proposed by USAKA, any party to the review process can initiate the formal process for conflict resolution that is defined in Section 2-19 of the Standards.

Conflict resolution (Section 2-19 of the Standards) is a procedural mechanism for expediting resolution of disputes among the appropriate agencies (Subsection 2-6.1) and USAKA about compliance with an environmental standard. The intent of establishing procedures specific to disputes that may arise is to give all agencies a way of resolving disputes quickly before they escalate and impede implementation of environmental standards at USAKA. Conflict resolution procedures establish a formal approach to resolving disputes so that disagreements among parties are addressed at the point of origin or the lowest administrative level possible. If disputes cannot be resolved using the conflict resolution procedures, the RMI government retains the right, as specified in Section 162 of the Compact, to seek judicial review of USAKA's actions.

The Standards contain mechanisms for automatic adoption of new health-based standards and for periodic review of the Standards to ensure that public health and safety and the environment are being protected (Section 2-22).

The procedures (Subsection 2-17.3.5) provide that USAKA may seek to obtain variances or exemptions from the Standards in emergencies, or by demonstrating that the project or activity in question will have no significant effect on an environmental category addressed by the Standards. Exemptions or variances require the approval in writing of all appropriate agencies.

Air Quality

The Standards for air quality (Section 3-1) are derived from applicable sections of 40 CFR, parts 50 through 87, which establish air quality regulations according to the Clean Air Act (CAA).

The CAA protects ambient air quality through a combination of permitting and source control for most emitters and requires emitters to demonstrate compliance with source control standards. The standards for air quality provide protection that is similar to the protection provided by U.S. statutes and regulations, but they do not incorporate many of the technology-based requirements of the U.S. statutes and regulations specified under the CAA. For achieving the goal of maintaining the current air quality at USAKA, performance standards were developed that do not allow air quality to be degraded by more than 25 percent of the ambient air quality standard for a criteria pollutant plus the "baseline" ambient air concentrations for that pollutant. Baseline is defined in the Standards as conditions existing on the day before the effective date of the Standards. In addition, in no instance shall ambient air quality concentrations be allowed to exceed 80 percent of any criteria pollutant standard. The Standards do not specify the means for achieving these standards for ambient air quality. Consequently, there are no absolute requirements for applying control technologies or achieving emission reductions except for facilities or activities that are covered by the U.S. rules of the National Emissions Standards for Hazardous Air Pollutants (NESHAPs).

A DEP must be prepared before a new major stationary source is constructed or an activity begins that has the potential to produce emissions that exceed levels established in the DEP. For modifying sources, the Standards require modifying the DEP if air emissions increase above DEP levels by 5 percent or more and require demonstration of compliance for the sources that are regulated. In addition, the Standards define modification of sources as significant increases above permitted levels, not actual emissions as in the United States, and allow emission-decrease credits for a source.

Water Quality and Reef Protection

The USAKA Standards for water quality and reef protection (Section 3-2) derive from 40 CFR, parts 100-140 and 400-403, which implement provisions of the amended Clean Water Act (CWA). The Marine Water Quality and Earthmoving Regulations of the RMI were also consulted. The USAKA Standards apply to surface water, groundwater, and coastal marine water, including coastal reefs.

The proposed Standards for water quality and reef protection differ from the U.S. statutes and regulations in that they eliminate controls that are inapplicable to USAKA, such as state certification programs, and they incorporate controls for protecting groundwater supplies. The USAKA water quality and reef protection standards are consistent with the RMI regulations by classifying the marine water at USAKA and assigning numerical standards on the basis of existing conditions for coastal water, for groundwater uses, and for groundwater areas. Primary standards for groundwater are health-based and apply to all classes of groundwater. Secondary standards are based on aesthetics and on other factors not related to health.

The Standards require USAKA to submit to appropriate agencies a water quality management plan similar in content to that required under U.S. statutes and regulations. The plan must identify wetland and coastal areas where dredging, quarrying, or discharge of dredged or fill material is prohibited; nonpoint sources of pollution; sources of groundwater contamination; reef resources and the management and control practices necessary to protect them; and water bodies that do not comply with the USAKA Standards. The plan also must assess the nature and extent of stormwater discharges and include a discussion of management and control practices that ensure compliance with water quality standards. Unlike the plan required by U.S. statutes and regulations, the plan required by the Standards does not include effluent limits, total maximum loads, measures for implementing municipal or industrial water treatment, or basin plans.

The Standards do not require that water quality that is below the quality specified by the standard be improved; however, Subsection 3-2.5 of the Standards does state that the required water quality management plan must identify point and nonpoint sources of pollution and institute management and control practices to reduce or eliminate such pollution. In addition, Subsection 3-6.5.8 (Restoration) provides for cleanup of spills or other contamination.

The Standards do not specifically require treatment for stormwater that is discharging contaminants to surface water; however, the Standards address stormwater runoff from the airfields as a point source, and regulate stormwater that is not captured as a point source under the water quality classifications for coastal water uses and groundwater. In addition, the required water quality management plan specifies that point and nonpoint sources of pollution must be identified and managed, and requires assessment of the nature and extent of stormwater discharges and identification of management and control practices to reduce or eliminate adverse effects. The Standards prohibit the discharge of sewage by USAKA vessels into RMI waters.

Drinking Water Quality

The Standards for drinking water quality (Section 3-3) are based on (1) applicable sections of 40 CFR, parts 141 through 143, which establish primary and secondary drinking water regulations and implementation and enforcement provisions according to the SDWA, as amended, and on (2) other related regulations applicable to public water systems.

In general, the drinking water quality standards adhere to U.S. statutes and regulations except that they clarify applicable provisions to address conditions at USAKA. The standards retain all U.S. health-based requirements and eliminate U.S. provisions applicable to Indian tribes. The Standards use the monitoring requirements for a community of 10,000, even though USAKA has only approximately 3,000 people. Unlike U.S. statutes and regulations, the Standards have no real-time monitoring for certain constituents. The use of a 10,000 population monitoring requirement increases the frequency and number of contaminants tested. All public water systems at USAKA are subject to the Standards for drinking water, which establish maximum contaminant levels (MCLs) for organic chemicals, inorganic and microbiological contaminants, turbidity, and radioactivity. In lieu of MCLs, treatment techniques are required to ensure the removal of 99.9 percent of *Giardia lamblia* cysts and 99.99 percent of viruses.

MCL goals (MCLGs) are established for organic and microbiological contaminants. The Standards also establish maximum desirable contaminant levels (MDCL) for the aesthetic characteristics of drinking water. Unlike U.S. statutes and regulations, the Standards do not grant exemptions from testing for any system. Because of the fragile nature of USAKA's supplies of freshwater and the potential for degradation, the Standards require filtration for all sources of surface water and groundwater and eliminate the determination of the need for filtration required by U.S. statutes and regulations.

The Standards have adopted the current lead and copper rule MCLs of the SDWA.

Endangered Species and Wildlife Resources

The Standards for endangered species and wildlife resources (Section 3-4) derive from 50 CFR, parts 17, 23, 402, 424, and 450 to 452, implementing the Endangered Species Act (ESA), as amended. Other U.S. statutes embodied in the Standards are the Marine Mammal Protection Act of 1972 (MMPA), the Fish and Wildlife Coordination Act (FWCA), and the Migratory Bird Conservation Act. The Standards also list RMI native species potentially susceptible to impacts from USAKA actions.

The Standards protect those species at USAKA that have been proposed, petitioned, or listed as candidates for endangered or threatened status under the U.S. process; establish procedures that protect species protected under RMI law; incorporate procedures for evaluating effects on fish, wildlife, and plants; and expand protection of marine mammals, migratory birds, and habitats of local or regional significance. The Standards do not incorporate parts of U.S. statutes and regulations that address exemptions, state cooperative agreements, permits based on economic hardship, special rules for threatened wildlife, the process of listing and designating critical habitats, experimental populations, certain regulations pertaining to the Convention on International Trade in Endangered Species, and the sections pertinent to special issues, such as manatee protection statutes. The Standards require USAKA to offer the USFWS and the RMI the opportunity to review and comment on proposed activities that may result in a significant effect on fish and wildlife resources for species and habitats that are listed as candidate, petitioned, or proposed for threatened or endangered status. Coordination with USFWS or USNMFS is required when assessing potential effects on terrestrial and marine species and on habitats of biological significance.

U.S. statutes and regulations require biological assessments for major construction activities or when a project proponent identifies the potential to affect a threatened or endangered species or its critical habitat adversely. The Standards also require biological assessments that develop comparable analysis but do not specify preparation for major construction activities.

Ocean Dumping

The Standards for ocean dumping (Section 3-5) derive primarily from 40 CFR, parts 220-233 and 33 CFR, part 324, which implement the Ocean Dumping Act (ODA) of 1972. Sections that address discharge of dredged or fill material or material designated for dredging or for excavation or filling of water are derived from Section 404 of the CWA. Also reviewed were RMIEPA regulations; the Convention on the Territorial Sea and Contiguous Zone, 1958; MARPOL, 73/78; the Convention on the Continental Shelf, 1958; the Convention on the Law of the Sea, 1982; and the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1990.

The Standards for ocean dumping differ from U.S. statutes and regulations in that they call for a case-by-case assessment of the need for ocean dumping and eliminate state certification programs. They address the process of designating and monitoring sites for ocean dumping and the occurrence of individual ocean dumping events. For selecting and designating disposal sites, both the Standards and U.S. statutes and regulations require that the cumulative effects of current and previous discharges be considered.

In cases of individual ocean dumping events, the Standards use performance criteria that are reviewed on a case-by-case basis to determine whether to allow dumping, whereas the U.S. statutes and regulations include a separate set of procedures for assessing all proposed designations. The USAKA review is based on the submittal of a DEP (Subsections 2-17.3.1 and 3-5.5.1) in which the environmental effects of the proposed dumping operation, the need for ocean dumping, alternatives to ocean dumping, and the effect of the proposed action on aesthetic, recreational, and economic values and cultural resources are considered. This procedure consolidates the four types of reviews required for activities within the United States into one review process. In addition to performance criteria, there are specific prohibitions on ocean dumping, which include the types of materials expressly prohibited (such as radioactive materials) and the establishment of limits for specific waste constituents.

Material and Waste Management

The Standards for waste and material management (Section 3-6) are derived from the U.S. statutes and regulations that address the use and management of hazardous material and solid waste in the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Toxic Substance Control Act (TSCA); the Clean Water Act; and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

The Standards' goal of regulating waste and material management is to minimize the procurement, use, storage, and transportation of all substances that might endanger the environment and the health and safety of the population. The objectives of the waste and material management section are to identify, classify, and manage—including recycling—all materials imported for use at USAKA in an environmentally responsible manner. Waste and materials management applies to all materials that are imported or purchased for use on USAKA that have the potential to affect the environment adversely. The Standards classify all materials as general-use materials, hazardous materials and petroleum products, or prohibited materials.

Although these Standards integrate requirements that are similar to those applied in the United States, the Standards differ in several ways. After being introduced to USAKA and identified and classified, materials are subject to security, storage, and inspection requirements that are not required in the United States. The treatment, storage, and transportation of medical wastes are regulated under the Standards, although they are not in U.S. statutes and regulations. The treatment and disposal of hazardous wastes without a DEP is prohibited under the proposed Standards, and hazardous wastes must be shipped off-island. Also prohibited at USAKA is any new use of polychlorinated biphenyls (PCBs) or introduction of new PCBs or PCB items. New underground storage tanks (USTs) are not allowed to be installed at USAKA.

The Standards require preparation and implementation of a contingency plan—the Kwajalein Environmental Emergency Plan (KEEP)—for responding to releases of oil, hazardous material, pollutants, or contaminants to the environment. KEEP (3-6.4) is similar to the spill prevention control and countermeasure (SPCC) plan required in the United States, but KEEP also incorporates response provisions of the National Contingency Plan (NCP).

Cultural Resources

The Standards for cultural resources (Section 3-7) are derived from the National Historic Preservation Act (NHPA), (16 U.S.C. §§ 470), sections 106 and 110(f). The act establishes federal responsibilities and implementing regulations in 36 CFR Part 800 and in the U.S. Archaeological and Historic Preservation Act (AHPA—P.L. 93-291). The regulations for promoting cultural preservation that are in the RMI's Historic Preservation Act of 1991 also were consulted.

The Standards for cultural resources are comparable to the U.S. statutes and regulations on which they are based. The cultural resources standards are similar to the U.S. statutes and regulations because the Advisory Council on Historic Preservation (ACHP) reviews all documentation of interaction between USAKA and the RMIEPA. Under the Standards, the RMI Historic Preservation Office (RMIHPO) executes the function of the state historic preservation officer. All communication between USAKA and the RMIHPO will require coordination through the RMIEPA. In addition, the standards replace all references to the National Register of Historic Places and National Landmarks with references to the RMI National Register of Historic Places, which incorporates these resources at USAKA already listed in the U.S. statutes and regulations.

The Standards require submitting to the appropriate agencies a programmatic DEP (Subsections 2-17.3.1 and 3-7.5.2) on protecting cultural resources at USAKA that must address the potential effects of typical operations at USAKA on cultural resources. The programmatic DEP also must establish procedures to identify potential cultural resources in areas where they were not known, and mitigation procedures for all adverse effects on previously unidentified cultural resources. For proposed activities not covered by the programmatic DEP, a specific DEP (Subsection 3-7.5.2) that discusses the potential for significant effects on cultural resources is required.

2.3 Comparison of Alternatives and Mitigations

Because two Proposed Actions are presented in this Supplemental EIS, this section organizes the comparison of the alternatives to each Proposed Action into two separate parts. First, the level-of-activity alternatives are compared. Next, the Proposed USAKA Environmental Standards and Procedures and the No-Action Alternative are compared. Both parts of this comparative analysis address the extent to which the alternatives meet the purpose and need for the actions. Major differences among the environmental impacts of the alternatives are identified in Figures 2.3-1 and 2.3-2, and where there are significant impacts, potential mitigation measures are summarized.

The Intermediate Level-of-Activity Alternative (Proposed Action) is the preferred alternative under the first Proposed Action; and the adoption of the USAKA Environmental Standards and Procedures is the preferred alternative under the second Proposed Action.

2.3.1 Level-of-Activity Alternatives

Under the No-Action Alternative, no increase in testing and no new construction (i.e., that was not in the 1989 EIS Proposed Action) would occur at USAKA. USAKA is the only reasonable site for field testing of the BMD system; therefore, major elements of the SDI Program would not be developed or tested under the No-Action Alternative (including NMD and Global Missile Defense [GMD]). The viability of BMD as a national defense option would be seriously jeopardized if the No-Action Alternative were selected and DoD would not be able to comply with the schedule in the Missile Defense Act of 1991, as amended by the 1993 Defense Authorization Act, to develop for deployment an ABM System.

In the Low Level-of-Activity Alternative, simple SITs would occur using single launches that would be tracked by ground-based and airborne trackers. The increased number of launches would occur primarily at Meck. More complex SITs, which would prove the system could operate in a stressful and realistic combat environment, could not take place. Limiting the test activities to the Low Level of Activity would mean the acquisition of BMD would be postponed until the increased level of activity needed to verify system performance could be performed. Selection of this alternative would jeopardize BMD as a national defense asset, and DoD would not be able to comply with the schedule in the Missile Defense Act of 1991, to develop an ABM System for deployment.

The Intermediate Level of Activity, the Proposed Action, would meet the need to demonstrate the capabilities of BMD in a highly stressful and realistic combat environment. Proceeding with the Proposed Action would ensure that the ABM System desired by the President and Congress can be evaluated for future development.

ENVIRONMENTAL RESOURCE	LEVEL OF ACTIVITY ALTERNATIVES							
	NO ACTION		LOW LEVEL		INTERMEDIATE LEVEL		HIGH LEVEL	
	Basis for Evaluation		Basis for Evaluation		Basis for Evaluation		Basis for Evaluation	
	ES[1]	USAKA[2]	ES[1]	USAKA[2]	ES[1]	USAKA[2]	ES[1]	USAKA[2]
Land and Reefs								
Kwajalein, Meck, Illeginni, Ennugarret		N/A		N/A	●	N/A	●	N/A
Omelek, Legan, Gellinam, Eniwetak		N/A		N/A		N/A	●	N/A
Water Resources								
Kwajalein			●	●	●	●	●	●
Roi-Namur			○	○	○	○	○	○
Air Quality								
Noise								
Ennugarret		N/A		N/A	●	N/A	●	N/A
Island Plants and Animals								
Legan					●	●	●	●
Eniwetak							●	●
Marine Biological Resources								
Roi-Namur			○	○	○	○	○	○
Meck					●	●	●	●
Gellinam							●	●
Rare, Threatened and Endangered Species								
Broad Ocean Area			●	●	●	●	●	●
Illeginni					●	●	●	●
Cultural Resources								
Kwajalein	●	●	●	●	●	●	●	●
Roi-Namur	●	●	●	●	●	●	●	●
Meck	●	●	●	●	●	●	●	●
Legan					●	●	●	●
Illeginni					●	●	●	●
Ennugarret					●	●	●	●
Omelek							●	●
Eniwetak							●	●

LEGEND

- ○ Significant beneficial impact
- ● Significant adverse impact
- Blank No or nonsignificant impact
- N/A No USAKA Standard directly applicable

[1] ES = Significance of impacts determined from Existing Statutes and Regulations

[2] USAKA = Significance of impacts determined from Proposed USAKA Environmental Standards and Procedures

Note:
Entry in Resource row means impact is USAKA-wide.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Impacts – Level-of-Activity Alternatives

FIGURE 2.3-1
p.1

ENVIRONMENTAL RESOURCE	LEVEL OF ACTIVITY ALTERNATIVES							
	NO ACTION		LOW LEVEL		INTERMEDIATE LEVEL		HIGH LEVEL	
	Basis for Evaluation		Basis for Evaluation		Basis for Evaluation		Basis for Evaluation	
	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]	ES [1]	USAKA [2]
Housing								
Kwajalein	●	N/A	●	N/A	●	N/A	●	N/A
Roi-Namur	●	N/A	●	N/A	●	N/A	●	N/A
Land Use								
Kwajalein		N/A		N/A	●	N/A	●	N/A
Illeginni		N/A		N/A	●	N/A	●	N/A
Ennugarret		N/A		N/A		N/A	●	N/A
Omelek		N/A		N/A		N/A	●	N/A
Legan		N/A		N/A		N/A	●	N/A
Gellinam		N/A		N/A		N/A	●	N/A
Eniwetak								
Income and Fiscal Conditions	○	N/A	○	N/A	○	N/A	○	N/A
Recreation, Education and Public Health								
Kwajalein		N/A	●	N/A	●	N/A	●	N/A
Roi-Namur		N/A	●	N/A	●	N/A	●	N/A
Transportation		N/A		N/A		N/A		N/A
Water Supply								
Wastewater								
Kwajalein					●	●	●	●
Roi-Namur			○	○	○	○	○	○
Solid Waste	●				●	●	●	●
Hazardous Materials		●		●		●		●
Hazardous Waste								
Energy and Fuels		N/A		N/A		N/A		N/A
Aesthetics								
Kwajalein		N/A	●	N/A	●	N/A	●	N/A
Ennugarret		N/A		N/A	●	N/A	●	N/A
Range Safety								
Ennugarret		N/A		N/A	●	N/A	●	N/A
Electromagnetic Radiation		N/A		N/A		N/A		N/A

LEGEND

- ○ Significant beneficial impact
- ● Significant adverse impact
- Blank No or nonsignificant impact
- N/A No USAKA Standard directly applicable

[1] ES = Significance of impacts determined from Existing Statutes and Regulations

[2] USAKA = Significance of impacts determined from Proposed USAKA Environmental Standards and Procedures

Note:
Entry in Resource row means impact is USAKA-wide.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Impacts – Level-of-Activity Alternatives

FIGURE 2.3-1
p.2

ENVIRONMENTAL RESOURCE	STANDARDS ALTERNATIVES: NO ACTION: EXISTING STATUTES AND REGULATIONS	STANDARDS ALTERNATIVES: PROPOSED ACTION: USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES
Land and Reef [1]		
Water Resources	No Impact	• Overall more protection
Air Quality	No Impact	• Short-term increase in pollutants possible • Long-term better protection because incremental increase is limited
Noise [1]		
Island Plants and Animals	No Impact	• More species are protected
Marine Biological Resources	No Impact	• More species are protected
Rare, Threatened and Endangered Species	No Impact	• DEP process establishes framework of consultation and coordination • Candidate species are protected
Cultural Resources	No Impact	• Similar
Land Use [1]		
Socioeconomic [1]		
Transportation [1]		
Water Supply	No Impact	• Overall more protection
Wastewater	No Impact	• Similar
Solid Waste	No Impact	• Overall more protection
Hazardous Materials	No Impact	•Overall more protection
Hazardous Waste	No Impact	• Overall more protection
Energy and Fuels [1]		
Aesthetics [1]		
Range Safety [1]		
Electromagnetic Radiation [1]		

[1] No USAKA Environmental Standard specifically addresses these resources; associated impacts are addressed by other sections of USAKA standards.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Comparison of Alternatives – USAKA Environmental Standards And Procedures

FIGURE 2.3-2

The High Level of Activity would meet the need for the Proposed Action but would exceed the numbers and types of testing required to developmentally and operationally test the BMD system. Under the High Level-of-Activity Alternative, there would be more infrastructure created at USAKA than is required to conduct the testing of the necessary ABM systems and components. Construction of facilities would proceed under the High Level-of-Activity Alternative at a pace that would be beyond that necessary for the number of people who could reasonably be expected to support USAKA testing over the next 10 years. The advantage of the High Level-of-Activity Alternative is that it gives more flexibility to USAKA to meet additional (but for now, unforeseen) mission needs.

2.3.2 Proposed USAKA Environmental Standards and Procedures

The evaluation of the proposed USAKA Environmental Standards and Procedures in Chapter 4 of this SEIS documents that the proposed Standards would protect the particular environment of USAKA while appropriately reflecting the special governmental relationship between the RMI and the U.S., as provided in the Compact.

The No-Action Alternative, the continued use of U.S. statutes and regulations, would protect the USAKA environment but would not reflect the special governmental relationship between the two countries, as specified in the Compact. The proposed Standards provide a similar level of protection of human health and safety and the environment as existing statutes and regulations (or, in some areas, a higher level of protection). However, the proposed Standards also incorporate revised procedures that eliminate administrative requirements that are not appropriate at USAKA and that provide for participation by U.S. environmental and resource agencies and RMIEPA. For these reasons, the proposed Standards better meet the intent of the Compact than the No-Action Alternative.

2.4 Alternatives Considered but not Carried Forward

The 1989 EIS describes in detail the following two alternatives, which were examined early in the scoping process for that document but were eliminated from further consideration as unreasonable (see pages 2-60 through 2-62 of the 1989 DEIS).

Reduced Activities. This alternative would reduce or eliminate missile testing in the Pacific Ocean region. USAKA's location is a critical factor for missile testing, because it provides security and a high degree of safety. A Pacific Ocean missile test range is also critical for tracking the NASA space shuttle and other United States and foreign space objects. Because missile flight testing is an essential part of developing and maintaining a credible defense system, this alternative was determined to be unreasonable.

Relocation of Missile Range and BMD Activities. This alternative would move USAKA facilities and functions to another location in the Pacific Ocean. It was also considered to be unreasonable because of the investment in infrastructure at USAKA and because of the long delays such an extensive relocation would cause in SDI development and decisionmaking.

In addition to the alternatives discarded as unreasonable in the 1989 EIS, a number of alternative locations for new SLV launch facilities at USAKA were evaluated in order to identify the alternatives evaluated in this SEIS. The screening analyses of alternative locations for SLV launch facilities are documented in the *Kwajalein Missile Range (KMR) National Missile Defense Test Facilities Siting Recommendation Technical Report* (USASSDC, 1993e) and its Attachment 4 *Environmental Site Suitability Study for NMD Elements at USAKA.*

The 11 USAKA islands were screened for suitability as locations for new SLV launch facilities using the following exclusionary criteria; those islands that were excluded based on this analysis were considered not to be reasonable alternatives to analyze in this SEIS.

Mission Objectives. Each island was evaluated to determine whether it could support launches with a trajectory toward the BOA without flying over the exclusion areas around inhabited islands. Analysis of SLV trajectories indicated that Roi-Namur, Ennugarret, Gagan, and Kwajalein could not be locations of SLV launches without violating this exclusionary criterion.

Public Health and Safety. Each island was evaluated to assess whether guided, high-performance SLVs could be safely assembled, integrated, tested, and launched without endangering public health and safety at and near the launch site. In addition, critical USAKA facilities (KREMS system on Roi-Namur and Kwajalein island infrastructure and Ennylabegan telemetry) must not be endangered. Safety exclusion areas (as specified by U.S. Army regulations) were drawn around each potential launch site; where the exclusion area for a launch site included inhabited areas or areas with critical USAKA facilities, that site was dropped from further analysis. Based on this analysis, in addition to the islands excluded because they could not accomplish mission objectives without compromising safety, Ennylabegan Island was excluded from further evaluation because of insufficient safety distances to Marshallese inhabitants on the island and insufficient safety distances to critical USAKA telemetry facilities.

Physical Space. Each island was evaluated to determine whether it has sufficient area to safely accommodate both explosive materials and inhabited buildings (based on an Explosive Safety Quantity Distance of 1,250 feet [381 meters] for facilities with more than 100 pounds [45 kilograms] of Class 1.1 explosive). Based on this analysis, in addition to the islands excluded above, Gellinam Island was dropped from further consideration.

The natural and man-made features of the environment that may be affected by the Proposed Actions or alternatives are described in this chapter. The 1989 USAKA Environmental Impact Statement (EIS) is incorporated by reference and new data are provided where conditions have changed since the 1989 EIS was issued.

The affected environment is primarily the air, land, reef, lagoon, and ocean areas of the 11 USAKA islands. With the exception of Ebeye and Ennubirr (where most of the Marshallese who work at USAKA reside), other islands in Kwajalein Atoll are not expected to be directly affected by the Proposed Actions and are not addressed.

3.1 Background

The history of Kwajalein Atoll is described in the 1989 DEIS in Chapter 3, Section 3.8–Historical, Archaeological, and Cultural Resources. Little is known of the pre-modern-era history of Kwajalein. During the German colonial presence in the Marshall Islands from 1885 to 1914, the Germans established copra plantations and trading stations. Shortly after the outbreak of World War I, the Japanese took control of most of Micronesia, including the Marshall Islands. The League of Nations later mandated the Marshall Islands to Japan. In 1935, Japan began to fortify the Marshall Islands, and turned Kwajalein Atoll into a stronghold through which shipping, supplies, and reinforcements were routed to other atolls in the Marshall Islands. In February 1944, the islands of Kwajalein and Roi-Namur were subjected to one of the most severe coordinated air, land, and sea bombardments of World War II. After the U.S. occupied the atoll, Kwajalein's naval and air facilities were used as a logistical base for continuing American military operations in the Pacific Theater.

During the 1940s and 1950s, the U.S. Navy used Kwajalein to support weapons testing in the South Pacific, and as a logistical base to support military operations in Korea. With the development of intercontinental ballistic missiles (ICBMs) and sea-launched ballistic missiles (SLBMs), Kwajalein Atoll was selected as the United States' primary range for support of antiballistic missile (ABM) testing. Construction has continued on Kwajalein Atoll to the present, and Kwajalein, Roi-Namur, Illeginni, and Meck islands are now dominated by man-made features. The remaining USAKA islands are less developed. Characteristics of the islands vary considerably, as shown in Table 3.1-1. For example, Ennugarret currently has no active USAKA facilities and is

Table 3.1-1
Characteristic Features of Selected Kwajalein Atoll Islands

	USAKA Islands											Non-USAKA Islands	
	Kwajalein	Roi-Namur	Meck	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Omelek	Eniwetak	Ennugarret	Ebeye	Ennubirr
Marshallese spelling	Kuwajleen	Ruōt im Namur	Meik	Āne-eļļap-kan	Ambo	Llikijior	Kowak-kan	Kiden-en	Komle	Āne-wetak	Ane-karan	Epjā	Āni-bōn
Total area (acres)	748	398	55	124	18	31	6	5	8	15	24	74	20
Leased area (acres)	748	398	55	71	18	31	6	5	8	15	6	0	0
Population	Total nonindigenous population on Kwajalein and Roi-Namur: 3,100 (1991)		No permanent population	67 Marshallese	.... No permanent population							10,000 Marshallese (1991)	500 Marshallese (1988)
USAKA activities	Base headquarters, meteorological rocket launches, radars, optical sensing, communications, range support, base operations, housing, community support	KREMS radar tracking, launches, optical sensing, range support, base operation housing, community support	Launches, optical sensing, range support	Portion of the island leased by USAKA and used for telemetry	Optical sensing, radar	Optical sensing, telemetry, ordnance disposal, RV land impacts, multistatic measurement system	Optical sensing, telemetry	Radar, hydro-acoustic impact timing system, multistatic measurement system	Meteorological rocket launches	Optical sensing	Portion of the island leased; no USAKA activities	No direct USAKA activities; residence of indigenous workforce	
Facilities/buildings	Extensively built up with range support and base facilities, housing, and community support	Largely built up with range support and base facilities, breakwater, and pier	Extensively built up within range support facilities, breakwater, and pier	Helipad, antennas, and buildings, two small Marshallese settlements, pier	Helipad, camera tower, short roads, finger jetty, marine ramp	Helipad, road, radars, camera towers, antennas, old launch facilities, jetty	Helipad, camera towers, antennas, marine ramp, personnel pier	Helipad, radars, other small buildings, marine ramp	Helipad, launch pads, missile assembly buildings, road, marine ramp, and pier	Helipad, camera towers, two developed sites linked by a road, pier, marine ramp	No active facilities	Highly built up urban environment	Concrete block housing, pier

not inhabited. In contrast, Kwajalein Island is the headquarters of USAKA and is the location of the largest nonindigenous workforce in the atoll.

The following sections are organized by major resource group. For each resource, introductory text defines the resource, identifies the region of influence, and summarizes or references the 1989 EIS. Relevant elements of the affected environment are then discussed, with a focus on elements of the environment that have changed since the 1989 EIS was prepared. Unique or characteristic features of particular islands are highlighted in tables or in text.

Figures 3.1-1 through 3.1-11 illustrate the natural and cultural resources of the 11 USAKA islands. These figures reflect information that has been updated since the 1989 DEIS was prepared. The primary sources for new information are the *Natural Resources Plan* (USAEDPO, 1991a) and a biological reconnaissance conducted in February 1992, which led to revisions in some of the delineations of valuable resource areas shown in the *Natural Resources Plan* maps. In addition, the names and locations of some cultural resources shown in the 1989 EIS and the *Natural Resources Plan* have been revised here based on a review of the Kwajalein and Roi-Namur Battlefield National Register of Historic Places nomination forms conducted by James Walker (USASSDC Senior Historian) and Doug Cubbison of Teledyne Brown Engineering in August 1993.

3.2 Land and Reef Areas

Kwajalein Atoll is a crescent-shaped coral reef, dotted with a string of approximately 100 islands, that encloses the world's largest lagoon (1,100 square miles [2,849 square kilometers]). The combined land area of the islands totals only 5.6 square miles (14.5 square kilometers) (see Figure 1.1-3 in Chapter 1). Lagoon depths are typically 120 to 180 feet (37 to 55 meters), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly to as much as 13,000 feet (3,962 meters) within 5 miles (8 kilometers) of the atoll.

For this analysis, the region of influence includes reef and land areas for the 11 USAKA islands on which significant environmental impacts could occur from the Proposed Actions or alternatives.

The three largest islands of the atoll—Kwajalein, Roi-Namur, and Ebadon—account for nearly one-half the total land area. The typical size of the remaining islands is a few acres; some islands are ephemeral sand keys that just break the water's surface at low tide. All islands of the atoll are nearly flat, with few natural points that exceed 15 feet (5 meters) above mean sea level. The following subsections briefly summarize relevant island and marine geology features of the 11 USAKA islands. Section 3.2 of the 1989 DEIS includes more complete descriptions.

3.2.1 Island Geology

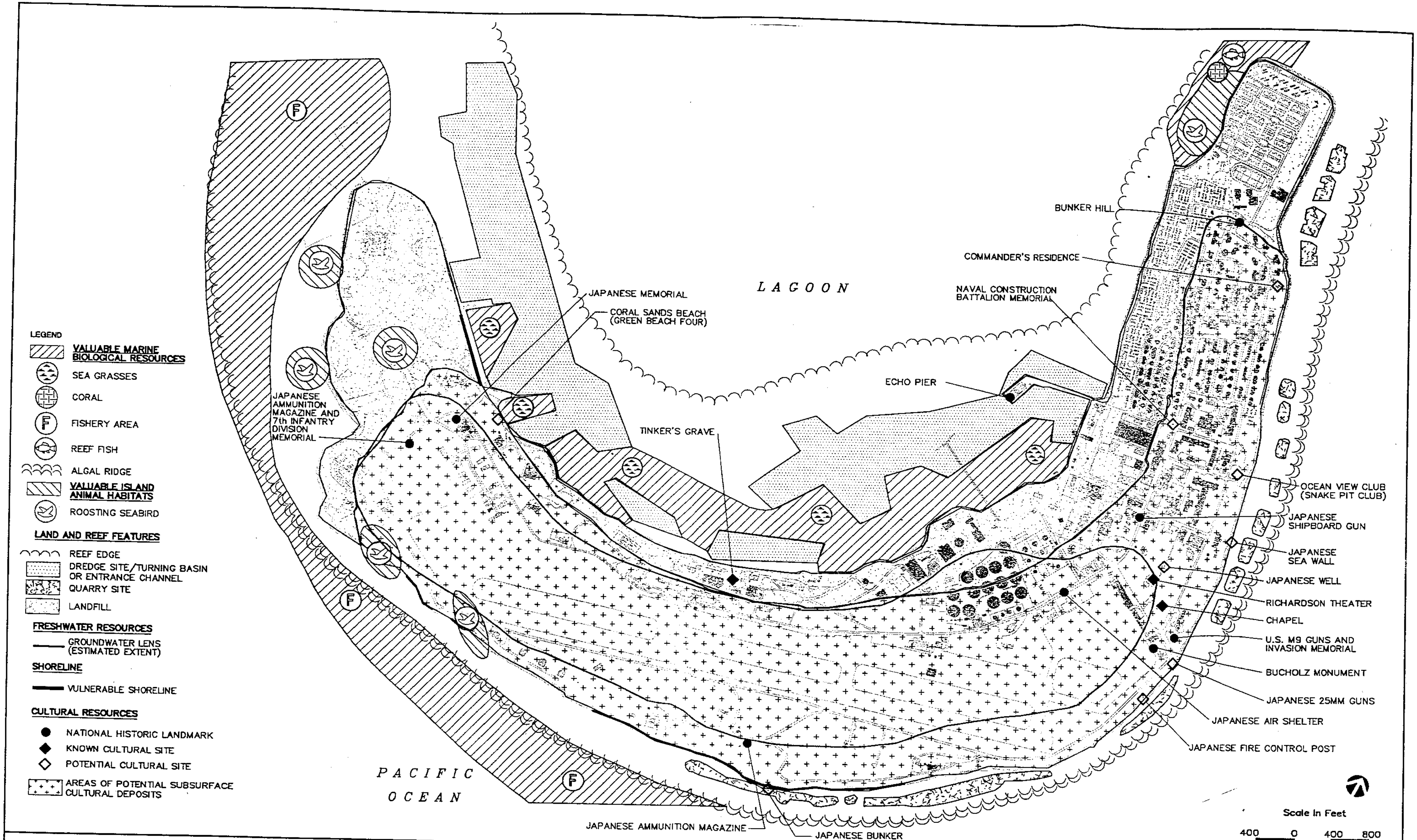
The reefs and islands of Kwajalein Atoll consist of the remains of coral reef rock and sediments (to a depth of several thousand feet) lying atop submarine volcanoes that formed 70 to 80 million years ago. As the volcanoes subsided, coral reefs grew upward to remain close to the surface of the ocean and formed the ring of islands that create the lagoon. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Approximately 25 natural passages through the reef flat admit small boats to the lagoon.

The Kwajalein Atoll Development Authority (an RMI development agency) is constructing a 7,700-foot (2,347-meter) causeway linking Gugeegue and South Loi islands (northeast of Ebeye). Little information about the final design of the causeway is available; it is not known what effect, if any, the causeway may have on current flow in and out of Kwajalein lagoon.

Both the reef rock from which the atoll is built and the sands and sediments of its beaches and lagoon bottom are formed entirely from the remains of calcium-secreting marine organisms such as coral, coralline algae, calcareous algae, mollusks, and foraminiferans. The tops of the reefs are a thin veneer of actively growing organisms that accrete over the remains of prior generations of reef organisms and add to the reef structure. The reef-building organisms advance wave-resistant structures in the face of persistent and sometimes severe wave and storm attack, but they are sensitive to sedimentation, burial, and changes in circulation caused by human activities.

Land areas that emerge from the reef flat are formed from loose corals, coral boulders, and sediments thrown up from the reef flat by large waves and storms and by the emergence of portions of the reef flat as a result of sea level changes over the last 4,000 years. The islands created in this fashion have soils with low fertility because of three major factors: (1) the soil particles are generally coarse, (2) organic content is low, and (3) they are alkaline.

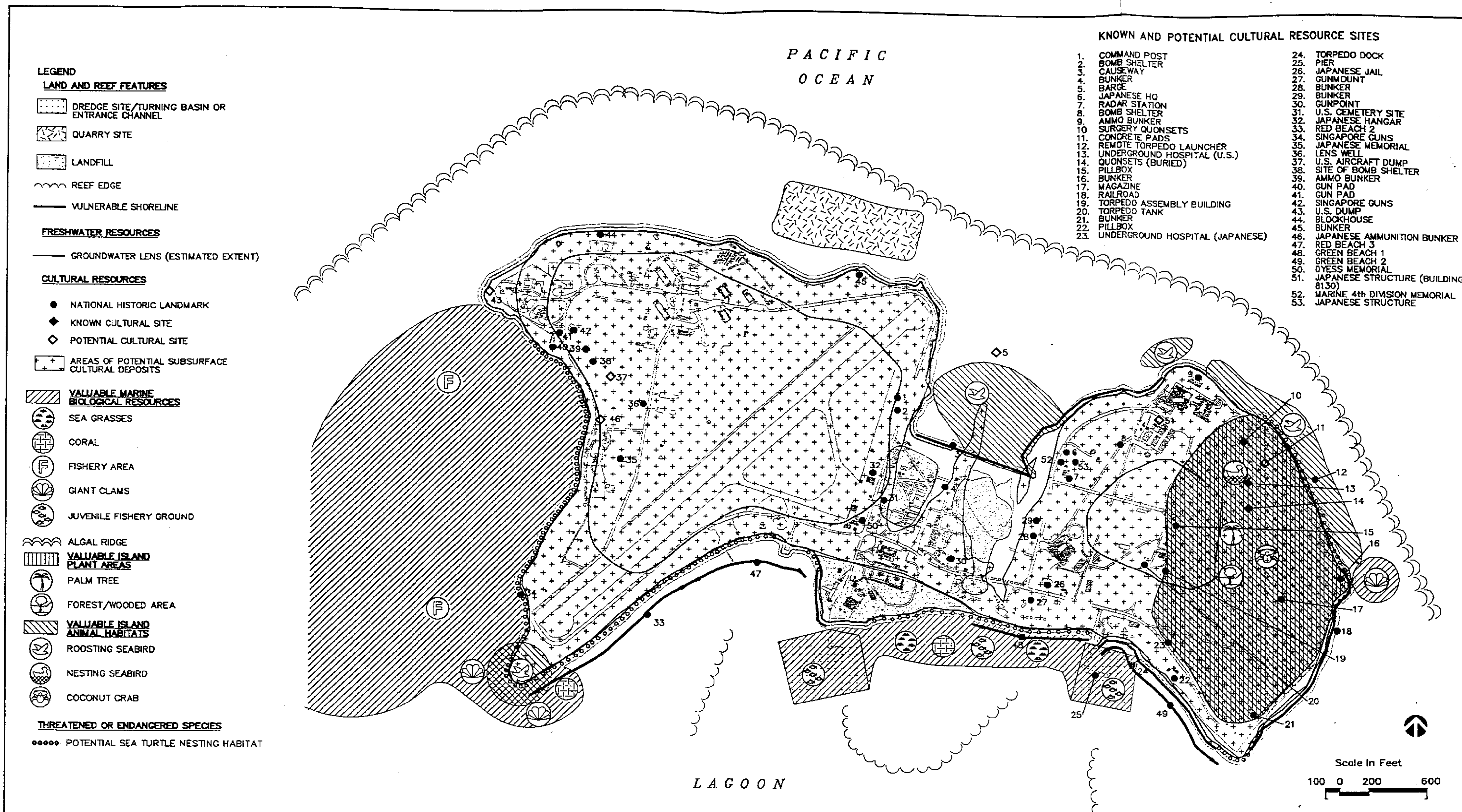
Shorelines of the islands are dynamic, constantly eroding or accreting, depending on local wave and current patterns and on the nature and extent of the fringing reef. The shorelines of 10 USAKA islands were inventoried by Sea Engineering, Inc., and R. M. Towill Corp. (1988), to identify vulnerability to erosion. Figures 3.1-1 through 3.1-10 illustrate vulnerable shorelines of 10 of the 11 USAKA islands (information is not available for Ennugarret Island, whose shorelines have not been surveyed). The areas mapped in these figures derive from maps in the *Natural Resources Plan* (USAEDPO, 1991a), which in turn were based on data in the *Shoreline Inventory and Protection Study* (Sea Engineering, Inc., and R. M. Towill Corp., 1988). Vulnerable shorelines identified in Figures 3.1-1 through 3.1-10 are defined as shoreline reaches rated "high" in the *Shoreline Inventory* for both of the two parameters of damage and overtopping vulnerability or as "high" for one parameter and "medium" for the other.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
KWAJALEIN

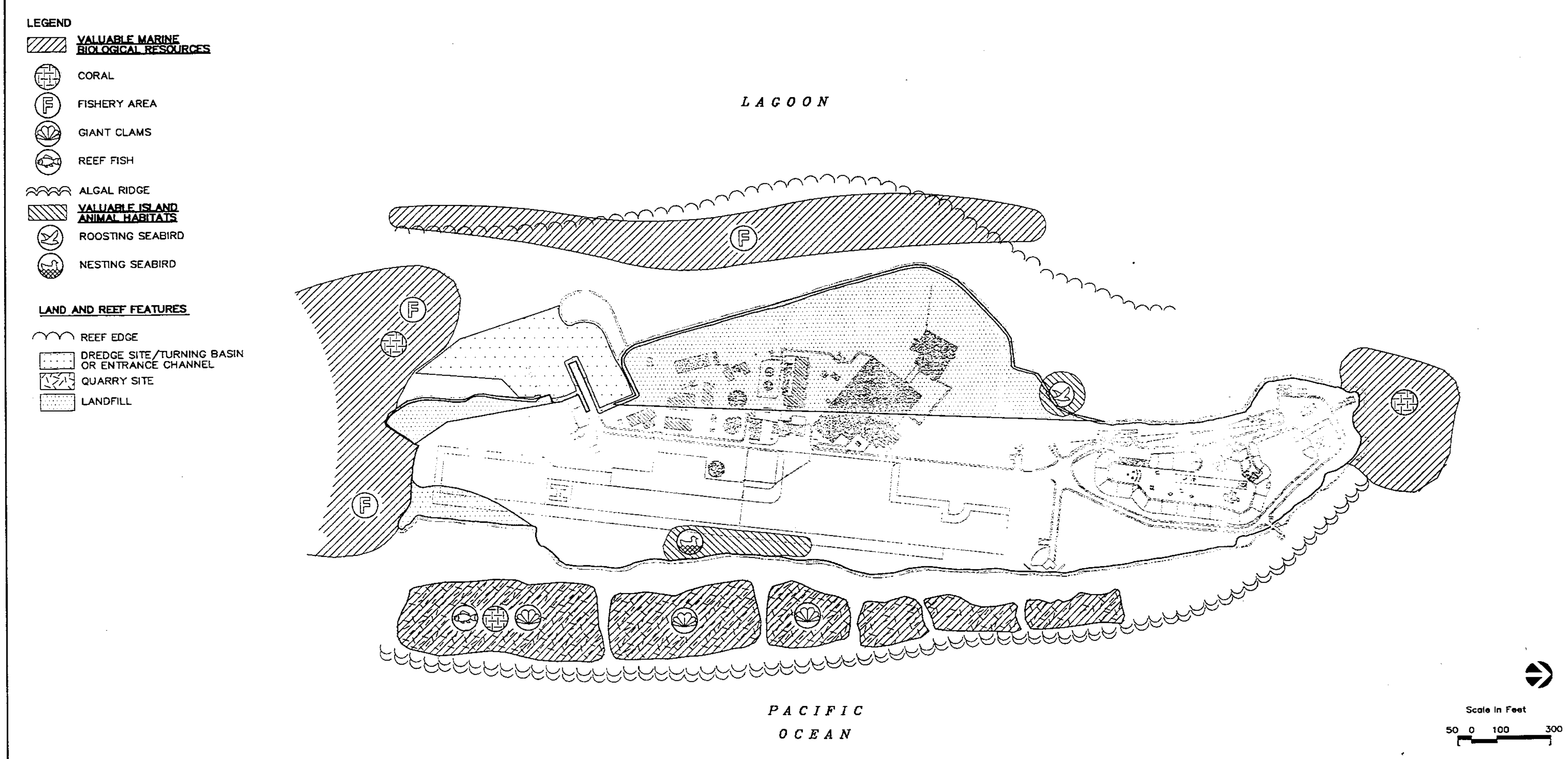
FIGURE 3.1-1



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
ROI-NAMUR

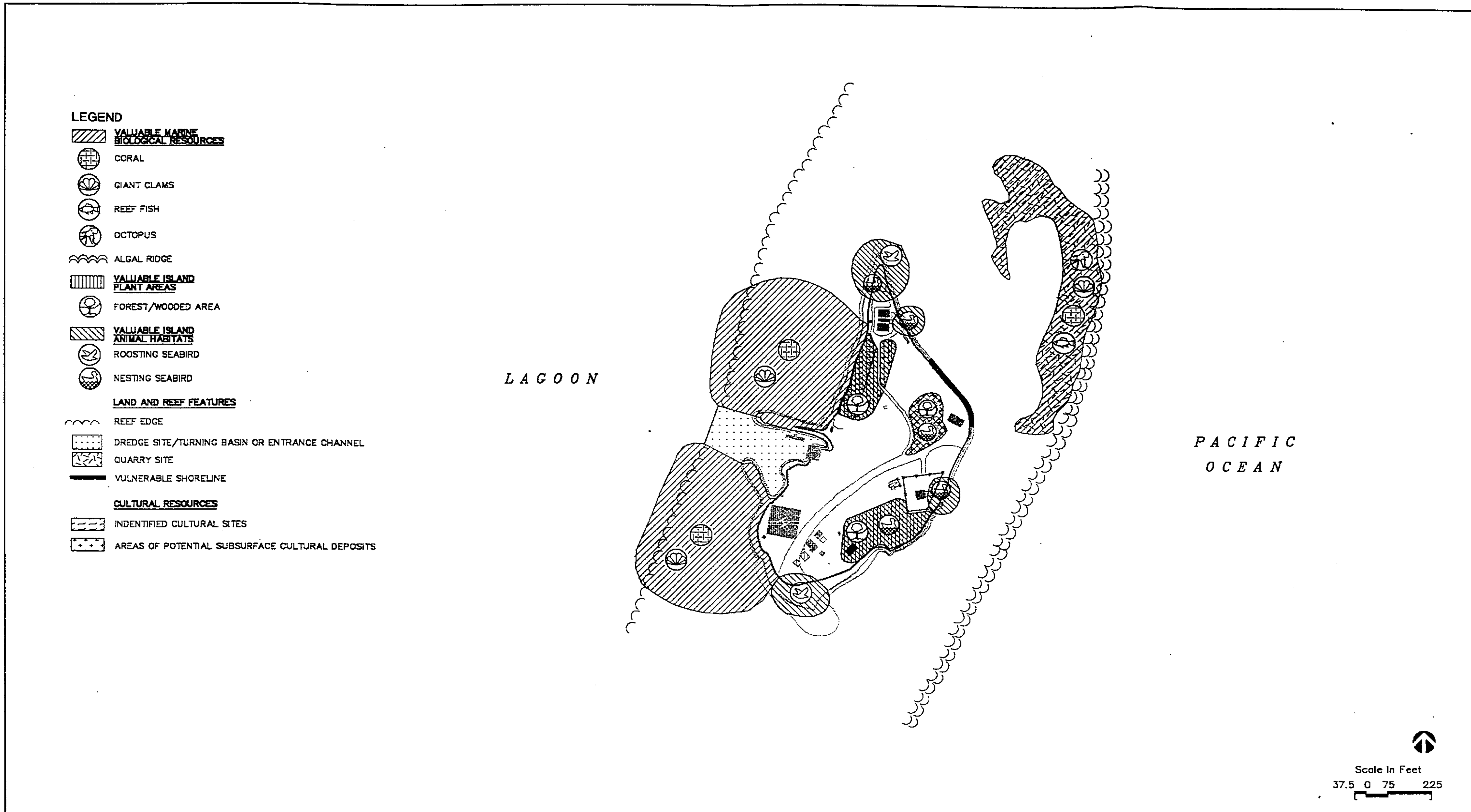
FIGURE 3.1-2



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
MECK

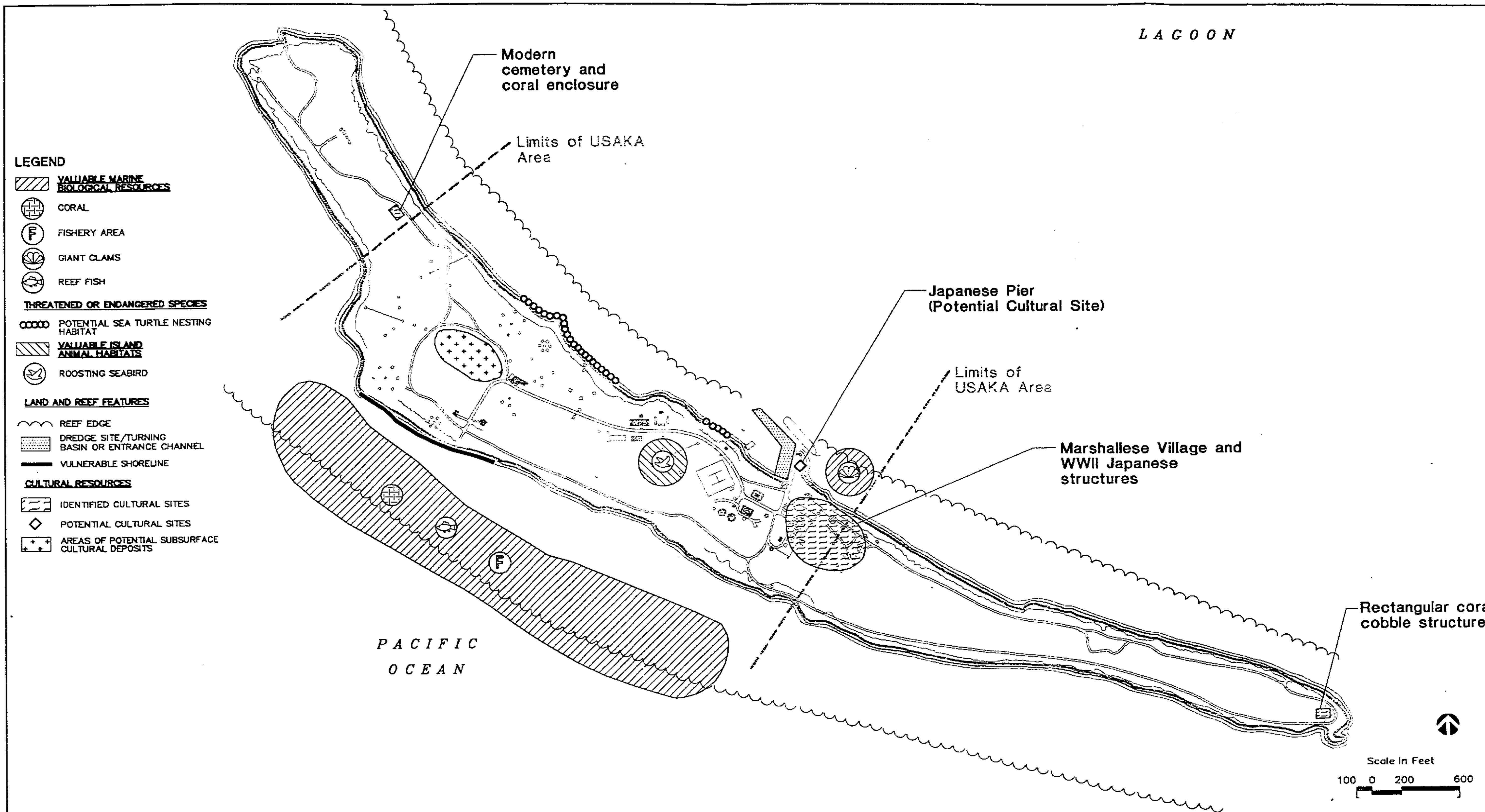
FIGURE 3.1-3



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
OMELEK

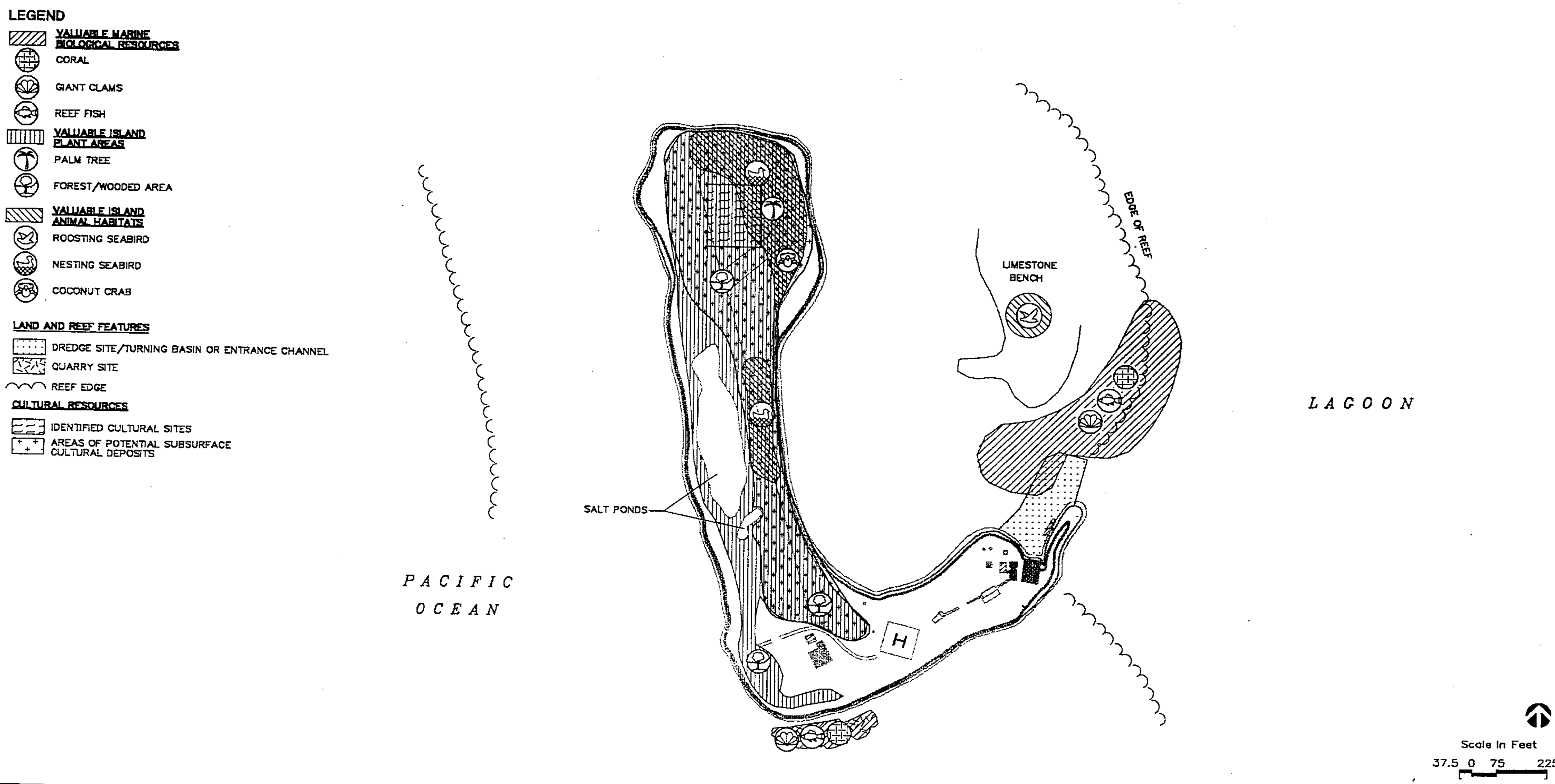
FIGURE 3.1-4



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
ENNYLABEGAN

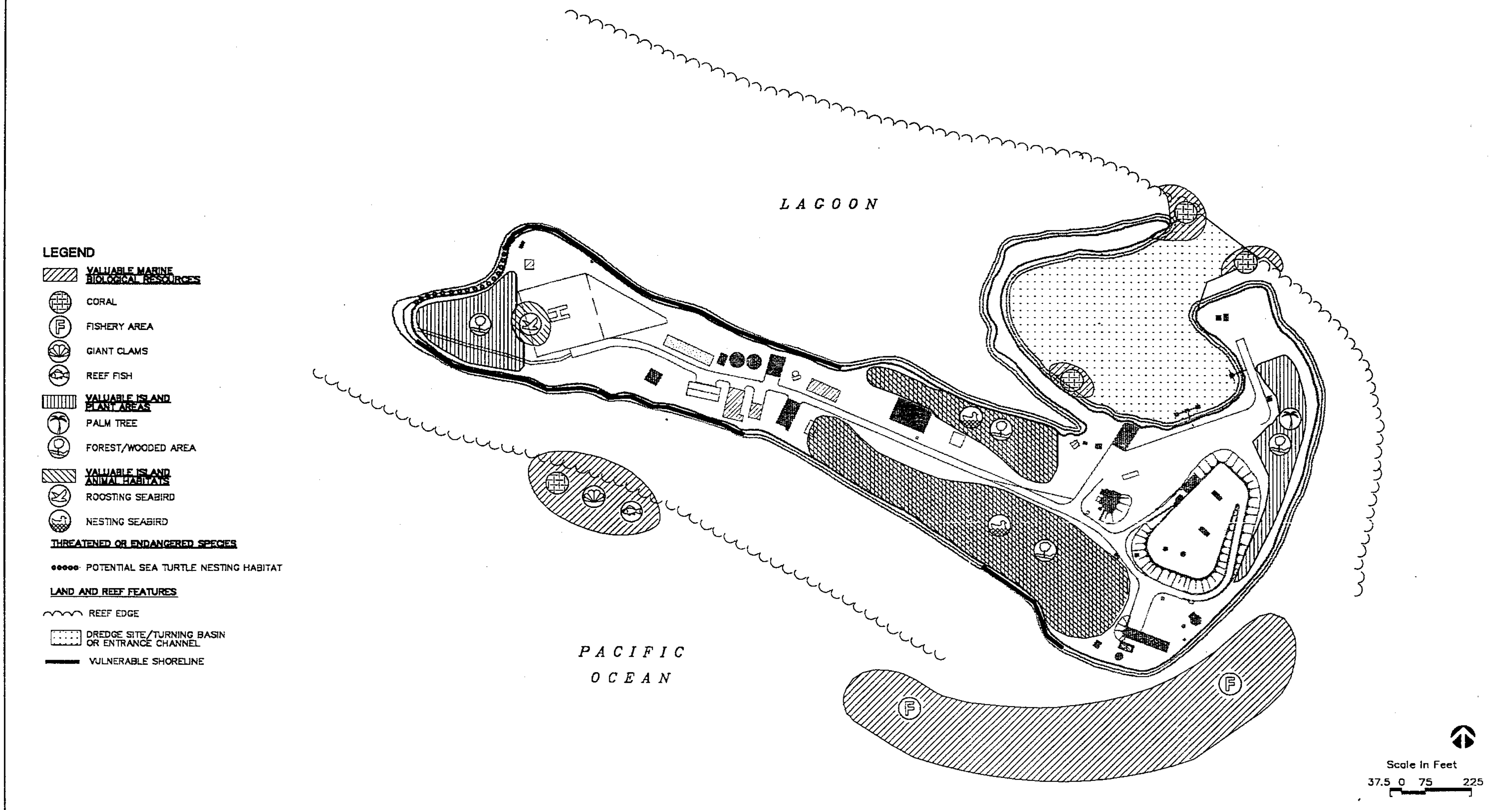
FIGURE 3.1-5



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
LEGAN

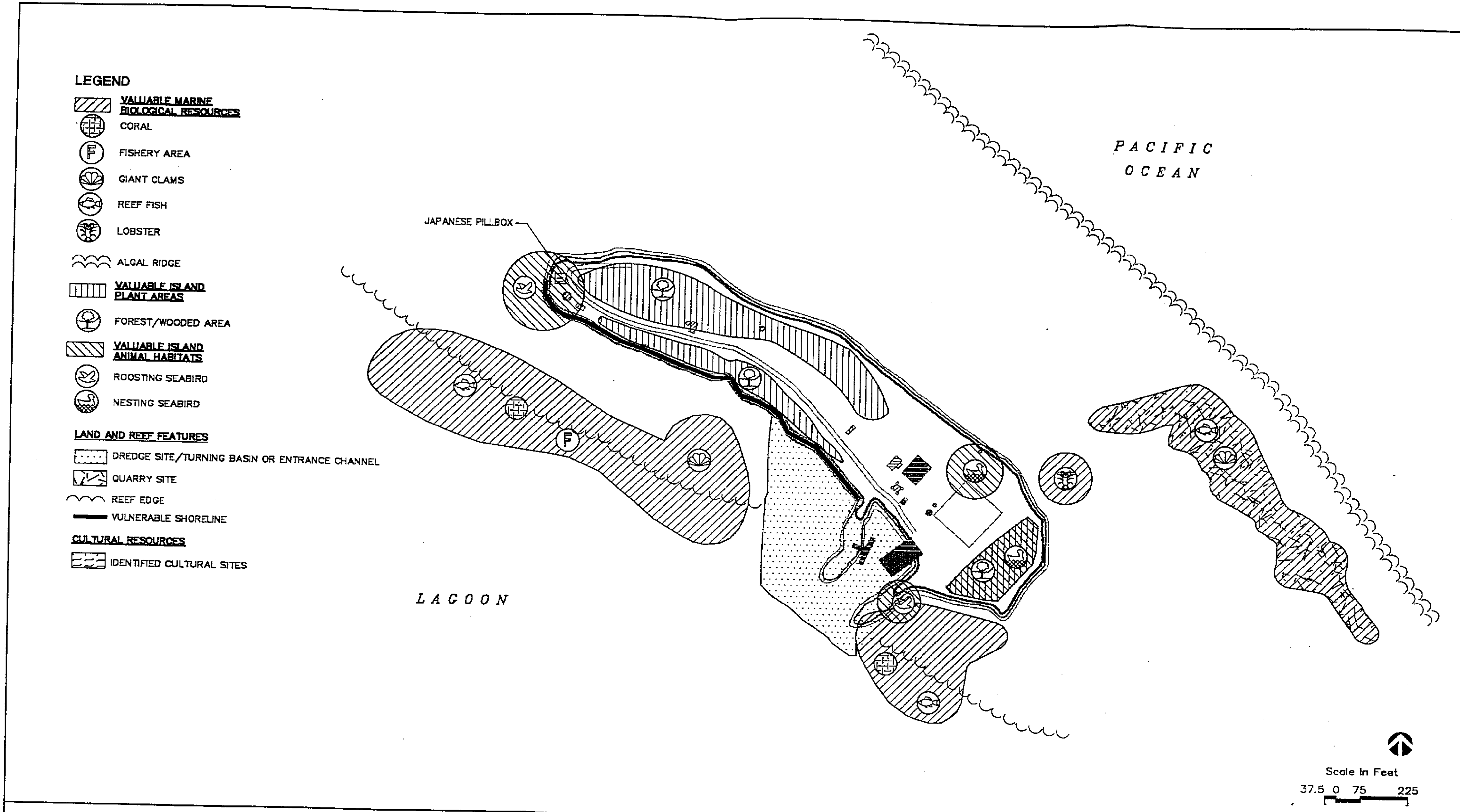
FIGURE 3.1-6



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
ILLEGINNI

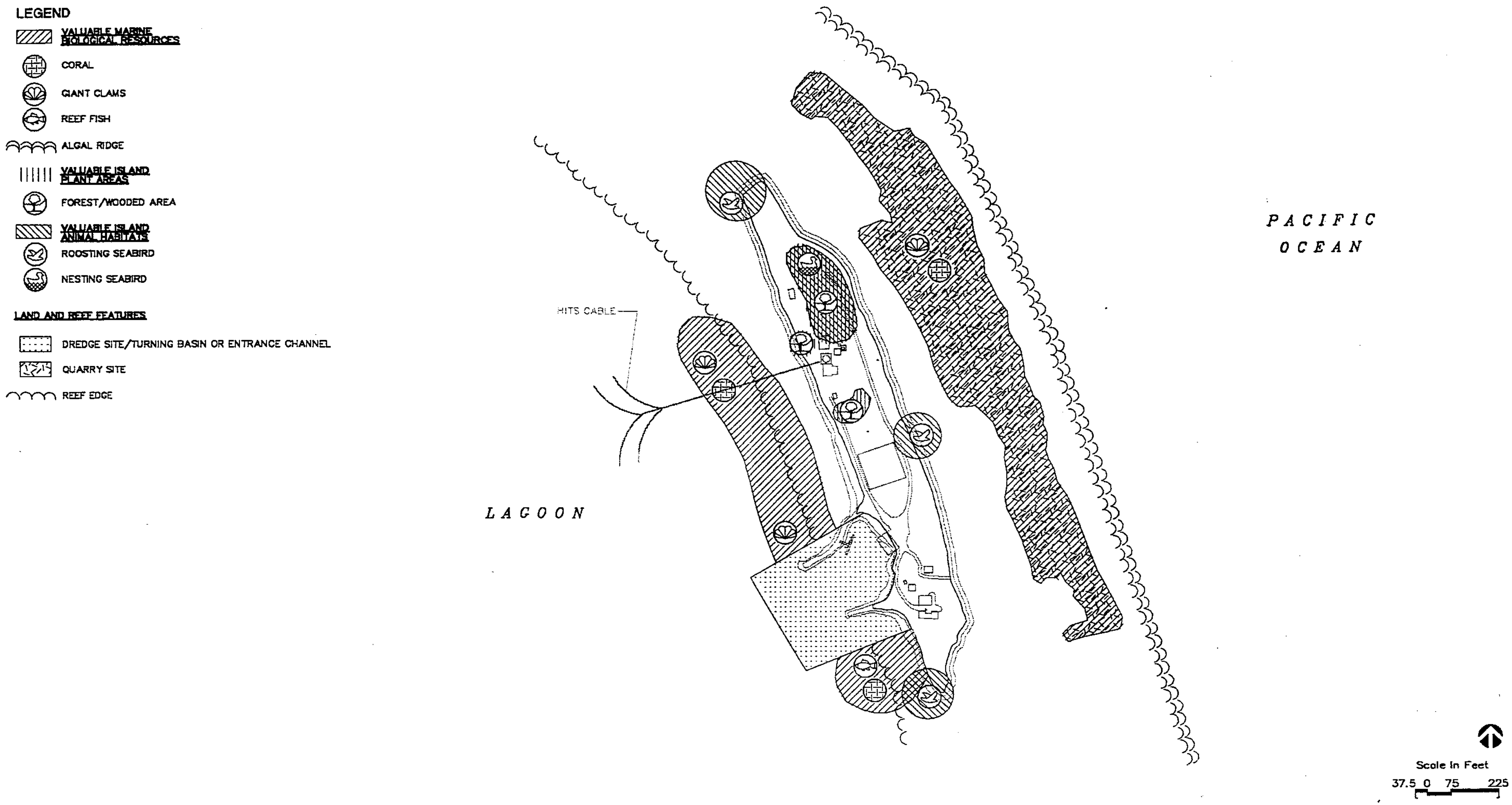
FIGURE 3.1-7



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
GAGAN

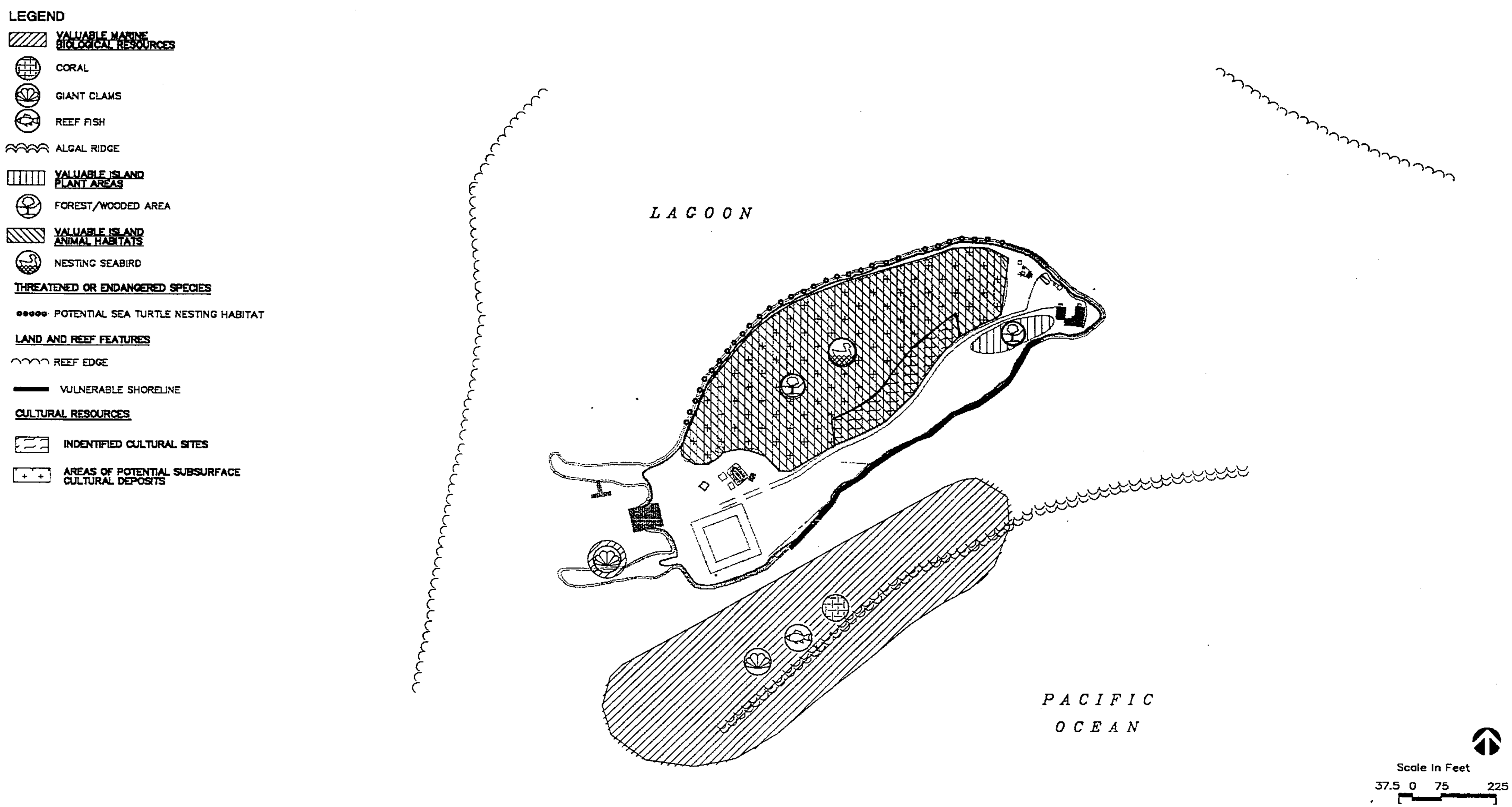
FIGURE 3.1-8



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
GELLINAM

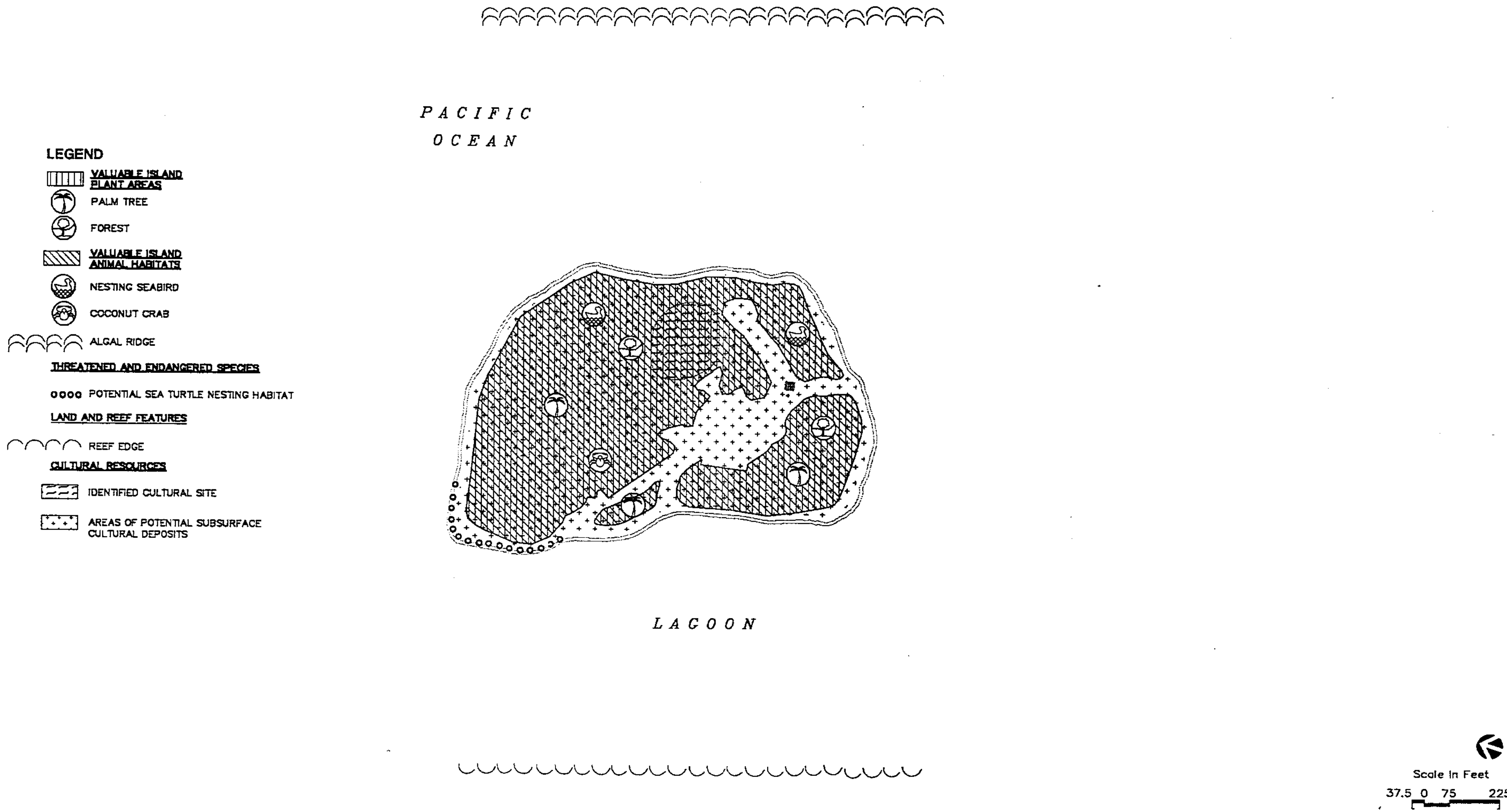
FIGURE 3.1-9



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
ENIWETAK

FIGURE 3.1-10



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Natural and Cultural Resources
ENNUGARRET

FIGURE 3.1-11

3.2.2 Marine Geology

The geology of Kwajalein Atoll is typical of Micronesian atolls. On the ocean side of the atoll's islands, there is generally a shallow reef flat extending to a seaward reef slope. Ocean reef flats on the windward (north and east) side of the atoll are subjected to stronger wind and wave action and are characterized by well-defined spur-and-groove systems (i.e., a series of ridges and channels) more often than are leeward ocean reef flats. Ocean-side beaches are generally composed of gravel- to cobble-sized material, while lagoon-side beaches are more often sand.

Windward ocean reef flats are composed of hard rock that extends downward for 2 to 4 feet (0.6 to 1.2 meters), with softer or unconsolidated rock below that level (Sea Engineering, Inc., and R. M. Towill Corp., 1988). Lagoon reef flats are typically more narrow than the ocean reef flats and are composed of softer rock. Only the harder rock from the ocean-side reef flats has been found suitable for use as armor stone for shoreline protection.

Considerable filling to expand available land area has been done at USAKA since the time of Japanese occupation. Quarrying and dredging are the methods used to provide the needed fill material. In addition, quarries provide virtually all of the armor stone used for shoreline protection. Quarry holes have historically been set back at least 100 feet (30 meters) from the seaward margin of the ocean reef flat. The intent of this setback is to maintain the natural protection from storm waves and surges that is provided by the reef and to serve as a buffer between waves and the quarrying operations. In the long term (over a period of several years), quarrying typically results in some degree of habitat enhancement because it provides a more diverse environment than that offered by the reef flat. Quarry shape and flushing characteristics are the primary factors that determine the extent to which habitat enhancement occurs. Fill material has also been dredged from the atoll reef flats and the lagoon. Harbors are dredged as the need arises, typically once every 10 years. On average, approximately 10,000 cubic yards (7,650 cubic meters) are dredged from harbors annually.

Quarrying data for years prior to 1988 are not available. Quarrying during 1988 yielded 62,500 cubic yards (47,813 cubic meters) of fill material. There has been no quarrying at USAKA since 1990.

Needs for quarried material are substantial. Revetments for protection against the 50-year design storm require 9.6 cubic yards (7 cubic meters) per linear foot of protected shoreline (Sea Engineering, Inc., and R. M. Towill Corp., 1988). In the 1989 EIS, the need for 274,000 cubic yards (209,610 cubic meters) of aggregate was identified to meet only high-priority repair needs on all USAKA islands. The need for aggregate has increased because of the damage caused by Tropical Storm Zelda in November 1991.

3.3 Water Resources

Water resources at Kwajalein Atoll consist of freshwater and marine water. Freshwater resources include rainwater and groundwater (at Kwajalein and Roi-Namur). Marine water resources include the lagoon and outer ocean areas. The region of influence includes all freshwater resources of the 11 USAKA islands and the marine water resources of the lagoon and nearshore ocean in the immediate vicinity of these islands.

New sources of water resource information and data that have been developed since preparation of the 1989 EIS and that have been reviewed for this section are listed below.

- *1990 Local Climatological Data, Annual Summary: Kwajalein, Republic of the Marshall Islands* (NOAA, 1990a)
- *Ground-Water Quality Survey No. 38-26-0357-90, U.S. Army Kwajalein Atoll* (USAEHA, 1990)
- Memorandum for Commander: Water Quality Engineering Consultation No. 31-24-G949-91, Potable Water Quality Issues, U.S. Army Kwajalein Atoll (USAEHA, 1991a)
- *Soil and Ground-Water Contamination Study No. 38-26-K144-91, U.S. Army Kwajalein Atoll* (USAEHA, 1991b)
- Memorandum for Commander: USAKA CY91 and CY92 Comprehensive Potable Water Monitoring Program—First and Second Quarter Results. U.S. Army Kwajalein Atoll (USAEHA, 1991c, 1992c)
- *Wastewater Management Study No. 32-24-H 601-91, Waste Discharge Analysis, U.S. Army Kwajalein Atoll* (USAEHA, 1991d)
- *Study of Zones of Mixing at Kwajalein Atoll*. Report prepared by Advanced Sciences, Inc. (USASSDC, 1993c)
- *Wastewater Treatment Study*. Report prepared by CH2M HILL (USASDC, 1992d)
- *Marine Heavy Metals Study, U.S. Army Kwajalein Atoll, Final Technical Report* (USASDC, 1991)
- Memorandum for Commander: USAKA CY91 Comprehensive Potable Water Monitoring Program—Third Quarter Results. U.S. Army Kwajalein Atoll (USAEHA, 1992b)

3.3.1 Freshwater

Freshwater resources at USAKA consist of rainwater obtained from catchments and groundwater lenses that occur beneath the larger islands. The 1989 EIS describes the general features of the resource.

3.3.1.1 Rainfall

Seasonal rainfall is the primary source of freshwater at USAKA. Normal annual precipitation is approximately 100 inches (254 centimeters) (NOAA, 1990b), but the amount of precipitation is highly variable, ranging from 70 to 149 inches (178 to 379 centimeters) per year (USAEHA, 1990). The wet season extends from May through November when the normal monthly precipitation varies between 10 and 11 inches (25 and 28 centimeters). During the dry season from December to April, rainfall varies from approximately 3 to 8 inches (8 to 20 centimeters). Rainfall is highly variable, as noted by comparing the minimum monthly precipitation of 0.04 inch (0.1 centimeter) in February 1977 with the maximum monthly precipitation of 30.38 inches (77 centimeters) in December 1950. Significant dry seasons have occurred recently, such as in 1984 (the driest year on record) and in 1992. The period between 1988 and 1991 had generally below-normal rainfall. Mean monthly rainfall shows a decline when these recent data are included with the record for the period of 1945-1990.

KWAJALEIN

Rainfall is captured for potable use from 80 acres (32 hectares) of catchment located adjacent to the runway on Kwajalein. Capture efficiency is currently estimated at about 600,000 gallons (2,271,200 liters) of water per inch (2.5 centimeters) of rainfall. During the 1985-1991 period, the average capture of rainwater was only 4.7 million gallons (17.8 million liters) per month (down from the 8.8 million gallons [33.3 million liters] per month reported in the 1989 EIS). During low-rainfall periods the volume can decline significantly. During the drought of 1984-1985, the average capture was only 2.8 million gallons (10.6 million liters) per month—less than one-third of the daily demand. During the wet season, much greater amounts of rainfall are captured. The highest recorded capture of rainfall occurred in August 1990, when 12.35 million gallons (46.75 million liters) were captured. Raw water is stored in 14 1-million-gallon aboveground storage tanks. Water from Kwajalein is supplied to the other islands that do not have catchments and to ships that visit.

ROI-NAMUR

On Roi-Namur, there are two catchment basins located to the southeast of the runway. These catchments yield approximately 250,000 to 800,000 gallons (946,325 to 3,028,240 liters) of water per month. Raw water is stored in one 1-million-gallon (3.8-million-liter) and two 750,000-gallon (2.8-million-liter) steel tanks.

OTHER ISLANDS

Meck has a rainwater catchment area of 3.5 acres (1.4 hectares) adjacent to the airfield runway. Raw water storage is provided by two 250,000-gallon (946,325-liter) and one 500,000-gallon (1.9-million-liter) tanks. Ennylabegan has a rainwater catchment of 3.96 acres (1.6 hectares) (formed by the helipad) that delivers water to two 145,000-gallon (548,873-liter) tanks for potable uses. Illeginni has a rainwater catchment of 1.74 acres (0.7 hectare) (formed by the helipad) and a 200,000-gallon (757,066-liter) potable water storage tank; however, these facilities are inactive. For all other islands, people who work on those islands carry water from Kwajalein.

3.3.1.2 Groundwater

Groundwater provides a significant source of potable water on Kwajalein and Roi-Namur islands, supplementing rainwater from catchments on these islands. Protection of the groundwater resource is of paramount importance in maintaining the quality of adequate supplies of potable water. Groundwater conditions at USAKA were surveyed in 1980 (Hunt and Peterson, 1980) and most recently in several U.S. Army Environmental Hygiene Authority (USAEHA) water quality studies, summarized below. Additionally, the U.S. Geological Survey (USGS) is conducting studies of groundwater conditions at Kwajalein and Roi-Namur islands to determine the nature and extent of the freshwater lenses, to estimate freshwater availability for potable uses, and to estimate the rates and directions of advective contaminant transport for known sites of environmental contamination. The Roi-Namur investigation draft report received its final review during the fall of 1992, while work continued on the Kwajalein studies. Preliminary results of the Roi-Namur studies are discussed below. Section 3.13 Utilities, Subsection 3.13.1, Water Supply, contains a description of the potable water treatment and distribution system.

Groundwater occurs on Kwajalein Atoll as a lens of fresh to brackish water floating on deeper marine waters in the subsurface rock strata of larger and wider islands. Seasonal infiltration of rainwater recharges the aquifer. The size and salinity of the lens are affected by many factors, including the distribution and composition of the rock, tidal fluctuations, gravitational forces, salt spray, mineral dissolution, and the rate of groundwater pumping (on those islands where the lens is pumped).

KWAJALEIN

On Kwajalein, freshwater demand generally exceeds the rainfall that is collected in catchments; therefore, to augment the catchment water supply, groundwater is pumped from shallow wells. It is essential to maintain a balance between the amount of groundwater pumped and the anticipated recharge because overdrafting can lead to deterioration of water quality in the lens through increased mixing of lens water with marine water. Lens storage capacity has been estimated at about 270 million gallons (1,022 million liters), with fluctuations of greater than 20 percent in response to recharge or pumping (Hunt and Peterson, 1980). Data to accurately determine the amount of sustainable yield of the Kwajalein aquifer are not available, but the 1989 DEIS estimated it to be more than 50 million gallons (189 million liters) per year (Hunt and Peterson, 1980).

Two studies of groundwater conditions on Kwajalein are being conducted by the USGS. A comprehensive groundwater model is being developed to evaluate the interactions among hydrologic, infiltration, and tidal factors that affect the aquifer. When calibration is completed, the model will be used to determine safe yields and to further formulate a groundwater protection and management plan. As part of the model development, well samples from a number of both existing and new wells have been analyzed to determine the chemical composition of the groundwater. Chemical analyses include those for inorganic and organic constituents that will be used to assess nutrient levels, geochemical interactions with the limestone and marine layers, and potential sources of contamination (Tribble, pers. comm., 1992).

ROI-NAMUR

On Roi-Namur, the groundwater system beneath both original islands consists of a thin lens of freshwater overlying seawater, separated by a zone of transition. The larger lens is beneath the Roi side and contains potable water. Six lens wells on the Roi side draw a monthly yield of between 250,000 and 400,000 gallons (946,333 and 1,514,132 liters). Between 1980 and 1992, the average yearly yield was about 2.3 million gallons (8.7 million liters). During the USGS study, 49 monitoring wells were installed, two synoptic rounds of water level measurements were performed, water quality samples were collected quarterly, and 12 years of rainfall and water use data were collected to establish a model of the groundwater system (Hunt, pers. comm., 1992). Aquifer pump tests and rainfall records indicate that about 80 million gallons (303 million liters) of recharge occurs. A calibrated model of the groundwater system indicates that at least 3.5 million gallons (13.2 million liters) per year of sustainable yield can be expected from the existing well system. This amount is approximately 50 percent more yield than present demand.

The aquifer tests were also used to assess the fate and transport of contaminants from sources on Roi-Namur. Groundwater flow conditions indicate that contaminants from existing sources are likely to flow away from the extraction well system. The yield of the freshwater lens on the Namur side of the island was evaluated and is not of potable water quality because of its high salinity.

3.3.1.3 Freshwater Quality

USAKA freshwater quality is affected by materials that enter the catchments with runoff by infiltration through surface soils, by mixing with marine waters, and through changes that occur during collection, storage, and treatment of the source water. To evaluate each of these impacts, USAKA initiated several studies, summarized below.

Groundwater Quality Survey (USAEHA, 1990). This survey identified and evaluated potential sources of groundwater contamination on Kwajalein and Roi-Namur. The survey concluded that the freshwater lenses for both islands are very vulnerable to contamination through improper waste handling and/or disposal practices. Several sites were identified that require further study to determine the existence and extent of subsurface contamination.

On Kwajalein, 34 potential sources of contamination were identified. Sources located near the runway and groundwater recharge zone were rated as having the highest potential for impact on the freshwater lens. Seven underground storage tanks were recommended for integrity testing.

Eight potential sources of contamination were identified on Roi-Namur; all were evaluated as having high potential for impacts on the freshwater lens because the extent of the freshwater lens and the rate of recharge have not been determined.

Recommendations included the elimination or severe restriction of all waste handling and disposal practices above the recharge zone of the islands' freshwater lenses, continuation of tank assessments and cleanup work, implementation of improved management practices, and a requirement for proper storage and containment facilities.

Water Quality Engineering Consultation, Potable Water Quality Issues (USAEHA, 1991a). The purposes of this study included (1) conducting a review and health assessment of the comprehensive drinking water monitoring program performed by the USAEHA from May 1990 to May 1991 and (2) providing guidance on drinking water issues of concern. This study (relative to the freshwater supply) indicated that elevated trihalomethane levels were being reduced by the new water treatment plant, and that some nonhealth-significant volatile organic chemicals (VOCs) were found in the wells sampled in the monitoring program. A number of recommendations were made to continue the evaluation and improvement of water quality at USAKA. Additional information from this study and the 1991 followup investigations is discussed in Subsection 3.13.1.1, Potable Water Systems.

Soil and Groundwater Contamination Study (USAEHA, 1991b). This study assessed soil, groundwater, marine surface water, and marine sediment contamination within source areas and in migration pathways at Kwajalein and Roi-Namur. This study is a followup assessment to the *Groundwater Quality Survey* (USAEHA, 1990) summarized above.

Samples were collected from 22 sites—14 on Kwajalein and 8 on Roi-Namur. Soil or groundwater contamination, or both, was confirmed at 21 of the 22 sites. Groundwater contamination was most widespread downgradient of the Kwajalein defense fuel support point area (i.e., the fuel farm). In addition, the groundwater contaminant concentration was at its highest level in this soil area. Groundwater was contaminated with chlorinated solvents at several former solvent storage sites that were sampled; however, chlorinated solvent concentrations were determined to be generally very low in the shallow freshwater portion of the groundwater lens. The report concludes that the long-term utility of groundwater as a water supply source has not been affected by chlorinated solvent contamination.

Soil was contaminated with metal and/or organic compounds at 20 of the sampling sites. The report concluded that, at some of these sites, soil contaminant levels or their distributions are such that there is no significant human health or other environmental impact under current site use conditions.

3.3.2 Marine Water Quality

In general, previous studies indicate that marine water quality in the vicinity of USAKA is excellent except in the immediate areas of identified point and nonpoint sources (U.S. Army Ballistic Missile Defense Systems Command [BMDSCOM], 1980; AECOS, 1988; Titgen et al., 1988; Sea Engineering, Inc., 1989; USASDC, 1989a). Water quality can be degraded by wastewater, suspended sediment, thermal discharges, stormwater runoff, sandblasting and construction debris, solid waste disposal, and landfill leachate.

Sites that have impaired marine water quality are associated with activities on Kwajalein, Roi-Namur, and Meck islands. There are few or no problems identified in the vicinity of other islands.

Marine surface water and reef sediment samples were collected from areas adjacent to the Kwajalein and Roi-Namur landfills and tested for metals, pesticides, polychlorinated biphenyls (PCBs), and semivolatile organic compounds (USAEHA, 1991d). Sample results did not indicate that significant quantities of contaminants were being released from the landfill into the adjacent marine environment.

A few marine water quality studies have sampled both water column and biota for chemical analysis (USAEHA, 1977; AECOS, 1988). As described in the 1989 DEIS (pages 3-37 through 3-41) and FEIS (pages 4-10 and 4-11), marine crabs taken near old landfills and shallow water scrap metal and ash dumpsites previously used on Kwajalein showed elevated levels of copper and mercury. Similar results were obtained at or near the open dump on Roi-Namur.

Water quality measurements taken from five locations at Kwajalein and near Roi-Namur in 1988 indicated only one area, the shallow reef flat on southwestern Kwajalein, as having potential contamination. Ash from burned refuse and scrap metal disposed of onshore and in shallow water in this area were identified as potential sources of contamination. Scrap iron, steel, copper pipe, brass fittings, and lead battery case disposal in the area has been documented (AECOS, 1988). Summary data from the earlier studies are presented in the 1989 DEIS (pages 3-37 through 3-44).

General Oceanic Conditions. The waters around Kwajalein Atoll are well mixed and are not affected by large nearby land masses and continents. Around Kwajalein and other atolls in the Marshall Islands, the Pacific Ocean is deep and its waters are considered pollution-free, pristine, and transparent.

The prevailing tradewinds cause strong currents to enter the Kwajalein lagoon and passes. These currents are a major source of ocean water exchanging with lagoon water, and they help to keep the lagoon relatively well mixed. It is not known to what extent a causeway being constructed by the Kwajalein Atoll Development Authority (KADA) to link Gugeegue and Ebeye islands may affect lagoon circulation patterns.

Colder, oceanic surface waters enter the lagoon through passes between atoll islands. Currents flow westerly or southwesterly across the lagoon at surface speeds of 0.1 to 0.25 knot. The prevailing currents are not subject to reversal with tidal stage, but they appear to accelerate during tidal change, reaching maximum velocity at half-tide (Sea Engineering, Inc., 1990). The lagoon has a surface area of approximately 704,000 acres (285,020 hectares). Marine water temperatures at Kwajalein are relatively uniform throughout the year. Seasonal surface water temperatures vary from 82°F to 88°F (27.8°C to 31°C). Water quality in the nearshore and lagoon waters is generally of very high quality, with high dissolved oxygen and pH at levels typical of mid-oceanic conditions. Lagoon turbidity levels generally tend to be higher than oceanic waters because of higher plankton populations and increased suspended sediment from wave action, and from tidal and wind-generated currents. Localized water quality impairment is related to several point and nonpoint sources, including wastewater discharges, stormwater runoff, thermal discharges, suspended sediments, sandblasting debris, landfill leachate, and brackish groundwater mixing with nearshore waters.

Thermal Discharges. A 1975 survey identified 11 thermal discharges at USAKA on Kwajalein, Roi-Namur, and Meck islands associated with either power plant or radar cooling (McCain and Maragos, 1975). Generally, these thermal discharges have elevated temperatures of a few degrees above ambient conditions and dissipate rapidly in the receiving water. The most significant thermal discharges are from power plants on Kwajalein Island. Under existing operations, two 7,500-gallon-per-minute (gpm) (28,390-liter-per-minute [Lpm]) pumps intake lagoon water to cool the primary unit, Power Plant 1 (Facility 992); the backup unit (Power Plant 2); and for other nonpotable uses (USAEDPO, 1992). The present discharge from Power Plant 1 has been estimated to be up to 7,500 gpm (28,390 Lpm), with effluent temperatures ranging between 94°F and 95.4°F (34.5°C and 35.2°C, respectively), while ambient nearshore lagoon temperatures were measured at 81.1°F to 85.1°F (27.3°C to 29.5°C) (McCain and Maragos, 1975; U.S. Army BMDSCOM, 1980; USASDC, 1992c). When operating, Power Plant 2 discharges about 4,800 gpm (18,170 Lpm) of 86.0°F (30.0°C) cooling water.

With the current construction and future operation of new facilities (Power Plant 1B and the Freshwater Production Facility [desalination plant]), three 6,000-gpm (22,712-

Lpm) high-pressure pumps and one 8,000-gpm (30,283-Lpm) low-pressure pump will replace the 7,500-gpm (28,390-Lpm) pumps. Using the current design estimates for the new facilities, the total discharge to the lagoon will be 9,300 gpm (35,204 Lpm), or up to 13.3 million gallons (50.34 million liters) per day. Approximately 1,500 gpm (5,678 Lpm) (16 percent) of the flow is attributable to the Freshwater Production Facility, with the balance coming from once-through power plant cooling. Maximum design temperature allowance of the effluent is estimated to be 10°F (5.6°C) over ambient lagoon water temperature. A water quality study using a numerical model and field measurements indicates that the Power Plant 1 discharge disperses and dilutes to within 1° of ambient temperatures in an area approximately 50 feet (15 meters) from the shoreline outfall (Sea Engineering, Inc., 1990). No apparent impacts on receiving water or marine biota have been noted in the vicinity of the discharge (McCain and Maragos, 1975; U.S. Army BMDSCOM, 1980; USASSDC, 1992f).

Stormwater Runoff. Stormwater runoff quantity and quality have not been the subjects of specific studies. Although paving and structures contribute to an increase in runoff flows, the porous nature of the surface soils allows rainfall to infiltrate rapidly. The 1990 wastewater management study identified 37 stormwater discharge outfalls on three islands—20 outfalls on Kwajalein, 7 on Roi-Namur, and 10 on Meck (USAEHA, 1991d). Water quality samples of the outfalls were not collected in this study. Overland flows and unknown connections to the storm drainage systems may provide pathways for sources of contaminants to reach the outfalls.

Quarrying and Dredging. Harbor maintenance and fill activities produce suspended sediments that may have an impact on coral and other marine organisms. Maintenance and facility improvements periodically require dredging on several islands. Recently completed or proposed improvements on Kwajalein include dredging around the fuel pier and deepening the access at the barge slip ramp.

Solid and Hazardous Waste. Past studies of marine waters in the vicinity of solid waste disposal sites on Kwajalein and Roi-Namur showed levels of copper and lead exceeding EPA water quality criteria and Trust Territories of the Pacific Islands (TTPI) standards for copper and zinc (AECOS, 1988; USAEHA, 1977). As described in pages 4-13 through 4-15 of the 1989 FEIS, elevated concentrations of oil and grease and metals were found in samples of ocean sediments and sandblast grit at Kwajalein Island in the June 1989 testing (USASDC, 1989b). Analysis of sediment samples from the reef adjacent to the Kwajalein landfill showed metal levels generally within normal background ranges, with the exception of slightly elevated levels of copper, iron, and lead above background levels in one of the five samples (USAEHA, 1991b). Results of a sampling of fish and invertebrates conducted in 1991 in the areas of the Kwajalein marina and BSR dock (i.e., sandblasting areas) indicated no correlation between the presence of metals in the marine water and the source locations (USASDC, 1991). However, elevated copper, chromium, and lead concentrations in several marine organisms from these locations were found to closely correspond with sediment metal concentrations derived from sandblasting grit (USASDC, 1991).

Sanitary Wastewater Discharge. Sanitary wastewater is discharged to the lagoon at Kwajalein after receiving secondary treatment. The average daily flow was approximately 0.38 million gallon per day (mgd) (1.45 million liters per day [mLd]), with a biochemical oxygen demand (BOD) of 2.5 mg/L and suspended solids of 2.0 mg/L for the period September 1992 through August 1993 (JCWSI, 1993). These characteristics are well below the limits of 0.6 mgd (2.27 mLd) and 30 mg/L for BOD and suspended solids established for this facility under the National Pollutant Discharge Elimination System (NPDES) permit that formerly applied to USAKA discharges. Previous water quality and biological investigations in receiving waters in the vicinity of the outfall have not shown any adverse impacts (AECOS, 1988; Titgen et al., 1988).

Wastewater at Roi-Namur is discharged to an outfall on the ocean reef flat on the west side of the island or to septic tank/leachfield systems. The outfall discharges approximately 0.05 mgd (0.19 mLd) of raw wastewater, having BOD of approximately 220 mg/L and suspended solids of 274 mg/L (USAEHA, 1991d). Wastewater volume is within the NPDES permit limits of 0.065 mgd (0.247 mLd) for daily flow; however, BOD and suspended solids levels are well in excess of this facility's NPDES permit limits of 30 mg/L for each of these constituents. A facility plan to develop a treatment plant at Roi-Namur plant has been prepared (USASDC, 1992d). The report recommends adding a primary treatment process, increasing capacity, and extending the outfall to the edge of the reef. This new treatment facility is described under the Low Level of Activity in this SEIS (Section 4.3). By relocating the point of discharge to a higher energy location, primary treatment will be sufficient to meet criteria, and a waiver of secondary requirements is appropriate. A mixing zone study has been undertaken to evaluate the effects of the new discharge location and to determine a mixing zone (USASSDC, 1993c).

Other Wastewater Discharges. The USAEHA conducted a waste discharge analysis in late 1990 to determine the physical and chemical characteristics of potentially significant point source discharges from USAKA activities (USAEHA, 1991d). The study compared concentrations measured in the discharge samples with U.S. Environmental Protection Agency (U.S. EPA) ambient water quality guidelines. The study recognized that U.S. EPA criteria are not applicable to concentrations measured in the discharges; however, these criteria were used to identify discharges that should receive further study to determine the effects of the discharges on receiving waters.

On Kwajalein Island, the study identified seven sources as potentially significant:

- Wastewater treatment plant (FN 1228) effluent showed elevated levels of arsenic, copper, and selenium.

- Vehicle washing and steam cleaning operations at the motor pool facilities (vehicle wash rack oil-water separator, FN 803) generate oily wastewater that is passed through an oil-water separator before it is discharged to the lagoon via the storm drainage system. Solvents used at the wash rack chemically emulsify the oil and allow it to pass through the separator. Waste from the oil-water separator showed elevated levels of chemical oxygen demand (COD), oil and grease, cadmium, lead, zinc, naphthalene, and acenaphthene.

- Water that collects in the bottoms of the bulk fuel storage tanks at the fuel farm is discharged to the lagoon via the storm drainage system. Bottom water from the fuel tank farm showed elevated levels of COD, oil and grease, cadmium, copper, nickel, lead, zinc, benzene, ethylbenzene, toluene, and naphthalene.

- Approximately once each month, 1 of the 14 uncovered concrete raw water storage tanks is drained and cleaned. Approximately 2 feet (61 centimeters) of sludge is removed from the tank and discharged to the lagoon. Sludge from the water storage tank included elevated levels of COD, silver, cadmium, copper, nickel, lead, and zinc.

- Water treatment plant (FN 933) sludge showed elevated COD, arsenic, copper, nickel, lead, and zinc.

- Power plant (FN 992) once-through cooling water does not receive corrosion inhibitors and showed elevated levels of nickel and zinc.

- Wastewater from the photo laboratory pump station wet well showed elevated copper and zinc (this pump station has since been permanently disconnected, and flow is now directed to the wastewater treatment system).

Table 3.3-1 summarizes the elevated concentrations identified for these seven discharge sources.

It should be noted that water quality criteria are for established ambient conditions in the receiving waters. The sample data do not reflect dilution and dispersion that may occur in the marine environment at the point of discharge. A study of nearshore mixing has been conducted to determine receiving water impacts (USASSDC, 1993). The study provides the basis for determining the size of a mixing zone for these discharges.

On Roi-Namur, the wastewater management study identified three sewage pump station discharges to the ocean, reef, and lagoon as significant sources, in addition to the power plant shop wastewater (USAEHA, 1991d). The raw sewage discharge and the primary sewage pump station showed elevated levels of oil and grease, copper,

Table 3.3-1
Summary of Potentially Significant Wastewater
Pollutant Discharge Concentrations on Kwajalein Island

Source	Pollutant	Concentration (mg/L)
Wastewater treatment plant effluent (FN 1228)	Arsenic	0.8
	Copper	0.14
	Selenium	0.048
Vehicle wash rack oil/water separator discharge (FN 803)	COD	670.0
	Oil and grease	180.0
	Cadmium	0.0217
	Lead	0.097
	Zinc	1.29
	Naphthalene	12.9
	Acenaphthene	1.1
Fuel farm tank bottom water (FN 951-961)	COD	85,000.0
	Oil and grease	23,000.0
	Cadmium	0.0054
	Copper	7.5
	Nickel	0.748
	Lead	0.348
	Zinc	100.0
	Benzene	59.0
	Ethylbenzene	2.9
	Toluene	86.0
	Naphthalene	7.41
Raw water storage tank sludge (FN 937-986)	COD	4,100.0
	Silver	0.061
	Cadmium	0.0148
	Copper	76.0
	Nickel	0.252
	Lead	0.526
	Zinc	4.8
Water treatment plant sludge (FN 933)	COD	3,200.0
	Arsenic	0.0507
	Copper	10.1
	Nickel	0.131
	Lead	0.0962
	Zinc	1.56
Power plant cooling water discharge (FN 992)	Nickel	0.097
	Zinc	3.2
Photo lab pump station, wet well discharge (FN 1243)	Copper	0.031
	Zinc	0.058

Source: USAEHA, 1991d.

nickel, and/or zinc, while the industrial wastewater from the power plant shop (FN 8026) showed elevated levels of the same substances plus cadmium.

The wastewater management study identified the oil-water separator discharge on Meck as having elevated levels of oil and grease, copper, lead, and zinc (USAEHA, 1991d).

Ocean Dumping. A description of ocean dumping activities is provided in Subsection 3.13.3.4.

3.4 Air Quality

Air quality at Kwajalein is affected by ongoing activities that include electricity generation, transportation, and missile launches. For the purposes of this analysis, the air quality region evaluated includes areas in Kwajalein Atoll where people, vegetation, fauna, and marine life may be affected by air emissions from the current launch program activities and the Proposed Actions or alternatives.

In this section, the climate of the atoll is discussed with a focus on the way it affects air quality. Existing air pollution emission sources, ambient air quality standards, and the air pollution dispersion modeling analysis that was used to estimate air quality impacts from current operations are also discussed. Information presented here is drawn from the 1989 EIS, from the *Environmental Quality Protection Plan* (USAEDPO, 1991b), and from a site visit to Kwajalein in February 1992. Emissions calculations and air pollutant dispersion modeling were used to estimate air quality.

3.4.1 Climate

Climate in the Marshall Islands affects the dispersion of air pollutants and resulting air quality. The Marshall Islands climate is characterized as a tropical marine climate that varies little in temperature and humidity, but shows high variation in precipitation. Rainfall averages 100 inches (254 centimeters), falling primarily from May through November. Tradewinds averaging 9 to 16 mpg (14.5 to 25.8 kpg) blow generally from east-northeast approximately 80 percent of the time (Figure 3.4-1). Additional climate date for the Kwajalein atoll are contained in the 1989 DEIS (pages 3-47 to 3-49).

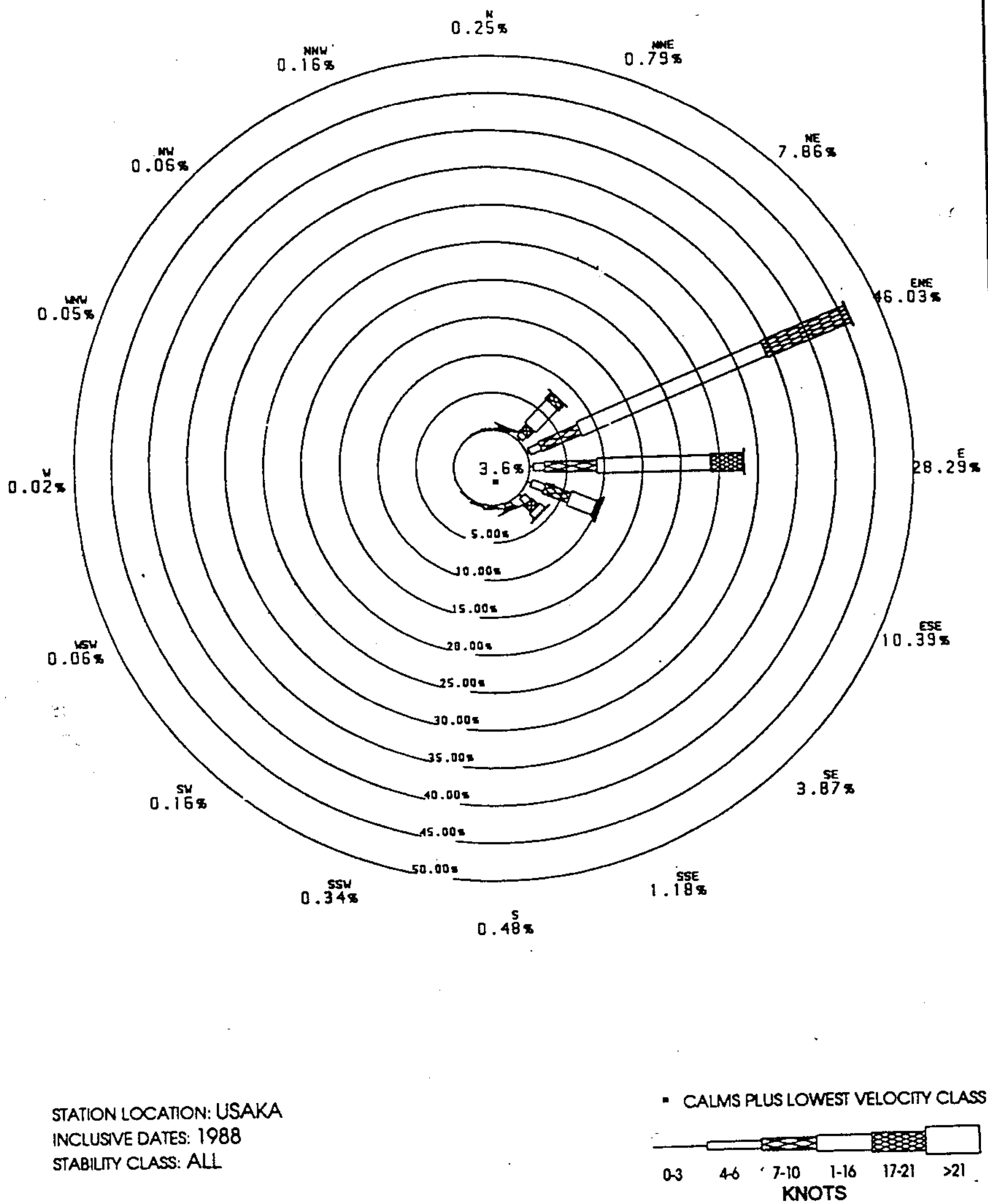
3.4.2 Existing Air Pollution Sources

The primary air pollution sources in USAKA are power plants, fuel storage tanks, solid waste incinerators, and transportation. Rocket launches are generally a smaller source of emissions. A list of air pollution sources and estimated emissions is presented in Table 3.4-1. Criteria pollutants are particulate matter less than 10 microns in size (PM_{10}), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3, regulated as VOC emissions), and lead (Pb). Locations of the air pollution sources on Kwajalein, Roi-Namur, and Meck are shown in Figures 3.4-2 through 3.4-4. Most of the sources in USAKA are combustion sources that produce particulate matter, NO_x, CO, SO_2, and hydrocarbon (HC) emissions. The power plants use diesel fuel and currently are the largest combustion air pollution sources in the atoll. Solid waste incineration is the second largest air pollution source.

Table 3.4-1
Summary of Calculated Annual Air Pollutant Emissions
(tons/year)

Source	CO	NO_x	SO_2	TSP	PM_{10}	Pb	VOCs
Kwajalein							
Power Plant 1	240	741	307	84	84	0.01	0.1
Power Plant 1A	116	1,390	97	34	17	0.001	41
Power Plant 2	63	154	47	6	6	---	0.05
Solid waste incinerator	42	0.1	8	10	20	0.03	1
Commercial boilers	<0.1	0.3	2	0.03	0.02	---	0.005
Fuel tank farm	---	---	---	---	---	---	743
Aircraft operations	148	34	5	45	15	---	127
Motor vehicles	59	14	---	62	21	---	10
Marine vessels	2	10	64	7	2	---	1
Maintenance/photo lab	---	---	---	---	---	---	35
Bakery	---	---	---	---	---	---	1
Roi-Namur							
Power plant	569	523	291	47	47	---	1
Solid waste incinerator	49	0	1	5	5	0.003	1
Maintenance	---	---	---	---	---	---	6
Aircraft operations	99	21	3	36	12	---	94
Meck							
Power plant	43	164	20	16	8	---	4
Aircraft operations	44	10	2	1	---	---	22
Other Islands							
Ennylabegan power plant	9	42	3	3	2	---	3
Illeginni power plant	5	21	1	2	1	---	2
Eniwetak power plant	2	7	0	1	0.3	---	1
Legan power plant	3	14	1	1	0.5	---	1
Gellinam power plant	5	21	1	2	1	---	2
Gagan power plant	3	14	1	1	0.5	---	1
Omelek power plant	2	7	0.5	1	0.3	---	1

Source: Calculated from emission factors from U.S. EPA's *Compilation of Air Pollutant Emission Factors* (U.S. EPA, 1985) and source testing of June 1989 (USASDC, 1989b).

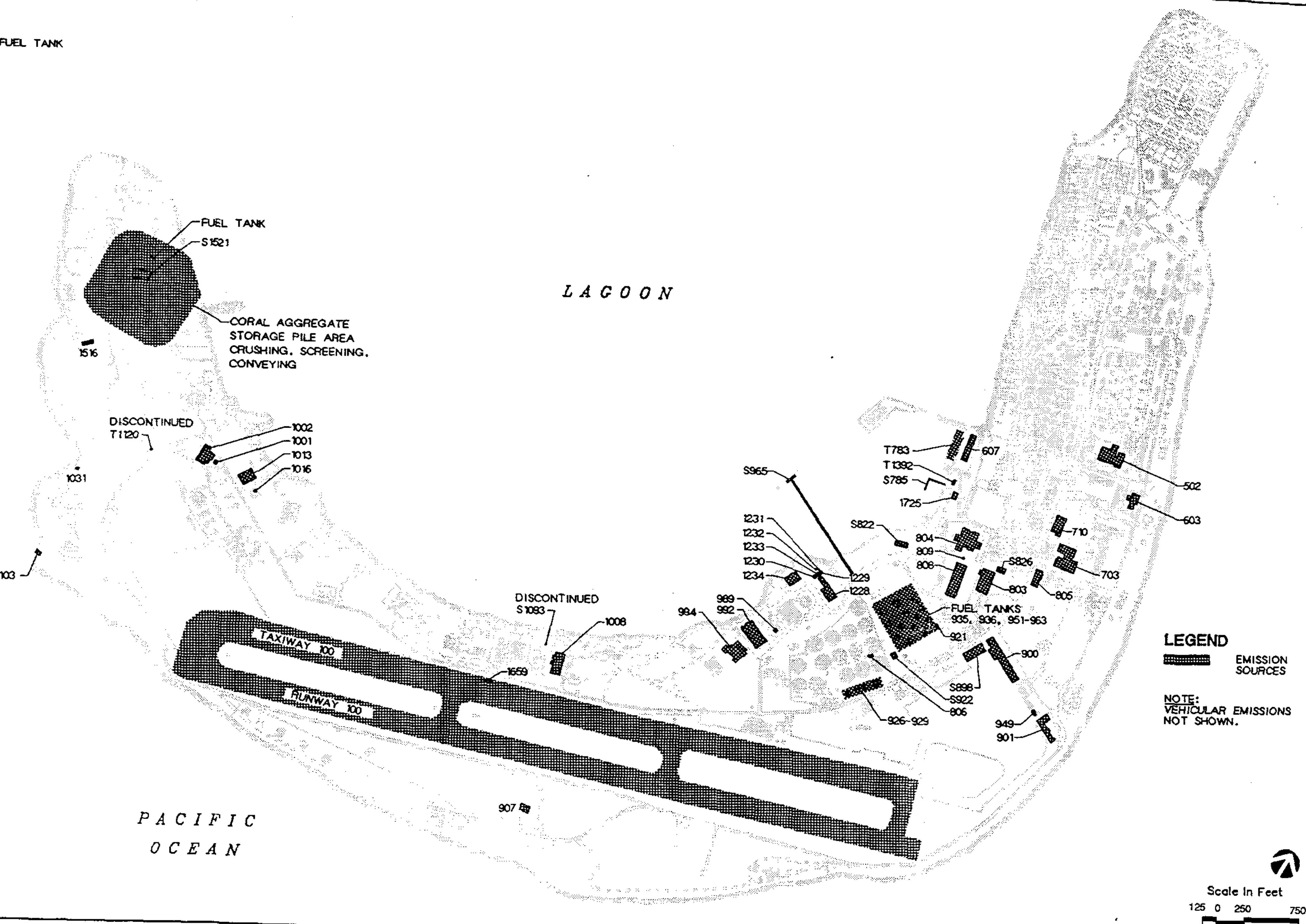


Hourly Average Surface Winds
Percentage Frequency of Occurrence

FIGURE 3.4-1

FACILITY DESCRIPTION:

100	BUCHOLZ ARMY AIRFIELD & APPURTENANCES
500	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
502	YOKWE YUK CLUB, 6TH STREET
603	HOSPITAL, EMERGENCY DIESEL GENERATOR AND FUEL TANK
607	MARINE MAINTENANCE SHOPS
697	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
703	PACIFIC DINING ROOM AND BAKERY
710	LAUNDRY-DRY CLEANING PLANT
726	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
727	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
T783	FINGER PIER, MARINE DEPARTMENT
S785	SMALL BOAT MARINA FINGER PIERS
797	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
798	UNDERGROUND FUEL TANK, MOGAS (NOT SHOWN)
803	AUTO BODY & FENDER/GENERATOR REPAIR SHOP
804	FOM MAINTENANCE SHOPS
805	SPECIAL SERVICES PHOTO LAB
806	INSTRUMENTATION CONTROL CENTER, EMERGENCY DIESEL GENERATOR AND FUEL TANK
808	AUTOMOTIVE MAINTENANCE SHOPS
809	SERVICE STATION WITH BUILDING
S822	SANDBLAST FACILITY
S826	VEHICLE PAINT SPRAY FACILITY
S898	AIRCRAFT MAINTENANCE HANGAR
900	AVIATION MAINTENANCE SHOPS
901	AIR TERMINAL, EMERGENCY DIESEL GENERATOR AND FUEL TANK
907	WEATHER STATION, EMERGENCY DIESEL GENERATOR AND FUEL TANK
921	FUEL TRUCK LOADING FACILITY
S922	LUBE OIL TANKS (NO.22 & NO.23)
926-929	FUEL TANKS (NOS. 1-4)
935,936, 951-963	FUEL TANKS (NOS. 5-17)
938	PUMPHOUSE, 3 EMERGENCY DIESEL GENERATORS AND FUEL TANKS
949	MAINTENANCE/FLIGHT OPERATIONS BUILDING
S965	FUEL PIER
989	READY STORAGE TANK, DIESEL, FOR POWER PLANT NO. 1
992	POWER PLANT NO.1
994	POWER PLANT NO.1A
1001	ELECTRICAL SUBSTATION, EMERGENCY DIESEL GENERATOR AND FUEL TANK
1002	PHOTO LAB, USAKA
1008	COMMUNICATION CENTER, EMERGENCY DIESEL GENERATOR AND FUEL TANK
1013	POWER PLANT NO.2
1016	READY STORAGE FUEL TANK, DIESEL
1031	METEOROLOGICAL ROCKET LAUNCH PAD
S1093	INCINERATOR, CLASSIFIED WASTE
1103	GARBAGE DISPOSAL RAMP
T1120	INCINERATOR, FILM
1228	SEWAGE TREATMENT PLANT, OFFICE & LAB
1229	SETTLING TANK NO.1
1230	SETTLING TANK NO.2
1231	CHLORINE CONTACT TANK
1232	CHLORINATION BUILDING
1233	SLUDGE PUMP BUILDING
1234	SLUDGE DRYING BUILDING
T1392	MARINA FUELING FACILITY
1516	INCINERATOR PIT, SOLID WASTE DISPOSAL
1518	UNDERGROUND FUEL TANK, DIESEL (NOT SHOWN)
S1521	WAREHOUSE, GENERAL PURPOSE
1659	TACAN BUILDING, EMERGENCY DIESEL GENERATOR AND FUEL TANK
1725	MARINA MAINTENANCE BUILDING



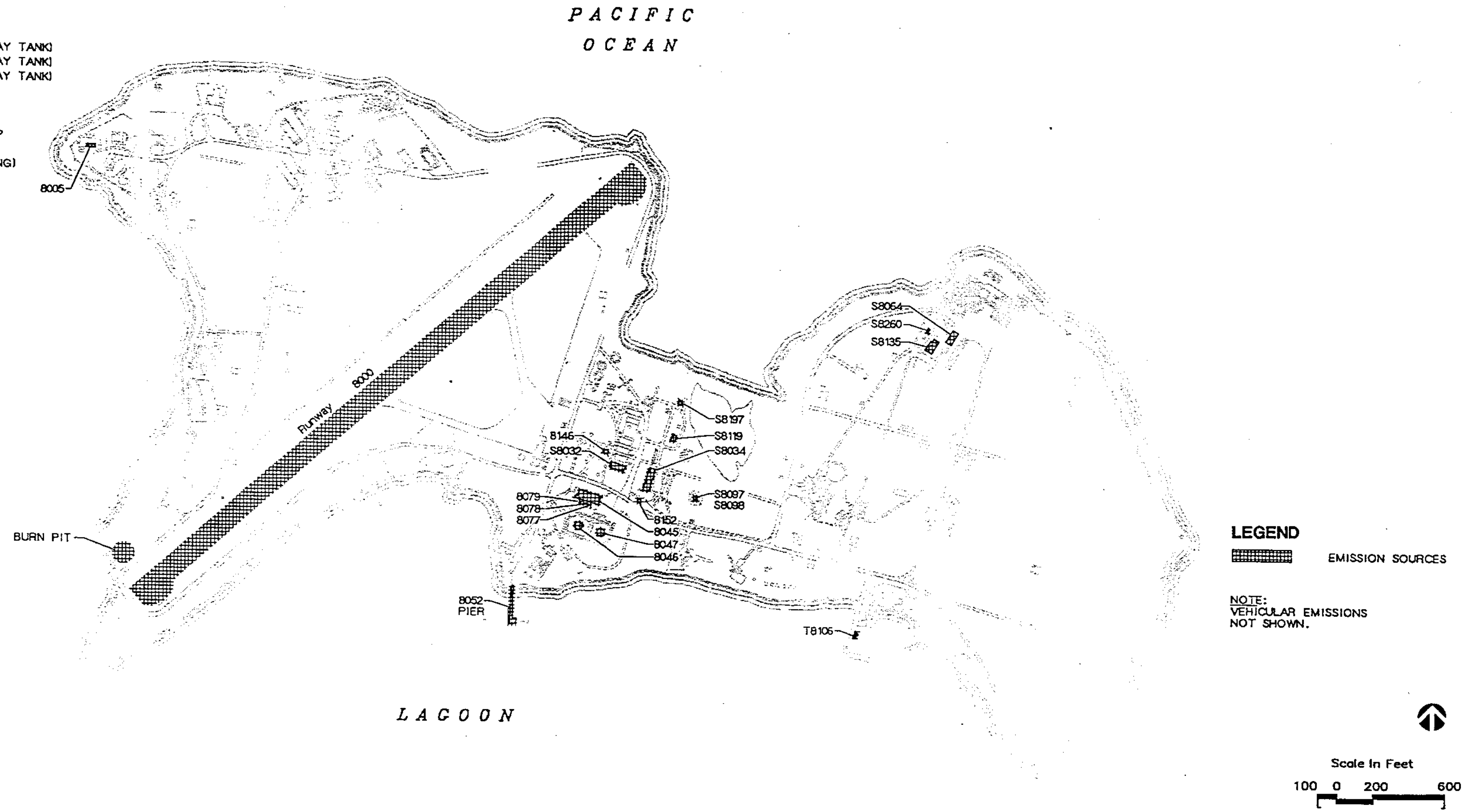
U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Air Pollution Sources
KWAJALEIN

FIGURE 3.4-2

FACILITY DESCRIPTION:

8000	DYESS ARMY AIRFIELD, ROI-NAMUR
8005	ROCKET LAUNCH FACILITY
S8032	SPRAY PAINTING/METAL SHOPS
S8034	VEHICLE MAINTENANCE SHOP
8045	POWER PLANT
8046	FUEL STORAGE TANK, DIESEL
8047	FUEL STORAGE TANK, DIESEL
8052	CARGO/FUEL PIER
S8064	MAINTENANCE SHOP
8077	FUEL TANK, DFM (POWER PLANT DAY TANK)
8078	FUEL TANK, DFM (POWER PLANT DAY TANK)
8079	FUEL TANK, DFM (POWER PLANT DAY TANK)
S8097	FUEL TANK, MOGAS
S8098	FUEL TANK, MOGAS
T8106	MARINA FINGER PIER
S8119	AUTOMOTIVE BODY & FENDER SHOP
S8135	MAINTENANCE SHOP, KREMS
8146	AIR COMPRESSOR SHELTER (PAINTING)
8152	GAS STATION WITHOUT BUILDING
S8197	SANDBLAST SHELTER
S8260	SANDBLAST SHELTER



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Air Pollution Sources
ROI-NAMUR

FIGURE 3.4-3

FACILITY DESCRIPTION:

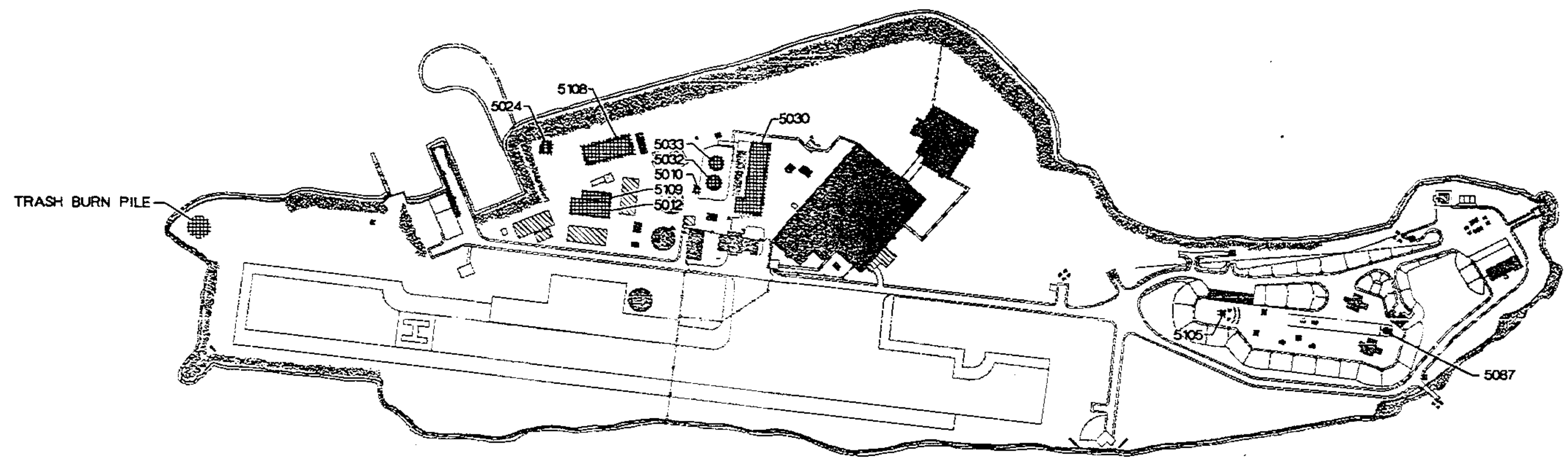
5010	FUEL TANK, MOGAS
5012	MAINTENANCE SHOP
5024	SANDBLAST/PAINT SHED
5030	POWER PLANT
5032	FUEL TANK, DIESEL (DIRTY)
5033	FUEL TANK, DIESEL (CLEAN)
5087	ERIS LAUNCH SILO
5105	LAUNCH STATION, HEDI/SBI
5108	SANDBLASTING AREA
5109	PAINT SHOP

LEGEND

▩ EMISSION SOURCES

NOTE:
VEHICULAR EMISSIONS NOT SHOWN.

LAGOON



PACIFIC OCEAN

Scale In Feet

150 0 100 300

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Air Pollution Sources
MECK

FIGURE 3.4-4

Annual emissions of criteria pollutants were calculated based on emission factors from U.S. EPA's *Compilation of Air Pollutant Emission Factors*, AP-42 (1985) and source testing that was done in June 1989 (USASDC, 1989e). Source testing was performed on Power Plants 1 and 2 and the landfill burn pit on Kwajalein and on the Roi-Namur power plant.

Solid waste incinerators are being installed to replace the landfill burn pit and waste oil burner that used to operate on the island (see page 3-50 of the 1989 DEIS). This complex is planned to begin operations in late 1993. When this complex is operational, the apparent air quality impacts from the burn pit would be eliminated. The rubbish burn pits on Roi-Namur and Meck do not contribute significantly to air quality impacts. They are relatively small operations compared with other significant sources. The facility at Roi-Namur is operated daily. The facility at Meck operates only once per week.

The *Environmental Quality Protection Plan* (USAEDPO, 1991b) identified noncriteria air pollutants that are emitted from various sources on USAKA. The majority of these pollutants are related to transportation on the islands, vehicles, aircraft, or fuel storage tanks. The primary organic constituents of these noncriteria pollutants are:

- Butane—from vehicle fueling operations
- Xylene—from storage tanks and aircraft operations
- Toluene—from storage tanks and aircraft operations
- Benzene—from vehicle fueling operations and storage tanks
- Formaldehyde—from aircraft and vehicle operations

These constituents represent slightly less than one-half of total VOC emissions.

Meteorological and sounding rockets are currently launched from Kwajalein, Roi-Namur, and Omelek islands in USAKA. Pollutants emitted from these launches include hydrogen chloride (HCl) and aluminum oxide (Al_2O_3). Air quality impacts from these launches are generally insignificant because of the periodic and short duration of emission and the small quantities of propellants involved. Typical meteorological rockets contain less than 200 pounds (91 kilograms) of solid propellant and typical sounding rockets contain less than 10,000 pounds (4,536 kilograms).

Recent rocket launch programs for the Strategic Defense Initiative (SDI) have been principally ERIS launches on Meck Island (up to one launch per year). The solid fuel rocket motors used in these launches average approximately 14,000 pounds (6,350 kilograms) of propellant. The launch events typically last less than 5 minutes and emissions from the rocket launch generally have an impact in the Mid-Atoll Corridor because of the direction of the prevailing winds and the location of the launch site. The environmental impact of these launches is insignificant because the HCl is absorbed into the water and reacts with carbonates in sea water to make salt. The Al_2O_3 settles into the water and adds minutely to the suspended solids in sea water. Rocket launch activity is summarized in Table 3.4-2.

Table 3.4-2 Rocket Launch Activity at USAKA Existing Conditions[1]						
Rocket	Island	Number of launches per year	Rocket Launch Emissions (pounds per launch event)			
			CO	HCl	Al_2O_3	Pb
Meteorological	Kwajalein	24	18	6	6	
Sounding[2]	Roi-Namur	8	1,017	0	0	48
Strategic[3]	Meck	4	4,221	1,620	1,177	

[1]Based on 1992 activities.
[2]Assumes Talos Rocket motor (source: USDOE, 1992).
[3]ERIS program scheduled for 1992 and 1993.

3.4.3 Ambient Air Quality

The Clean Air Act regulates air pollutants that are defined as criteria pollutants or toxic air pollutants. Ambient air quality standards for these pollutants, established by U.S. EPA, are presented in Table 3.4-3.

Table 3.4-3
Ambient Air Quality Standards

Pollutant	Averaging Time	EPA Standard (micrograms/ cubic meter)
PM_{10}	24-hour Annual	150 50
Nitrogen dioxide	Annual	100
Carbon monoxide	1-hour 8-hour	40,000 10,000
Sulfur dioxide	3-hour 24-hour Annual	1,300 365 80
Ozone	1-hour	235
Lead	Calendar quarter	1.5

Source: 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards.

The Clean Air Act Amendments of 1990 require control technology development for sources emitting a variety of air toxics. These standards will be phased in over a 10-year period beginning November 15, 1992.

The primary toxic air contaminant emitted from solid rocket launches is HCl. The Clean Air Act Amendments allow regulation of rocket engine test firing by the manufacturer and do not regulate the launch by an operational user. No guideline HCl concentrations have been developed for Kwajalein Atoll. The U.S. Air Force used the following impact criteria, developed by the National Academy of Sciences, for evaluating rocket launch impacts (USDOT, 1986):

- 3.03 mg/m^3 (.73 ppm) (30-minute)—Public exposure limit
- 4.5 mg/m^3 (1.1 ppm) (30-minute)—Emergency exposure limit

The National Research Council (NRC) has developed a short-term public emergency guideline limit (SPEGL) for public exposure to HCl of 1 ppm (1.5 $\mu g/m^3$).

Because Al_2O_3 is emitted from rocket launches as a particulate, the 8-hour work threshold limit value of 10 mg/m^3 (2.41 ppm) for short-term nuisance dust exposures (Table 3.4-4) was selected as the most applicable guideline concentration. Threshold limit values are considered conservative for workers who experience short-duration exposures during relatively infrequent normal operations. Guideline concentrations for short-term public exposures are not available. For longer-term public exposures (24-hour and annual), the ambient air quality standards (Table 3.4-3) for PM_{10} are most appropriate (USDOT, 1986).

Ambient air quality and meteorological data were collected on Kwajelein Island from the period July 1991 through November 1992. Data were collected at two stations, an "upwind" station and a "downwind" station. The parameters measured during the study were SO_2, CO, NO_x, TSP (total suspended particulate), lead, PM_{10} (particulate matter less than 10 microns in aerodynamic diameter), and meteorological parameters (wind speed and wind direction). The data are reported in *Final Report Ambient Air Quality Study No. 43-21-N717-93, U.S. Army Kwajalein Atoll Republic of the Marshall Islands, April 1991–November 1992 (USAEHA, 1993).*

According to the USAEHA report, "Data recovery for the USAKA study was persistently hampered by the harsh environmental conditions of the Kwajalein Atoll area. In particular, the consistently high relative humidity (75-83 percent) and the salt content of the air proved extremely stressful to both the ambient air quality analyzers and the data acquisition system (USAEHA, 1993)." Consequently data recovery was significantly below targets throughout the study.

Conclusions of the study as related to the SEIS are summarized below:

- No excursions of the short-term National Air Quality Standards (NAAQS) for SO_2, NO_2, PM_{10}, or lead were reported at either the upwind or the downwind station.

Table 3.4-4
Exposure Guidelines for Hydrogen Chloride and Aluminum Oxide

Pollutant	Exposure Duration	Guideline	Exposure Term	Application	Organization
Hydrogen chloride (HCl)	Instantaneous	5 ppm (7.5 mg/m^3)	Permissible exposure limit-ceiling (PEL-C)	Workplace	Occupational Safety and Health Administration (OSHA)
	Instantaneous	5 ppm (7.5 mg/m^3)	Threshold limit value-ceiling (TLV-C)	Workplace	American Conference of Governmental Industrial Hygienists (ACGIH)
	30 minutes	50 ppm (75 mg/m^3)	Emergency exposure guidance level (EEGL)	Public	National Research Council (NRC)
	30 minutes	100 ppm (150 mg/m^3)	Immediately dangerous to life and health (IDLH)	Workplace	National Institute for Occupational Safety and Health (NIOSH)
	1 hour	20 ppm (30 mg/m^3)	EEGL	Public	NRC
	1 hour	1 ppm (1.5 mg/m^3)	Short-term public emergency guidance level (SPEGL)	Public	NRC
Aluminum oxide (Al_2O_3) as aluminum dust	8 hours	10 mg/m^3 (2.41 ppm)	Threshold limit value–time-weighted average (TLV-TWA)	Workplace	ACGIH

- Excursions of the 24-hour NAAQS for TSP were recorded at both the upwind and the downwind monitoring stations during the study. These excursions were probably related to entrained salt particles from Tropical Storm Zelda and other storms. The annual NAAQS for TSP was exceeded at the upwind station but not at the downwind station. PM_{10} concentrations, although they did not exceed the NAAQS, were notably high, again probably the result of sea salt aerosol from the trade winds and storms.

- No excursions of the 1-hour NAAQS for CO were recorded. However, several excursions of the 8-hour NAAQS were recorded at the downwind station.

- Recorded NO_x, NO, and NO_2 levels at the downwind station were consistently higher than levels measured at the upwind station.

Evaluation of the station operation for CO indicates that the 8-hour excursions of the CO standard should not be considered representative of conditions at USAKA. All excursions occurred during a 4-week period from the middle of May through the middle of June 1992. Because the exceedances occurred during a specific short-term period, and because 8-hour exceedances without accompanying 1-hour exceedances are very unlikely, the validity of these data has been questioned. The two most reasonable explanations for these exceedances are the existence of a temporary portable source in the vicinity of the downwind station, or analyzer performance. A U.S. EPA audit during this period indicated analyzer performance problems, which were thought to be corrected. No records are available to indicate the existence of a temporary source, although portable generators are widely used on the island. It can be concluded that the data are not representative of conditions at USAKA.

With the exceptions noted, the data indicate that air quality on Kwajalein Island meets ambient air standards, which is expected because of the relatively small number of air pollution sources (Table 3.4-1) and the good dispersion produced by strong, persistent tradewinds and the lack of topographic features to inhibit dispersion.

Dispersion modeling was performed to estimate existing air quality conditions on each USAKA island. The Industrial Source Complex Short-Term (ISCST) model and the Rocket Exhaust Effluent Dispersion Model (REEDM) were used to estimate downwind air pollutant concentrations from stationary sources and missile launches, respectively. The ISCST model was used because of its applicability to multiple point, area, and volume sources in flat terrain. Predicted concentrations were based on maximum short-term and annual emission rates from the sources, the ambient air quality data from USAEHA (summarized above), and actual meteorological data collected at USAKA for 1988. The dispersion modeling summarized in Table 3.4-5 shows that predicted concentrations of SO_2, CO, NO_2, and PM_{10} on each USAKA island, when added to background values, are below the ambient air quality standards.

Table 3.4-5
Predicted Air Quality Concentrations—Existing Conditions
Criteria Pollutants
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												Background	Total Impact	EPA Ambient Air Quality Standards
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye			
PM_{10}	24-hour	52.6	16.1	1.03	0.473	5.29	2.15	0.780	0.662	0.365	1.03	1.06	4.32	N/A[a]	53	150
	Annual	9.41	5.76	0.163	0.005	0.225	0.06	0.047	0.031	0.045	0.163	0.014	0.066	N/A[a]	9	50
NOx	Annual	52.4	18.0	3.43	0.046	1.01	1.11	1.07	0.749	2.29	3.43	0.056	0.274	9.4[b]	62	100
CO	1-hour	2,110	2,010	111	93.3	712	291	118	122	43.7	111	368	590	15,912[b]	18,022	40,000
	8-hour	1,060	1,210	41.4	11.7	182	61.4	18.1	33.3	8.09	41.4	90.3	157	5,953[b]	7,163	10,000
SO_2	3-hour	91.8	69.4	21.2	5.56	214	15.7	15.9	7.24	9.1	21.2	11.8	29.1	130[b]	344	1,300
	24-hour	42.7	34.6	6.07	1.26	31.2	3.06	3.92	3.95	2.13	6.07	2.23	6.41	26[b]	69	365
	Annual	11.4	9.28	1.07	0.154	0.829	0.270	0.369	0.254	0.395	1.07	0.024	0.076	3[b]	14	80
VOCs	1-hour	2,390	2,720	243	42.3	234	133	51.6	82.4	34.6	243	420	365	N/A	2,720	N/A[c]

[a]No applicable values.
[b]Background concentrations are highest values from USAEHA, 1993, upwind station.
[c]No ambient air quality standard exists for VOCs, which are controlled to limit ozone formation.

Predicted 1-hour average impacts from VOC sources were also evaluated. Table 3.4-6 summarizes the predicted impacts for five air toxic compounds. Each compound is a fraction of the total VOC emissions. Based on the appropriate fraction, the maximum predicted impacts are compared to the threshold limit value (TLV) for each compound as published in *1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (American Conference of Governmental Industrial Hygienists, [ACGIH], 1992). As the table shows, the maximum predicted impacts for all five compounds are below their respective TLV.

3.4.4 Upper Atmosphere

Concentrations of Carbon Dioxide

During the last 150 years, the combustion of fossil fuels has resulted in increasing concentrations of carbon dioxide throughout the earth's atmosphere. Current annual emissions of carbon dioxide are estimated at 24,240 million tons (21,990 million metric tons) per year from man-made sources and 1,100,000 million tons (997,898 million metric tons) per year from natural sources. The estimated atmospheric residence time for carbon dioxide is 2 to 4 years. Carbon dioxide is a relatively minor constituent of the earth's atmosphere, but it is important in influencing the global climate because of its radiational properties. The principal climatic effect of increasing carbon dioxide in the lower atmosphere is a potential increase in temperature known as the greenhouse effect. Climatic effects on a global scale could result in some alterations in local climate and weather patterns. Some scientists are concerned that prolonged warmer periods could cause ocean levels to rise, increasing the frequency of catastrophic flooding in low-lying areas such as the RMI. The extent of carbon dioxide buildup and the associated warming that has been predicted depend on the growth rate of energy production and the choice of fuels over the next decades (Stern et al., 1984).

Concentrations of Stratospheric Ozone

Ultraviolet radiation in sunlight is harmful to plants and animals, including humans (National Research Council [NRC], 1982). Low concentrations of ozone (O_3) in the stratosphere (at an altitude of 9.3 to 31 miles [15 to 50 kilometers]), block much of the harmful ultraviolet wavelengths in sunlight from penetrating to the earth's surface. Stratospheric absorption of harmful ultraviolet wavelengths is a sensitive function of the amount of ozone. Many dynamic physical and chemical processes influence the abundance of ozone in the stratosphere. The solar flux, stratospheric circulation, temperature, and the relative concentrations of dozens of different chemical species affect both the production and destruction or removal of stratospheric ozone (McElroy and Salawitch, 1989; Bennet et al., 1991). Over the last 10 to 15 years, there has been increasing international concern that ozone concentrations in the

Table 3.4-6
Predicted Air Quality Concentrations—Existing Conditions
Air Toxics
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	TLV[a]
Butane	1-hour	1018.3	1116.9	99.7	17.4	98.8	56.0	21.7	33.8	14.7	99.7	172.1	160.2	1,900,000
Xylene	1-hour	57.3	98.8	8.5	2.3	6.7	3.5	1.3	2.7	0.8	8.5	16.4	5.1	434,000
Toluene	1-hour	32.0	55.2	4.8	1.3	3.7	1.9	0.7	1.5	0.5	4.8	9.2	2.8	377,000
Benzene	1-hour	8.3	14.2	1.2	0.3	1.0	0.5	0.2	0.4	0.1	1.2	2.4	0.7	32,000
Formaldehyde	1-hour	8.3	14.2	1.2	0.3	1.0	0.5	0.2	0.4	0.1	1.2	2.4	0.7	1,200

[a]Threshold limit value.

stratosphere are decreasing, with consequent adverse effects to humans, plants, and animals.

Ozone is formed in the stratosphere by the photolysis of molecular oxygen (O_2), a process that occurs mostly at altitudes above 15.5 miles (25 kilometers) (NRC, 1982). It is estimated that only about 1 percent of stratospheric ozone is removed by downward transport into the troposphere (altitudes below 9.3 miles [15 kilometers]). The other 99 percent is destroyed by chemical reactions in the stratosphere that re-form ozone into molecular oxygen (NRC, 1982). The most important photochemical reactions that destroy ozone involve various radicals of nitrogen, hydrogen, and chlorine. Precursors of these radicals have natural sources, such as marine biological processes and volcanos, and man-made sources, such as various agricultural and waste management practices and industrial chlorofluorocarbons (Symonds et al., 1989; Rasmussen et al., 1980; NRC, 1982; Molina and Rowland, 1974). Exhaust products from the chemical propulsion systems of rockets have also been identified as contributing to ozone destruction (American Institute of Aeronautics and Astronautics, 1991; Aftergood, 1991). The ozone destruction reactions are catalytic and the effects are persistent.

3.5 Noise

The region of influence for noise is defined as areas in Kwajalein Atoll in which even minimal noise levels associated with USAKA activities are received. The loudest noise sources are typically rocket motors used for missile launches. Typical maximum sound pressure levels associated with missile launches at USAKA are 124 to 154 dBA[1] at 250 feet (76 meters). A conservative criterion for defining the boundary of the region of influence is a maximum sound pressure of 55 dBA, which would be considered to be a very low daytime level. Missile launches at USAKA would generate maximum sound pressure levels of 55 dBA for short durations at a distance of approximately 16 to 26 miles (26 to 42 kilometers). Therefore, the region of influence for noise impacts is defined as areas within 26 miles (42 kilometers) of the islands of Kwajalein, Roi-Namur, Meck, Omelek, Illeginni, Eniwetak, and Gellinam—islands that are either currently the location of launches or that would be the location of launches in the Proposed Action or alternatives.

Noise sources on USAKA islands include rocket launches, airport operations, power plants, construction, and other sources such as ground and marine transportation (see pages 3-53 through 3-58 of the 1989 DEIS and page 4-17 of the 1989 FEIS).

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[1] The number of fluctuation cycles per second is the frequency of a sound. Loudness of a sound is determined by the magnitude of the fluctuations. The unit commonly used for describing the magnitude of a sound is the decibel (dB). Because the human ear is less sensitive to sounds in the high and low frequency ranges, a weighting scale is often used to approximate the response of the ear; this method is called A-weighting (dBA).

KWAJALEIN

The primary noise sources on Kwajalein are aircraft, power plants, marine sandblasting and service, air conditioning units, and small diesel engine generators. The average annual day-night level (DNL) contour lines of 65 dBA at the airport show that no noise-sensitive receptors are affected (see Figure 3.4-1 in the 1989 DEIS). At the time the 1989 EIS was prepared, there were two power plants: Power Plant 1 has nine 1,500-kW units and Power Plant 2 has six 880-kW units. Onsite monitoring of Power Plant 1 and estimated noise levels for Power Plant 2 define a 65-dBA DNL contour that does not encompass any sensitive receivers.

The source-to-receptor distances for a 65-dBA DNL contour for 10- to 50-ton (9- to 45-metric-ton) and 51- to 200-ton (46- to 181-metric-ton) air conditioning units are 95 feet and 170 feet (29 meters and 52 meters), respectively. All other noise sources emit less than 65-dBA DNL at sensitive receiver locations.

The only major change in potential noise sources since the 1989 EIS was prepared has been the addition of Power Plant 1A. Concerns about the possible noise levels from the new power plant were evaluated in the *USAKA Mitigation Project, Technical Report* (USASDC, 1989d). Limited onsite noise monitoring of Power Plant 1 was performed to ensure that the 65-dBA DNL had no effect at sensitive receiver locations. The addition of Power Plant 1A was predicted to increase noise 1 dBA over the current levels. Additions of less than 3 dBA are not considered to be audible by humans. In addition, the 65-dBA DNL will still not affect any sensitive receivers.

ROI-NAMUR

The primary noise sources on Roi-Namur are missile launches, aircraft, power plants, and air conditioning units. The 115-dBA occupational noise maximum allowable level is exceeded during HAVE-JEEP launches at distances up to 1,400 feet (420 meters). All personnel on Roi-Namur are workers involved with USAKA activities who are provided with appropriate hearing protection to reduce exposure to allowable levels. The 65-dBA DNL contour for the airport is contained within the airport area; therefore, no noise-sensitive receivers are affected (see Figure 3.4-2 in the 1989 DEIS). No noise-sensitive receivers are located within the 65-dBA DNL contour associated with the Roi-Namur power plant. The noise levels for the air conditioning units are the same as those described for Kwajalein. All other noise sources emit less than 65-dBA DNL at sensitive receivers.

MECK

The primary noise sources on Meck Island are a 350-kW diesel engine generator, helicopter operations, and air conditioning units. The noise levels for the air conditioning units are the same as those described for Kwajalein. There are no noise-sensitive receivers within the 65-dBA DNL.

OTHER ISLANDS

There are no major noise sources on the other islands beyond occasional launches of meteorological rockets, helicopters, and small power plants. Roi-Namur sounding rocket launches produce a maximum noise level of 82 dBA on the nearby (non-USAKA) inhabited island of Ennubirr. This 82-dBA level is the maximum USAKA noise level impact on a non-USAKA inhabited island.

3.6 Island Plants and Animals

This section briefly describes the commonly occurring plants and animals found on the USAKA islands at Kwajalein Atoll. The region of influence includes plant and animal resources from the 11 USAKA islands that may be significantly affected by the Proposed Actions or alternatives. The information used in this discussion comes from the draft and final USAKA EIS dated June 1989 and October 1989, respectively. These documents, in turn, were based primarily on biotic surveys performed to establish baseline conditions for plants (Herbst, 1988) and for birds (Clapp, 1988). A field survey was conducted in February 1992 to update information.

Table 3.6-1 is a listing of the characteristic terrestrial plants and animals of the USAKA islands. Figures 3.1-1 through 3.1-11 show the distribution of important floral and faunal features at USAKA.

Island flora on the USAKA islands falls into seven major vegetation types that range from mixed broadleaf forest to exotic herbaceous vegetation. The seven vegetation types are:

- Broadleaf forest
- Coconut forest
- Pemphis forest
- Tournefortia forest
- Beach scrub
- Exotic communities
- Secondary herbaceous vegetation

Of these, the broadleaf forest and beach scrub best represent conditions that existed prior to human disturbance. Among the USAKA islands, major mature broadleaf forest stands are now restricted primarily to Eniwetak, Ennugarret, and Legan. Where areas have been cleared and are kept mowed for use and maintenance of USAKA facilities, exotic herbaceous vegetation (grasses and forbs) dominates.

A total of 51 species of birds has been recorded through time at Kwajalein Atoll as a result of several scientific investigations (Baker, 1951; Amerson, 1969; Schipper, 1985; Clapp, 1988). All of the common birds at USAKA are either resident seabirds that

Table 3.6-1
Characteristic Plants and Animals of Selected USAKA Islands

Characteristic	Kwajalein	Roi-Namur	Meck	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Omelek	Eniwetak	Ennugarret
Vegetation	Nonnative weeds and grasses dominate.	Nonnative weeds and grasses dominate; some coconut trees; Pandanus.	Nonnative weeds and grasses dominate, with some native trees on northern end.	Central part cleared; grasses, weeds, and other small plants dominate. Mixed broadleaf forest on northern and southern ends with only Pipturus and Allophylus observed. Southeastern side has only Pemphis forest type on USAKA islands.	Southern end dominated by nonnative grasses. Rest of island is best mixed broadleaf forest at USAKA.	Around buildings,* nonnative grasses and weeds dominate. Some shrubs and mixed forest at southern end, and a large dense mat of Wedelia along the road.	One-half island mixed broadleaf forest; other half cleared, dominated by nonnative vegetation.	Small wooded patch with Pisonia on northern end, with grasses and small plants on remainder.	Three small native forest patches; remaining two-thirds of island alien community type.	Western two-thirds of island has best Pisonia forest at USAKA; other areas are sparsely vegetated.	Nonnative weeds and grasses with beach scrub at margin. Mixed broadleaf with Pisonia and Pandanus in the interior.
Birds	Large numbers of shorebirds, particularly golden plovers and ruddy turnstones as well as several pintail ducks.	Shorebirds use southern tip and Pemphis bushes on western shore. Resting terns use southern tip. Reef herons along southwest shore flats and tidepools off north end of runway.	Mostly shorebirds, but some black-naped terns roost at southeast corner of runway.	White terns believed to nest in Pemphis forest. Brown and black noddies nest in forested parts.	Central lake attracts breeding birds and shorebirds. Broadleaf forest has most of the nesting white terns at USAKA; also brown and black noddies.	Black-naped terns roost at northern end, and shorebirds occur in cleared areas not covered by Wedelia. Black and brown noddies and white terns occur.	Black-naped terns believed resting; crested terns roosting at north point and west shore. Black and brown noddies and white terns also occur.	Wooded patch has large black noddy population. Sandpits to north and south and large pile of rocks at north end provide roosting habitat for black-naped terns. Ruddy turnstones use cleared areas.	A few black-naped terns observed resting on southwest and north points. Black noddies, also occur.	Largest nesting population of black noddies at USAKA, possibly entire atoll.	White terns nesting south side and northeast. Black noddy nesting northeast
Other animals	Lizards, rodents, dogs, and cats.	Some dogs and numerous cats are present. Coconut crabs (Birgus latro) observed; rodents, lizards, pigs, and ducks.	Lizards and rodents present.	Numerous pigs and chickens; some dogs and cats and several species of lizards observed. Rodents likely.	Coconut crabs (Birgus latro) observed.	Lizards, rodents, and a pair of cats were observed.	Lizards and one cat observed.	No other animals were seen.	No other animals were observed.	Lizards were observed.	Coconut crabs, birds, and rodents.

Source: Summarized from Clapp, 1968, and Herbst, 1966, updated February 1992 field reconnaissance.

nest on the ground or in trees or are migratory shorebirds that nest in the Arctic in warmer months and winter at USAKA and other Central Pacific islands.

The nesting species are the more important of the two categories because of the vulnerability of chicks and eggs to predation or disturbance and the limited land area that is available for nesting use. Seabird nesting has been adversely affected by past clearing of native vegetation and disturbance of other nesting habitat. Shorebird populations, by comparison, may have benefited from the additional area available for foraging and resting.

Nonavian terrestrial animals are limited to a few species of lizards, rodents, coconut crabs, and introduced domestic animals.

3.7 Marine Biological Resources

This section briefly describes the commonly occurring marine plants, animals, and habitats found on the USAKA islands of Kwajalein Atoll. The region of influence includes all marine biological resources in the vicinity of the 11 USAKA islands that may receive significant environmental impacts from the Proposed Actions or alternatives. .The information used in this section comes from the 1989 EIS. The Marine Biological Resources discussions in the 1989 EIS documents were based primarily on biotic surveys performed by the University of Hawaii Sea Grant Extension Service (Titgen et al., 1988) to establish baseline conditions. Characteristic features of species and families of the major phyla found during the Titgen survey are listed in Table 3.7-1. Figures 3.1-1 through 3.1-11 show the distribution of important marine biological features at USAKA. The 1989 DEIS and the original literature from which that document was derived contain more complete descriptions of Kwajalein Atoll marine biological communities. According to Titgen et al. (1988), the overall quality of the marine environment surrounding USAKA facilities is good.

Different species assemblages populate the reef habitats of each of the USAKA islands, but virtually all of these habitats support populations of fish, shellfish, and invertebrates of subsistence and cultural value.

3.7.1 Fishing

Although fishing in the lagoon and along the reef is a very common activity of Marshallese at Kwajalein Atoll, there are no catch records or other fisheries statistics available for Kwajalein Atoll and there are currently no recognized full-time commercial fishermen. Titgen et al. (1988) interviewed a number of Marshallese fishermen concerning target species and availability of those species. The general response was that fish are plentiful and they have no trouble catching enough for any occasion. Those interviewed reported that there has been no noticeable decline in fish abundance at the atoll over the past 10 to 15 years. The most commonly

Table 3.7-1
Characteristic Features of the Nearshore Marine Biota of Selected USAKA Islands

Reef Habitats	Kwajalein	Roi-Namur	Ennugarret	Meck	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Omelek	Eniwetak
Ocean Reef Coral	Low coverage of branching and encrusting forms	Low coverage; staghorn and branching dominate	Generally similar to Roi-Namur except nearshore environment is undisturbed	Severely disturbed	Low abundance, few species; encrusting forms	Sparse, due to natural events	50 percent coverage; diverse	Wide reef flat	Quarry dominates reef	---	No reef flat; pass reef has moderate abundance; brain and lobate forms
Algae	Abundant blue-greens, green, browns; corallines present	Abundant blue-greens, greens; browns and reds numerous	---	Primarily blue-greens	Mats, mostly of blue-greens and greens	Sparse red algal mats	Heavily grazed greens, blue-greens, browns, and reds	---	Low diversity, blue-greens	---	Moderate; blue-greens and greens
Invertebrates	Numerous sea urchins, sea cucumbers, topshells, snails, and crabs	Not abundant; giant clams, snails, sea urchins, and sea cucumbers	---	Hermit crabs, snails, and crabs	Sparse	Moderate numbers; snails, sea cucumbers, and crabs	Very abundant; cnidarians, giant clams, and barnacles	Rich diverse quarry	Low diversity; crabs, hermit crabs, and snails	---	Moderate diversity; giant clams and soft coral
Fish	Numerous eels, schools of mullet; gobies and wrasses	Moderate density; wrasses, butterfly, groupers, jacks, and surgeons	---	Eels	Abundant seaward; surgeon, damsel, wrasses, butterfly, and grouper	Abundant, especially surgeon fish	Very diverse; wrasses, damsel, angel, butterfly, snappers, and jacks	---	Low diversity	---	Resemble ocean reef fauna; surgeon, grouper, jacks and parrot
Lagoon Reef Coral	Lush coral; branching forms dominate, large knolls	Large beds; low diversity	---	Low coverage, some encrusting forms	Well developed; storm damage; large lobate forms	---	Wide reef flat	One of best reefs in atoll, high diversity; more than 70 percent coverage; staghorn	Good development; 75 percent coverage, many forms, including staghorn	Low abundance	---
Algae	Abundant greens, browns, and reds	Not abundant; greens, blue-greens, browns, and reds	---	Sparse; blue-green	100 percent coverage; greens, blue-greens, browns, and reds	---	Sparse	Moderate coverage of greens, reds, and browns	Diverse reds, greens, blue-greens, and browns	Moderate coverage; blue-greens and browns	---
Invertebrates	Abundant sponges, crabs, snails, hydroids, and sea cucumbers	Large anemone colonies and worm clusters; giant clams	---	Sparse; topshells, sponges, and tunicates	Soft corals dominate; topshells, giant clams, and sea urchins	---	Giant clams; alcopora	Rich; giant clams, sea cucumbers, soft corals, sea urchins, and anemones	Diverse; giant clams dominate; snails and anemones	Low diversity; giant clams, topshells, snails, and sea cucumbers	---
Fish	Rich, diverse; parrot, rabbit, surgeon, rudder fishes, and sharks	Moderate abundance; clown fish, groupers, wrasses, and damsel	---	Moderately diverse; wrasses, damsel, squirrel, and emperor	Abundant; convict tang, damsel, wrasses, grouper, and rabbit	---	Diverse, moderate; sparse near fuel dock	Diverse, abundant; squirrel, damsel, butterfly, wrasses, snappers, and jacks	Abundant; wrasses, butterfly, damsel, snappers, and parrot	Abundant; rabbit, surgeon, parrot, and shark	---
Other	Green sea turtle	Green sea turtle	---	---	---	---	---	Green sea turtle	---	---	---
Lagoon Floor Coral	Small outcrops on sand; more dense on rocks; staghorn dominate	Low coverage; encrusting forms	---	---	---	---	---	---	---	---	---
Algae	Greens dominate in sand; greens, browns, and reds on rocks	Large patches of green with some browns and reds	---	---	---	---	---	---	---	---	---
Invertebrates	Moderate numbers of anemones, snails, crabs, and sea urchins	Abundant; sea cucumbers, topshells, hydroids, crabs, and tunicates	---	---	---	---	---	---	---	---	---

Table 3.7-1
Characteristic Features of the Nearshore Marine Biota of Selected USAKA Islands

Reef Habitats	Kwajalein	Roi-Namur	Ennugarret	Meck	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Omelek	Eniwetak
Fish	Diverse, abundant; rabbit, goat, groupers, wrasses, snappers, tangs	Moderate numbers; damsel, wrasses, surgeon, jacks, and rudder	—	—	—	—	—	—	—	—	—
Harbor Coral	80 percent coverage; moderately diverse; branching forms	—	—	—	Large solitary forms and branching colonies	Diverse, 25 percent coverage; table coral	25 percent coverage; coral thickets of branching forms and lobate forms	—	3 percent coverage; encrusting forms	25 percent coverage	Less than 5 percent coverage; some branching and encrusting forms
Algae	Dense stands of greens, blue-greens, and browns on bottom and pier	—	—	—	Sparse	Abundant; greens, browns, blue-greens, and reds	Heavily grazed greens and some blue-greens	—	Reduced; mostly blue-greens and browns	—	High coverage; mostly blue-greens, greens, and reds
Invertebrates	Diverse; oysters, snails, barnacles, clams, hydroids, and sea stars	—	—	—	Low abundance; burrowing shrimp	High diversity; sea urchins, giant clams, sponges, and sea stars	Moderate numbers; topshells, oysters, sponges, and hydroids	—	Moderate; giant clams. Abundant; topshells, anemones, and sea stars	—	Moderate; soft coral, snails, giant clams, and sea cucumbers
Fish	Low abundance; wrasses, angel, butterfly, surgeon, goat, and grouper	—	—	—	Low abundance; wrasses, damsel, and surgeon	Medium diversity; wrasses, damsel, butterfly, jacks, and box fish	Moderate diversity; damsel, parrot, grouper, and surgeon	—	Low diversity; squirrel, surgeon, parrot, wrasses, and butterfly	—	Low diversity; surgeon and parrot
Quarries Coral	Diverse; branching forms dominate	—	—	5 percent coverage; diverse table and branched forms	—	2 percent coverage, but high density	—	Rich and diverse; brain, fire, encrusting, and mushroom forms	5 percent coverage; diverse; brain, fire, encrusting forms	50 percent coverage; diverse; branched and encrusting forms	—
Algae	Not abundant; browns and reds dominate	—	—	Moderate; mostly blue-greens, reds, and greens	—	High productivity of greens, browns, reds, and blue-greens	—	Rich greens, browns, reds, and blue-greens	Moderate; browns, greens, and reds	Moderate; greens and browns	—
Invertebrates	Sea cucumbers dominate; sea urchins and snails common	—	—	Diverse; sea urchin, sea cucumber, topshell, and giant clams	—	Abundant; topshells, giant clams, sea urchins, sea stars, ascidian	—	Diverse; soft coral, snails, sea urchins. Abundant; giant clams	Diverse; giant clams, sea urchins, topshells, and shrimp	Moderate; sea urchins, sea cucumbers, and giant clams	—
Fish	Diverse; angel, butterfly, wrasses, damsel, trigger, goat, and file	—	—	Diverse; abundant; wrasses, damsel, butterfly, squirrel, goat, and halfbeaks	—	Diverse; abundant; surgeon, butterfly, wrasses, and shark	—	Most diverse; surgeon, parrot, wrasses, damsel, butterfly, and goat	Diverse; abundant; surgeon, damsel, butterfly, and parrot	Diverse; goat, halfbeaks, wrasses, mullet, butterfly, and damsel	—
Seagrass Beds Plants	A few acres of seagrass beds in lagoon	Sizable seagrass beds; green algae	—	—	—	—	—	—	—	—	—
Invertebrates	—	Shrimp, limpets, sponges, and barnacles	—	—	—	—	—	—	—	—	—
Fish	—	Juvenile nursery area; goby	—	—	—	—	—	—	—	—	—

Source: Tilgen, et al., 1988; updated February 1992 field reconnaissance.
— = data not reported.

reported fish caught at the USAKA islands are listed in Table 3.6-2 of the 1989 DEIS. Figures 3.1-1 through 3.1-11 show key fisheries locations for each of the 11 USAKA islands.

Although the Republic of the Marshall Islands is an oceanic nation, national commercial fishing activities are minimal (Asian Development Bank [ADB], 1990). Subsistence fishing has been the traditional fishing activity. Limited commercial fishing serves the population centers of Majuro and Ebeye. There are no statistical data maintained by the RMI government regarding local catch by volume or species (ADB, 1990). Within Kwajalein Lagoon, subsistence fishing may occur in areas outside the Mid-Atoll Corridor at all times, and within the Mid-Atoll Corridor area of the lagoon during visitation periods that occur between the closure periods provided for in the Military Use and Operating Rights Agreement (MUORA) between the RMI and U.S. governments. In addition, subsistence fishing occurs in nearshore ocean waters.

Extensive commercial fishing occurs in offshore waters of the RMI Exclusive Economic Zone (EEZ). Fishing for tuna, skipjack, and billfish is conducted by U.S. purse seiners and Japanese pole and line and longline vessels. Fishing productivity in the EEZ area has been monitored by the South Pacific Commission for the past 27 years. A total of 184 Japanese vessels (53 pole/line and 131 longliners) used the RMI waters during the June 1989 to June 1990 period. The Japanese catch was reported to be 16,085 metric tons (mt). The U.S. catch from 49 vessels was estimated at 2,286 mt during the same period. The RMI EEZ is one of the most productive for the distant-water Japanese fleet. Total EEZ catch of oceanic species has varied between 8,000 to 30,000 mt per year since the 1970s.

Geographically, most of the catch of bigeye and yellowfin tuna is taken from the southern and western regions of the EEZ. Blue marlin and other billfish are mostly caught in the northern portion of the EEZ. Fishing activities in both the northern and southern part of the EEZ are concentrated in the January-April period each year, with declining activity during the rest of the year.

Fisheries development in the RMI is expected to increase under a proposed fishing development plan to be funded by the Asia Development Bank and administered by the Marshall Islands Marine Resources Authority (MIMRA) to augment the economic base of the RMI (ADB, 1990). Fisheries development would support a rapidly increasing population, help stem the inflow of outer island population to Majuro and Ebeye, and provide cash inflow to a developing market economy. Accordingly, the RMI's long-term objective is to harvest fisheries resources with national vessels and crews (ADB, 1990). The Fisheries Development Project proposes to base seven 10-meter vessels and seven 15-meter vessels in the RMI to exploit lagoon and high seas fishing resources. Permanent development of national commercial fishing would involve more frequent deployment of vessels in lagoon and nearshore waters in the future. It is uncertain if the total number of vessels using the EEZ would increase or remain stable as RMI vessels enter the market. According to the ADB, the fishing resources of RMI EEZ waters are considered underexploited; therefore, the addition of RMI-owned vessels would augment the foreign flag vessels using RMI waters, resulting in a future increase in vessel operations in the EEZ.

3.8 Rare, Threatened, or Endangered Species

Biological resources discussed in this section include terrestrial and marine species listed as rare, threatened, or endangered by one or more of the following:

- U.S. Fish and Wildlife Service (USFWS)
- U.S. National Marine Fisheries Service (USNMFS)
- East-West Center (EWC)
- South Pacific Regional Environmental Programme (SPREP)

Species discussed include sea turtles, giant clams, seagrasses, and marine mammals. The region of influence includes habitats of rare, threatened, or endangered species for all 11 USAKA islands and the surrounding marine environment that could be significantly affected by the Proposed Actions or alternatives. The area within which these species are discussed includes both Kwajalein Atoll and the broad ocean area (BOA), north and east of the atoll. Data sources are the terrestrial and marine surveys cited earlier, as well as from the agencies and organizations listed above.

3.8.1 Sea Turtles

USFWS lists the green sea turtle (*Chelonia mydas*) as Threatened and the hawksbill turtle (*Eretmochelys imbricata*) as Endangered. Turtles are commonly sighted at USAKA and several, including representatives of both of the above species, have established semi-permanent residence at the "turtle ponds" on Kwajalein Island and on Ennylabegan. Sea turtles continue to be a traditional food source for the Marshallese. Turtles were once common at the former food disposal ramp area on Kwajalein Island and both listed species were reported to be much more abundant off Roi-Namur in the past than at present.

In a survey of the shores of eight USAKA islands (all USAKA islands except Kwajalein, Roi-Namur, and Ennugarret) in March 1988, no evidence of nesting sea turtles was found. Ennylabegan was determined to have the best potential turtle nesting beaches, but the presence of a Marshallese population and domestic pigs, dogs, and cats makes it unlikely that much, if any, successful nesting occurs there. During a February 1992 field reconnaissance, Ennylabegan was again found to have the best potential turtle nesting beaches in addition to Ennugarret (not visited by the previous survey teams). With the possible exception of beaches on the north side of Eniwetak, and a small area at the northwest end of Illeginni, none of the other USAKA islands had substantial amounts of beach wide or high enough at that time to offer good nesting potential. This may be due in part to the effects of Tropical Storm Zelda, which struck the area in November 1991 and may have washed away much of the sand previously identified as potential nesting habitat in the *Natural Resources*

Plan (USAEDPO, 1991a). Anecdotal evidence exists of the accidental destruction of several turtle nests on Gellinam in 1989, but there are no documented records of this occurrence and the nature of the beaches in early 1992 (primarily steep rubble) would not support turtle nesting. Green sea turtle nesting at Roi-Namur has been alleged, but no substantive information (Clapp, 1988) is available to document that claim.

3.8.2 Giant Clams

There are five species of giant clam found at Kwajalein Atoll. The largest species (*Tridacna gigas*) has been significantly reduced in numbers throughout the Marshall Islands and has been extirpated from the Caroline Islands. The only reproductively viable population of this species at USAKA was found off Gellinam Island (Titgen et al., 1988). Although not currently listed as Threatened or Endangered, its status is being examined by the RMI government and the USNMFS for such listing. These clams are harvested by foreign fishermen for sale in Asian markets. The Marshallese also eat this species, but prefer the smaller, more common species.

3.8.3 Seagrass

A single species of rare seagrass (*Halophila minor*) is found in the lagoons near two USAKA islands, Kwajalein and Roi-Namur; the larger concentrations occur off Roi-Namur.

3.8.4 Marine Mammals

Marine mammals that may occur in the Kwajalein area and that are listed under the Endangered Species Act (ESA) include several species of cetaceans (i.e., the blue whale [*Balaenoptera musculus*], finback whale [*Balaenoptera physalus*], humpback whale [*Megaptera novaeangliae*], and sperm whale [*Physeter catodon*]). These are open-water, widely distributed species and are not likely to be found in the vicinity of the USAKA islands. Marine mammals may be found, however, in the BOA north and east of Kwajalein Atoll.

3.9 Cultural Resources

Cultural resources of USAKA comprise the remains of human activity significant in the history, prehistory. architecture, or archaeology of the area. Both the National Historic Preservation Act (NHPA) and the RMI Historic Preservation Act protect prehistoric, historic. and traditional use resources, which, as defined in the 1991 RMI Historic Preservation Act [Section 3(13)(24)(33)] and summarized here, include:

- Prehistoric resources: Resources produced by preliterate, indigenous people of the USAKA area

- Historic resources: Resources or landscapes produced since the advent of written records in the USAKA area

- Traditional use resources: Resources including sites, landmarks, and locations to which oral traditions of the indigenous people of the Marshall Islands are attached

Cultural resources include resources that are listed on or determined to be eligible for listing on the U.S. National Register of Historic Places, or that meet the criteria for National Register listing. A summary of the prehistoric and historic background of Kwajalein Atoll is provided in Section 4.8 of the 1989 DEIS. Figures 3.1-1 through 3.1-11 indicate the known and potential cultural resources of the 11 USAKA islands. The sites and areas indicated on these maps are based on the sources used in the 1989 EIS and also a review of the Kwajalein and Roi-Namur Battlefield National Register of Historic Places nomination forms, conducted by James Walker (USASSDC Senior Historian) and Doug Cubbison of Teledyne Brown Engineering in August 1993.

Numerous cultural resource surveys have been performed on Kwajalein Atoll, with nearly all of the work focused on Roi-Namur and Kwajalein islands. Although National Register evaluations have been undertaken for World War II era resources on Kwajalein and Roi-Namur, resources on the other nine USAKA islands have not been evaluated to determine their eligibility for listing on the National Register of Historic Places, in compliance with Section 110 of the NHPA. In addition, since the 1989 EIS was prepared, the U.S. Congress has directed DoD to inventory, protect, and conserve DoD cultural resources associated with the Cold War (DoD Appropriations Act, 1991, PL 101-511, Section 8120 104 STAT 1905). Cold War era resources on Kwajalein, Meck, Roi-Namur, and Illeginni, may need to be inventoried and evaluated in consultation with the RMI Historic Preservation Office (RMIHPO). Table 3.9-1 is a preliminary list of potential Cold War era resources.

Investigations documenting traditional Marshallese use of the islands have yet to be undertaken for the USAKA area. The 1991 Marshall Islands cultural resource law and the proposed USAKA cultural resource regulations both consider traditional use sites and areas to be significant resources that may be eligible for listing on the National Register of Historic Places. Surveys of traditional use areas on Arno and Majuro Atolls resulted in the identification of more than 230 such sites. These sites included fishtraps, cemeteries, and isolated coral heads and microatolls associated with mythological or traditional historical figures, functional attributes, or the presence of a particular fish species. Sites similar to these will almost certainly be associated with some or all of the USAKA islands.

Although the cultural resources mitigation measures identified in the 1989 EIS are now standard procedure at USAKA, no construction has occurred since 1989 at any of the cultural resource sites identified in that EIS. There has been no report of any damage to cultural resources along the shorelines of USAKA islands as a result of

Table 3.9-1
Preliminary List of Potentially Significant Cold War
Cultural Features Located at USAKA

Island	Facility Number	Facility	Year Built	Current Status
Kwajalein	987	ZAR receiver antenna	1961	Inactive
	988	ZAR receiver building	1960	Rg cal laboratory/warehouse
	992	ZAR power plant	1961	Power Plant 1
	993	ZAR transmitter building	1961	General warehouse
	1010	Joint technical operations building	1960	Range command building
	1011	TTR-4	1960	Range safety center
	1012	TTR-5	1962	Inactive
	1017	Battery control building	1961	HF transmitter building
	1023	Live storage area	1961	Inactive
	1024	Live storage area	1961	Inactive
	1025	Live assembly area	1961	Ordnance storage
	1026	Live assembly area	1961	Ordnance storage
	1045	Zeus discriminating radar	1962	General warehouse
	1099	Zeus missile launch area	1960	FPQ-19 radar site
Roi-Namur	8060	TRADEX radar	1961	TRADEX radar
	8111	ALTAIR radar	1967	ALTAIR radar
	8141	ALCOR radar	1968	ALCOR radar
	8194	MMW radar	1981	MMW radar
Meck	5049	STTF	1976	Inactive
	5050	Meck Island Control Building	1968	Meck Island Control Building
	5057	Sprint Silo No. 7	1968	Inactive
	5058	Sprint Silo No. 8	1968	Inactive
	5059	Sprint Silo No. 9	1968	Inactive
	5060	Sprint Silo No. 10	1968	Inactive
	5064	Ordnance area	1968	LEAP holding bay
	5065	Ordnance area	1968	LEAP PAB
	5070	Launch equipment building	1969	Launch equipment building
	5071	Spartan Silo No. 21	1969	Inactive
	5072	Spartan Silo No. 22	1969	Inactive
	5080	Spartan MAB	1969	ERIS/BP MAB
	5084	Sprint transport load	1968	Loading pad
Illeginni	9033	Remote launch equipment building	1971	Inactive
	9034	Launch equipment building	1971	Inactive
	9035	Missile assembly building	1971	Power plant
	9041	Spartan Silo No. 31	1971	Inactive
	9042	Spartan Silo No. 32	1971	Inactive
	9043	Sprint Silo No. 12	1971	Inactive
	9044	Sprint Silo No. 13	1971	Inactive
	9045	Personnel shelter	1981	Inactive

Tropical Storm Zelda in November 1991. However, many of the historic World War II resources on Kwajalein and Roi-Namur are badly deteriorating as a result of the harsh South Pacific environment (Walker, 1992). In compliance with Section 101 and Section 110 of the National Historic Preservation Act, a preservation program is required to help ensure that these resources and others on the remaining nine USAKA islands are preserved and not allowed to deteriorate. Table 3.9-2 summarizes the cultural resources that have been identified on each island. It is based on data presented in the 1989 DEIS (Section 3.8) and a February 1992 site visit.

3.10 Land Use

This section briefly characterizes existing land use patterns on the USAKA islands and USAKA's Master Plan process. Changes since the 1989 EIS was prepared are discussed.

The region of influence for land use is limited to the USAKA islands. Land use on other Kwajalein Atoll islands would not be affected by the activities evaluated in this SEIS. Information in this section derives from the 1989 EIS, the *Natural Resources Plan* (USAEDPO, 1991a), and the *1992 USAKA Master Plan Report* (USAEDPO, 1992).

The principal land use patterns for the four islands (i.e., Kwajalein, Roi-Namur, Meck, and Omelek) on which mission-related construction was proposed in 1989 were described in the 1989 DEIS. Color aerial photographs illustrated land uses for these and the other USAKA islands, with the exception of Ennugarret (see Figures 3.9-4 to 3.9-12, 1989 DEIS). Figures 3.1-1 through 3.1-11 of this document show the current land uses on all of the USAKA islands.

3.10.1 USAKA Master Plan

The purpose of the *1988 USAKA Master Plan* (USAEDPO, 1988b) is to provide a comprehensive framework for facilities programming, design, and construction so that development will occur in a manner that meets mission requirements, uses scarce land resources efficiently, and minimizes adverse impacts to the environment. Army Regulation 210-20 (U.S. Army Headquarters, 1987) and proposed revisions to this regulation (Coordinating Draft of AR 210-20, Master Planning for Army Installations, November 1, 1991) recognize that master plans must be flexible in order to respond to changing mission requirements, funding priorities, and environmental regulations. AR 210-20 requires that short-range (annual) and long-range plans be updated as conditions change.

In 1991, the USAKA Master Plan was updated to provide greater flexibility for future revisions and to incorporate the *Natural Resources Plan* (NRP) and *Environmental*

Table 3.9-2
Cultural Resources at USAKA Islands

Resource	Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennugarret
Historical	Japanese air shelter, cemetery, well, bunkers, defensive bunkers, skeletal remains, sunken warships, and potable water system	Radar station, pillboxes, Japanese and U.S. cemeteries, artillery posts, ordnance and machine gun bunkers, hospital, torpedo tank, dock, and support facilities	Largely disturbed; no evidence of remains	No historic resources identified	Japanese and possible U.S. concrete structures; cemetery	No historic resources identified	No historic resources	Japanese pillbox	No historic resources	No resources	World War II concrete foundation, communication cables, railroad grade remains, earth berms, gun shells, and live ordnance
Archaeological	Buried prehistoric remains, including shell middens, ornamental and utilitarian shell artifacts, and house sites 2,000 to 2,500 years old	Some resources of historic and prehistoric eras	No evidence	Coral slab features; three reef rock slabs	Marshallese cemetery; possible buried midden adzes and shell debris	Buried prehistoric remains include pearlshell fishhook, adzes, wooden maul, possible house remains, and garden areas	No resources	No resources	None identified	Oven and firepit features, marine mollusk shell, and fish bone midden	500- to 700-year-old fire pit

Quality Protection Plan (EQPP) for USAKA (USAEDPO, 1991a; 1991b). A 1992 Concept Plan for Kwajalein (Figure 3.10-1) was developed, based on facility needs and recommendations of these plans.

The Master Plan's land use concept plans address Kwajalein and Roi-Namur only. The EQPP focuses on these two islands and Meck because activities that could result in environmental impacts currently occur primarily on these three islands. The NRP addresses all the USAKA islands, with the exception of Ennugarret.

A summary of the current land use patterns and the status of mission-related and other construction projects for each USAKA island follows.

KWAJALEIN

Kwajalein, with a land area of 748 acres (303 hectares), is the headquarters island of USAKA. It is extensively developed with housing and community facilities toward the eastern end of the island, air operations, supply, and utilities near the center of the island, and research, development, and communications operations toward the western end of the island. Although a number of new facilities have been constructed since the 1989 EIS was prepared (e.g., Power Plant 1A, a helicopter hangar, recreational facilities, administrative and communications facilities, a liquid nitrogen plant, and a warehouse), there have been no changes in the overall land use patterns of the island, shown in Figure 3.9-1 of the 1989 DEIS.

ROI-NAMUR

Roi-Namur has an area of 398 acres (161 hectares) and is the only USAKA island other than Kwajalein with a resident nonindigenous population. Although several construction projects have been completed since the 1989 EIS was prepared (including a recreation center, a beach pavilion, and a potable water storage tank), there have been no changes to the overall land use patterns of the island shown in Figure 3.9-2 of the 1989 DEIS.

MECK

Since 1989, Meck has been the principal location of mission-related construction that was analyzed in the 1989 DEIS. The resulting land use pattern on Meck is essentially the same as was shown in Figure 3.9-3 of the 1989 EIS, with two exceptions: (1) the Research and Development Operations on the island's north end has expanded southward into the obsolete runway in the Flight Operations area, and (2) the southern tip of the island is used as a salvage/storage yard instead of for research and development operations.

OMELEK

No construction has occurred on Omelek since a 10,000-gallon (37,853-liter) fuel tank was installed in 1989. Conditions are the same as those described in Figure 3.9-4 of the 1989 DEIS.

ENNYLABEGAN

USAKA controls 71 acres (28.4 hectares) in the central portion of this 124-acre (50-hectare) island. Facilities include communications equipment, telemetry antennas, support buildings, a helipad, and a pier. The island supports two small Marshallese settlements, located outside the USAKA area.

LEGAN

Facilities on this 18-acre (7.3-hectare) island are limited to the southern end, used for optical sensing and radar. Facilities include a helipad, marine ramp and finger jetty, radar, and supporting equipment. No facilities have been constructed on Legan since the addition of a 10,000-gallon (37,853-liter) fuel tank in 1989. The remainder of the island is covered with a mixed broadleaf forest and an interior brackish pond.

ILLEGINNI

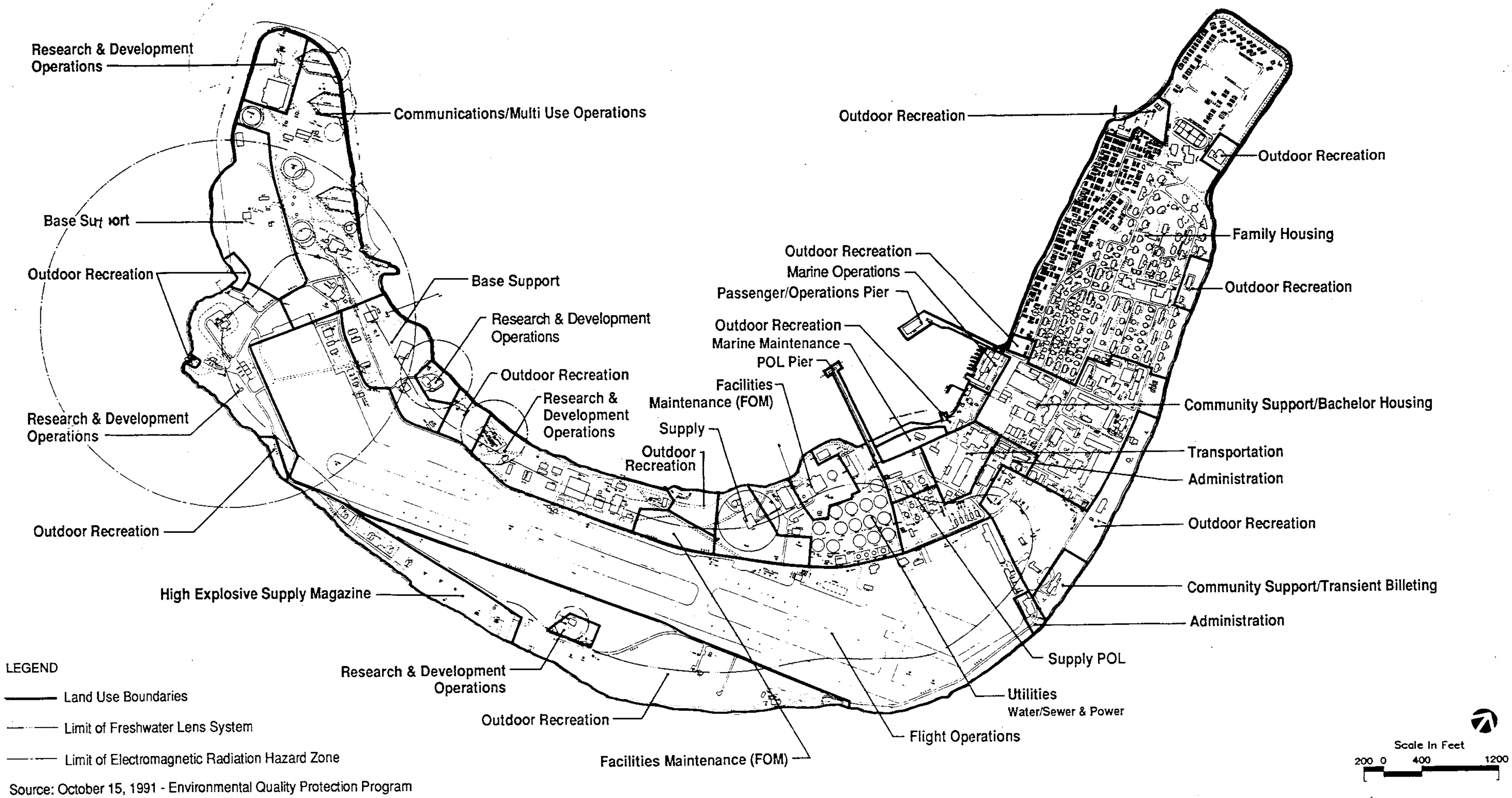
This 31-acre (13-hectare) island houses telemetry equipment, a fixed camera tower, and a multistatic measurement system. Supporting facilities include a helipad, marine ramp, fuel pier, diesel generator, and temporary trailers. It has two dozen abandoned buildings, including a launch pad. Small areas of the island are forested. No facilities have been constructed on Illeginni since a 1,216-square-foot (113-square-meter) building to support the multistatic measurement system was constructed in 1990.

GAGAN

This 6-acre (2.4-hectare) island is used for radar, optical sensing, and telemetry equipment. Supporting facilities include a helipad, a pier, a marine ramp, and two finger jetties. Most of the facilities are located on the southwest end of the island. A mixed broadleaf forest covers the undeveloped portions. No new facilities have been constructed on Gagan since a 10,000-gallon (37,853-liter) fuel tank was constructed in 1989.

GELLINAM

This 5-acre (2-hectare) island is the smallest of the USAKA islands and most of it is developed with facilities to conduct sensing and hydroacoustic impact timing activities, and support a multistatic measurement system. Facilities include radar, measurement systems, support buildings, a helipad, a pier, and a marine ramp. A building to support the multistatic measurement system (1,216 square feet [113 square meters])



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

1992 Concept Plan
KWAJALEIN

FIGURE 3.10-1

and a 10,000-gallon (37,853-liter) fuel tank have been built on the island since 1989.

ENIWETAK

Most of this 15-acre (6-hectare) island is covered by a dense forest. Existing facilities used for optical sensing are clustered on the east end of the island. Facilities include camera equipment and support buildings. On the opposite end of the island are a helipad, pier, and marine ramp.

ENNUGARRET

USAKA controls 6 acres (2.4 hectares) of this 24-acre (9.7-hectare) island. Except for the remains of an abandoned communications tower, the island is undeveloped. Much of the island is covered by forest.

3.11 Socioeconomic Conditions

This section describes employment, population, housing, income, fiscal conditions, recreation, education, and health care.

The socioeconomic region of influence is defined primarily as the 11 USAKA islands and secondarily as the islands of Ebeye and Ennubirr, where most of the Marshallese who work at USAKA reside. Information for this section is derived from the 1989 EIS, from the Analysis of Existing Facilities (JCWSI, 1991), and from a site visit in February 1992.

3.11.1 Employment

Employment at USAKA, which is the primary economic activity at Kwajalein Atoll and directly influences both population and housing, has provided a relatively stable base for the local economy. Direct U.S. government payments to landowners and funds allocated to KADA are also major contributors to the local economy. Detailed employment statistics for 1988 are provided in Subsection 3.10.1 of the 1989 DEIS, pages 3-129 through 3-135.

Nonindigenous employees at USAKA are primarily personnel working for the military, federal civil service, individuals recruited by USAKA contractors, and family members. As of January 1992, a total of 1,690 nonindigenous personnel associated with operations, construction, and short-term (transient) operations were employed at USAKA (Table 3.11-1). This level of employees was lower than average for USAKA; in September 1988, the number of construction and transient employees had been approximately 300 higher than in January 1992, and the number of construction and transient employees was expected to increase by at least 250 by the end of 1993 (Wynne, pers. comm., 1992).

In mid-1991, approximately 970 Marshallese were regularly employed at USAKA, of which 800 were employed by the logistic engineering contractor (JCWSI/DynCorp). The remainder are employed by other onsite contractors (JCWSI, 1991).

Table 3.11-1
Distribution of Nonindigenous Employees and Family Members Population at USAKA (January 1992)

	Employees	Family Members	Total
Operations personnel			
Accompanied	455	1,301	1,756
Unaccompanied	1,178	0	1,178
Subtotal, operations	1,633	1,301	2,934
Transient personnel	29	4	33
Construction personnel	28	0	28
Total	1,690	1,305	2,995

Source: Turgeon, pers. comm., 1992.

3.11.2 Population

The January 1992 nonindigenous population at USAKA was 2,995 (Table 3.11-1). This number compares with a peak nonindigenous population in 1971 of 4,756, and 2,972 in 1988 (USASDC, 1989a).

The Marshallese population of Kwajalein Atoll was approximately 10,960, as of mid-1991, of which 10,000 live at Ebeye Island and the remainder live at other islands (Ebadon, Ennubirr, Biggerman, Ennylabegan, Ennubuj, and Gugeegue) (JCWSI, 1991). The November 1988 RMI census had found a population of 8,277 at Ebeye, 494 at Ennubirr, and smaller numbers at other islands. There are no inhabitants within the Mid-Atoll Corridor; therefore, population centers are at the north and south parts of the atoll.

3.11.3 Housing

Housing for USAKA's personnel is located on Kwajalein and Roi-Namur islands and consists of family housing, unaccompanied personnel housing (UPH), and transient housing. Construction workers are usually housed in temporary trailers provided by the construction contractor. Housing at USAKA is described on pages 3-137 through 3-142 of the 1989 DEIS.

Family Housing. There have been minor changes in the number or status of family housing units since the 1989 EIS was prepared. Family housing consists of concrete block buildings and trailers, all located on Kwajalein Island. There are 425 habitable single-family and multifamily units, and 249 trailers used for family housing, giving a total of 674 units (JCWSI, 1992a). The most recently constructed family housing units are 136 units contained in 24 townhouse buildings, constructed in 1989.

Unaccompanied Personnel Housing. UPH units are used by base operations personnel without family, and are also rented on an as-available basis to temporary construction personnel. On Kwajalein, there are 384 rooms with a capacity of 436 people, housed in seven buildings. In all but the Pacific Bachelor Quarters, personnel are normally housed two per room; in the Pacific Bachelor Quarters, entry-level personnel are housed in rooms with three to four persons, with shared bathroom facilities.

On Roi-Namur, 231 personnel are housed in 231 rooms in eight buildings; in addition, there are 10 two-bedroom trailers that can house a total of 20 personnel, bringing the total for Roi-Namur UPH to 251.

The Army standard used at USAKA for UPH is a private room with a private bath and 270 square feet (25 square meters) net living area (AR 210-50, Table 4-2 [U.S. Army Headquarters, 1987]), for grades E7 through E9 (at USAKA, most UPH is occupied by contractor personnel at grades equivalent to these military grade levels).

Transient Personnel. Transient personnel are housed primarily at the Kwajalein Lodge, which has 37 rooms, but can accommodate up to 52 visitors. The lodge was renovated in 1989, but was damaged by Tropical Storm Zelda in November 1991, and has been repaired. The Pacific and Ocean Bachelor Quarters, to include the third floor of Building 708 can accommodate up to 373 transient personnel. Transients are also housed in 11 "VIP" and 3 "vacation" trailer units, and in any available UPH units.

According to Kwajalein Housing Services staff, the only housing units at USAKA that meet Army Regulation 210-11 and Army design standards are the 136 family units constructed at Kwajalein in 1988 and the 100-unit UPH dormitory constructed on Roi-Namur in 1989 (Kelly, pers. comm., 1992). In particular, the 249 trailers used for family housing date to the 1960s, and have been proposed to be removed as substandard. They have been retained, however, in order to reduce crowding in other housing units.

Marshallese Housing. Housing for the Marshallese is located principally on Ebeye Island (northeast of Kwajalein Island) and Ennubirr (southeast of Roi-Namur Island), with smaller numbers at Ennylabegan and other islands. Since 1989, a housing development of approximately 40 units was built on the north end of Ebeye Island near the proposed causeway, which will link Ebeye to Gugeegue Island to the north. At Gugeegue, approximately 200 units were built in 1989-90.

The roofs of most houses on Ebeye (including the newly constructed units) were blown off during Tropical Storm Zelda in November 1991. As of February 1992, representatives from the Federal Emergency Management Agency (FEMA) were completing a disaster relief program on the island. No new housing has been constructed on Ennubirr since 1989, and no existing housing suffered significant damage from Tropical Storm Zelda.

3.11.4 Income and Fiscal Conditions

All funding for base services at USAKA (e.g., education, medical services, utilities) is provided by the U.S. government, with the exception of some funding for recreational operations supported by USAKA residents through retail and user fees. Precise data concerning the total income earned by USAKA nonindigenous personnel are not available. However, an estimate of the total income of USAKA nonindigenous contract employees can be derived from data on the 5 percent income tax paid to the RMI government by all contract employees. In 1991, income tax receipts amounted to $2,357,491, which corresponds to a total income of at least $47,149,820 (Patrick, pers. comm., 1992).

Public services on Ebeye and Ennubirr islands are funded by RMI and by the Kwajalein Atoll Local Government (KALGOV).

In 1991, the total direct earnings of Marshallese employed at USAKA were $11,120,500.

The Compact of Free Association specifies the grants and cash payments to be made by the United States for use of the USAKA lands and lagoon area. Compact funding and land use payments totaled $57.69 million in 1991 (Patrick, pers. comm., 1992).

3.11.5 Recreation

Formal recreational facilities are limited to Kwajalein and Roi-Namur islands, and include facilities for indoor and outdoor sports, hobbies, movies, and a library, as described on pages 3-143 and 3-144 of the 1989 DEIS. Since 1989, several of the tennis courts and the bowling alley have been refurbished, the Ivey gymnasium has been renovated, and lights have been installed on the softball field at Kwajalein. New facilities include a youth center, an arts and crafts facility, and unaccompanied personnel recreation centers on both Kwajalein and Roi-Namur.

Recreation operations continue to be funded by user fees and the profits from retail food and merchandise operations. The latter has grown from $740,000 in 1986 to a projected $2 million in 1992.

3.11.6 Education

USAKA's educational programs include preschool, elementary, junior and senior high schools, and adult education, all of which are located on Kwajalein and are operated by the logistic engineering contractor (currently Johnson Controls World Services). The Ivey School serves grade K, the George Seitz School serves grades K through 6, and the Kwajalein Junior/Senior High School serves grades 7 through 12. Preschool serves children 3 to 6 years of age. In February 1992, there were 48 teachers in the USAKA school system.

Table 3.11-2 indicates the number of students by grade enrolled in USAKA schools for the academic year 1991-92. The total enrollment of 530 is 115 students more than it was when the 1989 USAKA EIS was prepared. These numbers include five Marshallese children in each of grades K through 5. Five Marshallese students are added each year, and will each proceed through grade 12 in the USAKA school system.

Table 3.11-2
USAKA School Academic Year Enrollment
(1991 to 1992)

Grade	Number
Preschool	127
1	51
2	60
3	35
4	51
5	45
6	35
7	38
8	27
9	43
10	37
11	27
12	27
Total	657

Source: Dale, pers. comm., 1991.

Four classrooms, two destroyed by Tropical Storm Zelda and two adjacent deteriorated classrooms, were replaced in 1992, and elementary school capacity is now adequate (Dale, pers. comm., 1992). The high school is currently well below capacity (Pera, pers. comm., 1992).

3.11.7 Health

The hospital and medical facilities at USAKA include both in-patient and out-patient care and a dental clinic. Kwajalein Hospital, a two-story building built in 1951 and subsequently expanded, is the primary health care facility. Staff consists of five physicians and two surgeons, six registered nurses, four nurse assistants, and four licensed practical nurses or licensed vocational nurses.

A dispensary, located on Roi-Namur, is staffed by one medical technician. There is a first aid station on Meck, staffed by a medical technician.

According to the head of medical services, USAKA medical facility capacity and staff are adequate for the current population of 2,995, and should be adequate to support a population of approximately 5,000. There are no major health care needs that are not being met, although quarterly visits from an allergist, dermatologist, ear/nose/throat specialist, and orthopedist would be worthwhile and existing hospital facilities are cramped. There are approximately 15,000 to 18,000 outpatient visits per year, with approximately 55 in-patient days per year (Lindborg, pers. comm., 1992).

The Kwajalein Hospital provides care for patients referred from Ebeye, but, according to the head of USAKA medical services, there have been a few referrals in the past 5 years because the RMI government prefers to keep medical disbursement funds within its own medical system, rather than pay for care at USAKA (Lindborg, pers. comm., February 1992).

Health conditions at Ebeye and Ennubirr are summarized in Subsection 3.10.7 of the 1989 DEIS.

3.12 Transportation

Kwajalein's isolated location and island geography make transportation vital to USAKA. The following sections describe existing transportation systems at USAKA, focusing on air, ground, and marine transportation facilities and operations. The region of influence includes the 11 USAKA islands, plus the entire Kwajalein lagoon for marine transportation.

New information used to develop this section includes the *Environmental Quality Protection Plan* (USAEDPO, 1991b), and reports and data provided by Johnson Controls World Services, Inc., and DynCorp.

3.12.1 Air Transportation

Air transportation carries mission workers, visitors, and cargo between outside locations and USAKA and among USAKA islands. Air support facilities are concentrated on Kwajalein Island; they serve USAKA and as a refueling stop for military and nonmilitary flights in the Pacific Ocean.

Air Transportation Facilities

KWAJALEIN

Local air service between islands is provided by eight aircraft operated by Johnson Controls World Services/DynCorp for USAKA. The four Shorts SD3-30 turbo-prop aircraft for service between Kwajalein and Roi-Namur islands were replaced in 1992 by three DeHaviland-7 aircraft. The DeHaviland-7 aircraft have a capacity of 50 passengers each and are usually at capacity on the to-work and work-return flights during the week.

Five UH-1H helicopters are based on Kwajalein and serve the other USAKA islands; each can carry up to 11 passengers. An 18,590-square-foot (1,727-square-meter) helicopter hangar was constructed on Kwajalein Island in 1989 (JCWSI, 1991).

Long distance air service is provided from Kwajalein by Airline of the Marshall Islands (AMI), Continental/Air Micronesia, and the Air Mobility Command (AMC). AMI in turn connects Kwajalein and other Marshall Island destinations with frequent flights of its three turbo-prop aircraft. Continental/Air Micronesia connects Kwajalein Island with four flights each eastbound and westbound. AMC connects Kwajalein Island with Hickam AFB, Hawaii; flight frequency per week has increased from three to four since 1989.

In addition, some Kwajalein test activities involve technical flights by modified commercial or military aircraft (e.g., the HALO and COBRA EYE programs described in Section 2.2).

Tropical Storm Zelda did significant damage to the air support facilities on Kwajalein Island in November 1991. The roof of the airplane hangar was damaged and has been repaired. The new helicopter hangar suffered minor damages, which have been repaired. Repair work is complete on the intra-atoll air terminal (FN 688). Terminal functions are working from temporary quarters; once repaired, the terminal will be used for indoor parking of ground support vehicles. A warehouse for holdover cargo (FN 975) was damaged beyond repair and will be rebuilt at the same site. The old helicopter hangar (FN 995), used to store large aircraft replacement parts and other equipment, was extensively damaged and will be demolished and replaced with a warehouse structure.

OTHER ISLANDS

There have been no changes to the air transportation support facilities on any of the other islands. Dyess Army Airfield on Roi-Namur serves fixed-wing aircraft and helicopters; paved landing pads accommodate helicopters serving Eniwetak, Ennylabegan, Gagan, Gellinam, Illeginni, Legan, and Omelek islands. Helicopters land on the runway at Meck Island, which is no longer authorized for use by fixed-wing aircraft. There is neither helipad nor airstrip on Ennugarret.

Air Transportation Operations

Table 3.12-1 summarizes the air transportation operations for the month of January 1992.

Table 3.12-1
USAKA Air Transportation Operations
(January 1992)

Carrier	Aircraft Type	Total Arrivals and Departures
Air Mobility Command	C-141	32
Continental/Air Micronesia	B-727	35
USAF	C-130	5
USN	C-12	1
AMI	DO-228	53
AMI	HS-748	7
AMI	DC-8	17
CIE	G-II	2
FAA	B-727	1
USMC	C-130	1
Australia	P-3	2
Australia	C-130	1
USAKA Aircraft	DeHaviland-7	313
	UH-1H	194

Source: Lefebvre, 1992; and Eady, 1992.

Table 3.12-2 shows the number of passengers served at Kwajalein air facilities.

Table 3.12-2
Passengers Served (One Way) at Kwajalein and Operation Hours of Intraisland Flights (January 1992)

Carrier/Aircraft	Passengers (one way)	Operation Hours
Air Mobility Command	711	N/A
Continental/Air Micronesia	1,157	N/A
Airline of the Marshall Islands	1,241	N/A
Fixed wing (DeHaviland-7)	9,760	160
Helicopter (UH-1H)	2,145	182

Source: Lefebvre, 1992; and Eady, 1992.

3.12.2 Ground Transportation

Because distances traveled on the USAKA islands are short, people travel for the most part by bicycle or on foot, or by using scheduled shuttle buses. Motor vehicles are used on Kwajalein and Roi-Namur almost exclusively for work and administrative functions. Private automobiles may not be brought to USAKA. There have been small changes in the total number of vehicles at USAKA since 1989.

Ground Transportation Facilities

Facilities consist of roadways and pathways used by motor vehicles, bicycles, and pedestrians. Several motor vehicle maintenance facilities have been constructed on Kwajalein Island since 1989.

KWAJALEIN

There are approximately 13 miles (21 kilometers) of paved roads and 6.5 miles (10.4 kilometers) of unpaved roads on Kwajalein Island. Bicycles are the principal means of transportation and travel on the same paths used by pedestrians as well as on roads used by motor vehicles. The low level of motor traffic precludes the need for separate bike paths.

A fleet of shuttle buses and vans transport personnel to work and community service areas from residential areas. The buses serve routes on a regular daytime schedule and the vans offer transportation by special arrangement, day or evening.

Since 1989, two car washes, a truck wash, and a secure modular building have been constructed on Kwajalein Island to support ground transportation.

ROI-NAMUR

There are approximately 8 miles (13 kilometers) of paved roads and 1 mile (1.6 kilometers) of unpaved roads on Roi-Namur. There are currently 110 vehicles on the island, double the number since 1989.

Personnel arriving for work from Kwajalein Island by air either walk, bike, or take one of three shuttle buses.

OTHER ISLANDS

Meck Island has about 1 mile of paved road and Ennylabegan Island has 1 mile of paved road and one-half mile (0.8 kilometer) of unpaved road. Apart from several vehicles on Meck, Ennylabegan, and Illeginni islands, there are no vehicles on the other USAKA islands where there is no permanent population.

Ground Transportation Operations

Since 1989, there have been small changes to the routing and schedule of the shuttle buses that serve Kwajalein Island. These changes have not altered the numbers of miles driven or passengers served. Table 3.12-3 is a summary of the general purpose and passenger vehicle operations for 1991.

Table 3.12-3
General Purpose and Passenger Vehicle
Operations Summary for Kwajalein and Roi-Namur Islands

Vehicle Type	Average In-use Vehicle Inventory	Miles Operated
Ambulances	4	7,400
Buses	10	83,800
Trucks (<8,500 lbs GVW)	268	1,817,900
Trucks (>8,500 lbs <24,000 GVW)	39	293,600
Trucks (>24,000 lbs GVW)	16	127,200
Total, all vehicles	337	2,322,500

Source: USAEDPO, 1991b.

3.12.3 Marine Transportation

Ships and smaller craft carry ocean cargo and fuel to USAKA and deliver workers and cargo, including fuel, between islands.

Marine Transport Facilities

Local marine transport is provided under contract by JCWSI/DynCorp. There have been some changes to the marine fleet serving USAKA since 1989. The following is a summary of the existing USAKA marine fleet (with notes on changes since 1989):

- Two harbor tugs
- One LCU (Landing Craft Utility) 1466 class (down from three in 1989)
- One new LCU, 2000 class, used for island cargo support
- Two high-speed catamaran ferries
- Five LCMs (Landing Craft Mechanized)
- One aluminum 65-foot (20-meter) personnel boat T-600 Spartan
- Three barges (down from five in 1989; one for cargo, one for fuel, and one for water transport)
- Two new high-speed boats used for island security patrols

Marine transport facilities are concentrated at Kwajalein Island, which serves as a base for most of the fleet and hosts oceangoing ships and barges delivering cargo and fuel to USAKA. Other islands have piers for loading and unloading personnel and material. Periodic dredging is required to keep the approach channels and harbors deep enough for the boats. Since 1989, there has been some dredging at Ennylabegan Island harbor (in 1991) and there is currently dredging associated with construction of a replacement dry dock on Kwajalein Island. Completion of the dry dock facility is expected in 1994-95. Additionally, there will be dredging on Kwajalein in the vicinity of the fuel pier.

Several new marine support facilities have been added since 1989. A ship lift/control building (3,250 square feet [302 square meters]) was partially constructed on Kwajalein Island in 1990 and will be completed in 1994. A 235-foot (72-meter) seawall and 380 feet (116 meters) of a new breakwater were constructed at Illeginni Island in 1989. About 100 feet (31 meters) of seawall on Meck Island were removed in 1991 as a result of the installation of the fiber optics cable to Eniwetak Island. Tropical Storm Zelda did not inflict significant damage to marine facilities.

Cargo handling facilities at Kwajalein Island have more capacity than is currently needed, even though only one cargo ship at a time can be docked for unloading. Passenger facilities are being used near full capacity. The average monthly numbers of passengers carried by the interisland ferries has increased from 55,596 in 1989 to 62,005 in 1991.

Marine Transport Operations

The passenger fleet consists of two catamaran ferries, an LCM, and the personnel boat T-600 Spartan. Each catamaran runs on a 6-day schedule, has a crew of five, and can carry up to 199 passengers. One catamaran carries Marshallese workers back and forth between Ebeye and Kwajalein islands. The other catamaran carries workers between Kwajalein and Meck Island. The LCM makes two runs a day, 7 days a week, from Roi-Namur Island to nearby islands, primarily to ferry Marshallese workers to Roi-Namur Island. The LCM has a crew of three and can carry up to 190 passengers. Between passenger runs, the LCM provides support to other islands with cargo hauls. The T-600 Spartan serves as backup for the other passenger craft; it can carry about 70 passengers and has a crew of three.

A tanker or fuel barge delivers liquid fuel to Kwajalein Island about six times a year; cargo deliveries are made every 28 days or 13 times per year. Table 3.12-4 summarizes the current marine transportation operations at USAKA.

Table 3.12-4
Summary of Marine Transportation Operations at USAKA
(January 1992)

Operation	Kwajalein Island	Roi-Namur Island
Oceangoing ships using port	6	
Total days spent in port	23	
Scheduled ferry trips	450	48
Nonscheduled ferry trips	11	0
Scheduled cargo trips	23	6
Mission support	4	0
Search and rescue	1	0
Barge trips	14	0
Tug trips	16	0
Total	519	54
Passengers carried	55,001	3,404
Operating hours, passengers, and cargo	1,241	68

Source: JCWSI, 1992b.

3.13 Utilities

USAKA's facilities include the full complement of utilities found in most small towns in the United States. USAKA's utilities include facilities for electrical power generation and distribution, potable water treatment, wastewater treatment and disposal, solid waste disposal, and hazardous waste storage.

The region of influence for utilities includes all USAKA islands that have utility facilities. Kwajalein and Roi-Namur have the full range of utilities to support operations as well as their residential communities; most other islands have electrical generation facilities and permanent or temporary water and wastewater systems.

The following sections summarize utility facilities on each island. Section 3.12 of the 1989 DEIS provides more detail about utilities. Information to supplement the 1989 EIS was obtained from the *Environmental Quality Protection Plan* (USAEDPO, 1991b), and interviews with USAKA and JCWSI personnel during a February 1992 site visit.

3.13.1 Water Supply

Water supply at USAKA is made up of potable (freshwater) and nonpotable (saltwater) systems.

3.13.1.1 Potable Water Systems

KWAJALEIN

Under normal conditions, Kwajalein's potable water system can provide an adequate supply of freshwater. Demand (which averaged 300,000 gpd [1,135,599 Lpd] over the period January 1, 1989, through December 31, 1991) is more than met by available daily supply of 430,000 gallons (1,627,692 liters) from rainwater catchments and groundwater (JCWSI, 1991).

The lens well system was heavily used during 1988 because of high catchment water turbidity resulting from construction activity in the immediate area. About 60 million gallons was withdrawn from the lens well system each year during the 1989 through 1990 period. After installation of a new package water treatment plant, surface water has been used to a greater extent, and lens well water withdrawal was reduced to 31 million gallons (117 million liters) during 1991 (JCWSI, 1991).

One of the 14 existing 1-million-gallon (3.8-million-liter), reinforced-concrete tanks used to store raw water collected from the catchments and lens wells has been converted to store treated water from the package water treatment plant and another is in the process of being covered. Raw water is pumped from storage to treatment in the package water treatment plant. The treated water receives pH adjustment and chlorination before being stored in the covered concrete tank.

Turbidity has been well within the allowable maximum contaminant level (MCL) of the 1986 Amendments to the Safe Drinking Water Act (SDWA) since installation of the new 400-gpm (1,514-Lpm) package water treatment plant in 1990 (JCWSI, 1991).

A desalination facility with a capacity of 150,000 gallons (567,800 liters) per day is scheduled to begin construction in 1993. The desalination plant will make use of waste heat from new Power Plant 1A. Nine of the 14 existing raw water storage tanks are scheduled to be covered by FY95.

ROI-NAMUR

On the Roi side of the island, two rainwater catchments and a system of lens wells with a total daily pumping capacity of 65,000 gpd (246,047 Lpd) are available. Daily demand averaged 35,000 gpd (132,487 Lpd) during the period from January 1989 through December 1991 (JCWSI, 1991). Raw water is stored in three tanks before treatment; treated water is stored in a single elevated tank linked to the distribution system. A draft technical report (Hunt, pers. comm., 1992) includes analysis of the allowable sustainable yield of 3.45 MG (13 ML) from the groundwater lens, analysis of precipitation data, and a summary of system demand and historical collection of catchment water and groundwater pumping. Peak monthly pumping of groundwater may be as great as 1.25 MG (4.7 ML), a rate equivalent to 41,700 gpd (157,848 Lpd). USGS staff have clarified that short-term, or seasonal, pumping rates greater than the annualized 3.45 MG (13 ML) are not expected to have a negative impact on the groundwater lens (Hunt, personal communication, 1992). Pumping values on the order of the historical maximum monthly withdrawal (40,000 to 50,000 gpd [151,413 to 189,267 Lpd]) also are not expected to adversely affect the groundwater lens.

OTHER ISLANDS

Meck Island is served by a rainwater catchment adjacent to the former runway; raw water is stored in three tanks, and then filtered and chlorinated before distribution. On Ennylabegan, the helipad acts as a catchment; as at Meck, water is filtered and chlorinated before distribution. At Ennylabegan, potable water consumption averaged 2,650 gpd (10,031 Lpd) during the period from January 1989 through December 1991 (JCWSI, 1991). A portion of this water demand stems from water provided to Marshallese inhabitants of the non-USAKA portion of the island.

None of the other islands has a developed water system. Personnel working on those islands bring their water supplies with them.

Potable Water Quality

The 1989 EIS identified problems of turbidity and elevated total trihalomethanes (TTHMs) in Kwajalein treated water quality (USASDC, 1989b, pages 4-18 through 4-20). Since then, drinking water at USAKA has received additional scrutiny and the turbidity problem has been corrected with the installation of the new water filtration plant in 1990. TTHM levels have also decreased since the new water filtration plant became operational (Table 3.13-1), although fourth quarter 1991 and first quarter 1992 results show a reversal of this trend.

Table 3.13-1
Quarterly 1990-92 Total Trihalomethane and Turbidity Concentrations for Kwajalein

	1990				1991				1992	
Parameter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	MCL
TTHMs[a] (μg/L)	213	305	192	99	99	82	95	140	161	100
Turbidity[b] (NTU)	—	1.7	0.3	0.31	0.47	0.47	0.17	—	0.16	1
Turbidity[c]									0.27	

μg/L = micrograms per liter.
NTU = nephelometric turbidity units.
[a]Concentrations shown based on averaging of results from the following five locations: finished water from the water treatment plant, distribution system representative site (Quarters 202), water tower, Quarters 129B, and the photo laboratory.
[b]Turbidity concentrations from finished water at the water treatment plant.
[c]Turbidity concentrations from water sampling of distribution system.
Source: USAEHA, 1991c.

Potable Water Quality Issues (USAEHA, 1991c and 1992c). This assessment was a technical evaluation of a wide variety of drinking water quality issues and operations that could adversely affect human health. The report concluded that open raw water storage on Kwajalein Atoll has adversely affected drinking water quality; that the 1990 comprehensive potable water quality monitoring program (established pursuant to the *1989 Environmental Mitigation Plan*) indicates compliance with U.S. EPA health-based regulations; and that the reduction of elevated TTHM levels to levels below the U.S. EPA MCL of 100 μg/L was apparently a result of the good performance of the new Kwajalein water treatment facility. Increases in the TTHM levels observed in late 1991 and early 1992 are probably attributable to increased residence time in the distribution system because of conservation efforts during the dry weather period, consequent increased use of lens well water, and storage of water in the uncovered raw water storage tanks.

Comprehensive Potable Water Quality Monitoring Program (USAEHA, 1992b). A comprehensive water quality monitoring program was established by USAKA in 1990 for Kwajalein, Roi-Namur, and Meck islands, pursuant to the 1989 Environmental Mitigation Plan. Water quality was also measured on Ennylabegan in 1991. Samples were collected from a variety of water sources (i.e., raw, finished, and distribution locations) and tested for selected physical parameters and a broad range of VOCs, semivolatile organic compounds (SVOCs), inorganics, pesticides, and radionuclides. These results were compared with applicable MCLs for drinking water and secondary MCLs for certain inorganic substances. A summary of key monitoring program results for 1990 and 1991, by island, follows.

KWAJALEIN

All Kwajalein water sample concentrations met the applicable MCLs and secondary MCLs with the exception of TTHM and turbidity levels. Table 3.13-1 compares the 1990, 1991, and 1992 (first quarter) quarterly sample results for these parameters with the corresponding MCLs.

Table 3.13-1 shows that TTHM levels from the first three quarters of 1990 exceeded the MCL for communities with populations greater than 10,000 (Kwajalein's population is approximately 3,000). The study concluded that these exceedances posed no immediate health risk. A significant reduction in TTHM formation was noted in the third quarter 1990, apparently a result of startup of the new water treatment plant and lower concentrations of free available chlorine (FAC) required to maintain adequate residual disinfection in the distribution system. TTHM values increased significantly in the fourth quarter of 1991 and the first quarter of 1992, possibly because of longer residence times resulting from conservation efforts during dry weather periods.

During dry weather periods, a larger proportion of freshwater comes from the lens well system. Lens well system water has higher nutrient levels, which foster algae growth (algae and other organic matter contribute to TTHM formation).

One of the 14 raw water storage tanks has been covered and eight more are scheduled to be covered. Covering the raw water tanks will inhibit algae growth, and thereby reduce formation of organic matter in the raw water supply. In addition, the operation of the desalination plant, now under construction, will reduce use of the lens well or catchment system. For these reasons, it is unlikely that the recent (1991/1992) TTHM levels will be experienced following startup of the desalination plant.

Table 3.13-1 shows that the MCL for turbidity was exceeded during the second quarter of the 1990 monitoring program. However, subsequent turbidity measurements are all well below the MCL, indicating that the reported proper operation and functioning of the water treatment plant beginning in the fourth quarter of 1990 is the primary reason for these lower levels. Results from the 1991 samples (USAEHA, 1991c) indicate that the new water treatment plant continues to produce high-quality water with low turbidity free from stain-causing substances (iron and manganese), low hardness, and slight corrosivity.

Results from the first and second quarters of the 1990 monitoring program show that low levels of nine VOCs were detected in raw water sources (the Aviation and Helo wells). These VOCs are associated with cleaning and degreasing solvents as constituents or breakdown products and appear to originate from nearby aircraft maintenance activities that use these solvents. None of the VOCs exceeded corresponding MCL levels. Moreover, results from the 1991 monitoring program showed that neither VOCs nor SVOCs were detected in source waters.

Inorganic concentrations (metals, nitrate, total dissolved solids, chloride, and sulfate) were in low or nondetectable levels and below applicable secondary MCLs for all 1990 and 1991 samples. Radionuclides were not detected in any of the 1990 or 1991 finished water samples.

The first round of monitoring of lead and copper showed that Kwajalein Island was within the lead and copper action levels for the 90th percentile sample (however, the sample size did not meet requirements for the numbers of samples taken and one of the 19 first-draw samples exceeded the lead action levels).

ROI-NAMUR

Results of the 1990 monitoring program showed that water quality at Roi-Namur met all of the primary MCLs. Acceptable TTHM levels were found in all samples, with an average concentration of 66 μg/L observed. Covered water storage reservoirs were identified as factors yielding the lower TTHM concentrations. Results from the 1991 monitoring program also indicated generally acceptable water quality with the presence of two VOCs (i.e., trichloroethylene and tetrachloroethylene) at concentrations below the MCL. The second, third, and fourth quarter monitoring program results for 1991 revealed TTHMs at 57, 76, and 54 μg/L, respectively. In the first quarter 1992, TTHMs were recorded as 93 μg/L. These concentrations were recorded at five locations: a water truck at the water treatment plant, the mess hall, the Samba Club (FN 8106), the welding shop, and the power plant.

The first quarter 1992 TTHM monitoring results show values approaching the MCL for this contaminant. Conservation efforts may be providing greater residence time in the distribution system, and thus contribute to the formation of additional TTHMs. Roi-Namur exceeded the lead action level at the 90th percentile. Users have been notified, and water quality sampling results are being monitored to determine whether the high lead results are an anomaly or reflect actual lead levels in the water system. Copper concentrations were below the action level.

MECK

Analyses of the 1990 Meck potable water supply showed an acceptable water quality with low values reported for most constituents. In 1991, sample results showed variability for some parameters. Free available chlorine (FAC) for disinfection was absent at several locations. Measurable residual chlorine is required to be maintained in all parts of the distribution system. Excessive turbidity was also found in parts of the system. First quarter 1992 results indicated that turbidity was about 0.6 nephelometric turbidity unit (NTU) on the average in the distribution system.

TTHM values historically have been well under the 100-μg/L standard. First quarter 1992 results show TTHM values of 84 μg/L, an increase consistent with increases noted for Kwajalein and Roi-Namur. Infrequent use of portions of the distribution system was identified as a potential cause of the deterioration in water quality.

ENNYLABEGAN

Results of the 1991 (USAEHA, 1991a) sampling showed the chemical quality of the finished water met all MCL standards, although excessive chlorination caused the FAC levels to be high enough to cause objectionable taste and odor. First quarter 1992 results of monitoring at Ennylabegan reported turbidity values of 0.8 and 1.5 NTU for the finished water leaving the water treatment plant and in the distribution system, respectively. There was a significant increase in TTHMs for the first quarter of 1992 compared with the preceding three quarters. Second, third, and fourth quarter monitoring results for TTHMs in 1991 were 31, 78, and 34 μg/L, respectively, and the first quarter 1992 results were 109 μg/L of TTHMs. Ennylabegan exceeded the lead action level at the 90th percentile for the first round of monitoring. Users have been notified, and water quality sampling results are being monitored to determine whether the high lead results are an anomaly or reflect actual lead levels in the water system. Copper was below the action level.

3.13.1.2 Nonpotable Water Systems

The primary nonpotable (saltwater) systems are located on Kwajalein, Roi-Namur, Ebeye, and Ennylabegan islands. Nonpotable water is used for flushing toilets, power plant cooling water, and, to a limited extent, for fire fighting. Nonpotable water is also supplied to the saltwater swimming pools (two on Kwajalein and one on Roi-Namur). The systems are functional; however, the seawater pumping station on Roi-Namur is susceptible to breakdown during storms and needs more capacity based on existing loads. Although the nonpotable distribution system on Kwajalein provides adequate capacity, it is in poor condition because of age and the variety of piping materials used in its construction. In 1992, USAKA reported that Meck's nonpotable water system was no longer in service.

3.13.2 Wastewater Collection, Treatment, and Disposal

Domestic wastewater discharges at USAKA are within the limits set by an NPDES permit issued before the passage of the Compact of Free Association (Permit No. TT011035), which specified discharge limits for the Kwajalein wastewater treatment plant and other domestic wastewater discharges. The permit established limits of 30 mg/L BOD and 30 mg/L suspended solids.

KWAJALEIN

The wastewater system for Kwajalein consists of a force main and gravity collection system, nine pump stations, a secondary wastewater treatment plant, and an outfall extending into the lagoon. The wastewater treatment plant is now approximately 12 years old. Effluent discharged from the plant averaged 2.0 mg/L suspended solids and 2.5 mg/L BOD for the period September 1992 through August 1993. Plant flow averaged 382,000 gpd (1,446,023 Lpd) for this period at approximately 148 gallons (560 liters) per capita per day (JCWSI, 1993).

ROI-NAMUR

Untreated wastewater at Roi-Namur is discharged to an outfall on the ocean reef flat on the west side of Roi and to septic tank/leachfield systems on Namur. The outfall discharges approximately 0.05 mgd (0.19 mLd) of raw wastewater, having a BOD of approximately 220 mg/L and suspended solids of 274 mg/L (USAEHA, 1991d).

OTHER ISLANDS

Meck and Ennylabegan each use three septic tank/leachfield systems. Other islands have portable toilets or pit latrines. USAKA has initiated a program to replace portable toilets on those islands with 15 composting toilets.

3.13.3 Solid Waste

The solid waste utility at USAKA includes facilities and operations for collection, handling, and disposal of municipal solid waste (MSW), medical waste, construction waste, and the waste products generated from routine base operations.

3.13.3.1 Municipal Solid Waste

MSW is defined as garbage, refuse, sewage sludge, and septage. Solid waste disposal practices on the USAKA islands include open burning of solid waste, septage disposal and burial in open or excavated trenches, and operation of open dumps.

MSW collection, transport, separation, and incineration operations continue to exist on Kwajalein and Roi-Namur; however, waste separation and temporary storage are now practiced on 10 of the 11 USAKA islands (excluding Ennugarret, where there are currently no USAKA facilities). As recommended in the *USAKA Environmental Mitigation Plan* (USASDC, 1989c), MSW is segregated into wet wastes (e.g., food wastes from the dining facilities on Kwajalein, Roi-Namur, and Meck; and grass clippings and yard wastes) and other wastes. Wet wastes are composted. Also, each island has separate receptacles for aluminum waste, paper waste, and garbage. When these waste types are collected on the other islands, they are transported to Kwajalein by barge for recycling or disposal. Recyclable or salvageable material, primarily aluminum and some large pieces of equipment such as trucks, is sent to the mainland or Hawaii or offered at local bid sales. Hazardous wastes are kept separate from solid wastes. A summary of specific solid waste operations on Kwajalein, Roi-Namur, Meck, and the other islands follows.

KWAJALEIN

The 1989 DEIS reported that 20 to 30 tons (18 to 27 metric tons) of waste per day are generated on Kwajalein. Significant changes in waste volume or weight have not been observed since 1989. Wet wastes are collected and taken to the composting area near Building 1500. Food wastes are placed in the west end of the composting area, and soil, palm fronds, and other yard wastes are placed in layers over the food wastes. Some disintegrated or pulverized classified papers are also added to the compost mixture. When a compost mulch is formed, it is used as a soil for landscaping purposes and in the nursery on Kwajalein. Food wastes are no longer disposed of in the ocean off Kwajalein.

Other municipal refuse is brought to the landfill area for storage or burning in the air curtain burning pit. This pit is scheduled to be replaced with interim fixed hearth incinerators in late 1993. Stored solid wastes are segregated by type in the Kwajalein landfill.

ROI-NAMUR

Food wastes that are collected on Roi-Namur are placed in trenches on the northeast portion of the island. Other wet garbage and septage from the portable toilets are disposed of in trenches along the northeast side of the island in an area of heavy vegetation. Refuse and other solid wastes are taken to a scrap dump on Roi-Namur, where they are segregated. Paper and wood product wastes are burned daily in an open burn pile (except when the prevailing northeast tradewinds are not strong enough to blow smoke away from the island), while other segregated wastes are transported to Kwajalein for recycling or disposal.

MECK

On Meck, food wastes are disposed of in the ocean off the leeward (south) end of the island. Paper and wood trash are taken to the leeward end of the island for weekly (depending on the accumulation rate) burning in an open burn pile. As recommended in the *USAKA Environmental Mitigation Plan* (USASDC, 1989c), the solid waste storage area on Meck has been cleared of most of the wastes previously stored there. Minimal scrap material now accumulates in the storage area prior to transport to Kwajalein for storage or disposal.

Minimal quantities of solid waste are generated on the other USAKA islands, and are transported to Kwajalein.

3.13.3.2 Medical Waste

Medical wastes, or potentially infectious wastes, are generated at the Kwajalein clinic and hospital, the Kwajalein dental clinic, and the clinics on Roi-Namur and Meck. As of November 1991, approximately 20 pounds (9 kilograms) per day of medical waste required disposal. These wastes are placed first in medical waste bags and then in molded containers that are secured. On Kwajalein, the wastes are transported daily to the air curtain burn pit in the landfill. Wastes from the clinics on Roi-Namur and Meck are also taken to the Kwajalein air curtain burn pit for disposal.

3.13.3.3 Construction Solid Waste

Construction waste consists of construction debris and asbestos. The 1989 EIS indicated that these wastes were generated on Kwajalein, Roi-Namur, Meck, Illeginni, and Omelek, but there was no organized program for their disposal. In 1989, USAKA removed asbestos that was stored in Building 1045 on Kwajalein. Additional exposed asbestos and construction debris may have been generated at these islands and on some of the other USAKA islands (e.g., Ennylabegan) as a result of damage from Tropical Storm Zelda.

Construction debris is generated frequently as new facilities are built and as existing facilities are upgraded or demolished. Management practices for this waste are to use the debris as fill material when needed, or to accumulate the debris in large piles. Waste transportation procedures have been established on Meck and Omelek as recommended by the 1989 Environmental Mitigation Plan.

Asbestos is no longer taken to the Kwajalein landfill for burial nor to FN 1045 on Kwajalein. It is now transferred to FN 1521 and shipped to the United States for disposal. Approximately 80,350 pounds (36,446 kilograms) of asbestos were shipped off-island during the calendar year of 1991. The asbestos in multiple targeted facilities (as identified in the *1989 Environmental Mitigation Plan*) was removed by March 1991, and asbestos in FN 1045 was removed by December 1991. An installationwide asbestos survey was completed in October 1992. These remedial activities and changes in asbestos management are the results of recommendations in the *1989 Environmental Mitigation Plan*.

3.13.3.4 Operations Solid Waste

Operations waste consists of small scrap materials, empty containers, sandblasting grit, batteries, and waste oil and lubricants. The 1989 DEIS stated that piles of scrap materials and empty containers were located on all of the islands except Ennugarret, sandblasting activities lacked controls to prevent the spread of sandblast media, and spent lead-acid battery casings (reportedly with the acid drained and neutralized) were not reclaimed or recycled.

During the February 1992 field visit, it was observed that the piles of minor scrap materials and empty containers had been cleared from each of the USAKA islands and transported via barge to the Kwajalein landfill. Sandblasting continues on all of the islands except Ennugarret.

Used sandblasting grit is not captured or contained on any of the islands except Meck. Pursuant to the 1989 Environmental Mitigation Plan, a designated sandblasting area with containment consisting of a concrete floor and side walls has been constructed and is currently in use on Meck. Toxicity Characteristic Leaching Procedure (TCLP) testing of the sandblasting grit (recommended in the *1989 Environmental Mitigation Plan*) indicates that, based on its toxicity characteristics, this waste is not hazardous.

Since March 1991, waste batteries have been shipped off-island intact (without draining the acid). Currently, one trailer of spent batteries is shipped off-island every 3 months. This shipment is approximately equivalent to 50 automobile and truck batteries. Waste acid from the spent lead-acid batteries is no longer drained, collected, neutralized, or disposed of at USAKA.

Waste oil is generated by maintenance activities throughout USAKA. Since the 1989 EIS was completed, considerable effort has been made to segregate waste oils from waste solvents (thereby avoiding the potential generation of a hazardous waste). Waste oil is generally collected in 55-gallon (208-liter) drums for transport to the Kwajalein landfill where they are consolidated into large portable tanks for shipment and offsite recycling. Each drum is screened for halogenated compounds (a solvent component) and those with contents with less than 1,000 ppm of these compounds are recycled. On Kwajalein, oils recovered in the concrete pit beneath Power Plant 1 are separated from water, filtered, and recycled into the fuel oil burned in the power plant.

Scrap metal collected on all of the USAKA islands (e.g., automobiles with the oil drained, air conditioning compressors) is either reused by USAKA residents (individuals may make bids on scrap metal for reuse) or it is disposed of through ocean dumping. A 1989 Memorandum of Understanding (MOU) between USAKA and Region 9 of U.S. EPA allows disposal of scrap metal (which may include computer parts, demolition scrap, and vehicle parts) in the Pacific Ocean in the vicinity of Kwajalein Atoll. The MOU permits USAKA to conduct an ocean dumping activity once every 3 months. The MOU permits an initial amount of up to 5,000 tons (4,536 metric tons), with a limit of 2,000 tons (1,814 metric tons) per year thereafter. The first ocean dumping (of 1,520 tons [1,379 metric tons] of waste) under this MOU occurred December 29, 1990, and other ocean dumping has occurred periodically since then.

3.13.4 Hazardous Materials and Waste

3.13.4.1 Hazardous Materials

In this EIS, hazardous materials are defined broadly to include all substances covered by the Occupational Safety and Health Administration's (OSHA) workplace hazard communication standard or with the potential to cause safety or health hazards if spilled or mishandled—substances that at USAKA include fuels, solid rocket booster propellants, explosives, solvents, pesticides, compressed gas, lubricants, and petroleum products. This definition broadly corresponds to the definition of hazardous materials used in the proposed USAKA Standards. The safety aspects of hazardous materials management are addressed in Sections 3.15 and 4.15, Range Safety; bulk fuel storage capacity for diesel fuel marine (DFM) is addressed in Subsections 3.13.5 and 4.13.5, Energy. All of the USAKA islands except Ennugarret employ operations that require the use and storage of hazardous materials such as fuels, lubricants, paints, or cleaning solvents.

KWAJALEIN, ROI-NAMUR, AND MECK

The 1989 DEIS described aboveground fuel storage tanks on all of the USAKA islands (except Ennugarret) while Kwajalein has both aboveground and underground storage tanks. Containment for the USAKA aboveground tanks consists of concrete, coral, and/or asphalt-lined coral berm walls and floors in most cases, and the 1989 DEIS noted evidence of fuel leakage into the Kwajalein groundwater. Storage of solvent and petroleum products in 55-gallon (208-liter) drums is primarily limited to activities on Kwajalein, Roi-Namur, and Meck, although periodic maintenance and painting activities on other islands occur. Explosive ordnance and pesticides were described as adequately stored, handled, and used.

Nineteen of the 35 aboveground fuel storage tanks at USAKA are located on Kwajalein. Four of these tanks are not in service and will be dismantled. Approximately 10 million gallons (38 million liters) of bulk fuel capacity (diesel, MoGas, and JP-5) exist in the fuel farm on Kwajalein and significant upgrades to this facility are planned; however, the full capacity is rarely used. Roi-Namur has seven aboveground storage tanks, while three are located on Meck. Seventeen underground storage tanks have been identified on Kwajalein, and those that are abandoned or not in compliance with federal regulations have been scheduled for removal.

Approximately five hundred 55-gallon (208-liter) drums filled with petroleum products are stored in the open yard of the fuel tank farm on Kwajalein. Although the packaged-petroleum product storage area has no containment safeguards, the drums are segregated and they are inspected every day for leaks. Plans for constructing proper containment structures are in progress.

Hazardous materials are currently stored in designated warehouses on Kwajalein prior to distribution. Products are stored by the end user at facilities on Kwajalein, Roi-

Namur, and Meck. Containers for pesticides, herbicides, and fungicides are triple rinsed prior to being burned at the Kwajalein landfill. The containers are not reused. Rinsates from containers and equipment are used in pesticide and herbicide application solutions.

OTHER ISLANDS

There are one to three bulk fuel aboveground storage tanks located on each of the other USAKA islands (excluding Ennugarret). The 55-gallon (208-liter) drums containing petroleum products and solvents are typically stored in covered sheds on their side near the island's generator building. In most cases, the drums have either aluminum containment bins or drip pans, or both. Paints and miscellaneous products are generally stored in a storage box. The composition and volume of hazardous materials vary depending on installation activities, but a shipment of new stock is received at USAKA every 28 days.

3.13.4.2 Hazardous Wastes

Hazardous wastes are defined as certain hazardous and toxic waste categories, specifically solvents, solvent-oil mixtures, PCBs, and acids/bases. Asbestos, sandblasting grit, and spent batteries are considered solid waste and are addressed under Subsection 3.13.3.

The 1989 EIS reported that solvent and oil wastes were disposed of in unlined, bermed pits on Kwajalein and Roi-Namur and that PCBs were stored in Building 1500 on Kwajalein. USAKA's past practices for management of waste solvents included land disposal and burning along with waste oils, as well as storing wastes for periods greater than 90 days. Pursuant to the *1989 Environmental Mitigation Plan*, burning of the oil/solvent mixtures in Kwajalein and Roi-Namur oil burn pits ceased.

Unexploded ordnance continues to be safely stored when identified before being transported to Illeginni Island for destruction. Destruction consists of detonation in a pit where all or most of the ordnance's organic constituents are consumed in the explosion. EOD technicians conduct a survey of the site and rake the EOD pit after detonation to look for debris and explosives not fully consumed in the detonation. Organic and metallic residuals may remain after detonation, but the levels would generally not be high enough to be classified as hazardous. This is supported by study results, collected by the USAEHA, that indicate residual contamination was detected in less than fifty percent of the detonation episodes reviewed (USAEHA, 1988). Existing metallic (e.g., lead) residuals resulting from accumulated World War II small arms ammunition (e.g., bullets) may also be present at the site.

Since the 1989 EIS was prepared, several sites on Kwajalein and Roi-Namur associated with past hazardous material handling practices have been confirmed as having soil with metal and/or organic compound contamination (USAEHA, 1991b). Results from this study indicate that contaminant levels are not high enough to classify these soils or sites as hazardous.

Currently, hazardous and toxic wastes are collected in satellite waste accumulation areas on all USAKA islands except Ennugarret and then taken to Kwajalein to be stored in FN 1521 for less than 90 days. Therefore, the facilities at Kwajalein are not considered treatment, storage, or disposal facilities as defined by U.S. federal regulations. As each shop or facility generates hazardous waste and fills separate waste containers (e.g., 55-gallon [208-liter] drums) for materials such as solvents, waste oils, or thinners, a hazardous waste label that describes the contents and identifies the generating shop is placed on the drum. Workers have been instructed in proper segregation of wastes generated in their work areas. The filled drums are moved within 72 hours to either FN 1521 or to a staging area on another island. Drums from Roi-Namur, Meck, and the other islands are transported by barge to Kwajalein once each week. Each of the other USAKA islands has drum overpacks and spill kit booms located on the island for use, if needed to prevent spills or contamination by any hazardous materials used on the island. In most areas, use of overpack drums or drip pans for secondary containment has been initiated. These activities represent implementation of recommendations made in the *1989 Environmental Mitigation Plan.*

Also pursuant to the *1989 Environmental Mitigation Plan*, USAKA inventoried wastes and evaluated the hazards of the waste streams. A waste code is now assigned to the incoming waste and arrangements are made for sampling and disposal when hazardous waste drums arrive at FN 1521 on Kwajalein. Segregated storage areas for ignitable, toxic, PCB, and corrosive wastes are marked with individual signs within FN 1521. FN 1521 is used specifically for storage of hazardous wastes followed by monthly off-island shipments for treatment and disposal. During the 1991 calendar year, hazardous wastes shipments from Kwajalein consisted of approximately 55,000 pounds (24,948 kilograms) of paint wastes, 8,000 pounds (3,629 kilograms) of corrosives, 1,310,000 pounds (594,203 kilograms) of an oil and solvent mixture, 55,400 pounds (25,129 kilograms) of miscellaneous hazardous wastes, and 396,000 pounds (179,622 kilograms) of PCB materials.

The *1989 Environmental Mitigation Plan* recommended initiation of a waste minimization study to reduce the quantities of hazardous wastes being generated at USAKA. Progress has been made in this area, with shops decreasing the use of chlorinated solvents, using product substitution with less hazardous materials. USAKA has also obtained a U.S. EPA hazardous waste generator identification number as recommended by the *1989 Environmental Mitigation Plan*. Hazardous waste shipping and disposal are managed under a JCWSI subcontract.

USAKA continues to make progress with its ongoing program to decommission equipment containing PCBs. Transformers have been sampled and labeled as to their PCB content, and this information has been documented. When a PCB-containing transformer requires maintenance, it is decommissioned and replaced with a non-PCB transformer. Approximately 30 PCB transformers were removed through mid-1991, and more than 100 remained. Empty transformers, along with the 55-gallon (208-liter) drums that contain drained PCB oils, are stored in FN 1521 on Kwajalein prior to shipment off-island. Those portions of the concrete floor of FN 1500 that had been contaminated with PCBs has been removed as recommended in the *1989 Environmental Mitigation Plan*. PCB-related wastes are taken to FN 1521 for temporary storage; then the wastes are shipped off-island within 90 days for disposal.

3.13.5 Energy

As measured by the amount of fuels consumed, most of the energy used at USAKA is used for the production of electricity. USAKA maintains power plants and related electric utility facilities on ten islands. Electricity is produced by engine generator sets that burn DFM and is distributed by underground feeders. There are no electrical interties among islands. Table 3.13-2 is a summary of existing power plant capacities, historical peak loads, fuel oil consumed in 1991, and fuel oil storage capacity at each plant.

Other fuels used at USAKA include DFM used for marine transport; motor vehicle gasoline (MoGas), which is also used for small boats; and JP-5, used for military and civilian aircraft.

KWAJALEIN

Kwajalein has three power plants designated Power Plants 1, 1A, and 2.

Power Plant 1A became operational in April 1991 and reached full plant production in June 1991. Power Plant 1A produced 58 percent of Kwajalein's electrical requirements for June through December 1991 and is expected to produce a higher percentage of the island's power in future years. Table 3.13-3 summarizes Kwajalein's 1991 power plant production data. A new power plant, 1B, is expected to be online by 1994. Its four 4,400-kW units will replace Power Plant 1, which will be demolished.

Table 3.13-4 shows the Kwajalein fuel tank farm storage capacity. Table 3.13-5 shows approximate annual fuel consumption by use. Historical fuel oil consumption for Kwajalein Island power production is shown in Figure 3.13-1.

Table 3.13-2
USAKA Power Plant Summary

Island/Plant	Number of Engines[a] and Size (kW)	Plant Capacity[a] (kW)	Historical Peak Load[b] (kW)	Historical Peak Load[b] Date	1991 Fuel Consumption (gal)	DFM Storage Capacity[a] (gal)
Kwajalein						
Plant 1	9 x 1,500	10,500	10,250	June 1990	3,550,000	70,000
Plant 1A[c]	3 x 4,000	12,000	8,100	September 1991	1,715,000	
Plant 2	6 x 715	4,290	4,200	October 1973	160,000	53,000
Roi-Namur	9 x 1,500	13,500	5,875	June 1991	2,900,000	653,000
Meck	5 x 565	2,825	400	---	220,000	350,000
Ennylabegan	4 x 195	780	525	September 1982	130,000	20,000
Illeginni	3 x 130	390	273	---	90,000	30,000
Eniwetak	3 x 60	180	84	---	30,000	10,000
Omelek	2 x 60	120	84	---	30,000	10,000
Gellinam	2 x 60 + 2 x 130	380	266	---	90,000	10,000
Gagan	2 x 130	260	182	---	60,000	10,000
Legan	2 x 130	260	182	---	60,000	10,000
Totals					9,035,000	1,226,000

[a]Source: JCWSI, 1992a.
[b]Source: USAKA monthly utility statistics—electrical. January 1971 to December 1991 (JCWSI, 1992a). Kwajalein, Roi-Namur, and Ennylabegan statistics from monthly report. Other island peak load and fuel consumption estimated.
[c]Plant 1A became operational in April 1991.

Table 3.13-3
1991 Kwajalein Power Production

Kwajalein	kWh x 1,000	Percent
Power Plant 1	47,047	62
Power Plant 1A	26,864	35
Power Plant 2	2,100	3
Total	76,011	100

Source: USAKA monthly utility statistics—electrical. January 1991 to December 1991 (JCWSI, 1992a).

Table 3.13-4 Kwajalein Fuel Farm Storage Capacity (gallons)	
Fuel	Storage Capacity
DFM	6,387,150
JP-5	2,731,596
MoGas	619,416
Source: Williams Brothers Engineering Company, 1991.	

Table 3.13-5 Approximate Yearly Fuel Consumption (gallons)			
Fuel	Power Generation	Automotive and Small Boat	Aircraft
DFM	9,035,000	41,000	---
JP-5	---	---	5,570,000
MoGas	---	135,000	---
Source: Williams Brothers Engineering Company, 1991.			

ROI-NAMUR

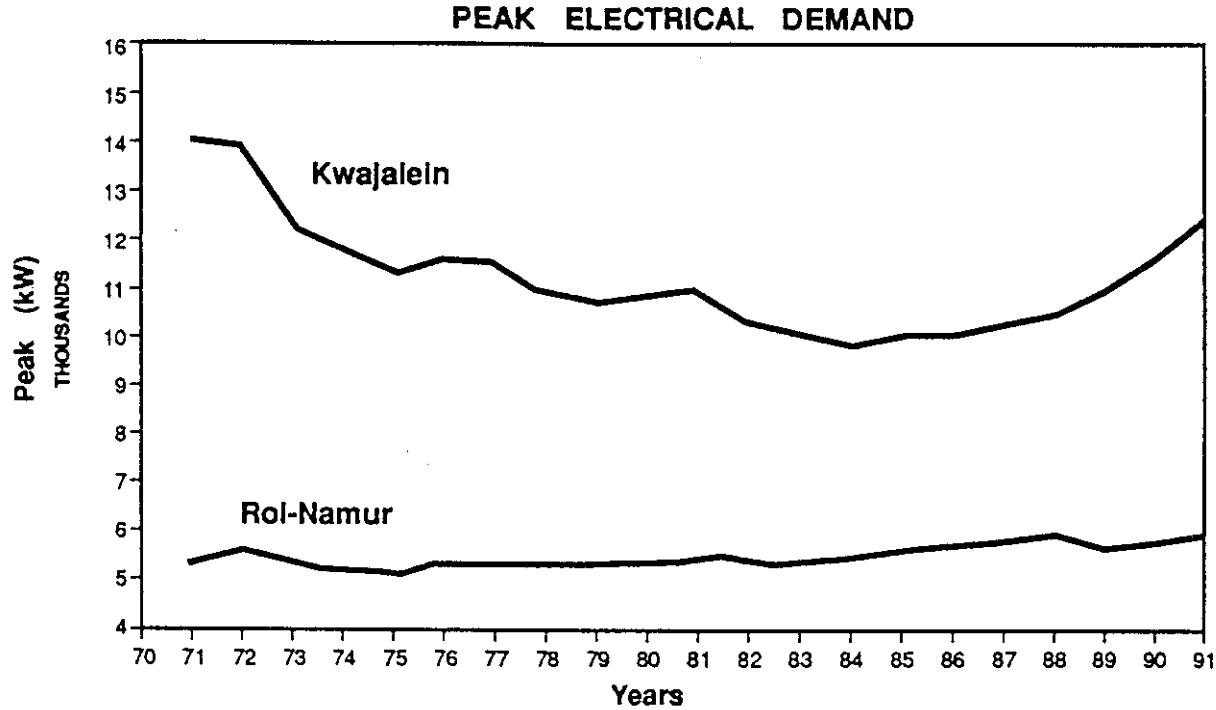
Peak loads on the Roi-Namur power plant and power production from this facility have been stable since 1989. Historical peak load and power plant fuel consumption are shown in Figure 3.13-1.

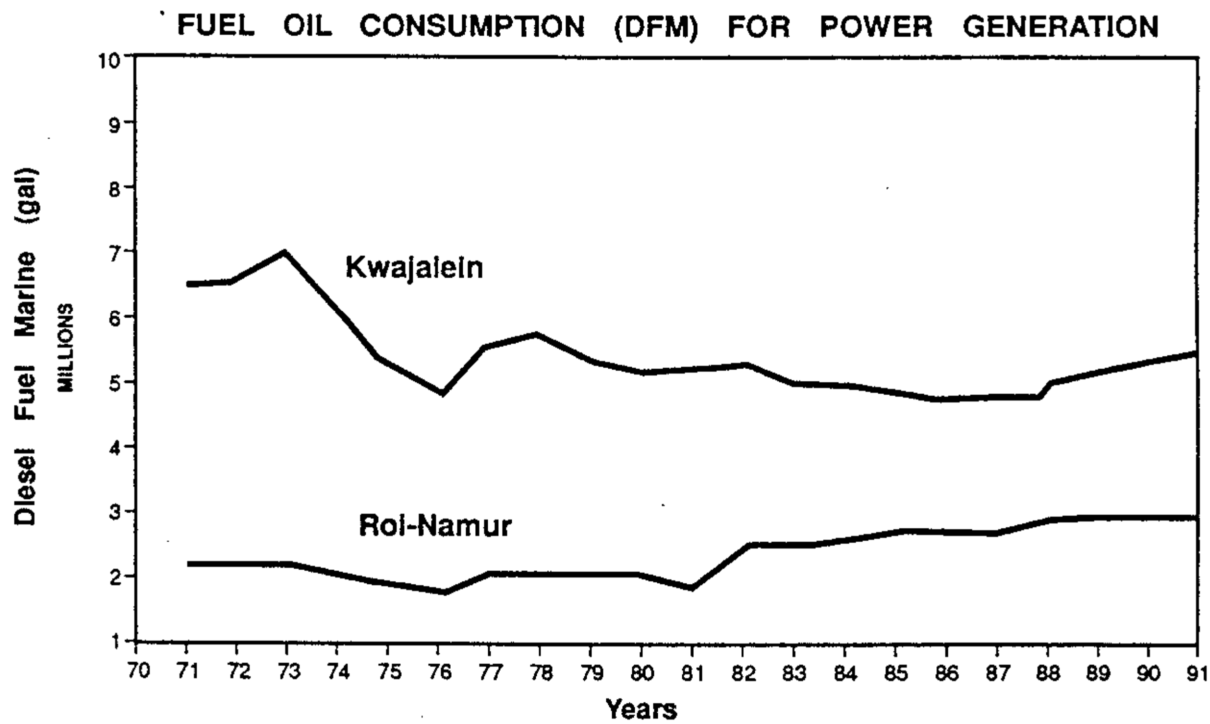
MECK

Five 565-kW engine-generator sets were installed in 1989 to meet current mission requirements of the island. The five 565-kW generators replaced three 350-kV generators. Power plant fuel consumption was estimated to be 220,000 gallons (832,773 liters) in 1991 (Table 3.13-2).

OTHER ISLANDS

The other islands each have a small diesel-fired power plant with varying unit sizes, as shown in Table 3.13-6.





SOURCE:

Based on USAKA Monthly Statistics – Electrical (Johnson Controls World Services, Inc.)

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Energy Consumption
KWAJALEIN AND ROI-NAMUR

FIGURE 3.13-1

Table 3.13-6 Existing Power Plant Capacity Other USAKA Islands	
Island	Number and Size (kW) of Power Plant Units
Ennylabegan	4 x 195
Illeginni	3 x 130
Eniwetak	3 x 60
Omelek	2 x 60
Gellinam	2 x 60 and 2 x 130
Gagan	2 x 130
Legan	2 x 130
Ennugarret	None

3.14 Aesthetics

The region of influence for aesthetics encompasses the 11 USAKA islands, all of which are potential locations of proposed activities that could affect the natural or man-made landscape.

The USAKA islands have a long history of human occupation and modification. A significant portion of the natural landscape of most of the USAKA islands has been altered or replaced by structures. On Kwajalein, Meck, Roi-Namur, and Illeginni islands man-made structures and features dominate. On Ennugarret, and to a lesser extent, Eniwetak and Legan islands there are fewer man-made structures, and the landscape is still dominated by trees and other natural ground covers. Other islands lie between the ends of this spectrum. Resident viewers of the landscape are found only on Kwajalein, Roi-Namur, and Ennylabegan.

Section 3.13 of the 1989 DEIS describes the aesthetic character of several of the USAKA islands, and Figures 3.9-4 through 3.9-12 of the 1989 DEIS are color photographs of each of the islands except Ennugarret.

Since 1989, construction projects have been completed on several of the islands, as described in Section 3.10 of this document; however, none of these projects has significantly changed existing land use patterns and, consequently, none has significantly modified the visual resources of the USAKA islands as described in the 1989 EIS.

3.15 Range Safety

Range safety is accomplished by compliance with USAKA regulations, and use of established procedures and safety precautions to prevent injury to people and to minimize damage to property. Range safety applies to preparation, testing, and execution of USAKA programs. Other range safety objectives are the successful completion of mission objectives and the prevention of incidents that could have international repercussions. The region of influence for range safety encompasses all 11 USAKA islands and other islands at Kwajalein Atoll and nearby atolls that could be located beneath the flight trajectory of missiles launched at USAKA, or reentry vehicles targeted to the USAKA area.

3.15.1 Ground Safety

Ground safety is the protection of people and the public from injury when conducting potentially hazardous operations and handling hazardous materials. Several of the islands are affected by building construction, the storage and assembly of explosives and rocket propellants, and the operation of heavy equipment, as described in Section 3.14 of the 1989 DEIS.

Kwajalein Island, the center of USAKA operations, has activities that include receiving fuels, propellants, and explosives; maintaining aircraft, vehicles, and other equipment; providing electricity, water, and waste disposal utilities; and conducting specialized testing activities. Kwajalein, Roi-Namur, Meck, Omelek, and Illeginni islands are, or in the past have been, sites for assembling and launching missiles.

Missile launch programs at USAKA typically consist of single or multi-staged solid propellant rockets, with payloads that may contain liquid propellants. The solid rocket motors are composed of fuels and oxidizers in a rubber binding material (other chemical compounds are added to modify performance characteristics). While solid rocket motors are classified as explosives, most propellants do not detonate, but are extremely flammable. Payload vehicles have propulsion systems based on gaseous propellants such as helium or nitrogen, or liquid propellants such as monomethyl hydrazine (MMH) and nitrogen tetroxide (N_2O_4). Liquid fuels may be toxic, corrosive, and/or very flammable.

Explosives are used at USAKA for missile flight programs and for construction activities such as quarrying. Small amounts of explosives are used in missile launches for stage separation and flight termination systems, which destroy in-flight missiles that show abnormal flight characteristics. Explosives are stored on Kwajalein, Roi-Namur, Meck, and Omelek. Solid rocket motors are stored on Kwajalein and Roi-Namur and moved to the other islands for a limited time before launches.

Launch facilities consist of structures used for the assembly and launch of missiles that contain experimental payloads. The primary buildings are missile assembly buildings, payload assembly buildings, launch control buildings, and launch pads. These structures are spaced according to explosive safety quantity-distance (ESQD) criteria defined in AR 385-64 and other regulations. The buildings at launch areas are constructed to protect personnel from explosive pressure and fragments. Launches on smaller islands such as Omelek may be done remotely, when building separation is insufficient to protect personnel. The number of personnel working at launch facilities is limited during missile assembly and other potentially hazardous operations.

The site plans of launch facilities are reviewed and approved by the Department of Defense (DoD) Explosives Safety Board prior to construction. This evaluation takes into account the separation between magazines, operations buildings, transportation routes, and unrelated inhabited buildings. Waivers for building separation have been obtained for storage magazines adjacent to the Kwajalein and Roi-Namur airfields.

The ground safety plans for programs at USAKA contain emergency procedures for response to potential accident scenarios. For example, the emergency procedures for a missile launch program include the response to misfire and hangfire conditions, an explosion or fire on the launch pad, and the impact of an errant rocket flight.

Fire protection is provided by fire suppression systems in most operations buildings, and by continuously staffed fire stations on Kwajalein, Roi-Namur, and Meck islands.

Unexploded ordnance (UXO) from World War II is routinely discovered during construction and excavation on many USAKA islands. UXO materials found on USAKA islands vary in size from 30-caliber rifle rounds to 5-inch (12.7-centimeter) gun rounds. Although 500-pound (227-kilogram) bombs have been removed from the lagoon, ordnance of this size is rarely discovered on USAKA.

When UXO is discovered, the EOD team is contacted for its safe removal and disposition. The EOD team collects and transports (via a flat bed truck) ordnance discovered on Kwajalein or Roi-Namur to the ordnance bunkers located on these islands (one bunker is located on each island). Ordnance discovered on other USAKA islands is also transported (via barge) to the storage bunkers on Kwajalein and Roi-Namur. While being transported by truck or barge, the UXO is enclosed in wooden boxes with sand to keep it stationary during transport.

When sufficient quantities of EOD accumulate in the storage bunkers, the EOD team transports it by barge to the EOD area on Illeginni for destruction. Plastic explosives are used to detonate the UXO on Illeginni after it has been secured in a specially constructed pit.

3.15.2 Flight Safety

Flight safety provides protection to USAKA personnel, inhabitants of the Marshall Islands, and ships and aircraft operating in areas potentially affected by these missions, as described in Subsection 3.14.2 of the 1989 DEIS. Specific procedures are required for the preparation and execution of missions involving aircraft, missile launches, and reentry payloads. These procedures include regulations, directives, and flight safety plans for individual missions.

The area affected by aircraft and missile operations varies according to the type of mission. Incoming reentry vehicle impacts may affect the Mid-Atoll Corridor or the BOA to the north and east of the atoll. Aircraft operations may affect an area of 180 miles (289 kilometers) around USAKA. A larger area is affected by sounding rocket or other ballistic missile launches from USAKA with trajectories typically to the north-northeast, where the lowest number of inhabited islands are located.

The largest affected areas result from test flights involving the collision of a target missile with an interceptor missile launched from USAKA. The collision debris footprint, or area where collision debris could fall, extends for hundreds of miles away from the designated interception point.

Flight safety activities include the preparation of a flight safety plan that includes evaluating risks to inhabitants and property near the flight, calculating trajectory and debris areas, and specifying range clearance and notification procedures.

Flight safety plans are developed for both launch missions and incoming reentry vehicles. Potential hazards exist at USAKA when missiles are launched and when reentering payloads are targeted for areas near the islands. Reentry vehicles are typically launched from Vandenberg Air Force Base (VAFB) in California, the Pacific Missile Range Facility (PMRF) in Hawaii, or Wake Island.

Notification is made to inhabitants near the flight path, and international air and sea traffic in the caution area designated for specific missions. Warning messages are transmitted to appropriate authorities to clear caution areas of this traffic and to inform the public of impending missions. The warning messages contain information describing the time and area affected and safe alternate routes. RMI is informed in advance of launches and reentry payload missions.

In missions that involve the potential for reentry debris near inhabited islands, precautions are taken to protect personnel. In Mid-Atoll hazard areas, where an island has a high probability of impact by debris, personnel are evacuated. In caution areas, where the chance of debris impact is low, precautions may consist of evacuating or sheltering nonessential personnel. Sheltering is required for reentry vehicle missions impacting the Mid-Atoll Corridor in Kwajalein Atoll. The Mid-Atoll Corridor is declared a caution area when it contains a point of impact.

missions impacting the Mid-Atoll Corridor in Kwajalein Atoll. The Mid-Atoll Corridor is declared a caution area when it contains a point of impact.

Instrumentation is used for range safety by tracking incoming reentry vehicles and terminating missile flights in order to prevent an impact on inhabited islands. The Kwajalein Range Safety System links the USAKA radar systems to a range safety center on Kwajalein. A missile and payload can be tracked during the entire flight by the range safety center. Missiles launched from USAKA are equipped with flight termination systems that allow destruction of the missile if the flight deviates significantly from planned criteria or otherwise poses a threat to the public. For example, a flight would be terminated if the missile path intersects the Marshall Islands protection circle, an artificial boundary around inhabited atolls and islands.

3.16 Electromagnetic Environment

Electromagnetic radiation (EMR) emitted from USAKA radars is a potential hazard to humans and a potential source of interference with other communications and sensing equipment. Radars and radio-frequency transmitters emit non-ionizing radiation. Communications emissions are generally of low frequency and low emitted power and pose minimal threat. Radar testing at USAKA involves several powerful radar systems and requires safety measures to protect USAKA personnel. Sources of EMR at USAKA and the mechanisms used to ensure the safety of personnel and to prevent interference are described in Section 4.15 of the 1989 FEIS.

There are currently 22 radio frequency sources at USAKA, including 11 radar systems and 11 communications transmitters. Kwajalein has seven major sources of microwave radiation; Roi-Namur has five sources, four of which are the major radar systems at USAKA. There are smaller radar systems on the mid-atoll islands of Legan and Gellinam.

USAKA radars are typically operated at a minimum inclination of 2 degrees above horizontal, which allows a hazard-free zone from ground surface to at least 15 feet (5 meters). In tests requiring radar beams to go below the horizon, safety procedures require exclusion from hazard zones. Radar systems have mechanical and software stops to prevent the main beam from being directed at the ground or in specified sectors where it may present a hazard. Radars also have the potential to interfere with aircraft instrumentation. More powerful radars, such as TRADEX, have computer-controlled interlocks to reduce power output in the direction of approaching aircraft.

The primary physical reaction to electromagnetic radiation exposure is cellular heating, with symptoms such as eye damage as an early consequence. Test data have been used to establish the Permissible Exposure Limit (PEL) of 0.4 watt per kilogram in a 6-minute period. EMR hazard zones were then established to provide a safety factor 10 times greater than the PEL. These hazard zones are defined in USAKA

Regulation 385.3, which is based on other Army regulations on microwave and radio frequency safety.

A number of references in the scientific literature suggest that human exposure to electrical and magnetic fields considerably below those that cause cellular heating may pose a health threat (U.S. Congress, Office of Technology Assessment, 1989). The available literature has focused on magnetic fields in the extremely low frequency (ELF) range (30 to 300 Hertz ([Hz]), while radars have operating frequencies in the gigahertz (billions of Hertz) range. Moreover, the findings of literature studies are inconclusive. Although some potential effects on public health have been suggested, none of these studies allows definite conclusions about risk to be drawn. Current research does not provide a basis for predicting significant adverse impact of low-level, high-frequency radiation.

Environmental Impacts of the Proposed Actions and Alternatives

The two actions analyzed in this Supplemental Environmental Impact Statement (SEIS)—the level-of-activity alternatives and the proposed USAKA Environmental Standards and Procedures (the Standards)—could affect the natural and human environment of Kwajalein Atoll. The two actions could be implemented separately or together and this chapter describes their potential interrelation.

4.1 Introduction

This chapter is organized by environmental resource (parallel to the organization of Chapter 3). In each section (e.g., "4.2 Land and Reef Areas"), the potential environmental consequences of each level-of-activity alternative on the resource are evaluated. Additionally, if the proposed Standards apply to that resource, then the environmental consequences of implementing the relevant standard are evaluated. In Table 4.1-1, sections of the SEIS are related to the applicable chapters of the proposed Standards and Procedures. The procedures in the Standards (Part 2, Procedures), which apply to all of the environmental categories in the Standards, are evaluated on page 4-2 under the heading "Procedures."

4.1.1 Levels of Activity

Because the level-of-activity alternatives could be implemented separately from or in conjunction with the proposed Standards, the significance of the potential impacts of each level-of-activity alternative is assessed using the two sets of standards where two sets exist. If the proposed Standards do not address a resource area, then the existing U.S. statutes and regulations are used. Significance criteria are developed for each set of standards for each resource area. Where the assessment of the significance of impacts based on the existing U.S. statutes and regulations and the proposed Standards leads to different conclusions, mitigations that are appropriate to each set of standards are identified.

4.1.2 Proposed USAKA Environmental Standards and Procedures

The level-of-activity alternatives are analyzed in the first part of each section using the existing U.S. statutes and regulations and the proposed Standards. This analysis reveals differences between the two sets of standards. In the second part of each section, the implementation of the proposed Standards is addressed directly. The potential impacts of implementing the Standards are assessed using the following definitions of levels of significance:

Table 4.1-1
Relationship of Proposed USAKA Environmental Standards and Procedures to Resource Area Sections

Supplemental EIS Section	Relevant Section of the Proposed USAKA Standards and Procedures
4.1 Introduction	Procedures
4.2 Land and Reef Areas	---
4.3 Water Resources	Water Quality and Reef Protection
4.4 Air Quality	Air Quality
4.5 Noise	---
4.6 Island Plants and Animals	Endangered Species and Wildlife Resources
4.7 Marine Biological Resources	Endangered Species and Wildlife Resources
4.8 Rare, Threatened, or Endangered Species	Endangered Species and Wildlife Resources
4.9 Cultural Resources	Cultural Resources
4.10 Land Use	---
4.11 Socioeconomic Conditions	---
4.12 Transportation	---
4.13 Utilities	
4.13.1 Water Supply	Drinking Water Quality
4.13.2 Wastewater	Water Quality and Reef Protection
4.13.3 Solid Waste	Waste and Materials Management/Ocean Dumping
4.13.4 Hazardous Materials	Waste and Materials Management/Ocean Dumping
4.13.5 Hazardous Waste	Waste and Materials Management/Ocean Dumping
4.13.6 Energy	---
4.14 Aesthetics	---
4.15 Range Safety	---
4.16 Electromagnetic Environment	---

- **No or Negligible Impact.** No differences between the existing U.S. statutes and regulations and the proposed Standards as they pertain to the protection of human health and safety and the environment.

- **Nonsignificant Impact.** Differences exist, but the proposed Standards provide a similar level of protection of human health and safety and the environment.

- **Significant Impact.** The proposed Standards provide a lower or higher level of protection of human health and safety and the environment.

Procedures

As described in Chapter 2 of this SEIS, the procedures outlined in Part 2 of the proposed Standards derive from the procedural requirements of more than a dozen U.S. environmental regulations. They provide a comprehensive framework for reporting, notification, monitoring, analysis, training, transportation of hazardous substances, facility requirements, recordkeeping, emergency equipment, auditing, oversight, conflict resolution, technical support, periodic review, and savings and severability. The proposed procedures establish a single mechanism, a Document of Environmental Protection (DEP) to replace the multitude of different permit processes under existing U.S. statutes and regulations. They establish a single mechanism for compliance with all of the proposed Standards. They also provide for information-sharing and participation by appropriate U.S. agencies and the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA).

No Action: Existing U.S. Statutes and Regulations

The existing U.S. statutes and regulations include procedural requirements established by more than a dozen environmental statutes. However, in many cases, the procedural aspects were clearly inapplicable for USAKA after the Compact (Public Law 99-239) became effective in October 1986 (e.g., provisions related to U.S. Indian tribes or grants for states).

The environmental framework of the Compact does not envision the regulatory authority of any U.S. environmental agency to extend to the statutes that form the basis of the proposed Standards for U.S. activities at USAKA. Therefore, although the environmental laws and regulations specified by Section 161 of the Compact apply after the passage of the Compact, U.S. environmental agencies no longer have regulatory authority for those laws at USAKA.

Proposed USAKA Standards and Procedures

As described in more detail in Chapter 2, the proposed procedures are similar to U.S. statutes and regulations in many respects. For example, they require USAKA to produce reports on existing or potential environmental conditions, and to develop and maintain studies and plans that are subject to periodic review to ensure accuracy and completeness.

Several sections of the proposed procedures differ from U.S. statutes and regulations. The USAKA procedures contain provisions that address both the special relationship between the U.S. and RMI governments and the seven environmental categories in Part 3 of the Standards. The procedural requirements include, but are not limited to, auditing (Section 2-16); compliance assurance (Section 2-17), including Documents of Environmental Protection (Subsection 2-17.3); oversight (Section 2-18); and conflict resolution (Section 2-19). These aspects of the procedures also provide for participation of the appropriate U.S. environmental agencies (identified in Section 2-6 of the Standards) and the RMIEPA in reviewing and commenting on proposed actions and in documenting the resolution of environmental concerns raised during the review process.

The proposed Standards include requirements for internal audits at least every 2 years of facilities and programs that potentially could affect human health and safety and the environment, with external audits by an independent U.S. agency at least every 4 years.

The DEP is a procedural mechanism for USAKA, U.S. agencies, and the RMIEPA to coordinate and review activities proposed by USAKA that have the potential to affect the environment. The procedures specify the actions that require a DEP and the information to be provided in the DEP. All parties to the review and comment process must sign the DEP. If the content of a DEP is disputed, any party to the process may initiate the conflict resolution process.

The procedures (Subsection 2-17.3.5) provide that USAKA may request variances or exemptions from the Standards by demonstrating that the project or activity in question will have no significant effect on an environmental category addressed by the Standards. Exemptions or variances require the written approval of all appropriate agencies.

The procedures provide a mechanism for oversight (Section 2-18) and for conflict resolution (Section 2-19). The conflict resolution procedures establish three levels of conflict resolution, and emphasize the resolution of disputes at the point of origin or at the lowest administrative level. Conflict resolution can be initiated by USAKA, by RMIEPA, or by appropriate U.S. agencies. Pending the outcome of the resolution process, the Commander, USAKA, may decide to continue, delay, or stop the activity that is subject to dispute, taking into account the concerns expressed by the RMIEPA or federal agency. In exceptional circumstances, if the Commander, USAKA, after consultation with the appropriate agencies, decides that it is necessary to begin an action before resolution of the dispute, the matter is elevated to the Commanding General, USASSDC, for authorization to proceed. Prior to arriving at a decision, the Commanding General must consult with the appropriate agencies. If disputes still cannot be resolved, the RMI government retains the right to seek judicial review of USAKA actions.

Overall, the procedures section provides a more complete framework for facilitating environmental protection than would occur in the No-Action Alternative. If the proposed Standards are not implemented, consultation and coordination with U.S. agencies would continue, but, because these agencies currently lack regulatory authority at USAKA, the procedural elements of existing U.S. statutes and regulations could not be enforced as they would within the United States. The procedures of the proposed Standards provide a comprehensive framework that offers the opportunity for all appropriate agencies to participate in the implementation of the Standards. While this framework does not provide U.S. agencies with regulatory authority comparable with their authority within the United States, it does provide mechanisms to review, comment on, and challenge USAKA actions affecting the environment through conflict resolution.

Mitigation

Because no significant adverse impacts of the procedural aspects of the proposed Standards were identified, no mitigation is proposed.

4.2 Land and Reef Areas

Land and reef areas are defined here as the physical geological features of the upland areas, island shorelines, and adjacent reef flats of the 11 USAKA islands, which may be affected directly or indirectly by quarrying, dredging, and filling.

Because the reefs are of biological origin and are a continually growing biological feature, they are discussed as such in Section 4.7, Marine Biological Resources. Similarly, the impacts associated with quarrying, dredging, and filling of the reef flats are of interest in relation to water quality and biological resources and are discussed in Section 4.3, Water Resources, and Section 4.7, Marine Biological Resources.

Geological impacts are those that change the physical configuration of the islands and adjacent reef flats or change the shoreline erosion potential of the islands and, in so doing, affect the structural integrity and their consequent landform, or affect current patterns in the lagoon. Historically, the lagoon and reef flats have been quarried and dredged to provide fill for construction projects and materials for shoreline revetments. In the past, quarrying activity has not been allowed to approach closer than 100 feet (31 meters) from the outer edge of the reef or closer to the islands than minus 1-foot (31-centimeter) mean lower low water. Excavation is now also limited to a maximum dimension of 300 feet (91 meters) in any direction to provide further assurance that appreciable erosion will not result from quarrying. Setbacks and maximum quarry dimensions have been established to provide buffer zones between the breaking waves and the quarry hole and between the islands and the quarry hole to protect the structural integrity of the islands and facilities from the effects of storm waves and ocean swells.

4.2.1 Level-of-Activity Alternatives

Levels of Significance

The proposed Standards for quarrying and dredging are addressed in Section 4.3 of this SEIS, Water Resources. There are no other standards that directly relate to geological impacts at USAKA. Levels of significance are related to potential impacts to shoreline configuration and the physical integrity of the 11 USAKA islands.

- **No or Negligible Impact.** No change in configuration of the shoreline or the reef flat; therefore, no reduction of island integrity or altered lagoon current patterns would be present.

- **Nonsignificant Impact.** Changes in configuration would occur but are not expected to adversely affect shoreline configuration, island integrity, or lagoon current patterns.

- **Significant Impact.** Change in configuration expected to reduce shoreline stability or island integrity, or to alter lagoon current patterns.

NO ACTION

Impacts

Quarries cause long-term impacts to coral reefs, as is evident from the quarry pits dug at Kwajalein before and during World War II. There is no apparent evidence that the coraline algae will build the bottoms of these quarries up to level of the reef flat in the near future (i.e., within a few decades). Quarrying a portion of a reef flat should not, however, reduce the capacity of the remaining reef flat to resist physical weathering or the capacity of the coraline algae on the reef flat or in the pits to maintain a constant elevation with respect to mean sea level changes (resulting from sea level rise or island subsidence). Over extended periods (thousands of years), these quarry holes can be expected to fill in and the reef flat return to its natural state as a result of natural reef-building processes.

The deepened areas left by dredging operations can be expected to fill in much faster than the quarry holes because of the natural transport of sediments. Dredging is required about every 10 years to maintain usable harbor depths.

New land created by fills become a permanent fixture of the USAKA islands as long as shoreline protection facilities are constructed and maintained to prevent and repair shoreline erosion.

Under the No-Action Alternative, quarrying and dredging activities would continue in the ocean reef flats adjacent to several of the USAKA islands, in several of the harbors, and in the lagoon, as described for the Proposed Action in the 1989 EIS and in Subsection 3.2.2 of this SEIS. Quarried and dredged material provides armor stone needed for repair and construction of shoreline protection facilities (including repairs of shoreline areas damaged in Tropical Storm Zelda in November 1991) and aggregate needed for fill and construction of new infrastructure and mission support facilities. The following list is a summary of the quantities of aggregate stockpiled as of March 1992 by Johnson Controls World Services, Inc. (JCWSI) and the U.S. Army Corps of Engineers, as well as the JCWSI-estimated annual requirements for use of that material for routine maintenance at USAKA under the No-Action Alternative.

Stockpiled, Quarried, and Dredged Material at Kwajalein, March 1992 in Cubic Yards (cubic meters)

	Aggregate	Armor Stone	Unprocessed Quarry Material
USACE stockpiled	0	0	6,569 (4,992)
JCWSI stockpiled	88,685 (67,400)	3,315 (2,519)	8,160 (6,201)
JCWSI annual needs	6,350 (4,826)	300 (228)	0

The stockpiled material is planned to be used to repair the damage caused by Tropical Storm Zelda in 1991 and by other lesser storms and storm-generated ocean swells, and to support existing infrastructure repair needs.

Amounts of quarried and dredged material and the required quarry area for each island under each level-of-activity alternative are shown in Table 4.2-1.

Reef Quarrying

In order to confirm that the limitations USAKA currently observes for its quarrying and dredging activities can adequately protect the integrity of the USAKA islands, wave attack at the island shorelines over various reef configurations was analyzed. Results of modeling wave attack over the quarries demonstrate that wave energy is not lost over the quarry to the extent it would be if the quarry did not exist. Broken waves may re-form over the quarry and break again at the inshore edge of the quarry. Thus, quarrying too close to the inshore area, especially on relatively narrow reef areas, can result in increased wave energy reaching the island shore. This may result in added shoreline erosion and beach loss, especially during high tide or storm activity. The analysis has been applied to the potential quarrying areas for the USAKA islands and recommendations for suitable quarry areas are provided.

The identification of suitable reef areas was conducted by first searching available literature to determine characteristics of waves over coral reefs and to select a modeling technique. The approach taken is based on equations developed by Gerritsen (1980, 1981) to model energy losses on coral reefs as related to bottom friction and wave breaking. I. R. Young (1989) confirmed the model in field measurements taken over the Great Barrier Reef. Available information was then used to define the reef and wave characteristics typical of the USAKA islands. Wave action over undisturbed and mined areas for a range of reef width and wave conditions was then analyzed. Criteria were developed for protection of the integrity of the land and reef areas from wave action over the quarries. Finally, predictions of wave action over reef areas of each USAKA island were used to recommend suitable quarrying areas.

The models were run using high-water (worst-case) conditions, with varying wave heights and periods for a number of reef widths. Table 4.2-2 shows the model variables used. Factors that affect the impact of reef mining on the wave characteristics

Table 4.2-1
Required Quarry Material and Associated Quarry Areas

Island	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Kwajalein				
Armor stone (cubic yards)	0	35,280	46,880	46,880
Aggregate (cubic yards)	1,100	23,260	28,210	28,210
Total (cubic yards)	1,100	58,540	75,090	75,090
Quarry area required (square yards)	393	23,520	31,253	31,253
Roi-Namur				
Armor stone (cubic yards)	0	12,000	12,000	12,000
Aggregate (cubic yards)	0	25,500	25,750	25,750
Total (cubic yards)	0	37,500	37,750	37,750
Quarry area required (square yards)	0	9,107	9,196	9,196
Meck (with rock revetment)				
Armor stone (cubic yards)	0	7,000	81,500	83,500
Aggregate (cubic yards)	0	10,400	448,400	451,200
Total (cubic yards)	0	17,400	529,900	534,700
Quarry area required (square yards)	0	4,667	160,143	161,143
Meck (with tribar revetment)				
Armor stone (cubic yards)	0	7,000	61,700	63,700
Aggregate (cubic yards)	0	10,400	285,400	288,200
Total (cubic yards)	0	17,400	347,100	351,900
Quarry area required (square yards)	0	4,667	101,929	102,929
Omelek				
Armor stone (cubic yards)	0	1,200	1,200	5,300
Aggregate (cubic yards)	2,000	5,300	5,300	161,800
Total (cubic yards)	2,000	6,500	6,500	167,100
Quarry area required (square yards)	714	1,893	1,893	57,786
Ennylabegan				
Armor stone (cubic yards)	200	200	200	600
Aggregate (cubic yards)	325	325	325	825
Total (cubic yards)	525	525	525	1,425
Quarry area required (square yards)	133	133	133	400
Legan				
Armor stone (cubic yards)	0	0	0	4,100
Aggregate (cubic yards)	0	0	400	7,100
Total (cubic yards)	0	0	400	11,200
Quarry area required (square yards)	0	0	143	2,733

Table 4.2-1
Required Quarry Material and Associated Quarry Areas

Island	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Illeginni				
Armor stone (cubic yards)	0	0	15,500	15,500
Aggregate (cubic yards)	0	0	22,200	22,200
Total (cubic yards)	0	0	37,700	37,700
Quarry area required (square yards)	0	0	10,333	10,333
Gagan				
Armor stone (cubic yards)	0	0	0	13,300
Aggregate (cubic yards)	0	0	0	4,000
Total (cubic yards)	0	0	0	17,300
Quarry area required (square yards)	0	0	0	8,867
Gellinam				
Armor stone (cubic yards)	0	2,500	2,500	6,600
Aggregate (cubic yards)	0	3,500	3,500	26,000
Total (cubic yards)	0	6,000	6,000	32,600
Quarry area required (square yards)	0	1,667	1,667	9,286
Eniwetak				
Armor stone (cubic yards)	0	600	600	600
Aggregate (cubic yards)	0	900	900	151,900
Total (cubic yards)	0	1,500	1,500	152,500
Quarry area required (square yards)	0	400	400	54,250
Ennugarret				
Armor stone (cubic yards)	0	0	3,000	3,000
Aggregate (cubic yards)	0	0	16,000	16,000
Total (cubic yards)	0	0	19,000	19,000
Quarry area required (square yards)	0	0	5,714	5,714

Note: These numbers are based on a quarry hole of not more than a 15-foot depth; armor stone would be 30 percent of the total yield in a given quarry; aggregate would be 70 percent and, of that aggregate, 20 percent would be assumed for production loss (i.e., waves, transportation).

at the shoreline include reef width, quarry location, quarry width, reef profile, wave height, and wave period (time interval between waves). In general, waves with greater wave heights and periods have less attenuation over the reef and the impacts of quarrying are greater. However, the period and height of the waves have a relatively small effect on wave attenuation compared with reef and quarry dimensions. Table 4.2-2 shows the relationship between reef width and wave attenuation. Conservative calculations using a 300-foot-wide quarry of indeterminate length running parallel to the shoreline were used to generate Table 4.2-3. The table shows that the impact of quarrying on the dissipation of the wave energy becomes increasingly significant as the reef width decreases. The impacts of higher waves at the shoreline should be considered for quarry sites located on relatively narrow reefs (reef widths of less than approximately 750 feet [229 meters]).

Table 4.2-2
Variables for Modeling Wave Attenuation at Kwajalein Atoll

Variable	Value
Reef width (feet)	500, 750, 1,000, 1,500, 2,000, and 2,500
Incident wave height (feet)	5, 10, and 15
Wave period (seconds)	8, 12, and 16
Water elevation (feet)	+2.5 relative to MSL

The proximity of the shoreward edge of the quarry to the shoreline is also a factor in wave height increase. Modeling shows that wave heights at the shoreline increase the closer the edge of the quarry is to the shore. This indicates that the distance of the reef inshore to the quarry edge is more important than the distance between the seaward reef edge and the quarry. The current practice of maintaining a 100-foot (31-meter) distance between the seaward reef edge and the quarry appears to be adequate to protect the integrity of the reef.

In determining the maximum percentage of the reef width that can be used for quarrying, an allowable factor of a 10 percent increase in wave height (21 percent increase in wave energy) was considered to be sufficient to protect the shoreline. The rationale for the 10 percent level is that it represents an order of magnitude less than the natural wave height for high-wave conditions. Typical practices for coastal design provide an adequate rationale for critical infrastructure and structures on the shoreline. Applying this rationale to the reef quarries results in a recommendation that no more than 20 percent of the reef width should be used for quarrying.

The 10 percent factor was used to evaluate existing reef areas around the USAKA islands, and potential quarry areas were selected based on the following assumptions:

- Quarrying would be done on the ocean side only.

Table 4.2-3
Summary of Model Prediction Results
Percent Increase in Wave Height Relative to Undisturbed Reef

Incident Wave Height (ft)	Wave Period (sec)	Increase in Transmitted Wave Height (%)	Incident Wave Height (ft)	Wave Period (sec)	Increase in Transmitted Wave Height (%)
500-foot reef			750-foot reef		
5	8	38	5	8	18
5	12	62	5	12	21
5	16	75	5	16	22
10	8	72	10	8	22
10	12	97	10	12	23
10	16	108	10	16	24
15	8	88	15	8	22
15	12	112	15	12	23
15	16	112	15	16	24
1,000-foot reef			1,500-foot reef		
5	8	9	5	8	0
5	12	10	5	12	1
5	16	13	5	16	1
10	8	10	10	8	0
10	12	16	10	12	1
10	16	16	10	16	3
15	8	12	15	8	0
15	12	12	15	12	2
15	16	16	15	16	4
2,000-foot reef			2,500-foot reef		
5	8	2	5	8	2
5	12	2	5	12	2
5	16	2	5	16	2
10	8	1	10	8	1
10	12	2	10	12	1
10	16	2	10	16	2
15	8	2	15	8	2
15	12	2	15	12	2
15	16	2	15	16	2

Note: This table assumes a 300-foot-wide quarry area.

- Quarrying would not be done in areas of valuable marine resources identified in the *USAKA Natural Resources Plan* (USAEDPO, 1991a).

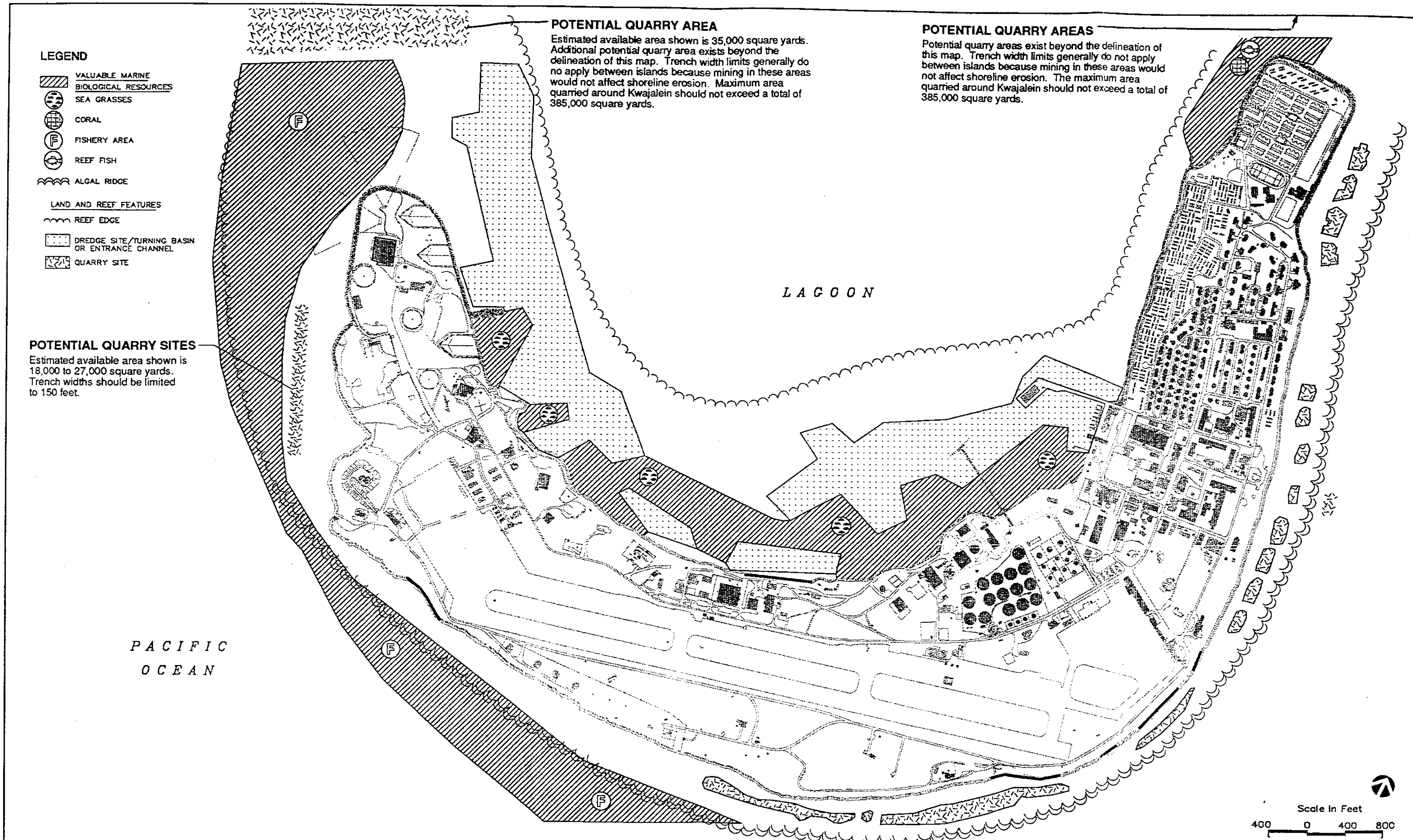
- Quarrying would not be done in areas directly offshore from vulnerable shorelines identified in the *Shoreline Inventory and Protection Study* (Sea Engineering, Inc., and R. M. Towill Corp., 1988).

Portions of the potential quarry areas directly adjacent to the USAKA islands are shown in Figures 4.2-1 through 4.2-9. Designation of these potential quarry areas resulted from a technical analysis of quarry locations that would minimize impacts on shorelines. Areas of the reefs surrounding the 11 USAKA islands along with estimates of the portions of these areas that are available for use as quarry sites are shown in Table 4.2-4. The reef areas associated with each of the 11 islands are divided in Table 4.2-4 into three location-types: ocean-side, lagoon-side, and inter-island. The interisland portion of the reef associated with a given island is considered to be the adjacent reef up to one half the distance to the next island. The distance and directions listed in parentheses in the table for the interisland reefs correspond to the length and location relative to the island for each interisland reef considered.

Areas were measured from maps from the *Kwajalein Atoll Coastal Resources Atlas* (USAEDPO, 1989b) using a planimeter or by assuming an estimated average or representative width over the length of the reef. Areas of reef that had already been quarried were included in the total reef area, but were not considered as areas available for quarrying. In addition, areas identified in the maps in Figures 3.1-1 through 3.1-11 as containing valuable natural resources or fisheries areas were not included among the areas identified as available for quarrying (interisland reef flat areas have not been surveyed in terms of marine biological resources). In identifying available quarry areas, quarry widths for the ocean-side reefs were restricted to the lesser of 300 feet [91 meters] or 20 percent of the width of the reef. It should be noted that, whereas Figures 4.2-1 through 4.2-9 indicate the total potential quarry area, Table 4.2-4 indicates available quarry area (i.e., the lesser of 20 percent of the reef width or 300 feet [91 meters], where applicable).

Maximum quarry widths (300 feet [91 meters] or 20 percent of the total reef width for reefs less than 1,500 feet wide) are identified in Figures 4.2-1 through 4.2-9, where applicable. These width restrictions were applied primarily to limit the increase in wave energy on the shoreline. The reefs between islands have a limited role in reducing the height of waves reaching the shorelines of the adjacent islands and are therefore not necessarily limited to the maximum criteria of 300 feet [91 meters] or 20 percent of the reef width.

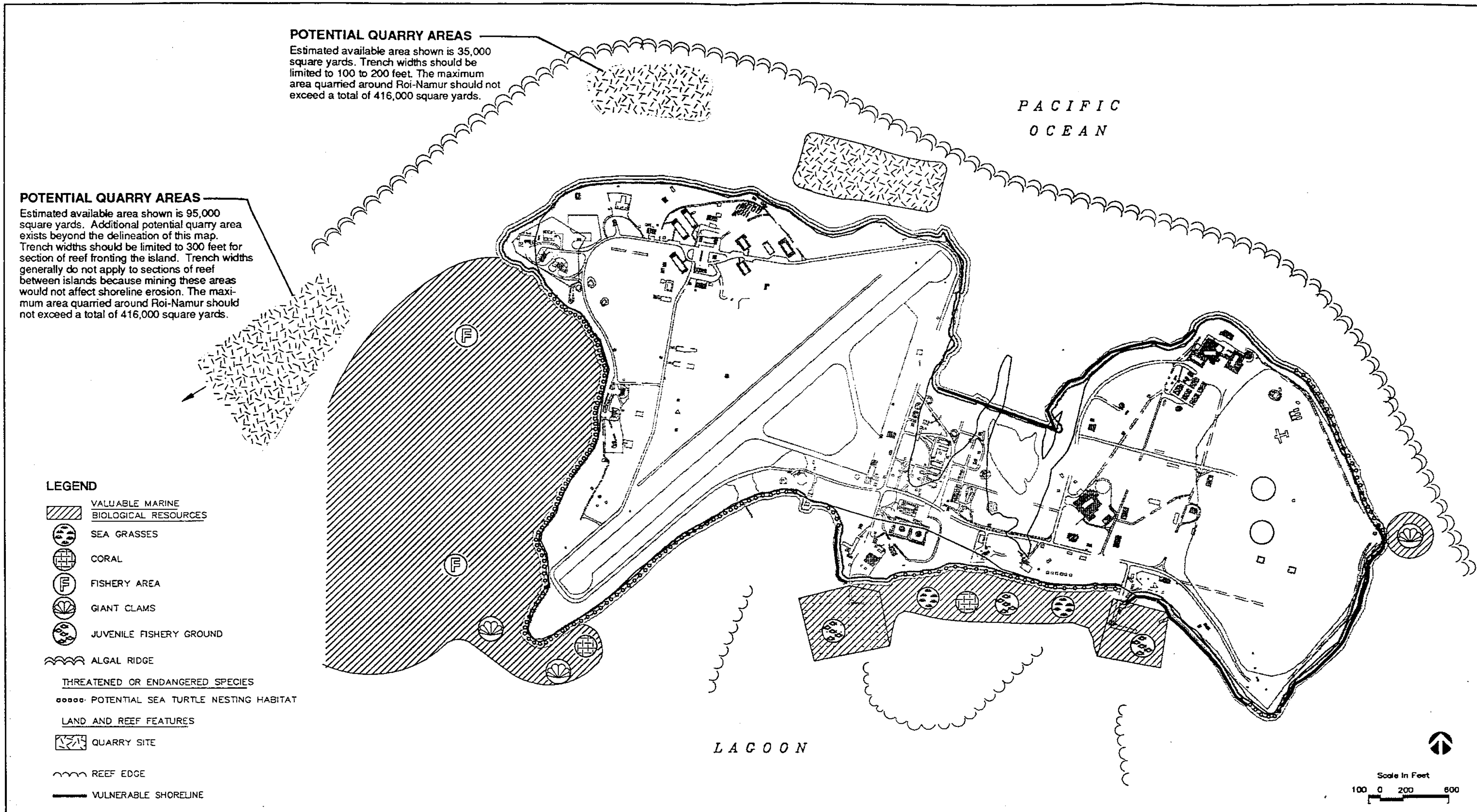
Increases in wave energy entering the lagoon increase the possibility of shoreline erosion to islands on the other side of the lagoon. However, the potential for increased erosion of lagoon-side beaches as a result of mining of reefs on the opposite side of the lagoon is low. In general, increased wave energy entering the



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
KWAJALEIN

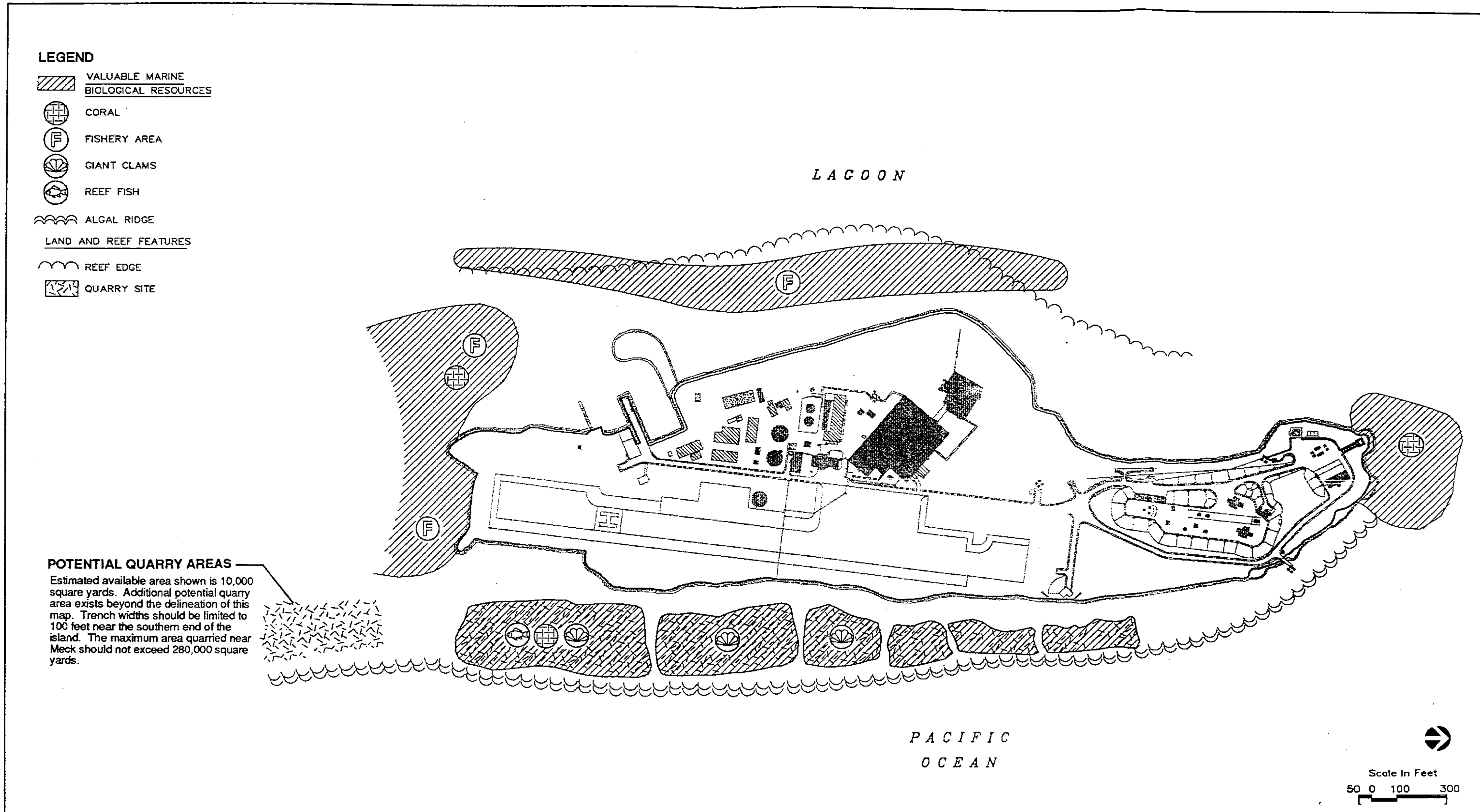
FIGURE 4.2-1



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
ROI-NAMUR

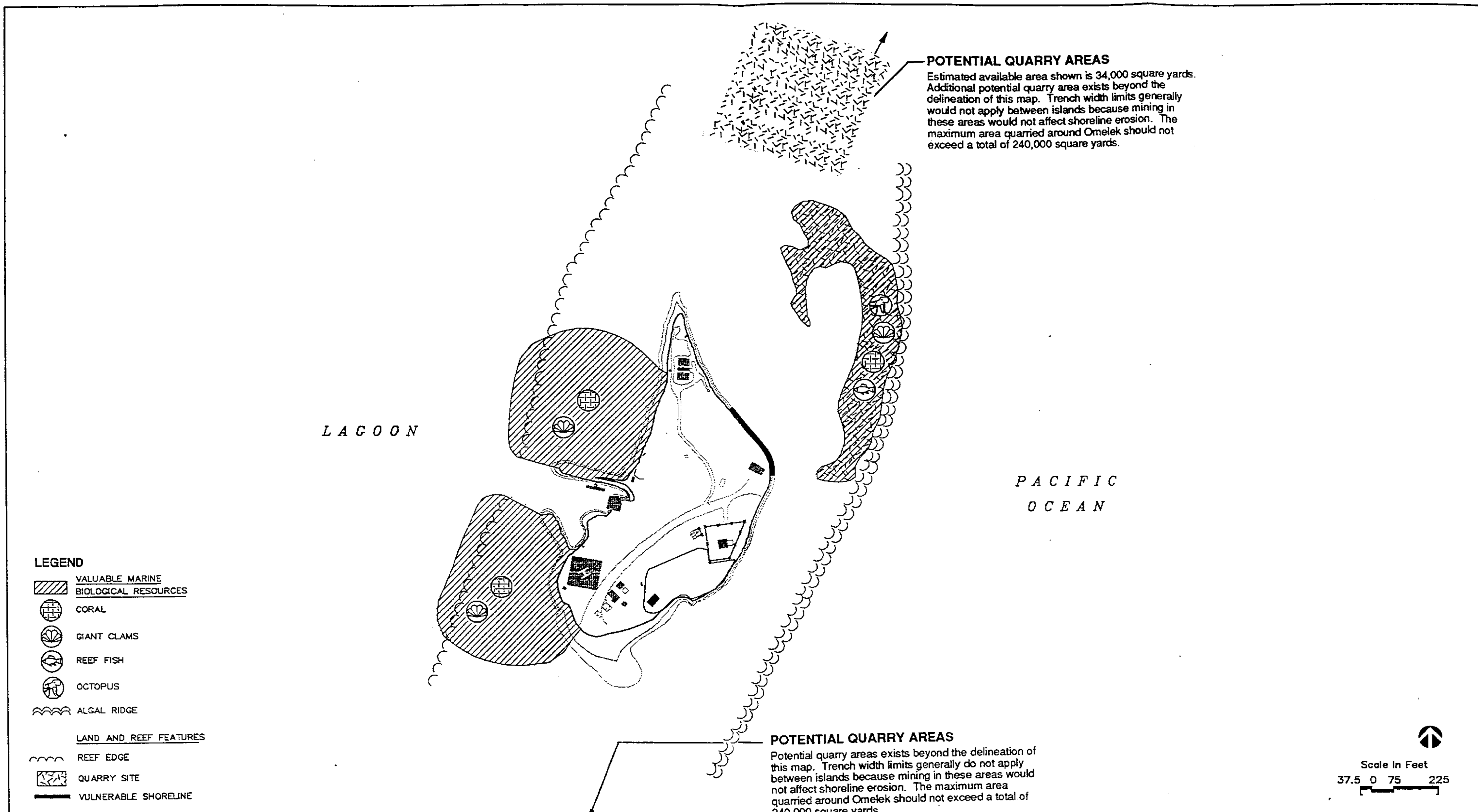
FIGURE 4.2-2



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
MECK

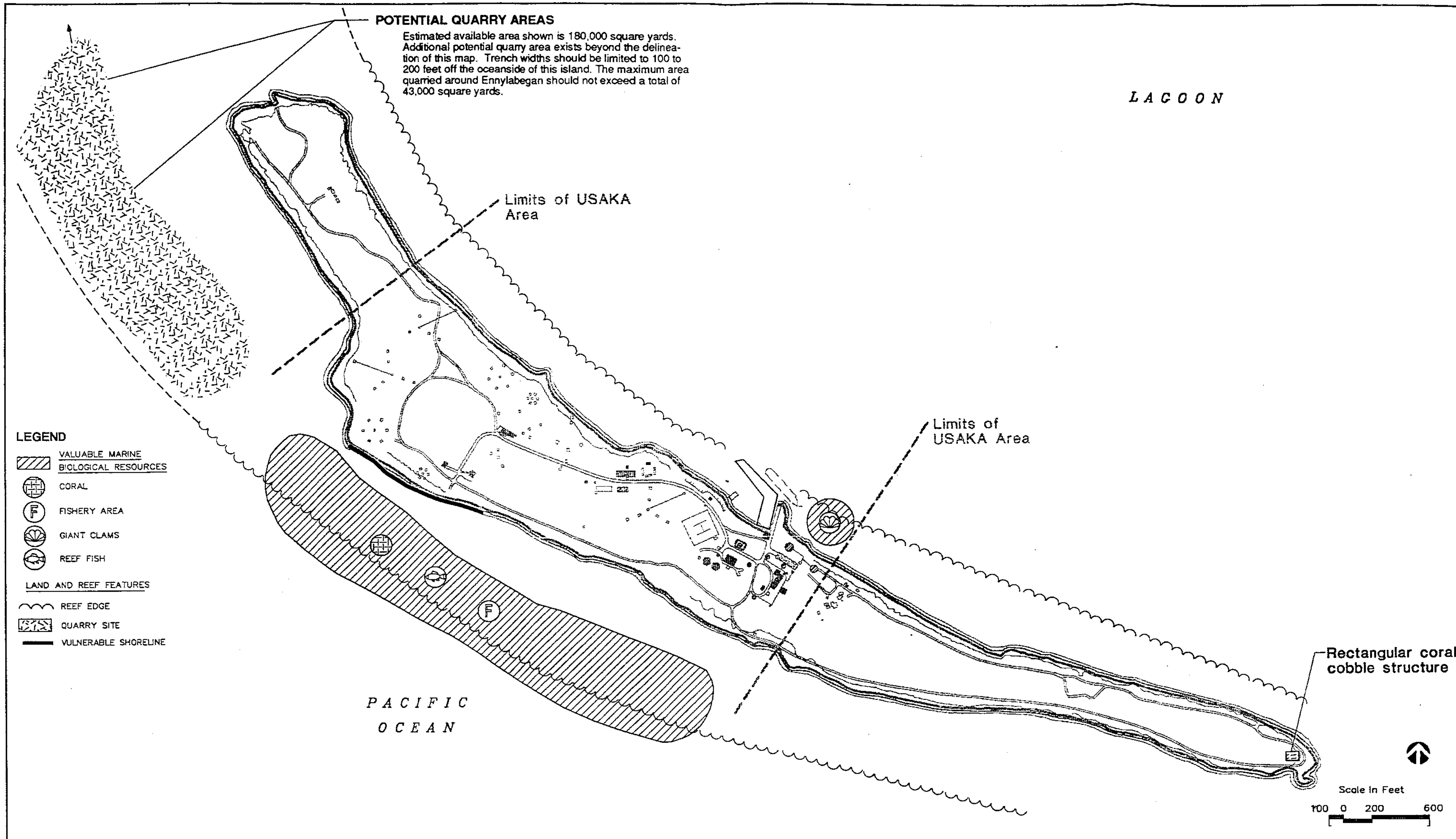
FIGURE 4.2-3



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
OMELEK

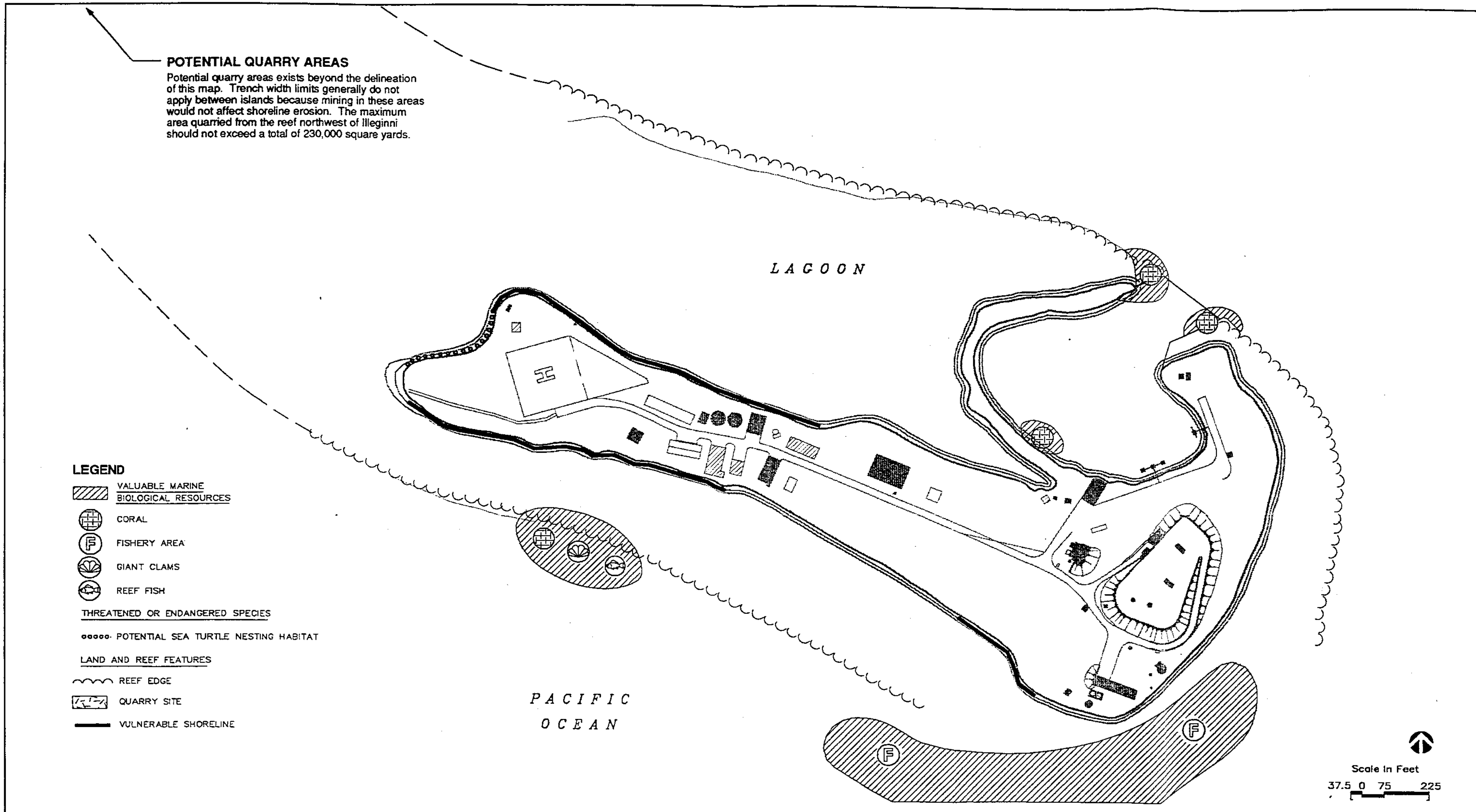
FIGURE 4.2-4



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
ENNYLABEGAN

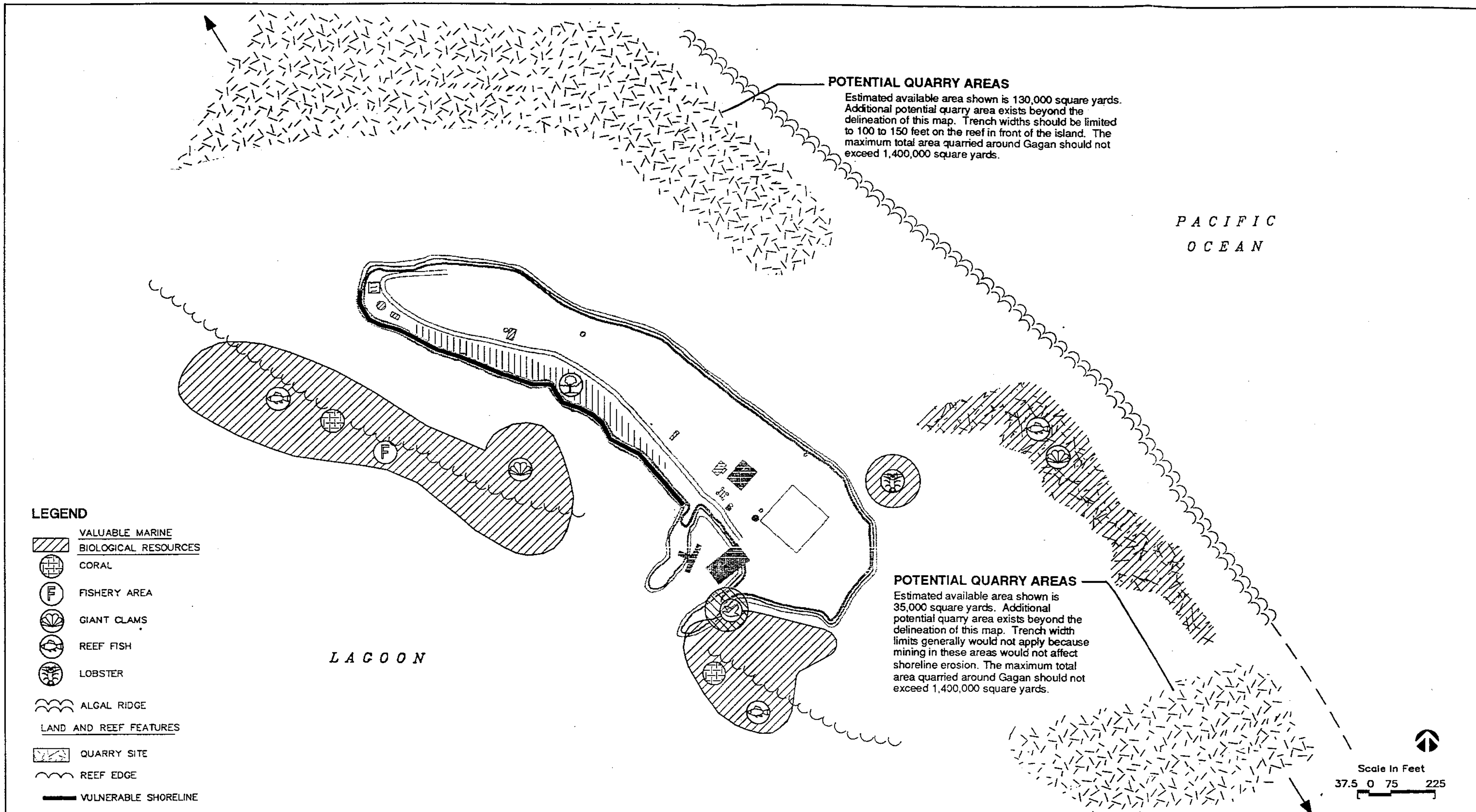
FIGURE 4.2-5



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
ILLEGINNI

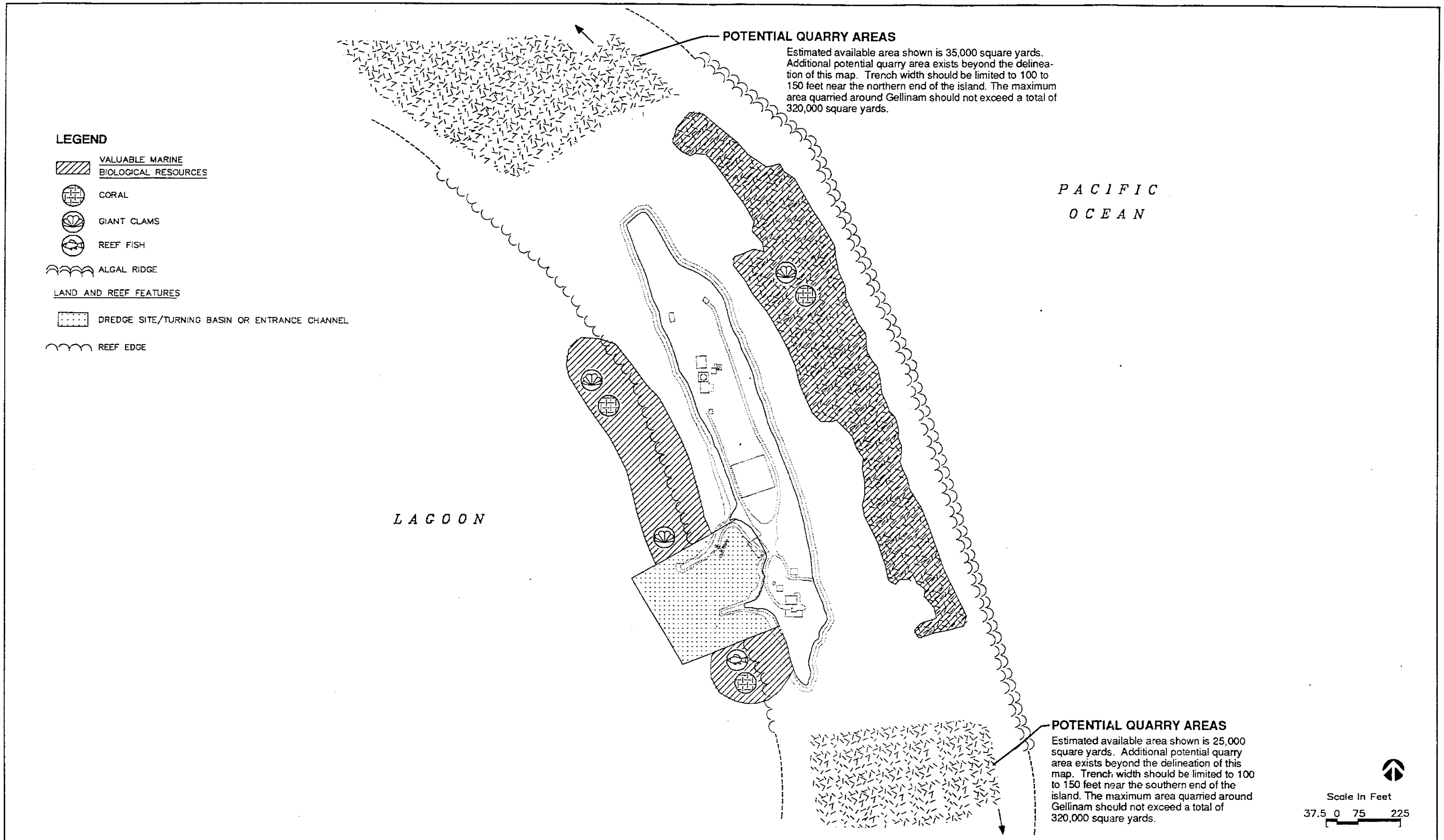
FIGURE 4.2-6



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
GAGAN

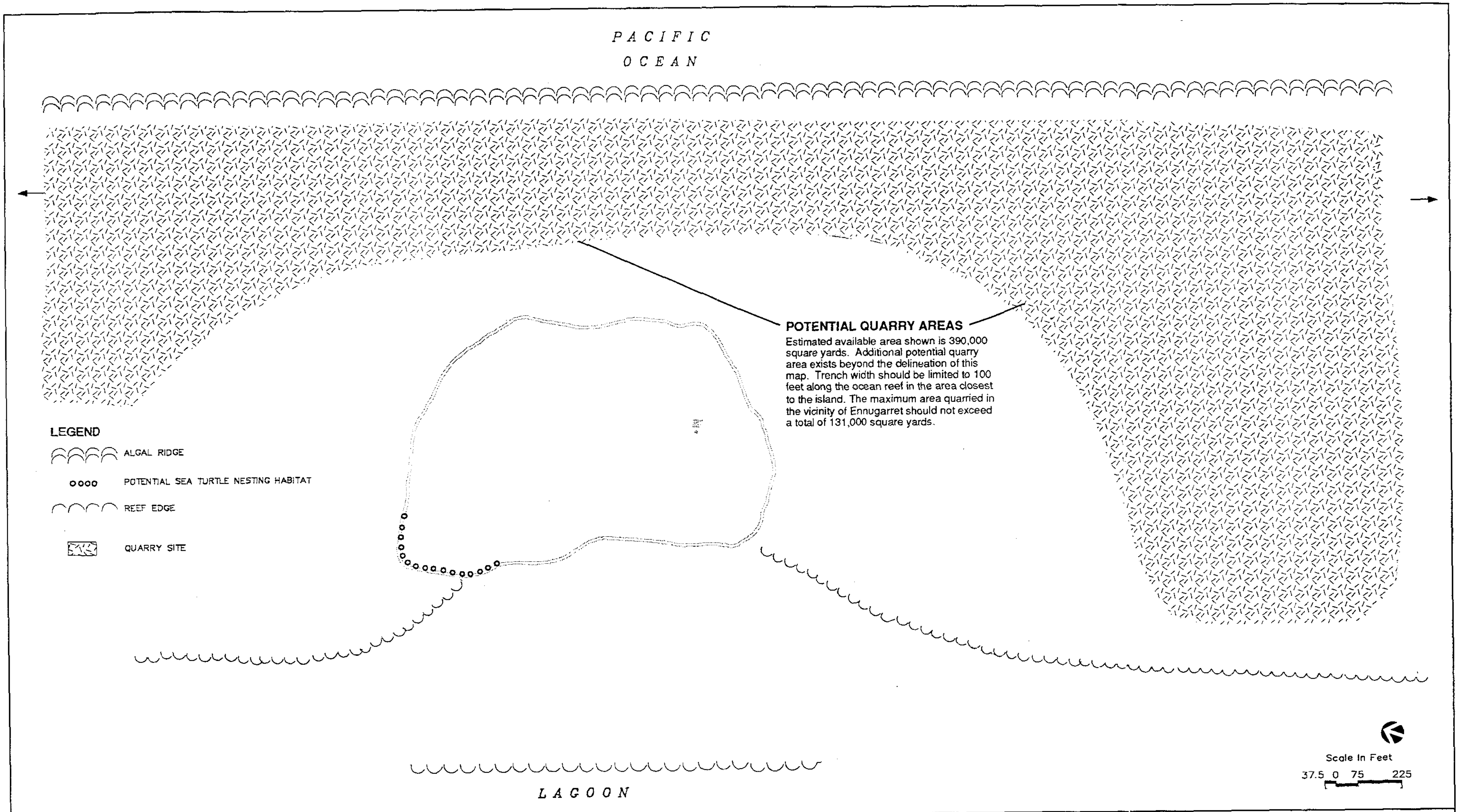
FIGURE 4.2-7



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
GELLINAM

FIGURE 4.2-8



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Potential Quarry Sites
ENNUGARRET

FIGURE 4.2-9

Table 4.2-4
Total Reef Area and Available Quarry Areas for the USAKA Islands

Island	Reef Location	Total Reef Area (sq. yd.)	Available Area for Quarrying (sq. yd.)
Kwajalein	Ocean-side	1,200,000	25,000
	Lagoon-side	360,000	0
	Interisland (1 mile NW; 1 mile NE)	1,800,000	360,000
	Kwajalein total	3,360,000	385,000
Roi-Namur	Ocean-side	2,160,000	126,000
	Lagoon-side	230,000	0
	Interisland (1 mile SW)	1,450,000	290,000
	Roi-Namur total	3,840,000	416,000
Meck	Ocean-side	200,000	0
	Lagoon-side	60,000	0
	Interisland (2-3/4 miles S)	1,400,000	280,000
	Meck total	1,660,000	280,000
Omelek	Ocean-side	110,000	0
	Lagoon-side	180,000	0
	Interisland (1-3/4 miles N; 1 mile S)	1,190,000	240,000
	Omelek total	1,480,000	240,000
Ennylabegan	Ocean-side	450,000	36,000
	Lagoon-side	270,000	0
	Interisland (1/4 mile NW)	170,000	0
	Ennylabegan total	890,000	36,000
Legan	Ocean-side	110,000	0
	Lagoon-side	390,000	0
	Interisland	0	0
	Legan total	500,000	0
Illeginni	Ocean-side	180,000	0
	Lagoon-side	370,000	0
	Interisland (1-1/2 miles NW)	1,150,000	230,000
	Illeginni total	1,700,000	230,000
Gagan	Ocean-side	160,000	18,000
	Lagoon-side	0	0
	Interisland (0.8 mile N; 9.6 miles S)	7,150,000	1,400,000
	Gagan total	7,310,000	1,418,000
Gellinam	Ocean-side	115,000	0
	Lagoon-side	0	0
	Interisland (1-1/2 miles N; 1-3/4 miles S)	1,620,000	320,000
	Gellinam total	1,735,000	320,000

Table 4.2-4
Total Reef Area and Available Quarry Areas for the USAKA Islands

Page 2 of 2

Island	Reef Location	Total Reef Area (sq. yd.)	Available Area for Quarrying (sq. yd.)
Eniwetak	Ocean-side	0	0
	Lagoon-side*	75,000	0
	Interisland	0	0
	Eniwetak total	75,000	0
Ennugarret	Ocean-side	197,800	23,000
	Lagoon-side	0	0
	Interisland (0.2 mile N; 0.2 mile S)	541,200	108,000
	Ennugarret total	739,000	131,000
	USAKA total	23,289,000	3,456,000

*Eniwetak is located inside the lagoon just in from the Eniwetak Passage; the reef has limited exposure to the open ocean.

lagoon will disperse to a large degree before reaching the opposite side, minimizing the increase in wave heights.

Because interisland reefs do not have as important a role in controlling shoreline erosion as the reefs fronting the islands, the restrictions on quarrying do not need to be as strict as those for oceanside reefs. For estimates in Table 4-2.4, it was assumed that up to 20 percent of each interisland reef width could be used for quarry material (even when that distance would exceed 300 feet [91 meters]). However, because interisland reefs have not been surveyed to identify valuable marine biological resource areas, any interisland reef area being considered for quarrying must be surveyed for the presence of valuable marine biological resources (as defined using criteria similar to those used in the *USAKA Natural Resources Plan* [USAEDPO, 1991a]). Any areas or habitats containing such resources would be avoided. Table 4.2-5 summarizes the Low Level-of-Activity quarry requirements compared with suitable quarry areas both on an island-by-island basis and for all USAKA islands.

Commercial Sources of Aggregate and Armor Rock

Importing aggregate from outside the RMI is an alternative to producing aggregate by quarrying at Kwajalein, at least for some uses. Recently, a number of construction projects at USAKA have used aggregate imported from the United States because of lower cost. It appears that the costs and logistical challenges for transporting armor rock are greater than for aggregate, although armor rock from the United States is apparently denser and may last longer than armor rock quarried at Kwajalein. Aggregate and armor rock purchased outside the RMI are sterilized before shipment by barge to Kwajalein. To the extent that purchased aggregate and armor stone can be used, quarrying at Kwajalein can be correspondingly reduced.

LOW LEVEL OF ACTIVITY

Impacts

Geological effects of quarrying, dredging, and filling under this alternative can cause long-term impacts (e.g., open holes, deepened areas, and new land) to coral reefs as discussed in the No-Action Alternative.

The only fill associated with the Low Level-of-Activity Alternative is a very small fill area (less than 1 acre [4,047 square meters]) for port improvement at Legan. Shoreline protection activities using armor stone and aggregate from quarrying would take place at Kwajalein, Roi-Namur, Meck, Omelek, Eniwetak, and Gellinam. Assuming that the quarrying guidelines identified in the No-Action Alternative are observed, there would be no significant impacts to land and reef resources under this alternative.

Table 4.2-5
Quarry Area Comparisons—Low Level-of-Activity Alternative

Island	Total Adjacent Reef Area (sq. yd.)	Suitable Reef Area for Quarrying (sq. yd.)	Quarrying Requirements for Low Level of Activity (sq. yd.)	Quarrying Requirements as a Percent of Total Adjacent Reef Area	Quarrying Requirements as a Percent of Available Reef Area
Kwajalein	3,360,000	385,000	23,520	0.7	6.1
Roi-Namur	3,880,000	420,000	9,107	0.2	2.2
Meck	1,660,000	280,000	4,667	0.3	1.7
Omelek	1,490,000	240,000	1,893	0.1	0.8
Ennylabegan	890,000	43,000	133	0.0	0.3
Legan	500,000	0	0	0.0	0.0
Illeginni	1,700,000	230,000	0	0.0	0.0
Gagan	7,360,000	1,418,000	0	0.0	0.0
Gellinam	1,715,000	320,000	1,667	0.1	0.5
Eniwetak	75,000	0	400	0.5	0.0
Ennugarret	739,000	131,000	0	0.0	0.0
USAKA total	23,369,000	3,467,000	41,387	0.2	1.3

Mitigation

As long as the quarry size and location guidelines discussed under the No-Action Alternative are followed, and as long as interisland reefs are surveyed for valuable marine biological resource areas and any such areas are not quarried, no significant impacts are predicted. No additional mitigation is required.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

Table 4.2-6 shows the quarry volumes proposed for each island under the Intermediate Level-of-Activity Alternative compared with the available reef area. A major fill (approximately 15 acres [60,704 square meters]) would occur at Meck Island, extending the island approximately 1,100 feet (335 meters) to the south. Based on the analysis of available reef at Meck, it appears that there is insufficient suitable area for this additional fill immediately adjacent to the island. It is likely the fill could be obtained from the reef between Meck and adjacent islands. The alteration of Meck Island by adding land surface should not adversely affect shoreline configuration, island integrity, or lagoon current patterns, as long as the protective measures for siting and sizing quarries identified above are followed.

If the protective measures for siting and sizing quarries identified above are followed, quarrying to meet the fill requirements for the Meck addition and the shoreline protection activities at other islands should have nonsignificant impacts on the integrity of the USAKA islands and shoreline configurations. The islands that would have substantial increases in quarrying or dredging above the Low Level-of-Activity Alternative would include Illeginni, Ennugarret, and Kwajalein, with relatively smaller amounts at Omelek and Roi-Namur.

As mentioned above (Low Level-of-Activity Alternative), purchasing aggregate and armor stone from commercial sources outside USAKA is an alternative to quarrying at USAKA. Commercial purchase may be more feasible for aggregate than for armor stone because of lower shipping costs. If aggregate or armor stone is purchased outside USAKA, the total area to be quarried may be able to be reduced.

Mitigation

As long as the quarry size and location guidelines discussed under the No-Action Alternative are followed, and as long as interisland reefs are surveyed for valuable marine biological resource areas and any such areas are not quarried, no significant impacts are predicted. No additional mitigation is required.

Table 4.2-6
Quarry Area Comparisons–Intermediate Level-of-Activity Alternative

Island	Total Adjacent Reef Area (sq. yd.)	Suitable Reef Area for Quarrying (sq. yd.)	Intermediate Level-of-Activity Quarrying Requirements (sq. yd.)	Quarrying Requirements as a Percent of Total Adjacent Reef Area	Quarrying Requirements as a Percent of Available Reef Area
Kwajalein	3,360,000	385,000	31,253	0.9	8.1
Roi-Namur	3,880,000	420,000	9,196	0.2	2.2
Meck (w/rock) (w/tribar)	1,660,000	280,000	160,143 101,929	9.6 6.1	57.1 36.4
Omelek	1,490,000	240,000	1,893	0.1	0.8
Ennylabegan	890,000	43,000	133	0.0	0.3
Legan	500,000	0	143	0.0	0.0
Illeginni	1,700,000	230,000	10,333	0.6	4.5
Gagan	7,360,000	1,418,000	0	0.0	0.0
Gellinam	1,715,000	320,000	1,667	0.1	0.5
Eniwetak	75,000	0	400	0.5	0.0
Ennugarret	739,000	131,000	5,714	0.8	4.4
USAKA total	23,369,000	3,467,000	220,875[1] 162,661[2]	1.0 0.7	6.4 4.7

[1]For alternative using rock for shoreline protection on Meck Island.
[2]For alternative using tribar for shoreline protection on Meck Island.

HIGH LEVEL OF ACTIVITY

Impacts

Table 4.2-7 compares the quarry volumes required for each island under the High Level-of-Activity Alternative with the available reef areas.

The substantial increase in aggregate and armor stone needed for this alternative could have a significant adverse impact on land and reef resources if the protective measures for quarrying described above are not followed. Islands with substantially increased quarrying and dredging in this alternative include Omelek, Legan, Gellinam, and Eniwetak, with smaller increases at Ennylabegan and Gagan. The addition of 45,000 square feet (4,181 square meters) of area to Gellinam would contribute to this impact because of the additional fill required. Consequences of the impact could be shoreline erosion and increased vulnerability of structures to wave action. As stated above, commercial purchase of aggregate and/or armor stone would reduce the total quarry area involved.

Mitigation

As long as the quarry size and location guidelines discussed under the No-Action Alternative are followed, and as long as interisland reefs are surveyed for valuable marine biological resource areas and any such areas are not quarried, no significant impacts are predicted. No additional mitigation is required.

4.2.2 Proposed USAKA Environmental Standards and Procedures

Proposed USAKA Standards for Water Quality and Reef Protection are addressed in Section 4-3 of this SEIS. There are no proposed USAKA Environmental Standards and Procedures that relate to other geological impacts at USAKA.

4.3 Water Resources

4.3.1 Level-of-Activity Alternatives

Water quality and waste management issues associated with ongoing operations at USAKA were addressed in the 1989 EIS, the *USAKA Environmental Mitigation Plan* (USASDC, 1989c), and the *Environmental Quality Protection Plan* (USAEDPO, 1991b). Common areas of concern are addressed in each document. A brief summary of the issues follows.

Table 4.2-7
Quarry Area Comparisons—High Level-of-Activity Alternative

Island	Total Adjacent Reef Area (sq. yd.)	Suitable Reef Area for Quarrying (sq. yd.)	High Level-of-Activity Quarry Requirements (sq. yd.)	Quarrying Requirements as a Percent of Total Adjacent Reef Area	Quarrying Requirements as a Percent of Available Reef Area
Kwajalein	3,360,000	385,000	31,253	0.9	8.1
Roi-Namur	3,880,000	420,000	9,196	0.2	2.2
Meck (w/rock) (w/tribar)	1,660,000	280,000	161,143 102,929	9.7 6.2	57.6 36.8
Omelek	1,490,000	240,000	57,786	3.9	24.1
Ennylabegan	890,000	43,000	400	0.0	0.9
Legan	500,000	0	2,733	0.6	0.0
Illeginni	1,700,000	230,000	10,333	0.6	4.5
Gagan	7,360,000	1,418,000	8,867	0.1	0.6
Gellinam	1,715,000	320,000	9,286	0.5	2.9
Eniwetak	75,000	0	54,250	72.3	0.0
Ennugarret	739,000	131,000	5,714	0.8	4.4
USAKA total	23,369,000	3,467,000	350,961[1] 292,747[2]	1.5 1.3	10.2 8.5

[1]For alternative using rock for shoreline protection on Meck Island.
[2]For alternative using tribar for shoreline protection on Meck Island.

Freshwater

Surface Water. Rainfall provides a significant part of the potable water supply on Kwajalein, Roi-Namur, and Meck islands, where there are rainwater catchments. Surface water can be affected by contaminants released to surface soils, by spills, and through erosion of sediments by wind and water action. Stormwater and irrigation can also transport contaminants to nearshore marine waters.

Groundwater. The groundwater lens currently supplies major portions of the potable supply on Kwajalein and Roi-Namur. Groundwater quality could be degraded by increased salinity (chloride concentration) if increased pumping draws marine water into the lens. The lens is also vulnerable to spills, leaks, and other releases of contaminants (e.g., organic compounds, solvents, metals, and petroleum hydrocarbons) that could occur as a result of substantial increases in population, operations, or construction/land use changes.

Marine Water

Past studies have shown that nearshore and offshore marine waters are largely unaffected by USAKA operations except in the vicinity of point and some nonpoint source discharges (USAEHA, 1991b; 1992b). Increased populations and operational activities could result in increased flow volume, concentration, and mass of contaminants entering marine waters. Mixing zone studies have been conducted (USASSDC, 1993c) in the vicinity of the following discharges to determine the area affected:

- Kwajalein wastewater treatment plant outfall, the power plant thermal discharge, and storm drain discharges
- Roi-Namur wastewater outfall and storm drain discharges
- Meck storm drain discharge

The purpose of this study was to use waste stream analytical data, appropriate dilution models, and background field data to evaluate dilution characteristics at the discharge points, and to predict a mixing zone required to meet water quality standards for each discharge. The study also included modeling the mixing zones required to meet future population increases in support of USAKA missions. Study results indicate that a limited area is affected by the discharges and data to support a mixing zone application are available. As a result, no significant levels of contaminants of concern have been identified. General categories of contamination that affect marine water quality and their sources are shown in Table 4.3-1.

Table 4.3-1 Potential Areas of Concern–Marine Water Resources	
Parameter	Source
Temperature (heat)	Power plants, radars
Dissolved oxygen	WWTP effluent, marine sanitation
Solids (floatable, suspended, settleable)	WWTP, water treatment plant sludge, marine sanitation, dredge and fill, stormwater runoff
Toxic metals	Wastewater effluent, stormwater runoff, groundwater, power plant cooling discharge, raw water storage sludge
Organics	Wastewater effluent, stormwater runoff
Nutrients	Wastewater effluent, stormwater runoff
Hydrocarbons	Fuel tank farm sludge, tank leaks, stormwater runoff

Earlier, point source discharges to lagoon and marine waters on 10 USAKA islands were investigated by the U.S. Army Environmental Hygiene Agency (USAEHA) to determine the presence of constituents of concern (USAEHA, 1991b). The types of contaminants identified in the USAEHA wastewater management study that were found to exceed U.S. Environmental Protection Agency (U.S. EPA) ambient water quality criteria are presented in Table 4.3-2.

Levels of Significance–Existing U.S. Statutes and Regulations

The environmental significance of water quality impacts may be expressed in terms of actual or potential effects on human health and safety through the direct uses (e.g., drinking, contact, or swimming) of a water resource (surface, groundwater, or marine). Additionally, compliance with protective standards and achieving recommended guideline levels may also be used to measure water quality impacts. Maximum contaminant levels (MCLs) for drinking water are set forth in the Safe Drinking Water Act (SDWA).

Freshwater

Adverse impacts on water quality may be measured by reduction in the potable water supply available for human uses. Degradation of water quality as a result of contamination may lead to a reduction in the potable supply in the future. The following levels of significance are defined for use in evaluating the effects of the proposed actions on the freshwater resources at USAKA.

Table 4.3-2
USAKA Wastewater Discharge Summary

Discharge Type/Status	Waste Type	Source (Kwajalein except as noted)	Receiving Water	Flow (gpd)	Contaminants[a,b]
Outfall pipe, active	Treated sewage	WWTP 1228	Lagoon	520,000	As, Cu, Se
Storm drain, active	Industrial wastewater	Vehicle wash rack 803	Lagoon	N/A	COD, O&G, Cd, Pb, Zn, SVO
Storm drain, active	Tank bottom water	Fuel storage farm 951-961	Lagoon	N/A	COD, O&G, Cd, Cu, Ni, Pb, Zn, VO, SVO
Storm drain, active	Sludge	Water storage tank 937-986	Lagoon	N/A	COD, TSS, As, Cd, Cu, Ni, Pb, Zn
Sewer system, active	Sludge	WWTP 933	Lagoon	N/A	COD, TSS, Ar, Cu, Ni, Pb, Zn
Outfall pipe, active	Cooling water	Power Plant 1, 992	Lagoon	N/A	Ni, Zn, heat
Overflow pipe, emergency only	Industrial wastewater	Sewage pump station 1236	Lagoon	N/A	Cu, Zn, VO
Outfall pipe, disconnected	Raw sewage	Sewage pump station 8192, Roi-Namur	Ocean	N/A	COD, O&G, TSS, Cu, Ni, Pb, Zn, all PCBs
Outfall pipe, disconnected	Raw sewage	Sewage pump station 8048, Roi-Namur	Lagoon	N/A	Cu, Ni, Zn

Source: USAEHA, 1991d.
[a]Criteria exceeded (i.e., levels exceeded U.S. EPA Ambient Water Quality Criteria).
[b]Abbreviations:

As	Arsenic	Zn	Zinc	N/A	Not applicable or data unavailable
Ag	Silver	PCB	Polychlorinated biphenyls		
Cd	Cadmium	O&G	Oil and grease		
Cu	Copper	TSS	Total suspended solids		
Ni	Nickel	VO	Volatile organics		
Pb	Lead	SVO	Semivolatile organics		
Se	Selenium	COD	Chemical oxygen demand		

- **No or Negligible Impact.** No or very limited use of surface or groundwater resources. No discharges that would impair the natural ambient water quality. Raw water quality meets or is better than SDWA quality for all parameters.

- **Nonsignificant Impact.** Water use is less than the sustainable supply of catchment water and the groundwater pumping rate is less than the allowable sustained yield for the groundwater lens. Raw water quality from groundwater or catchments meets or is better than SDWA quality.

- **Significant Impact.** Water use is more than the sustainable combined supply of catchment and lens well water and groundwater pumping rate exceeds the allowable sustained yield levels for the groundwater lens. Increased chloride levels exceed 100 mg/L. Water quality may be impaired to levels higher than SDWA MCLs as a result of contamination from uncontrolled leaks, disposal, and other sources.

Marine Water

Water quality in nearshore waters is generally defined as the suitability of the waters to support valuable resources and uses such as marine ecology, fisheries (e.g., sport or commercial), public health (water contact sports), and aesthetics.

Water quality protection measures are promulgated to protect human health and the natural environment from activities that directly or indirectly lead to damage of water resources; limit the uses of the resource; or cause potential harm to humans, aquatic life, or other life forms that use the resource.

- **No or Negligible Impact.** No effect on water quality in nearshore or offshore marine waters, or effects are within the range of natural variability or observed uncertainty; pollutant concentrations not detectable or at trace levels; no change from ambient temperature or turbidity levels.

- **Nonsignificant Impact.** Measurable effect on water quality, but levels are within the limits of the National Pollutant Discharge Elimination System (NPDES) permit that formerly applied at USAKA; receiving water concentrations less than U.S. EPA water quality guidelines (1987); measurable temperature elevations of 1°C or less from ambient conditions outside a zone of initial dilution; turbidity increases of less than 1 nephelometric turbidity unit (NTU) in Class AA (ocean) or A (lagoon) waters, and less than 2 NTU in Class B waters (harbor and marina areas), except during dredging, where levels are >5 NTU, but <10 NTU beyond 300 feet (90 meters) of the dredge.

- **Significant Impact.** Effects on water quality with exceedances of the limits of the NPDES permit that formerly applied at USAKA; receiving water concentrations greater than U.S. EPA water quality guidelines (1987); temperature elevation of 1°C or greater beyond a zone of initial dilution; turbidity increases of greater than 1 NTU in Class AA or A waters, and greater than 2 NTU in Class B waters; accumulation of suspended solids in ecologically important areas (e.g., coral, fishing grounds, shellfish, and seagrass beds); during dredging, turbidity plumes exceed 10 NTU beyond 300 feet (90 meters) of the dredge.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

Freshwater

The following definitions of levels of significance based on the proposed Standards were used to evaluate freshwater.

- **No or Negligible Impact.** No or very limited use of surface or groundwater resources. No discharges that would impair the natural ambient water quality. Raw water quality meets primary and secondary groundwater protection criteria for all parameters.

- **Nonsignificant Impact.** Water use is less than the sustainable supply of catchment water and the groundwater pumping rate is less than the allowable sustained yield for the groundwater lens. Raw water quality from groundwater or catchments is degraded when compared with ambient water quality, but meets primary and secondary groundwater protection criteria.

- **Significant Impact.** Water use is more than the sustainable supply of catchment water and the groundwater pumping rate exceeds the allowable sustained yield levels for the groundwater lens. Total dissolved solids exceeds 500 mg/L and chloride levels exceed 250 mg/L. Water quality may be degraded as a result of contamination from uncontrolled leaks, disposal, and other sources. Water quality exceeds primary or secondary groundwater protection criteria MCLs.

Marine Water

Marine water quality levels of significance for the proposed Standards are essentially the same as for U.S. statutes and regulations. Criteria are revised for turbidity associated with dredging.

- **No or Negligible Impact.** No effect on water quality in nearshore or offshore marine waters, or effects are within range of natural variability; pollutant concentrations not detectable or at trace levels; no change from ambient temperature or turbidity levels; water meets the general criteria applicable to all surface waters (Subsection 3-2.7.7).

- **Nonsignificant Impact.** Measurable effect on water quality, but levels are within water quality criteria of the Standards outside of a permitted mixing zone; receiving water concentrations less than water quality criteria for classification of water body; measurable temperature elevations of 1°C or less from ambient conditions outside a zone of initial dilution; turbidity increases of less than 1 NTU in Class AA or A waters, and less than 2 NTU in Class B waters that meet Trust Territory of the Pacific Islands (TTPI) and RMI standards; during dredging, turbidity levels are <10 NTU at 300 feet (90 meters) from the dredge.

- **Significant Impact.** Effects on water quality with exceedances of USAKA water quality criteria; receiving water concentrations greater than water quality criteria for classification of water body temperature elevation 1°C or greater beyond a zone of initial dilution; turbidity increases of greater than 1 NTU in Class AA or A waters, and greater than 2 NTU in Class B waters exceeding TTPI and RMI standards; turbidity levels greater than 10 NTU at 300 feet (90 meters) from the dredge; and accumulation of suspended solids in ecologically important areas (e.g., coral, fishing grounds, shellfish, and seagrass beds).

NO ACTION

Impacts

Existing water resources conditions are described in Chapter 3, Subsections 3.3.1–Freshwater, 3.3.2–Marine Water, and 3.12.1–Potable Water. Key impacts on water resources derive from several principal causes:

- Water shortage during dry years
- Degradation of the groundwater from overdrafting
- Increased pollutant loadings to marine waters from all point source discharges (e.g., wastewater or cooling water)
- Potential increase in contamination from nonpoint and other uncontrolled sources of pollution (e.g., runoff, leaks, spills, or dumping)

Several ongoing USAKA studies and recently completed investigations could lead to additional protective measures to ensure the long-term viability of the water supply and maintain marine and potable water quality. These measures and potential follow-on actions are discussed below.

Freshwater

Potable Water Supply and Quality. Under the No-Action Alternative, increased efforts to improve water quality through contaminant source identification, source control, and water supply integrity protection are occurring as the *1989 USAKA Mitigation Plan* is implemented (Kirkpatrick, pers. comm., 1992). The Mitigation Plan (summarized in Appendix A of this document) includes 20 freshwater and 7 marine water quality action items. As of the end of 1993, all but one marine water quality action and one freshwater quality action have been completed, initiated, or are under way as ongoing programs. When fully implemented, these actions will address most of the identified water resources issues (quantity and quality) of concern to USAKA. The remaining *marine water* quality Mitigation Plan item, construction of the Roi-Namur wastewater treatment plant, is part of the Low Level-of-Activity Alternative. One remaining *freshwater* quality Mitigation Plan protection item, replacement of the bulk fuel storage facility, has been replaced by a repair program planned for FY93; a second, improved fuel tank containment is part of the Low Level-of-Activity Alternative.

Implementation of the Mitigation Plan Actions listed in Table 4.3-3 will contribute to improvement in water quality through additional treatment, protection, or prevention measures and result in no or negligible impacts.

Groundwater. A key study currently being conducted that may lead to significant improvement in maintaining water quality is the Groundwater Supply Study being conducted by the U.S. Geological Survey (USGS). The purpose of the study is to characterize groundwater systems on Kwajalein and Roi-Namur islands and to determine more accurately the extent of the freshwater lens and controlling factors. Aquifer models are being developed to provide a comprehensive groundwater management plan for various rainfall conditions. The results of these studies will be used to determine a safe yield during normal and dry year conditions for USAKA. As described above (Subsection 3.3.1.2), a draft report on the aquifer model for Roi-Namur is undergoing USAKA review and the Kwajalein study is currently in progress (Hunt, pers. comm., 1992).

Table 4.3-3
Remaining USAKA Environmental Mitigation Plan Actions Affecting Water Quality

Action	Status/Location	Purpose
Install desalination plant	Construction in FY93-94; Kwajalein	Augment potable water supply
Tank containment at aboveground sites	Planned; start in FY95; several islands	Improve groundwater protection
Repair bulk fuel storage facility and install containment	Planned for FY93-95; Kwajalein	Improve groundwater protection
Covers for raw water storage	Planned for FY95; Kwajalein	Improve potable water quality
New wastewater treatment plant	Planned for FY94; Roi-Namur	Improve effluent quality

Results of the 1991 *Soil and Groundwater Contamination Study* (USAEHA, 1991b) showed some evidence of groundwater contamination at nearly all the sites investigated in this study. The study recommended the following actions:

- A formal groundwater protection strategy should be developed for Kwajalein and Roi-Namur islands.

- A corrective action strategy should be implemented for Kwajalein Atoll.

Implementation of the recommendations from these studies could provide additional protection of USAKA's groundwater resources.

Marine Water

Waste Discharges. Nearshore marine waters at USAKA may be affected by both point and nonpoint source discharges. The point source discharges have been investigated by USAKA to determine whether the discharge may have harmful characteristics (e.g., heat, contaminants of concern, bacteria, and suspended solids). As identified in Table 4.3-2 above, recent investigations have detected contaminants of potential concern in several effluents on Kwajalein and Roi-Namur (USAEHA, 1991d, 1992b). Based on the data collected in the 1991 USAEHA discharge study, seven point source discharges at Kwajalein and two on Roi-Namur were shown to contain contaminants of concern. The data collected were from the waste stream and did not define the degree to which these discharges are adversely affecting the marine environment at USAKA. A study of these discharges was subsequently conducted to evaluate dilution characteristics at the discharge points, and to predict a mixing zone required to meet water quality standards for each discharge (USASSDC, 1993c). The study also modeled the mixing zones required to meet future population increases in support of USAKA missions. The study results indicate that a limited area is affected by the discharges and data to support a mixing zone application are available. Few studies have been conducted in the lagoon or ocean waters or on islands other than Roi-Namur and Kwajalein.

The 1991 USAEHA Study also noted that significant unaccounted-for industrial waste is randomly present in the Kwajalein sewage collection system (USAEHA, 1991d). The study recommended that all industrial discharges to the system should be identified, evaluated for their treatability, and pretreated or controlled as necessary to ensure that both the operation of the treatment plant is not impaired and the receiving water quality is not degraded.

Most point source discharges identified in the 1991 USAEHA study are not expected to affect the environment because of the small volumes discharged, high-energy receiving waters, and the low concentration levels. The steps being undertaken as part of the Mitigation Plan (Appendix A) to improve waste management practices should address these pollution sources.

As an example of the ongoing efforts to identify impairment of water quality or the environmental resources, a study of environmental conditions around the Kwajalein marine terminal and BSR dock areas found elevated concentrations of chromium, copper, and lead detected in water, sediment, and fish tissues (USASDC, 1991). The metal concentrations appear correlated with sandblasting operations; however, the data are inconclusive in correlating the levels to specific human health or environmental problems. The levels detected exceed some of the legal limits used by other nations for fish consumption (USASDC, 1991); however, except for mercury, the U.S. has not developed human health guidelines for fish.

At Roi-Namur, untreated sewage is discharged onto the ocean reef flat. The 1989 EIS did not identify these discharges as a significant water quality impact, in part because of plans to install a package treatment plant. The plant has not yet been constructed. A primary treatment plant and outfall extension are proposed as part of the Low Level-of-Activity Alternative.

Thermal Discharges. The addition of Power Plant 1B on Kwajalein will change the volumes of thermal discharge to the lagoon. Thermal discharges have been shown to have adverse effects on coral and other sensitive marine organisms. In a review of cases where corals have been observed to suffer from "bleaching" or a loss of photosynthetic pigments, elevated seawater temperature appears to be a common factor (Jokiel and Coles, 1990). Increases of 1.8 to 3.6°F (1 to 2°C) greater than the ambient summer range in Hawaiian waters were correlated with significant bleaching. Field observations at Eniwetak Atoll showed a higher upper lethal and sublethal limit than subtropical Hawaiian corals, because of the 3.6°F (2°C) difference in normal maximum (summer) temperature in tropical waters (Coles et al., 1976).

In 1990, the lagoon discharge of existing power plant units (Power Plants 1 and 2) was investigated using temperature profiles, drogues, and a dye release study to determine the configuration and dispersion of the heated effluent plume (Sea Engineering, 1990). This study also used the U.S. EPA PDS Dilution Model for Thermal Discharges in Shallow Water to predict the buoyant plume configuration for the existing Power Plants 1 and 2 and to project the effects from the new power plants (Power Plant 1A and Power Plant 1B). Under existing conditions, Power Plant 1 has a flow of 7.2 million gallons per day (mgd), while Power Plant 2 discharges at a rate of about 1.4 mgd when in operation. Both discharges are about 94°F (34.4°C) or up to 12°F (6.7°C) higher than the ambient lagoon temperature of 81.9°F (27.7°C). When Power Plant 1B becomes operational in FY95, Power Plant 1 will be demolished. Under normal operations, Power Plants 1A and 1B would have a combined flow of between 6.5 and 8.6 mgd of 93.9°F (34.4°C) effluent.

Field studies and model results show that heat rapidly dissipates in nearshore receiving waters. Excess isotherms (i.e., a temperature plot of the difference between ambient receiving water and discharge plume temperatures) were shown to decline to 1°C within about 50 feet (15 meters) of the discharge (Sea Engineering, 1990). The State of Hawaii's thermal discharge standards for coastal waters (changes shall not exceed ±1°C) and the TTPI and RMI standard (no variance of more than 0.9°C from natural conditions) can be used for comparison. Using these standards as reasonably comparable guidelines, the new power plant discharges will have an impact on the nearshore marine environment, that is, an area of approximately 50 feet (15 meters) in radius from the point of discharge will exhibit a temperature elevation in excess of the Hawaii, TTPI, and RMI standards.

No significant coral heads are located near the power plant discharge area, which is generally sandy bottom, although there are seagrass beds in the nearshore area. It is possible that the existing thermal plume may contribute to lack of coral establishment in the area; however, based on the study and model results, the area affected would be restricted to the vicinity of the outfall. The mixing zone study (USASSDC, 1993c) conducted for thermal discharges to the lagoon indicates that a limited zone is influenced by the discharge and a mixing zone may be defined for meeting water quality standards.

There is a potential that once-through cooling water from the new plant may contain heavy metals picked up in the cooling process and discharged to receiving waters. Nickel and zinc concentrations exceeding U.S. EPA water quality criteria have been detected in the cooling water effluent of Power Plant 1, but receiving water concentrations have not been measured to assess the effect of the discharge on the marine environment (USAEHA, 1991a). However, the mixing zone study used conservative assumptions regarding background metal concentrations and the site-specific measurements and modeling would not preclude developing a mixing zone to define the impact area of discharged metals. The modeling data confirmed previous studies of the thermal plumes and no significant impact is anticipated.

Desalination Plant. Construction of a 150,000-gallon-per-day (gpd) (570,000-liter-per-day [Lpd]) desalination plant is scheduled to be completed by FY94, and to produce potable water from lagoon water to augment the catchment and lens well supplies. Heated water from the power plant cooling cycle will be used as the feed stock to the desalination plant. Depending on the type of desalination process selected for design, a thermal discharge of brine could be generated by the plant. Effluent from the desalination plant will be recombined with the power plant cooling stream prior to discharge to the lagoon through the existing outfall.

The desalination process complicates the assessment of thermal discharge impacts because the desalination effluent would have a higher salinity than the once-through cooling water used in modeling the impact of the new power plant and in the project's Environmental Assessment (USASDC, 1992c). By increasing the salinity of the cooling water with the desalination brine, a final cooling water discharge would be produced with greater salinity than either the existing power plant discharge or one predicted for the new power plants. An increase in salinity could increase plume density, thereby decreasing the buoyancy of the existing plume. It is possible that the plume could sink and be more resistant to surface mixing forces (winds, waves, and currents). A sinking plume could potentially affect a larger area of the seabed, impacting coral, seagrasses, and fish at greater distances when compared with a buoyant plume. However, based on the modeling conducted to date, the desalination plant is expected to produce nonsignificant impacts on water resources.

Quarrying and Dredging. Quarrying and dredging activities occur on a periodic basis for both routine maintenance and for new construction at all islands leased by USAKA. In the Environmental Assessment for dredging Kwajalein harbor in navigation areas around the fuel pier, proposed mitigation measures included the monitoring of turbidity in the vicinity of the dredge before, during, and after dredging. Additionally, it was recommended that filter fabric (silt curtains) be used in areas downcurrent of the dredge if turbidity levels exceed 10 NTUs above ambient conditions more than 300 feet (90 meters) from the dredge site (USASDC, 1992e). Incorporating similar monitoring and mitigation requirements in future dredging programs would reduce potential impacts on water quality and marine biota to nonsignificant levels.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Under the Low Level of Activity, the principal types of actions that could affect water quality are:

- Increased launch activity on two islands (Meck and Omelek)
- Laying a fiber optics cable between Meck and Ennylabegan
- An 18 percent increase in USAKA's nonindigenous population (from 3,250 to 3,825)
- New construction on Kwajalein, Roi-Namur, and Meck
- Fuel tank containment improvements at eight islands
- Dredging and shoreline protection activities on several islands
- Increased effluent flows from the Kwajalein and Roi-Namur WWTPs

Potential water quality impacts that may be caused by the Low Level-of-Activity Alternative are identified in Table 4.3-4, and the potential water quality effects associated with the actions identified in that table are discussed below.

Launches. On Kwajalein and Roi-Namur, meteorological and sounding rocket launches will increase in this alternative. As described in Section 2.1, these are relatively small rockets, with nonsignificant air quality impacts. There have been no reported water quality impacts associated with launches of these rockets; therefore, no or negligible impacts are expected from increased launches.

There would be an increase in launches from Meck. With larger rocket boosters, the potential for water quality impacts associated with deposition of fuels, combustion products, and spills from accidents is increased. Liquid propellants, such as monomethyl hydrazine (MMH) and nitrogen tetroxide, may be used in some of the strategic launch vehicle payloads. A nonsignificant impact is expected from these liquid propellants because these propellants are not handled in bulk but are stored and used in small containers; therefore, the risk of large spills and/or releases of fuel is low.

Table 4.3-4
Potential Water Quality Impacts of the
Low Level-of-Activity Alternative Based on U.S. Statutes and Regulations

Action	Impact	Source	Contaminants	Significance Determination
Launches	Local area	Fuel, debris	Organics, acid rain	No or negligible
Population	18% increase	Spills, dumping	Organics	Nonsignificant
Wastewater	18% increase on Kwajalein; 11% on Roi-Namur; construction of new wastewater treatment plant on Roi-Namur	Domestic, industrial	Metals, BOD, TSS	Nonsignificant
Construction	Major construction on Kwajalein, Roi-Namur, Meck; interisland fiber optics cable installation	Erosion, spills, excavation	Organics, TSS, fuels, turbidity	Nonsignificant
Marine vessels	Increased traffic	Sanitary waste	BOD, TSS, bacteria	Nonsignificant
Quarrying and dredging	Quarrying, dredging on eight islands	Blasting, excavating	TSS, turbidity	Nonsignificant

In some test programs, such as Lightweight Exoatmospheric Projectile (LEAP) and Brilliant Pebbles (BP), rockets launched from Meck may use ClF_5 as part of the fuel system for payloads in missiles. This oxidizer is extremely toxic and corrosive and reacts vigorously with water and silicon-containing compounds, such as sand and glass. Use of ClF_5 at USAKA is a concern because of its reactive and toxic properties. USAKA has proposed special handling methods to reduce the potential for accidental release in populated areas and to move the material to the place of use on Meck. The Environmental Assessment for the LEAP test program (SDIO, 1992) described shipment and handling of small quantities of fuel in steel containers. Material would be moved from the Kwajalein dock to Meck for storage in Building 5103, which was specifically sited, designed, and constructed for liquid propellants. Because the amount of ClF_5 used for payload motor fuel in a single launch is small, a release would not be expected to affect a large area of marine or lagoon waters or upland area. The impact of the release on shore or in the immediate area, however, would degrade water quality and have an impact on marine biota in the vicinity. Storage on Meck would avoid the potential to degrade potable water supplies on Kwajalein or Roi-Namur through catchment or lens contamination. The potential for release of ClF_5 to the environment is very low because of the protective measures used in its handling and disposal. Therefore, the use of ClF_5 would have a nonsignificant impact on USAKA's water resources.

Solid propellants are the most common fuels in the launch stages of most strategic launch vehicles (SLVs). No water quality impacts are expected from normal launches (see Air Quality, Subsection 4.4.1). An accidental release of solid or liquid propellants could have a temporary and localized effect on water quality. However, negligible impacts from such accidents can be expected because of the buffering capacity of the ocean. Negligible long-term impacts are expected from the large rocket programs.

Population. The 18 percent increase in USAKA nonindigenous population and associated increased activity levels has the potential to degrade or exacerbate conditions that lead to surface or groundwater degradation. Until the USGS study of groundwater samples and characteristics is completed for both Roi-Namur and Kwajalein, the information needed to improve existing USAKA groundwater protection plans and specify additional safeguards is not available. Additional measures would need to be implemented to maintain or improve water quality protection. A corrective action strategy has not been developed, but USAKA has taken steps as identified in Appendix A (Mitigation Plan) to improve waste management and water quality since the 1989 EIS. Therefore, population increases are expected to have a nonsignificant impact on water resources, assuming continued implementation of Mitigation Plan measures.

Wastewater

Kwajalein. An 18 percent increase in nonindigenous USAKA population on Kwajalein over the No-Action level would yield an additional 78,000 gpd (295,260 Lpd) or an 18 percent increase (0.38 to 0.52 mgd) in wastewater flows from the Kwajalein wastewater treatment plant. The increased loadings are less than the design capacity of the existing Kwajalein treatment plant (0.60 mgd). Therefore, a nonsignificant impact could be expected to occur in the lagoon waters from discharge of effluent with biochemical oxygen demand (BOD), suspended solids, and other constituents at these increased flow rates.

Under normal operating conditions, the increased loading would yield a proportional increase in mass loading to the lagoon. The existing treatment plant discharges elevated levels of arsenic, copper, and selenium (USAEHA, 1991d). It is not known whether the increased wastewater flows will lead to a proportional increase in the levels of these substances. However, the USASSDC (1993c) study of wastewater discharges shows that establishing a mixing zone for the Kwajalein outfall is feasible for the estimated flows under each of the level-of-activity alternatives. Development of the mixing zone for the outfall would maintain compliance with water quality standards.

Roi-Namur. The wastewater discharges would also increase by approximately 11 percent above the No-Action Alternative. However, as part of this alternative, a new wastewater treatment plant and outfall would be constructed. The new facility is planned to have sufficient primary treatment capacity (70 gpd) for additional wasteloads; therefore, a nonsignificant impact is expected from the increased wasteloads.

Water quality would be improved in the area of the existing outfall by relocating the outfall to the outer edge of the reef and by providing primary treatment of the waste. Using the U.S. EPA hydrodynamic model UDKHDEN, dilution and dispersion studies of alternative discharge points off the reef edge show that rapid dilution of 100:1 or greater could be achieved using the designs considered in the model (USASDC, 1992d). Adding treatment would reduce solids, most nutrients, and other constituents depending on the process selected. However, metals detected in the waste stream may not be removed to levels less than U.S. EPA ambient water quality criteria. A preliminary study of the zone of mixing appeared to depend on the total nitrogen levels in the predicted effluent (USASDC, 1992d). Because the new outfall location would allow for greater dilution and dispersion of treated wastewater, impacts on the receiving water at this location are expected to be nonsignificant. The USASSDC study of wastewater discharges shows that establishing a mixing zone for the Roi-Namur outfall is feasible. Development of a mixing zone for this discharge would maintain compliance with water quality standards; therefore, no significant impact would result from increased waste flows projected under the alternatives. Industrial discharges will be separately treated prior to discharge. A mixing zone study could be used to assess the area of potential impact of residual metals in the vicinity of the new outfall extension.

A new power plant (13.5 MW) would be constructed on Roi-Namur. The plant is proposed to use a closed-loop freshwater cooling system. Cooling water would likely contain metals and possibly biocides and corrosion-inhibitors to reduce algae growth. Although plant design details are not yet known, it is assumed that any cooling water blowdown or discharge would receive pretreatment before discharge to the wastewater treatment system and would, therefore, have a nonsignificant impact on receiving waters.

Under existing statutes and regulations, the discharge requirements for the Roi-Namur treatment plant may need to be amended to include additional monitoring for cooling water corrosion products and possibly for corrosion inhibitors.

Construction. Increased program activities will require additional construction under this alternative, as shown in Table 2.1-13. Construction actions can generate dust, potential spills and leaks, debris, and other activities that have the potential to degrade water quality. Generally, best management practices are employed to reduce or control erosion, prevent or clean up leaks and spills, and collect debris at construction sites. Construction activities have the potential to lead to significant impacts on water quality, but compliance with existing USAKA practices for erosion control, debris management, and fuels management should have no or negligible impact on water resources. Potential best management practices for construction sites would include, but would not be limited to, use of detention basins, revegetation of graded areas with native plants, and installation of straw bales and silt fences to minimize stormwater runoff to the lagoon or ocean waters. The water quality of construction site runoff can be maintained by prompt cleanup of petroleum products from fuel spills; oils and greases used on equipment; and proper disposal of paints, solvents, and other hazardous materials used during construction.

Construction of the wastewater treatment plant outfall extension at Roi-Namur would affect water quality in the immediate area of the trenching (effects of effluent discharge are addressed below). Turbidity would increase during excavation and pipe-laying and if concrete is used for backfill around the outfall. Most construction activity would likely occur during low tide when the reef surface is exposed, which limits the dispersion of suspended solids, concrete runoff, and other materials used in construction. Turbidity levels would return to ambient conditions during the next tidal cycle when high tide sweeps the reef area. Nonsignificant impacts are expected from the temporary and localized nature of construction as it proceeds across the reef.

A new saltwater intake for cooling water would be constructed on Roi-Namur to serve the radars and other facilities. Construction would require disturbance of bottom sediments in the lagoon. Because of the fine grain materials present, an increase in water column turbidity would be expected during trenching and pipelaying. The amount of material disturbed would be minimal and localized around the existing line and would cause nonsignificant impacts to water resources.

The upgrade to the Meck power plant would be air-cooled and is not currently planned to have a cooling water discharge.

A new fiber optics cable would be constructed between Meck Island and Ennylabegan Island. Trenching across the lagoon reef and terrace would require excavating and burial of the cable. Construction activities would likely occur at low tide when the reef is accessible. Debris would be sidecast or disposed of on land areas of the islands. Residual and unconsolidated debris would be suspended on the advancing tide, causing a localized impact by increasing turbidity. Interisland reef flats are high energy environments that disperse and transport suspended materials rapidly. No or negligible impact would be expected because of the small size of trench excavation required for the cable and the minor quantities of debris materials placed in suspension.

Marine Vessels. Shipping activities at USAKA would be increased over the No-Action Alternative levels to support the increased range activities, new construction, and population growth. Increased vessel traffic could yield more discharge of raw or poorly treated sewage from vessels calling at USAKA. Although sanitary sewage discharges from vessels are typically small and the duration of visits is brief, discharges of raw or poorly treated sewage from these sources could degrade water quality and present a health risk through water contact activities. Federal regulations require that all vessels owned and operated by the United States that have installed sewage discharging marine sanitation devices limit the fecal coliform count to ≤1,000 per 100 millimeters with no visible floating solids. A local impact on water quality could result depending on the type of sanitation devices (if any) on other ships visiting USAKA and the duration of the visits. However, Kwajalein lagoon is typically well mixed with a constant current across the lagoon; therefore, dispersion of waste discharges would be expected to reduce the impact to nonsignificant levels within a short distance from the discharge. The cumulative effect of the construction of a causeway at Gugeegue Island north of Ebeye (an unrelated project of the RMI) on lagoon circulation is unknown.

Quarrying and Dredging. Table 2.1-12 identifies that 69,185 cubic yards (52,894 cubic meters) of dredged fill material is required for construction and shoreline protection, while 58,780 cubic yards (44,940 cubic meters) of quarried armor rock would be needed for shoreline improvements. Dredging, blasting, and excavating reef materials for shoreline protection applications would cause an adverse impact in and nearby the area subject to quarrying or dredging (USAEDPO, 1989a; USASDC, 1992e). Temporary impairment of water quality would result from increased turbidity, and from suspended organic and reef materials in the water column. The duration of the impact would be proportional to the duration of the dredging activity, grain size, and the quantity of fine-grain materials suspended. Impact duration would also be dependent on ambient current conditions. Most coarse-grain material would settle in the immediate reef area, while some fine-grain material and organic debris would drift downcurrent to settle on relatively undisturbed marine habitat. Subsection 4.7.1 provides further information on biological impacts.

As one of the Environmental Mitigations resulting from the 1989 EIS, USAKA has adopted a policy to use silt curtains and/or turbidity control standards for dredging operations. Adherence to policy recommendations could substantially reduce, but not eliminate, the potential impact. Marine water quality would deteriorate in the immediate dredging or filling area for the period of excavation or disposal, but would return to ambient conditions through settlement of the coarser material and flushing of fine grain suspended material by currents and tidal action.

Quarrying and dredging operations are likely to exceed the TTPI turbidity standards for Class AA, A, and B waters and the RMI standards for marine waters because of the high ambient clarity of USAKA waters. If carried out over a long period, these impacts could be considered to be significant. However, dredging projects at USAKA would be mostly short-term, and water quality conditions would return to ambient levels within a few days of completing the activity. Quarrying and dredging would be conducted only in designated areas within Class A or B waters, thereby avoiding reef areas known to have valuable biological resources. Most work would occur in high-energy areas, with rapid flushing and resettlement of materials. The use of silt curtains downcurrent of the dredge, now standard practice, should reduce impacts to nonsignificant levels. Because of the quantities of new quarrying and dredging actions proposed and the turbidity management practices used by USAKA, there would be temporary and nonsignificant impacts on water quality and marine biota in the vicinity of these activities. Alternatively, the use of commercially purchased aggregate and/or armor stone would reduce the amount of quarrying required at USAKA, and the associated turbidity impacts on surrounding waters.

Dredge materials are likely to be discharged to upland disposal sites for further use as fill materials. Because of the shortage of fill materials at USAKA, upland disposal reduces the potential for water quality impacts in receiving waters. Containment of the dredge spoil and excess waters would be used to prevent water quality impacts from overland flow and impacts from these activities are expected to be nonsignificant.

Mitigation–Existing U.S. Statutes and Regulations

Because there are no significant impacts, no mitigation is required.

Impacts–Proposed USAKA Environmental Standards and Procedures

The Low Level-of-Activity Alternative has several types of actions that could affect water quality, summarized in Table 4.3-5, that would be subject to the proposed Standards.

Launches. Impacts of rocket launch activities and reentry vehicle (RV) landings at USAKA would not be assessed differently using the proposed Standards.

Population. The 18 percent increase in USAKA's nonindigenous population is expected to have a nonsignificant impact on water resources for the same reasons as those listed under the existing U.S. statutes and regulations.

Wastewater

Kwajalein. An 18 percent increase in nonindigenous USAKA population on Kwajalein over the No-Action level would yield an additional 78,000 gpd (295,260 Lpd) or an 18 percent increase (0.38 to 0.52 mgd) in wastewater flows from the Kwajalein wastewater treatment plant. The increased loadings are less than the design capacity of the existing Kwajalein treatment plant (0.60 mgd). Therefore, a nonsignificant impact on lagoon receiving waters could be expected from these increased flows.

Metals in the discharge could meet water quality standards by establishing a mixing zone in the vicinity of the discharge. As described for the Low Level-of-Activity Alternative, the USASSDC study of wastewater discharges (USASSDC, 1993c) predicted for all alternatives that establishing a mixing zone is feasible. Development of the mixing zone would maintain compliance with water quality standards and would result in a nonsignificant impact.

A DEP would be required to assess the impact of additional discharges to lagoon waters.

Roi-Namur. Under the proposed Standards, addition of cooling water discharges from the new Roi-Namur power plant would require a Notice of Proposed Activity (NPA). The NPA would need to identify any potential impacts on water quality from alteration of the Roi-Namur wastewater treatment plant effluent quality. Until design parameters of the proposed power plant are known, water quality impacts are uncertain, but it is assumed that the cooling water discharge would be adequately treated. Based on that assumption, the addition of more waste loads and the new power plant would have a nonsignificant impact on receiving water quality.

In this alternative, a new primary wastewater treatment plant would be constructed on Roi-Namur and an existing outfall extended to deeper water. Under Subsection 3-2.7.1 of the proposed Standards, marine waters on the ocean side of Roi-Namur Island in the location of the proposed wastewater discharge would be designated class B (primarily because of the existing raw sewage discharges at that location). Subsection 3-2.7.1(d) states that, "All point sources from domestic wastewater treatment facilities shall receive a minimum of secondary treatment unless otherwise authorized in 3-2.7.1(f)." However, the Standards do provide (Subsection 3-2.7.1(f) for a variance for alternative treatment levels if overall water quality standards are achieved. With the proposed outfall extension, the new wastewater treatment plant would improve water quality off Roi-Namur and would comply with the Standards if a variance is approved by the appropriate agencies.

Table 4.3-5
Assessment of Potential Water Quality Impacts of the
Low Level-of-Activity Alternative Based on Proposed USAKA Standards

Action	Impact	Source	Contaminants	Significance Determination
Launches	Local area	Fuel, debris	Organics, acid rain	No or negligible
Population	18% increase	Spills, dumping	Organics	Nonsignificant
Wastewater	18% increase on Kwajalein; 11% increase on Roi-Namur; construction of new treatment plant	Domestic, industrial	Metals, BOD, TSS	Nonsignificant
Construction	Major construction on Kwajalein, Roi-Namur, Meck; interisland fiber optics cable construction	Erosion, spills, excavation	Organics, TSS, turbidity, fuels	Nonsignificant
Marine vessels	Shipping of supplies increased	Sewage discharges	BOD, TSS, bacteria	No or negligible
Quarrying and dredging	Quarrying, dredging on eight islands	Blasting, excavating	TSS, turbidity	Nonsignificant

Construction. New, major construction projects listed in Table 2.1-13 have the potential for increased spills, erosion, and debris entering nearshore waters causing increased levels of metals, hydrocarbon, turbidity, and other contaminants. Adherence to existing USAKA erosion control and spill prevention guidance would reduce or avoid uncontrolled discharges. Adoption of the Standards would not substantively improve protection, but would establish water criteria for assessing potential impacts of releases. Impacts would not be assessed differently using the proposed Standards because there are no substantive differences between the two sets of standards.

Adoption of the proposed Standards may require additional measures to reduce or control turbidity from excavating trenches for cable laying. The Standards specify turbidity levels that are the same as under U.S. statutes and regulations, but they are now subject to meeting water quality objectives in Class I TTPI marine waters. The high-energy reef flats where cables would be laid would be designated Class I waters with a turbidity objective of 1 NTU or less. In the small working area excavated during low tide, sediment and debris would be produced that may exceed the standard when the tide advances and suspends the material. It is probably impractical and ineffective to use filter fabric for this construction. Because the areas disturbed to trench and lay the cable are not extensive, an exceedance of the turbidity criteria would be considered of temporary duration and a nonsignificant impact.

Marine Vessels. Shipments to USAKA would be increased over the No-Action levels to support the increased range activities, new construction, and population growth. Adoption of the Standards may affect sewage discharges from vessels calling at USAKA because the proposed Standards prohibit sewage discharges from USAKA vessels to the waters of RMI. While discharges from non-USAKA vessels are typically small and the duration of visits is short, discharges of raw or poorly treated sewage could degrade water quality and present a health risk through water contact activities. As discussed above under existing U.S. statutes and regulations, a local impact on water quality could result depending on the types of sanitation devices (if any) on non-USAKA ships visiting USAKA and the durations of the visits. However, currents and surface mixing in Kwajalein lagoon would be expected to disperse the wastes and reduce impacts to nonsignificant levels within a short distance from the discharge. The USAKA Standards would prohibit discharges to Kwajalein lagoon from anchored, moored, or moving vessels, and therefore, would be somewhat more protective than existing U.S. statutes and regulations.

Quarrying and Dredging. Table 2.1-12 identifies that 69,185 cubic yards (52,894 cubic meters) of dredged fill material is required for construction and shoreline protection, while 58,780 cubic yards (44,940 cubic meters) of quarried armor rock would be needed for shoreline improvements. Quarrying and dredging activities are expected to have nonsignificant impacts on water resources for the same reasons as those listed under the existing U.S. statutes and regulations.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Under the proposed Standards, a DEP that assesses the degree of impact from increased treatment plant flows on receiving water quality and biota would be prepared. The Standards require a greater level of documentation and identification of ways to avoid or reduce impacts; therefore, it is possible that a lesser degree of impact to marine waters could be expected.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Under the Intermediate Level of Activity, the principal types of increased activity potentially affecting water quality are related to the following factors:

- All of the factors under the No-Action and Low Level-of-Activity alternatives
- Additional launch activity on Meck or Illeginni
- A 52 percent increase in nonindigenous USAKA population (from 3,250 to 4,925)
- Major new construction on Meck or Illeginni, with other projects on Legan and Ennugarret
- Discharges from minor new sources
- Increase in WWTP effluent volume for Kwajalein and Roi-Namur
- Deployment of two support vessels; increased ship traffic
- A major increase in land surface on Meck from quarrying and filling

Impacts–Existing U.S. Statutes and Regulations

Potential water quality impacts that may be caused by the Intermediate Level of Activity are identified in Table 4.3-6.

Launches. There would be an increase in the numbers and types of vehicles launched from USAKA, particularly from Meck. Additional liquid fuel storage facilities would be added on Illeginni and Meck, increasing the potential for accidental release on these islands. Assuming continuation of the controls already imposed on launch activities and construction of designated storage areas, no or negligible water quality impact is expected from additional launch activity.

Population. A 52 percent increase in USAKA nonindigenous population is associated with this level-of-activity alternative. This increase would have the same potential for uncontrolled releases that could impair water quality as under the Low Level of

Activity. Although there would be an increased risk of occurrence, the impact would still be considered nonsignificant because of the control measures being implemented by USAKA.

Table 4.3-6
Assessment of Potential Water Quality Impacts of the
Intermediate Level-of-Activity Alternative Based on Existing U.S. Statutes and Regulations

Action	Impact	Source	Contaminants	Significance Determination
Launches	Local area; new facilities on Meck or Illeginni	Fuel, debris	Organics, acid rain	Nonsignificant
Population	52% increase	Spills, dumping	Organics	Nonsignificant
Construction	Increased construction; major projects on Illeginni and Meck	Erosion, spills, excavation	TSS, oil, fuels	Nonsignificant
Wastewater	53% increase on Kwajalein; 21% on Roi-Namur	Domestic, industrial	Metals, BOD, TSS	Significant (Kwajalein); Nonsignificant (Roi-Namur)
Marine vessels	Increased traffic; stationing two support vessels	Sanitary discharges	BOD, TSS, bacteria	Nonsignificant
Quarrying and dredging	Major quarrying, dredging on eight islands; expansion of Meck	Blasting, excavating	TSS, turbidity	Nonsignificant

Construction. Construction on Meck and the development of Illeginni to support the proposed launch programs have the potential to affect the nearshore marine waters through runoff of erodible material, fuel spills and leaks, and other construction-related sources. The narrow configuration of the islands and the lack of sewage and stormwater control systems leaves the nearshore areas vulnerable to accidental discharges from the land or directly to intertidal areas. Application and enforcement of existing USAKA control measures during construction would avoid impacts or reduce them to nonsignificant levels.

Wastewater

Kwajalein. The increase in the nonindigenous USAKA population above the No-Action Alternative associated with this alternative would be expected to generate a 53.3 percent increase (0.38 to 0.67 mgd) in wastewater flows at Kwajalein. This would exceed treatment plant capacity (0.6 mgd). Operational changes and an additional clarifier (proposed in Subsection 4.13.2 as a wastewater mitigation for this alternative) would raise capacity to 0.84 mgd. An increase in metals, other toxics loading, and some conventional pollutants, with associated impacts on receiving water quality, could occur because the additional treatment would not remove these substances. As described above for the Low Level-of-Activity Alternative, the USASSDC study of wastewater discharges predicted for all alternatives (USASSDC, 1993c) that establishing a mixing zone is feasible. Development of the mixing zone would maintain compliance with water quality standards and result in a nonsignificant impact. Without the addition of one clarifier and implementation of operational changes, however, a significant impact on water quality would be expected.

Roi-Namur. Although a 21 percent increase in flow above the No-Action Alternative would be expected in this alternative, the design capacity of the proposed wastewater treatment plant would be sufficient to meet primary treatment requirements. Assuming that the new treatment plant and a mixing zone meet the requirements for a variance from the secondary treatment requirements of the Standards, nonsignificant impacts on receiving waters would be expected.

Other Islands. Impacts associated with increased activity levels on Meck, Illeginni, and other islands are discussed in Subsection 4.13.2.1 (Wastewater). No significant discharges to groundwater or surface waters resulting from increased wastewater loadings were identified. Nutrients in groundwater could increase, but the lens supply is not used for drinking water on these islands. No or negligible impact on water resources is expected.

Marine Vessels. With a substantial increase in construction activities to support the Intermediate Level-of-Activity Alternative, material and fuel shipments to USAKA would increase. In transit, vessels could discharge untreated or treated sanitary wastes to USAKA waters, impairing water quality, at least locally. Also, under this alternative, additional ships would be deployed to USAKA to support the increased range operations. U.S. vessels with marine sanitation devices are required to treat sewage on board with disposal in Kwajalein lagoon or in oceanic waters depending on holding capacity and deployment schedules. Adequate on-board treatment could reduce pollutant levels to approximately the same as primary treated wastes or better. Depending on the location of waste disposal, water quality could be impaired in a localized area. Local water quality impacts could be exacerbated depending on the types of sanitation devices (if any) on other ships visiting USAKA and the duration of the visits. However, because lagoon waters are generally well mixed, disposal of wastes from these vessels would be expected to have a nonsignificant, temporary impact on water quality.

Quarrying and Dredging. Quantities of quarrying and dredging proposed under this alternative are greater than under the Low Level-of-Activity Alternative and are listed in Table 2.1-14. The land surface area of Meck Island would be increased by mining and placing fill on the southern island margin. The same types of water quality and marine biota impacts potentially will accrue from these actions and at additional locations. Adherence to the same standard mitigation measures identified for the Low Level-of-Activity Alternative would reduce these potential impacts to nonsignificant levels. Alternatively, the use of commercially purchased aggregate and/or armor stone would reduce the amount of quarrying required at USAKA, and the associated turbidity impacts on surrounding waters.

Mitigation—Existing U.S. Statutes and Regulations

The mitigation measure identified in Subsection 4.13.2 (Wastewater) to add another clarifier at the Kwajalein treatment plant and implement operational changes would be sufficient to reduce the water quality impact from increased flows to a nonsignificant level.

Impacts—Proposed USAKA Environmental Standards and Procedures

Under the Intermediate Level of Activity, the principal types of increased activity potentially affecting water quality are the same as identified under U.S. statutes and regulations. Table 4.3-7 provides a summary of potential impacts and comparison to the proposed Standards.

Mitigation—Proposed USAKA Environmental Standards and Procedures

The same impacts that result from wastewater flows at Kwajalein identified for this alternative under the existing statutes and regulations would occur, and an additional clarifier and implementation of operational changes would be needed at the wastewater treatment plant to provide additional capacity. Under the proposed Standards, a DEP that assesses the degree of impact from increased treatment plant flows on receiving water quality and biota would be prepared. The Standards require a greater level of documentation and identification of ways to avoid or reduce impacts; therefore, a lesser degree of impact to marine waters could be expected.

HIGH LEVEL OF ACTIVITY

The High Level-of-Activity Alternative would involve a substantial increase in launch operations and expansion of operations on additional islands. All of the impacts associated with the No-Action, Low, and Intermediate Levels of Activity would also occur under this alternative. The principal types of increased activity potentially affecting water quality are related to the following factors:

- All of the impacts of the No-Action, Low, and Intermediate Levels of Activity
- Additional launch activity on Meck, Omelek, Illeginni, and Eniwetak
- An increase in the nonindigenous USAKA population from 3,250 to 5,400 (66 percent)
- Major new construction on Eniwetak, Omelek, Legan, Gagan, and Gellinam, with smaller construction activities at other islands

Table 4.3-7
Assessment of Potential Water Quality Impacts of the
Intermediate Level-of-Activity Alternative Based on Proposed USAKA Standards

Action	Impact	Significance Determination	Explanation	Difference Between U.S. Statutes and Regulations and Proposed Standards
Launches	Increased activity	No or negligible	Launches would be regulated the same under the proposed Standards	None
Population	52% increase	Nonsignificant	Adoption of groundwater protection standards and water quality criteria could require additional preventive and remedial measures	Groundwater protection standards not established under U.S. statutes and regulations
Wastewater	53% increase on Kwajalein; 21% on Roi-Namur	Significant	A DEP required for increased flows	Higher level of documentation and analysis of impacts required in USAKA Standards
Construction	Increased construction; major work on Illeginni	Nonsignificant	Some construction control measures already in place; water quality and reef protection standards unlikely to be exceeded because of turbidity controls	U.S. statutes and regulations do not require turbidity control measures
Marine vessels	Increased traffic; two ships stationed	No or negligible	Standards prohibit USAKA vessels from discharging treated or untreated sewage into RMI waters	U.S. statutes and regulations apply to fewer vessels and allow some treated and untreated discharges
Quarrying and dredging	Major quarrying, dredging	Nonsignificant	Marine water classification and water quality criteria for turbidity would require additional control measures	U.S. statutes and regulations do not require control measures

- New discharges from minor sources
- Increased effluent flows from Kwajalein and Roi-Namur WWTPs
- Major quarrying and dredging at Gagan, Omelek, Gellinam, and Eniwetak; smaller amounts at Kwajalein, Meck, Legan, and Ennylabegan

Impacts—Existing U.S. Statutes and Regulations

Potential water quality impacts that may result from the High Level-of-Activity Alternative are identified in Table 4.3-8.

Table 4.3-8
Assessment of Potential Water Quality Impacts of the
High Level-of-Activity Alternative Based on U.S. Statutes and Regulations

Action	Impact	Source	Contaminants	Significance Determination
Launches	Local area	Fuel, debris	Organics, acid rain	Nonsignificant
Population	66% increase	Spills, dumping	Organics	Nonsignificant
Wastewater	68% increase on Kwajalein; 34% on Roi-Namur	Cooling water	Metals	Significant (Kwajalein) Nonsignificant (Roi-Namur)
Construction	Increased over Intermediate Level; major work on Gagan, Gellinam, Legan, Eniwetak, and Omelek; cable laying from Kwajalein to Wake Island; cable for HITS sensors at Gellinam	Erosion, spills, excavation	TSS, oil, fuels, turbidity	Nonsignificant
Marine vessels	Stationing two support vessels, increased traffic	Sewage discharges	BOD, TSS, bacteria	Nonsignificant
Quarrying and dredging	Major quarrying, dredging; fill on Gellinam	Blasting, excavating	TSS, turbidity	Nonsignificant

Launches. There would be an increase in the numbers and types of vehicles launched from USAKA over the No-Action, Low, and Intermediate Level-of-Activity alternatives.

Population. A 66 percent increase in the total USAKA nonindigenous population would have the same potential for uncontrolled releases that could affect water quality that is described under the Low Level of Activity. Although there would be an increased risk of such releases, the potential impact is still considered to be nonsignificant because of the control measures currently being implemented at USAKA.

Wastewater

Kwajalein. A 68 percent increase in the nonindigenous USAKA population on Kwajalein Island is projected to yield a similar increase in wastewater flows (from 0.38 to 0.73 mgd) when compared with the No-Action Alternative level. These flows would exceed plant capacity (0.6 mgd). Adding the improvements identified in Subsection 4.13.2.1 as mitigation for this alternative (i.e., a clarifier, a blending tank, and operational changes) would increase capacity to 1.0 mgd; however, some conventional pollutants could still be passed to the lagoon receiving waters and increased metals and other toxic loadings could also occur. As described above for the Low Level-of-Activity Alternative, the USASSDC study of wastewater discharges (USASSDC, 1993c) predicted for all alternatives that establishing a mixing zone is feasible. Development of the mixing zone would maintain compliance with water quality standards and would result in a nonsignificant impacts. Without the additional plant improvements, however, a significant impact on water quality would be expected.

Roi-Namur. A 34 percent increase in flow would be expected in this alternative; however, the design capacity of the proposed wastewater treatment plant would be sufficient to meet primary treatment requirements. Assuming that the new treatment plant and a mixing zone meet the requirements for a variance from the secondary treatment requirements of the Standards, nonsignificant impacts on receiving waters would be expected.

Construction. Development of Eniwetak and Gellinam for launches, the construction of new launch facilities at Omelek, and new sensors at Gagan and Legan have the potential to affect the nearshore marine waters through runoff of erodible material, fuel spills and leaks, and other construction-related sources. Removal of vegetation on Gagan for development of new facilities would expose soils to erosion forces. Movement of surface materials onto the reef would increase nearshore turbidity and suspended sediment loads.

The small size of these islands and the lack of sewage system and stormwater control systems leaves the nearshore areas vulnerable to accidental discharges from the land or directly to intertidal areas. Implementation and adherence to standard prevention and control measures during development and construction should reduce the impacts to a nonsignificant level.

Construction of a fiber optics cable from Kwajalein to Wake Island may require trenching across the reef at some point at USAKA. The final route has not been established, but impacts would be similar to those resulting from interisland cable connections as described under the Low Level-of-Activity Alternative. A fiber optics cable would also be placed between Gellinam and the Hydroacoustic Impact Timing System (HITS) sensors on the lagoon floor. Turbidity levels would be increased during trenching in the vicinity of construction for both projects. Nonsignificant impacts are expected during construction as a result of the relatively small trench width and short duration of these operations.

Marine Vessels. Increased construction and range support activities would require increased vessel traffic. As described under the Low and Intermediate Level-of-Activity alternatives, local water quality impairments can be expected from vessel discharges of both treated and untreated sewage. Water quality impacts could be exacerbated if vessels without marine sanitation devices or poor treatment capability predominate and remain in the lagoon for extended periods. However, vessel discharges of sewage are expected to result in nonsignificant impacts to water quality because of the active currents and mixing that occur in USAKA's lagoon waters.

Quarrying and Dredging. Under this alternative, new construction programs on several USAKA islands would require dredged and quarried material totaling 360,000 cubic yards (275,230 cubic meters) (see Table 2.1-15). Turbidity and suspended solids in the vicinity of the dredging and disposal areas would increase during the period of active mining. Water quality would be impaired in the area of the dredge activity depending on the type of equipment and cutter head used (e.g., hydraulic, bucket, or dragline) and the substrate mined (e.g., sand, coral, or rock). A plume of suspended material would move downcurrent to impact water quality beyond the area of activity. However, if silt curtains are used to contain sediment, water quality impacts should be reduced to local occurrences and should be nonsignificant. Alternatively, the use of commercially purchased aggregate and/or armor stone would reduce the amount of quarrying required at USAKA, and the associated turbidity impacts on surrounding waters.

Mitigation–Existing U.S. Statutes and Regulations

The mitigation measures identified in Subsection 4.13.2 (Wastewater) for this alternative (i.e., one additional clarifier, a blending tank, and operational changes) would increase hydraulic capacity and operational efficiency of the Kwajalein treatment plant enough that water quality impacts would be reduced to a nonsignificant level.

Impacts–Proposed USAKA Environmental Standards and Procedures

The High Level-of-Activity Alternative involves a substantial increase in launch operations and an expansion of operations on additional islands. The impacts associated with the Low and Intermediate Levels of Activity would also occur under this alternative. Potential water quality impacts that may result from the High Level of Activity would be approximately similar in type to those under the Intermediate Level of Activity, except that the magnitude of the wastewater flows and the quantities of dredge and fill would increase. The significance of water quality impacts under the High Level of Activity, assuming USAKA Standards, would be the same as those listed in Table 4.3-7. However, under the proposed Standards, a DEP that assesses the degree of impact from increased treatment plant flows on receiving water quality and biota would be required.

Mitigation–Proposed USAKA Environmental Standards and Procedures

The same impacts that result from wastewater flows at Kwajalein identified for this alternative under the existing statutes and regulations would occur, and an additional clarifier, a blending tank, and operational changes would be needed at the wastewater treatment plant to provide additional capacity and operational efficiency. Under the proposed Standards, a DEP that assesses the degree of impact from increased treatment plant flows on receiving water quality and biota would be required. The Standards require a greater level of documentation and identification of ways to avoid or reduce impacts; therefore, a lesser degree of impact to marine waters could be expected.

4.3.2 Proposed USAKA Environmental Standards and Procedures

The USAKA Standards for water quality and reef protection differ from the U.S. statutes and regulations by establishing groundwater protection controls and setting numerical standards for coastal waters, groundwater uses, and groundwater areas. The USAKA Standards do not establish specific limits in all cases, but a DEP will be required for nearly all activities potentially affecting water quality. The DEP process has different requirements for analysis and documentation than the U.S. statutes and regulations.

NO ACTION

Existing U.S. Statutes and Regulations

Under existing U.S. statutes and regulations, the applicable regulations for water quality are derived from the SDWA and the Clean Water Act (CWA). While SDWA regulations apply to potable water supplies and domestic water quality, the CWA provides a comprehensive framework of regulations that apply to many activities affecting the quality of natural water bodies, including surface water, groundwater, and marine waters. Under the CWA, ambient water quality criteria are established by U.S. EPA as guidelines for protection of aquatic life in marine and freshwater systems. Table 4.3-9 provides an overview of applicable CWA sections that could be triggered by the types of activities expected to occur under the three level-of-activity alternatives.

Table 4.3-9
Examples of USAKA Activities Regulated by the Clean Water Act

Regulation	Proposed Action	Impacts	CWA Reference
Oil removal plans	Construction	Oil spills	40 CFR 109
Water quality management plan	Construction	Groundwater protection	40 CFR 130.6(c) and 130.10
Groundwater quality standards	Water supply	Groundwater protection	40 CFR 141.11, .12, .15, .16, .61, and .62
Antidegradation standards	Point/nonpoint discharges	Marine water protection	40 CFR 131.12
Point source discharges	Thermal, industrial, and WWTP	Municipal and industrial wastewater	40 CFR 122.21, 125.3; 40 CFR 133.100
Dredge/fill activities	Shoreline protection	Water quality and marine biology	40 CFR 220-228
Ocean disposal	Disposal of bulky metallic waste	Ocean dumping	40 CFR 230-330
Stormwater	Construction	Erosion, runoff	40 CFR 122.26
Marine sanitation	Shipping traffic; research vessel support	Marine water quality	40 CFR 140

In addition to the CWA provisions, Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) applies to the discharge of dredged materials in ocean waters.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Proposed USAKA Environmental Standards and Procedures

The proposed Standards for water quality and reef protection differ from the U.S. statutes and regulations, which are largely based on the Clean Water Act (40 CFR Parts 100-140 and 400-403) and Earthmoving Regulations of the RMI, in that controls or procedures that are not applicable to the USAKA environment are eliminated, such as state certification programs.

Water quality and reef protection procedures and standards are contained in Sections 2-17 and 3-2 and Subsection 2-9.2.2 of the proposed Standards. The prime objective of the regulations is to protect the waters, public health, safety, and the environment at USAKA. Table 4.3-10 is a summary of the Standards that would be applicable to the level-of-activity alternatives.

Table 4.3-10
Examples of Activities Regulated Under the USAKA Environmental Standards and Procedures

Regulation	Proposed Action	Comparison with U.S. Statutes and Regulations	USAKA Reference
Oil removal plans	Construction	No similar change	3-2.8.1; 3-6.14;
Water quality management plan	Support and operations facilities	Requires site-specific plan identifying wetland and coastal areas, non-point sources of pollution, sources of groundwater contamination, and management and control practices for reef resources and stormwater	3-2.4, 3-2.5.1, 2-8.2.2; Appendix 3-2C, and 3-2I
Groundwater quality standards	Water supply	Increases groundwater protection; sets quality limits	Appendix 3-2C.2; Appendix 3-2D; Appendix 3-2E
Antidegradation standards	Point/nonpoint discharges	Improves marine water protection	3-2.6.2
Point source discharges	Thermal, industrial, and WWTP	Defines municipal and industrial wastewater standards	3-2.7.1; 3-2.7.3; 3-2.7.5; Appendix 3-2G.4
Dredge/fill activities	Shoreline protection	Expands dredging, fill, and quarrying permit requirements	2.17-3; 3-2.8.2; 3-2.7.2
Ocean disposal	Disposal of bulky metallic waste	Defines ocean dumping on case-by-case basis	3-2.8.2; 3-5
Stormwater	Nonpoint sources	Requires control of erosion, runoff	3-2.5.1(f); 3-2.7.3
Marine sanitation	Research vessel support	Prohibits all discharges of sewage from USAKA vessels to RMI waters	3-2.7.4; 3-2.8.3

In Table 4.3-11, a summary of the differences between the USAKA Standards for water quality and the comparable U.S., TTPI, and other regulations is presented, including an overview of differences resulting from adopting the USAKA level of protection.

Overall, the proposed USAKA Standards provide increased protection of water resources by adopting the more stringent requirements of the U.S., TTPI, and RMI regulations. The USAKA Standards include setting of numerical surface water objectives and the antidegradation standard requires control of pollution sources if water quality is impaired under existing conditions, as well as a clear demonstration that future discharges would not impair receiving waters or affect environmental resources at USAKA. The proposed Standards allow for variances in several areas; however, the applicant must clearly demonstrate that other alternatives have been evaluated and that there are no other feasible actions that would avoid, reduce, or further mitigate impacts to the environment.

Under the proposed Standards, a substantial body of data is required for all new sources or for those continuing under the Notice of Continuing Activity (NCA), DEP, or NPA. Each of these processes requires USAKA to gather a sufficient level of data and prepare an analysis of potential impacts and alternatives to the action. The documentation is subject to review by appropriate U.S. resource agencies and RMIEPA. This analysis and review cycle would result in a greater level of evaluation and demonstration of impact than under U.S. statutes and regulations. The proposed Standards also include provisions for several levels of conflict resolution by the appropriate agencies in cases where the demonstration of protection offered by USAKA for an action is deemed inadequate by reviewers.

The specificity of the demonstration and data analysis required and the level of scrutiny offered by the proposed Standards significantly improves levels of protection. USAKA has initiated or is required by the proposed Standards to develop and gain approval of a water quality management plan, to complete the Environmental Mitigations of the 1989 EIS, and to adopt the antidegradation standards that are key elements in a comprehensive set of measures to improve and protect water resources at USAKA.

Mitigation

Because no significant adverse impacts of the water quality elements of the proposed Standards are identified, no mitigation is required.

Table 4.3-11
Summary of USAKA Water Quality Standards Comparison

Regulation	USAKA	U.S./Other	Conclusion
Classification of Coastal Water Uses	Creates three classes; precludes discharges to AA (ocean) waters.	Adopts TTPI classifications.	Discharge locations restricted by receiving water classifications. Best practicable treatment not required, but overall protection is the same or more stringent than existing standards.
Water Quality Management Plans	Establishes water quality plans similar to U.S.; specific studies needed for new sources and when treatment capacity or limits exceeded.	Requires water quality plans and implementation plans by states.	Management plans provide a process to improve or maintain water quality by requiring studies to assess effects. Use of TMDLs, effluent limits, and treatment requirements; however, a DEP could be used to establish needs for specific discharges. Implementation process would be the final determinant of level of protectiveness.
Antidegradation Standards	Protects Groundwater Class I/II; limits degradation to existing condition, if current levels exceed limits; Class III groundwater cannot be degraded without a waiver.	U.S. requires similar policy; standards for protecting existing uses; and to maintain or improve existing conditions.	USAKA Standards protect existing water quality. Where existing quality is degraded, control and corrective actions are required. Restoration is not required under 3-2 Water Quality and Reef Protection section, but is required by 3-6 Materials and Waste Management. Waivers are restricted to human health and marine resource issues; other issues not included as in TTPI/RMI regulations.
Point and Non-point Source Discharges	Requires a DEP for new discharges and dredge and fill activities. Stormwater discharges are included for points sources. Stormwater assessments required.	U.S. requires full NPDES permit for discharges. Permit required for stormwater.	USAKA Standards are the same or exceed U.S. regulations in analysis of environmental effects; require an assessment of source control and waste minimization actions. USAKA DEP and NPDES permit processes provide similar protection.
Dredge or Fill Material	A DEP is required for dredge and fill actions. USAKA requires analysis of alternatives, a water quality assessment,and mitigation measures identified.	A 404 permit is required in the U.S.	USAKA Standards exceed U.S. regulations in analysis of impacts and are applicable to quarrying and spoil disposal. DEP and 404 permit process provide similar protection. Turbidity control measures are key elements in protection of the environment.
Discharge from Marine Vessels	Prohibits discharge of sewage by USAKA vessels to RMI waters.	U.S. regulations applicable only to vessels with sanitation devices. U.S. limits for fecal coliform (<200/150 ml) and suspended solids (150 mg/L).	USAKA Standards prohibit all discharges of sewage from USAKA vessels into RMI waters; therefore, some discharges currently allowed would be eliminated.
Water Quality Criteria for Surface Water	USAKA establishes water quality criteria for 40 toxic substances. Seven criteria not included in U.S. statutes and regulations. Additional criteria are listed for specific source categories. Approximately 120 criteria identified. Criteria are not specific to fresh or marine waters. Most USAKA Standards are equal to or more stringent than U.S.	Federal regulations list 126 substances, and are defined for fresh and marine water, and for human health. Both acute and chronic protection values listed. TTPI has same criteria as USAKA. Phosphorus value is more stringent in Class B waters.	USAKA Standards would essentially regulate the same substances, but actual application of criteria is based on specific DEP rather than for all waters at USAKA. Application factors in DEP would determine the effectiveness of the protection standards.
Primary Groundwater Standards	Standards applicable to all classes of groundwater at USAKA.	Standards applicable to drinking water sources. Limits set for 46 metals and organics and 5 radiochemicals.	USAKA Standards afford greater protection to all groundwater resources than existing regulations. Application of Standards could require additional treatment and compliance costs.
Secondary Groundwater Standards	Basically the same as U.S.; applicable to all groundwater sources.	U.S. standards are for aesthetic and nonhealth reasons.	USAKA Standards provide the same or greater level of protection.

4.4 Air Quality

4.4.1 Level-of-Activity Alternatives

Activities associated with the level-of-activity alternatives that have the potential to affect air quality in Kwajalein Atoll include power generation, solid waste incineration, transportation, fuel storage and handling, and rocket launches. Impacts of these activities are evaluated with respect to the following air quality issues, which are further described below.

- Criteria pollutants
- Noncriteria pollutants
- Stratospheric ozone depletion
- Global warming
- Acid rain

This section addresses air quality issues that apply to all level-of-activity alternatives first. Issues that have the potential to affect global resources (stratospheric ozone depletion, global warming, and acid rain) are analyzed assuming a maximum contribution of USAKA rocket launches. Air quality issues are then evaluated specifically within the context of the level-of-activity alternatives. Finally, the proposed USAKA Environmental Standards and Procedures are analyzed.

Criteria Pollutants

Criteria pollutants are those chemical compounds for which ambient air quality standards have been promulgated. These criteria pollutants are emitted primarily from combustion sources such as power plants, boilers, aircraft engines, marine vessel boilers and engines, automotive engines, solid waste incinerators, burn pits, explosive ordnance disposal (EOD) activities, and missile launches. These pollutants are regulated and controlled so that the concentration does not exceed either short-term or long-term standards of these compounds in ambient air. These standards are listed as National Ambient Air Quality Standards (NAAQS) and are shown in Table 4.4-1, along with proposed Standards for air quality.

Noncriteria Pollutants

Noncriteria pollutants are other air pollutants that are regulated and controlled by emission standards or other health-risk-based criteria. These pollutants are emitted from industrial or maintenance activities, such as the use of solvents from paints, automobile maintenance, and missile maintenance activities; metals and organic emissions from solid waste incineration activities; emissions related to photographic chemical usage; and HCl emissions from missile launches.

Table 4.4-1
National Ambient and Proposed USAKA Air Quality Standards

Pollutant	Averaging Time	National Ambient Air Quality Standards ($\mu g/m^3$)[a]	USAKA Ambient Air Quality Standards ($\mu g/m^3$)[b]
Carbon monoxide (CO)	1-hour 8-hour	40,000 10,000	10,000 + baseline 2,500 + baseline
Ozone (O_3)	1-hour	235	58.75 + baseline
Nitrogen dioxide (NO_2)	Annual	100	25 + baseline
Sulfur dioxide (SO_2)	3-hour 24-hour Annual	1,300 365 80	325 + baseline 91.25 + baseline 20 + baseline
Particulate matter less than 10 μm aerodynamic diameter (PM_{10})	24-hour Annual	150 50	37.5 + baseline 17.5 + baseline
Lead	Quarterly	1.5	.375 + baseline

[a]National standards other than those for ozone and those based on annual or quarterly averages are not to be exceeded more than once per year. Standards based on annual or quarterly averages are not to be exceeded. The ozone standard is not to be exceeded more than an average of 1 day per year over a 3-year period.
[b]USAKA air quality standards are measured in the same way as those for NAAQS, with the exception that ozone is not averaged over a 3-year period. The formula for computing the USAKA standard is the lesser of 80% × NAAQS, or 25% × NAAQS + baseline conditions, with existing sources on an island-by-island basis just prior to the effective date of the USAKA Standards.

Stratospheric Ozone Depletion

Exhaust products from the chemical propulsion systems of rockets such as those proposed to be launched from USAKA have been identified as contributing to ozone depletion (American Institute of Aeronautics and Astronautics, 1991; Aftergood, 1991). The most important photochemical reactions that destroy ozone involve various radicals of nitrogen, hydrogen, and chlorine. The largest SLV booster proposed to be launched from USAKA, the SR-19, would emit into the stratosphere about 2.65 tons (2.4 metric tons) of hydrogen chloride, or a total equivalent of 2.58 tons (2.3 metric tons) of inorganic chlorine from one launch. In the High Level-of-Activity Alternative, from 1992 to 1998, the number of launches of SLVs would range between 4 and 84 per year. Assuming maximum impact of 84 launches per year, the launches planned at USAKA under this alternative would release a maximum of approximately 216 tons (196 metric tons) of inorganic chlorine into the stratosphere per year. In fact, many of the launches would not involve SR-19 boosters, so the amount of inorganic chlorine released would be considerably less.

These calculations indicate that the High Level-of-Activity Alternative would contribute 0.066 percent to the annual total global stratospheric chlorine burden of 330,000 tons (299,369 metric tons) (Prather et al., 1990). A launch rate of nine Space

Shuttles and six Titans per year has been calculated to deposit about 800 tons (726 metric tons). Natural nonvolcanic sources add 72,500 tons (65,771 metric tons) of chlorine to the stratosphere annually, and the highly variable volcanic component adds 110,000 tons (99,790 metric tons) to 1,100,000 tons (997,898 metric tons) of chlorine as hydrogen chloride each year (Bennet et al., 1991).

USAKA SR-19 booster emissions of water into the stratosphere would be about 3.3 tons (3.0 metric tons) per launch and approximately 276 tons (250 metric tons) annually assuming an 84-launch-per-year schedule. The High Level-of-Activity Alternative would emit into the stratosphere no more than 6.5×10^{-5} percent of the annual total global stratospheric water flux, which is 425,000,000 tons (385,551,500 metric tons) (Bennet et al., 1991). The stratospheric deposition of water from all other rocket chemical propulsion systems, assuming nine Space Shuttle and six Titan launches per year, has been calculated at 3,580 tons (3,248 metric tons) in 1992 (Bennet et al., 1991; Kolb et al., 1990).

Nitrogen oxide compounds, which are combustion products of some other chemical propulsion systems, may be involved in ozone depletion. In the High Level-of-Activity Alternative, the proposed USAKA launches would introduce a maximum of approximately 112,000 pounds (50,802 kilograms) of nitrogen oxides into the stratosphere.. Global nitrogen oxide emissions in 1989 were 20,000 tons/year (18,144 metric tons/year). The USAKA contribution is 0.28 percent of the total. The contribution of USAKA booster systems compared with the total propulsion system contribution of NO_x is small.

In addition to gaseous substances, solid-phase species have been implicated in the catalytic destruction of stratospheric ozone. A correlation between ozone depletion and large increases in stratospheric aerosol content as a result of volcanic activity has been reported (Jager and Wege, 1990; Hofmann and Solomon, 1989; Adriani et al., 1987). This suggests that ozone depletion is surface-area-dependent. The effects of aluminum oxide particles (an exhaust product of solid-fuel rocket boosters) on stratospheric ozone are being investigated. Studies of the effects of aluminum oxide are inconclusive as to its impacts on stratospheric ozone. The emissions of aluminum oxide into the stratosphere from the number of launches proposed for the High Level-of-Activity Alternative would be a maximum of approximately 397 tons (360 metric tons), annually, assuming all launches were SR-19 boosters.

The emissions calculated for the launch schedule of nine Space Shuttles and six Titans can be used to put the estimate of the ozone depletion potential of the High Level-of-Activity Alternative in perspective. The sum of the ozone depletion potential from the homogeneous chemical species produced by all current solid-propellant booster systems could be as high as 0.034 percent (Bennet et al., 1991). The maximum annual 84 launches of SR-19 boosters in this alternative would produce ozone-depleting species 0.086 percent of that resulting from all current chemical propulsion systems globally. Compared with a schedule of nine Space Shuttles and six Titans, it is estimated that the launches associated with the High Level-of-Activity Alternative could result in a maximum annual global ozone loss in the range of 0.001 to 0.01 percent.

Changes in the earth's stratospheric ozone layer may result in changes in the amount of damaging solar ultraviolet radiation striking the surface of the earth. The NRC has estimated a 2 to 5 percent increase in basal cell skin cancer incidence for a 1 percent decrease in stratospheric ozone and an increase in squamous cell skin cancer of about double that estimate. The predicted increases are appreciably greater at lower latitudes than at higher (NRC, 1982). Recent research has calculated a 2.4 percent increase in basal cell skin cancer and a 4.0 percent increase in squamous cell skin cancer for every 1 percent decrease of ozone (Kelfkins et al., 1990). NRC is hesitant to make quantitative predictions about the increase in the incidence of melanoma skin cancer associated with a decrease in ozone (NRC, 1982).

Since the 1982 NRC report, additional research has been published. The effect of changes in the ozone layer on the incidence of skin cancer was explored using data from Norway. In that study it was noted that melanoma exhibits approximately the same ultraviolet dose-relationship as that found for nonmelanoma skin cancer (Henriksen et al., 1990). In a summary of a comprehensive report prepared for U.S. EPA, which examined the relationship between ultraviolet radiation and malignant melanoma, Longstreth (1988) predicted that a 1 percent depletion of ozone would result in an increase of 1 to 2 percent in melanoma incidence and an increase of .8 to 1.5 percent in melanoma mortality.

Other human health hazards associated with ultraviolet radiation exposure are sunburn, degenerative changes in skin, photokeratitis (an acute, painful affliction of the cornea), and damage to the immune system. It appears that domestic food animals would not be significantly affected by increased incidence of ultraviolet radiation. Plant species appear to be sufficiently adaptable so that food crop yields would be maintained. The effects of increased ultraviolet radiation on terrestrial faunal ecosystems have not been extensively studied (NRC, 1982). Currently, the data are inconclusive about impacts of enhanced ultraviolet radiation on marine organisms.

Although the quantitative relationship between ozone layer depletion and human skin cancer is incompletely understood, an estimate of the potential effect of the High Level-of-Activity Alternative on the incidence of human skin cancer was made. Employing a ratio of a 2 percent increase in human skin cancer for each 1 percent decrease in stratospheric ozone (Longstreth, 1988), an extrapolation based on an assumption of 84 launches of the SR-19 booster shows that this alternative could potentially result in a 0.002 to 0.02 percent increase in human skin cancers. The incidence of nonmelanoma skin cancer in the United States was approximately 600,000 cases in 1990 (Silverberg et al., 1990). Based on the assumptions listed above, the High Level-of-Activity Alternative would add 12 to 120 nonmelanoma skin cancer cases annually to the total United States population, and would add negligible cases of nonmelanoma cancer to the population at USAKA and RMI. The overall average annual age-adjusted (U.S. 1970 standard distribution) melanoma incidence rate for the United States during the period 1982 to 1986 was 9.4 per 100,000 (U.S. Department of Health and Human Services, 1989). Applying this incidence rate to the 1990 United States population figure of 248,700,000 persons, approximately 23,400 cases of melanoma would be expected. The High Level-of-Activity Alternative is expected to add negligible cases of melanoma to the total United States populations on an annual basis and negligible cases to the populations at USAKA and RMI.

Impacts on stratospheric ozone depletion from the High Level of Activity are considered nonsignificant because the quantities of emissions, environmental impacts, and human health effects from this alternative are small in the context of other sources identified above.

Global Warming

Background

Over the past 150 years, human activities have produced a significant increase in the concentration of carbon dioxide (CO_2) in the earth's atmosphere. The average CO_2 concentration has increased on a worldwide basis by approximately 25 percent since the middle of the 19th century, from 290 parts per million (ppm) in 1850 to 350 ppm in 1990. CO_2 is currently increasing in the atmosphere at a rate of about 1.5 ppm per year, equivalent to a net global accumulation of about 3.3 billion tons (3 billion metric tons) of carbon per year. In the carbon cycling literature, CO_2 mass is commonly expressed in terms of a carbon equivalent. Virtually all of the increase in CO_2 emissions is attributable to human causes, including fossil fuel combustion and tropical deforestation. The largest source is fossil fuel combustion, which releases about 6.2 billion tons (5.6 billion metric tons) of carbon per year into the atmosphere. By comparison, increased decomposition and slash burning following tropical deforestation release about 2.2 billion tons (2 billion metric tons) of carbon per year into the atmosphere (Houghton and Woodwell, 1989).

Although CO_2 is still a relatively minor constituent of the atmosphere (~0.03 percent by volume), the increase in its concentrations has been the cause of much concern because of CO_2's role as a "greenhouse gas." Greenhouse gases absorb infrared radiation (radiant heat) from the earth's surface, which warms the air in a manner that is loosely analogous to the warming that occurs inside a greenhouse. In this respect, CO_2 has an important role in regulating the temperature of the earth's atmosphere. CO_2 is only one of several greenhouse gases whose concentrations are increasing in the atmosphere. Others include methane, nitrous oxide, water vapor, ozone, and chlorofluorocarbons (Houghton and Woodwell, 1989).

Recent analyses of land and marine temperature records have confirmed that the earth has warmed by approximately 0.9°F (0.5°C) over the past century (Houghton and Woodwell, 1989). The causes of the warming are not known, however. The observed warming trend could be natural or human-caused, or both. While there is a strong circumstantial link between global temperature rise and increasing CO_2 concentrations in the atmosphere, no proof has yet been demonstrated. The correlation of CO_2 with temperature does not establish whether changes in the global concentrations of greenhouse gases cause—or were caused by—the observed warming trends.

Expected Impact of Global Warming

Carbon dioxide would form approximately 25 percent by weight of the combustion products of the largest SLV booster to be used at USAKA (the SR-19) (Martin Marietta, 1985). Each SR-19 booster would release approximately 8,423 pounds (3,821 kilograms) of CO_2 into the troposphere. If all of the 84 SLV launches proposed for the High Level-of-Activity Alternative were SR-19 boosters, maximum annual releases of CO_2 to the troposphere from rocket launches at USAKA would be approximately 707,500 pounds (320,915 kilograms) of CO_2, or 97 tons (88 metric tons) of carbon per year. The total maximum annual release of carbon is less than 1×10^{-5} percent of the annual global accumulation of carbon of 3.3 billion tons (3 billion metric tons) per year. The contribution of USAKA rocket launches to global carbon accumulation would be so minuscule that the immediate and long-term effects of USAKA launches on global warming would be nonsignificant.

Expected Impact on Sea Level Rise in the Marshall Islands

As noted in the 1989 EIS, there is considerable uncertainty in the scientific literature regarding the effects of increased greenhouse gas emissions on sea level changes in the Marshall Islands. Current estimates of sea level changes following a doubling of greenhouse gas emissions are variable and highly speculative. There is considerable uncertainty in the scientific literature regarding the magnitude and spatial extent of climate change following an increase in greenhouse gas emissions, and even greater uncertainty regarding the effects of global warming on terrestrial and oceanic systems, including a general rise in sea level caused by melting of glaciers and the polar ice caps.

In a recent study (NOAA, 1990b), the National Oceanic and Atmospheric Administration assessed the effects of the higher sea levels that scientists advising the Intergovernmental Panel on Climate Change (IPCC) predicted in 1990. The IPCC scientists have conjectured that, depending on the assumptions chosen, ocean levels could rise by a little over 1 foot during the next century to as much as 3 feet. Taking the lower estimate of 1 foot per century, the NOAA study concluded that the population of the 29 atolls and 5 islands of the Marshall Island group would need to be protected against a rising sea by the year 2022. Higher sea level rise would cause the loss of a substantial portion of the islands, according to NOAA.

Whether or not the predicted changes occur, as described above, the launches associated with the level-of-activity alternatives are expected to produce a negligible increase in greenhouse gas emissions. Furthermore, the duration of the proposed launches at USAKA is short compared with time scales of change in the atmosphere and oceans. For these reasons, the proposed launches would have a negligible effect on sea level changes in the Marshall Islands.

Overall, the immediate and cumulative effects of the proposed USAKA launches on the greenhouse effect would be minute and are therefore considered nonsignificant.

Acid Rain

Background

Studies indicate that acid deposition (dry and wet) is caused primarily by three "strong acids" (in decreasing order of importance): sulfuric acid (H_2SO_4), nitric acid (HNO_3), and hydrochloric acid (HCl). H_2SO_4 and HNO_3 have their origins in the oxidation of gaseous SO_2 and NO_2, while HCl is produced by the reaction of H_2SO_4 with atmospheric sodium chloride (salt) of marine origin. Globally, most of the strong acid formation is a consequence of fossil fuel combustion (Wayne, 1985).

Even in remote areas, natural precipitation is slightly acid because of the presence of carbonic acid, which is formed when carbon dioxide in the atmosphere diffuses into water droplets. However, because carbonic acid is a "weak" acid, the pH of natural rainwater is limited to minimum values of ~5.6 (Wayne, 1985).

The proposed USAKA launches would produce emissions of HCl, as well as the acid precursors SO_2 and NO_2. The maximum predicted downwind concentration of HCl is expected to range from 97.5 $\mu g/m^3$ for the No-Action Alternative to 393 $\mu g/m^3$ for the High Level-of-Activity Alternative (both 1-hour averages). The maximum predicted downwind concentration of NO_2 is expected to range from 0.0112 $\mu g/m^3$ for the No-Action Alternative to 0.159 $\mu g/m^3$ for the High Level-of-Activity Alternative (both annual averages). Modeling was not performed for SO_2 because the solid rocket emissions of sulfur compounds are extremely small. Of the rockets launched at USAKA, sulfur is a constituent of the solid fuel propellant of only four rocket types, all small meteorological rockets. Assuming that the average meteorological rocket has a propellant weight of 57 pounds (26 kilograms) (as does the Viper III rocket), that 20 percent of the propellant weight is polysulfide (plastic) binder, that 30 percent of the polysulfide binder is sulfur, that 100 percent of the sulfur is converted to SO_2 during combustion, and that 72 rockets per year are launched, the resulting atmospheric loading rate is 492 pounds per year (0.25 ton [0.23 metric ton] per year). This amount is small compared with emissions of Al_2O_3, CO, and HCl, and is expected to produce negligibly small concentrations of SO_2 in the atmosphere.

In the atmosphere, the gas-phase oxidation of SO_2 is dominated by reaction with hydroxyl (OH) radicals, and the final product is sulfuric acid aerosol ("gas to particle conversion"). The solubility of SO_2 is relatively low, so there is little direct diffusion of SO_2 into rain droplets to form sulfurous acid, H_2SO_3. The average lifetime of SO_2

with respect to the former reaction is approximately 3 to 4 days (U.S. EPA, 1984). Because the oxidation reactions that drive the formation of H_2SO_4 are slow, the sulfuric acid aerosols tend to be transported for long distances (i.e., hundreds of miles downwind of the source). At these distances, dispersion of the H_2SO_4 aerosols tend to minimize the effect on the acidity of the rainwater. Moreover, the acid neutralizing (or buffering) capacity of the oceans is so large that the impact of even very low pH rainwater would be immeasurable.

The gas-phase oxidation of NO_2 in air is dominated by reaction of OH radicals in the presence of a catalyst (usually molecular nitrogen or oxygen) to form a variety of products, including HNO_3 vapor. Nitrogen trioxide and nitrous acid play active roles in photochemical cycles, but make much smaller direct contributions to acid deposition. The average lifetime of NO_2 with respect to reaction with OH radicals is approximately one-half day (U.S. EPA, 1984). Because the oxidation reactions that drive the formation of HNO_3 are relatively fast, this tends to favor short-range transport of the acid aerosols (i.e., less than 100 miles [161 kilometers] downwind of the source). Even at these distances, the dispersion of the nitric acid aerosols would be great enough to minimize the impact on the acidity of the rainwater. The acid neutralizing (or buffering) capacity of the oceans is so large that the impact of even very low pH rainwater would be immeasurable.

The proposed launches at USAKA would produce direct emissions of HCl, a strong acid. HCl is considerably more soluble in water than either H_2SO_4 or HNO_3; therefore, it can be expected to be removed by direct absorption of acid vapors much faster than either of the other two acids evaluated (U.S. EPA, 1984). Nonetheless, given the relatively low concentrations of HCl predicted downwind, the impact of the proposed launches on the pH of rainwater is expected to be negligible. Moreover, the buffering capacity of the oceans surrounding the Marshall Islands is so great that the impact of even low pH rainwater would be negligible.

Levels of Significance—Existing U.S. Statutes and Regulations

U.S. statutes and regulations derive from the U.S. Clean Air Act regulations as revised through February 1992. Levels of significance assuming U.S. statutes and regulations are:

- **No or Negligible Impact.** Any change in air pollutant emissions would be less than the regulatory threshold for emissions (Table 4.4-2).

- **Nonsignificant Impact.** Air pollutant emissions could be greater than the regulatory threshold for emissions (Table 4.4-2), but would be less than ambient air quality or hazardous/toxic emissions standards.

- **Significant Impact.** The increase in air pollutant emissions would cause or contribute to exceedance of the NAAQS or the applicable toxic air contaminant health criterion.

Table 4.4-2 Regulatory Review Emission Rates[a] (in tons per year)	
Parameter	Threshold
Carbon monoxide	100
Nitrogen oxides	40
Sulfur dioxide	40
PM_{10}	15
Particulate matter	25
Ozone	40 (of VOCs)
Lead	0.6
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7
Hydrogen sulfide (H_2S)	10
Total reduced sulfur (including H_2S)	10
Reduced sulfur compounds (including H_2S)	10

[a]Derived from U.S. EPA Prevention of Significant Deterioration (PSD) Regulations (40 CFR 52.21).

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

New standards for regulating air pollutant emissions are proposed in the USAKA Standards. Levels of significance for the proposed Standards are:

- **No or Negligible Impact.** There would be no change in air pollutant emissions relative to existing conditions. Air pollutant emissions would increase, but the increase would be less than the regulatory threshold for review defining major increases in emissions (Table 4.4-3).

- **Nonsignificant Impact.** Increases in air pollutant emissions would not cause or contribute to exceedance of 80 percent of the ambient air quality standards. No activity at USAKA, either alone or in combination with other sources, would cause an increase of more than 25 percent of an NAAQS when added to baseline conditions (defined in the Standards as the conditions on the day before the Standards become effective). Increases in air pollutant emissions would not exceed the applicable criteria for hazardous/toxic air pollutants specified in the proposed Standards (Appendix C).

- **Significant Impact.** The increase in air pollutant emissions would cause or contribute to an exceedance of 80 percent of an ambient air quality standard or would cause or contribute to exceedance of the applicable toxic air contaminant health criterion. The activity at USAKA, singly or in combination with others, would cause more than a 25 percent increase of an NAAQS when added to baseline conditions after pollution controls are added.

Table 4.4-3
USAKA Environmental Standards
Air Pollutant Thresholds
(in tons per year)

Parameter	Threshold
Carbon monoxide	100
Nitrogen oxides	40
Sulfur dioxide	40
Ozone	40 of VOC
Lead	0.6
Particulate matter (less than 10 microns)	15
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7

NO ACTION

In addition to the existing facilities, the No-Action Alternative includes the construction of Power Plant 1B on Kwajalein Island. This power plant will be built as an addition to existing Power Plant 1.

Emissions under the No-Action Alternative are described in Table 4.4-4. The emission estimates are based on the projected increase in activity above actual 1990 conditions as described in Chapter 3. Based on the projected activities, the following assumptions were used.

- The USAKA population would increase by 4.8 percent above 1990 conditions.

- The calculation to determine emissions from the fuel tanks is based on the number of turnarounds for each tank. It is assumed that the fuel usage would increase by the same percentage as the population increase; therefore, the number of turnarounds per tank would increase by 4.8 percent for this alternative.

- The production rate at the bakery would increase in proportion to the population increase. Therefore, the bakery emissions would increase by 4.8 percent above 1990 conditions.

- There would be a 13 percent increase in marine vessel usage above 1990 conditions.

Major emissions from USAKA occur from the power plants on Kwajalein and Roi-Namur islands. Based on the emission estimate, these sources would be classified as major for sulfur dioxide and nitrogen oxides under the U.S. statutes and regulations.

Rocket launches as described in Chapter 2 for the No-Action Alternative would continue. The number of launches and maximum likely emissions of the rockets are shown in Table 4.4-5.

Table 4.4-4
Summary of Calculated Potential Pollutant Emissions
No-Action Alternative
(tons per year)

Island	VOCs	SO_2	PM_{10}	TSP	Pb	NO_x	CO
Kwajalein	836.0	366.0	125.5	241.5	3.92×10^{-2}	3,659.0	964.0
Roi-Namur	186.0	304.0	64.0	87.8	3.58×10^{-2}	546.0	1,017.0
Meck	56.9	22.1	8.3	17.0	7.77×10^{-4}	174.0	87.3
Ennylabegan	5.3	3.0	2.0	3.0	1.46×10^{-4}	42.0	9.0
Illeginni	4.4	1.0	1.0	2.0	9.7×10^{-5}	21.0	5.0
Eniwetak	3.2	1.0	0.3	1.0	4.86×10^{-3}	7.0	2.0
Legan	2.3	1.0	0.5	1.0	4.86×10^{-5}	14.0	3.0
Gellinam	3.6	1.0	1.0	2.0	9.73×10^{-5}	21.0	5.0
Gagan	2.3	1.0	0.5	1.0	4.86×10^{-5}	14.0	3.0
Omelek	2.2	1.0	0.3	1.0	4.86×10^{-5}	7.0	2.0

The impacts of stationary and mobile sources were modeled using the Industrial Source Complex model developed by U.S. EPA. The model used measured historical meteorological data from USAKA background ambient air concentrations measured by USAEHA in 1991 and 1992 and predicted air pollutant concentrations. The predicted ambient air concentrations of significant pollutants are shown for criteria pollutants in Table 4.4-6 for the averaging periods corresponding to the ambient standards for each pollutant. Predicted concentrations of noncriteria pollutants are shown in Table 4.4-7 for 1-hour averaging periods. The 1-hour average period represents the peak value expected during normal operations.

Background values for SO_2, NO_2, CO, and PM_{10} used in the modeling were taken from *Final Report Ambient Air Quality Study No. 43-21-N717-93 U.S. Army Kwajalein*

Atoll Republic of the Marshall Islands April 1991-November 1992 (U.S. Army Environmental Hygiene Agency, 1993). The values for each pollutant, except PM_{10}, are the highest concentrations for each averaging period of data collected at the upwind station. The PM_{10} data collected during the study showed extremely high values in the period right before and immediately after Tropical Storm Zelda. Highest concentrations were measured at the upwind site, nearest the ocean. It is expected that the high PM_{10} values are heavily influenced by sea salt aerosol caused by the high winds and high tides associated with Tropical Storm Zelda. Compliance with air quality standards does not normally include natural resources. Therefore, there are no applicable PM_{10} background concentration values at Kwajalein.

Table 4.4-5
Rocket Launch Estimated Emissions
No-Action Alternative

Rocket	Island	Number of Launches per Year	CO per launch (lb)	HCl per launch (lb)	Al_2O_3 per launch (lb)	Pb per launch (lb)
Meteorological	Kwajalein Roi-Namur Omelek	24 24 24	18	6	6	0
Sounding[1]	Roi-Namur	8	1,017	0	0	48
Strategic launch vehicle	Meck[2] Omelek[3]	4 4	15,752	11,416	20,444	0

[1]Assumes Talos rocket motor. Source: USDOE, 1992.
[2]SLV launches are scheduled from Meck Island in 1992 and 1993; assumes SR-19 rocket motor.
[3]Launches are scheduled from Omelek Island in 1994 through 1998; assumes SR-19 rocket motor.

Ambient Air Quality. Based on the assumptions identified above, the emission estimates provided should represent reasonable upperbound conditions and, therefore, the impact represents maximum conditions. Modeling of the emissions under the No-Action Alternative shows no predicted exceedances of U.S. ambient air quality standards.

Rocket Launches. The Rocket Exhaust Effluent Diffusion Model version 7.01 (REEDM) was used to determine maximum 30-minute concentrations of criteria and noncriteria pollutants that may be released from SLVs scheduled under the No-Action Alternative. The model calculates a predicted concentration of pollutants every minute after launch, based on the emission rate and dispersion of the rocket exhaust plume. The time, location, and predicted concentrations were summarized and the highest 30-minute average concentrations were reported. These peak impacts are reported in Table 4.4-8. The 30-minute average impacts were converted to 1-hour, 8-hour, and annual impacts in accordance with generally accepted practices.

Table 4.4-6
Predicted Ambient Air Concentrations
No-Action Alternative
Criteria Pollutants
(micrograms per cubic meter)

Pollutant	Averaging Period	Island													Maximum Total Impact	EPA Ambient Air Quality Standards
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	Background		
PM_{10}	24-hr	52.6	17.4	1.01	0.452	5.11	2.06	0.741	0.762	0.354	1.01	1.01	4.32	N/A[a]	53	150
	Annual	8.35	6.60	0.162	0.00501	0.208	0.0582	0.0467	0.0305	0.0446	0.162	0.0113	0.0601	N/A[a]	8	50
NO_2	Annual	67.4	27.3	3.45	0.0544	1.34	1.14	1.09	0.760	2.30	3.45	0.0801	0.365	9.4[b]	77	100
CO	1-hr	2,110	2,010	111	92.7	712	291	117	130	42.9	111	388	590	15,912[b]	18,022	40,000
	8-hr	1,060	1,210	41.4	11.6	181	61.0	18.0	33.7	8.04	41.4	89.2	157	5,953[b]	7,163	10,000
SO_2	3-hr	104	121	21.2	5.57	214	11.9	15.9	13.1	9.10	21.2	21.0	20.7	130[b]	344	1,300
	24-hr	47.5	57.6	6.07	1.21	31.1	3.04	3.92	4.84	2.13	6.07	3.83	4.47	26[b]	84	365
	Annual	11.2	14.6	1.07	0.0156	0.786	0.268	0.368	0.255	0.394	1.07	0.0343	0.0596	3[b]	18	80
VOC	1-hr	2,390	2,740	244	42.3	243	136	52.6	82.7	35.7	244	422	378	N/A	2,740	N/A

[a]No applicable values.
[b]Background concentrations are highest values from USAEHA, 1993, upwind station.

Table 4.4-7
Predicted Ambient Air Concentrations
No-Action Alternative
Air Toxics
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	TLV[a]
Butane	1-hr	1015.9	1123.3	100.2	17.4	103.1	57.1	22.1	33.9	15.1	100.2	157.7	165.4	1,900,000
Xylene	1-hr	86.7	95.5	8.5	1.5	8.8	4.9	1.9	2.9	1.3	8.5	13.4	14.1	434,000
Toluene	1-hr	48.3	53.4	4.8	0.8	4.9	2.7	1.1	1.6	0.7	4.8	7.5	7.9	377,000
Benzene	1-hr	12.4	13.8	1.2	0.2	1.3	0.7	0.3	0.4	0.2	1.2	1.9	2.0	32,000
Formaldehyde	1-hr	12.4	13.8	1.2	0.2	1.3	0.7	0.3	0.4	0.2	1.2	1.9	2.0	1,200

[a]TLVs (threshold limit values) are taken from the American Conference of Governmental Industrial Hygienists (ACGIH) and are used as guidelines only. There are no applicable emission standards under the Clean Air Act for these air toxics.

This extrapolation allows comparison with published air quality or industrial hygiene standards. The integration of model outputs was started downwind at 1,000 meters to separate ambient air impacts from the range safety requirements at the launch site. Criteria pollutant impacts are compared with the U.S. EPA ambient air quality standards. Noncriteria pollutants are compared with the threshold limit values (TLV) as published by the American Conference of Governmental and Industrial Hygienists (ACGIH) and Short-Term Public Emergency Guidance Levels (SPEGLs) from the National Research Council (NRC). Table 4.4-8 summarizes the maximum predicted impacts from SLVs in the No-Action Alternative. For purposes of this analysis, the SLVs are assumed to consist of an SR-19 booster and a payload package. The SR-19 booster is the largest single rocket motor of the various types of rocket motors currently contemplated for use at USAKA. The impacts predicted by modeling this SLV are the largest impacts expected with the existing inventory of rocket motors available for use at USAKA. The air quality impacts of rocket launches are roughly proportional to the mass of the rocket motor propellant. Therefore, the use of smaller rocket motors with similar fuel composition would result in smaller impacts than the impacts of the SR-19 motor analyzed here. Similarly, a larger number of launches of smaller rocket motors would have impacts roughly in proportion to the total mass of propellant.

The rocket launches were modeled at two separate wind speeds, 17.75 mph (28.6 km/hr), which is typical at the area, and 2.25 mph (3.6 km/hr), which is typical at calm periods. The impacts reported are the maximum impacts predicted by the REEDM model. These maximum impacts occur typically during the low wind speed condition. Higher winds result in more rapid dispersion and lower predicted impacts. As shown in Table 4.4-8, the maximum impacts are below relevant standards. The REEDM model calculated ground level impacts downwind of the rocket launch site starting approximately 555 yards (508 meters) downwind of the rocket launch pad. As shown, all impacts are well below the applicable standard or guideline level for each pollutant. The short-term impacts assume one launch. The annual impacts assume four single launches in 1 year.

Because the SLVs are the largest category of rockets proposed to be launched at USAKA, the analysis of SLVs provides a conservative analysis of likely air quality impacts of most rockets launched at USAKA. However, as indicated in Table 4.4-9, some sounding rockets that may be launched at USAKA (those with Talos first stages), while smaller than SLVs, do emit lead, which is not emitted by the SLVs that were modeled for their air quality impacts. According to the *Kauai Test Facility (KTF) Environmental Assessment*, the Talos rocket motor emits 48 pounds of lead per launch (USDOE, 1992).

Table 4.4-8 Predicted Impacts from SLV Launches No-Action Alternative (micrograms per cubic meter)					
Pollutant	30-minute Impact[a]	1-Hour Impact[b]	8-Hour Impact[c]	Annual Impact[d]	National Ambient Air Quality Standard or Noncriteria Pollutant Guidance Level
CO	2.0	1.74	1.22	---	1-hour = 40,000 8-hour = 10,000
NO_2	28.3	24.6	---	0.0112	Annual = 100
HCl	112	97.5	---	---	1-hour = 1,500[e]
Al_2O_3	2,370	2,063	1,444	---	8-hour = 10,000[f]

[a]30-minute average impact determined from the REEDM model.
[b]30-minute average converted to a 1-hour average using the power law equation: $x_s = x_k(t_k/t_s)^{0.20}$, where x_k = the 30-minute average, x_s = the 1-hour average, t_k = 30 minutes, and t_s = 1-hour (60 minutes); from *Workbook of Atmospheric Dispersion Estimates*, U.S. EPA, Research Triangle Park, North Carolina, Revised 1970.
[c]U.S. EPA factor to convert a 1-hour impact to an 8-hour impact is 0.7.
[d]Annual average impact = (1-hour impact × number of launches)/8,760 hours per year; four launches per year assumed.
[e]HCl SPEGL.
[f]Al_2O_3 threshold limit value-time weighted average (TLV-TWA) from ACGIH.

The following information about the potential impacts of lead emissions is based on information from the *Environmental Assessment, ZEST Flight Test Experiments* (SDIO, 1991). The ZEST test used a Talos rocket motor for its first stage. Only the first stage of the Talos/Aries Sounding Rocket (TASR) vehicle (Talos) contributes to the surface mixing layer as the second-stage solid motor and third-stage liquid engine do not ignite until much higher altitudes.

Table 4.4-9 Estimated Rocket Launch Emissions Low Level of Activity						
Rocket	Island	Maximum Number of Launches per Year	CO per launch (lb)	HCl per launch (lb)	Al_2O_3 per launch (lb)	Pb per launch (lb)
Meteorological	Omelek Kwajalein Roi-Namur	24 24 24	18	6	6	0
Sounding[1]	Roi-Namur Meck	8 8	1,017	0	0	48
Strategic launch vehicles[2]	Meck Omelek	12 4	15,752	11,416	20,444	0

[1]Assumes Talos rocket motor. Source: USDOE, 1992.
[2]Assumes SR-19 rocket motors.

Results of the model calculations summarized in the *ZEST Flight Test Experiments Environmental Assessment* show only modest concentrations of lead. The maximum predicted 8-hour concentration from a single launch is 0.000973 mg/m^3 at a distance of 0.5 kilometer downwind and 0.00300 mg/m^3 at 1.0 kilometer downwind (concentrations at greater distances are lower).

The NAAQS for lead is $1.5\mu/m^3$ averaged over 3 months. One launch per quarter would result in a quarterly average concentration of 4.56×10^{-4} $\mu g/m^3$ based on 2,190 hours per quarter. For a conservative assessment of air quality impacts, lead impacts were calculated based on the number of sounding rocket launches assumed for the High Level-of-Activity Alternative, a maximum of 16 launches annually (two per quarter at each of two sites on Meck and Roi-Namur). A worst-case scenario, with all eight launches at each site occurring in one quarter and all launches involving Talos rockets, would result in a maximum predicted lead concentration of 3.65×10^{-3} $\mu g/m^3$. This value is well below the NAAQS for lead.

ACGIH recommends a short-term exposure limit of 0.150 mg/m^3 averaged over 8 hours. All of the 8-hour concentrations listed above are well under that amount.

It should be noted that the analysis of lead emissions in the *ZEST Flight Test Experiments Environmental Assessment* was based on an assumption of 43 pounds of lead per launch, as opposed to 48 pounds per launch as reported in the *KTF Environmental Assessment*. Using the larger number per launch would not make a substantial difference in the concentrations reported above. For example, the maximum predicted 8-hour concentration from a single launch would increase from 0.000973 mg/m^3 to 0.001086 mg/m^3. Emissions from single launches and the maximum number of launches per quarter would remain below applicable regulations and guidelines even using the 48-pound-per-launch assumption.

It should also be noted that reporting requirements for lead identified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) do not apply to rocket launch emissions.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Emission estimates were developed to determine the impact on the environment of new sources and increased emissions from existing mobile and stationary sources. The estimates are based on projected activities identified in Chapter 2 for this alternative. In addition, the estimates account for changes in USAKA's waste management practices and for the increase in population associated with this alternative. The following assumptions were used.

- The USAKA population would increase by 18 percent compared with the No-Action Alternative.

- The percent increase in automobile emissions would be 7 percent compared with the No-Action Alternative.

- The increase in airplane emissions above the No-Action Alternative would be 13 percent.

- There would be a 1 percent increase in marine vessel usage compared with the No-Action Alternative.

- The emissions levels recently measured at the Roi-Namur burn pit would be reduced by burning only wood and paper waste. A 33 percent reduction has been assumed.

- The potential maximum boiler emissions at the Kwajalein facilities have been estimated based on the maximum heat input. The emission rate for this level of activity was assumed to be 36 percent of the potential maximum boiler emissions.

- The number of turnarounds per bulk fuel tank would increase by 18 percent based on the percentage increase in population.

- The percent increase in bakery emissions above baseline would be equal to the percent increase in population.

Based on the assumptions identified above, the emission estimates provided should represent reasonable upperbound conditions. The impact on the environment, therefore, represents maximum likely impacts of this alternative. A summary of calculated potential pollutant emissions is shown in Table 4.4-10.

Table 4.4-10
Summary of Calculated Potential Pollutant Emissions
Low Level of Activity
(tons per year)

Island	VOCs	SO_2	PM_{10}	Pb	NO_x	CO
Kwajalein	1,535	491	350	5.72×10^{-3}	4,162	2,216
Roi-Namur	212	511	122	3.87×10^{-2}	928	1,487
Meck	77	75	12	1.07×10^{-3}	240	104
Ennylabegan	16	577	8.2	7.81×10^{-4}	172	37
Illeginni	7.4	21	2.2	2.11×10^{-4}	61	15
Eniwetak	3.7	6.2	0.4	3.79×10^{-5}	18	5.2
Legan	3.7	6.2	1.0	9.77×10^{-5}	29	6.1
Gellinam	5.0	14	1.5	1.41×10^{-4}	82	20
Gagan	3.7	9.6	1.0	9.77×10^{-5}	29	6.1
Omelek	2.2	4.1	0.3	2.53×10^{-5}	12	3.5

New stationary sources under this alternative include a solid waste incinerator at Kwajalein, a power plant and incinerator at Roi-Namur, and a power plant upgrade and incinerator at Meck. New mobile sources include one new catamaran for service to Meck and one new ship anchored off Kwajalein for payload recovery.

In addition to the sources identified, USAKA would also conduct rocket launch activities that would result in emissions to the environment, as discussed in the previous section. The projected emission rates are based on the rocket motors and launch frequency as described in Table 4.4-9 and Chapter 2 of this document.

Ambient Air Quality. Stationary and mobile sources at USAKA were modeled and the maximum concentrations were predicted as shown in Table 4.4-11 for the criteria pollutants and in Table 4.4-12 for the noncriteria pollutants. The predicted maximum impacts for each island are not expected to exceed U.S. EPA ambient air quality standards, as shown in Tables 4.4-11 and 4.4-12.

Rocket Launches

Launches of SLVs associated with this alternative were modeled assuming SR-19 boosters, as described previously in the No-Action Alternative, and the maximum concentrations of criteria and noncriteria pollutants were predicted as shown in Table 4.4-13. The predicted maximum impacts are not expected to exceed U.S. EPA ambient air quality standards or the noncriteria pollutant guideline levels. The short-term impacts assume two simultaneous launches. The average annual impacts assume eight launches of two rockets per year, a number of simultaneous launches larger than actually proposed to occur.

Mitigation—Existing U.S. Statutes and Regulations

Because there are no significant impacts, no mitigation is required.

Impacts—Proposed USAKA Standards and Procedures

Stationary Source Emissions

An analysis was conducted of the proposed 13.5-MW power plant at Roi-Namur to determine how impacts would be assessed under the proposed Standards. Table 4.4-14 shows the results of the analysis.

Because the Roi-Namur power plant has the potential to emit SO_2, PM_{10}, NO_2, and CO by more than the levels required in a Prevention of Significant Deterioration (PSD) evaluation, under U.S. statutes and regulations, the power plant would undergo new source review. New source review under PSD would require the application of best available control technology (BACT) to the emissions from the plant. These controls would probably reduce the amount of emissions from the plant.

Table 4.4-11
Predicted Air Quality Concentrations
Low Level-of-Activity Conditions
Criteria Pollutants
(micrograms per cubic meter)

Pollutant	Averaging Period	Island													Maximum Total Impact	EPA Ambient Air Quality Standards
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	Background		
PM_{10}	24-hr	48.6	19.3	3.41	0.414	4.17	1.56	0.611	0.787	0.317	3.41	1.07	2.64	N/A[a]	49	150
	Annual	8.30	7.42	0.335	0.00584	0.156	0.0620	0.0463	0.0301	0.0443	0.335	0.0115	0.0491	N/A[a]	8	50
NO_2	Annual	67.6	28.2	4.71	0.0635	1.35	1.20	1.11	0.762	2.30	4.71	0.0819	0.367	9.4[b]	77	100
CO	1-hr	2,110	2,370	286	74.2	269	135	55.5	142	38.7	286	440	226	15,912[b]	18,282	40,000
	8-hr	964	1,430	110	11.9	98.6	29.3	8.75	37.2	8.07	110	105	72.5	5,953[b]	7,383	10,000
SO_2	3-hr	104	121	31.1	10.0	214	13.3	15.9	13.2	9.10	31.1	21.2	20.7	130[b]	251	1,300
	24-hr	47.5	58.3	10.6	1.91	31.1	3.08	3.93	2.03	2.13	10.6	3.87	4.62	26[b]	84	365
	Annual	11.3	15.0	1.76	0.0219	0.801	0.301	0.375	0.0198	0.395	1.76	0.0333	0.0638	3[b]	18	80
VOC	1-hr	2,410	3,140	252	49.3	246	137	53.1	96.0	36.9	252	485	386	N/A	3,140	N/A

[a]No applicable values.
[b]Background concentrations are highest values from USAEHA, 1993, upwind station.

Table 4.4-12
Predicted Air Quality Concentrations
Low Level of Activity Conditions
Air Toxics
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	TLV
Butane	1-hr	1,026.1	1,286.8	103.3	20.3	105.2	57.8	22.3	39.4	15.8	103.3	199.0	175.4	1,900,000
Xylene	1-hr	87.2	109.4	8.8	1.7	8.9	4.9	1.9	3.4	1.3	8.8	16.9	14.4	434,000
Toluene	1-hr	48.7	61.1	4.9	1.0	5.0	2.7	1.1	1.9	0.7	4.9	9.5	8.0	377,000
Benzene	1-hr	12.6	15.8	1.3	0.2	1.3	0.7	0.3	0.5	0.2	1.3	2.4	2.1	32,000
Formaldehyde	1-hr	12.6	15.8	1.3	0.2	1.3	0.7	0.3	0.5	0.2	1.3	2.4	2.1	1,200

For purposes of evaluating the proposed Standards, a simplified screening model was used to predict the total contribution of the proposed plant to ambient air quality at Roi-Namur (because a screening model was used, results are not strictly comparable with data in Table 4.4-11). The applicable standard was then calculated by multiplying 25 percent times each of the criteria pollutant ambient air quality standards and adding that amount to the baseline condition for that pollutant. The resulting number would be the applicable standard for that pollutant at Roi-Namur. This number was also compared with the result of calculating 80 percent of the NAAQS for each criteria pollutant to ensure that the maximum limit would not be exceeded.

Table 4.4-13
Predicted Impacts from Rocket Launches
Low Level of Activity
(micrograms per cubic meter)

Pollutant	30-minute Impact[a]	1-Hour Impact[b]	8-Hour Impact[c]	Annual Impact[d]	National Ambient Air Quality Standard or Noncriteria Pollutant Guidance Level
CO	3.39	2.95	2.07	---	1-hour = 40,000 8-hour = 10,000
NO_2	47.9	41.7	---	0.0381	Annual = 100[d]
HCl	190	165	---	---	1-hour = 1,500[e]
Al_2O_3	4,130	3,600	2,520	---	8-hour = 10,000[f]

[a]30-minute average impact determined from the REEDM model.
[b]30-minute average converted to a 1-hour average using the power law equation: $x_s = x_k(t_k/t_s)^{0.20}$.
[c]U.S. EPA factor to convert a 1-hour impact to an 8-hour impact is 0.7.
[d]Annual average impact = (1-hour impact × number of launches)/8,760 hours per year; eight launch events each of two boosters assumed.
[e]HCl SPEGL.
[f]Al_2O_3 threshold limit value-time weighted average (TLV-TWA) from ACGIH.

A comparison of the expected emissions from the plant without BACT to the 25 percent USAKA standard revealed that there would be sufficient capacity in air quality to operate the power plant at Roi-Namur without exceeding any standard for criteria pollutants. It should be noted, however, that, without pollution control devices, the plant would use a considerable amount of the increment standard for SO_2 (17 $\mu g/m^3$ of 35 $\mu g/m^3$ maximum) and NO_x (31 $\mu g/m^3$ of 52 $\mu g/m^3$ maximum). In no case do the plant emissions approach 80 percent of the ambient air quality standards.

Contrasting this result with emissions allowed under U.S. statutes and regulations (assuming BACT would be required) reveals that, except for SO_2, the plant would be allowed to emit approximately the same amount of pollutants as under the Standards.

Table 4.4-14
Estimated Roi-Namur Power Plant Impacts
Standards Comparison
(micrograms per cubic meter)

Activity	SO_2	PM_{10}	NO_2	CO	Pb
No-Action Alternative (assumed baseline; see Table 4.4-6)	121 (3-hr) 58 (24-hr) 15 (annual)	0 (24-hr) 0 (annual)	27 (annual)	2,010 (1-hr) 1,210 (8-hr)	$<1.0 \times 10^{-1}$ (24-hr)
Allowable increment = 25% of NAAQS	325 (3-hr) 91 (24-hr) 20 (annual)	38 (24-hr) 13 (annual)	25 (annual)	10,000 (1-hr) 2,500 (8-hr)	.375 (24-hr)
Maximum increment = 80% of NAAQS	1,040 (3-hr) 292 (24-hr) 64 (annual)	120 (24-hr) 40 (annual)	80 (annual)	32,000 (1-hr) 8,000 (3-hr)	1.2 (24-hr)
USAKA standard = 25% of NAAQS + baseline	446 (3-hr) 149 (24-hr) 35 (annual)	38 (24-hr) 13 (annual)	52 (annual)	12,010 (1-hr) 3,710 (8-hr)	.375 (24-hr)
Low Level-of-Activity Alternative = power plant incremental emissions assuming no BACT	154 (3-hr) 69 (24-hr) 17 (annual)	11 (24-hr) 3 (annual)	31 (annual)	335 (1-hr) 235 (8-hr)	2.63×10^{-4} (24-hr)
Low Level-of-Activity Alternative = power plant emissions assuming BACT (existing regulations)	26 (3-hr) 12 (24-hr) 3 (annual)	11 (24-hr) 3 (annual)	29 (annual)	335 (1-hr) 235 (8-hr)	1.31×10^{-3} (24-hr)

Note: This analysis was performed using simplified modeling techniques solely for the purpose of evaluating regulatory programs. Determination of impacts and control technologies will require more thorough analysis. Concentrations for averaging periods other than 1 hour are based on U.S.EPA, 1988.

For SO_2, the difference between the ability to comply with the two standards is a result of the use of diesel fuel, with up to 2 percent sulfur under the Standards. U.S. statutes and regulations would probably require the use of low-sulfur fuel. Under the Standards, the Roi-Namur plant would be allowed to contribute more SO_2 to ambient conditions than it would under U.S. statutes and regulations assuming BACT were required (17 $\mu g/m^3$ annually versus 3 $\mu g/m^3$ without BACT). The impact from the contribution is nonsignificant, however, because it does not violate NAAQS or any health- or welfare-based standard. Although the Standards would allow an increase of SO_2 emissions in the short term, the Standards would be more protective in the long term because the maximum increment of SO_2 that can be discharged is much lower than U.S. statutes and regulations (35 $\mu g/m^3$ for the USAKA Standards versus 80 $\mu g/m^3$ for the U.S. statutes and regulations).

Rocket Launches

Based on an analysis of health-based criteria, the modeling demonstrates that the rocket launches under this alternative would not exceed 80 percent of the ambient air quality standards. In addition, the contribution of criteria pollutants would not cause an exceedance of 25 percent of the criteria pollutant standards when added to the No-Action Alternative concentrations for the atoll.

Other Sources

A review of the ambient air quality concentrations in Table 4.4-11 demonstrates that, in this alternative, no source on any USAKA island would exceed 80 percent of the ambient air quality standards, nor would any by itself or in addition to other sources cause an exceedance of 25 percent of the standard when added to the concentrations that would occur in the No-Action Alternative.

Mitigation—Proposed USAKA Standards and Procedures

Because there are no significant impacts predicted under this alternative, no mitigation is required.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Projections of stationary and mobile emissions for this alternative were prepared based on the following assumptions. The summary of calculated potential pollutant emissions for this alternative is shown in Table 4.4-15.

- Population would increase by 52 percent above the No-Action population of 3,250.

- Automobile use would increase by 27 percent from the No-Action Alternative.

- The increase in airplane emissions would be 50 percent above the No-Action Alternative.

- The increase in helicopter emissions would be 14 percent above the No-Action Alternative.

- The increase in the existing marine vessel usage would be 16 percent above the No-Action Alternative.

- The potential maximum boiler emissions at Kwajalein were estimated based on the maximum heat input. The emission rate for this level of activity was assumed to be 76 percent of the potential maximum boiler emissions.

- The number of turnarounds per bulk fuel tank would increase by 52 percent for the Intermediate Level of Activity based on the percent increase in population.

- The percent increase in bakery emissions above baseline is equal to the percent increase in population.

Table 4.4-15
Summary of Calculated Potential Pollutant Emissions
Intermediate Level of Activity
(tons per year)

Island	VOCs	SO_2	PM_{10}	Pb	NO_x	CO
Kwajalein	2,188	874	464	9.35×10^{-3}	4,388	2,967
Roi-Namur	252	511	102	3.87×10^{-2}	935	1,514
Meck	94	76	12	1.07×10^{-3}	241	111
Ennylabegan	17	577	8.2	7.81×10^{-4}	172	37
Illeginni	27	101	11	1.04×10^{-3}	132	31
Eniwetak	3.8	6.2	0.4	3.79×10^{-5}	18	5.3
Legan	3.8	6.2	1.0	9.77×10^{-5}	29	6.1
Gellinam	5.2	14	1.5	1.41×10^{-4}	82	20
Gagan	3.8	9.6	1.0	9.77×10^{-5}	29	6.1
Omelek	2.3	4.1	0.3	2.53×10^{-5}	12	3.5

Based on the assumptions identified above, the emission estimates provided should represent reasonable upperbound conditions. The impact on the environment would, therefore, represent maximum conditions.

New stationary sources would include renovation and modernization of the power plant, a new 20,000-gallon (75,707-liter) fuel storage tank, a missile assembly building, and a maintenance facility, all at Illeginni. New mobile sources for this alternative include docking of two large ships at Kwajalein and additional catamaran trips to transport people to Illeginni and Meck. Portable TMD-GBR radars would be temporarily deployed and operated on Meck, Omelek, Illeginni, Gagan, Gellinam, and/or Legan. Each unit would be powered by a mobile 1-MW diesel-powered generating unit. Per hour, these units would emit approximately 33.1 pounds (15 kilograms) of nitrogen oxides, 16.6 pounds (7.5 kilograms) of carbon monoxide, 3.7 pounds (1.68 kilograms) of sulfur dioxide, 3.3 pounds (1.5 kilograms) of particulates, and 0.95 pound (0.43 kilogram) of volatile organic compounds, based on a fuel consumption rate of 25 gallons per hour (from *Ground Based Radar Family of Strategic and Theater Radars Environmental Assessment*, U.S. Army Program Executive Office, June 1993).

The generating units powering the TMD-GBR would be operated only during TMD test activities—typically for no more than 4 hours per test. Because the generating units would operate infrequently, and for short durations, they are not likely to cause any significant impacts to local or regional air quality. Also because they would operate so infrequently, their emissions are not included in the modeling of ambient air quality summarized below.

The number of rocket launches at USAKA would increase, as shown in Table 4.4-16, resulting in increased emissions. The projected emissions are based on the predicted schedule identified in Chapter 2.

Table 4.4-16
Rocket Launch Activity for the Intermediate Level of Activity

Rocket	Island	Maximum Number of Launches per Year	CO per launch (lb)	HCl per launch (lb)	Al_2O_3 per launch (lb)	Pb per launch (lb)
Meteorological	Omelek Kwajalein Roi-Namur	24 24 24	18	6	6	
Sounding[1]	Roi-Namur Meck	8 8	1,017	0	0	48
Strategic launch vehicles[2]	Illeginni Meck Omelek	20 24 4	15,752	11,416	20,444	0

[1]Assumes Talos rocket motor. Source: USDOE, 1992.
[2]Assumes SR-19 rocket motors.

Ambient Air Quality. Dispersion modeling was performed to estimate the air quality impact of projected increases in emissions from stationary and mobile sources. All sources at USAKA were input into the model and the maximum concentrations were predicted, as outlined in Table 4.4-17 for the criteria pollutants and Table 4.4-18 for the noncriteria pollutants. The predicted maximum impacts are not expected to exceed U.S. EPA ambient air quality standards.

Table 4.4-17
Predicted Air Quality Concentrations
Proposed Action: Intermediate Level-of-Activity Conditions
Criteria Pollutants
(micrograms per cubic meter)

Pollutant	Averaging Period	Island													Maximum Total Impact	EPA Ambient Air Quality Standards
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	Background		
PM_{10}	24-hr	71.2	24.2	2.27	0.488	4.89	1.76	1.69	0.839	0.603	2.27	1.21	3.50	N/A[a]	71	150
	Annual	11.5	8.89	0.366	0.00663	0.246	0.0662	0.156	0.0313	0.113	0.366	0.0138	0.0568	N/A[a]	12	50
NO_2	Annual	71.2	30.0	4.78	0.0646	1.37	1.20	2.11	0.764	2.30	4.78	0.0842	0.384	9.4[b]	81	100
CO	1-hr	3,200	3,020	1,93	85.7	360	193	77.4	163	48.7	193	552	329	15,912[b]	19,112	40,000
	8-hr	1,450	1,820	85.4	12.4	137	40.3	12.5	43.7	8.59	85.4	134	105	5,953[b]	7,773	10,000
SO_2	3-hr	112	122	32	11.5	42.8	21.3	68.5	13.4	3.96	32	21.6	32.6	130[b]	252	1,300
	24-hr	51.7	59.1	11.8	2.05	8.04	2.78	10.5	2.66	0.886	11.8	3.97	7.14	26[b]	85	365
	Annual	14.3	15.7	2.01	0.0230	0.334	0.195	0.582	0.0648	0.120	2.01	0.0333	0.0957	3[b]	19	80
VOC	1-hr	3,250	3,860	270	61.8	346	187	123	120	47.5	270	600	474	N/A	3,860	N/A

[a]No applicable values.
[b]Background concentrations are highest values from USAEHA, 1993, upwind station.

Table 4.4-18
Predicted Air Quality Concentrations
Proposed Action: Intermediate Level-of-Activity Conditions
Air Toxics
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	TLV
Butane	1-hr	1,383.5	1,577.7	128.2	25.3	143.8	166.5	49.8	49.1	20.7	128.2	245.1	207.7	1,900,000
Xylene	1-hr	117.6	134.1	10.9	2.2	12.2	14.2	4.2	4.2	1.8	10.9	20.8	17.7	434,000
Toluene	1-hr	65.7	74.9	6.1	1.2	6.8	7.9	2.4	2.3	1.0	6.1	11.6	9.9	377,000
Benzene	1-hr	16.9	19.3	1.6	0.3	1.8	2.0	0.6	0.6	0.3	1.6	3.0	2.5	32,000
Formaldehyde	1-hr	16.9	19.3	1.6	0.3	1.8	2.0	0.6	0.6	0.3	1.6	3.0	2.5	1,200

Rocket Launches

The launches of SLVs associated with this alternative were modeled and the resulting maximum concentrations of criteria and noncriteria pollutants were predicted as shown in Table 4.4-19. The predicted maximum impacts are not expected to exceed U.S. EPA ambient air quality standards or the noncriteria pollutant guideline levels. The short-term impacts assume four simultaneous rocket launches. The annual average impacts assume 12 launches of 4 boosters per year.

The increases in activity from Low to Intermediate Level would lead to an increase in emissions; however, the net increase in emissions would not trigger regulatory action, nor would it lead to a significant air quality impact.

Mitigation—Existing U.S. Statutes and Regulations

No mitigation is required for this alternative.

Impacts—Proposed USAKA Environmental Standards and Procedures

A review of the ambient air quality concentrations in Tables 4.4-17 and 4.4-19 demonstrates that, in this alternative, no source on any USAKA island would exceed 80 percent of the ambient air quality standards, nor would any by itself or in addition to other sources cause an exceedance of 25 percent of the standard when added to the concentrations that would occur in the No-Action Alternative.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because no significant impacts are predicted under this alternative, no mitigation is required.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Emission estimates for this alternative were based on the following assumptions regarding stationary and mobile sources. A summary of calculated potential pollutant emissions for this alternative is shown in Table 4.4-20.

- Population would increase by 66 percent above the No-Action population of 3,250.
- Automobile usage would increase by 33 percent.
- Airplane emissions would increase 51 percent above the No-Action Alternative.

Table 4.4-19
Predicted Impacts from Rocket Launches
Intermediate Level of Activity
(micrograms per cubic meter)

Pollutant	30-minute Impact[a]	1-Hour Impact[b]	8-Hour Impact[c]	Annual Impact[d]	National Ambient Air Quality Standard or Noncriteria Pollutant Guidance Level
CO	5.89	5.13	3.59	---	1-hour = 40,000 8-hour = 10,000
NO_2	83.2	72.4	---	0.0992	Annual = 100
HCl	329	286	---	---	1-hour = 1,500[e]
Al_2O_3	7,070	6,155	4,309	---	8-hour = 10,000[f]

[a]30-minute average impact determined from the REEDM model.
[b]30-minute average converted to a 1-hour average using the power law equation.
[c]U.S. EPA factor to convert a 1-hour impact to an 8-hour impact is 0.7.
[d]Annual average impact = (1-hour impact × number of launches)/8,760 hours per year; 12 launch events with four boosters each assumed.
[e]HCl SPEGL.
[f]Al_2O_3 threshold limit value-time weighted average (TLV-TWA) from ACGIH.

Table 4.4-20
Summary of Calculated Potential Pollutant Emissions
High Level of Activity
(tons per year)

Island	VOCs	SO_2	PM_{10}	Pb	NO_x	CO
Kwajalein	2,160	906	470	9.67×10^{-3}	4,397	2,982
Roi-Namur	259	511	126	3.87×10^{-2}	935	1,520
Meck	106	77	12	1.07×10^{-3}	246	134
Ennylabegan	17	577	8.2	7.81×10^{-4}	172	37
Illeginni	27	106	11	1.09×10^{-3}	132	31
Eniwetak	7.5	8.1	1.4	1.3×10^{-4}	45	6.3
Legan	7.0	7.9	2.4	1.89×10^{-4}	34	8.4
Gellinam	14	28	2.9	2.81×10^{-4}	163	39
Gagan	6.8	12	2.0	1.89×10^{-4}	56	7.1
Omelek	3.6	2.9	1.4	1.38×10^{-4}	40	1.5

- Helicopter emissions would increase 67 percent above the No-Action Alternative.
- The increase in the existing marine vessel usage above levels in the No-Action Alternative would be 24 percent.
- Boiler emissions at Kwajalein were estimated based on maximum heat input.

- The number of turnarounds for each bulk fuel tank would increase proportionately with population.

- Bakery emissions would increase proportionately with population.

Based on the assumptions identified above, the emission estimates provided should represent upperbound conditions. The impact on the environment would therefore represent maximum conditions.

New stationary sources for this alternative include a new 20,000-gallon (75,707-liter) fuel storage tank at Eniwetak; a new power plant and a new 20,000-gallon (75,707-liter) fuel storage tank at Legan; expansion of the existing power plant, replacement of the current fuel tank with a new 20,000-gallon (75,707-liter) tank, and a new missile assembly building at Gellinam; a new power plant and a new 20,000-gallon (75,707-liter) fuel storage tank at Gagan; and a new, more efficient power plant and a new 50,000-gallon (189,267-liter) fuel tank at Omelek.

In addition to the stationary and mobile sources modeled, USAKA would conduct rocket launch activities under the High Level-of-Activity Alternative, which would result in emissions to the environment. The projected emissions included in Table 4.4-21.are based on the predicted schedule for the High Level of Activity in Chapter 2.

Table 4.4-21
Estimated Rocket Launch Emissions
High Level of Activity

Rocket	Island	Maximum Number of Launches per Year	CO per launch (lb)	HCl per launch (lb)	Al_2O_3 per launch (lb)	Pb per launch (lb)
Meteorological	Omelek Kwajalein Gellinam Roi-Namur	24 24 24 24	18	6	6	0
Sounding[1]	Roi-Namur Meck	8 8	1,017	0	0	48
Strategic launch vehicles[2]	Meck Omelek Illeginni Eniwetak	28 8 24 24	15,752	11,416	20,444	0

[1]Assumes Talos rocket motor. Source: USDOE, 1992.
[2]Assumes SR-19 rocket motors.

Ambient Air Quality. Dispersion modeling was performed to estimate the air quality impact of projected emissions increases. Mobile and stationary sources at USAKA were modeled and the maximum concentrations predicted are shown in Table 4.4-22 for the criteria pollutants and Table 4.4-23 for the noncriteria pollutants. The predicted maximum impacts are not expected to exceed U.S. EPA ambient air quality standards.

Rocket Launches

The launches of SLVs associated with this alternative were modeled and the resulting maximum concentrations of criteria and noncriteria pollutants were predicted, as shown in Table 4.4-24. The predicted maximum impacts are not expected to exceed U.S. EPA ambient air quality standards or the noncriteria pollutant guideline levels except for annual impacts of NO_x. The short-term maximum predicted impact assumes a simultaneous launch of six SLVs. The annual average impacts assume 14 launches of six rockets simultaneously, a number larger than that proposed to occur in this alternative. This scenario results in no predicted annual impacts that exceed the NAAQS.

Mitigation–Existing U.S. Statutes and Regulations

Because no significant impacts are predicted for this alternative, no mitigation is required.

Impacts–Proposed USAKA Environmental Standards and Procedures

A review of the ambient air quality concentrations in Tables 4.4-22 and 4.4-24 demonstrates that in this alternative, no source on any USAKA island would exceed 80 percent of the ambient air quality standards, nor would any by itself or in addition to other sources cause an exceedance of 25 percent of the standard when added to the concentrations that would occur in the No-Action Alternative.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Because no significant impacts are predicted for this alternative, no mitigation is required.

4.4.2 Proposed USAKA Environmental Standards and Procedures

The proposed Standards for air quality do not automatically require technology controls for emissions; instead, they focus on capping contributions to ambient air quality to 25 percent of ambient air quality standards when added to the baseline conditions and not exceeding 80 percent of any standard. This could, in some cases, allow USAKA to construct and operate major sources without any pollution control devices installed.

Table 4.4-22
Predicted Ambient Air Concentrations
High Level-of-Activity Conditions
Criteria Pollutants
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												Background	Maximum Total Impact	EPA Ambient Air Quality Standards
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye			
PM_{10}	24-hr	71.8	24.4	5.48	0.536	4.78	1.59	1.75	1.99	0.603	5.48	1.21	3.55	N/A[a]	72	150
	Annual	11.5	8.93	0.392	0.00679	0.228	0.304	0.164	0.132	0.115	0.392	0.0146	0.0526	N/A[a]	12	50
NO_2	Annual	71.6	30.0	9.08	0.0754	1.39	7.08	2.22	3.22	2.36	9.08	0.114	0.391	9.4[b]	81	100
CO	1-hr	3,170	3,200	305	94.4	357	192	76.8	176	49.7	305	557	325	15,912[b]	19,112	40,000
	8-hr	1,450	1,870	119	14.2	136	48.8	12.6	52.2	8.62	119	135	104	5,953[b]	7,823	10,000
SO_2	3-hr	145	122	131	11.6	55	54.3	73.7	18.9	8.11	131	21.6	42.1	130[b]	275	1,300
	24-hr	62.5	59.1	41.2	2.45	10.1	9.78	11.4	11.2	1.55	41.2	4.00	8.63	26[b]	89	365
	Annual	18.6	15.7	2.84	0.0271	0.391	1.99	0.653	0.818	0.138	2.84	0.0430	0.111	3[b]	22	80
VOC	1-hr	3,290	3,920	302	338	350	189	124	121	48.8	302	608	482	N/A	3,920	N/A

[a]No applicable values.
[b]Background concentrations are highest values from USAEHA, 1993, upwind station.

Table 4.4-23
Predicted Ambient Air Concentrations
High Level-of-Activity Conditions
Air Toxics
(micrograms per cubic meter)

Pollutant	Averaging Period	Island												
		Kwajalein	Roi-Namur	Meck	Omelek	Ennylabegan	Legan	Illeginni	Gagan	Gellinam	Eniwetak	Ennubirr	Ebeye	TLV
Butane	1-hr	1,390.9	1,608.2	123.9	138.8	135.8	79.1	50.8	49.8	20.6	123.9	249.6	209.2	1,900,000
Xylene	1-hr	118.2	136.7	10.5	11.8	11.5	6.7	4.3	4.2	1.7	10.5	21.2	17.8	434,000
Toluene	1-hr	66.1	76.4	5.9	6.6	6.5	3.8	2.4	2.4	1.0	5.9	11.9	9.9	377,000
Benzene	1-hr	17.0	19.7	1.5	1.7	1.7	1.0	0.6	0.6	0.3	1.5	3.1	2.6	32,000
Formaldehyde	1-hr	17.0	19.7	1.5	1.7	1.7	1.0	0.6	0.6	0.3	1.5	3.1	2.6	1,200

Table 4.4-24
Predicted Impacts from Rocket Launches
High Level of Activity
(micrograms per cubic meter)

Pollutant	30-minute Impact[a]	1-Hour Impact[b]	8-Hour Impact[c]	Annual Impact[d]	National Ambient Air Quality Standard or Noncriteria Pollutant Guidance Level
CO	8.08	7.03	4.92	---	1-hour = 40,000 8-hour = 10,000
NO_2	114	99.2	---	0.159	Annual = 100
HCl	452	393	---	---	1-hour = 1,500[e]
Al_2O_3	9,720	8,462	5,924	---	8-hour = 10,000[f]

[a]30-minute average impact determined from the REEDM model.
[b]30-minute average converted to a 1-hour average using the power law equation.
[c]U.S. EPA factor to convert a 1-hour impact to an 8-hour impact is 0.7.
[d]Annual average impact = (1-hour impact × number of launches)/8,760 hours per year; 14 launch events of six boosters each assumed.
[e]HCl SPEGL.
[f]Al_2O_3 threshold limit value-time weighted average (TLV-TWA) from ACGIH.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

The emission of air pollutants is regulated under the Clean Air Act (CAA), as amended and as implemented in 40 CFR, Parts 50-87. The CAA uses a combination of technology-forcing and health- and welfare-based provisions to achieve its goal of attaining clean air. For areas of the United States that have not attained ambient air quality standards for criteria pollutants, the CAA requires the achievement of these standards without regard to cost. The theory behind the laws affecting nonattainment areas is to force technology to achieve compliance with the ambient air quality standards in nonattainment areas. In nonattainment areas, after undergoing new source review, major new sources of criteria air pollutants are required to use the lowest achievable emission rate (LAER) contained in any state implementation plan or that is technologically achievable in similar sources, whichever is most stringent. LAER is not required if the owner can demonstrate that the limit is not achievable for the source, or the most stringent limitation is not achievable by similar sources. Because the technology for controlling air pollutants continues to become more effective and more complex, the LAER forces new major stationary sources to procure state-of-the-art technology, which is often very expensive.

For areas of the United States that are in compliance with ambient air quality standards the CAA requires compliance with PSD requirements for major stationary sources. The purpose of PSD review is to prevent further deterioration of air quality within a region by imposing maximum increments that can be used by a source after pollution controls are applied. The increment is determined by type of pollutant and class of air region. Pristine areas such as national parks and wilderness areas are identified as Class I regions. Class III regions are those designated for heavy industrial use, though there are none in the United States. All other regions are Class II, which makes up all other areas of the United States except those in nonattainment. PSD review of emission controls requires the use of BACT. The establishment of BACT, in contrast to LAER, allows the consideration of cost in the selection of the technology.

PROPOSED ACTION: USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

The proposed Standards, which derive primarily from applicable sections of 40 CFR 50 through 87 of the CAA, differ from the CAA provisions in several important respects. The Standards require that a DEP be issued for new sources and for modifications of existing stationary sources, if those modifications, either singly or in combination with other modifications, cause an increase by more than 5 percent in the emission level of a pollutant above the DEP emission level for that source. The approval of the DEP depends on the ambient air impacts that each source contributes to the ambient air concentration of the region. Ambient air impacts from the facility are not allowed to increase ambient air concentrations by more than 25 percent of any criteria air pollutant above the baseline ambient air concentration, or 80 percent of the effective standards for that pollutant. Although emission controls are not required (but are implied as a part of the DEP), there is no specified criterion that the emission level cannot exceed as long as there is no contribution causing exceedance of the ambient standards. Also, there is no definition of nonattainment areas. Thus, the Standards attempt to achieve ambient air levels by placing a limit on the ambient air impacts caused by each project.

The major difference between U.S. regulations and the proposed Standards is that the Standards emphasize control of ambient air quality impacts through modeling to determine that no emissions of pollutants will cause an increase in ambient air concentrations greater than the amount permitted by the Standards. U.S. regulations place specific emission limits on stationary sources (LAER, BACT) and in some cases require modeling to ensure that the ambient air quality standards for the region are not exceeded.

It is necessary to analyze the results of a new source review under both sets of standards in order to determine whether the USAKA Standards achieve the necessary level of protectiveness. The proposed power plant at Roi-Namur provides an illustrative example, as described above under the Low Level-of-Activity Alternative.

Although the proposed Standards could allow an increase of emissions in the short term, they would be more protective in the long term because the maximum increment standard of pollutants is much lower than U.S. ambient air quality regulations. If extensive development were to occur, the provisions for air quality in the Standards could have a significant beneficial effect on the environment by effectively capping emissions at a lower level than under existing statutes and regulations.

It is important to note that, under the Standards, the Roi-Namur power plant would use a considerable portion of the increment standard for PM_{10} and SO_2. This means that the Army would be required to shut down or control existing sources before any additional sources of emissions of those two pollutants could be added.

Mitigation

Because no significant adverse impacts of the air quality elements of the proposed Standards were identified, no mitigation is required.

4.5 Noise

4.5.1 Level-of-Activity Alternatives

Potential areas of concern include noise generated from rocket launches, aircraft, power generation, construction, and any other activities that may cause an increase in the existing noise levels. The region of influence is defined as any area at Kwajalein Atoll that may experience a change in existing noise levels because of USAKA activities. Potential impacts of noise on wildlife are addressed in Section 4.6, Island Plants and Animals.

Levels of Significance

There are no legally established national standards for noise, and the proposed Standards do not address noise. The Department of the Army (DOA), Department of Defense (DoD), and U.S. EPA have regulations, pamphlets, and standards that address noise. Information from these sources and criteria used in the 1989 EIS were compiled and summarized and are used to define the impact criteria for this analysis.

Several types of noise descriptors are used in the analysis. The primary descriptor for noise measurements is the decibel (dB). Technical definitions of each noise descriptor are given in the glossary of this document. A summary of the impact criteria derivation follows.

U.S. Army Regulation (AR) 200-1, *Environmental Quality—Environmental Protection and Enhancement*, addresses noise analysis and noise abatement (in Chapter 2). AR 200-1 uses the Day-Night Level (DNL) standard as the primary noise descriptor. The DNL is used to evaluate noise levels at noise sensitive receptor locations, such as living quarters, schools, and hospitals, and is based on a 24-hour noise exposure level. AR 200-1 established three DNL zones for the evaluation of community annoyance.

Table 4.5-1 shows the three zones and their acceptability ratings based on noise level limits.

There are no applicable community annoyance standards for the single-event noise exposures characteristic of rocket launches or EOD activities. The short-term maximum noise level of 82 dBA used in the 1989 EIS for evaluation of community annoyance is used again here for evaluation of rocket launch activities and their impacts at sensitive receptor locations. EOD activities are evaluated using the U.S. EPA recommended levels (U.S. EPA, 1974) for community annoyance caused by surface blasting. Maximum noise levels are regulated by the number of daily occurrences. For example, the U.S. EPA recommends that blast noise levels at sensitive receptor locations not exceed 125 dB at any time, and that no more than 10 events at 115 dB occur in any 24-hour period.

Table 4.5-1
DNL Noise Level Zone Classification

Zone	Acceptability	Noise Level (DNL dBA)	Noise Level (DNL dBC)
1	Acceptable	<65	<62
2	Normally unacceptable	65 to 75	62 to 70
3	Unacceptable	>75	>70

Occupational health exposure levels are regulated by DoD MIL-STD-1474C, *Noise Limits for Military Material*, and DOA Pamphlet 40-501, *Hearing Conservation*. Steady-state noise sources, such as noise from power plants and pumping facilities, are evaluated using the noise dose exposure. MIL-STD 1474C establishes specific categories based on hearing conservation and communication requirements and sets noise limits that correspond to each. For personnel-occupied areas, the noise exposure limit for an 8-hour period is 85 dBA. For areas where the noise exposure levels exceed the 85-dBA limit, appropriate hearing protection is required.

Single-event and impulsive noise exposure levels for personnel-occupied areas, such as those from rocket launch and EOD facilities, are regulated by MIL-STD 1474C and DOA Pamphlet 40-501. For hearing damage criteria, rocket launches are evaluated using the maximum sound pressure level in dBA, and EOD activities are evaluated using the maximum sound pressure level in dB. MIL-STD 1474C and DOA 40-501 limit the maximum noise level at personnel-occupied areas to 140 dBA without appropriate hearing protection. Typical sound levels of familiar noise sources and the usual public responses are shown in Figure 4.5-1.

For each alternative, all sources that may cause an increase in the existing noise levels were evaluated. Because there are limited data regarding ambient noise at USAKA, a sound pressure level of 55 dBA is used as a reference for the existing noise level. This level represents a conservative DNL for an average suburban residential neighborhood (U.S. EPA, 1974). Based on the criteria discussed above, the following levels of significance are used to evaluate potential impacts:

- **No or Negligible Impact.** No increase in ambient noise level, as measured by DNL. Short-term maximum noise levels not greater than 82 dBA in noise-sensitive areas.

- **Nonsignificant Impact.** No increase in ambient noise levels above the 65-dBA DNL, and maximum short-term noise levels less than 92 dBA in noise-sensitive areas. Maximum noise levels in the workplace adhere to those specified by MIL-STD 1474C and DOA 40-501. Blast noise does not exceed recommended U.S. EPA limits for community annoyance.

- **Significant Impact.** An increase in ambient noise levels above the 65-dBA DNL, or maximum short-term noise levels greater than 92 dBA. Maximum noise levels in the workplace exceed those specified by MIL-STD 1474C and DOA 40-501. Blast noise exceeds recommended U.S. EPA limits for community annoyance.

Noise Source Evaluation Methods

Sound levels used in the evaluation derive from technical reports and publications on similar types of equipment or systems. Whenever possible, sound level data from actual or similar equipment are used. Calculations for mechanical systems, such as power plants and pumping stations, are estimated using information contained in Army TM 5-805-4, *Noise and Vibration Control for Mechanical Equipment.*

Launch Vehicle Noise Evaluation Methods

Sound levels for rocket launches are taken from existing technical reports or calculated using the NASA Empirically Derived Prediction Model from Chapter 6 of *Sonic Vibrations for Ground Facilities* (Sutherland, 1968). With the exception of rockets with a Talos first-stage booster, all rocket launch calculations are for the first stage only. Second-stage ignition occurs at least 60 seconds after launch for most launch system configurations. After 60 seconds, the launch vehicle altitudes are sufficiently high that the noise levels generated by the first stage can be considered to be the maximum ground noise levels. The Talos booster has a relatively short thrust period (approximately 6 seconds); therefore, the second stage is ignited at altitudes low enough to cause an increase in the existing noise levels at close receiver locations. Table 4.5-2 contains a list of the different vehicle configurations modeled for noise.

Public Response	dBA	Familiar Noise
	145	
Physically Painful	140	Sonic Boom
Extremely Loud	135	
	130	
	125	
Threshold of Physical Discomfort	120	Jet Takeoff (Near Runway)
	115	
	110	Rock Music Band (Near Stage)
	105	
	100	Piledriver at 50 feet
	95	Freight Train at 50 Feet Ambulance Siren at 100 feet
Hearing Damage Criteria for an 8-Hour Workday	90	
	85	Inside Boiler Room
Most Residents Highly Annoyed	80	Garbage Disposal in Home at 3 Feet
	75	
	70	Inside Sports Car at 50 MPH
Acceptability Limit for Residential Development	65	Average Urban Area
	60	
Goal for Urban Areas	55	Inside Department Store
	50	Typical Daytime Suburban Background
	45	
	40	
No Community Annoyance	35	Typical Library Quiet Rural Area
	30	
	25	Inside Recording Studio
	20	
	15	
	10	
	5	
Threshold of Hearing	0	

Source: Adapted from the U.S. Department of the Air Force, 1987, 1989.

U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Typical Sound Levels of Familiar Noises and Public Responses

FIGURE 4.5-1

Table 4.5-2 Launch Vehicle Configurations for Noise Modeling					
Vehicle Type	Talos-Aries	M56A1-M57A1	HAVE-JEEP IX (Aries II)	M55A1-M56A1	SR-19
First-stage booster	Talos	M56A1	Talos	M55A1	SR-19
Second-stage booster	M56A1	M57A1	M56A1	M56A1	None
Third-stage booster	None	None	M57A1	None	None

Launch Vehicle Noise Evaluation

Table 4.5-3 contains the results of launch vehicle noise calculations for each of the launch vehicle configurations listed in Table 4.5-2. Noise levels are calculated for each significance criterion. System Integration Tests (SITs) for the Intermediate and High Level-of-Activity alternatives would require simultaneous launches of up to six vehicles. Noise level calculations using the M55A1-M56A1 launch vehicle were performed for the maximum number of launch vehicles in each of the alternatives. Distance and sound levels for each significance criterion are listed in Table 4.5-3. Table 4.5-4 presents multiple launch noise calculations.

Table 4.5-3 Distance to Significance Criteria for Single Launches						
Significance Criteria and Sound Level Information		Launch Vehicle Types and Distance to Impact Criteria in Feet (meters)				
Significance Criteria and Related Impacts	Sound Level (dBA)	Talos-Aries	M56A1-M57A1	HAVE-JEEP XI	M55A1-M56A1	SR-19
Significant Impact Maximum levels specified by MIL-STD 1474C and DOA 40-501. Instantaneous hearing damage. Possible structural damage.	140	150 (46)	225 (69)	150 (46)	350 (107)	250 (76)
Recommend minimum distance for all noncritical personnel. No hearing protection required for noises of less than 10 minutes. Possible short-term hearing loss. Window rattling.	115	2,000 (610)	3,000 (914)	2,000 (610)	4,000 (1,219)	3,000 (914)
Nonsignificant Impact Highly annoying sound level.	92	14,000 (4,267)	14,500 (4,420)	14,000 (4,267)	19,000 (5,791)	14,000 (4,267)
No or Negligible Impact Most residents annoyed.	82	23,000 (7,010)	30,000 (9,144)	21,500 (6,533)	31,000 (9,449)	24,000 (7,315)

Table 4.5-4 Distance to Significance Criteria for Simultaneous Multiple Launches				
Significance Criteria and Sound Level Information		Launch Vehicle Types and Distance to Impact Criteria in Feet (meters)		
Significance Criteria and Related Impacts	Sound Level (dBA)	Two Each M55A1-M56A1	Four Each M55A1-M56A1	Six Each M55A1-M56A1
Significant Impact Maximum levels specified by MIL-STD 1474C and DOA 40-501. Instantaneous hearing damage. Possible structural damage.	140	850 (259)	1,250 (381)	1,750 (533)
Recommend minimum distance for all noncritical personnel. No hearing protection required for noises of less than 10 minutes. Possible short-term hearing loss. Window rattling.	115	6,500 (1,980)	10,000 (3,048)	12,500 (3,810
Nonsignificant Impact Highly annoying sound level.	92	25,000 (7,620)	34,000 (10,363)	39,000 (11,887)
No or Negligible Impact Most residents annoyed.	82	39,500 (12,040)	48,000 (14,630)	52,500 (16,000)

NO ACTION

Noise-producing activities that are part of the No-Action Alternative include rocket launches, aircraft and helicopter flight activities, power generators, and other ongoing and future construction activities. Full discussions of specific noise source issues were addressed in the 1989 EIS, Subsection 4.4.2. No significant impacts were identified from the Proposed Action of the 1989 EIS, which corresponds to the No-Action Alternative of this SEIS.

LOW LEVEL OF ACTIVITY

Impacts

Under this alternative, there would be a substantial increase in the number of rocket launches from Meck and in major construction activities proposed for Kwajalein, Roi-Namur, and Meck.

KWAJALEIN

Under the Low Level-of-Activity Alternative, there would be no increase in rocket launches at Kwajalein and there is not expected to be a substantial increase in aircraft flight activity at Kwajalein (see Section 4.12). Several construction activities are associated with this alternative.

The distance from the proposed location of the new solid waste incinerator to the closest sensitive receiver location is approximately 7,300 feet (2 kilometers). Estimated noise levels from this facility would be reduced by atmospheric divergence to negligible levels at sensitive receiver locations.

Other construction projects associated with this alternative include unaccompanied and family housing units, physical securities facilities upgrade, the religious education facility, and several storage and warehouse facilities. Construction of these facilities, along with the solid waste incinerator and the GBR-T on top of FN 1500, are expected to have short-term negligible or nonsignificant impacts at sensitive receiver locations.

ROI-NAMUR

Under the Low Level of Activity, there would be no substantial increase in the number of rocket launches or aircraft flight activity at Roi-Namur (see Section 4.12).

Construction of a new power plant on Roi-Namur is proposed as part of this alternative. The facility is to be constructed directly east of the existing power plant, which would be demolished. The facility would be enclosed in a building and have a capacity of approximately 13.5 MW. Calculations of the expected noise levels and relevant contour line distances are listed in Table 4.5-5. Calculations assume the use of exhaust silencers and the complete enclosure of the generators and drive units with no additional attenuation from shielding of existing structures or atmospheric absorption. The closest sensitive receiver location is at the unaccompanied housing facilities located approximately 2,630 feet (802 meters) from the proposed power plant location on the island's northern shore. This distance is slightly greater than the distance to the calculated 66 dBA DNL negligible impact contour line; therefore, impact from the operation of this facility should have a negligible impact at sensitive receiver locations. Power plant facility workers must be provided with proper hearing protection to remain within MIL-STD-1474C and DOA 40-501 standards.

Noise from construction of the power facility is expected to cause short-term nonsignificant impacts at sensitive receiver locations. Other construction activities, including a saltwater intake upgrade, wastewater treatment plant, and shoreline protection projects, could cause short-term nonsignificant impacts at sensitive receiver locations.

Table 4.5-5
Estimated Noise Levels
Roi-Namur Power Plant

Level of Impact Significance	Estimated DNL Noise Level[1] (dBA)	Distance to Impact Criterion in feet (meters)	Distance to Receptor in feet (meters)
No or negligible	66	2,540 (774)	Residential housing 2,630 (802)
Nonsignificant MIL-STD 1474C and DOA Pamphlet 40-501 8-hour standard	90[2]	120 (37)	Plant workers (within 120 [37])

[1]Noise levels are calculated using U.S. Army TM 5-805-4.
[2]Calculated L_{eq} for 8-hour period.

MECK

There would be a substantial increase in rocket launch activity from Meck under the Low Level of Activity. Launches would include sounding rockets and strategic launch vehicles using Talos, M56A1, SR-19 and M55A1, or M55G1 first-stage boosters. Up to five single launches are assumed to occur each quarter. Launch vehicle noise levels are listed in Table 4.5-3. Noise levels of 140 dBA would occur within 350 feet (107 meters) of the launch facility. The 115-dBA, short-term noise criterion would be exceeded on Meck Island and at distances up to 4,000 feet (1,219 meters) from the launch facilities. Noise levels on Eniwetak and Meck would exceed the 92-dBA significance criterion for all launches, and on Eniwetak noise levels would exceed the 115-dBA short-term criterion during M55A1-M56A1 launches. In accordance with range safety procedures, personnel on Omelek, Eniwetak, and Meck would be provided with the proper hearing protection during launches and, therefore, noise exposures would not exceed the MIL-STD-1474C and DOA 40-501 short-term noise exposure levels. There are no sensitive receivers within the 82-dBA negligible noise level criterion distance.

In addition to the increase in rocket launch activities, this alternative requires major construction activities on Meck for range support in this alternative. Impacts caused by construction could have a short-term nonsignificant impact on working personnel.

OTHER ISLANDS

All of the other USAKA islands would have either no activities or limited construction activities for shoreline protection in this alternative. There is expected to be a negligible impact because of noise at these islands.

Mitigation

No impacts are expected from activities under this alternative; thus, no mitigation is required.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

Noise-producing activities under the Intermediate Level of Activity would include a substantially higher level of rocket launches, an increased level of aircraft and helicopter flight activities, new and renovated power generation facilities, and several major construction projects. Launch activities include multiple strategic vehicle launches from Illeginni, Omelek, and Meck, and continued meteorological and sounding rocket launches from Kwajalein and Roi-Namur.

KWAJALEIN

Increased aircraft traffic at Kwajalein airport is expected under this alternative. Current calculated DNL levels for the airport show no impact at sensitive receiver locations (see Figure 3.4-1 in the 1989 DEIS). The expected increase in traffic at Bucholz Airfield above the levels of flight activities assessed in the 1989 EIS (which correspond to the No-Action Alternative for this SEIS) would result in an increased DNL of 1 to 2 dBA. An increase of this size would have a negligible impact at any sensitive receiver location on Kwajalein.

There are no major construction activities scheduled for Kwajalein under this alternative. Construction of shoreline protection would have a short-term negligible or nonsignificant impact.

ROI-NAMUR

There are no major construction activities scheduled for Roi-Namur under this alternative. Construction of shoreline protection would have a short-term negligible or nonsignificant impact.

MECK

For this alternative, there would be multiple concurrent launches of strategic vehicles from Meck. The types of launches that would occur include sounding rockets and SLVs using Talos, M56A1, SR-19, and M55A1 or M55G1 first-stage boosters. Launch vehicle noise levels for all vehicle types are summarized in Table 4.5-3. Noise levels for multiple vehicle launches are listed in Table 4.5-4. For the purposes of noise analysis, it is assumed that the concurrent launches would involve the simultaneous launch of four SLVs. Dual launches (i.e., two simultaneous launches) would have smaller noise impacts.

During SITs involving four simultaneous launches, the 140-dBA short-term noise criterion would be exceeded on Meck at distances up to 1,250 feet (381 meters) from the launch facilities. Noise levels on Eniwetak and Omelek would exceed the 92-dBA significance criterion for all launches from Meck, and noise levels on Eniwetak would exceed the 115-dBA short-term criterion during simultaneous M55A1-M56A1 and SR-19 launches. Noise levels would exceed the 82-dBA significance criterion on Gellinam during multiple launches of M55A1-M56A1 and SR-19 vehicles. Because there are no sensitive receivers on Meck, Eniwetak, Omelek, and Gellinam, multiple vehicle launches are expected to have a short-term nonsignificant impact on working personnel. In accordance with range safety procedures, personnel on Omelek, Eniwetak, and Meck would be provided with the proper hearing protection during launches and would not be exposed to noise levels that exceed the MIL-STD-1474C and DOA 40-501 short-term noise exposure levels. There are no sensitive receivers within the 82-dBA no or negligible noise level criterion.

LEGAN

EOD activities on Legan could result in short-term maximum noise levels of up to 140 dB at a distance of 320 feet (98 meters). This results in noise levels of 125 dB within 1,800 feet (549 meters), or 92 dB within 80,300 feet (24,475 meters) of the detonation. Because of the infrequency of EOD activities and distance to the closest inhabited island, it is not expected that the U.S. EPA recommended limits for blast noise would be exceeded. Construction of the EOD facilities and renovation of the existing radar systems could result in a short-term nonsignificant impact on working personnel.

ILLEGINNI

In this alternative, there would be multiple concurrent launches of up to four strategic launch vehicles from Illeginni. The types of boosters used in this test are not known; however, an M56A1-M57A1 two-stage rocket was used to model the potential noise impacts. Similar launch vehicles might also be used, with noise impacts that are no greater than those described here.

Calculations of significant noise level distances for single and multiple vehicle launches in different launch configurations were performed and are summarized in Tables 4.5-3 and 4.5-4. The 140-dBA short-term noise criterion would be exceeded on Illeginni at distances up to 1,250 feet (381 meters) from the launch facilities. The 115-dBA noise level would be exceeded at distances up to 10,000 feet (3,048 meters). The maximum distance for the 82-dBA negligible impact criterion is approximately 48,000 feet (14,630 meters). The minimum distance to the boundary of the Mid-Atoll Corridor from Illeginni is approximately 81,000 feet (24,689 meters). There are no inhabited islands within the Mid-Atoll Corridor; therefore, there are no sensitive receivers that would be exposed to levels exceeding the 82-dBA significance criterion. In accordance with range safety procedures, personnel on Illeginni would be provided with the proper hearing protection during launches and would not be exposed to noise levels that exceed the MIL-STD-1474C and DOA 40-501 short-term noise exposure levels.

EOD activities on Illeginni could result in short-term maximum noise levels of up to 140 dB at a distance of 320 feet (98 meters). This results in levels of 125 dB within 1,800 feet (549 meters), or 92 dB within 80,300 feet (24,475 meters) of the detonation. Because of the infrequency of EOD activities and distance to the closest inhabited island, no noise sensitive receptors are expected to exceed the U.S. EPA recommended limits for blast noise. Construction of the EOD facilities could result in a short-term nonsignificant impact on working personnel.

Major construction and renovation activities are planned to support the increased level of activity on Illeginni. Because there are no sensitive receiver locations on Illeginni, impacts resulting from these activities are expected to cause short-term nonsignificant impacts on working personnel.

ENNUGARRET

EOD activities on Ennugarret could result in short-term maximum noise levels of up to 140 dB at a distance of 320 feet (98 meters). This results in levels of 125 dB within 1,800 feet (549 meters), or 92 dB within 80,300 feet (24,475 meters) of the detonation. Depending on the numbers and types of EOD activities per day, maximum noise levels could exceed the significant impact criteria on Ennugarret, Roi-Namur, and Ennubirr. Only one-quarter of Ennugarret is leased by USAKA. If portions of the island were not controlled and Marshallese citizens were present, they could be exposed to significant short-term noise levels resulting in temporary or permanent hearing damage. Addition of the EOD facility would also require construction activities with short-term nonsignificant noise impacts.

Mitigation

At Ennugarret, ensuring that no personnel are exposed to noise levels that exceed Army standards and U.S. EPA guidelines would require USAKA to obtain authority to control the entire island during EOD activities, ensuring that no unauthorized personnel would be present on the island during detonation. Advance notification of EOD activities should be provided to personnel on Roi-Namur and Ennubirr. If ordnance as large as 500 pounds is detonated, it may be necessary to provide personnel on both islands with some form of hearing protection, such as earplugs, or moving indoors. No other mitigation for noise should be necessary under this alternative.

HIGH LEVEL OF ACTIVITY

Impacts

Noise-producing activities in the High Level-of-Activity Alternative include all those associated with the No-Action, Low Level-of-Activity, and Intermediate Level-of-

Activity alternatives. New launch facilities would be installed on Omelek, Eniwetak, and Gellinam, and additional launches would occur at Meck. New power generators would be installed on Omelek, Legan, and Gagan and the facility at Gellinam would be upgraded. Most islands would also experience substantial construction activity.

KWAJALEIN

Under the High Level of Activity, there would be an estimated 39 percent increase in fixed-wing flight activity and a 67 percent increase in helicopter flight activity at Bucholz Airfield compared with the No-Action Alternative. This increase would result in a 3- to 4-dBA increase in the existing noise level contours. The resulting levels would have no impact on any of the sensitive receiver locations on Kwajalein.

Limited construction activities under this alternative could have a negligible impact at sensitive receptors.

MECK

Increased numbers of SLVs would be launched from Meck in this alternative (up to 28 annually), in addition to continuing launches of sounding rockets. Some of the launches from Meck would be simultaneous launches of several boosters. Calculations of significant noise level distances for single and multiple vehicles launches in different configurations are summarized in Tables 4.5-3 and 4.5-4.

During simultaneous launches of six M55A1-M56A1 boosters (the loudest booster expected to be used at USAKA), the 140-dBA short-term noise criterion would be exceeded at distances from the launch site of up to 1,750 feet (533 meters). The 115-dBA short-term noise criterion would be exceeded at distances up to 12,500 feet (3,810 meters) from the launch facilities. Because there are no sensitive receivers on Meck, Eniwetak, Omelek, and Gellinam, the noise impacts of multiple launches from Meck would have only short-term, nonsignificant impacts on working personnel, who would be equipped with proper hearing protection during launches.

The maximum distance for the 92-dBA nonsignificant impact would be approximately 39,000 feet (11,887 meters); the 82-dBA negligible impact criterion distance would be approximately 52,500 feet (16,002 meters). The minimum distance to the Mid-Atoll Corridor line from Meck is approximately 46,000 feet (14,021 meters), and the distance to Ninji, the closest inhabited island, is approximately 51,000 feet (15,544 meters). Noise impacts at Ninji would, therefore, be nonsignificant.

ENNYLABEGAN

Minor construction activities would have a negligible impact on working personnel.

OMELEK

Construction of new launch facilities, power generation facilities, and shoreline protection would take place under this alternative. Up to eight launches of single SLVs would occur annually from two launch facilities. Noise levels of 140 dBA would occur within 350 feet (107 meters) of the launch facility. The 115-dBA, short-term noise criterion would be exceeded on Omelek Island and at distances up to approximately 4,000 feet (1,219 meters) from the launch site. There are no inhabited islands within the 82-dBA negligible noise level criterion distance. Because no personnel reside on Omelek, and rockets would be remotely launched from Meck, impacts resulting from the construction and use of these facilities is expected to cause short-term nonsignificant impacts on working personnel.

LEGAN

Several construction activities, such as power generation facilities and shoreline protection would take place under this alternative (in addition to those described under the Intermediate Level-of-Activity Alternative). Because no personnel reside on Legan, noise impacts resulting from the construction and use of these facilities are expected to cause short-term nonsignificant impacts on working personnel.

GAGAN

The full development of Gagan under this alternative would include several construction activities and the installation of a 565-kW generator. Because no personnel reside on Gagan, impacts resulting from the construction and use of these facilities is expected to cause short-term nonsignificant impacts on working personnel.

GELLINAM

Under the High Level-of-Activity Alternative, launches of meteorological rockets would take place at Gellinam. Because no personnel reside on Gellinam, impacts resulting from the rocket launches are expected to have short-term nonsignificant impacts on working personnel. In accordance with range safety procedures, personnel on Gellinam would be provided with the proper hearing protection during launches, so exposure would not exceed the MIL-STD-1474C and DOA 40-501 short-term noise exposure levels. Construction of a new meteorological rocket launch facility, expansion of the existing generator, and additional shoreline protection are expected to cause short-term nonsignificant impacts on working personnel.

ENIWETAK

Launches of strategic launch vehicles for SITs in this alternative would be conducted at Eniwetak. Launch activities would be controlled from Meck. Calculations of significant noise level distances for single and multiple vehicle launches of different launch configurations are summarized in Tables 4.5-3 and 4.5-4. During simultaneous launches of six boosters, the 140-dBA short-term noise criterion would be exceeded on Eniwetak at distances up to 1,750 feet (533 meters) from the launch facilities. The 115-dBA short-term noise criterion would be exceeded at distances up to 12,500 feet (3,810 meters) from the launch facilities. Noise levels on Omelek and Meck would exceed the 92-dBA significance criterion for all launches and would exceed the 115-dBA short-term criterion during multiple concurrent M55A1-M56A1 and SR-19 launches. The maximum distance for the 82-dBA negligible impact criterion is approximately 52,500 feet (16,002 meters). The minimum distance to the Mid-Atoll Corridor line from Eniwetak is approximately 52,800 feet (16,093 meters), and the distance to Ninji, the closest inhabited island, is approximately 58,000 feet (17,678 meters). Because there are no inhabited islands within the Mid-Atoll Corridor, there are no sensitive receivers within the 82-dBA significance criterion distance. In accordance with range safety procedures, personnel on Omelek, Eniwetak, and Meck would be provided with the proper hearing protection during launches, so exposure would not exceed the MIL-STD-1474C and DOA 40-501 short-term noise exposure levels.

Construction projects include a six-silo launch facility, a new power generation facility, and other supporting projects and shoreline protection. Because no personnel reside on Eniwetak and the rockets would be launched remotely from Meck, impacts from the construction and use of these facilities are expected to cause only short-term nonsignificant impacts on working personnel.

OTHER ISLANDS

Under this alternative, there would be no major noise impacts at other USAKA islands other than those described under the other alternatives.

Mitigation

Because there are no significant impacts from noise in this alternative in addition to those described for the Intermediate Level of Activity, no additional mitigation is required.

4.6 Island Plants and Animals

4.6.1 Level-of-Activity Alternatives

The primary activities that may adversely affect island plants and animals are related to the clearing of mature vegetation and associated habitat destruction required for new launch facilities, supporting infrastructure, and construction of shoreline revetment. Undisturbed stands of native vegetation and/or seabird nesting and roosting areas are the key areas of concern. Impacts and mitigations associated with rare, threatened, or endangered species are discussed in Section 4.8.

Levels of Significance—Existing U.S. Statutes and Regulations

The primary existing statute that protects biological resources at USAKA is the Endangered Species Act of 1975, which is addressed in Section 4.8, Rare, Threatened, or Endangered Species. For other island plants and animals at USAKA, the following definition of levels of significance is used in this SEIS.

- **No or Negligible Impact.** No vegetation would be destroyed.
- **Nonsignificant Impact.** Any vegetation destroyed would represent neither an unusual vegetation association nor would it serve as identified seabird nesting or roosting habitat.
- **Significant Impact.** Native vegetation that represents an unusual vegetation association and/or serves as identified seabird nesting or roosting habitat would be destroyed.

Levels of Significance—Proposed USAKA Environmental Standards and Procedures

Section 3-4 of the proposed Standards addresses Endangered Species and Wildlife Resources. As explained below (Subsection 4.6.2), the proposed Standards extend protection to species and habitats that are not protected under the Endangered Species Act. Actions that potentially may affect these species and habitats undergo a review and coordination process with appropriate resource agencies and the RMIEPA. Although the proposed Standards would change the coordination and review process, they would not change the substance of the broadly defined levels of significance identified above.

NO ACTION

Impacts associated with the No-Action Alternative for this SEIS are those described in relation to the Proposed Action of the 1989 EIS, as modified by the 1989 Mitigation Plan that resulted from the Record of Decision on that EIS. Table 2.2-2 of this SEIS presents the status of that Mitigation Plan. All of the mitigation activities associated with island plants and animals have been initiated and many have been completed.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

KWAJALEIN

Kwajalein Island has been so extensively altered by human activity that there is little native vegetation or associated wildlife habitat on the island. Although the extensive clearing has encouraged the use of cleared areas by shore birds, none of the proposed activities would interfere with any known use of areas identified in the *Natural Resources Plan* (USAEDPO, 1991a) for seabird roosting or nesting. There is some potential that seabird roosting areas identified (in the NRP) at the southern end of the runway might be altered and/or disturbed by shoreline protection to be constructed adjacent to that area. This disturbance is not expected to have measurable effects on seabird populations. There are no or negligible impacts with respect to island plants and animals associated with the Low Level-of-Activity Alternative at Kwajalein Island.

ROI-NAMUR

Like Kwajalein Island, Roi-Namur has been extensively altered by human activities. There is an area of dense vegetation at the eastern end of the island, but none of the planned activities is proposed for this area. There would be no or negligible impacts with respect to island plants and animals associated with the Low Level-of-Activity alternative at Roi-Namur.

MECK

Like Kwajalein Island and Roi-Namur, Meck has been extensively altered by human activities. There is little native vegetation remaining to serve as wildlife habitat other than a few small areas that may be used by seabirds for nesting and roosting (see Figure 3.1-3). Proposed construction would not affect the areas possibly used by seabirds for nesting. There would be no or negligible impacts with respect to island plants and animals associated with the Low Level-of-Activity Alternative at Meck.

ENNYLABEGAN

The USAKA-leased portion of Ennylabegan, like Kwajalein Island, Roi-Namur, and Meck, has been extensively altered by human activities. There is little native vegetation remaining to serve as wildlife habitat in the areas where proposed actions are to take place under the Low Level-of-Activity Alternative. There would be no or negligible impacts with respect to island plants and animals associated with the Low Level-of-Activity Alternative at Meck.

OMELEK

About two-thirds of Omelek has been cleared and is kept mowed; however, there are three remaining patches of native forest, two of which are reported to support black noddy nesting (Clapp, 1988). Fuel tank containment upgrading proposed for this alternative would occur at the site of the existing fuel tank, within an area that is already cleared and disturbed. The only other action proposed as a part of the Low Level-of-Activity Alternative is construction of 210 feet (64 meters) of shoreline protection along the southeastern shore of the island. This might result in the removal of a small portion of the seaward edge of the native forest stand on this end of the island and is considered to have no or negligible impact. This assessment is based on the following facts: (1) Clapp did not characterize Omelek as a major black noddy nesting colony (as he did Eniwetak); (2) only a relatively small amount of forest habitat may be affected; and (3) no black noddy nesting was observed during the February 1992 reconnaissance visit to Omelek (although active black noddy nesting was observed on several of the other USAKA islands at that time), showing that these birds do not use this habitat in every nesting season.

LEGAN

Harbor dredging and the creation of a breakwater are proposed for an area not known to have native vegetation or wildlife habitat; nonsignificant impacts are anticipated. The improvements to fuel tank containment would occur at the existing tank site within a previously cleared area; nonsignificant impacts are anticipated.

ILLEGINNI

The improvements to fuel tank containment would occur at the existing tank site within a previously cleared area; nonsignificant impacts are anticipated.

GELLINAM

Most of Gellinam has been cleared and is kept mowed. The actions proposed in the Low Level-of-Activity Alternative (i.e., shoreline protection, installation of a HITS cable, and fuel tank containment upgrading) would not affect the little native vegetation and wildlife habitat that remain; therefore, there would be no or negligible impacts associated with these actions.

ENIWETAK

There would be no or negligible impacts to Eniwetak's plants and animals because proposed actions for this alternative (i.e., approximately 140 feet [43 meters] of shoreline protection and replacement of an existing fuel tank) are not expected to affect these resources. Potential impacts to turtles are addressed in Section 4.8.

OTHER AREAS

Seabirds in other areas potentially could be affected by parachutes used to slow the descent of the GSTS payload. The parachutes are released in three stages. The first is a 6-foot-diameter (2-meter-diameter) pilot parachute, released at high altitude. The pilot parachute pulls out a 25-foot (8-meter) drogue parachute, which in turn releases three 75-foot (23-meter) main parachutes. The parachutes and risers are made of nylon and/or Kevlar materials. The parachutes are designed to be jettisoned from the hardware upon impact in the ocean (within the BOA) and would not be retrieved. A total of 35 parachutes would be left to sink in the ocean. Although there is some steel hardware attached to the parachutes, they are not expected to sink rapidly to the ocean bottom.

While on the surface of the water, the parachutes have the potential to entangle sea birds that might rest on or near the parachutes. This is expected to be a negligible impact because of relatively small numbers of birds that might be affected over the period of time that a parachute would float on the surface.

Noise Impacts on Animal Life

Short-term noise impacts, such as those resulting from rocket launches, are known to startle nearby wildlife. Published studies on the effects of short-term noise impacts on wildlife (Manci et al., 1988) indicate that birds tend to "flutter" when short-term, loud noises occur, but return to normal behavior within a short time following the noise event. Because rocket launches occur on an infrequent basis, significant impacts on the local wildlife are not expected to result from launch events in any of the alternatives. Other noise sources, such as generators and pumping stations, do not produce sound levels that are likely to pose a significant impact to wildlife.

Mitigation–Existing U.S. Statutes and Regulations

No activities were identified as a part of this alternative that have the potential to cause significant impacts on island plants and animals; therefore, no mitigation measures are necessary.

Impacts–Proposed USAKA Environmental Standards and Procedures

Under the USAKA Standards, Appendices 3-4F and 3-4G include more species and habitats than are included, as protected, under U.S. statutes and regulations. Because the RMI and the USFWS or USNMFS review and comment on preliminary reviews of USAKA actions that may affect these wildlife resources and may prepare a coordination report, their involvement at this stage could include recommendations for minimizing potential adverse impacts. USAKA could disagree with the coordination report recommendations and proceed with the action. USAKA must then justify the action to the RMI and the USFWS or USNMFS when it disagrees and proceeds with the action and the conflict resolution process may result.

Mitigation–Proposed USAKA Environmental Standards and Procedures

The involvement of the RMI and the designated agency for actions that may affect the species and habitats listed in Appendices 3-4F and 3-4G could result in the identification of a broader range of mitigation for consideration by USAKA than would occur under the U.S. statutes and regulations. If the RMI and USFWS agree that the taking of a migratory bird is involved, the coordination procedures shall include preparation of a DEP. A DEP shall also be prepared when the RMI and the designated agency agree that a proposed USAKA activity will result in a significant effect on the habitats of special concern listed in Table 3-4G.3 and Appendix 3-4H.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

The following paragraphs assess potential impacts from activities proposed for this alternative in addition to those described for the Low Level-of-Activity Alternative.

KWAJALEIN

Although there would be a larger population at Kwajalein and additional construction (i.e., command control center, ground entry point [GEP] communications facility, and fiber optics cable), there would be no or negligible impacts with respect to island plants and animals associated with the Intermediate Level of Activity at Kwajalein because so little native vegetation or associated wildlife habitat remains on this island.

ROI-NAMUR

There would be no or negligible impacts with respect to island plants and animals associated with the Intermediate Level-of-Activity Alternative activities (i.e., increased population, possible GEP communications facility, and shoreline protection) at Roi-Namur because the few remaining areas of native vegetation on the island are not expected to be affected by the planned activities.

MECK

Substantial construction activity is planned on Meck in this alternative (e.g., 1,100-foot [333-meter] island expansion, new launch facilities, silo renovations, and quarrying and dredging). There should be no direct impacts on island plants and animals because the little native vegetation remaining is not expected to be affected by these planned activities, and none of the activities is proposed to occur in a small area along the ocean shoreline reported to be the nesting area of seabirds. As described above, the noise associated with the increased number of rocket launches at Meck could cause seabirds to temporarily leave nests, but they are likely to return to normal behavior within a short time after each launch. Air emissions from rocket launches should not affect the seabird nesting area because the prevailing tradewinds would carry any groundlevel concentrations of emissions away from that area. Overall, nonsignificant impacts on island plants and animals are expected.

OMELEK

The only action proposed as a part of the Intermediate Level-of-Activity Alternative is construction of approximately 450 feet (136 meters) of new shoreline protection and replacement of approximately 20 feet (6 meters) of existing damaged revetment to protect the Omelek launch facilities. No or negligible impacts would occur from these activities because native vegetation would not be affected.

LEGAN

Legan is currently in an almost undeveloped state, except for the USAKA facilities at its extreme southern end, and is densely forested. Intermediate Level-of-Activity projects on Legan would clear approximately 0.3 acre (740 square meters) of the existing forest for an EOD pit at the northern end of the island and an additional area for an access road. The road would be located to make use of an existing somewhat overgrown track in order to reduce the amount of clearing involved in its construction. The EOD pit construction would remove habitat identified as valuable for seabird nesting (white terns and black noddies were observed nesting at the northern end of the island during the February 1992 field reconnaissance visit) and coconut crabs. Because of the location of existing facilities on Legan and the required explosive safety quantity-distance (ESQD) for EOD, no practical alternative exists at Legan other than placing the EOD pit at the northern end of the island. No impacts would occur to the salt pond area. Construction associated with this alternative would result in a significant impact as a result of the destruction of a small area of native forest, a portion of which may be used as seabird habitat.

ILLEGINNI

The Intermediate Level-of-Activity Alternative at Illeginni consists primarily of reconstruction of existing heavily deteriorated or destroyed structures, and would result in a nonsignificant impact because these activities would occur primarily in areas that have been previously disturbed and contain little or no native vegetation.

GAGAN

The only proposed actions at Gagan associated with the Intermediate Level-of-Activity Alternative are the construction of a 100-square-foot (9-square-meter) building and a tower base for a splash detection radar, in an area that has no native vegetation. This construction would result in no or negligible impact to island plants and animals.

GELLINAM

The only proposed action at Gellinam associated with the Intermediate Level-of-Activity Alternative is the renovation of an existing splash detection radar (SDR). This renovation would result in no or negligible impact to island plants and animals.

ENNUGARRET

Except for an abandoned communications tower, there is no existing development on this island, which is covered with dense forest and regrowth of herbaceous vegetation in areas once cleared for a tower guying system. The actions being considered as part of the Intermediate Level-of-Activity Alternative (construction of an EOD pit, access road, helicopter pad, and marine ramp) would clear the forest from about 25 percent of the island in areas where seabird nesting (white terns and black noddies) was observed during the February 1992 field reconnaissance visit. Because much of the forest would remain and there were no major nesting colonies, this constitutes a nonsignificant impact. These nonsignificant impacts could be further reduced if the forested area cleared to provide a safe approach to the helicopter pad is allowed to regrow to and remain in a brushy state to protect island soils from erosion and to provide some level of wildlife habitat.

Mitigation–Existing U.S. Statutes and Regulations

LEGAN

Constructing an EOD pit on Legan island could not be accomplished without destroying some portion of an area used for seabird nesting. For that reason, the impacts of constructing the EOD pit on Legan island could only be mitigated by locating the EOD pit on another island.

Impacts–Proposed USAKA Environmental Standards and Procedures

Refer to analysis in Low Level-of-Activity section.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Refer to analysis in Low Level-of-Activity section.

HIGH LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

The following paragraphs assess potential impacts from activities proposed for this alternative in addition to those described for the Intermediate Level-of-Activity Alternative.

KWAJALEIN

The only construction project at Kwajalein identified in this alternative is the installation of a fiber optics cable linking Kwajalein Island to Wake Island. The cable would be laid across the lagoon side reef in or adjacent to the trench that was recently created for the SFOTS cable system. There are no or negligible impacts with respect to island plants and animals associated with the High Level-of-Activity Alternative at Kwajalein Island because the fiber optics cable installation is not expected to affect the little remaining native vegetation and associated wildlife habitat.

MECK

The only new construction at Meck in this alternative would be shoreline protection along two areas of the ocean shoreline. While the areas affected do not contain any potential turtle nesting areas, the more northerly of the two shoreline protection reaches is adjacent to a nonvegetated rocky area that has been identified as a nesting area for seabirds. If the shoreline construction activity is confined to the immediate shoreline, and construction equipment does not enter the nesting area, impacts on any nesting birds should be nonsignificant.

ENNYLABEGAN

The only additional proposed actions associated with the High Level-of-Activity Alternative are installation of additional antennas and a fiber optics cable, and repair of about 100 feet (30 meters) of existing shoreline protection. None of these activities would occur in areas with significant native vegetation or wildlife habitat. There are no or negligible impacts with respect to island plants and animals associated with the High Level-of-Activity Alternative at Ennylabegan.

OMELEK

About two-thirds of Omelek has been cleared and is kept mowed, but there are three remaining patches of native forest, two of which are reported to support black noddy nesting (Clapp, 1988). Actions proposed as a part of the High Level-of-Activity Alternative would remove all but about 8,000 square feet (720 square meters) of this remaining vegetation and associated seabird nesting habitat. This is considered to be a nonsignificant impact based on the following facts: (1) Clapp (1988) did not characterize Omelek as a major black noddy nesting colony; (2) only a relatively small amount of forest habitat may be affected; and (3) no black noddy nesting was observed during the February 1992 reconnaissance visit to Omelek (although active black noddy nesting was observed on several of the other USAKA islands at the same time), showing that these birds do not use this habitat in every nesting season.

LEGAN

Legan is currently in an almost undeveloped state, except for the USAKA facilities at its extreme southern end, and is densely forested. In this alternative, approximately 1.4 acres of forested area on the northwestern and northeastern sides of the island would be cleared for radar and camera facilities. This construction would remove some habitat identified as valuable for seabird nesting (white terns and black noddies were observed nesting at the northern end of the island during the February 1992 field reconnaissance visit) and coconut crabs. This would have a small but significant effect by destroying seabird habitat. Shoreline protection repair at Legan would not affect any previously undisturbed areas, and none of the construction would affect the salt pond area or the island.

GAGAN

About one-half of the island has been cleared and is kept mowed. Under this alternative, almost all remaining native forest vegetation would be removed, which would result in loss of seabird nesting habitat for black noddies and white terns identified by Clapp in 1988. This is considered to be a nonsignificant impact because no major nesting colonies have been identified on the island and no nesting of these species was observed during the February 1992 field reconnaissance visit when they were actively nesting on several other islands. However, if future surveys conducted during the breeding season determine that seabird nesting has resumed at Gagan, new facilities should be located to avoid vegetative clearing of the nesting habitat or provide alternative noddy nesting habitat by allowing current mowed island areas to revegetate (or be actively revegetated) to the extent possible.

GELLINAM

The actions proposed under the High Level-of-Activity Alternative include filling a portion of the reef flat at both ends of the island, construction of new launch and launch support facilities, and additional shoreline protection facilities.

Gellinam Island has been extensively cleared and is kept mowed. However, there is a small stand of *Pisonia* near the northern end that was bulldozed several years ago to remove potential interference with antenna reception. Numerous black noddies nested in these trees. The *Pisonia* stand is regenerating naturally and by February 1992 was approximately 15 feet high (5 meters). It is being used extensively for black noddy nesting and numerous chicks were observed during the February 1992 field reconnaissance visit. In addition, the few mature *Pisonia* trees left standing near the existing facilities supported approximately 75 active black noddy nests at that time. As long as this remaining *Pisonia* stand is not removed or harmed, a nonsignificant impact is expected.

The fill and associated shoreline protection proposed as a part of this alternative would impact areas reported as seabird roosting areas (Clapp, 1988) on both ends of the island; however, this is considered to have a nonsignificant impact because sufficient roosting areas remain on Gellinam and on other islands.

ENIWETAK

About two-thirds of Eniwetak is covered with a dense, mature *Pisonia* forest, with trees as tall as approximately 65 feet (19 meters). Under this alternative, launch facility and support facility construction activities would result in removal of almost all of this forest. According to Herbst (1988), "This is the best example of a *Pisonia* forest vegetation type seen during the survey, and should be protected." In addition to its botanical interest, the whole of this vegetation type receives intensive use as black noddy nesting colony. Clapp (1988) noted that this may be the largest concentration of reproducing black noddies in the atoll. The amount of clearing associated with this alternative represents a significant impact on island plants and animals.

Mitigation–Existing U.S. Statutes and Regulations

The following mitigation measures have been identified to address potentially significant impacts of the High Level-of-Activity Alternative.

LEGAN

Construction associated with this alternative would result in a somewhat greater amount of forest destruction (1.7 acres [0.7 hectare] total) than the Intermediate Level-of-Activity Alternative (0.3 acre [0.1 hectare]). Unless the facilities proposed for this alternative can be moved to another, previously disturbed area, there would be an unmitigable impact on a small area of seabird habitat.

ENIWETAK

Siting of the facilities associated with proposed High Level-of-Activity actions at Eniwetak could not be accomplished without significant impacts to island plants and animals. The only way to mitigate these impacts would be to place these facilities on another island.

Impacts–Proposed USAKA Environmental Standards and Procedures

Refer to analysis in Low Level-of-Activity section.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Refer to analysis in Low Level-of-Activity section.

4.6.2 Proposed USAKA Environmental Standards and Procedures

In addition to the formal consultation requirements regarding listed species (addressed in Section 4.8, Rare, Threatened, or Endangered Species), the proposed Standards require coordination with the USFWS or the USNMFS before carrying out any actions that may significantly affect either individual species or habitats listed in Appendices 3-4F and 3-4G of the proposed Standards. These lists cover essentially all migratory bird species and most remaining native terrestrial vegetation occurring at USAKA.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

Regulatory Framework

U.S. statutes and regulations that apply to the No-Action Alternative are those associated with any federal action that may adversely affect natural resources (i.e., a NEPA review as exemplified by this SEIS and the associated regulatory agency review that would occur through the NEPA process).

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Implementation of the proposed USAKA Standards could provide a significant positive impact because they provide a higher level of protection than the U.S. statutes and regulations. U.S. statutes and regulations do not require coordination with the appropriate natural resource agencies for USAKA actions that affect species and habitats identified in Appendices 3-4F and 3-4G of the Standards. In addition, Subsection 3-4.6.3 of the Standards requires USAKA to coordinate with the USFWS or USNMFS and with RMI and to prepare a formal coordination report to develop mitigation measures for actions that may significantly affect fish and wildlife resources. In summary, more activities are reviewed for potential effects on more species and more habitats than come under review under the U.S. statutes and regulations, and a mechanism is provided to establish binding protective measures.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because the proposed Standards are more protective of island plants and animals than existing statutes and regulations, no mitigation is required.

4.7 Marine Biological Resources

4.7.1 Level-of-Activity Alternatives

The marine resources potentially affected by the level-of-activity alternatives are coral reef habitat and marine plants and animals.

Potential areas of concern include the oceanside and lagoon nearshore reef flats of the USAKA islands. Kwajalein, Illeginni, Ennugarret, and Meck are the islands with proposals for the largest amounts of dredging and quarrying. The Mid-Atoll Corridor lagoon impact area and the BOAs north and east of the atoll could also be affected by rocket launches and intercepts. Commercial fishing in the BOA impact areas could potentially be affected by Notices to Mariners (NOTMARS) issued during scheduled reentry or interceptor events.

Levels of Significance—Existing U.S. Statutes and Regulations

The primary existing statute that protects biological resources at USAKA is the Endangered Species Act of 1975, which is addressed in Section 4.8, Rare, Threatened, or Endangered Species of this SEIS. For other marine species and habitats at USAKA, the definition of levels of significance provided below is used in this SEIS. The significance of impacts is defined in terms of the degree of loss or major damage to coral reefs and the potential for recovery of the reef resource as marine habitat. Significance also reflects the extent of potential decline in the productivity of and access to nearshore fishery resources because of increasing USAKA populations and the destruction of reef habitat.

- **No or Negligible Impact.** There would be no measurable destruction of reef habitat requiring long-term recovery and little or no habitat loss or physical removal of coral would occur. No measurable decline would be anticipated in fishery resources at Kwajalein.

- **Nonsignificant Impact.** Reef habitat would be altered and fishery resources potentially could be affected. Recovery of reef habitat would be anticipated over a period of years.

- **Significant Impact.** Habitat would be modified from hard to soft substratum that would delay indefinitely or prevent coral reef recovery. The reef habitat around USAKA would be reduced to the extent that a noticeable decline in the fishery resources would be predicted.

Levels of Significance—Proposed USAKA Environmental Standards and Procedures

Section 3-4 of the proposed Standards addresses Endangered Species and Wildlife Resources. As explained below (Subsection 4.7.2), the proposed Standards extend protection to marine species and habitats that are not protected under the Endangered Species Act. Actions that potentially may affect these species and habitats undergo a review and coordination process with appropriate resource agencies and the RMI. Although the proposed Standards would change the coordination and review process, they would not change the substance of the broadly defined levels of significance identified above.

NO ACTION

The 1989 EIS identified several activities that had the potential to affect marine biological resources. These actions and corresponding mitigations have been completed. Quarrying and dredging were completed in 1990 on the oceanside reefs of Kwajalein, Roi-Namur, and Meck islands. Approximately 60,000 cubic yards (45,900 cubic meters) of material were removed from roughly rectangular and triangular-shaped sites on the reef flats. A breakwater was created by filling about

15,000 square feet (1,395 square meters) on the southwestern side of Meck Island. Maintenance dredging of the harbor area is conducted approximately once every 10 years on an as-needed basis. Port facility upgrades were constructed at Meck and Omelek islands.

To mitigate potential adverse impacts from dredging and quarrying, USAKA conducts surveys before dredging or blasting to determine the presence of sensitive resources such as the giant clam, sea turtles, and marine mammals. These surveys help USAKA avoid sensitive resources when siting cable and pipeline alignments. If giant clams are determined to be in dredging or blasting areas, USAKA will transplant the clams to suitable habitat nearby. RMI, with the assistance of USAKA, has experience in transplanting immature clams to suitable habitats. Site planning and construction practices have been improved at USAKA and the use of silt curtains or other turbidity control devices has been implemented to mitigate impacts.

In the No-Action Alternative, missile testing activities would continue and reentry vehicles would land in the lagoon or in the BOAs (as well as at the Illeginni land impact area). A fiber optics cable line was trenched through coral reef habitat between Meck and Omelek islands for the GSTS launches.

A desalination plant is under construction on Kwajalein Island and is scheduled for completion in 1994. It would use the existing power plant cooling water intake. An environmental assessment was completed for the desalination plant and power plant upgrade in 1992 (USASDC, 1992c). The sewage treatment plant proposed for Roi-Namur in the 1989 EIS was not built. A new site is being investigated and this activity is included in the Low Level-of-Activity Alternative, below.

Commercial Fishing. USAKA reentry vehicle (RV) events would continue, and RVs would land in the lagoon or BOA at approximately the same frequency experienced under the current conditions. Missions that currently involve RVs number up to about 12 per year. The BOA and Mid-Atoll Corridor are also affected during launches. Missions involving intercepts can affect the BOA as well. The closure periods of the Mid-Atoll Corridor are specified in the Military Use and Operating Rights Agreement (MUORA) between the U.S. and RMI governments and are not affected by the number of launches or intercepts at USAKA (missions are scheduled to coincide with this schedule of closures). USAKA observes the requirements of the MUORA to avoid interference with commercial activities, including the exploitation of living and nonliving resources of the sea.

Areas affected by launches or intercepts within the BOA are not closed; instead air traffic and ships are notified ahead of each mission by Notices to Airmen (NOTAMS) and NOTMARS, respectively. These identify the area and periods involved in each mission and warn air and ship traffic away from the affected areas. The RMI government is informed, and announcements are made on local radios, in local newspapers, and on the Ebeye ferry. The actual number of days that areas of the BOA are affected varies with each year's mission schedule. The projected number and duration of such periods would remain the same in the No-Action Alternative, and thus the impact on existing fishing activities in BOA waters is expected to be generally similar to the current frequency of missions. If the number of RMI or foreign fishing vessels using the Kwajalein Atoll lagoon or BOA areas of the RMI's Exclusive Economic Zone (EEZ) increased in the future, vessel use of these areas would be precluded at the same frequency.

Impacts of missions on fishing would not be significant because of the immense lagoon area of Kwajalein Atoll that would remain available for fishing and because only a relatively tiny portion of the EEZ area would be affected for short periods (a few hours) during launches or intercepts. Fishing activities could continue in other parts of the EEZ, the Kwajalein lagoon area, in nearshore waters, at other atoll lagoons, and in open ocean areas outside the areas affected by the mission activity. USAKA would continue providing NOTMARS advising fishing vessels of pending missions in order to allow safe exit from the Mid-Atoll Corridor or the areas of the BOA affected by launches or intercepts. After the mission has ended, fishing vessels could return to these areas. Again, no long-term impact on RMI fishing production or license revenues would be expected because the duration of each mission is short (a few hours) and could be scheduled in advance by vessel operators. Moreover, the majority of the commercial catch occurs in the southern and western areas of the EEZ, which are less likely to be affected by an increase in the frequency of missions because reentry and intercept closures typically occur to the north and east in the BOA.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Broad Ocean Area

In this alternative, there would be as many as 104 launches of all types per year from USAKA. The ignition of solid-fueled rockets can release emissions of aluminum oxide, hydrochloric acid and, to a lesser extent, lead. During the rocket flight, particles descend and spread over the surface of the ocean. The ocean layer at the atmosphere-water interface is the sea-surface microlayer. This zone is the upper 50 μm and is important because it provides an interface for the exchange of gases between the atmosphere and ocean. It also provides habitat for neustonic organisms that exist in the surface film of the water. Because this layer receives deposition from natural and man-made materials, contaminants, such as metals, have been reported in concentrations higher than in water layers below the microlayer. These higher concentrations have been identified as potential causes for reduced productivity by phytoneuston in the microlayer and potentially as a source of contamination in egg and larval stages of fish that occur in the microlayer.

The distribution of rocket exhaust by-products is dependent on meteorological conditions during a launch; it would typically cover large areas of ocean waters.

Because USAKA is located in a remote area of the Pacific Ocean, the cumulative contribution from all sources of anthropogenic (human-made) pollutant would be relatively low compared with areas downwind from highly populated and industrialized areas of the world. Based on observation of the abundance and diversity of coral, ocean, and lagoon habitat and fish, the potential impacts to reef habitat and on fishery resources at USAKA and surrounding ocean waters from rocket launches would be negligible.

Reentry vehicles from missile launches are planned to fall into the lagoon impact area of the Mid-Atoll Corridor or into BOAs (i.e., 85 nautical miles north or 280 nautical miles east). The RVs that land in the lagoon are retrieved, while those that land in BOAs are not. The landings of the RVs are expected to have a negligible impact on marine biological resources because they involve relatively small amounts of material and generally do not include toxic or hazardous materials (other than small amounts of lithium batteries).

The descent of the GSTS payload would be slowed via parachutes. The parachutes would be released in three stages. The first is a 6-foot-diameter (2-meter-diameter) pilot parachute, released at high altitude. The pilot parachute pulls out a 25-foot (8-meter) drogue parachute, which, in turn, releases three 75-foot (23-meter) main parachutes. The parachutes and risers are made of nylon and/or Kevlar materials. The parachutes are designed to be jettisoned from the hardware on impact in the ocean and would not be retrieved. A total of 35 parachutes would be left to sink in the ocean. Although there is some steel hardware attached to the parachutes, they are not expected to sink rapidly to the ocean bottom.

The currents in the BOA are not well known. Meanders and eddies from the two main currents (i.e., North Equatorial Current [east to west] and the Equatorial Countercurrent [west to east]) as well as wind conditions affect the movement of surface and bottom waters. If air is trapped in a parachute, it would remain buoyant longer and would probably drift longer distances. Those parachutes that do not sink rapidly may drift into nearshore waters where they potentially could sink and get snagged on coral reefs. This would kill the corals covered by a parachute. This is expected to be a nonsignificant impact because, even though a Kevlar parachute would not degrade quickly in the marine environment, the impact area is relatively small.

ROI-NAMUR

Other activities that have the potential to affect marine biological resources through water quality impacts include the construction of an outfall for a wastewater treatment plant on the northwestern end of Roi-Namur. The outfall would be moved to deeper water from its current location in water depths of about 0.4 foot (12 centimeters). This would be a beneficial impact because the design of the new treatment plant would include compliance with water quality standards for the effluent. In addition, the extension into deeper waters would allow more mixing of the effluent with the receiving waters.

A new saltwater intake would be constructed near the southwest pier at Roi-Namur. The intake would supply cooling water for the radars and other facilities. Because the existing power plant is being converted to a closed-loop freshwater cooling system and the new power plant would have a similar closed-loop freshwater system, less seawater would be required for cooling. The reduction in water use will reduce the potential for impingement and entrainment of marine biological resources. This would be a beneficial impact as compared with existing conditions.

Bottom disturbances for the new saltwater intake and the wastewater treatment plant outfall extension would result in temporary increases in suspended sediments. Habitat would be destroyed along the pipeline paths; however, the habitat should return to preexisting conditions after construction is completed. The trench for the pipeline would be backfilled and sealed with concrete. This would provide additional hard substrate for the establishment of hard-bottom communities. Benthic invertebrates should recolonize the area rapidly. Giant clams have been reported in the area offshore of the northwest end of Roi-Namur. Direct disturbance of giant clams along the outfall route would be a significant impact; for that reason, a reconnaissance survey would be done to site the trench for the purpose of avoiding the clams. If the clams cannot be avoided, USAKA would mitigate the potential impacts by transplanting the clams to suitable habitat nearby. RMI, with the assistance of USAKA, has experience with transplanting giant clams. The impacts are expected to be nonsignificant.

Most construction activities that involve the removal or disturbance of bottom sediments or hard substrate can have an impact on marine biological resources. These impacts include the direct destruction of organisms (e.g., removal from the water or burial during dredging) and their habitats. Indirect impacts include effects related to increases in turbidity and suspended sediments, such as clogging of gills and respiratory organs; reduction of visibility resulting in impaired ability to feed and to avoid predators; impairment of development in egg, larval, and juvenile life stages; and chronic exposure to contaminants associated with suspended particulates.

ENNYLABEGAN AND MECK

A fiber optics cable would be installed to connect Ennylabegan Island with Meck Island. The activity would include laying reinforced cable over the sea floor. Field reconnaissance surveys would be conducted to select alignments that do not impact giant clams. The cable would be placed on the sea floor surface to avoid coral mounds. Trenching, which would be required only to bury the cable as it comes ashore, would temporarily increase suspended sediments downcurrent from the trenching activity. The trench for a cable would be less than a foot wide and a foot deep. The effects from this activity on these two islands would be negligible.

Quarrying and Dredging

Dredging is proposed at Illeginni, Legan, and Ennylabegan islands to improve the harbor areas. The inside curve of the harbor at Illeginni contains areas with 50 to 60 percent live coral coverage. Plants and animals could be significantly affected by dredging in this area. Reductions in coral habitat could result in losses in the abundance and composition of finfish resources that depend on that habitat for food and shelter. Areas with greater than 50 percent coverage of live coral exist near the dredging at Legan and Ennylabegan. Destruction caused by removal or siltation that results from increased turbidity could cause significant impacts to these live coral communities and would affect the fish and invertebrate populations that inhabit these areas. Standard procedures at USAKA include the use of silt curtains, which are designed to reduce the transport of suspended particulates. If it is determined during construction activities that the use of a silt curtain does not reduce the particulate load downcurrent from the activity, USAKA will employ the use of a secondary silt curtain. Impacts from these actions are considered to be nonsignificant if the protective practices are followed.

Dredging would also be used as a means of collecting aggregate material for construction projects and for renourishment of shorelines for beach protection. During the Low Level of Activity, dredging for these reasons would occur at Kwajalein, Roi-Namur, Meck, Omelek, Ennylabegan, Gellinam, and Eniwetak. The dredging would occur in areas with known quantities of sandy material. Recolonization of sea floor areas affected by the removal of bottom sediments would occur through migration of individuals from unaffected areas and by the transport (by currents) of eggs and larvae from unaffected species. Opportunistic benthic populations are typically rapid colonizers of disturbed areas and the community composition would likely be dominated by these species during the early phases of recolonization (i.e., within days of the disturbance). The abundance of opportunists would diminish over time and the community composition would become balanced by the establishment of more stable species that occurred prior to the dredging activity. The effects of increased turbidity and the change in the benthic community would likely have a negligible impact on fishery resources in the areas to be dredged.

Isolated coral heads or patches of coral that occur near the dredging areas could be affected by the settling of suspended particulates generated during dredging. Corals can release a mucous to coat their surface as a protective measure and to remove the alien particles. This mechanism is normally effective at removing particulate concentrations that occur during natural perturbations. The corals become stressed during this behavior and long-term impacts can result in mortality of the coral colonies. Those corals nearest and downcurrent of dredging activities would be most susceptible. The loss of some of these isolated colonies would not be permanent, as new colonies would develop in areas with suitable substrate. These would be negligible impacts on reef habitat and associated fishery resources.

Reef flats are quarried by USAKA for armor stone for shoreline protection. The flats are cemented agglomerations of dead coral, coralline algae, and other reef organisms. They have very little live coral. The material is quarried by blasting. The zone of impact from blasting is influenced by water depth and the size of the charge. Egg and larval forms are more susceptible than larger adults, and benthic organisms, such as crustaceans, are less susceptible than finfish. The USNMFS suggests that a 300-foot (91-meter) clearance from blasting be provided to avoid impacts to protected resources such as sea turtles and marine mammals. The explosive shock that results from blasting can result in internal damage to the swim bladder and digestive organs, and can disorient fish, temporarily reducing their ability to avoid predators and feed. Predation by sharks and other species may increase near blasting areas. The blast also results in an increase in turbidity. This is a temporary effect. Turbidity levels should return to background shortly after each blasting event. The effects of increased turbidity on corals and fish have been discussed above. Silt curtains are used as standard procedures during blasting activities. If siltation is excessive with silt curtains in place, USAKA will use a second silt curtain or will reduce the size of the blasting charge. Blasting for armor rock in this alternative will be conducted at Meck, Roi-Namur, Eniwetak, and Ennylabegan. Impacts are expected to be nonsignificant because ocean reef flats are not abundant with fish and live corals. In addition, as shown in Table 4.2-5, the total area that might be quarried is less than one-half of 1 percent of the total reef area adjacent to USAKA islands, and less than 1 1/2 percent of suitable reef areas.

After the reef flat quarries have been excavated, the inactive quarries may be colonized to become productive reef environments. The exposure of hard substrate on quarry walls and the irregular topography that results provide habitat for attaching organisms, such as hard and soft corals, anemones, hydroids, sponges, and bryozoans. The attaching organisms form communities that attract a variety of invertebrates and fish. This is demonstrated by the rich biota of the old quarries on Kwajalein and the abandoned Meck quarry. In the long term (over a period of years), this could be a beneficial impact of the quarrying activity.

Alternatively, the use of commercially purchased aggregate and/or armor rock would reduce the amount of quarrying required at USAKA, and the associated effects of quarrying described above.

Shoreline Protection

The placement of fill material on the beach for shoreline protection would result in the burial of intertidal benthic invertebrates. Because intertidal organisms are accustomed to the extreme conditions that result from the rise and fall of the tide, many should survive this level of burial. The filling activity would result in the creation of a turbidity plume that would extend downcurrent from the fill site. Silt curtains would be used as standard procedures to minimize the dispersion of elevated levels of suspended material. The loss of organisms in the intertidal zone would have a negligible impact on the marine biological resources.

Commercial Fishing

Launch activities would slightly increase over No-Action levels, from 80 to 84 launches per year to 88 to 104 launches per year; therefore, a corresponding increase would be expected in the frequency of missions that would affect the Mid-Atoll Corridor and BOA. As stated above, the closure period of the Mid-Atoll Corridor is fixed in the MUORA and would not be affected by the increase in missions; however, use of areas within the BOA could be affected more frequently by launch or intercept missions. The impact on commercial fishing would not be expected to be significant for the same reasons discussed under the No-Action Alternative.

Mitigation—Existing U.S. Statutes and Regulations

No additional mitigation actions are required assuming that USAKA observes the USAKA Mitigation Plan recommendations for use of silt curtains and for surveys of giant clam species and for relocation of any identified specimens.

Impacts—Proposed USAKA Environmental Standards and Procedures

The USAKA Standards include a larger number of species provided protection than the U.S. regulations and also include marine habitats, for which a preliminary review of effects must be conducted with regard to environmental impacts on marine biological resources. Under the USAKA Standards, RMI and USFWS or USNMFS may prepare a coordination report for USAKA actions that it believes may affect fish and wildlife resources and habitats identified in Appendices 3-4F or 3-4G. Because Appendix 3-4G includes identification of marine habitat around each island affected by this level of activity, the involvement of the resource agencies and the preparation of coordination reports are likely to include recommendations to USAKA for minimizing adverse impacts to these resources. If USAKA does not agree with the findings in a coordination report, the action may proceed; however, USAKA must justify its actions to the RMI and either USFWS or USNMFS and conflict resolution may result. If the RMI and the designated agency agree that a proposed activity will result in a significant effect on the species and habitats listed in Table 3-4G.3, a DEP must be prepared.

Mitigation—Proposed USAKA Environmental Standards and Procedures

The mitigation proposed under existing U.S. statutes and regulations would also apply to the USAKA Standards. The involvement of the RMI and either USFWS or USNMFS for actions that may affect the species and habitats listed in Appendices 3-4F and 3-4G may identify more resource protection mitigation for consideration by USAKA than would occur under the U.S. statutes and regulations.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

This alternative includes the Low Level-of-Activity Alternative plus additional activities discussed in Subsection 2.1.3. The additional activity requires more launches and more personnel, which reflect a greater magnitude of development. Discussions of the general potential effects of proposed actions on the marine biological resources are contained in the Low Level-of-Activity analysis and are not repeated here unless the effect is considered to be different.

Broad Ocean Area

The increase in launches from the Low to the Intermediate Level-of-Activity alternatives would result in an increase in the number of tests in which RVs enter the lagoon impact area or the Broad Ocean Area. In addition, in this alternative, some launches might be made in a southwesterly direction from Illeginni. Even though there would be an increased number of RVs, the impact is considered to be negligible, because the RVs that enter the lagoon would be retrieved (while RVs that land in the BOAs would be left on the ocean floor). There are no toxic or hazardous substances in the RVs in quantities large enough to affect marine life.

The increase in launches is expected to have a negligible impact on the productivity of the microlayer in areas where solid-fuel rocket emissions land on the sea surface for the reasons explained in the evaluation of the Low Level-of-Activity Alternative.

Renovations are proposed for the fuel pier at Roi-Namur. This would have a negligible impact because the renovations are being made to an existing facility, where the environment has already been disturbed by dredging and other harbor activities.

ENNUGARRET

The island of Ennugarret might be developed to accommodate the relocation of the EOD facility. If this island were selected (other islands are being considered and only one of the islands would be developed for this activity), a marine ramp, piers, and jetties would be constructed. This development is planned for the south central portion of the island. The construction of jetties would result in the filling of nearshore, sandy bottom habitat. The marine plants and animals in the bottom sediments would be buried. The zone of impact would extend beyond the fill area to nearby habitats that could be affected by increased siltation during the construction process. This impact is associated with the construction period and should be short term and localized. A silt curtain would be used to minimize increases in turbidity downstream from the construction site. The effects on reef habitat and on fishery resources would be nonsignificant.

The creation of jetties would also provide some beneficial impacts. The addition of a hard substrate in areas previously having a sandy bottom would provide suitable habitat for encrusting organisms, such as corals. The development of hard bottom communities on the jetties would also attract other more motile forms of finfish and invertebrates.

Shoreline Protection, Quarrying, and Dredging

Dredging for construction and shoreline protection materials would increase for the Intermediate Level of Activity. The most significant activity would be at Meck, where USAKA proposes to fill the southern end of the island and create an additional 15 acres (60,704 square meters) of land surface. After Meck, the largest volumes would occur at Kwajalein, Illeginni, and Ennugarret. Alternatively, the use of commercially purchased aggregate and/or armor rock would reduce the amount of quarrying required at USAKA, and the associated effects of quarrying described above.

As shown in Table 4.2-6, even if all aggregate and armor rock is quarried at Kwajalein, the total area quarried would be only 1 percent of the total reef area adjacent to USAKA islands, or 6.4 percent of reef areas suitable for quarrying.

MECK

Quarrying and dredging for the Meck expansion would require approximately 530,000 cubic yards (394,050 cubic meters) of material, although that could be reduced to approximately 347,100 cubic yards (265,530 cubic meters) if tribar structures are used instead of fill to stabilize the shoreline of the new fill area. The loss of 15 acres (60,704 square meters) of sea floor would reduce the availability of benthic invertebrates as a food source for fish that use the area. The southern end of the island is identified as a fishery area in Chapter 3 of this SEIS. The filling would result in turbidity plumes downcurrent from this area. If currents transport sediments along the ocean side of the island, the coral communities, reef fish, and giant clams that occur in the inactive quarry sites may be affected. The loss of coral habitat could result in the migration of the reef fish associated with the quarry sites to other suitable habitat. A loss in the availability of fish to catch in those areas may result.

The loss of 15 acres because of filling and the loss of coral communities and reef fish in the inactive coral sites could be a significant impact within the context of Meck Island itself; although 15 acres represents less than 5 percent of the reef area adjacent to Meck Island, and only about 0.03 percent of the total reef adjacent to the 11 USAKA islands. If the extension of the island does not alter the current patterns on the ocean side of the island to the detriment of flushing capability in the inactive quarry sites, corals likely would recolonize the area, which would eventually be followed by the return of reef fish. The loss of giant clams, however, would be a permanently significant impact because reproductively viable populations at USAKA are scarce. As standard operating procedures, USAKA would use silt curtains to control the dispersion of suspended particulates from the construction site. If levels were not controlled, USAKA should mitigate by using a second silt curtain system.

Commercial Fishing

Under this alternative, launch activity would increase from 96 to 140 launches per year. Intercept and reentry events may also increase by a corresponding magnitude; however, the actual number would be defined in yearly program schedules. As stated above, the closure period of the Mid-Atoll Corridor is fixed in the MUORA and would not be affected by the increase in missions; however, use of areas within the BOA could be affected more frequently by launch or intercept missions. The impact on commercial fishing would not be expected to be significant for the same reasons discussed under the No-Action Alternative.

Mitigation—Existing U.S. Statutes and Regulations

Surveys of the area for sensitive resources, such as the giant clam, should be conducted and species should be transplanted before quarrying or dredging activities begin. Mitigation should include transplanting giant clams to other suitable habitat not disturbed by this action. Double silt curtain systems should be used as necessary to control turbidity. If filling of the fish habitat around Meck cannot be avoided, then construction of the island extension should be designed to allow lagoon flushing and to promote new coral growth.

Impacts—Proposed USAKA Environmental Standards and Procedures

The USAKA Standards require a different review and coordination process, extending some level of protection to marine species and habitats that would not be afforded protection under U.S. statutes and regulations. The process is described above under the Low Level-of-Activity Alternative.

Mitigation—Proposed USAKA Environmental Standards and Procedures

The mitigation proposed under existing U.S. statutes and regulations would also apply to the USAKA Standards; however, the coordination and review process could lead to additional mitigation of marine habitats and species not protected under U.S. statutes and regulations, as described above under the Low Level-of-Activity Alternative.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

This alternative includes activities of the Low and Intermediate Level-of-Activity alternatives, plus the addition of personnel and development associated with tests involving multiple, near-concurrent launches and ground-based tracking.

Broad Ocean Area

The number of launches would increase; therefore, there would be an increase in RVs entering the lagoon and the BOAs. RVs entering the lagoon would be recovered, whereas the RVs in the BOAs would be left in place. The increase in RVs would result in no significant impact to marine biological resources.

The increase in the number of launches would result in additional rocket exhaust by-products falling on the sea surface microlayer. Effects on productivity in the microlayer and potential water quality impacts on marine resources are expected to be negligible.

OMELEK

The fuel ramp at the Omelek Island harbor would be repaired. Construction activities in the water have the potential to increase turbidity and siltation. Construction would be short term and turbidity increases would be highly localized. This minor activity would result in no or negligible impact to marine resources.

GAGAN

A substantial amount of development would occur at Gagan Island for this alternative. The removal of most of the existing vegetation could result in increased sediment loads in nearshore waters around the island. Siltation would have the greatest effect on sessile organisms such as hard and soft corals in nearshore waters, especially in lagoon waters, where the fish and coral assemblage is diverse and abundant. Turbidity plumes are expected to be confined to the very nearshore area and should not affect coral communities. The potential loss of coral along the shore as a result of siltation is not expected to impact the finfish community. The impacts are considered to be nonsignificant because the effects would be short term and localized.

GELLINAM

On Gellinam Island, fill would be placed on both ends of the island to increase its size to accommodate the explosive hazard safety arcs associated with new launch facilities. About 18,000 square feet (1,672 square meters) of land would be added to the northern end, while 27,000 square feet (2,508 square meters) would be added to the southern end.

The placement of fill to enlarge the island would bury organisms living in or on the bottom sediments. No significant filling of areas with live corals is expected, although the area may contain isolated coral mounds. The filling would also result in temporary increases of suspended material that would be dispersed by local currents. The lagoon terrace area, with a well-developed coral reef of nearly 80 percent coverage, would be most susceptible to the loading of suspended particulates. The corals may not have the ability to remove sediment loads that exceed ambient conditions (i.e., particulate size and concentration). The death of the live corals would change the fish and invertebrate species composition that normally associate with certain coral communities.

The increased sediment load in the water, as a result of filling, would also stress the fish population in the immediate vicinity downstream of the filling. Those fish that do not avoid the turbidity plumes may be affected by clogging of gills and stress to respiratory functions. The reduction in visibility within turbidity plumes may also affect the feeding ability of fish that rely on sight to capture prey. Likewise, the ability of prey to avoid predators may be affected by reductions in visibility. These effects are likely to continue through the duration of filling. The combination of the loss of coral and the potential suspended particulate effects on fish may significantly alter the fish composition and abundance. It is expected that corals would recolonize the area after construction is complete; however, their growth is slow. It could take 5 to 10 years for fish populations to return to the same levels as prior to construction.

The dredging of materials used to enlarge the island would also increase turbidity levels downstream of the activity, affecting sessile species by siltation and motile species by impairing respiratory and predator-prey interactions. Standard operating procedures call for the use of silt curtains. If one curtain is found to be ineffective, USAKA should mitigate by using a secondary curtain or by altering the schedule so that construction would occur during conditions in which the curtain can function effectively.

ENIWETAK

Eniwetak would also be extensively modified under the High Level-of-Activity Alternative. Most of the vegetation would be removed. A marine fuel ramp and structural protection would be developed northeast of the existing harbor facilities. This construction activity would result in increases in siltation to waters around the island. The impacts are expected to be nonsignificant because of their short-term and localized nature. The construction of the fuel ramp and the placement of material to protect the ramp from wave and current action would alter the lagoon bottom in those areas as a result of filling and dredging. This impact is expected to be nonsignificant because of the limited area involved.

The construction of a jetty to protect the new marine fuel ramp may result in an increase in habitat for the giant clam. Giant clams are currently found on the existing jetties at Eniwetak Island.

Fiber Optics Cables

Fiber optics cables would be constructed at Kwajalein Island to connect with Wake Island (the location for this connection has not been designated and may cross either the ocean or the lagoon reef); at Gagan across the ocean reef flat for the Impact

Detection and Timing System; and at Gellinam Island to connect with existing HITS sensors on the lagoon floor less than 500 feet (152 meters) from shore. The cable would be located on the sea floor in a manner that avoids placing the cable on coral mounds. Trenching is only required near the shore for trenches less than a foot wide and deep. No or negligible impact is expected from this level of activity.

Shoreline Protection

The High Level-of-Activity Alternative includes an additional 3,350 feet (1,038 meters) of shoreline protection measures beyond those included in the Low and Intermediate levels. Most of the High Level-of-Activity Alternative increases would occur at Legan, Omelek, Gellinam, and Meck. The placement of fill and armor stone along the shore would result in short-term, localized increases in turbidity. Material placed below mean low water would likely bury organisms in or on the sediment surface. These impacts are considered to be nonsignificant.

Quarrying and Dredging

The quarrying and dredging activities that are necessary for construction on land and for the shoreline protection measures would result in a total of about 360,000 cubic yards (275,229 cubic meters) of material above the amounts in the Intermediate Level-of-Activity Alternative. More than 66 percent of this material is for construction projects; the remaining 34 percent is for shoreline protection. Eighty-eight percent of the construction material would go to projects on Omelek and Eniwetak islands, requiring about 150,000 cubic yards (114,750 cubic meters) each.

The need for construction materials and armor stone would require the opening of new quarry areas. Because some of the oceanside reef flats are already extensively quarried for armor stone and aggregate (e.g., the islands of Meck, Kwajalein, and Gellinam), quarries may have to be sited in interisland reef flats. As shown in Table 4.2-7, the total area that might be quarried would amount to 1.5 percent of the total reef area adjacent to USAKA Islands, or 10.2 percent of reef areas suitable for quarrying. Impacts during quarrying include an increase in suspended particulates downstream of the quarry site that would result from blasting and the movement of material, and the direct effects of blasting on wildlife. Live coral areas and areas where fish and macroinvertebrates are concentrated may be susceptible to increases in turbidity that could result in smothering of corals and other invertebrates and could impair respiration in finfish.

The blasting of the consolidated limestone material can cause mortality or temporary impairment of functions in fish and other organisms leading to an increase in susceptibility to predation. Community composition in specific areas may change after extended activities, especially because fish eggs and larval forms are the most susceptible to the effects from blasting. These effects, however, are not anticipated to be long term. As abundance and composition of prey species changes, the feeding locations and behaviors of predators would also change. Only nonsignificant impacts are anticipated for subsistence fishing or for the long-term abundance and composition of reef fish communities. Alternatively, the use of commercially purchased aggregate or armor rock, or both, would reduce the amount of quarrying required at USAKA and the associated effects of quarrying described above.

Commercial Fishing

Under the High Level-of-Activity Alternative, launch activity would increase from 88 to up to 172 launches per year. Intercept and reentry events may also increase by a corresponding magnitude; however, the actual number would be defined in yearly program schedules. As stated above, the closure period of the Mid-Atoll Corridor is fixed in the MUORA and would not be affected by the increase in missions; however, areas within the BOA could be affected more frequently by launch or intercept missions. The impact on commercial fishing would not be expected to be significant for the same reasons discussed under the No-Action Alternative.

Mitigation–Existing U.S. Statutes and Regulations

Surveys of the area for sensitive resources, such as the giant clam, should be conducted and species should be transplanted before activities begin. If filling of areas to enlarge Gellinam cannot be avoided, then it should be designed to allow lagoon flushing and promote new coral growth.

Impacts–Proposed USAKA Environmental Standards and Procedures

The coordination and review process required under the USAKA Standards extends protection to a greater number of marine species and habitats than under the U.S. statutes and regulations. This process could result in mitigation being extended to more marine species and habitats, where USAKA activities may result in significant effects. The process is described above under the Low Level-of-Activity Alternative.

Mitigation–Proposed USAKA Environmental Standards and Procedures

The mitigation proposed under existing U.S. statutes and regulations would also apply to the USAKA Standards; however, the coordination and review process could lead to additional mitigation, as described above under the Low Level-of-Activity Alternative.

4.7.2 Proposed USAKA Environmental Standards and Procedures

The proposed Standards change both the numbers of species and habitats protected and the roles of the RMI and U.S. resource agencies.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

The applicable statutes for protection of marine biological resources are the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1384 and 1401-1407), the Fish and Wildlife Coordination Act (U.S. Congress, 1985), and the Migratory Bird Treaty Act (16 U.S.C. 703-712). Existing U.S. statutes and regulations provide no substantive or procedural protections for marine biological resources that are not listed as threatened or endangered. Identification of potential impacts on these resources is accomplished mainly through the environmental impact analysis process under NEPA. There is generally, however, no substantive requirement to alter proposed activities to prevent harm to a nonprotected species.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Proposed USAKA Environmental Standards and Procedures

Section 3-4, Endangered Species and Wildlife Resources, of the Standards, establishes standards for the conservation of species and habitats of special concern, including threatened and endangered species. The Standards derive from the ESA, as amended, and from the MMPA, FWCA, and the MBTA (16 U.S.C. 703-712). The Standards incorporate parts of the RMI wildlife protection statutes, listing native species that require protection. They also include species and habitats that do not have the same level of protection under U.S. statutes and regulations.

The proposed Standards addresses endangered species and wildlife resources. The Standards include marine species and habitats that, under existing U.S. statutes and regulations, would not receive the same level of protection potentially afforded by the USAKA Standards. The objective of this subsection of the Standards is to ensure that actions conducted at USAKA are not likely to jeopardize the continued existence of any species or result in the destruction or adverse modification of habitats on which they depend.

The species protected under the proposed Standards are grouped into two categories. The first category includes those species currently designated under U.S. regulations that could be present at USAKA; those that are candidates for designation, or are petitioned for designation according to U.S. statutes and regulations that could be affected by USAKA activities; those designated by the RMI that may be affected by USAKA activities; and marine mammals designated under U.S. statutes and regulations. These species are listed in Appendices 3-4A through 3-4E of the Standards. The second category is composed of other wildlife resources, including fish, marine invertebrates, and migratory birds and habitats of special concern. These species are listed in Appendices 3-4F and 3-4G of the Standards.

For the first category, communication about the potential for proposed USAKA activities to affect the listed species is established through the consultation process that involves USAKA, RMI, and either the USFWS or USNMFS (which is involved when the affected species are marine mammals). For the second category, communication is accomplished through the coordination process involving USAKA, RMI, and either USFWS or USNMFS.

Table 4.7-1 is a brief comparison of the differences between U.S. statutes and regulations and the proposed Standards for endangered species and wildlife resources. Because of the significant overlap of marine biological resources with the standards for endangered species and wildlife resources, this table also applies to the discussion of the Standards in Subsection 4.8.1 of this SEIS.

The standards for endangered species and wildlife resources identify USNMFS and USFWS as designated resource agencies for marine and terrestrial resources, respectively. Although these agencies are responsible for evaluating biological assessments and preparing biological opinions and coordination reports for activities at USAKA, currently they have no authority to enforce the ESA at USAKA. An analysis of the Compact (Section 161) states that the U.S. government shall apply NEPA and, where an EIS is required, comply with related environmental regulations, including the ESA. Therefore, under existing U.S. statutes NEPA and ESA apply, but the USFWS and USNMFS do not retain regulatory authority. The procedures in the Standards are consistent with the provisions of the Compact. Under both standards, USAKA is required to communicate with the resource agencies via the consultation or coordination processes. This level of communication provides USAKA with information about potential effects and recommendations for mitigating impacts to the resources. If the consultation or coordination process results in a DEP in which USAKA would incorporate resource protection measures recommended by USFWS or USNMFS, the Standards could provide increased protection compared with the current situation in which USNMFS and USFWS lack regulatory authority for environmental activities at USAKA.

Overall, the Standards may have a significant beneficial impact on marine biological resources because more activities would be reviewed for potential effects on these resources; moreover, ongoing activities would be reviewed for potential impacts on fish and wildlife.

Mitigation

Because the USAKA Standards are protective of more marine biological resources than existing U.S. statutes and regulations, no mitigation is required.

4.8 Rare, Threatened, or Endangered Species

4.8.1 Level-of-Activity Alternatives

The potential areas of concern are protected species found in the marine and terrestrial habitats of Kwajalein Atoll.

Table 4.7-1
Summary Comparison of U.S. Regulations and USAKA Standards Affecting Marine Biological Resources and Rare, Threatened, or Endangered Species

Regulation	USAKA	U.S.	Difference	Comment
Species and critical habitats	Two general categories: (1) includes all species or critical habitats designated under U.S. federal regulations plus species designated for protection by RMI and marine mammals listed in the Marine Mammal Protection Act that may be affected by USAKA activities (Appendices 3-4A to 3-4E), and (2) birds that may be affected by USAKA activities and are listed in the Migratory Bird Treaty Act and species and habitats (corals, giant clams, seagrass beds, and other marine and terrestrial habitats) agreed on by USAKA, USFWS, USNMFS, and RMI as being of special concern (Appendices 3-4F and 3-4G).	Includes those species or critical habitats designated under U.S. federal regulations.	USAKA Standards protect more species through required consultation process than under U.S. federal regulations, and add coordination requirements for additional species.	
Involvement of resource agencies	Streamlines coordination procedures with resource agencies. Species or habitats are evaluated for potential effects caused by USAKA activities. Consultation occurs with appropriate agency or RMI for species or habitats in Appendices 3-4A to 3-4E. Coordination occurs with these agencies for species or habitats in Appendices 3-4F and 3-4G.	Consultation required only for listed species and critical habitats under U.S. statutes and regulations.	Input from appropriate agency or RMI also required for birds listed under the Migratory Bird Treaty Act (Appendix 3-4F) and the species and habitats listed in Appendix 3-4G.	A greater number of species and habitats are evaluated with respect to USAKA actions, affording these species and habitats potential protection that would not occur under existing statutes and regulations.
Consultation procedure	The DEP process binds USAKA to actions agreed on during the process. USAKA can proceed with actions after the DEP is completed.	U.S. agencies do not have extra-territorial enforcement authority at USAKA.	The USAKA Standards can result in taking of resources if conflict resolution is not reached.	USAKA Standards set up a mechanism for consultation, coordination, and conflict resolution that does not now exist.

Levels of Significance—Existing U.S. Statutes and Regulations

The only threatened, endangered, or candidate species protected by the ESA that are known to occur in the Kwajalein Atoll area are the hawksbill turtle (*Eretmochelys imbricata*) and the green sea turtle (*Chelonia mydas*) listed as endangered and threatened, respectively. The placement of beach fill and the construction of new revetments may potentially impact sea turtle nesting. Although nesting has not been confirmed on any of the USAKA islands, turtles continue to be observed in the area and have been a component of the Marshallese culture for some time. Potential nesting beaches are described in Section 3.7 and in the *Natural Resources Plan* (USAEDPO, 1991a). There is anecdotal information (Ott, pers. comm., 1992a) that turtle nesting occurred on Gellinam Island in the recent past.

Other federally listed species, including candidate species, that may occur at Kwajalein Atoll include: leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), olive ridley sea turtle (*Lapidochelys olivacea*), blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter catodon*).

RMI has indicated concern for the giant clam (*Tridacna gigas*) and a locally rare seagrass (*Halophila minor*). The seagrass has some significance to the green sea turtle. Adults of this turtle species are herbivorous and feed in seagrass beds and among coral reefs. Halophila minor is the only seagrass at the atoll. The hawksbill feeds primarily on sponges and may be more common in deeper reef areas where sponges are more common.

- **No or Negligible Impact.** No takings of individuals or of critical habitat for protected species. No decline in the extent of seagrass beds at USAKA, no change to sandy beach habitat, and no disturbance of turtles or removal of eggs.

- **Nonsignificant Impact.** Nonsignificant impacts are defined as no takings of individuals or loss of critical habitat for protected species; effects from siltation and turbidity would not permanently affect the reproductive viability of giant clams; short-term modifications to sandy beach habitat through revetments and beach fill, installation of facilities, or other semi-permanent structures would not prevent turtle nesting; limited human contact with turtles would not affect nesting or feeding behavior; alteration of the sea floor caused by dredging would not permanently alter conditions necessary for the growth of seagrasses.

- **Significant Impact.** Significant impacts are defined as the taking of any giant clam or the destruction of its habitat through degraded water quality or reef destruction; destruction of seagrasses in beds off Kwajalein or Roi-Namur Islands; permanent loss of preferred sandy beach turtle nesting habitat (e.g., beaches); taking of turtles or marine mammals within USAKA; or disturbance of turtles leading to decline in nesting activity or loss of adult turtles.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

The definition of the significance of impacts based on the proposed Standards parallels the definition of significance based on the existing statutes and regulations, except that the proposed Standards protect more species. In addition to the species listed as threatened and endangered under the ESA, the proposed Standards protect species listed pursuant to the RMI endangered species and marine mammal statutes and species found in the RMI that are protected under the Marine Mammal Protection Act of 1972.

By giving the species listed in these statutes status equal to the species and habitats protected under the ESA, an additional 23 animal species (plus all species of sponges) would be subject to consultation with USFWS or USNMFS if activities at USAKA could potentially affect them. The species protected by the proposed Standards, in addition to the species protected by the ESA, include the following:

Common Name	Scientific Name
Ratak Micronesian Pigeon	*Ducula oceania ratakensis*
Offshore Spotted Dolphin	*Stenella attenuata attenuata*
Coastal Spotted Dolphin	*Attenuata graffmani*
Eastern Spinner Dolphin	*Stenella longirostris orientalis*
Whitebelly Spinner Dolphin	*Stenella longirostris longirostris*
Costa Rican Spinner Dolphin	*Stenella longirostris centoramericana*
Common Dolphin	*Delphinus delphis*
Striped Dolphin	*Stenella coeruleoalba*
No common name	*Trochus niliticus*
No common name	*Trochus maximus*
Black-Lip Mother-of-Pearl Oyster	*Pinctada margaritifera*
Spinner Dolphin	*Stenella longirostris*
Pacific Bottlenose Dolphin	*Tursiops gilli*
Pygmy Sperm Whale	*Kogia breviceps*
Pilot Whale	*Globicephala macrorhynehus*
False Killer Whale	*Pseudorca crassidens*
Short-finned Pilot Whale	*Globicephala macrorhynehus*
Melon Headed Whale	*Peponocephala electra*
Pygmy Killer Whale	*Feresa attenuata*
Risso's Dolphin	*Grampus griseus*
Bottlenose Dolphin	*Tursiops sp.*
Killer Whale	*Orcinus orca*
Blainville's Beaded Whale	*Mesoplodon densirostris*

In addition to protecting these species (plus the five species of sea turtles and four species of whales that would be protected under the existing statutes and regulations), the proposed Standards identify a second category of species that require a coordination process with either USFWS or USNMFS if a proposed activity affects them. These species are listed in Appendices 3-4F and 3-4G of the USAKA Standards. These appendices include species of birds that may occur within the RMI that are protected under the Migratory Bird Conservation Act. In addition, RMI, in consultation with the resource agencies, has included species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora and both terrestrial and marine habitats of significant biological concern at USAKA.

Appendix 3-4G of the USAKA Standards includes 50 species of corals, 5 species of giant clams, and 10 habitats of concern. This appendix includes some of the birds, marine mammals, and sea turtles that are also included in the lists in Appendices 3-4A through 3-4E. The Standards require that the strictest designation apply to species that are on more than one list.

NO ACTION

Impacts

Activities under this alternative that have not been completed and that have the potential to affect rare, threatened, or endangered species are as described in Section 4.7 of the 1989 EIS for the Proposed Action. Potential impacts from construction, quarrying and dredging, and a new thermal discharge were identified. Mitigation measures were also identified and are implemented through the USAKA Environmental Mitigation Plan.

LOW LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

ROI-NAMUR

The extension of the wastewater treatment plant outfall into deeper waters at Roi-Namur and the installation of a fiber optics cable in the lagoon at Ennylabegan have the potential to affect giant clams (see Section 4.7 of this document for a discussion of clam impacts). The area of impact for the outfall and cable corridors is relatively narrow. The outfall would be trenched and, therefore, the potential exists for increases in turbidity. USAKA would conduct preconstruction corridor selection studies to aid in siting the pipeline route. This information would be used to avoid areas with giant clams and other sensitive resources. Turbidity from trenching would be highly localized and short term. Potential impacts are anticipated to be nonsignificant. The cable would be placed on the sea floor surface to avoid coral mounds and other resources. This would prevent impacts to clams or other resources; however, if giant clams could not be avoided, USAKA would mitigate by transplanting the clams to suitable nearby habitat in areas unaffected by these actions.

The construction of a saltwater intake near the southwest pier on Roi-Namur, along with 600 feet (182 meters) of shoreline protection and upgrading of 700 additional feet of existing revetment have the potential to increase siltation in the area downstream of the construction activity. Under certain wind conditions, the turbidity plume may be carried to the east towards the seagrass beds that occur between the two harbor areas. USAKA uses silt curtains for construction projects in the water to minimize the dispersion of suspended particulates towards the seagrass beds. If the use of a single curtain does not meet the performance conditions of no change in turbidity greater than 10 NTUs, a second curtain should be used. Because the proposed activity is localized and impacts are expected to be short term, the potential effects on the seagrass beds are expected to be negligible.

ENNYLABEGAN

Ennylabegan has potential turtle nesting beaches along the lagoon shoreline. The fiber optics cable proposed for this alternative would be installed adjacent to the existing SFOTS, for which an environmental assessment was prepared (ECT, 1992). The SFOTS Environmental Assessment assessed the likelihood of impact to turtle nesting habitat as nonsignificant because it appeared unlikely that significant turtle nesting occurred on Ennylabegan because of its population. The fiber optics cable proposed for this alternative would be unlikely to have any significant impact on turtle nesting.

ENIWETAK

Shoreline protection measures proposed in this alternative for Eniwetak Island include 140 feet (43 meters) of revetment on the northeastern shore. This area may impinge slightly on an area identified in the *Natural Resources Plan* (USAEDPO, 1991a) and during the February 1992 field reconnaissance visit as potential turtle nesting habitat (Figure 3.1-10). However, the overlap is at most slight and there are no recent records of turtles nesting on Eniwetak beaches. Much of the sandy beach along the northern shoreline of the island is potential sea turtle nesting habitat. Construction of a revetment for shoreline protection on the northeast shoreline would not affect the potential sea turtle nesting area on this island and is considered to be a nonsignificant impact.

In its May 18, 1989, letter about the 1989 DEIS, the USNMFS made recommendations to minimize the potential for any adverse impacts on sea turtles. The following precautions were incorporated into the 1989 FEIS and are standard operating procedures regarding the presence of turtles and marine mammals in offshore work areas:

- Quarry sites should be surveyed prior to each day's operations to ensure that no turtles are present.

- Quarry blasting should be restricted to the smallest practical charge.

- Blasting should be delayed until any turtles present in the area are outside a 100-meter radius from the blasting area.

- Any injuries or deaths of turtles caused by construction, blasting, or quarrying should be reported to USNMFS.

If the recommendations of USNMFS are followed for sea turtles and marine mammals before any construction, quarrying, or dredging, there should be no or nonsignificant impacts associated with those activities.

Broad Ocean Area

In this alternative, GSTS test activities have some potential for impacts to sea turtles. The current design of the GSTS payload system would use parachutes made of nylon and Kevlar materials to slow the descent of the GSTS payload to the BOA. Each payload would release one 6-foot-diameter (2-meter-diameter) pilot chute at high altitude, which would pull out one 25-foot-diameter (8-meter-diameter) drogue chute, which in turn would pull out three main chutes, each 75 feet (23 meters) in diameter. A maximum of 35 parachutes would be discarded in the BOA from a total of 7 launches.

Hardware attached to the parachutes (e.g., reefing-line cutters and jettison components) would assist the parachutes in sinking. The time it would take for parachutes to sink would depend on the profile of the parachutes as they fall into the ocean and on how much air is trapped in each parachute. Once in the water, ocean currents would influence the movement of the parachutes. The longer the parachutes stay buoyant, the farther they would be likely to drift.

Little is known of the current patterns in the BOA. The North Equatorial Current (i.e., east to west) and the Equatorial Countercurrent (i.e., west to east) are the major patterns in the Marshall Islands. However, wind conditions and landforms, as well as meanders and spin-off eddies, can create highly variable small-scale current patterns. Subsurface currents probably are very different from surface patterns.

General surface patterns appear to be almost opposite on the east and west sides of the BOA. Along the eastern side of the BOA, the current pattern is from the southeast to the northwest, while along the western portions of the BOA, the currents move from the northeast to the southwest.

The potential for drifting parachutes to adversely affect rare, threatened, or endangered species is probably very low to remote. The BOA is a large area and the number of parachutes (35) to be jettisoned is small. Very little is known of the numbers and distribution of marine biological resources in the RMI, including sea turtles and marine mammals. Of the protected species, sea turtles and marine mammals would have the greatest risk (albeit very remote) of incidental impact.

Both green sea turtles and hawksbill turtles are known to occur in the inshore and offshore regions of the BOA. Green sea turtles are thought to use the northern islands for nesting and the southern islands for foraging. Less is known about the distribution of the hawksbill turtle; however, evidence suggests that its distribution is similar to that of the green sea turtle.

Entanglement of these two groups of animals caused by plastics in the marine environment and discarded fishing nets and lines, is a well-documented phenomenon worldwide. Once entangled, these animals usually die by drowning. Even though the probability of entanglement of a protected species with a parachute (including attached cords) adrift is very low, the loss could be important because of the takings that occur by the Marshallese. Marine turtles and their eggs are harvested whenever available in the Marshall Islands (Eckert, 1991). Thomas et al. (1989) indicate that the green sea turtle is under "heavy hunting pressure for its shell, meat and its eggs on most atolls" in the Marshall Islands.

In open ocean waters, the leatherback turtle may be most at risk to an incidental taking because of its pelagic nature. It rarely occurs in shallows, especially in coral reef areas, where damage to the leather shell could occur. It feeds on jellyfish and might be attracted to a drifting parachute, especially the smaller pilot chutes, because of their possible resemblance to jellyfish. The leatherback turtle is probably the least abundant of the marine turtles occurring in the RMI. The loss of a sea turtle by incidental entanglement would be considered a taking under the Endangered Species Act. The taking of a protected species would be a significant impact.

Marine mammals are also susceptible to entanglement. Pinnipeds (e.g., seals and sea lions) are the marine mammals most frequently associated with entanglement. Pinnipeds are not known to occur in the Marshall Islands. Marine mammals, including several species of spinner dolphins, spotted dolphins, and bottlenose dolphins, and whale species such as the melon-headed whale, sperm whale, pilot whale, and false killer whale, are known to occur in the RMI. Most are oceanic in nature and potentially occur in the region of the BOA. All are cetaceans and the probability of entanglement is very low as is their mistaking the parachutes for food. However, the longer a parachute stays in suspension, the greater the potential for entanglement or a taking under the Endangered Species Act.

Mitigation—Existing U.S. Statutes and Regulations

To mitigate the unlikely but potentially significant impact of taking a protected species, the GSTS parachute hardware could be redesigned so that parachutes could be retrieved with the rest of the payload rather than being jettisoned and allowed to drift and sink slowly.

Impacts–Proposed USAKA Environmental Standards and Procedures

As described above (Levels of Significance–Proposed USAKA Environmental Standards and Procedures), the proposed Standards would protect more species, including their critical habitats, than the existing U.S. statutes and regulations. No comprehensive data exist regarding most of the additional species protected under the proposed Standards; therefore, it is difficult to predict whether any of the actions proposed under this alternative would affect any of the additional species protected under the proposed Standards. Impacts to island plants and animals generally are as described in Section 4.6 of this document, and Marine Biological Resources are addressed in Section 4.7.

Mitigation–Proposed USAKA Environmental Standards and Procedures

If activities that are part of this alternative could potentially affect species protected under the Standards, the requirements for mitigation would be species specific. For species and critical habitats listed in Appendices 3-4A through 3-4E, a biological assessment prepared by USAKA and a biological opinion prepared by USFWS or USNMFS would be used to determine whether mitigation would be required. As appropriate, statements regarding the incidental taking will be included in all biological opinions that address a proposed action that involves taking of a species listed in Appendices 3-4A through 3-4E. For species and critical habitats listed in Appendices 3-4F and 3-4G, a coordination report prepared by RMI and either USFWS or USNMFS would serve as the mechanism to suggest mitigation for consideration by USAKA. The specific mitigation, other than avoidance, would be determined during these processes.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

The Intermediate Level of Activity includes all actions described above for the Low Level-of-Activity Alternative. Additional activities for this alternative include requirements for larger volumes of construction and shoreline protection materials. Because of the increase in the number and/or magnitude of activities between the two alternatives, the following impacts are identified for analysis.

Quarrying and Dredging

The volume of material to be quarried and dredged would increase more than five times above the amount indicated for the Low Level of Activity to a total of as much as 714,365 cubic yards (546,150 cubic meters) for the Intermediate Level of Activity.

The increases are most substantial at Kwajalein, Meck, Illeginni, Ennugarret, and Omelek.

The increases would require larger quarry areas and longer construction periods for dredging, blasting, and transporting material. Quarrying from interisland reef flats may be required for providing the necessary volume of material. New quarry sites should be selected in areas that do not have giant clam populations. USAKA would follow the precautions presented under the Low Level-of-Activity Alternative to reduce the potential for impacting protected species.

OMELEK

The *Natural Resources Plan* (USAEDPO, 1991a) notes potential turtle nesting habitat on the northwest and southeastern sides of the island. However, during the February 1992 field reconnaissance trip, the northwestern side of the island was found to be almost entirely composed of beach rock and the northern spit composed entirely of coral rubble. The southeast portion of the island possesses a small amount of steep sand beach, but it is doubtful that this represents more than a minimum of acceptable turtle nesting habitat. Therefore, no or negligible impacts are expected to occur from the shoreline protection activities proposed as part of this alternative.

ILLEGINNI

This alternative includes shoreline protection measures for approximately one-third of Illeginni Island. Figure 3.1-7 shows that a small portion of the shoreline on the western end of the island contains potential sea turtle nesting habitat. The construction of revetments and sandy fill material would eliminate the shoreline area as potential nesting habitat. During the February 1992 field reconnaissance visit, it was noted that the only potential nesting area was a small portion (approximately 100 yards [90 meters]) of beach on the extreme northwestern side of the island. The remainder of Illeginni's beaches are currently steep rubble or beach rock.

Two species of turtle may use the stretch of beach at Illeginni as nesting habitat—the green sea turtle, which is threatened, and the hawksbill turtle, which is endangered. Both turtles use sandy beaches in Pacific atolls for nesting and both species of turtles have been observed in the vicinity of USAKA. There are no records of turtle nesting on USAKA; however, comprehensive surveys have not been accomplished. Green sea turtles are regular in their nesting seasons and the beaches they use. Because no sea turtles have been observed on Illeginni, green sea turtles probably do not nest there. Hawksbill turtles, however, are more opportunistic and tend to nest on a more year-round basis at suitable sandy beaches; therefore, there is a higher chance that hawksbill turtles would use the beach at Illeginni. It is believed that the destruction of even 100 yards (90 meters) of turtle nesting habitat could have a significant impact on the hawksbill turtle through destruction of breeding habitat for turtles that would have used that beach.

Mitigation–Existing U.S. Statutes and Regulations

In addition to the mitigation identified for the Low Level-of-Activity Alternative, a nesting survey should be conducted for this alternative at Illeginni to determine whether this species appears to use this stretch of beach. Because hawksbill turtles may nest during any time of the year, the survey should occur over at least 1 year. The periodicity of the survey visits should be determined in consultation with turtle experts at NMFS. If there is no apparent use, that conclusion would support the proposed revetment construction without the need for further mitigation. If the nesting survey discovers turtle use of the beach, then alternatives to revetment of that beach should be explored. These measures could include relocation of the facilities needing protection so the revetment is not required, or designing alternative protection facilities so that the beach would not be covered.

Impacts–Proposed USAKA Environmental Standards and Procedures

For the assessment of impacts assuming the proposed Standards, see the discussion of Impacts–Proposed USAKA Environmental Standards and Procedures for the Low Level-of-Activity Alternative.

Mitigation–Proposed USAKA Environmental Standards and Procedures

For mitigation assuming the proposed Standards, see the discussion of Mitigation–Proposed USAKA Environmental Standards and Procedures for the Low Level-of-Activity Alternative.

HIGH LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

This alternative includes all of the actions identified in the Low Level of Activity and the Intermediate Level of Activity. The number and/or magnitude of actions would increase. This section discusses those effects not evaluated under the previous two alternatives.

OMELEK

In addition to the shoreline protection that would be part of the Low Level-of-Activity Alternative, approximately 1,050 feet (320 meters) of additional shoreline protection would be constructed along the northwest and southwest shoreline of the island to protect the new launch facilities and related structures that would be built as part of this alternative. The *Natural Resources Plan* (USAEDPO, 1991a) notes potential turtle nesting habitat on the southeastern side of the island. However, during the February 1992 field reconnaissance trip, the southeastern portion of the island was found to possess only a small amount of steep sand beach, and it is doubtful that this represents more than a minimum of acceptable turtle nesting habitat. Therefore, no or negligible impact is expected to occur from the additional shoreline protection in this alternative.

ENIWETAK

In this alternative, Eniwetak Island is proposed to be extensively developed with launch facilities. The *Natural Resources Plan* (USAEDPO, 1991a) noted potential turtle nesting beaches on the northern side of the island. As long as construction activities at Eniwetak avoid disturbing the beaches along the north side of the island, there should be no or negligible impacts on turtle habitat.

GELLINAM

The actions proposed under the High Level-of-Activity Alternative at Gellinam include filling a portion of the reef flat at both ends of the island, construction of new launch and launch support facilities, and additional shoreline protection facilities. None of the areas proposed for construction have been identified as locations for giant clam or turtle habitat. No significant impacts are anticipated.

Fiber Optics Cables

Fiber optics cables would be installed on Gagan and Gellinam and a cable would be placed to link Kwajalein with Wake Island. The cables would be routed to avoid placement in areas with giant clams. Coral mounds also would be avoided. Surveys would be conducted to collect the data necessary for selecting the cable routes that avoid conflicts with giant clams and corals and potential sea turtle nesting habitat. Trenching would not be required, with the exception of a 1-foot-wide by 1-foot-deep (0.3-meter-wide by 0.3-meter-deep) trench adjacent to the shore. Giant clam and other protected species are not found in these nearshore areas adjacent to the beach.

Shoreline Protection

Shoreline protection measures are programmed for six other USAKA islands under this alternative. None of the additional shoreline protection measures proposed for this alternative would affect potential sea turtle nesting habitat.

Quarrying and Dredging

The quarrying and dredging of reef flats and sea floor for construction materials would be preceded by the precautionary measures (e.g., silt curtains and preconstruction field surveys to determine the presence of protected species, reducing blasting charges) specified above as standard operating procedures. These measures would be taken to avoid adversely affecting protected species and habitats at Kwajalein Atoll.

Mitigation—Existing U.S. Statutes and Regulations

Mitigation measures beyond those identified for the Intermediate Level-of-Activity Alternative would not be needed because additional significant impacts are not identified.

Impacts—USAKA Environmental Standards and Procedures

For the assessment of impacts assuming the proposed Standards, see the discussion of Impacts—Proposed USAKA Environmental Standards and Procedures for the Intermediate Level-of-Activity Alternative.

Mitigation—Proposed USAKA Environmental Standards and Procedures

For mitigation assuming the proposed Standards, see the discussion of Mitigation—Proposed USAKA Environmental Standards and Procedures for the Intermediate Level-of-Activity Alternative.

4.8.2 Proposed USAKA Environmental Standards and Procedures

Existing U.S. statutes and regulations do not provide for coordination with resource agencies for species that are not listed or are not candidates or proposed for listing under federal statutes. The proposed Standards include 50 species of coral, 5 species of giant clam, 5 species of birds, and marine habitats on each of the 11 USAKA islands for which coordination activities would be required when the potential to significantly affect these resources exists.

The DEP process would not prohibit the commitment of irretrievable resources in jeopardy opinions for threatened or endangered species. This could lead to a taking of a protected species. Under the U.S. statutes and regulations, the resource agencies currently do not have regulatory authority for actions at USAKA, whereas the proposed Standards would establish a conflict resolution process to allow appropriate agencies to challenge USAKA actions.

NO ACTION

Species found at USAKA that are listed as threatened or endangered are protected under the ESA; actions that may affect them are subject to NEPA. Section 161 of the Compact specifies that the U.S. government will apply NEPA, and that for projects where an EIS is being prepared, USAKA will comply with standards similar to the ESA. Although the resource agencies (i.e., USFWS and USNMFS) do not have regulatory authority at USAKA, the Compact specifies that USAKA will comply with the ESA and NEPA.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Subsection 3-4.0, Endangered Species and Wildlife Resources, of the USAKA Environmental Standards and Procedures, establishes standards for the conservation of species and habitats of special concern, including threatened and endangered species. The Standards were derived from the Endangered Species Act of 1973 (16 U.S.C. 1531-1543), as amended; as well as the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1384 and 1401-1407), the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act (16 U.S.C. 703-712). The Standards incorporate parts of the RMI wildlife protection statutes, listing native species that require protection. They also include species and habitats that do not have the same level of protection under U.S. statutes and regulations.

The U.S. statutes and regulations from which the Standards for endangered species and other wildlife resources are derived are in Section 4.8.1 of this SEIS. The standards for the resources in Section 3-4 of the proposed Standards would be implemented in accordance with Subsections 3-4.5.3 and 3-4.6.3 and involve consultation and coordination, respectively, with RMIEPA and the appropriate U.S. resource agency.

Table 4.7-1 (in the Marine Biological Resources section of this SEIS) lists differences between existing U.S. statutes and regulations and the proposed Standards. Implementation of the Standards would protect the protected species and critical habitats listed in Appendices 3-4A to 3-4E, the migratory birds listed in Appendix 3-4F, and the species and habitats of significant biological importance listed in Appendix 3-4G of the Standards. Although some of the species listed in Appendices 3-4F and 3-4G are protected under federal statutes (e.g., birds under the Migratory Bird Conservation Act), coordination is not required under existing U.S. statutes and regulations. Likewise, not all of the species requiring consultation under the Standards (Appendices 3-4A to 3-4E) would be covered under existing U.S. statutes and regulations (e.g., RMI species in Appendix 3-4D and some of the marine mammal species in Appendix 3-4E). The USAKA Standards would provide opportunities to involve the U.S. resource agencies and to receive recommendations for minimizing potentially significant impacts to these resources.

The procedural aspects of consultation and coordination are presented in Figures 3.4-5 and 3.4-6 in the USAKA Standards. Actions that may affect protected species listed in Appendices 3-4A through 3-4E must undergo a consultation process that could lead to the preparation of a biological opinion by either the USFWS or USNMFS. Actions could proceed unless an adverse or jeopardy opinion is reached. If USAKA agrees with the provisions of a biological opinion, a DEP is prepared. If there is disagreement between USAKA, RMI, and either the USFWS or USNMFS, conflict resolution would proceed in accordance with Part 2-19 of the USAKA Standards.

For USAKA actions that may affect species and habitats listed in Appendices 3-4F and 3-4G of the USAKA Standards, procedures for coordination with RMI and the appropriate agency are presented in Figure 3.4-6 of the USAKA Standards. The appropriate agency would be USNMFS for marine biological resources and USFWS for terrestrial resources and sea turtles (when the turtles use terrestrial habitat [i.e., nesting on beaches]). For actions that may affect species or habitats listed in Appendices 3-4F and 3-4G, the RMI and USFWS or USNMFS would prepare a coordination report. If the taking of migratory birds would occur or the RMI and the designated agency agree that a proposed USAKA action may have a significant effect on the species and habitats listed in Table 3-4G.3, USAKA could initiate the DEP process to resolve the issues.

The inclusion of species of special concern to the RMI (Appendix 3-4B) would also result in the preparation of biological assessments for more species than would occur under the U.S. statutes and regulations.

Implementation of these components of the USAKA Standards could result in significant beneficial impacts (by providing a greater level of protection in considering a larger number of species during the consultation and coordination process with the resource agencies). For example, the extension of the wastewater treatment plant outfall at Roi-Namur under the Low Level-of-Activity Alternative would be preceded by a survey to select an alignment for the pipeline. Under the proposed Standards, consideration would be given to the occurrence of the corals listed in Appendix 3-4G and the five species of giant clams and sea turtles. Under the U.S. statutes and regulations, the USAKA preliminary review would focus on the sea turtles and only one species of giant clam (*Tridacna gigas*). The USAKA Standards provide protection for a greater number of species.

Although the USAKA Standards would involve consultation for more species and coordination on more species and habitat than the U.S. statutes and regulations, the DEP process under the USAKA Standards would not necessarily prevent the irreversible or irretrievable commitment of resources. The DEP process potentially could allow activities that result in a jeopardy opinion to proceed, unless USAKA decides to stop or alter the plans affecting the resource. Even though more species would be evaluated under the biological assessment process, the DEP process could result in adverse impacts to resources covered under the statute in situations where USAKA does not agree with jeopardy opinions. Takings of protected species could potentially result.

As discussed in Section 4.1 of this SEIS, since the implementation of the Compact, U.S. resource agencies have no regulatory authority for activities at USAKA. Under the proposed Standards, a formal process is established that provides for consultation and coordination and for conflict resolution that would not occur under the existing U.S. statutes and regulations. Therefore, the implementation of the proposed Standards should have no significant negative impact, and could have a significant positive impact by providing protection for a larger number of species.

Mitigation

Because no significant impacts of the proposed Standards on rare, threatened, or endangered species are identified, no mitigation is needed.

4.9 Cultural Resources

4.9.1 Level-of-Activity Alternatives

Archaeological, historical, and cultural resources comprise the material remains of human activity significant in the history, the prehistory, and the architecture, archaeology, or traditional culture of the USAKA area. These remains include buildings, structures, and objects that have qualities of location, design, materials, or workmanship that associate them with Marshall Islands history, architecture, prehistory, and cultural history.

Affected resources include significant or potentially significant resources that are eligible for listing on the U.S. National Register of Historic Places, as described immediately below.

Prehistoric Resources. Potential areas of concern include cultural resources produced by the preliterate, indigenous people of the USAKA area that are of archaeological interest (e.g., possible gravesites on Omelek Island).

Historic Resources. Potential areas of concern are the cultural resources or historic sites established since the advent of written records in the USAKA area that are of archaeological and/or historical interest (e.g., the World War II facilities on Roi-Namur that are included within the Roi-Namur National Battlefield Landmark).

Traditional Use Sites. Potential areas of concern are those resources to which oral traditions of the indigenous people of the Marshall Islands are attached.

Levels of Significance—Existing U.S. Statutes and Regulations

The significance of impacts to prehistoric archaeological and historic resources was evaluated with reference to the criteria used in 36 CFR 800, "Protection of Historic and Cultural Properties." The significance criteria were adapted to the particular resources prevalent in RMI and within the USAKA area.

- **No or Negligible Impact.** No adverse impact is expected and/or the level of impact is so slight it will not affect the resource.

- **Nonsignificant Impact.** Potential impacts may occur, but no substantial consequences are expected that would adversely affect the condition of the resource. Adverse effect is defined as destruction or alteration of a resource; isolation from or alteration of the resource's environment; addition of intrusive elements (visual, audible, or atmospheric); neglect; or transfer, lease, or sale of property.

- **Significant Impact.** Impacts would result in adverse effects on the resource (as defined above).

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

The definition of significance of impacts to prehistoric and historic resources was also evaluated with reference to criteria used in the proposed Standards, Subsection 3-7.5.4, "Assessing Potential of Effects on Cultural Resources." Differences between the two sets of regulations, as listed in Appendix B (of this SEIS), are primarily administrative and procedural. The levels of significance defined for the U.S. statutes and regulations also apply to the proposed Standards.

NO ACTION

Impacts–Existing U.S. Statutes and Regulations

The potential impacts of the No-Action Alternative are described in Section 4.8 of the 1989 EIS. Since the 1989 EIS was released, the potential importance of Cold War era resources has been recognized. When the 1989 EIS was published, the potential importance of impacts to these sites on the 11 USAKA islands was not understood. Although the importance of Cold War resources is now acknowledged, no surveys have been performed and of the preliminary listing of sites (Table 3.9-1), it is unknown which (if any) sites would be eligible for listing on the National Register of Historic Places. As a result, as part of the No-Action Alternative, several Cold War era resources have already been altered.

The Meck Island Control Building (FN 5050) was renovated to provide space for the HEDI/SBI launch control and technical support (construction completed). An addition also was made to the Spartan Missile Assembly Building (FN 5080). It is not known whether renovation of these facilities may have had a significant impact on historic resources.

The USAKA Mitigation Plan (Appendix A), adopted as an outcome of the 1989 EIS, included several measures aimed at minimizing impacts to cultural resources. These measures include conducting preconstruction surveys, determining the significance of any cultural remains discovered during such surveys, data recovery where appropriate, and consideration of potential cultural resource impacts in siting decisions.

The USAKA Mitigation Plan does not include a cultural resource management and site preservation plan as required by AR 420-40. Many historic World War II resources on Kwajalein and Roi-Namur (and possibly other islands) are badly deteriorated because of the harsh climate. For example, 6 years ago, the Command Post and Air Raid Shelter on Roi-Namur were in excellent condition; however, the facility is now badly deteriorated. Neglecting a resource so that it is allowed to deteriorate is considered a significant impact according to 36 CFR 800.9(b)(4). As a result, several historic resources could be significantly affected by the No-Action Alternative.

Cold War era resources located on USAKA islands need to be inventoried and evaluated to determine whether they are eligible for listing on the National Register of Historic Places. A first step in this process would be to determine, in conjunction with the RMIHPO, whether the Cold War sites at USAKA, as a class, are likely to be eligible for such listing. Resources that are determined by the RMIHPO to be eligible and that would be adversely affected would require archival research, mapping, and photographing according to the Standards of the Historic American Buildings Survey (HABS) and/or the Historic American Engineering Record (HAER). In cases where the resources have already been altered as a result of the No-Action Alternative, HABS/HAER recording could still provide a useful record of the remaining original features of the building or structures.

Because no inventory of traditional use areas has been conducted at USAKA, the presence of traditional use sites and, therefore, the potential for impacts to such sites, cannot be determined.

A management and site preservation plan that would include measures to evaluate traditional use sites and to arrest deterioration at historic World War II and other cultural resource sites should be developed. If site preservation measures are added to the USAKA Mitigation Plan when it is fully implemented, they would reduce the potential for significant impacts to cultural resources from ongoing activities at USAKA.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

On all islands where the numbers of visitors and residents would increase, potential significant impacts could occur to cultural resources through site vandalism.

In this alternative, dredging for construction projects and shoreline protection could have a significant impact on any sunken historic World War II ships and vessels that may be present adjacent to the lagoon shoreline of these islands. Because no complete survey of sunken ships and vessels has been performed, impacts to these resources cannot be assessed. Similarly, although no known traditional use sites would be affected, no survey of such sites has been completed and, therefore, impacts to these resources cannot be fully assessed.

Prior to the construction of the proposed facilities, a review of the adequacy of previous cultural resource surveys needs to be undertaken to determine whether work on all 11 USAKA islands is in compliance with cultural resource regulations. Recent discoveries of historic resources on Ennugarret suggest that previous inventories may not have been as intensive as those required by the cultural resource regulations.

KWAJALEIN

Historic Resources. Proposed shoreline protection construction located near the air terminal could have a significant impact on a historic World War II site consisting of 25-mm guns. This resource is located close to the shoreline and could be damaged if dredged material is placed over it. A National Register eligibility determination would be needed for this resource prior to project construction, or shoreline protection activities should be planned to entirely avoid the site. If the site is confirmed and cannot be avoided the resource could be moved temporarily and the site restored after shoreline protection construction is completed.

Shoreline protection activities on the east side of the island could have a significant impact on a Japanese Sea Wall, the Japanese 25 mm guns, and the Japanese Fire Control Post. These resources are identified as potential cultural sites on Figure 3.1-1. Though these resources are included in the National Historic Landmark nomination form, they have not been adequately mapped or recorded and should be investigated prior to construction activities. Care should be taken during shoreline protection activities to ensure that these resources are left intact and remain undisturbed.

The Religious Education Facility proposed for construction on Kwajalein Island in this alternative would be a physically separate structure, constructed with roof and siding materials that would resemble or be compatible with the existing chapel, which dates to World War II. The National Register eligibility of the existing chapel is unknown; however, as long as the new structure is constructed in a way that does not physically affect the existing chapel and that has a compatible architectural style with it, there should be no significant impacts on historic resources.

The ZAR Transmitter Building (FN 993), built in 1961 and a possible Cold War era historic resource, would be renovated for use as a controlled humidity warehouse. Further evaluation of the value of the ZAR Transmitter Building as a Cold War era resource would be needed to determine whether there would be a significant impact on the resource, or whether the original FN 993 is eligible for the National Register of Historic Places.

Archaeological Resources. Proposed shoreline protection activities along the southern perimeter of Kwajalein potentially could affect buried historic and prehistoric sites. The shoreline in these areas conforms to the original island surface and is identified as a potentially sensitive area for cultural resources (see Figure 3.1-1). As a result, if future surveys and subsurface testing in this area reveal National Register-eligible prehistoric or historic resources, the proposed shoreline protection activities could have a significant impact on cultural resources.

Construction of 188 units of unaccompanied personnel housing, the hospital upgrade, religious education facility, physical security upgrade, corrosion prevention facility, hazardous materials storage facility, and the cold storage and general purpose warehouses could adversely affect buried historic and prehistoric sites that may be located in the area. These facilities are situated in an area on Kwajalein that correlates with the original island surface. Because ground disturbance within this area has in the past yielded historic and prehistoric artifacts, it has been identified as potentially containing buried cultural resources. As a result, the construction of facilities in this area could have a significant impact on cultural resources on Kwajalein. The controlled humidity warehouse is located in an area of fill outside the original land area of the island. There is a low probability of finding subsurface cultural resources in such an area of fill.

ROI-NAMUR

Historic Resources. The wastewater treatment plant proposed for this alternative would be located in the general vicinity of two World War II era historic resources—a U.S. aircraft dump and the site of a bomb shelter (Sites 39 and 38 in Figure 3.1-2). There appears to be adequate space available to construct the new facility without affecting either of these resources; however, care should be taken in siting the facility and in managing construction activities to avoid impacts.

The existing wastewater outfall crosses the shoreline near the site of a World War II era U.S. dump (Site 43 in Figure 3.1-2). Care should be taken during the construction of the outfall extension to avoid placing materials on the site and to ensure that the historic site is not damaged in any other way. There appears to be adequate space to complete the construction project without affecting this site.

New wastewater collection lines will be installed on both the Roi and Namur sides of the island. Most of these lines will be installed in or adjacent to roads, and therefore are not likely to affect known historic sites; however, they will be located in the general vicinity of a number of known historical sites, including a gun pad and Singapore guns (Sites 41 and 42 in Figure 3.1-2), the Japanese command post and bomb shelter (Sites 1 and 2), a U.S. cemetery site and Japanese hangar (Sites 31 and 32), the Dyess Airfield memorial (Site 50), a Japanese jail and gunmount (Sites 26 and 27), a Japanese underground hospital (Site 23), and a bomb shelter (Site 8). Care should be taken during the installation of the wastewater collection lines to avoid affecting these resources by excavation or by placing material in them. In order to ensure that no impacts occur to these resources (which are part of the National Historic Roi-Namur Battlefield), the proposed location of each line should be checked in the field by a qualified historian or archaeologist and, where necessary, relocated (for example, to the other side of the road) to avoid all historic resources.

Shoreline protection activities could also have a significant impact on the causeway, bunker, and blockhouse, shown in Figure 3.1-2 as Sites 3, 45, and 44. These resources are included in the National Historic Roi-Namur Battlefield. Care should be taken during shoreline protection activities to avoid impacts to these resources. The resources should be adequately mapped and photographed prior to construction so that specific locational data are known.

Archaeological Resources. Proposed shoreline protection activities along the northern perimeter of Roi-Namur potentially may affect buried historic and prehistoric sites. The shoreline in these areas conforms to the original island surface and is identified as a potentially sensitive area for cultural resources (see Figure 3.1-2). As a result, if future surveys and subsurface testing in this area reveal National Register-eligible prehistoric or historic sites, the proposed shoreline protection activities could have a significant impact on cultural resources. The power plant, wastewater treatment plant, and wastewater collection lines are located in areas identified as having a potential for containing buried historic and prehistoric remains (see Figure 3.1-2). As a result, the construction of these facilities could have a significant impact on cultural resources if future surveys and subsurface testing reveal National Register-eligible resources in these areas.

MECK

Historic Resources. Although no field inventory of Cold War era resources has been performed, two potential sites may be affected by this alternative. The Cold War era Systems Technology Test Facility (FN 5049) would be renovated and would undergo extensive modification. The Ordnance Area Building (FN 5064), another Cold War era resource, would become the site for a sounding rocket rail launcher. If, in consultation with RMIHPO, these resources are determined to be National Register-eligible, the construction and/or renovation of the proposed facilities would have a significant impact on these resources.

Archaeological Resources. No archaeological resources are documented on Meck.

ENNYLABEGAN

Historic Resources. The proposed harbor area dredging could have a significant impact on a historic Japanese Pier (FN 6012) that was constructed in the late 1930s or early 1940s. The pier has not been formally recorded or evaluated to determine its eligibility for listing on the National Register. The pier should be recorded and its historical significance evaluated prior to initiating construction activities.

Archaeological Resources. No archaeological resources would be affected by proposed activities.

Mitigation—Existing U.S. Statutes and Regulations

If possible, in all cases where facilities and resource conflicts occur, site avoidance by redesigning the location of the facility or activity is desirable. However, if avoidance is infeasible, mitigation measures would be warranted.

Vandalism of sites resulting from increased visitors and residents on the various islands should be mitigated through fencing or data recovery (i.e., site excavation, analysis, and documentation) if fencing proves ineffective.

Traditional Use Sites. An inventory of traditional use areas should be completed at USAKA and appropriate measures taken to protect National Register-eligible sites. Until such a survey is undertaken, completing the review process prescribed by Section 106(h) of the Historic Preservation Act will ensure that individual projects do not affect such resources.

Potential Sunken Ships and Vessels. Prior to the commencement of dredging activities on Kwajalein, Roi-Namur, Meck, Omelek, Legan, Gellinam, and Eniwetak, a survey should be undertaken within the areas where dredging is planned to locate sunken vessels and ships that could be affected. If sunken ships or vessels are identified, they should be evaluated in accordance with National Register Bulletin 20, "Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places." If significant resources are found, they should be treated in compliance with the Abandoned Shipwreck Act of 1987 and with the RMI regulations governing access to prehistoric and historic submerged resources. Archival research should also be undertaken to provide historical background information on the vessel and its mission.

Potential Buried Cultural Resource Areas. When facilities are proposed for siting in areas that have a potential for yielding buried cultural resources, these areas should be sampled with subsurface testing to determine the presence or absence of cultural resources. If resources are present, the testing program should also provide information about the extent, nature, and significance of the resource. If significant resources are identified and cannot be avoided, a data recovery program that consists of site mapping, controlled excavations, and data analysis and recordation in compliance with 36 CFR 800.8 should be undertaken.

Historic Resources. On Roi-Namur, the historic World War II dump and historic sites in the general vicinity of proposed wastewater collection lines (that is, Sites 1, 2, 8, 23, 26, 27, 31, 32, 41, 42, and 50) should be avoided during construction. Alternatively, these resources should be intensively surveyed, mapped, photographed, and evaluated to determine whether they are National Register-eligible. Test or full-scale excavation of the site is not recommended because of the potential of encountering unexploded ordnance. During construction of the treatment plant outfall, any artifacts that are uncovered in the World War II dump area need to be mapped and recorded before continuing with construction.

The two Cold War era sites on Meck, the Japanese Pier on Ennylabegan, and the ZAR buildings on Kwajalein should be inventoried and evaluated in consultation with the RMIHPO to determine their historic significance and eligibility for National Register listing. If these resources are eligible, mitigation measures in compliance with the HABS/HAER standards would be needed. Mitigation would likely include detailed photographs of each resource, mapping, and archival research of the history of the facility and how it was made and used over time.

The historic sea wall, Japanese 25-mm guns, and Japanese Fire post on Kwajalein and the historic causeway, bunker, and blockhouse on Roi-Namur should be mapped and adequately recorded. Because these resources may be eligible to be listed on the National Register, mitigation measures in compliance with HABS/HAER would be required if they are adversely affected.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be the same as under existing U.S. statutes and regulations.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation would be the same as under existing U.S. statutes and regulations.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

The potential impacts related to vandalism and dredging identified for the Low Level-of-Activity Alternative are also a concern for this alternative.

Other impacts to cultural resources listed by the various islands below are in addition to those impacts identified for the No-Action and Low Level-of-Activity alternatives.

KWAJALEIN

Archaeological Resources. As one siting option, a new communications facility, the GEP, would be constructed on the north-central portion of Kwajalein Island. Three potential sites are being considered (see Figure 2.1-17). The facility would consist of an antenna, pedestal, and associated electronic equipment mounted within a radome. The location of the facility has not been selected. The westernmost GEP site is located in an area of extensive American logistics support activity during Operation Flintlock (February 1944), which means that the site may have some potential to contain subsurface cultural resources. Before a final site for the facility is selected, potential sites will be surveyed for the presence of surface or subsurface cultural resources. Any sites with the potential to contain cultural resources will be avoided to the extent possible; if avoiding all such sites is infeasible, mitigation measures will be implemented, as described below.

ROI-NAMUR

Archaeological Resources. As one siting option, a new communications facility, the GEP, would be constructed on a site directly across from FN 8115 on the western half of Roi-Namur Island (see Figure 2.1-18). The facility would consist of an antenna, pedestal, and associated electronic equipment mounted within a radome. The site is located within the original land area of the island, which is an area with potential for subsurface cultural deposits and will be surveyed for the presence of surface or subsurface cultural resources. If the site is found to contain cultural resources, mitigation measures will be implemented, as described below.

MECK

Historic Resources. The destruction of Spartan Silos No. 21 and No. 22 and of Sprint Silos Nos. 7, 8, 9, and 10 could result in a significant impact if these Cold War era resources are determined to be National Register-eligible. A National Register evaluation of these resources needs to be conducted prior to their destruction.

Archaeological Resources. No archaeological resources are documented on the island.

LEGAN

Historic Resources. No historic resources are documented on the island.

Archaeological Resources. The proposed access road bisects a buried prehistoric site located at the northern end of the island. The EOD pit is located in an area identified as having the potential to contain buried historic or prehistoric remains (see Figure 3.1-6). The National Register eligibility of the existing site or additional potential sites has not been determined. The construction of these facilities could have a significant impact on archaeological resources.

ILLEGINNI

Historic Resources. Several Cold War era resources could be adversely affected by this alternative if they are determined to be National Register-eligible. Under the Proposed Action, the Remote Launch Equipment Building (FN 9033) would be renovated and converted into a Missile/Payload Assembly Building. The Launch Equipment Building (FN 9034) would undergo extensive renovation. The Missile Assembly Building (FN 9035) would be renovated for use as a power plant. In addition, Spartan Silos No. 31 and No. 32 and Sprint Silos No. 12 and No. 13 could be destroyed. If these resources are eligible for National Register listing, the Proposed Action would have a significant impact on historic resources.

Archaeological Resources. No archaeological resources have been documented on the island.

ENNUGARRET

This island has not been completely surveyed for cultural resources and requires further survey work before a complete assessment can be made concerning potential impacts to cultural resources. Prior to project construction, an intensive cultural resource survey would be conducted.

Historic Resources. Construction of the proposed access road and the helicopter pad could have a significant impact on World War II sites recently identified on the island (Holmes, 1992). These sites would be evaluated to determine whether they are National Register-eligible prior to project construction.

Archaeological Resources. Construction of the EOD pit could adversely affect a buried prehistoric site located near the tip of the island. The extent of the site is unknown and proposed construction could have a significant impact on the site. Currently, it is unknown whether the site is National Register-eligible.

Mitigation—Existing U.S. Statutes and Regulations

If possible, in all cases where facilities and resource conflicts occur, site avoidance by redesigning the location of the facility or activity is desirable. However, if avoidance is unfeasible, mitigation measures would be warranted.

Vandalism of sites resulting from increased visitors and residents on the various islands should be mitigated through fencing, or data recovery (i.e., site excavation, analysis, and documentation) if fencing is ineffective.

Traditional Use Sites. An inventory of traditional use areas should be completed at USAKA and appropriate measures taken to protect National Register-eligible sites. Until such a survey is undertaken, completing the review process prescribed by Section 106(h) of the Historic Preservation Act will ensure that individual projects do not affect such resources.

Potential Sunken Ships and Vessels. Impacts occurring as a result of dredging or vandalism should be mitigated as specified above under the Low Level-of-Activity Alternative.

Potential Buried Cultural Resources Areas. Impacts resulting from the construction of facilities in potential cultural resources areas should be mitigated as specified above under the Low Level-of-Activity Alternative.

Historic Resources. Impacts to the 25-mm guns on Kwajalein (if they are determined to be National Register-eligible) and to the National Register World War II causeway, bunker, and blockhouse on Roi-Namur should be mitigated through site mapping and photographing in compliance with 36 CFR 800 and HABS/HAER standards. Archival research should also be conducted to document historical events associated with these resources and to determine how the resources were made and what building materials were used in their construction. As part of the HABS/HAER documentation process, a report should be prepared that describes the adversely affected resources and provides details of their historical significance. This report should include a discussion of whether other similar resources exist in the Marshall Islands and how their condition and integrity compares with the affected resources.

If the Cold War era resources on Meck (Spartan Silos No. 21 and No. 22 and Sprint Silos Nos. 7, 8, 9, and 10) and on Illeginni (Launch Equipment Buildings, FN 9033 and FN 9034; Missile Assembly Building, FN 9035; Spartan Silos No. 31 and No. 32; and Sprint Silos No. 12 and No. 13) are determined, in consultation with the RMIHPO, to be National Register-eligible, mitigation measures in compliance with HABS/HAER standards, as outlined for resources on Kwajalein and Roi-Namur, should be undertaken. In addition, if new silos are not planned in areas where Cold War era silos exist, one or more of the original silos should be left in place and preserved, if possible.

Archaeological Resources. If the prehistoric site on Legan is National Register-eligible, impacts resulting from the planned construction should be mitigated through a data recovery program consisting of site mapping, controlled excavations and data analysis, recordation, and documentation in compliance with 36 CFR 800.8.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be the same as under existing U.S. statutes and regulations.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation would be the same as under existing U.S. statutes and regulations.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

The potential impacts related to vandalism and dredging identified for the Low and Intermediate Level-of-Activity alternatives are also a concern for this alternative.

Other impacts to cultural resources listed by the various islands are in addition to those impacts identified for the No-Action and the Low and Intermediate Level-of-Activity alternatives.

OMELEK

Historic Resources. No historic resources have been identified on the island.

Archaeological Resources. The proposed shoreline protection near the tip of the island and the construction of the camera pad and road on the eastern shoreline could have a significant impact on possible gravesites (see Figure 3.1-4). These possible gravesites are identified as five coral slab features adjacent to the shoreline that could be adversely affected by construction activities. The proposed launch hill and silo, protective blast berm, underground equipment room, and remote equipment building are all located in areas that have a potential for containing buried historic or prehistoric remains. If future survey and subsurface testing work in these areas result in the discovery of National Register-eligible historic or prehistoric resources, the construction of these facilities could have a significant impact on cultural resources.

LEGAN

Historic Resources. No historic era resources are documented on the island.

Archaeological Resources. The area encompassed by the proposed SuperRadot, ballistics, and spectral camera facilities and the MPS-36 radar and command/control transmitter complex is identified as having a potential for containing buried historic or prehistoric remains (see Figure 3.1-6). The National Register eligibility of the potential sites has not been determined. If future surveys and subsurface testing work reveal the presence of National Register-eligible sites in this area, the construction of these facilities could have a significant impact on cultural resources.

ENIWETAK

Historic Resources. No historic resources are documented on the island.

Archaeological Resources. The construction of the protective berm, southern launch silo, camera pad (located just east of the proposed warehouse), and the warehouse would have a significant impact on a buried prehistoric site. Other proposed facilities, including the remote launch equipment building, underground equipment room, fuel tank containment area, power plant, northern launch silo, and camera pads (located along the shoreline and adjacent to the remote launch equipment building) are located in an area identified as having a potential for containing buried historic or prehistoric sites (see Figure 3.1-10). The National Register eligibility of the existing site or additional potential sites has not been determined. The construction of these facilities could have a significant impact on existing and potential cultural resources.

Mitigation—Existing U.S. Statutes and Regulations

If possible, in all cases where facilities and resource conflicts occur, site avoidance by redesigning the location of the facility or activity is desirable. However, if avoidance is unfeasible, mitigation measures would be warranted.

Impacts occurring as a result of dredging activities or vandalism associated with this alternative should be mitigated as specified previously under the Low and Intermediate Level-of-Activity alternatives.

Traditional Use Sites. An inventory of traditional use areas should be completed at USAKA and appropriate measures taken to protect National Register-eligible sites. Until such a survey is undertaken, completing the review process prescribed by Section 106(h) of the Historic Preservation Act will ensure that individual projects do not affect such resources.

Potential Buried Cultural Resources Areas. Impacts resulting from the construction of facilities in potential cultural resources areas should be handled as specified previously under the Low and Intermediate Level-of-Activity alternatives.

Historic Resources. No impacts would occur to identified historic resources because no facilities are planned in previously recorded site areas. As a result, mitigation measures for historic resources are not required.

Prehistoric Resources. If National Register evaluations indicate prehistoric sites affected by this alternative on Omelek and Eniwetak are eligible for listing, mitigation measures should be undertaken. Impacts resulting from planned construction on these islands should be mitigated through a data recovery program consisting of site mapping, controlled excavations and data analysis, recordation, and documentation in compliance with 36 CFR 800.8.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be the same as under existing U.S. statutes and regulations.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation would be the same as under existing U.S. statutes and regulations.

4.9.2 Proposed USAKA Environmental Standards and Procedures

The differences between the proposed USAKA Standards and existing statutes and regulations are largely procedural, as described below.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

The existing U.S. statutes and regulations that govern the treatment of cultural resources are embodied in the National Historic Preservation Act of 1966, the Archaeological and Historic Preservation Act of 1974, and Executive Order 11593.

Specifically, the regulations provide:

- Persons or groups who may have an interest in cultural resources affected by a project will be consulted.

- The area that will be disturbed by a project must be surveyed by a professional archaeologist to determine if the project area contains cultural resources.

- If cultural resources are identified, they require an evaluation of significance to determine whether they are eligible for listing in the National Register of Historic Places. This is done in consultation with the RMIHPO and the ACHP.

- If cultural resources eligible for the National Register are identified in a project area and would be adversely affected, a Memorandum of Agreement (MOA) must be prepared that outlines mitigation measures that will be implemented to lessen the impact of the project on cultural resources. This must be done in consultation with individual State Historic Preservation Offices (SHPOs) (including the RMIHPO) and the Advisory Council on Historic Preservation (ACHP).

These regulations are applicable to all federally funded, licensed, or permitted projects that may have an effect on cultural resources eligible for the National Register.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

The proposed USAKA Standards for cultural resources provide resource protection that is similar to the protection of the U.S. statutes and regulations. The differences between the two sets of regulations are administrative and procedural in nature.

Two notable procedural differences exist between the USAKA Standards and U.S. statutes and regulations:

1. The proposed USAKA Standards replace the role of individual state historic preservation officers with the RMIEPA, the central RMI contact for all issues related to the Standards. The RMIEPA would work in conjunction with the RMI Historic Preservation Office. The U.S. statutes and regulations specifically designate the RMI a Historic Preservation Office as the responsible review agency for projects affecting cultural resources.

2. The USAKA Standards require that a programmatic Document of Environmental Protection (PDEP) be established that would identify typical operations at USAKA and how they would affect cultural resources. The PDEP would also establish mitigation measures for resources that would be

adversely affected by USAKA activities. The U.S. statutes and regulations do not specifically require an equivalent document to the PDEP. However, under U.S. regulations, if sites are adversely affected, an MOA outlining mitigation measures is required. The implementation of the PDEP would be beneficial to the protection of cultural resources because impacts would be predicted before they occurred. The PDEP should also help to streamline the compliance process.

Based on a review of the overall effects of the differences between the two sets of standards, it is concluded that the proposed Standards would have no or negligible impacts in terms of the degree of protection afforded to cultural resources.

Mitigation

Because no significant impacts to cultural resources result from implementation of the proposed USAKA Environmental Standards and Procedures occur, no mitigation is needed.

4.10 Land Use

4.10.1 Level-of-Activity Alternatives

The level-of-activity alternatives include the construction of new facilities and renovation of existing structures for new activities. New and renovated facilities, if improperly located, could adversely affect surrounding land uses. As described in Section 3.10 of this document, land use at USAKA is guided by the *USAKA Master Plan Report* (USAEDPO, 1992).

Master planning for an Army installation is a process of integrating physical, social, aesthetic, economic, safety, ecological, functional, operational, and institutional factors to produce a comprehensive framework that will guide the long-range physical development of an installation to meet mission objectives. The current USAKA Master Plan incorporates traditional master planning, natural resources planning, environmental protection, historic preservation planning, and hazardous waste minimization planning. It includes land use Concept Plans for Kwajalein and Roi-Namur only, but addresses natural resources and environmental quality on all USAKA islands with the exception of Ennugarret. The Concept Plan for Kwajalein was most recently revised in 1992 and a summary is shown in Figure 3.10-1.

The current USAKA Master Plan was developed without consideration of the long-term mission plans for USAKA. The Master Plan does not provide guidance about the location and sequence of development for the required facilities.

Levels of Significance

Because there are no U.S. statutes and regulations nor USAKA Standards that directly address land use, a single set of levels of significance has been defined. Land use impacts are considered significant if they reflect land uses that are potentially incompatible with existing uses or with planned uses identified in the USAKA Master Plan Concept Plans. The proposed revisions to AR 210-20 (Master Planning for Army Installations) would affect the process and not the substance or objectives of master planning. The Army master planning regulations do not define significance in the context of NEPA; therefore, the levels of significance used in evaluating the land use impacts of the level-of-activity alternatives are defined as follows:

- **No or Negligible Impact.** Facility siting is considered to have no impact on land use if the new or renovated facility is sited in an area where the new use is entirely compatible with the area's existing uses (i.e., it would not cause health or safety hazards or nuisances) or is consistent with the USAKA Master Plan's goals and objectives.

- **Nonsignificant Impact.** Facility siting is considered to have a nonsignificant impact on land use if the new or renovated facility is sited in an area where the new use is largely compatible with the existing uses or is consistent with the Master Plan's goals and objectives; and the few incompatible elements would cause no health or safety hazards and minimal nuisance.

- **Significant Impact.** Facility siting is considered to have a significant impact on land use if the new facility is sited in an area where the new use is incompatible with existing uses (i.e., would cause health or safety hazards or nuisances) or is inconsistent with the current Master Plan's goals and objectives.

NO ACTION

Impacts

This alternative would have no substantial new land use impacts beyond those identified in the 1989 EIS. The types and locations of facilities proposed for the No-Action Alternative are expected to cause nonsignificant impacts because they are consistent with the USAKA Master Plan. On Kwajalein, these facilities include installation of the GBR-X radar facility, construction of the power plant and desalination plant, and other minor construction described in the 1989 EIS. On Meck, numerous new launch facilities and supporting facilities would be constructed, as shown in Figure 2.1-4.

On Omelek, facilities proposed and evaluated in the 1989 EIS have not yet been constructed. The extent of these proposed facilities (e.g., GSTS launch facilities, missile assembly building) and the presence of significant natural and cultural resources (see sections 3.6 and 3.9), indicate the need to analyze facilities to allow the optimal development for that island considering efficient functional relationships, human safety, and environmental quality. For potential impacts to natural and cultural resources of the No-Action Alternative, see Sections 4.6 (Island Plants and Animals) and 4.9 (Archaeological, Historical, and Cultural Resources).

LOW LEVEL OF ACTIVITY

Impacts

KWAJALEIN

The proposed 100-unit unaccompanied personnel housing (UPH) project would be constructed south of FN 602. In the USAKA Master Plan (Figure 3.10-1), that area is designated as Community Support/Bachelor Housing, a land use that would be compatible with the UPH project. Currently, however, the area is occupied by warehouses. Until the surrounding land uses are redeveloped into the long-term planned land use, which will take a number of years, residents of the new UPH facility are likely to be inconvenienced by the traffic and noise associated with the existing warehouse use of surrounding buildings. However, these land use impacts are unlikely to be significant because the majority of traffic and noise from warehouse activities would occur during work hours, when the majority of the residents of the UPH facility would not be present. In the long-term, the surrounding land uses are expected to evolve to land uses that meet the area's Master Plan designation of Community Support/Bachelor Housing and that would have fewer conflicts with the proposed UPH.

Other facilities proposed for construction on Kwajalein Island are expected to cause nonsignificant impacts because they are compatible with the USAKA Master Plan Concept Plan.

ROI-NAMUR

The proposed wastewater treatment plant, outfall extension, saltwater intake, and power plant are located on sites compatible with surrounding land uses. Nonsignificant impacts are expected because the treatment plant is consistent with recommendations of the Master Plan's *Environmental Quality Protection Plan.*

MECK

Facilities proposed for Meck in this alternative are expected to cause nonsignificant impacts because they are consistent with its current mission and land use patterns.

OTHER ISLANDS

At Ennylabegan, installation of a fiber optics cable would not affect land uses. Shoreline protection at Omelek, Gellinam, and Eniwetak, and past improvements at Legan, Illeginni, and Ennugarret would likewise not significantly affect existing land uses.

Mitigation

Because only nonsignificant impacts are identified, no mitigation is required.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

This alternative includes minor construction on several of the islands that would have negligible land use impacts (i.e., Omelek, Gagan, and Gellinam). On Legan, the construction of an EOD pit is expected to cause a nonsignificant impact because it would be consistent with the USAKA Master Plan's recommendation to locate such facilities on an isolated, unpopulated island.

New facilities proposed on three other islands are discussed below.

KWAJALEIN

As one siting option, a new communications facility, the GEP, would be constructed on the north central portion of Kwajalein Island. The facility would consist of an antenna, pedestal, and associated electronic equipment mounted within a radome. Three potential sites on Kwajalein are being considered. The easternmost site is situated on the border between land use zones designated in the *USAKA Master Plan Report* for supply (to the east) and outdoor recreation (to the west) (see Figure 3.10-1). Because of the potential for this site to affect outdoor recreation uses located to the west, its development could cause a significant impact.

Development of the GEP site located approximately 200 feet to the west of the easternmost site would be considered a fully compatible land use with no or negligible impacts because it would involve siting a GEP research and development facility within a research and development land use zone (see Figure 3.10-1).

Development of the westernmost GEP site would occur adjacent to Building 1045, in a land use area designated for base support (see Figure 3.10-1). Base support operations include laydown yards and maintenance for heavy equipment, landfill areas, salvage/surplus storage yards, range safety administration, and power plant facilities. Siting of a GEP radar in this area should not be incompatible with existing land uses (i.e., would cause no health or safety hazards or nuisances) and a nonsignificant land use impact can be expected from its development.

ROI-NAMUR

The proposed Roi-Namur GEP site is located directly across from Building 8115 (Spartan Bachelor Quarters) in an area designated in the *USAKA Master Plan Report* for community support and unaccompanied personnel housing. Although GEP facilities would normally be associated with research and development land use zoning, siting such a radar in this location is not considered incompatible with existing land uses. The location of this facility in the northeast portion of this land use zone is not expected to affect community support, housing, or associated functions and activities, because the facility will cause minimal noise or traffic impacts and no electromagnetic radiation (EMR) hazards to personnel. As a result, nonsignificant land use impacts are expected from the siting and development of a GEP radar at this location.

MECK

Construction of new launch facilities is planned for the southern end of the island. This construction would require that approximately 1,100 feet (335 meters) be added to the southern end of the island, resulting in a total expansion of approximately 15 acres (6 hectares). Because the new activities would be largely extensions of existing land uses at Meck, nonsignificant impacts would be anticipated.

ILLEGINNI

As an alternative launch site to Meck, substantial new construction and major renovation of existing unused structures are proposed for Illeginni. The daytime population would increase from 2 to 215 persons (there would be no permanent residents on the island). Some of the proposed activities are incompatible with other proposed activities; for example, the proposed fire station is planned to be located on or adjacent to the existing land target area. As noted in Section 2.1 and Figure 2.2-21, the existing EOD pit and the land target area need to be evaluated in terms of their continued use. These two uses could cause a significant impact to nearby land uses and should be located away from high use areas to avoid potential land use conflicts and safety hazards. While the location of specific facilities may need a land use review, the overall use of the island is consistent with the USAKA Master Plan in that it locates potentially hazardous activities away from populated islands. For potential impacts in the areas of safety resources, see Sections 4.6 and 4.15.

ENNUGARRET

In this alternative, the relocation of the EOD pit from Illeginni to Ennugarret would be evaluated. USAKA leases only 6 acres (2.4 hectares) of the island's 24 acres (10 hectares). According to the USAKA Safety Office, a safety arc of 2,400 feet (732 meters) should be established when operating any EOD pit (Department of the Army Technical Manual 9-1300-206). In addition, DoD Standard 6055.9-STD *Ammunition and Explosive Safety Standard* and Army Regulation 385-64 require that any mass detonating explosion location be separated from the installation boundary by a minimum of 1,250 feet (381 meters). These regulations, designed to protect human safety and property, could not be observed at Ennugarret because the required safety distances would extend beyond the limits of the area controlled by USAKA. For that reason, relocation of the EOD pit to Ennugarret would have a significant land use impact. The safety aspects of EOD activities are also addressed in Section 4.15.

Mitigation

If the easternmost Kwajalein GEP site is selected for development, consideration should be given to adjusting its location slightly in order to place it outside the area designated in the *USAKA Master Plan Report* for outdoor recreation. If the site cannot be relocated, the facility design and operation should include mitigations to minimize or compensate impacts to the existing outdoor recreational land uses in the area. Mitigations could include landscaping, building placement, and/or adding recreational areas of equal value in another location.

Review of potential land use conflicts on Illeginni and comprehensive analysis of the optimal use that island are recommended to ensure that proposed facilities are sited to foster efficient land use relationships and to minimize impacts to other land uses, human activity, and the natural environment. Because of potential for safety risks and interference with other potential land uses, use of Ennugarret for EOD should not be considered. In the event Ennugarret is chosen, USAKA should seek to expand boundaries under its control or obtain a restrictive easement to prevent harm to humans or property.

HIGH LEVEL OF ACTIVITY

Impacts

On several of the islands, this alternative includes construction that would have no or negligible land use impacts (Kwajalein, Roi-Namur, Meck, Ennylabegan, Illeginni, and Ennugarret). New facilities proposed on other islands are discussed below.

OMELEK

New launch facilities and related infrastructure are proposed for this island, which would result in an increase in the daytime population from 2 to 75 persons. Although the overall use of the island would be consistent with the USAKA Master Plan objective of locating potentially hazardous activities away from populated areas, the substantial increase in the intensity of development could lead to a significant land use impact (i.e., could cause health or safety hazards or nuisances) and indicates a need to analyze these facilities to ensure optimal development of the land through emphasis on efficient functional relationships, human safety, and environmental quality. For potential impacts to natural resources and safety, see Sections 4.6 and 4.15.

LEGAN

The sensor facilities and projected daytime population of 35 proposed for Legan may be incompatible with the EOD pit proposed for this island in the Intermediate Level-of-Activity Alternative, causing a significant land use impact. For potential safety impacts, see Section 4.15.

GAGAN

The proposed sensing and tracking facilities proposed for Gagan do not appear incompatible with other land uses at that island.

GELLINAM

The small-scale launch facilities and associated infrastructure proposed for Gellinam represent a major change to the island's existing land use that would require the relocation of some existing facilities (i.e., Radot, SDR, and HITS), and that would be a significant land use impact. To maintain explosive hazard safety distances associated with rocket launches, about 30,000 square feet (2,787 square meters) of land area must be added to the island. While the overall use of the island would be consistent with the USAKA Master Plan objective of locating potentially hazardous activities away from populated areas, the level of construction proposed could be a significant impact (i.e., could cause health or safety hazards or nuisances) and indicates a need for a review of potential land use conflicts and analysis of the facilities for the island to optimize land use relationships, human safety, and environmental quality. For potential impacts to safety and natural resources, see Sections 4.6 and 4.15.

ENIWETAK

The major launch facilities, associated infrastructure, and increase in daytime population from 2 to 75 persons on a 15-acre (6-hectare) island with valuable natural resources could be a significant land use impact (i.e., could cause health or safety hazards or nuisances). Potential land use conflicts should be reviewed and the facilities analyzed to ensure efficient land use relationships, human safety, and environmental quality. For potential impacts to safety and natural resources, see Sections 4.6 and 4.15.

Mitigation

The change in level of development and activity proposed for Omelek, Legan, Gellinam, and Eniwetak should be preceded by analysis of the siting of facilities for each island (within the framework of the USAKA Master Plan) to ensure efficient use of scarce land area, human safety, and minimal environmental impacts to natural and cultural resources. Sensors and EOD activities should not both be located on Legan and consideration should be given to separating these activities.

4.11 Socioeconomic Conditions

4.11.1 Employment, Population, and Housing

Level-of-Activity Alternatives

Population levels at USAKA vary in direct relation to permanent and temporary nonindigenous employment. Employment and nonindigenous population numbers are closely controlled at USAKA and change in direct response to program requirements and DoD decisions. Population levels directly affect the demand for housing and other support facilities and services. The quality of housing, base services, and support facilities is also affected at USAKA when the nonindigenous employment and population increase.

Assumptions about projected nonindigenous employment and population levels have been provided for each alternative (see Section 2.2). Population projections for the four level-of-activity alternatives are summarized in Table 4.11-1. Population trends are illustrated in Figure 4.11-1.

Under the No-Action Alternative, the nonindigenous population at USAKA would reach a peak level of approximately 3,250, including 1,375 family members. This level would be reached in 1994, and would continue at that level thereafter.

In the Low, Intermediate, and High Level-of-Activity alternatives, peak population levels would be reached in 1996, and are assumed to continue unchanged thereafter. The population projections for these alternatives are based on the assumption that the number of family members would be restricted to a total of 1,600, and that further population growth would occur among unaccompanied personnel. In the Low Level of Activity, the nonindigenous population would reach 3,825; in the Intermediate Level of Activity, the nonindigenous population would reach 4,925; and in the High Level of Activity, the nonindigenous population would reach 5,400.

The four level-of-activity alternatives are not expected to have a significant effect on levels of Marshallese employment. In the No-Action and Low Level-of-Activity alternatives, it is assumed that there would be 1,100 Marshallese employed. In the Intermediate and High Level-of-Activity alternatives, Marshallese employment would peak at 1,200 and 1,250, respectively. This relatively small increase in the level of Marshallese employment is not expected to affect housing needs on Ebeye or Ennubirr because employment needs are expected to be met by existing residents on those islands.

The nonindigenous population and employment projections are based on the assumption that there are adequate sources of employees to fill the forecast levels of USAKA nonindigenous mission and support personnel. In reality, the quality of life could affect decisions by potential employees to work at USAKA. Deficits in housing

Table 4.11-1
USAKA Peak-Year Population Projections

	Alternative			
	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Peak Year	1994	1996	1996	1996
Operations employees				
Kwajalein	1,425	1,750	2,700	2,960
Roi-Namur	300	350	400	440
Subtotal, operations employees	1,725	2,100	3,100	3,400
Family members, Kwajalein	1,375	1,600	1,600	1,600
Visitors, Kwajalein	100	100	175	300
Subtotal, Kwajalein	1,900	3,450	4,475	4,860
Subtotal, Roi-Namur	300	350	400	440
Subtotal	3,200	3,800	4,875	5,300
Construction workers, Kwajalein	50	25	50	100
Total nonindigenous, Kwajalein	2,950	3,475	4,525	4,960
Total nonindigenous, Roi-Namur	300	350	400	440
Total nonindigenous	3,250	3,825	4,925	5,400
Total Marshallese daily population	1,100	1,100	1,200	1,250
Total population	4,350	4,925	6,125	6,650

Assumptions:

1. Projections of peak resident population assume that only Kwajalein and Roi-Namur islands have housing for USAKA personnel and that all Marshallese reside on non-USAKA land, principally on Ebeye, Ennubirr, and Ennylabegan islands; the numbers for Marshallese reflect the numbers of Marshallese who would work at USAKA.
2. Projections assume that all family members reside on Kwajalein.
3. Projections assume that all construction workers during peak launch activities reside on Kwajalein.
4. Projections assume that all visitors reside on Kwajalein.

that meets standards could affect the recruitment and retainment of employees. For that reason, this subsection focuses on the demand for housing. Recreation, education, and medical services are addressed later in this section.

Levels of Significance

Because the proposed USAKA Standards do not address population and housing, a single set of definitions of significance is used. The significance of impacts to housing is evaluated with reference to USAKA's goal of meeting AR 210-50 (housing management) and AR 210-11 (billeting operations), and the Army Corps of Engineers design standards for new construction (USAEDPO, 1988a). Impacts on housing are evaluated using the following definitions of levels of significance:

- **No or Negligible Impact.** Housing would be adequate to meet demand and meet the above-referenced standards.

- **Nonsignificant Impact.** The supply of housing would be inadequate based on the above-referenced standards; however, if substandard units were included, there would be a sufficient number of units.

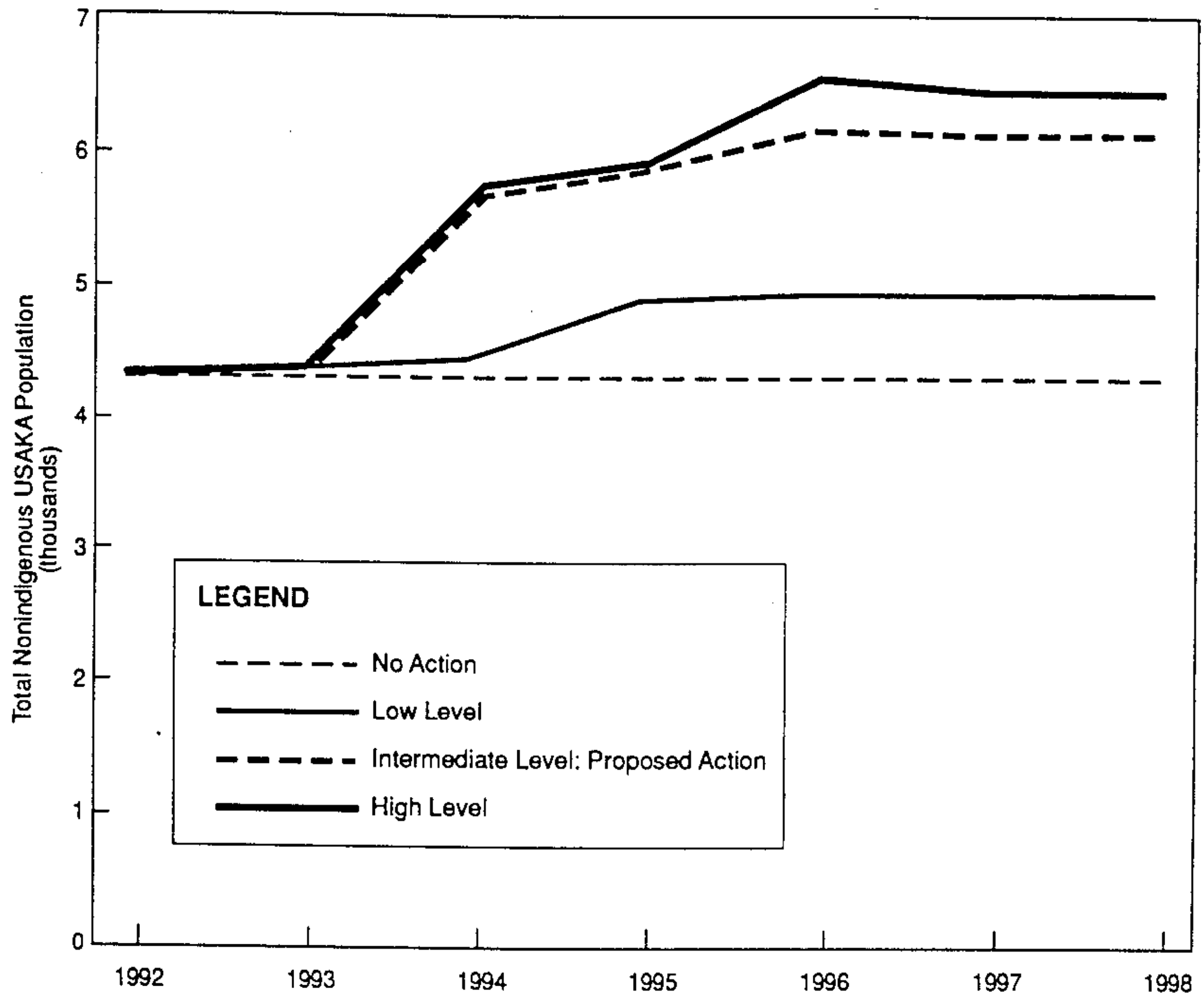
- **Significant Impact.** The supply of housing would be insufficient to accommodate the demand for housing, even if substandard facilities were included.

NO ACTION

The 1989 Draft EIS identified shortages in both family housing and unaccompanied personnel housing to meet the standards specified in AR 210-11 and AR 210-50, and found that increased demand would exacerbate those shortfalls unless additional housing units were constructed. The 1989 EIS stated that crowded housing conditions could have a negative effect on personnel recruitment and retainment.

Most of the existing housing at USAKA continues to be substandard when measured against the standards in AR 210-50. Sources from JCWSI housing department and USAKA have stated that only the newest 136 family housing units on Kwajalein meet standards and that as much as 95 percent of UPH housing (excluding 100 units on Roi-Namur) is substandard. According to Army regulations, substandard facilities can be inhabited and need not be replaced; however, there are plans to improve or replace substandard units (Kelly, Corby, and Dohrman, pers. comm., 1992).

Housing for construction workers is the responsibility of the individual construction contractors. Construction workers are housed in trailers brought to USAKA by their employers. For that reason, housing for construction workers is assumed to be satisfied by the construction contractor companies, and is not addressed further in this analysis.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Population Forecasts

FIGURE 4.11-1

Family Housing. The No-Action Alternative would mean the continued deficit of family housing meeting AR 210-50, the continued use of substandard living accommodations for accompanied personnel, and a slight shortage of family housing. As shown in Table 4.11-2, in the No-Action Alternative, a total of 688 family housing units would be required at Kwajalein to house the projected number of accompanied personnel and family members. Assuming that substandard units continue to be used, there would be a deficit of 14 units, a significant impact according to the definition of significance provided above. However, if substandard units are not included in the supply, the deficit would amount to 552 units.

Unaccompanied Personnel Housing. In the No-Action Alternative, 837 unaccompanied personnel units would be required at Kwajalein. Assuming that substandard units continue to be used, there would be a deficit of 401 units at Kwajalein, causing a significant impact. If substandard units are not counted, there would be a deficit of 837 units that meet standards.

At Roi-Namur, the No-Action Alternative demand would be 300. Assuming that substandard units continue to be used, there would be a deficit of 49 units, causing a significant impact. If substandard units are not counted, there would be a deficit of 200 units that meet standards.

LOW LEVEL OF ACTIVITY

Impacts

In this alternative, the peak nonindigenous population would reach 3,825, including 1,600 family members.

Family Housing. In this alternative, 90 units of family housing would be constructed along the northeastern shore of Kwajalein Island. The new units would increase the supply of family housing to 776, of which 226 units would meet standards. Demand for housing is predicted to reach 800 units. If substandard units are included, the projected deficit of family housing would amount to 36 units, causing a significant impact. If substandard units are excluded, the deficit would amount to 574 units.

Unaccompanied Personnel Housing. In this alternative, 288 new UPH units would be constructed on Kwajalein and 24 units demolished, for a net increase of 264 units. The new units would increase the supply of UPH on Kwajalein to 700 units, of which only the 288 new units meet standards. Demand for UPH is predicted to reach 1,050. If substandard units are included, there would be a deficit of 350 units at Kwajalein in this alternative, causing a significant impact. If substandard units are excluded, there would be a deficit of 786 units meeting standards.

At Roi-Namur, the projected demand for UPH would reach 350 units in this alternative. There would be a deficit of 99 units if substandard units are assumed to

Table 4.11-2
Housing Unit Peak-Year Capacity Requirements

	Alternative			
	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Family Housing[1]				
Capacity meeting standards[2]	136	136	136	136
Existing substandard capacity	538	538	538	538
Planned construction[3]	0	90	90	90
Total capacity[5]	674	764	764	764
Capacity required	688	800	800	800
Net surplus (deficit)	(14)	(36)	(36)	(36)
Net (deficit) capacity meeting standards[6]	(552)	(574)	(574)	(574)
UPH[3]				
Kwajalein				
Capacity meeting standards[2]	0	0	0	0
Existing substandard capacity[4]	436	412	412	412
Planned construction[3]y	0	288	288	288
Total capacity[5]	436	700	700	700
Capacity required	837	1,050	2,075	2,460
Net surplus (deficit)	(401)	(350)	(1,375)	(1,760)
Net (deficit) required capacity meeting standards[6]	(837)	(786)	(1,811)	(2,196)
Roi-Namur				
Capacity meeting standards[2]	100	100	100	100
Existing substandard capacity	151	151	151	151
Planned construction[3]	0	0	0	0
Total capacity	251	251	251	251
Capacity required	300	350	400	440
Net surplus (deficit)	(49)	(99)	(149)	(189)
Net (deficit) capacity meeting standards	(200)	(250)	(300)	(340)

[1]Capacity derived for alternatives from 2.0 family members per family and projected number of family members.
[2]AR 210-50.
[3]Would meet applicable standards.
[4]Assumptions on substandard units from Gene Dohrman, USAKA (see Source).
[5]Based on updated 1992 JCWSI numbers plus planned construction.
[6]Capacity required minus capacity meeting standards and planned construction.

Source: Dohrman, pers. comm., 1992.

be used, causing a significant impact. If substandard units are excluded, the deficit would be 250 units.

Mitigation

A minimum of 99 additional UPH units would have to be constructed on Roi-Namur to eliminate the shortage of housing there (250, if substandard units are to be replaced). At Kwajalein, a minimum of 350 units would need to be constructed (786, if substandard units are to be replaced). Alternatively, UPH units would have to house more personnel than the preferred one-person-per-unit standard, as currently occurs during peak periods.

At least 36 additional family housing units would be needed to meet the deficit predicted for Kwajalein (574 units if units that do not meet standards are replaced). Space for new construction on Kwajalein is at a premium and might have to be obtained at the expense of planned open space. Smaller footprints for buildings might be obtained by increasing the number of stories of planned structures and the floor to area ratio. This would increase the space available for additional housing or other land uses. Constructing higher buildings would have to be evaluated in relation to the operations of radars at Kwajalein to ensure that radars could be operated without violating personnel exposure limits for radar frequency radiation in the upper levels of apartment buildings. Higher buildings must also be evaluated for potential interference with aircraft operating at Kwajalein so as not to create flight hazards.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

As shown in Table 4.11-1, in this alternative, the peak nonindigenous population would reach 4,925, including 1,600 family members. Deficiencies noted under the No-Action and Low Level-of-Activity alternatives would remain constant for family housing at Kwajalein, but would increase for UPH at Kwajalein and Roi-Namur. These deficiencies would cause significant impacts.

Mitigation

On Roi-Namur, 99 additional UPH units would need to be built to satisfy the deficit of UPH in this alternative. On Kwajalein, the 264 UPH additional units added under the Low Level-of-Activity Alternative, combined with existing facilities, would not be sufficient to accommodate the projected mission and support unaccompanied personnel.

Additional housing units would have to be built to meet the significant increase of 650 mission and support personnel and their families. It is doubtful that UPH needs could be met on Kwajalein from existing and planned facilities even if the preferred one-person-per-room design is exceeded to the maximum extent practical. Additional family housing on Kwajalein could be obtained from existing structures by remodeling multifamily units to accommodate more one-bedroom units for families without children (if that can be done cost-effectively), or by constructing additional units. The projected increase in accompanied personnel and families is likely to comprise families with one worker and two family members. If this represents a family with two parents and one child, then some of the need for new family housing at USAKA would be for two-bedroom units.

As discussed above, space for new construction on Kwajalein is limited. Several alternatives for creating more housing space are possible. Space for new construction could be obtained from existing open space uses or could be created with additional fill. Housing structures could be designed with higher floor/area ratios, which would decrease the building footprint per square foot of usable space and make more efficient use of existing available land.

In addition, requirements for family housing could be reduced by limiting the number of employees who are allowed to bring their families to USAKA during their tours of duty; however, doing so might make it more difficult for USAKA to recruit the most qualified employees.

The existing family housing trailers are single-wide models with dimensions of 11 feet by 60 feet (3 meters by 18 meters). Six such trailers are lined up side by side on lots that occupy a total site area of approximately 80 feet by 250 feet (24 meters by 76 meters). A row of townhouses with six two-bedroom units occupies approximately the same site area as six of the trailers. The same site area could be used to support a three-story garden apartment structure (including building setbacks) that would provide 12 two-bedroom family housing units with an average of 1,250 square feet (116 square meters) each. These units would be comparable in size with the individual two-bedroom townhouse units constructed in 1988.

Twenty-two 12-unit garden apartments could be constructed to replace the 261 trailers. The garden apartments would occupy approximately half of the space currently occupied by the existing trailers. If each apartment unit were designed for only two stories and eight units, then approximately 33 buildings would be needed to replace all of the existing trailers. These 33 buildings could still be sited in approximately two-thirds of the space occupied by the existing trailers. The recovered land area that would result from using a garden apartment design could be used to construct other needed facilities, such as UPH, recreational facilities, and other support facilities.

The use of one or more leased hotel ships to house temporary unaccompanied personnel could free some of the existing and planned space for more permanent employees. The decision to use hotel ships should be preceded by an analysis of space limitations for construction of facilities on land. The difference in costs of leasing one or more ships should be balanced against the cost of constructing new facilities, and/or leasing or buying temporary structures. The analysis should also consider the length of time the facilities would be used and the time constraints to plan and construct new facilities given the projected needs of the alternative. Other factors, such as how to handle water and wastewater needs on board, and transportation of personnel to and from the ship on a reasonable schedule also should be considered. The potential that ships docked at Kwajalein for extended periods could cause noise impacts on nearby residential areas or could cause air quality problems may also need to be considered.

At Roi-Namur and Kwajalein, unaccompanied personnel could also be housed in more space-saving facilities, such as open barracks, tents, or trailers for short periods of peak activity.

HIGH LEVEL OF ACTIVITY

Impacts

As shown in Table 4.11-1, in this alternative the peak nonindigenous population would reach 5,400, including 1,600 family members.

Based on the deficiencies identified in Table 4.11-2, there would be significant impacts to all housing resources in the High Level-of-Activity Alternative. The deficit of family housing units is the same as in the Intermediate Level-of-Activity Alternative. UPH deficiencies noted under the Intermediate Level-of-Activity Alternative would be increased under this alternative. The number of mission and support personnel requiring housing in UPH would reach a peak level of 2,600. UPH requirements would exceed the existing capacity of units meeting standards by 2,196 units on Kwajalein and by 340 units on Roi-Namur. Table 4.11-2 shows peak-year housing requirements for this alternative.

Mitigation

Mitigation strategies for the High Level-of-Activity Alternative are generally parallel to those of the Intermediate Level-of-Activity Alternative. Housing the required number of personnel on Kwajalein under this alternative becomes more problematic because of the limited land area on which to construct additional housing facilities. If housing is to be constructed on the island, then higher density forms of housing would have to be considered and/or new fill areas would have to be constructed. The possibility of leasing one or more hotel ships to house unaccompanied personnel, discussed in the Intermediate Level of Activity above, may warrant greater scrutiny under this alternative.

4.11.2 Income and Fiscal Conditions

Level-of-Activity Alternatives

As noted in Chapter 3, USAKA makes a significant contribution to the economy of Kwajalein Atoll. Because USAKA activities would increase under all action alternatives, income and revenues of the RMI and local governments (Kwajalein Atoll Local Government, [KALGOV]) would grow. The principal effect would be on levels of income taxes paid by nonindigenous civilian contractors to the RMI government.

Income tax revenues are not the only sources of income to the RMI government from USAKA activities. As described in Section 3.10, the Compact of Free Association establishes the various grants and cash payments made by the United States to the RMI government for the U.S. government's use of RMI lands and waters. The annual Compact payments include fixed payments plus payments that are adjusted for inflation. The 1991 combined tax revenues and lease payments totaled $25.80 million, and Compact funding totaled $46.19 million, resulting in a total payment of $71.99 million. Lease payments and other funding pursuant to the Compact funding would not be directly affected by the level of nonindigenous employment or activities at USAKA and are, therefore, not expected to change substantially among the alternatives.

Levels of Significance

Because tax receipts from USAKA employees are an important part of the RMI fiscal revenues (in 1991, tax receipts from USAKA were 36 percent of the RMI annual revenues), they can be used to evaluate the potential effect of the level-of-activity alternatives on the income and fiscal conditions of the local economy. The proposed Standards do not address tax receipts; therefore, a single set of definitions of levels of significance is used.

- **No or Negligible Impact.** USAKA-based tax receipts to the RMI government do not change compared with the No-Action Alternative.
- **Nonsignificant Impact.** USAKA-based tax receipts to the RMI government change up to 5 percent compared with the No-Action Alternative.
- **Significant Impact.** USAKA-based tax receipts to the RMI government change more than 5 percent compared with the No-Action Alternative.

NO ACTION

Impacts

Income taxes are paid to the RMI government only by the civilian contractors working at USAKA; U.S. government employees pay income taxes only to the U.S. government. Income taxes are estimated based on the projected number of civilian contractor employees, which in turn derives from the current ratio of civilian contractors to total nonindigenous employees at USAKA (JCWSI, 1991):

- Military—2 percent of nonindigenous employees
- Civil service—5 percent of nonindigenous employees
- Civilian contractors—93 percent of nonindigenous employees

Table 4.11-3 shows the peak-year employment breakdown for each of the level-of-activity alternatives.

RMI income tax revenues from USAKA employees are computed for the level-of-activity alternatives by dividing the 1991 revenues of $2,357,491 by the 1,318 contract employees (JCWSI, 1991) and applying the $1,788 average payment so derived to the projected.employees in each alternative.

As shown in Table 4.11-4, the No-Action Alternative would lead to an increase in nonindigenous employment at USAKA of approximately 8.5 percent compared with the number of employees that existed at USAKA in January 1992.

Table 4.11-3
Peak-Year Employment by Category

	Alternative			
	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Peak year	1994	1996		
Military	37	44	66	74
Civil service	91	110	164	185
Civilian contractors[1]	1,697	2,046	3,045	3,441
Total	1,825	2,200	3,245	3,700

[1]Does not include construction workers.
Source: Ratios derived from JCWSI, 1991.

Table 4.11-4 Income Tax Receipts to RMI Government from USAKA Nonindigenous Contract Employees, Peak Year ($ Millions)	
No Action	3.034
Low Level of Activity	3.658
Intermediate Level of Activity	6.230
High Level of Activity	7.570

Assumptions:
1. Peak year: 1994 No Action, 1996 other action alternatives.
2. Figures based on $1,788, average 1991 annual payment per contract employee.
3. Figures not adjusted for inflation.

Source: Calculated from data provided by Patrick, personal communication, 1992.

LOW LEVEL OF ACTIVITY

Impacts

In this alternative the number of contract employees would increase to 2,046 in 1996, thereby increasing the amount of income tax revenues collected by RMI to $3.658 million. This represents an 84 percent increase over the No-Action Alternative, which (by the criteria for significance provided above) would be a significant positive impact.

Mitigation

Impacts are expected to be positive; therefore, no mitigative actions are necessary.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

In this alternative, the number of civilian contract employees would increase to a high of 3,045 in 1996, thereby increasing the amount of income tax revenues collected by RMI to $6.230 million. This represents a 213 percent increase over the No-Action Alternative, a significant positive impact.

Mitigation

Impacts are expected to be positive; therefore, no mitigative actions are necessary.

HIGH LEVEL OF ACTIVITY

Impacts

In this alternative, the number of contract employees would increase to 3,441, thereby increasing the amount of income tax revenues collected by RMI to $7.570 million. This represents a 280 percent increase over the No-Action Alternative, a significant positive impact.

Mitigation

Impacts are expected to be positive; therefore, no mitigative actions are necessary.

4.11.3 Recreation, Education, and Public Health

Level-of-Activity Alternatives

Levels of service provided in the areas of recreation, education, and public health are important to the morale, needs, and well being of the residents at USAKA.

Recreation. The restricted nature of life at USAKA makes recreational facilities important to the morale of the residents. Projected increases in the number of workers and family members could strain the capacity of existing facilities.

Education. Increases in the numbers of family members would increase the number of students to be served by the USAKA educational system.

Public Health. The adequacy of public health services is important to the well being of the residents and the prevention of wide-spread health problems. The perception of the residents of the adequacy of those services is also important. Although marginal services may serve the basic needs of the residents, facilities that are used at a level slightly beyond capacity could create morale problems among the residents.

Levels of Significance

The proposed USAKA Standards do not address recreation, education, and health; therefore, a single set of definitions of significance is used.

- **No or Negligible Impact.** There are sufficient existing or planned facilities relative to demand.

- **Nonsignificant Impact.** Deficiencies in facilities relative to demand could contribute to personnel morale problems.

- **Significant Impact.** Deficiencies in facilities relative to demand could affect the recruitment of new and the retention of existing USAKA employees.

Army standards for recreational facilities, AR 230, do not apply to facilities at USAKA because the facilities are operated by a private contractor. Recreational facilities are comparable to those of a municipality of similar size.

Army standards for elementary and secondary schools do not apply to facilities at USAKA because they are operated by a private contractor. The junior/senior high school is accredited by the North Central Association of Secondary Schools and Colleges. The elementary school is not accredited.

Although Army standards for health care facilities, as well as comparisons with typical facilities based on population served exist, they do not apply to USAKA because of its remote location and mission. Communities of comparable size with USAKA on the mainland would normally be served by a clinic, not a hospital. The number of beds currently existing at USAKA's hospital is based on the number of accidents, illnesses, and the number of flights to the mainland. Because air transportation to move patients from the Kwajalein hospital to other hospitals is limited, more beds are needed to hold patients awaiting transfer than would normally be allowed at another installation of similar size. Also, the consideration of possible mass casualty events increases beyond normal allowances the number of beds required. A detailed study is under way to determine health care requirements for USAKA.

NO ACTION

The school system at USAKA has, in the past (as it did in 1970), served up to 900 students with 63 teachers. The 1992 enrollment of 530 represents less than 60 percent of that capacity. The number of elementary and secondary education students for each level-of-activity alternative is projected based on the ratio of the school population to total family members in 1992 (41 percent), as shown in Table 4.11-5.

Table 4.11-5
School Age Population (K-12)

Level of Activity	Total Family Members	School Population[1]
No-Action	1,373	564
Low Level	1,600	656
Intermediate Level	1,600	656
High Level	1,600	656

[1]Figures for alternatives calculated using 41 percent of total family members.
Source: Calculated from data provided by Pera, pers. comm., 1992.

During the 1992 and 1993 deployments of the 84th Engineering Battalion, a total of seven classrooms were replaced (two of which had been damaged by Tropical Storm Zelda). This construction and the renovation of the hospital will bring those facilities well within the capacity required by population levels of this alternative.

The medical staff at USAKA has stated that facilities and staff are cramped but adequate to serve a population up to 5,000 people (Lindborg, pers. comm., 1992). A projection of the number of outpatient visits and inpatient days that would be expected for each level-of-activity alternative can be made based on the ratio of outpatient visits and inpatient days to total nonindigenous population in 1992 (6:01 and 0:02, respectively). These projections are shown in Table 4.11-6 and are compared with the estimated capacity of the existing medical facilities and staff.

Although hospital facilities are generally sufficient to serve the USAKA population, the existing facilities are cramped. The main hospital structure was built in 1951 as an administration building. The corridors are too narrow to meet hospital standards, and the existing spaces are functionally inadequate. The industrial hygiene and physical examination sections are currently located in two converted house trailers. The examination room doubles as the doctor's office. This unpartitioned space provides little privacy for the doctor and the patient. Many other rooms also have multiple functions. The treatment room serves as a cast room and physiotherapy room. An aisleway to the emergency room goes through the triage room. EKG testing, stress testing, and invasive procedures are done in the special procedures room. Many of these multiple functions in the same room cannot be performed at the same time.

Table 4.11-6
Health Care Facilities

	Total Nonindigenous Population	Outpatient Visits per Year[1]	Inpatient Days per Year[1]
Existing (1992)	2,995	18,000	55
No-Action Alternative (1994)	3,250	19,533	60
Low Level of Activity (peak)	3,825	22,988	70
Intermediate Level of Activity (peak)	4,925	29,599	90
High Level of Activity (peak)	5,400	32,454	99
Capacity of current medical facility and staffing[2]	5,000	30,050	92

[1]Outpatient visits and inpatient days for alternatives were projected using the following ratios (based on 1992 data):
1992 outpatient visits/1992 population: 6:01
1992 inpatient days/1992 population: 0:02
[2]Source: 1992 health care data and estimated capacity limits provided by Lindborg, pers. comm., 1992.

Recreational and health care facilities are considered to be adequate for the no-action population levels.

Based on the assessment of existing or planned educational, medical, and recreational facilities, no or negligible impacts are expected for the No-Action Alternative.

LOW LEVEL OF ACTIVITY

Impacts

The population under this alternative would reach 3,825, which would correspond to a school population of approximately 656, an increase of 92 students compared with the No-Action Alternative. Recent communication with the school staff at USAKA indicates that the existing facilities could easily absorb this increase (Pera, personal communication, 1992). If a 50/50 split is assumed between the elementary (K-6) and the high school (7-12), then the two elementary schools together and the high school would need to absorb only 46 students each. This represents an average increase of 6.5 students per class in the elementary school and 7.6 students per class for the high school. Because the average student/teacher ratio for the entire school system is only 11:1, the addition of students may not require the addition of faculty to the school staff, although the number of teachers and the grades affected would depend on the eventual distribution of students among grades. The impact of this alternative on the education system is nonsignificant.

The population of 3,825 in this alternative is slightly higher than the population of 3,600 projected to be served in the short-term in the 1988 *Master Plan Report* (USAEDPO, 1988b). Additional recreation facilities recommended in that report for the short term included expanded indoor recreational facilities, two each volleyball, tennis, and basketball courts, up to six additional handball courts, and two softball fields. The increase in population in this alternative could be considered a significant impact.

As part of this alternative, the existing hospital building would be expanded by 11,440 square feet (1,063 square meters). The addition would provide six physician offices, a nurse station, six examination rooms, a triage room, a trauma room, a treatment room, and a special procedures room. The renovation would relocate the industrial hygiene and physical examination sections into the existing hospital from the two converted house trailers in which they are now located. The project will increase the quality of USAKA's medical facilities and correct the deficiencies identified above (No Action).

Mitigation

The improvements to recreational facilities identified in the 1988 *Master Plan Report* as necessary to serve a population of approximately 3,600 should be initiated. Some additional improvements to facilities beyond those identified in the 1988 *Master Plan*

Report for short-term population levels may be needed to serve this alternative's peak population of 3,825.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

In this alternative, the nonindigenous population would increase to 4,925.

There would be no change in the number of family members or school age children in this alternative beyond the increase identified in the Low Level-of-Activity Alternative, and therefore, there would be no additional impact beyond the nonsignificant impact identified in that alternative.

This alternative's peak-year population of 4,925 would be close to the threshold of 5,000 cited in the 1988 *Master Plan Report* as requiring long-term recreational improvements. According to the established levels of significance, there would be a significant impact to recreation facilities under this alternative.

The increase in population in this alternative would be within but close to the capacity limits of the renovated health care facilities and should cause a nonsignificant impact.

Mitigation

Additional recreational facilities would be needed to meet the requirements of the predicted peak population for this alternative, as described for the Low Level-of-Activity Alternative.

HIGH LEVEL OF ACTIVITY

Impacts

The 1996 peak-year population of 5,400 would be above the threshold for long-term recreational improvement requirements described in the 1988 *Master Plan Report*. According to the established levels of significance, there would be a significant impact to recreational facilities under this alternative.

There would be no change in the number of family members or school age children in this alternative beyond the increase identified in the Low Level-of-Activity Alternative and, therefore, there would be no additional impact beyond the nonsignificant impact identified in that alternative.

The peak-year population levels of this alternative would exceed the capacity of the renovated USAKA health facilities, which the current health care staff state to be adequate to serve a population of 5,000. There could be a significant impact to health care facilities under this alternative.

Mitigation

Additional recreational facilities may be required beyond those identified as long-term needs in the 1988 *Master Plan Report*. In addition to the improvements described for the Low and Intermediate Levels of Activity, in the long-term, an additional pool and the repair or replacement of existing pools may be required, along with the addition of a new all-purpose recreation building on Kwajalein, as recommended for the long-term in the *Master Plan Report*.

According to current medical staff at USAKA, additional medical staff including two RNs, two nurse assistants, and possibly one physician should be added at the hospital on Kwajalein if the population of the island exceeds 5,000 people, as would occur in this alternative (Lindborg, pers. comm., 1992). This, in turn, would require additional space for offices, examining rooms, and other areas, to support the staff and population increases (Cross, pers. comm., 1992). The precise mix of additional medical staff and/or facilities should be further evaluated through a detailed programming study if such significant increases in population do occur.

4.12 Transportation

4.12.1 Air Transportation

Level-of-Activity Alternatives

Air transportation is an essential component of the infrastructure necessary for the mission of USAKA; it carries materials and people of USAKA between islands and to the mainland. The alternatives potentially affect the number of mainland flights, number of interisland trips, and airspace safety. Impacts of aircraft emissions on air quality and noise standards are addressed in Sections 4.4 and 4.5, respectively.

Levels of Significance

There would be increases in air traffic at Bucholz Airfield on Kwajalein as an indirect result of increased launch activity. The airfield capacity is established by the Federal Aviation Administration (FAA) based on the size and configuration of the runway, the aircraft that use the field, runway instrumentation, and airspace limitations. Different capacity limits are established for instrument and visual arrivals/departures. Levels of significance for impacts of alternatives on air transportation resources are defined in terms of the *FAA 1992 Air Traffic Control Capacity for Bucholz Airfield*. There are no proposed USAKA Environmental Standards and Procedures that apply to air transportation resources.

- **No or Negligible Impact.** There would be no changes in the number of arrivals and departures of aircraft from Bucholz Airfield.

- **Nonsignificant Impact.** Impacts are nonsignificant if the number of arrivals or departures is less than 50 percent of the maximum instrument flight rule (IFR) operations allowed by the *FAA 1992 Air Traffic Control Capacity for Bucholz Airfield* (Table 4.12-1). Fifty percent is selected to provide a substantial safety margin from the FAA-established capacity limits.

- **Significant Impact.** Impacts are significant if the number of arrivals or departures is more than 50 percent of the maximum allowed by the *FAA 1992 Air Traffic Control Capacity for Bucholz Airfield* (Table 4.12-1).

NO ACTION

Impacts

Under the No-Action Alternative, air transportation operations would continue as described in Chapter 3 with passenger connections to and from USAKA, routine round-trip flights to Roi-Namur from Kwajalein, and helicopter service.

Table 4.12-1
Federal Aviation Administration Air Traffic Control
Capacity for Bucholz Airfield, Kwajalein, July 1992

Flight Rule	Arrivals Per Hour, Priority Over Departures	Departures Per Hour, No Arrivals	Departures Per Hour, With Arrivals
Instrument Flight Rule (IFR)	20	25	20
Visual Flight Rule (VFR)	30	40	30

Source: FAA, 1992.

The increased numbers of passengers traveling to and from USAKA via the Bucholz Army Airfield is expected to be about 3 percent higher than the existing conditions described in Chapter 3. This estimate and similar estimates made for the other alternatives are based on 1.3 round-trips per year (for destinations beyond the atoll) for operations employees and their family members, one round-trip every 2 months for construction workers, and an average visitor stay of 2 weeks during the month-long peak launch period (Eady, pers. comm., 1992). Existing ground support equipment and staff are sufficient to provide service for the frequency of flights expected during peak launch periods in the No-Action Alternative.

Table 4.12-2 summarizes air transportation activity for the No-Action, Low, Intermediate, and High Level-of-Activity alternatives. Aircraft requirements and passenger loads for interisland flights by fixed-wing aircraft and helicopters are based on peak-year resident and daily populations (Tables 2.2-8 and 2.2-9) and on aircraft capacities.

LOW LEVEL OF ACTIVITY

Impacts

The Low Level-of-Activity Alternative would require that one DeHaviland-7 aircraft be added to make one round trip twice a week from USAKA to Wake Island to support testing at that island. This would require that the DeHaviland-7 fleet be increased from four to five to ensure backup for both the Wake Island and Roi-Namur flights. The existing DeHaviland-7 service to Roi-Namur is sufficient.

Table 4.12-2 shows that fixed-wing landing and takeoff activity would increase by 3 percent while helicopter landing and takeoff activity would remain the same, as compared with the No-Action levels. The additional passenger load served by Bucholz Airfield is estimated to be about 1 percent higher than the No-Action Alternative level.

Table 4.12-2
USAKA Air Transportation Operations for Peak Periods
in Four Alternative Levels of Activity: Takeoffs and Landings per Month

Carrier	Aircraft Type	No Action	Low Level	Intermediate Level	High Level
Air Mobility Command	C-141	32	32	32	41
Continental/Air Micronesia	B-727	35	35	35	35
Airline of the Marshall Islands		77	77	77	77
USAKA aircraft	DeHaviland-7 UH-1H	313 210	330 210	503 240	503 350
AST support	B-767	43	43	43	43
Other[1]	Various[2]	13	13	13	13
Total fixed wing		513	530	703	712
Total helicopter		210	210	240	350

[1]Other refers to transient aircraft from the U.S. government and Australia.
[2]Various refers to the following aircraft types: C-130; C-12; DO-228; HS748; DC-8; G-II; B-727; P-3; C-139; and B-767.
Source: Baseline figures from JCWSI, 1992b.

Assuming that all USAKA aircraft trips to transport personnel to other USAKA islands (i.e., the 540 monthly trips of DeHaviland-7 airplanes and UH-1H helicopters shown in Table 4.12-2)) were scheduled into a single hour-and-a-half period each morning and evening, under the Low Level-of-Activity Alternative the peak hourly number of arrivals and departures would be approximately six. This is well under 50 percent of the IFR hourly capacity of 20 flights per hour, and is therefore a nonsignificant impact. It is assumed that flights to and from destinations outside Kwajalein Atoll could be scheduled around peak morning and evening "commuter hours" if necessary to avoid air traffic congestion.

Mitigation

Mitigation is not required because significant impacts to air transportation are not expected under the Low Level-of-Activity Alternative.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

The Intermediate Level of Activity would require that the DeHaviland-7 fleet handle increased numbers of passengers commuting daily to Roi-Namur from Kwajalein Island. This would require that two aircraft make a total of 12 round-trip flights per day, an increase of four round trips per day over the No-Action Alternative. However, this increased activity does not require any additions to the DeHaviland-7 fleet beyond those assumed for the No-Action levels.

The increased demand for helicopter service would require that one helicopter and one crew be added to the No-Action level of five helicopters and four crews. Airfield facilities on all islands are adequate to handle the increased activity.

Table 4.12-2 shows that fixed-wing aircraft activity increases by 37 percent and helicopter activity increases by 14 percent when compared with the No-Action Alternative. Moreover, the additional passenger load served by Bucholz Airfield is estimated to be 13 percent higher than the No-Action levels. This additional demand for seats can be accommodated by existing facilities and staff. The additional passenger load would put Air Mobility Command (AMC) at full capacity and result in more passengers being carried by Continental/Air Micronesia (CAM) and Airline of the Marshall Islands (AMI) and less schedule flexibility for travelers.

Assuming that all USAKA aircraft trips to transport personnel to other USAKA islands (i.e., the 743 monthly trips of DeHaviland-7 airplanes and UH-1H helicopters shown in Table 4.12-2) were scheduled into a single hour-and-a-half period each morning and evening, under the Intermediate Level-of-Activity Alternative the peak hourly number of arrivals and departures would be approximately 8.2. This is below 50 percent of the IFR hourly capacity of 20 flights per hour, and is therefore a non-significant impact.

Mitigation

Mitigation is not required because significant impacts to air transportation are not expected under the Intermediate Level-of-Activity Alternative.

HIGH LEVEL OF ACTIVITY

Impacts

The increased demand for helicopter service between the USAKA islands will result in the need for increasing the No-Action fleet of five helicopters and four crews to a total fleet of seven helicopters and six crews in this alternative. Airfield facilities on all islands are adequate to handle the increased activity.

Table 4.12-2 shows that fixed-wing aircraft activity increases by 39 percent while helicopter activity increases by 67 percent when compared with the No-Action Alternative levels. The passenger load served by Bucholz Airfield in this alternative is estimated to be about 25 percent higher than the No-Action levels. According to USAKA personnel, this additional demand for seats would require one additional flight inbound to USAKA and one outbound to be scheduled each week by one of the carriers. Most of the increased passenger demand would be mission-related; therefore, it is anticipated that AMC would add the necessary flights to its schedule. The Bucholz Army Airfield facility can accommodate this increased air traffic.

Assuming that all USAKA aircraft trips to transport personnel to other USAKA islands (i.e., the 853 monthly trips of DeHaviland-7 airplanes and UH-1H helicopters shown in Table 4.12-2) were scheduled into a single hour-and-a-half period each morning and evening, under the High Level-of-Activity Alternative the peak hourly number of arrivals and departures would be approximately 9.4. This is below 50 percent of the IFR hourly capacity of 20 flights per hour, and is therefore a non-significant impact.

Mitigation

Mitigation is not required because significant impacts to air transportation are not expected under the High Level-of-Activity Alternative.

4.12.2 Ground Transportation

Level-of-Activity Alternatives

The level-of-activity alternatives potentially could affect the condition of the roadways, the level of service, the number of vehicles, the number of bus and shuttle trips, and the amount of bicycle and pedestrian travel at USAKA. Impacts of motor vehicle emissions on air quality and noise standards are addressed in Sections 4.4 and 4.5, respectively.

Levels of Significance

- **No or Negligible Impact.** No increase in traffic on roadways. No increase in the inventory of vehicles or the distances traveled by vehicles over the No-Action levels.

- **Nonsignificant Impact.** Increase in traffic volume up to the capacity of existing roadways. Increase in the number or operation of vehicles of no more than 50 percent. This percentage was selected to indicate a sizable increase.

- **Significant Impact.** Increase in traffic volume on the roadways beyond the capacity of the roads and/or increase in the inventory of vehicles by more than 50 percent.

There are no proposed USAKA Environmental Standards and Procedures that apply to ground transportation resources.

NO ACTION

Impacts

Ground transportation impacts are discussed for Kwajalein and Roi-Namur only, because these two islands have the majority of vehicles; this would be true for all alternatives.

Projections of vehicle requirements and the miles traveled in the four alternatives are proportional to the increase in persons using the vehicles. Ambulances and buses would increase in proportion to the numbers of persons living and working at Kwajalein and Roi-Namur islands. Light- and medium-weight trucks are assumed to increase over No-Action levels at half the rate of increase in nonindigenous workers, visitors, and Marshallese; scooter distance traveled is assumed to increase at the same rate as the increase in nonindigenous workers, visitors, and Marshallese. The slower increase in truck distance traveled is assumed to account for the shift to scooter use and more combined-purpose trips at higher fleet usage. For the purpose of estimating impacts, it is assumed that about 83 percent of the vehicles are located on Kwajalein and the remainder on Roi-Namur (see 1989 DEIS, Section 4.11, pages 4-60 to 4-62).

Electric scooters and bicycles are assumed to have negligible or nonsignificant impacts on ground transportation. The distance traveled by each type of vehicle is assumed to be constant per vehicle.

An estimate of the numbers of vehicles and the total distance traveled by each type of vehicle for the peak period in the No-Action Alternative is shown in Table 4.12-3. There would be no changes in the numbers of vehicles or the distance traveled over the reported levels in Chapter 3. However, 45 small trucks (<8,500 pounds [3,856 kilograms] gross vehicle weight [GVW]) have been replaced by 45 scooters. No or negligible impacts to ground transportation are expected because traffic and vehicle increases are not predicted in the No-Action Alternative.

LOW LEVEL OF ACTIVITY

Impacts

There would be some increases over the No-Action Alternative in the number of vehicles needed to support the Low Level-of-Activity Alternative, as shown in Table 4.12-3. Overall, there is projected to be a 7 percent increase (25 vehicles) in the number of vehicles and the distance traveled over the No-Action Alternative; 21 of the additional vehicles would be on Kwajalein and 4 on Roi-Namur.

The 10 buses listed in the No-Action Alternative are fully utilized at their maximum passenger capacity. The Low Level-of-Activity Alternative would require an additional bus to accommodate the resulting increase in demand.

Because the increased number of vehicles is less than 50 percent of the No-Action Alternative, the Low Level of Activity will have a nonsignificant impact on the ground transportation infrastructure of Kwajalein and Roi-Namur.

Mitigation

Mitigation is not required because significant impacts to ground transportation are not expected under the Low Level-of-Activity Alternative.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

Overall, an increase of 31 percent (105 vehicles) is projected over the No-Action Alternative; 87 of the additional vehicles would be on Kwajalein Island, 18 on Roi-Namur (Table 4.12-3). If scooters are excluded from the total because of their nonsignificant impact on traffic compared with trucks and buses, there would be a 27 percent increase in the number of vehicles and miles traveled. The 27 percent increase is within the 50 percent standard and represents a nonsignificant impact.

Mitigation

Mitigation is not required because significant impacts to ground transportation are not expected under the Intermediate Level-of-Activity Alternative.

Table 4.12-3
Projected USAKA Vehicle Inventory and Mileage for Four Alternatives

	No-Action Alternative			*Low Level Alternative*			*Intermediate Level Alternative*			*High Level Alternative*		
Vehicle Type	Average In-use Vehicle Inventory	Miles Operated (projected)	Kilometers Operated (projected)	Average In-use Vehicle Inventory[a]	Miles Operated (projected)	Kilometers Operated (projected)	Average In-use Vehicle Inventory[b]	Miles Operated (projected)	Kilometers Operated (projected)	Average In-use Vehicle Inventory[c]	Miles Operated (projected)	Kilometers Operated (projected)
Ambulances	4	7,400	11,909	4	8,400	13,518	6	10,600	17,059	6	11,300	18,185
Buses	10	83,800	134,859	12	95,600	153,849	14	119,600	192,472	15	127,800	205,669
Scooters	45	305,244	491,229	51	345,800	556,496	70	476,900	767,475	75	509,400	819,777
Trucks (<8,500 lbs; 3,864 kg GVW)	223	1,512,656	2,434,317	237	1,613,200	2,596,123	286	1,938,000	3,118,823	298	2,018,400	3,248,211
Trucks (>8,500 <24,000 lbs; >3,864 <10,909 kg GVW)	39	293,600	472,491	42	313,100	503,872	50	376,200	605,419	52	391,800	630,524
Trucks (>24,000 lbs; >10,909 kg GVW)	16	127,200	204,703	16	127,200	204,703	16	127,200	204,703	16	127,200	204,703
Total all vehicles	337	2,329,900	3,749,508	362	2,503,300	4,028,561	442	3,048,500	4,905,951	462	3,185,900	5,127,069

[a] Two ambulances would be on Kwajalein, one each on Roi-Namur and Meck; four work buses and five shuttle buses would be on Kwajalein; three work buses would be on Roi-Namur.
[b] Four ambulances would be assigned to Kwajalein, one each to Roi-Namur and Meck; five work buses and six shuttle buses would be on Kwajalein; three work buses would be on Roi-Namur.
[c] Four ambulances would be assigned to Kwajalein, one each to Roi-Namur and Meck; five work buses and six shuttle buses would be on Kwajalein; three work buses would be on Roi-Namur.

HIGH LEVEL OF ACTIVITY

Impacts

Overall, a 37 percent increase (125 vehicles) is projected over the No-Action Alternative; 104 of the additional vehicles would be on Kwajalein Island, 21 would be on Roi-Namur Island. If the scooters are excluded from the total because of their nonsignificant impact on traffic, there would be a 32 percent increase in the number of vehicles and miles traveled. The 32 percent increase is within the 50 percent standard and represents a nonsignificant impact.

Mitigation

Mitigation is not required because significant impacts to ground transportation are not expected under the High Level-of-Activity Alternative.

4.12.3 Marine Transportation

Level-of-Activity Alternatives

The alternatives affect the number of passenger ferry routes between Kwajalein and other islands, the frequency of cargo, water, and fuel trips, the size of the fleet, and the facilities required to support the marine vessels. The impacts to marine biological resources caused by increases in marine transportation are addressed in Section 4.7. Impacts of marine vessel emissions on air quality and noise standards are addressed in Sections 4.4 and 4.5, respectively.

Levels of Significance

- **No or Negligible Impact.** There would be no increase or decrease in the inventory of vessels or the operation of vessels.

- **Nonsignificant Impact.** The inventory of vessels or the operations of vessels would increase or decrease up to 50 percent. This threshold is selected to indicate a sizable increase in activity.

- **Significant Impact.** Impacts are significant if there would be an increase or decrease in the inventory of vessels or the operations of the vessels by more than 50 percent.

There are no proposed USAKA Environmental Standards and Procedures that apply to marine transportation resources.

NO ACTION

Impacts

Ferry service between Ebeye and Kwajalein to carry Marshallese workers to places of employment on Kwajalein would have to increase over the baseline conditions described in Chapter 3. The increased demand for ferry service would require that another LCM-8 craft and crew be added to the USAKA fleet.

Staff and operation budget cuts that are projected for the No-Action Alternative would result in a decreased capacity of staff to respond to peak demands and to maintain the base-level fleet in operating condition. The T-600 Spartan personnel boat would also be retired from the fleet, reducing the flexibility of marine operations to respond to unscheduled demands and to provide backup to regularly scheduled ferry service. The lack of a dry dock prevents marine operations from performing standard maintenance on larger vessels and removes a barge from service when it is used as a makeshift drydock for maintenance on smaller craft. However, a dry dock is currently under construction and is scheduled for completion by September 1994.

Under the No-Action Alternative, the fleet would add one LCM and retire the T-600 Spartan, resulting in a remaining total of 17 craft and no net change to the total number of craft described in Chapter 3.

Table 4.12-4 summarizes the projected USAKA fleet size for each of the four alternatives. Passenger fleet requirements and passenger loads for interisland trips are based on resident and daily populations (see Tables 2.2-8 and 2.2-9) and on passenger boat capacities.

Table 4.12-4
Projected USAKA Marine Fleet For Four Alternatives

Vessel	Number of Vessels by Alternative			
	No Action	Low Level	Intermediate Level	High Level
Harbor tugs	2	2	2	2
LCU, 1466 class	1	0	0	0
LCU, 2000 class	1	2	3	3
Catamaran ferry	2	2	2	2
Conventional hull ferry*	0	0	2	2
LCM	6	6	6	6
Barges	3	3	3	3
Speed boats (security)	2	2	2	2
Total fleet	17	17	20	20

*Capacity of ferry would have to be 215 for the Intermediate Level-of-Activity Alternative and 250 for the High Level-of-Activity Alternative.

LOW LEVEL OF ACTIVITY

Impacts

The Low Level of Activity would result in an increase of 60 workers on Meck Island during peak activity. These additional workers would be transported from their residences on Kwajalein to Meck on the Meck Island catamaran service with no change in fleet, crew, or schedule.

Table 4.12-5 summarizes the USAKA marine fleet operational hours estimated for the four alternatives.

Table 4.12-5
Projected[1] USAKA Marine Fleet Operational Hours
During Peak Periods for the Four Alternatives

Type of Marine Transport	No Action	Low Level	Intermediate Level	High Level
Ferry, running time	613	613	676	737
Ferry, standby time	433	433	477	520
Cargo, running time	250	261	290	299
Cargo, standby time	90	94	104	107
Other, running time	70	73	121	128
Other, standby time	30	31	52	55
Total hours per month	1,486	1,505	1,720	1,846

[1]Projections based on Monthly Activity Report, Kwajalein Support Project (JCWSI, 1992b).

The 1466 class LCU, used for cargo shipments from Kwajalein and other islands, would be retired and its cargo would be hauled by the larger 2000 class LCU. Harbors at Legan, Illeginni, and Ennylabegan islands would have to be expanded to accommodate the larger vessel. The impact on marine biological resources that would be created by this expansion is addressed in Section 4.7. Elimination of the 1466 class LCUs would diminish the flexibility of marine services to respond to small load and off-schedule cargo shipment demands.

Increased demand for deliveries of supplies, equipment, water, and fuel from Kwajalein to the other islands would be met with more frequent deliveries by the fleet. Peak conditions may require that vessels be used extra hours and that additional crews be trained.

Because the total fleet size available to accommodate the Low Level-of-Activity Alternative is identical to that of the No-Action Alternative (see Table 4.12-4), the impacts would be negligible.

It is estimated that the fleet would operate for 1 percent more hours during the Low Level-of-Activity Alternative than during the No-Action Alternative. The increase is a result of cargo and other nonpassenger fleet use (see Table 4.12-5). Because the increase in marine fleet operating hours is less than 50 percent, the impacts are nonsignificant.

Mitigation

Mitigation is not necessary because significant impacts to marine transportation are not expected under the Low Level-of-Activity Alternative.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

New mission activity on Illeginni Island would require a new ferry route to carry workers between Kwajalein and Illeginni. The increased demand for ferry service would result in the need for adding two conventional hull ships capable of accommodating 215 passengers at a speed of 20 knots (37 kilometers per hour [km/hr]), with additional crews for each. One of these ships would be used for regular service and the other for backup. Piers at Illeginni would have to be modified to accommodate the passenger service, and the harbor at Illeginni Island would have to be dredged to accommodate the conventional hull passenger ship.

Sufficient capacity exists to ferry workers from Kwajalein to Meck for activities associated with extension of that island.

The increased demand for cargo service to deliver supplies and equipment needed for new mission activity on Illeginni, Legan, and Ennugarret would require that an LCU 2000 class vessel be added to the USAKA fleet.

Increased demand for deliveries of water and fuel from Kwajalein to the other islands would be met through more frequent deliveries by the existing fleet and adding ship and maintenance crews to staff the increased demand and delivery schedule.

Tables 4.12-4 and 4.12-5 show that both the fleet size and operational hours associated with the Intermediate Level of Activity would increase by 18 percent and 16 percent, respectively, over the No-Action Alternative. Because these increases would be less than 50 percent, the impacts of the Intermediate Level of Activity are considered nonsignificant.

Mitigation

Mitigation would not be necessary because significant impacts to marine transportation are not expected under the Intermediate Level of Activity.

HIGH LEVEL OF ACTIVITY

Impacts

It is estimated that up to 70 workers residing on Kwajalein would have to travel to Omelek and another 75 from Kwajalein to Eniwetak every day during peak periods under the High Level-of-Activity Alternative. These workers would be transported to Omelek by extending the catamaran ferry route from Meck to Eniwetak and Omelek islands. Ferry service to Omelek and Eniwetak would require that an additional morning and evening trip be added to the Meck Island catamaran schedule. Also, dredging of the Omelek and Eniwetak harbors would be required.

Mission activity on Legan Island would require that the Illeginni ferry carry an estimated 35 workers between Kwajalein and Legan. This would require that the two conventional hull ferries added in the Intermediate Level-of-Activity Alternative be capable of accommodating 250 passengers at a speed of 20 knots per hour (37 km/hr). One of the ferries would serve the peak demand of two round trips per day for the Illeginni route. A second ferry with the same specifications would be needed as a backup to the Illeginni Ferry and could also serve as backup to the Meck Island catamaran route. The pier at Legan Island would have to be modified to accommodate the ferry. The conventional hull ferries are the same type as those specified in the Intermediate Level-of-Activity Alternative, except they would be a larger version to carry approximately 35 more passengers.

Peak estimates indicate that about 1,120 Marshallese would be traveling to Kwajalein every day. This service demand could be accommodated with the existing fleet by adding more trips to the schedule of one LCM-8 craft.

Increased demand for deliveries of water and fuel from Kwajalein to the other islands would be met through more frequent deliveries by the existing fleet and adding additional ship and maintenance crews to staff the extension of schedule.

The High Level-of-Activity Alternative would require an 18 percent fleet size increase over the No-Action Alternative levels (see Table 4.12-4). Because the threshold level of 50 percent would not be exceeded, this impact would be nonsignificant.

Fleet operational hours for the High Level of Activity show a 24 percent increase beyond the No-Action level (see Table 4.12-5). The increase would result from the Illeginni/Legan ferry service, the increase in ferry service to Meck and nearby islands, and an increase in cargo and other nonpassenger fleet use. Because the 50 percent threshold would not be exceeded, this impact is nonsignificant.

Mitigation

Mitigation would not be necessary because significant impacts to marine transportation are not expected under the High Level-of-Activity Alternative.

4.12.4 Proposed USAKA Environmental Standards and Proced

There are no proposed USAKA Environmental Standards and Procedures that address transportation. Impacts of air emissions from USAKA aircraft, ground vehicles, and marine fleet on air quality standards are addressed in Section 4.4.

4.13 Utilities

4.13.1 Water Supply

4.13.1.1 Level-of-Activity Alternatives

USAKA's water supply has the potential to be affected by increased demand th could stress the capacity of the system, which could lead to water quality or qua problems. Further, increased levels of test activities could increase the risk of contaminant releases to the water supply. This section addresses potential impa water supply and treated water quality.

Levels of Significance–Existing U.S. Statutes and Regulations

The environmental significance of impacts to the water supply facilities is meas terms of:

- Effects on human health and safety that are associated with the availabil use of freshwater
- Compliance with the provisions of the Safe Drinking Water Act (SDWA

Primary quantitative criteria for evaluation include turbidity (as reported in turl units), pH, bacteriological quality, and MCLs for various inorganic and organic compounds as regulated under the requirements of the SDWA.

The impact of increased demand is measured by the ability of the water suppl system to provide water of suitable quality and quantity for consumption and u the system users. The following levels of significance are defined for evaluatin alternative actions:

- **No or Negligible Impact.** Demand for water would allow for the continued use of water within the capacity of the existing systems (groundwater and catchments) without development of additional source of supply.

- **Nonsignificant Impact.** Increased demand would be small relative to the No-Action Alternative, but some minor shortfalls in capacity would occur. Drinking water quality is within health-based standards.

- **Significant Impact.** Substantial supply impacts and shortfalls in supply would exist, particularly during abnormally dry or drought conditions. Drinking water quality does not meet requirements of health-based standards.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

The levels of significance defined above for the existing U.S. statutes and regulations apply to the proposed USAKA Standards; however, the proposed USAKA Standards differ slightly in their definition of drinking water quality standards, as described below (Subsection 4.13.1.2, Proposed USAKA Environmental Standards and Procedures).

NO ACTION

Chapter 3, Subsection 3.13.1 describes the existing water supply conditions at USAKA. Table 4.13-1 summarizes the average population served from 1989 through 1991 and the projected peak population in 1994 for the No-Action Alternative. On two of the islands (Kwajalein and Roi-Namur), the day-use population includes residents in addition to transient workers. The other islands have no residents, thus the daily populations are made up of workers who commute from Kwajalein and Roi-Namur.

Table 4.13-1
No-Action Alternative Summary of Population

Island	Existing 1989-1991 Day-Use Population	Peak Population No-Action Alternative
Kwajalein	2,600	2,950
Roi-Namur	300	300
Meck	---	125
Omelek	2	2
Ennylabegan	2*	2*
Illeginni	2	2

*Forty Marshallese residents are also served.
Source: JCWSI Monthly Utilities Reports and Anderson, pers. comm., 1992.

supply needs are met even in drought conditions, so that there should be no or negligible impacts from the No-Action Alternative.

Water quality data for the fourth quarter 1991 and first quarter 1992 indicated an increase of TTHMs to values greater than the 100 μg/L MCL. The installation of the desalination plant and covering the raw water storage tanks (part of the No-Action Alternative) should help prevent the recurrence of elevated TTHMs in drinking water. However, if elevated TTHM levels continue to be measured, other methods to control TTHM formation exist, including alternative application points for disinfectants, alternative disinfectants (such as combined chlorine residual or ozone), and the use of organics removal processes (power activated carbon or granular activated carbon). For these reasons, elevated TTHMs are not expected to lead to significant long-term degradation of water quality.

OTHER ISLANDS

Personnel traveling to islands without developed potable water supplies would continue to carry water with them. It is expected that health-based standards would be met and that freshwater use would not increase under this alternative, resulting in no or negligible impacts.

Roi-Namur, Meck, and Ennylabegan showed increases in the TTHM values reported for samples taken from their distribution systems. Roi-Namur and Meck values were below the standard but Ennylabegan exceeded the standard of 100 μg/L.

The elevated TTHM levels appear to have been the result of the prolonged dry spell at Kwajalein during 1991-92. It is not expected that elevated TTHMs will continue to be measured at Roi-Namur, Meck, or Ennylabegan; however, if elevated TTHMs are observed, the alternative treatment methods identified above for Kwajalein can be implemented. For this reason, elevated TTHM levels are not expected to cause a long-term significant degradation of water quality.

Roi-Namur, Meck, and Ennylabegan all exceeded the lead action level for the 90th percentile during the 1991 sampling, but were within the standards for copper. Users have been notified, and water quality measurements are being monitored to determine whether the high lead levels are an anomaly. If water quality sampling continues to show elevated lead levels, additional corrective actions will be identified. Options include the adjustment of pH/alkalinity, water stabilization, the addition of corrosion inhibitors, or some combination of these actions.

LOW LEVEL OF ACTIVITY

Table 4.13-2 summarizes the projected peak population (in 1996) for the Low Level-of-Activity Alternative and the increase in demand for potable water.

Table 4.13-2 Low Level-of-Activity Alternative Summary of Population and Freshwater Demand		
Island	Peak Population	Increase in Demand Above No Action (gpd)
Kwajalein	3,475	57,750
Roi-Namur	350	5,500
Meck	185	3,900
Omelek	2	---
Ennylabegan	2*	---
Illeginni	2	---

*Forty Marshallese residents are also served.
Source: JCWSI Monthly Utilities Reports and Anderson, personal communication, 1992.

Impacts–Existing U.S. Statutes and Regulations

The Low Level-of-Activity Alternative would increase the demand for potable water.

KWAJALEIN

The increase in demand (based on a per capita consumption rate of 110 gpcd [416 Lpcd]) would be 57,750 gpd (218,601 Lpd) more than in the No-Action Alternative. The total demand under this alternative would be 382,250 gpd (1,446,931 Lpd), a value well within the available supply during normal rainfall conditions. This demand could be marginally met during drought conditions when the programmed desalination plant now under construction is placed in service (scheduled for FY94). If drought conditions were more severe than those experienced in 1984-1985, some shortfall of potable water could be expected. Conservation measures may reduce demand on the system. The addition of the desalination facility should reduce the likelihood of conditions that could lead to the elevated TTHM levels measured in late 1991 and early 1992. Nonsignificant impacts are anticipated.

ROI-NAMUR

Based on a per capita demand of 65 gpcd (246 Lpcd), the increase in demand for the Low Level-of-Activity Alternative would be 5,500 gpm (20,819 Lpd) more than the No-Action Alternative. Total daily pumping capacity at Roi-Namur is 65,000 gpd (246,045 Lpd). Total demand under this alternative is 38,500 gpd (145,734 Lpd). Assuming seasonal, or short-term, pumpage from the lens wells in the 40,000- to 50,000-gpd (151,412- to 189,265-Lpd) range, an adequate supply of water is expected even during drought conditions at Roi-Namur. Nonsignificant impacts on water quality are anticipated.

MECK

The increase in potable water use on Meck would be 3,900 gpd (14,763 Lpd) above the No-Action Alternative. Total demand under this alternative is projected to be 12,025 gpd (45,518 Lpd). Catchment water is stored for use following treatment on Meck. The supply of water on Meck is adequate during normal rainfall and is supplemented during periods of drought by water transported from Kwajalein; therefore, nonsignificant impacts are anticipated.

OTHER ISLANDS

Impacts to the remaining islands are expected to be minimal. Personnel going to islands without developed potable water supplies would continue to carry water with them. Nonsignificant impacts are anticipated.

Mitigation–Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts–Proposed USAKA Environmental Standards and Procedures

Impacts would be evaluated the same as under existing U.S. statutes and regulations.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Because no significant impacts are identified, no mitigation is required.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Table 4.13-3 summarizes the projected peak population (in 1996) for the Intermediate Level of Activity and the increase in demand for potable water exceeding the No-Action Alternative.

Impacts–Existing U.S. Statutes and Regulations

The Intermediate Level-of-Activity Alternative would increase the demand for potable water.

KWAJALEIN

The increase in demand would be 173,250 gpd (655,803 Lpd) more than the No-Action Alternative, at a consumption rate of 110 gpcd (416 Lpcd). The total demand under this alternative would be 497,750 gpd (1,884,133 Lpd), a value within the available supply during normal rainfall conditions after installation of the 150,000-gpd (567,795-Lpd) desalination plant. During drought conditions and with the proposed desalination plant in service, demands up to 380,000 gpd (1,438,414 Lpd) could be met. Conservation measures or other water saving measures would be required to reduce demand on the system during severe drought conditions. Nonsignificant impacts are anticipated.

Table 4.13-3
Intermediate Level-of-Activity Alternative
Summary of Population and Freshwater Demand

Island	Peak Population	Increase in Demand Above No Action (gpd)
Kwajalein	4,525	173,250
Roi-Namur	400	11,000
Meck	185	3,900
Omelek	2	---
Ennylabegan	2*	---
Illeginni	215	13,845

*Forty Marshallese residents are also served.
Source: JCWSI Monthly Utilities Reports and Anderson, personal communication, 1992.

ROI-NAMUR

The increase in demand would be 11,000 gpm (41,638 Lpm) (65 gpcd [246 Lpcd]) for the Proposed Activity Alternative. Total daily pumping capacity at Roi-Namur is 65,000 gpd (246,045 Lpd). Total demand under this alternative would be 44,000 gpd (166,553 Lpd). Assuming seasonal, or short-term, pumpage from the lens wells in the 40,000- to 50,000-gpd (151,412- to 189,265-Lpd) range, an adequate supply of water is expected even during drought conditions at Roi-Namur. Nonsignificant impacts are anticipated.

MECK

The increase in use of potable water on Meck is 3,900 gpd (14,763 Lpd) above the No-Action Alternative, although no incremental increase in population or water demand occurs from the Low to the Intermediate Level-of-Activity alternatives. Total demand under this alternative is projected to be 12,025 gpd (45,518 Lpd). Catchment water is stored for use following treatment on Meck. Apparently the supply of water on Meck is adequate during normal rainfall and is supplemented by transportation of water from Kwajalein during periods of drought. Nonsignificant impacts on water quality are anticipated.

ILLEGINNI

The increase in use of potable water on Illeginni for the Intermediate Level-of-Activity Alternative is 13,845 gpd (52,408 Lpd). Water is currently transported from Kwajalein to Illeginni for necessary uses. This practice is expected to be discontinued with the renovation and upgrading of Illeginni's potable and nonpotable water system that are proposed in this alternative. Nonsignificant impacts are anticipated.

OTHER ISLANDS

Impacts to the remaining islands are expected to be minimal. Personnel who travel to islands without developed potable water supplies would continue to carry water with them. Nonsignificant impacts are anticipated.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts have been identified, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be the same as under existing statutes and regulations.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because no significant impacts have been identified, no mitigation is required.

HIGH LEVEL OF ACTIVITY

Table 4.13-4 summarizes the projected peak population (in 1996) for the High Level-of-Activity Alternative and the increase in demand for potable water.

Impacts—Existing U.S. Statutes and Regulations

The High Level-of-Activity Alternative would increase the demand for potable water.

KWAJALEIN

The increase in demand for the High Level of Activity would be 221,100 gpd (836,930 Lpd) above the No-Action Alternative. The total demand under this alternative would be 545,600 gpd (2,065,260 Lpd), a value within the available supply during normal rainfall conditions after installation of the 150,000-gpd (567,795-Lpd) desalination plant. During drought conditions and with the proposed desalination plant in service, demands of up to 380,000 gpd (1,438,414 Lpd) could be met. Conservation measures would be required to reduce demand on the system during severe drought conditions. Nonsignificant impacts are anticipated.

Table 4.13-4
High Level-of-Activity Alternative
Summary of Population and Freshwater Demand

Island	Peak Population	Increase in Demand Above No Action (gpd)
Kwajalein	4,960	221,100
Roi-Namur	440	15,400
Meck	185	3,900
Omelek	70	4,420
Ennylabegan	2*	---
Illeginni	215	13,845
Eniwetak	75	4,745

*Forty Marshallese residents are also served.
Source: JCWSI Monthly Utilities Reports and Anderson, pers. comm., 1992.

ROI-NAMUR

The increase in demand would be 15,400 gpm (58,294 Lpd) above the No-Action Alternative. Total daily pumping capacity at Roi-Namur is 156,000 gpd (590,507 Lpd). Total demand under this alternative would be 48,400 gpd (183,209 Lpd). Assuming seasonal, or short-term, pumpage from the lens wells in the 40,000- to 50,000-gpd (151,412- to 189,265-Lpd) range, an adequate supply of water would be expected even during drought conditions at Roi-Namur. Nonsignificant impacts are anticipated.

MECK

The increase in use of potable water on Meck above the No-Action Alternative would be 3,900 gpd (14,762 Lpd). Total demand under this High Level-of-Activity Alternative is projected to be 12,025 gpd (45,518 Lpd). Catchment water is stored for use following treatment on Meck. Apparently the supply of water on Meck is adequate during normal rainfall conditions and is supplemented by transportation of water from Kwajalein during drought conditions. Nonsignificant impacts are anticipated.

OMELEK

The increase in use of potable water on Omelek would be 4,420 gpd (16,731 Lpd) more than in the No-Action Alternative. Water is currently transported from Kwajalein to Omelek for necessary uses. Water should be transported from Meck rather than Kwajalein unless abnormal rainfall conditions warrant use of Kwajalein. Nonsignificant impacts are anticipated.

ILLEGINNI

The increase in use of potable water on Illeginni would be 13,845 gpd (52,408 Lpd) more than the No-Action Alternative. As part of the Intermediate Level-of-Activity Alternative, the water supply and treatment system on Illeginni would be reconstructed, and it would be adequate to handle the increased demand in this alternative. This practice would continue under this alternative. Nonsignificant impacts are anticipated.

ENIWETAK

The increase in use of potable water on Eniwetak would be 4,745 gpd (17,961 Lpd) more than in the No-Action Alternative. Water should be transported from Meck to Eniwetak unless abnormal rainfall conditions warrant use of Kwajalein. Nonsignificant impacts are anticipated.

OTHER ISLANDS

Impacts to the remaining islands are expected to be minimal. Personnel going to islands without developed potable water supplies would continue to carry water with them. Nonsignificant impacts are anticipated.

Mitigation–Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation would be required.

Impacts–Proposed USAKA Environmental Standards and Procedures

Impacts would be the same as under existing statutes and regulations.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Because no significant impacts are identified, no mitigation would be required.

4.13.1.2 Proposed USAKA Environmental Standards and Procedures

The proposed Standards differ slightly in the language of the requirements compared with the existing U.S. statutes and regulations:

- *Giardia lamblia* and virus removal is required to be 99.9 and 99.99 percent, respectively. This level of removal is identical to the existing U.S. statutes and regulations; however, specific guidance as to how to achieve the removal is not stipulated, but instead, a general reference to applicable U.S. EPA guidance is used.

- Lead and copper MCLs are provided, whereas existing U.S. statutes and regulations specify "action levels." MCLs are more strict than the action levels.

- More frequent monitoring of water quality is required.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

Under the No-Action Alternative, the SDWA and the 1986 Amendments to the SDWA are the applicable regulations for drinking water.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

The proposed Standards differ from existing statutes and regulations in only a few respects. Table 4.13-5 summarizes the differences between the two sets of standards for drinking water.

Table 4.13-5
Summary of USAKA and U.S. Drinking Water Standards—Principal Differences

Regulation	USAKA	U.S./Other	Difference	Comment
Filtration and disinfection	Stipulates 99.9 and 99.99 percent removal of *Giardia lamblia* and viruses. Requires that contractors and agencies consult applicable guidance documents for implementing the Standards.	Same requirements as proposed USAKA Standards. Specifies a guidance manual for chemical disinfection in conjunction with filtration.	Although USAKA Standards do not specify use of the U.S. EPA guidance manual for filtration as do the U.S. statutes and regulations, USAKA Standards require that applicable and/or appropriate U.S. EPA guidance documents be reviewed.	Similar protection. Assuming that USAKA consults the guidance manual specified by U.S. EPA, the two sets of standards are comparable.
Lead and copper	MCL established.	Action levels established.	MCLs more stringent than action levels.	USAKA Standards more stringent.
Monitoring parameters	Monitoring requirements are based on a population of 10,000.	Sampling frequency determined by actual population served.	USAKA's actual population is less than 5,000.	USAKA Standards monitoring requirements provide better level of protection.

Under the proposed Standards, monitoring parameters are based on a population size of 10,000 versus the approximately 3,000 actual population of USAKA. This means that the water supply is tested more frequently for more contaminants.

The proposed USAKA Standards require 99.9 percent removal of *Giardia lamblia* and 99.99 percent removal of viruses. This requirement parallels the U.S. federal regulations for removal of these constituents. The U.S. EPA *Guidance Manual for*

Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources provides guidelines for chemical disinfection in conjunction with specified filtration to achieve the required removals. The proposed Standards do not specify guidelines for how to meet the requirements; however, the proposed USAKA Standards require agencies and contractors at USAKA to consult appropriate guidance documents for implementing the Standards. Assuming the U.S. EPA guidance manual is used at USAKA, the two standards are similar.

The proposed USAKA Standards have incorporated MCLs for lead and copper that are similar to the action levels (i.e., under the lead and copper rule) required under the federal regulations. The lead and copper rule was developed to address introduction of lead and copper from plumbing and piping in the distribution system as well as naturally occurring lead and copper in the water supply. Specifying MCLs (as opposed to action levels) for lead and copper introduces a requirement for more rapid initiation of any corrective actions in response to elevated lead or copper levels than would be the case under existing statutes and regulations.

In addition to the protections provided in Section 3-3 (Drinking Water), Section 3-6 (Materials and Waste Management) also helps protect drinking water quality. Subsection 3-6.8 in the Materials and Waste Management section of the Standards applies facility storage requirements to hazardous materials. Such provisions as protection of storage areas from exposure to weather, segregation of incompatible materials, inspections for leaking containers, and facility siting considerations to protect the lens well system are more protective than existing U.S. statutes and regulations. Adoption and implementation of these measures have the potential for a significant beneficial impact on the USAKA environment. Differences exist between the two sets of standards, but the proposed Standards overall provide a better level of protection of human health and safety and the environment.

Mitigation

Mitigations are not required because significant impacts are not identified.

4.13.2 Wastewater Collection, Treatment, and Disposal

4.13.2.1 Level-of-Activity Alternatives

USAKA's wastewater collection, treatment, and disposal facilities could be affected by increases in workforce and population. Such increases would place demands on the wastewater system that could affect the quantity and quality of effluents and ultimately the quality of receiving waters.

Levels of Significance—Existing U.S. Statutes and Regulations

The environmental significance of wastewater collection, treatment, and disposal is measured by the effectiveness of treatment, which is demonstrated by the quality of the effluent and by its effect on receiving waters. Standards are set under the Clean Water Act in accordance with Marine Water Quality and Earthmoving Regulations of the TTPI.

The quantitative criteria used to evaluate parameters include bacterial coliform levels, biochemical oxygen demand (BOD), suspended solids (SS), pH, and discharge flows. The impact of increased plant loading is measured by the ability of the facilities to collect and treat sewage and to continue to discharge effluent within the established discharge permit parameters.

The proposed Standards do not affect the definitions for the levels of significance defined below. The following levels of significance are defined for use in evaluating alternative actions:

- **No or Negligible Impact.** Wastewater collection, treatment, and disposal would continue without degradation of plant effluent quality. Plant influent flow would not exceed design capacity of the plant.

- **Nonsignificant Impact.** Impacts to the wastewater collection, treatment, and disposal would be small, but some increase in plant discharge constituents, not exceeding discharge requirements, would occur.

- **Significant Impact.** Substantial impacts and degradation of effluent quality would occur. Maximum effluent discharge requirements would be exceeded.

Levels of Significance—Proposed USAKA Environmental Standards and Procedures

The levels of significance for the proposed Standards are the same as those for the existing U.S. statutes and regulations.

NO ACTION

Part 3, Subsection 3.13.2 describes the existing wastewater collection, treatment, and disposal conditions at USAKA. The Kwajalein wastewater treatment plant is designed to treat an average flow of 450,000 gpd (1,703,399 Lpd) and remove 85 percent of suspended solids and BOD with an influent raw wastewater containing 324 mg/L SS and 171 mg/L BOD. The plant flow was within these parameters on an average flow basis from September 1992 to August 1993. An average monthly flow of 382,000 gpd (1,446,093 Lpd) was recorded for this period (JCWSI Monthly Utilities Reports). Raw sewage averaged 149 mg/L BOD and 59 mg/L SS for this period of record. The concentration of the sewage flows is well below the design values presented above. Per capita contribution of flow to the treatment plant has averaged 148 gpcd (560 Lpcd), a value somewhat greater than normally observed at U.S. mainland facilities. Infiltration/inflow and/or leaky water closets in the saltwater toilet flushing systems may be responsible for the relatively high per capita flow. A project to replace and slipline portions of Kwajalein's wastewater lines during 1993 may help reduce per capita flows.

Performance of the plant has met treatment requirements during the period September 1992 through August 1993; effluent BOD and SS have averaged 2.5 mg/L and 2.0 mg/L, respectively, during this period. The NPDES permit that formerly applied at USAKA set limits for fecal coliform and pH for the Kwajalein wastewater treatment plant of 70 most probable number (MPN)/100 ml to 230 MPN/ml and 6.5 to 8.5 units, respectively.

The primary impact to the wastewater system from the No-Action Alternative would result from the slightly increased population at Kwajalein. Loading generated by the additional population projected to use the facilities would increase flows compared with the existing conditions.

The additional 350 persons using the facilities (assuming the 148 gpcd [560 Lpcd] sewage flow-rate) will generate an additional 51,800 gpd (196,084 Lpd) at the treatment plant. Total sewage flow would reach 437,000 gpd (1,654,220 Lpd) under this alternative, well below the plant's peak hydraulic capacity of 600,000 gpd (2,271,198 Lpd). The plant is expected to continue to perform well (i.e., will meet treatment requirements with a low risk of exceedances) for the No-Action Alternative, resulting in no or negligible impacts on effluent quality.

Roi-Namur currently discharges untreated sewage through the existing outfall to the ocean. No increase in sewage flows at Roi-Namur is anticipated under this alternative. Flow expected under the No-Action Alternative is 47,000 gpd (177,911 Lpd) (based on 100 gpcd [379 Lpcd] plus 17,000 gpd [64,351 Lpd]) infiltration flow (USAEHA, 1991d) and is expected to result in no or negligible impacts on effluent quality.

LOW LEVEL OF ACTIVITY

The Low Level-of-Activity Alternative would increase the overall requirement for collection, treatment, and disposal of wastewater as compared with the No-Action Alternative.

Impacts–Existing U.S. Statutes and Regulations

The primary impact to the wastewater system results from increased loading generated by the additional population projected to use the facilities.

KWAJALEIN

The additional population using the facilities under this alternative would generate an additional 78,000 gpd (295,260 Lpd) flow, (based on the observed 148 gpcd [560 Lpcd] waste contribution at the treatment plant) over that for the No-Action Alternative. Total sewage flow would reach 515,000 gpd (1,949,481 Lpd), well below the plant's peak hydraulic capacity of 600,000 gpd (2,271,198 Lpd). The organic capacity of the plant would continue to be adequate, assuming sewage strength similar to that recorded during the past year, resulting in a nonsignificant impact.

ROI-NAMUR

An increase in sewage flows of 5,000 gpd (18,927 Lpd) is anticipated under this alternative. Total flow would be 52,000 gpd (196,837 Lpd), including infiltration, for the Low Level-of-Activity Alternative. In this alternative, a new primary treatment plant would be built and the existing outfall would be extended into deeper water. The proposed wastewater treatment plant, with a design capacity of at least 70,000 gpd (264,973 Lpd), would result in a significant beneficial impact.

MECK

This alternative would result in an additional 3,900-gpd (14,763-Lpd) wastewater flow for the peak population compared with the No-Action Alternative. The septic tank/leachfield system should adequately handle the additional discharge to the system. Groundwater would receive nutrients associated with the wastewater. Groundwater is not used for drinking water on Meck; therefore, the increased nutrients in the groundwater should result in a nonsignificant impact.

OTHER ISLANDS

Wastewater is generated in minimal volumes in association with activities on the other islands. Composting toilets would be used on these islands.

Mitigation—Existing U.S. Statutes and Regulations

A nonsignificant impact would result from the increased flows associated with this alternative.

Impacts—USAKA Environmental Standards and Procedures

Impacts would be the same as those under existing statutes and regulations.

Mitigation—USAKA Environmental Standards and Procedures

Impacts are predicted to be identical to those presented above for the existing U.S. statutes and regulations.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

The Intermediate Level of Activity would increase the overall requirement for collection, treatment, and disposal of wastewater.

Impacts—Existing U.S. Statutes and Regulations

The primary impact to the wastewater system results from increased loading generated by the additional population projected to use the facilities.

KWAJALEIN

The additional population using the facilities under this alternative would generate an additional 233,000 gpd (881,998 Lpd) at the treatment plant compared with the No-Action Alternative. Total sewage flow would reach 670,000 gpd (2,536,218 Lpd), a level higher than the plant's peak hydraulic capacity of 600,000 gpd (2,271,198 Lpd). Organic capacity of the plant would be within the capability of the plant, assuming that sewage strength would remain similar to that recorded during the past year. However, without additional clarifier capacity and operational improvements, plant operations would become unstable, with periodic suspended solids loss through the effluent, and the other primary measurement criterion—effluent BOD—might deteriorate to below current performance levels. Some excursions outside the current discharge requirements could occur without the clarifier and operational improvements, resulting in a significant impact to water resources. With the addition of a 30-foot-diameter (9-meter-diameter) clarifier and implementation of operational changes identified in the wastewater management study (USAEHA, 1991d), 840,000 gpd (3,179,677 Lpd) may be treated.

ROI-NAMUR

An increase in sewage flows of 10,000 gpd (37,853 Lpd) would be anticipated under this alternative. Total flow would be 57,000 gpd (215,764 Lpd), including infiltration flows. The proposed wastewater treatment plant, which has a design capacity of at least 70,000 gpd (264,973 Lpd), would result in a significant beneficial impact.

MECK

This alternative would result in an additional 3,900-gpd (14,763-Lpd) wastewater flow (assuming that the increased potable water usage discussed in Subsection 4.13.1 for this alternative all enters the disposal system) for the peak population compared with the No-Action Alternative. The septic tank/leachfield system should adequately serve the additional discharge to the system. Groundwater would receive nutrients associated with the wastewater. Groundwater is not used for drinking water on Meck; therefore, the increased nutrients in the groundwater should result in a nonsignificant impact.

ILLEGINNI

Significant increased activity on Illeginni would result in an additional 12,845 gpd (48,623 Lpd) of potable water being used (at a per capita use of 65 gcpd [246 Lcpd]). The wastewater facilities at Illeginni will be upgraded. The water used would enter the reactivated disposal system; thus, the resulting wastewater flows would be 12,845 gpd (48,623 Lpd). Use of composting-type toilets may be a viable means to reduce the quantity of wastewater requiring treatment. Nonsignificant impacts are expected from this alternative.

OTHER ISLANDS

Wastewater would be generated in minimal volumes in association with activities on the other islands, resulting in no or negligible impacts. Transportation of wastewater back to Kwajalein for treatment should continue. An alternative means to reduce the quantity of wastewater that requires transportation for treatment may be the use of composting toilets.

Mitigation—Existing U.S. Statutes and Regulations

A 30-foot-diameter (9-meter-diameter) clarifier would be needed at Kwajalein to increase hydraulic capacity of the plant. Conversion of the saltwater flushing system to a nonsaltwater-based gray water system has the potential to improve the performance of the wastewater system, providing that salinity swings are moderate. Reconstruction of the collection system could reduce leakage in water closets in the saltwater toilet flushing system together could eliminate excessive wastewater flows.

Alternative housing, such as providing living quarters aboard ships that are self-contained for a portion of the increase in staff, would reduce sewage loading to the treatment system because these vessels would be permitted to discharge treated sewage into RMI waters under certain conditions (see Section 4.3 for discussion of marine vessel wastewater impacts on water resources).

Impacts—USAKA Environmental Standards and Procedures

The impacts related to increased demand are identical to those discussed above for the existing U.S. statutes and regulations.

Mitigation—USAKA Environmental Standards and Procedures

Impacts are predicted to be identical to those presented above for the existing U.S. statutes and regulations; therefore, mitigation is also the same, with the exception that providing alternative housing aboard ships for a portion of the increase in staff would not be feasible because the USAKA Standards prohibit sewage discharges from USAKA marine vessels into RMI waters.

HIGH LEVEL OF ACTIVITY

This alternative would increase the overall requirement for collection, treatment, and disposal of wastewater.

Impacts—Existing U.S. Statutes and Regulations

The primary impact to the wastewater system results from increased loading generated by the additional population projected to use the facilities.

KWAJALEIN

The additional population using the facilities under this alternative would generate an additional 298,000 gpd (1,128,049 Lpd) at the treatment plant compared with the No-Action Alternative. Total sewage flow would reach 735,000 gpd (2,782,269 Lpd). The plant would receive an organic loading of approximately 83 percent of its design capacity, and flows would exceed the peak design hydraulic capacity of 600,000 gpd (2,271,198 Lpd). With the addition of one clarifier and one blending tank, and implementation of operational changes identified in the wastewater management study (USAEHA, 1991d), the capacity of the plant could be upgraded to 1 million gpd (3,785,330 Lpd) (USAEHA, 1991d). The 30-foot-diameter (9-meter-diameter) clarifier described in the Intermediate Level-of-Activity Alternative with one additional blending tank would provide the required additional clarifier and aeration capacity to treat a 735,000-gpd (2,782,269-Lpd) flow. Plant operations would become unstable without the improvements discussed, with periodic suspended loss through the effluent, and the other primary measurement criteria—effluent BOD—might deteriorate from current performance levels. Without these improvements, the current discharge requirements could not be met, which would cause more pollutants to enter receiving waters and reduce water quality. This would cause a significant impact on water resources.

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ROI-NAMUR

An increase in sewage flows of 16,000 gpd (60,565 Lpd) would b this alternative compared with the No-Action Alternative. Total 63,000 gpd (238,476 Lpd) for this alternative. The proposed was plant, which has a design capacity of at least 70,000 gpd (264,973 capture of septic tank effluents, would result in a significant bene

MECK

This alternative would result in an additional 3,900-gpd (14,763-L for the peak population compared with the No-Action Alternativ tank/leachfield system should adequately serve the additional disc Groundwater would receive nutrients associated with the wastewa not used for drinking water on Meck; therefore, the increased nu groundwater should result in a nonsignificant impact.

ILLEGINNI

Significant increased activity on Illeginni would result in an additic 12,845 gpd (48,623 Lpd) of potable water. Existing per capita use (246 Lcpd). The wastewater facilities will be upgraded to meet th The water used will ultimately enter the reactivated disposal syste wastewater flows to 12,845 gpd (48,623 Lpd). Use of composting viable means to reduce the quantity of wastewater requiring treatr Nonsignificant impacts are anticipated from this alternative.

ENIWETAK

Significant increased activity on Eniwetak would result in 4,875 gp potable water use (at a per capita use of 65 gcpd (246 Lcpd). Ne facilities would be installed under this alternative. The water used disposal system, which would either be composting toilets or a sept composting toilets may be a viable means to reduce the quantity o requiring treatment. Sufficient capacity would be employed to trea wastes will be shipped to Kwajalein. Nonsignificant impacts are an alternative.

OTHER ISLANDS

Wastewater is and would continue to be generated in minimal volu with activities on the other islands, resulting in no or negligible imp Transportation of wastewater back to Kwajalein for treatment shou alternative means to reduce the quantity of wastewater requiring tr treatment may be the use of composting toilets.

Mitigation–Existing U.S. Statutes and Regulations

Plant modifications (i.e., the addition of a 30-foot [9-meter] clarifier to increase hydraulic capacity and the addition of one blending tank to improve aeration capacity for organics) would be needed at Kwajalein. Conversion of the saltwater flushing system to a nonsaltwater-based gray water system has the potential to improve the performance of the wastewater system, providing that salinity swings are moderate.

Alternative housing, such as providing living quarters aboard ships that are self-contained for a portion of the increase in staff, would reduce sewage loading to the treatment system because these vessels would be permitted to discharge treated sewage into RMI waters under certain conditions (see Section 4.3 for discussion of marine vessel wastewater impacts on water resources).

Impacts–USAKA Environmental Standards and Procedures

The impacts related to increased demand are identical to those discussed above for the existing U.S. statutes and regulations.

Mitigation–USAKA Environmental Standards and Procedures

It is predicted that impacts would be identical to those presented above for the existing U.S. statutes and regulations; therefore, mitigation would also be the same with the exception that providing alternative housing aboard ships for a portion of the increase in staff would not be feasible because the USAKA Standards prohibit all sewage discharges from USAKA marine vessels into RMI waters.

4.13.2.2 Proposed USAKA Environmental Standards and Procedures

The proposed Standards for water quality differ from the existing U.S. statutes and regulations in several respects, as addressed below and also in Section 4.3, Water Resources.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

Under the No-Action Alternative, the existing U.S. statutes and regulations provide environmental protection of this resource. The Clean Water Act (33 U.S.C. 1251-1376) in effect on or before December 31, 1991, is the applicable U.S. law for this resource. Requirements of the CWA are found in 40 CFR 100-140 and 400-403.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Table 4.13-6 summarizes the differences between existing statutes and regulations and the proposed Standards as they pertain to water quality management. The following

Mitigation

Because no significant impacts of the proposed Standards on water quality were identified, no mitigation is required.

4.13.3 Solid Waste

4.13.3.1 Level-of-Activity Alternatives

The level-of-activity alternatives may affect the quality of human health and the environment as a result of increased generation of municipal, construction, and operations solid waste. Media that could be affected include groundwater, surface water, soil, and air.

Levels of Significance–Existing U.S. Statutes and Regulations

- **No or Negligible Impact.** No or little increase in the probability of adverse impacts to health or to the environment.
- **Nonsignificant Impact.** An increase in the probability of adverse impacts to health or the environment, but not to the extent that the action by itself or as a cumulative impact with existing conditions violates regulatory standards.
- **Significant Impact.** An action that poses a reasonable probability of adverse effects on health or the environment, or that by itself or as a cumulative impact with existing conditions violates regulatory standards.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

The proposed Standards do not affect the definitions of significance.

NO ACTION

Municipal Solid Waste. Adequate collection and disposal capacities exist on Kwajalein and Roi-Namur for the municipal solid waste currently generated. Collection methods are simple. Disposal practices include operation of open dumps, open burning (including air curtain burn pit operations), and burial. Such practices are not consistent with U.S. EPA guidelines for management of solid waste. The continuation of these practices could cause groundwater and marine water contamination and increased potential for disease vectors and would be a significant impact.

Medical Waste. Adequate collection and disposal capacities exist for the medical waste generated on Kwajalein, Roi-Namur, and Meck. The primary disposal practice for this material is to burn it in the air curtain burn pit at Kwajalein. Because this type of incineration is not consistent with U.S. EPA guidelines for management of solid waste, its continuation would be considered to be a significant impact.

Construction Solid Waste. Adequate collection and disposal capacity now exists for construction solid waste (i.e., construction debris and asbestos) currently generated. Construction waste is typically used in three ways. Concrete is used for shoreline protection. Scrap metal is recycled, if feasible. The remainder of the waste is disposed of in the landfill. Permitted construction waste accumulation is described in USAKA's standard practice instructions (SPIs). Asbestos is now stored in Building 1521 on Kwajalein prior to shipment to the United States for disposal. Continuation of these practices is considered a nonsignificant impact.

Operations Solid Waste. Adequate collection and disposal capacity now exists for operations solid waste (i.e., scrap materials, empty containers, sandblasting grit, batteries, and waste oil and lubricants) currently generated. Scrap materials are no longer stored in piles on the USAKA islands. Spent lead-acid batteries are shipped off-island every 3 months. Waste oil is reused in the power plants or shipped with other collected waste oil off-island for disposal or recycling. Scrap metals are stockpiled and then recycled off-island. Continuation of these practices is considered a nonsignificant impact.

LOW LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

Municipal Solid Waste. The Low Level-of-Activity Alternative would increase the volume of municipal waste generated, collected, and disposed of on Kwajalein and Roi-Namur as a result of the projected 18 percent increase (575 people) in population. Assuming generation rates of 12.8 pounds/person/day (5.8 kilograms/person/day) for municipal solid waste and 4.1 pounds/person/day (1.9 kilograms/person/day) for institutional food waste, this level of activity is expected to produce 24.5 tons per day (tpd) (22 metric tons per day [mtpd]) of municipal solid waste and 7.8 tpd (7 mtpd) of institutional food waste. This increase in waste would exacerbate potential shortcomings in existing waste handling practices (e.g., septage trenching and burial). There would be increased potential for groundwater and marine water contamination from landfilling and open dumping, and increased potential for disease vectors from septage trenching and burial. However, conscientious efforts are being made by landfill staff to minimize the amount of solid wastes that must be disposed of in the onsite landfill on Kwajalein, and to ensure that only wastes designated as acceptable for disposal are placed in the landfill. USAKA's recycling program for aluminum cans also reduces the amount of solid waste entering the landfill.

As part of this alternative, USAKA's existing solid waste incinerator (FN 1516) at the Kwajalein Island landfill would be replaced with three interim fixed-hearth incinerators (each with a 10-tpd capacity) in late 1993. Three permanent incinerators are planned to replace the interim units. Assuming continuous operation, these units would provide a capacity of approximately 15 to 18 tpd (14 to 16 mtpd) each. The total capacity of these three incinerators would be approximately 45 to 54 tpd (41 to 49 mtpd). This capacity would be sufficient to handle the amount of solid waste expected under the Low Level-of-Activity Alternative, resulting in a nonsignificant impact.

Medical Waste. An 18 percent increase in population under this alternative is expected to yield approximately 24 pounds (11 kilograms) of medical waste per day from Kwajalein, Roi-Namur, and Meck. The capacity of the planned three incinerators is adequate to handle this material and would result in a nonsignificant impact.

Construction Solid Waste. Planned construction activity under the Low Level-of-Activity Alternative would increase the volume of construction solid waste generated on Kwajalein, Roi-Namur, Meck, and Omelek. For example, power plant and other utility construction and upgrades are planned for Kwajalein and Roi-Namur, and new launch facilities are planned for Meck and Omelek. Construction waste generation at Kwajalein has been 2,500 tons per year (tpy) (2,268 mtpy), which is not representative of peak construction activity. Because of the predicted increase in population associated with this level of activity and the number of proposed projects, construction waste generation amounts are predicted to be as much as 50 percent higher (3,750 tpy [3,402 mtpy]). Proposed construction projects include the installation of a new GBR-T on FN 1500 and construction of new range operations and base support facilities. The current management practice of using construction solid waste as fill, along with the projected future need for more fill material, indicates that this waste will be managed in compliance with appropriate environmental standards.

Previously, the increased volume of construction debris resulted in uncovering and subsequent inadequate handling of additional asbestos-containing materials. However, the atollwide asbestos survey completed in October 1992 will reduce this potential.

Because existing management practices are adequate, the cumulative impact of the existing and incremental construction solid waste generation and handling practices resulting from this alternative are nonsignificant.

Operations Solid Waste. The increase in population and operations resulting from the Low Level-of-Activity Alternative would generate additional operations waste on Kwajalein, Roi-Namur, Meck, Omelek, Gellinam, Ennylabegan, and Eniwetak islands. Scrap materials are no longer allowed to accumulate and batteries are shipped off-island for disposal.

Because current management of these wastes is in accordance with appropriate environmental standards, the cumulative impacts of the existing and incremental operations solid waste generation and handling practices resulting from this alternative are nonsignificant.

Mitigation—Existing U.S. Statutes and Regulations

No mitigation is identified because there are no significant adverse impacts.

Impacts—Proposed USAKA Environmental Standards and Procedures

Based on the existing U.S. statutes and regulations, the increase in municipal, construction, and operations solid waste at the Low Level of Activity would be nonsignificant. Although the proposed Standards for medical wastes, asbestos, and ocean dumping exceed the existing U.S. statutes and regulations and the proposed review process for solid waste management is expected to be more protective, no change in the significance of impacts (i.e., nonsignificant) is identified based on the proposed Standards.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation is not required for implementation of this alternative because significant impacts are not anticipated.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Municipal Solid Waste. The Intermediate Level of Activity would increase the volume of municipal waste generated, collected, and disposed of at USAKA to approximately 31.5 tpd (29 mtpd) as a result of the projected 52 percent increase (1,675 people) in population. Institutional food waste production would increase to approximately 10 tpd (9 mtpd) under the Intermediate Level of Activity and would continue to be composted. The capacity of the three planned incinerators (i.e., 45 to 54 tpd [41 to 49 mtpd]) proposed for construction as part of the Low Level-of-Activity Alternative would be adequate for such an increase in solid waste; therefore, this alternative would result in a nonsignificant impact.

Medical Waste. A 52 percent increase in population under this alternative is expected to yield approximately 30 pounds (14 kilograms) of medical waste per day from Kwajalein, Roi-Namur, and Meck. The capacity of the planned three incinerators is adequate to handle this material, resulting in a nonsignificant impact.

Construction Solid Waste. The Intermediate Level-of-Activity Alternative would significantly increase the volume of construction solid waste generated on many of the USAKA islands. Based on the predicted increase in population and construction activity, it is anticipated that 1,500 tons (1,361 metric tons) of construction waste will be generated on Meck Island and 4,000 tons (3,629 metric tons) will be generated on Kwajalein. Proposed construction activities at Kwajalein include the construction of the Kwajalein Regional Operations Center.

As stated for the Low Level-of-Activity Alternative, the atollwide asbestos survey currently being completed will decrease the potential for uncovering and subsequent inadequate handling of additional asbestos-containing materials associated with construction activities. Destruction of existing silos on Illeginni and Meck in this alternative would require removal and disposal of asbestos that has been observed at those sites. Management practices for construction solid waste other than asbestos are generally to use the debris as fill material when needed. The debris may also be accumulated in large piles if it is not used as fill.

As the generation of construction solid waste increases, open dumping may occur and if landfilled, the construction solid waste would occupy needed landfill space. Therefore, the cumulative impact of the existing and incremental construction solid waste generation and handling practices resulting from this alternative are significant impacts in light of the limited availability of land area for accumulation of construction debris.

Operations Solid Waste. The increase in population and operations resulting from the Intermediate Level-of-Activity Alternative would generate additional operations waste on Kwajalein, Roi-Namur, Meck, Omelek, Illeginni, Legan, Gellinam, and Gagan islands (and possibly Ennugarret). Scrap materials are not allowed to accumulate on islands other than Kwajalein, batteries are shipped to Hawaii for disposal, and ocean dumping is permitted for scrap metal only. Because the rate of generation may require USAKA to resume on-island accumulation and the conditions of the ocean dumping MOU may not accommodate the additional wastes, the cumulative impact of the existing and incremental operations solid waste generation and handling practices resulting from this alternative are significant impacts. Impacts of the increased operations solid waste generation could be improper disposal of scrap metal and increased potential for groundwater and marine water contamination from landfilling and open dumping of these materials. Improper disposal of these materials would result in noncompliance with the existing U.S. statutes and regulations.

Mitigation—Existing U.S. Statutes and Regulations

Continued expansion of waste minimization and recycling efforts is recommended to reduce amounts of operation and construction waste. One option for waste minimization is the ordering of items in bulk packaging. Alternative uses and disposal options for used tires and scrap metal should also be investigated. Further efforts in recycling could address paper wastes, cardboard, plastic, or other high-volume wastes. Recycling would reduce the volume of wastes for incineration but would be limited by available markets for the recycled materials and the requirement for transportation of an increasing volume of wastes. Off-atoll shipping of wastes for recycling would be expensive. However, the combination of limited space available for continued landfilling, the expense of disposing wastes off-atoll, and the minimal likelihood that other land disposal areas on the atoll could be developed increases the potential that solid waste reduction and recycling efforts will be the most effective solution.

Currently, hazardous wastes and recyclable materials are shipped off-atoll for further management. This program could be expanded to include construction and operations solid wastes; however, there could be some difficulty in making arrangements for disposal of the solid wastes elsewhere, particularly in Hawaii, where disposal facilities are already limited.

Impacts—Proposed USAKA Environmental Standards and Procedures

The increase in construction and operations solid waste generation in the Intermediate Level of Activity will result in significant impacts under USAKA Standards for the same reasons presented in the existing U.S. statutes and regulations impact section.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation measures under the proposed Standards do not differ from the actions previously outlined under the existing U.S. statutes and regulations.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Municipal Solid Waste. The High Level of Activity would increase the volume of municipal waste generated, collected, and disposed of at USAKA as a result of the projected 66 percent increase (2,150) in population. Assuming daily generation rates of 12.8 pounds per person (5.8 kilograms per person) for municipal waste and 4.1 pounds per person (1.9 kilograms per person) for institutional food waste, 34.6 tpd (31 mtpd) of municipal and 11.1 tpd (10 mtpd) of food waste would be generated. The capacity of the three planned incinerators (45 to 54 tpd [41 to 49 mtpd]) planned for construction as part of the Low Level-of-Activity Alternative would be adequate for such an increase in solid waste and would result in a nonsignificant impact.

Medical Waste. A 66 percent increase in population under this alternative is expected to yield approximately 33 pounds (15 kilograms) of medical waste per day from Kwajalein, Roi-Namur, and Meck. The capacity of the three planned incinerators is adequate to handle this material and would result in a nonsignificant impact.

The cumulative impact of existing and incremental municipal solid waste generation and handling practices that would result from this alternative are nonsignificant impacts similar to those experienced under the Intermediate Level-of-Activity Alternative.

Construction Solid Waste. The High Level-of-Activity Alternative would significantly increase the volume of construction solid waste generated on many of the USAKA islands. The estimated amount of construction waste generated for the High Level-of-Activity Alternative is equal to the Intermediate Level-of-Activity Alternative—1,500 tpy (1,361 mtpy) at Meck Island and 4,000 tpy (3,629 mtpy) at Kwajalein.

The cumulative impact of the existing and incremental construction waste generation and handling practices resulting from this alternative are significant impacts in light of the limited availability of land area for accumulation of construction debris.

Operations Solid Waste. The increase in population and operations resulting from the High Level-of-Activity Alternative would generate additional operations waste on Kwajalein, Roi-Namur, Meck, Omelek, Illeginni, Legan, Gellinam, Gagan, Ennylabegan, and Eniwetak islands. Because the rate of generation will require USAKA to resume on-island accumulation and the conditions of the ocean dumping MOU will not accommodate the additional wastes, the cumulative impact of the existing and incremental operations solid waste generation and handling practices resulting from this alternative are significant impacts.

Mitigation—Existing U.S. Statutes and Regulations

The mitigation for this alternative is the same as that for the Intermediate Level-of-Activity Alternative.

Impacts—Proposed USAKA Environmental Standards and Procedures

The increase in construction and operations solid waste generation at the High Level of Activity will result in significant impacts under USAKA Standards for the same reasons presented in the existing U.S. statutes and regulations impact section.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation measures under the proposed Standards do not differ from the actions previously outlined under the existing U.S. statutes and regulations for the Intermediate Level-of-Activity Alternative.

4.13.3.2 Proposed USAKA Environmental Standards and Procedures

The Proposed USAKA Environmental Standards and Procedures address solid waste disposal, medical waste transport (municipal solid waste), asbestos material and waste management (construction solid waste), and ocean dumping (operations solid waste). The proposed Standards define some specific requirements that are not defined in the existing U.S. statutes and regulations. In addition, some of the proposed Standards provide for case-by-case evaluations and assessments. A hypothetical analysis of a solid waste landfill is provided to illustrate the difference between the existing U.S. statutes and regulations and the proposed USAKA Standards.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

The applicable regulations for solid waste disposal and new landfill or composting facilities derive from the U.S. EPA Solid Waste Regulations (40 CFR 258); those for medical waste are taken from 40 CFR 259.70; and the regulations for asbestos management derive from 40 CFR 61.150(a). Ocean dumping and discharge of dredge or fill material regulations are based on 40 CFR, parts 220-233, which implement the Marine Protection, Research, and Sanctuaries Act of 1972.

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

Overall, the proposed Standards and existing U.S. statutes and regulations are similar in most areas. The DEP documentation may provide a slightly more detailed level of review when compared with the existing permit review process because of the various agencies participating in the DEP process.

Under existing U.S. statutes and regulations, only U.S. EPA regulates solid waste disposal activities. The proposed Standards would provide for review of DEPs for solid waste disposal activities by the appropriate agency.

There is no federal requirement that corresponds to the proposed Standards' specifications for transporting medical waste within and outside health care facilities (however, five states have volunteered to participate in a pilot program for tracking medical waste). The proposed transport requirements for medical wastes would result in significant positive impacts because they would provide greater protection for human health and safety.

The proposed Standards require that asbestos-containing materials (ACM) be distributed (based on condition and location) only with the approval of the USAKA Commander, and that asbestos wastes be collected near the point of generation or removal, with transfer to a central collection area within 3 days. There are no similar federal requirements. However, existing U.S. statutes and regulations specify that asbestos wastes be placed in leak-tight containers whereas the proposed Standards further define the containment to be double polyethylene bags placed in a polyethylene-lined container. The USAKA Standards also specify that the asbestos material be wet to the touch and they define marking and labeling requirements. Although there are differences in the two sets of standards regarding asbestos wastes and materials, the proposed Standards provide similar levels of protection overall.

The proposed Standards for ocean dumping differ from the existing U.S. statutes and regulations in that they provide for a case-by-case assessment of the need and eliminate the state certification programs. The USAKA Standards and existing U.S. statutes and regulations specify consideration of all effects, including cumulative effects from previous and potential discharges when designating disposal sites. For discrete ocean dumping events, the proposed Standards use performance criteria during the case-by-case assessment and the existing U.S. statutes and regulations provide a separate set of procedures for assessing all proposed designations. In addition to performance criteria, specific material types and waste constituents (except as trace contaminants) are prohibited from ocean dumping under USAKA Standards.

A comparison of the proposed USAKA Standards and the existing U.S. statutes and regulations for the development and operation of solid waste landfills is shown in Table 4.13-7. In this comparison, solid waste landfills are assumed to refer to municipal solid waste landfills in the U.S. as opposed to other types of landfills (e.g., demolition/construction waste landfills). Only major headings are compared in Table 4.13-7.

The USAKA Standards reflect updates through December 31, 1991, for consistency with U.S. EPA requirements. The new solid waste landfill requirements were published on October 9, 1991, and are effective on October 9, 1993. These requirements are incorporated into the proposed Standards and require documentation through a DEP.

Based on an overall review of the differences summarized in Table 4.13-7, a higher level of protection is provided by the USAKA Standards and their adoption would result in a nonsignificant impact.

Mitigation

Because no significant adverse impacts of the proposed Standards on solid waste management were identified, no mitigation is required.

4.13.4 Hazardous Materials

4.13.4.1 Level-of-Activity Alternatives

The level-of-activity alternatives could lead to increased use of hazardous materials, broadly defined (see Subsection 3.13.4) to include fuels, solid rocket booster propellants, explosives, solvents, pesticides, compressed gas, lubricants, and petroleum products. These materials have the potential to affect human health and safety and the environment through impacts to groundwater, surface water, soil, and air. The safety aspects of hazardous materials management are addressed in Section 4.15, Range Safety. Storage of diesel fuel marine (DFM)—the fuel used in USAKA's power plants—is addressed in Subsection 4.13.6, Energy and Fuels.

Levels of Significance—Existing U.S. Statutes and Regulations

- **No or Negligible Impact.** There would be little or no increase in the probability of adverse impacts to health or to the environment as a result of the increased use of hazardous materials.

Table 4.13-7
A Comparison of Standards for Development and Operation of Solid Waste Landfills

	Standards	
Requirement	Proposed USAKA Environmental Standards and Procedures	Existing U.S. Statutes and Regulations
1. New facility development	ROC documentation	Permit application
2. Location restrictions	Similar	Similar
3. Design factors	Similar	Similar
4. Waste acceptance	Prohibits hazardous waste	Prohibits hazardous wastes and restricts infectious and nonbiodegradable medical wastes
5. Cover materials	Similar	Similar
6. Vector control	Similar	Similar
7. Explosive gas control	Similar	Similar
8. Open burning	Similar	Similar
9. Access restrictions	Requires barriers	Requires barriers and provides signs
10. Runon and runoff control	Similar	Similar (stormwater permit required)
11. Restrictions on liquids	Similar	Similar
12. Recordkeeping requirements	Records inspections, training, gas monitoring, analytical and testing data, and closure and postclosure care measures	Similar records maintained plus document incoming quantities and recycling efforts at landfill
13. Groundwater monitoring and corrective measures	Similar	Similar
14. Liner and leachate collection design requirements	Similar	Similar
15. Closure and postclosure requirements	Similar	Similar

- **Nonsignificant Impact.** There would be an increase in the probability of adverse impacts to health or the environment as a result of the increased use of hazardous materials, but not to the extent that the increased use of hazardous materials cannot adequately be handled by existing facilities or does not comply with regulatory standards.

- **Significant Impact.** An action involving increased use of hazardous materials would be identified as significant if it poses a reasonable probability of adverse effects on health or the environment, if it cannot adequately be handled by existing facilities, or if it does not comply with regulatory standards.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

If impacts are assessed using the proposed USAKA Environmental Standards and Procedures, the definition of significance provided above for existing statutes and regulations would still apply; however, the definition of "regulatory standards" would change. Under the proposed Standards, management of hazardous materials and hazardous wastes would be governed by a single set of integrated "cradle to grave" standards that are more stringent than existing U.S. statutes and regulations for hazardous materials. As described in more detail below, requirements specified in Section 3.8 of the Standards include:

- Separate areas for incompatible materials, with impervious floors having sufficient curbing to contain the volume of the largest container being used or 10 percent of the total volume of stored substances (where storage is defined as 10 percent of the reportable quantity or 55 gallons [208 liters] or greater)

- Adequate ventilation, protection from sources of heat, and security to prevent unauthorized access

- An internal communication or alarm system, and a telephone or two-way radio

- Provision of portable fire-control equipment and an adequate water volume and pressure for water hoses

NO ACTION

Subsection 3.13.4 describes existing hazardous materials management practices.

Impacts

Bulk fuel is stored on Kwajalein Island before use at Kwajalein or transfer to tanks on other USAKA islands for use. In the No-Action Alternative, fuel tanks on all islands would continue with the inadequate containment identified in the 1989 EIS.

The lack of adequate containment increases the risk of groundwater and soil contamination by petroleum products.

On Kwajalein, the full capacity of the current petroleum, oils, and lubricants (POL) storage (estimated at approximately 1,200 barrels if stored in a single layer) is rarely used. Monthly storage of POLs is estimated to be approximately 500 55-gallon (208-liter) drums in the No-Action Alternative. Upgrading the POL yard storage containment by adding secondary containment is planned to be initiated during 1993. Explosives, liquid propellants, solvents, and pesticides are adequately stored at USAKA.

Although there has been no recent inventory of hazardous materials and indoor hazardous material storage space, it appears that current storage capacity of approximately 45,000 square feet (4,181 square meters) (Ott, personal communication, 1992) is sufficient for current needs and is largely in use.

Based on review of existing and planned hazardous material handling and storage facilities for the No-Action Alternative, no or negligible impacts are expected.

LOW LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Fuel tank replacement and containment improvement plans were reviewed for this alternative and were assessed in terms of their impact on storage capacity and potential spill risks. Projections of the amounts of hazardous materials in two categories (POLs and other hazardous materials) were also made for this alternative and compared with estimates of storage capacity.

Above-ground Fuel Tank Replacement and Containment Improvements. In this alternative, 10 above-ground tanks on six islands (Kwajalein, Roi-Namur, Meck, Omelek, Illeginni, and Gellinam) would have improvements to fuel tank containment, involving new berms, the installation of flexible membrane liners, and oil/water separators. In addition, two tanks on Eniwetak (FN 7113) and Ennylabegan (FN 6006) would be replaced with new tanks with improved containment. In follow-on projects, the remaining above-ground facilities with inadequate containment on all USAKA islands would have containment upgraded to reduce risks of petroleum product spills. All work for tank containment and berm improvements would be confined to previously disturbed areas. These projects would address the inadequacy of existing fuel containment facilities at most USAKA above-ground fuel tanks, and would provide containment that would eliminate significant risks of spills contaminating soils and groundwater.

POLs. Monthly storage of POLs would increase to approximately 600 barrels, assuming that use of POLs would increase in proportion to population. This is well within the capacity of the POL yard at Kwajalein.

Other Hazardous Materials Use. Assuming that the use of hazardous materials increases in proportion to population, and that current use approximately equals current space, approximately 18 percent more hazardous material storage space would be needed in this alternative.

In this alternative, a new hazardous material storage facility would be constructed at the southern end of Kwajalein Island, between the Japanese Memorial Cemetery (FN 698) and the landfill. The building would have a gross floor area of 40,000 square feet (4,306 square meters). Facilities would include compartmented, segregated areas; spill containment structures; office and laboratory facilities; and support infrastructure. The facility will be designed to meet all applicable regulations for handling hazardous materials. The new facility would increase hazardous material storage space by a total of approximately 89 percent, providing adequate space for the increase in hazardous material use of approximately 18 percent predicted for this alternative. Existing hazardous material storage facilities would be evaluated for reuse or demolition. The increased use of hazardous materials in this alternative should have a nonsignificant impact.

As part of this alternative, a new concentrated cleaner and degreaser, "Everclean Blue Gold," may be used for cleaning payload assemblies and related equipment on Meck Island. Blue Gold is a water-based liquid concentrate composed of nonionic and anionic organic synthetic detergents, inorganic builders, a rust-inhibitor, and a nontoxic organic glycol ether solvent. Storage and use of this product would be in accordance with existing handling practices for solvents and degreasers at USAKA and its use would introduce no new hazardous materials handling requirements or issues. Based on review of existing and planned hazardous material handling and storage facilities for the Low Level-of-Activity Alternative, nonsignificant impacts are expected.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be comparable under the proposed Standards; however, as noted above, the Standards include new requirements for hazardous materials storage. The new hazardous materials storage facility proposed for this alternative would meet the requirements of the proposed Standards; however, other existing indoor storage may not meet the requirements of the proposed Standards, and might require upgrading if needed to accommodate the increased use of hazardous materials associated with this alternative. Based on the possible need to upgrade facilities to comply with these requirements, a potential significant impact can be assumed.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because most of the existing indoor hazardous material storage does not meet the requirements of the proposed Standards, it would probably require upgrading to conform. If the stock of hazardous materials used in this alternative cannot be entirely stored within the new hazardous material storage facility proposed in this alternative, existing facilities should be evaluated against the Standards and upgrades completed as necessary to ensure conformance.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Average monthly storage of POLs is predicted to increase to approximately 750 barrels, well within the capacity of the POL yard. The use of other hazardous materials is predicted to increase approximately 50 percent above No-Action Alternative amounts, well within the increase in hazardous material storage space added in the Low Level-of-Activity Alternative, and would result in a nonsignificant impact.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be comparable under the proposed Standards; however, as noted above, the Standards place new requirements for hazardous materials storage. The new hazardous materials storage facility proposed for this alternative would meet the requirements of the proposed Standards; however, other existing indoor storage may not meet the requirements of the proposed Standards, and might require upgrading. Based on the possible need to upgrade facilities to comply with these requirements, a potential significant impact can be assumed.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because existing hazardous material storage does not meet the requirements of the proposed Standards, it would probably require upgrading as necessary to conform.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

Monthly POL storage use is predicted to increase to approximately 875 barrels, well within the capacity of the POL yard. The use of other hazardous materials is predicted to increase approximately 75 percent above No-Action Alternative amounts, within the increase in hazardous material storage space added in the Low Level-of-Activity Alternative and resulting in a nonsignificant impact.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

Impacts would be comparable under the proposed Standards; however, as noted above, the Standards place new requirements for hazardous materials storage. The new hazardous materials storage facility proposed for this alternative would meet the requirements of the proposed Standards; however, other existing indoor storage may not meet the requirements of the proposed Standards, and might require upgrading. Based on the possible need to upgrade facilities to comply with these requirements, a potential significant impact can be assumed.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Because existing indoor hazardous material storage does not meet the requirements of the proposed Standards, upgrading as needed might be required to conform to the Standards.

4.13.4.2 Proposed USAKA Environmental Standards and Procedures

The proposed Standards for hazardous materials management apply to all materials that are imported or purchased for use on USAKA that have the potential to adversely affect the environment. Materials are classified as general-use materials, hazardous materials and petroleum products, or prohibited materials. The proposed Standards integrate requirements that are similar to the existing U.S. statutes and regulations. However, after the materials are introduced to USAKA, identified, and classified, they are subject to security, storage, and inspection requirements that are not required by the existing U.S. statutes and regulations.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

Regulatory Framework. The applicable regulations for hazardous material management are derived from several federal regulations. Chemical inventory, import, and new use requirements are taken from 40 CFR 707 through 721. The SPCC Design Requirements are outlined in 40 CFR 112, and marking requirements are based on 40 CFR 264. The management requirements for pesticide containers are described in 40 CFR 261.7 and pesticide use is defined by RMIEPA Pesticide Regulations—Part IV (No. 16).

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

The existing chemical substance management regulations focus on chemical substances rather than materials, and the substances must be listed in the Toxic Substances inventory. Distribution is unregulated once the chemical is listed unless a significant new use is identified. The proposed Standards require that all materials being brought into USAKA be categorized. Classification of hazardous materials and petroleum products must be assisted by a Material Safety Data Sheet (MSDS).

Storage requirements for new products, hazardous materials, petroleum products, and compressed gas are specified in the proposed Standards. In contrast, the existing U.S. statutes and regulations address only oil spill prevention planning requirements for nontransportation-related facilities. The proposed Standards require preparation of a KEEP.

No federal requirements exist that are similar to the Standards' requirements for the storage of hazardous materials or compressed gas. The Standards also differ regarding underground storage tanks (USTs). Existing U.S. statutes and regulations provide design requirements for installation of new USTs, but the proposed Standards prohibit the installation of new USTs.

The proposed Standards also address the use requirements for hazardous materials, petroleum products, and compressed gas. Again, there are no similar federal requirements for use of these materials.

The proposed Standards' provisions for increased storage, security, and inspection requirements for hazardous materials would be beneficial because they offer greater protection. The requirement that all activities at USAKA involving handling hazardous materials employ two people at a time would provide greater protection of human health. Application of these standards would result in beneficial impacts.

The proposed pesticide management standards differ from the existing U.S. statutes and regulations because there are no treatment options available to make a pesticide container nonhazardous waste (e.g., triple rinsing). Because there does not appear to be a method to delist the containers, the proposed Standards may provide more protection.

Although there are no differences between the existing U.S. statutes and regulations and the proposed USAKA Standards as they pertain to health-based standards, the proposed Standards would be more extensive regarding chemical identification and classification. The adoption of the Standards would represent an overall significant beneficial impact.

Mitigation

Because no significant adverse impacts are identified, no mitigation is necessary.

4.13.5 Hazardous Waste

4.13.5.1 Level-of-Activity Alternatives

The action alternatives may affect the quality of human health and the environment as a result of increased generation of hazardous wastes. Specific media include groundwater, surface water, soil, and air.

Hazardous waste is generated primarily as a result of facility maintenance activities, mission project operations, and electrical power generation. Because sufficient hazardous waste characterization and inventory is not available for these sources, the inventory reported by JCWSI in 1991 has been used as a basis for the No-Action Alternative, and a scale-up factor was applied to the No-Action Alternative to obtain the hazardous waste generation amounts for the other level-of-activity alternatives. Hazardous waste generation estimates were obtained by scaling up the No-Action Alternative amount according to the relative amount of air traffic volume (see Table 4.12-2) for that alternative. Air traffic volume (including total fixed-wing and total helicopter takeoffs and landings on a monthly basis) was selected as a scaling factor because it is a general indicator of the amount of mission project operations. Mission project operations and activities were assumed to be proportional to facility maintenance activities and electrical power generation. Not including special wastes (asbestos or polychlorinated biphenyl [PCB] materials) or the large amount of waste oil mix disposed of in 1991 (approximately 75,000 gallons [283,900 liters]), approximately 111,400 gallons (421,686 liters) of hazardous waste were transported off-atoll in 1991, which is assumed to be equal to the No-Action Alternative amount.

Levels of Significance—Existing U.S. Statutes and Regulations

- **No or Negligible Impact.** No or little increase would occur in the probability of adverse impacts to health or to the environment as a result of increased generation of hazardous waste.

- **Nonsignificant Impact.** There would be an increase in the probability of adverse impacts to health or the environment as a result of increased hazardous waste generation, but not to the extent that the increased hazardous waste generation cannot be handled adequately by existing facilities or does not comply with regulatory standards.

- **Significant Impact.** An action involving increased hazardous waste generation would be identified as significant if it poses a reasonable probability of adverse effects on health or the environment or if it cannot adequately be handled by existing facilities or does not comply with regulatory standards.

Levels of Significance–Proposed USAKA Environmental Standards and Procedures

Although the proposed Standards include some provisions that are more stringent than existing regulations (as described below), use of the proposed Standards would not affect the assessment of impacts using the definitions of significance provided above.

NO ACTION

Subsection 3.13.4 describes existing hazardous materials and waste practices.

Impacts

USAKA has made improvements in its hazardous waste management practices and facilities since the 1989 EIS and implementation of the USAKA Mitigation Plan. Solvent waste is no longer mixed with waste oil, stored in unlined pits, or open-burned on Kwajalein. Neutralized acids and bases are no longer discharged to the sanitary sewer, taken to the landfill for disposal, or left to evaporate. Transformers and drained oil containing PCBs are now stored in Building 1521 on Kwajalein prior to being shipped off-island for disposal. Building 1521 appears well maintained and neatly kept; however, segregated containment for incompatible wastes has not been provided. Stabilization and cleanup of the waste solvent/oil pits have been initiated. Based on these improvements and continued hazardous waste management progress, nonsignificant impacts are expected from continuing activities in the No-Action Alternative.

LOW LEVEL OF ACTIVITY

Impacts–Existing U.S. Statutes and Regulations

Significant progress has been made by USAKA in developing and implementing effective hazardous waste management practices, as described in the No-Action Alternative. For example, USAKA has instituted procedures for segregating solvents from waste oils and other wastes generated during maintenance activities. Additional improvements that are planned pursuant to the 1989 EIS include periodic training of individuals responsible for managing hazardous wastes and centralization of hazardous waste management responsibilities. Continuation of these improved management practices should be adequate to handle the increased hazardous waste volume associated with this alternative, resulting in nonsignificant impacts.

The Low Level-of-Activity Alternative air traffic volume is approximately 2 percent greater than the No-Action Alternative (see Subsection 4.12.1), resulting in an estimated hazardous waste generation of 114,000 gallons (431,528 liters) per year. Assuming the storage capacity of Building 1521 is 336 drums, and assuming that waste removal occurs monthly, hazardous waste would not be generated at a sufficient rate to exceed the capacity of the facility. Hazardous waste impacts associated with implementation of this alternative are expected to be nonsignificant if the waste is removed monthly. The facility does not have sufficient capacity (only 110,900 gallons [419,793 liters] can be stored if removal is bimonthly) to allow for bimonthly removal of the wastes. If waste is removed from Building 1521 on a monthly basis, nonsignificant impacts are expected because there would be adequate capacity.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

The proposed Standards for hazardous waste management (including PCBs) include requirements for reviews, recordkeeping, inventories, training, audits, and storage that exceed existing U.S. statutes and regulations. Additional waste disposal prohibitions are also provided. However, nonsignificant impacts are still anticipated based on the substantial progress USAKA has made in implementing effective hazardous waste management practices and because adequate hazardous waste storage capacity exists.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation is not required for implementation of this alternative because significant impacts are not anticipated.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

As described above, significant progress has been made by USAKA in developing and implementing effective hazardous waste management practices. However, the increased volume of hazardous waste generated from this alternative is more likely to exceed the existing facility capacity, thereby increasing the potential for exceeding applicable environmental standards. The Intermediate Level-of-Activity Alternative air traffic volume (addressed in Section 4.12) is 30 percent greater than the No-Action Alternative, giving an estimated hazardous waste generation of 144,800 gallons (548,116 liters) per year. The facility capacity is estimated to be approximately 221,800 gallons (839,587 liters) if the wastes are removed monthly. If the wastes are removed bimonthly, the capacity would drop to 110,900 gallons (419,793 liters), resulting in a nonsignificant impact because adequate capacity would still be available.

One example of exceeding applicable environmental standards that could result if the existing facility capacity is exceeded would be storage without proper containment. Another example is storage of incompatible wastes in the same area. Storage without proper containment or storage outside of properly designed facilities because of limited storage capacity could result in increased potential for contamination of navigable waters, fresh groundwater lenses, and soil because of hazardous waste discharges. Storage of hazardous wastes outside of properly designed facilities could also result in human exposure. If the wastes are not removed on a monthly basis, the hazardous waste facility capacity could be exceeded.

As described under the No-Action Alternative, USAKA has instituted procedures for segregating solvents from waste oils and other wastes generated during maintenance activities. Continued emphasis on waste minimization, periodic training of individuals responsible for managing hazardous wastes, and centralizing hazardous waste management responsibilities are recommended. Some examples of alternatives for hazardous waste minimization include decreasing the use of chlorinated solvents by substituting products with less hazardous materials; using low-volatile-organic-compound (VOC) paints and lubricants; and increasing the use of solvent recovery units. In addition, hazardous material must be removed from Building 1521 on a monthly basis to maintain adequate storage capacity. Centralizing hazardous waste management responsibilities and coordinating this effort among multiple contractors is also recommended. When each contractor is responsible for management of the hazardous wastes it generates (as currently practiced at USAKA), inconsistent waste management practices result because of differing interpretations of applicable requirements. This coordination would be important during implementation of this alternative because contractor activities would take place on each of the USAKA islands. Assuming that the waste minimization and management practices described above continue, no significant impacts are anticipated.

This alternative includes the use of an EOD pit for the destruction of unexploded ordnance on Legan (proposed site), Illeginni (existing site), or Ennugarret (proposed site). Approximately twice per year, accumulated ordnance that has been uncovered during construction or excavation would be transferred to the EOD pit for destruction. During detonation, all or most of the ordnance's organic constituents are consumed in the explosion. EOD technicians currently survey the Illeginni site and rake the EOD pit after detonation to look for debris and explosives not fully consumed in the detonation. Organic and metallic residuals may remain after detonation, but the levels would generally not be high enough to be classified as hazardous. This is supported by study results, collected by USAEHA, that indicate residual contamination was detected in less than 50 percent of the detonation episodes reviewed (USAEHA, 1988). Metallic (e.g., lead) residuals resulting from accumulated World War II small arms ammunition (e.g., bullets) may already be present at the proposed sites (WW II ammunition residuals are found in the soil at many locations at Kwajalein Atoll). The impact of these potential low-level contaminant residuals remaining from EOD activities is not predicted to be significant because: (1) there are no inhabitants on any of these islands; therefore, minimal risk for human exposure exists; (2) there are no groundwater resources (i.e., freshwater lens) present on these islands; and (3) construction of the pit prevents surficial runoff, which greatly reduces the chance for these potential pollutant concentrations to exceed trace levels or water quality criteria for the marine water.

If the frequency of use increases for the EOD pit (existing or proposed), then sampling and analyses for metal and organic constituents using soil samples from the pit is recommended. The significance of any inorganic analytical results would need to consider the background concentrations of these constituents (e.g., lead) already present from small arms ammunition remaining from World War II.

Mitigation—Existing U.S. Statutes and Regulations

Because no significant impacts are expected, no mitigation is required.

Impacts—Proposed USAKA Environmental Standards and Procedures

The proposed Standards for hazardous waste management (including PCBs) include requirements for reviews, recordkeeping, inventories, training, audits, and storage that exceed existing U.S. statutes and regulations, along with additional waste disposal prohibitions. However, analysis of the proposed activities against the Standards is expected to result in nonsignificant impacts for this alternative.

Mitigation—Proposed USAKA Environmental Standards and Procedures

Mitigation measures would not be required because no significant impacts are anticipated.

HIGH LEVEL OF ACTIVITY

Impacts—Existing U.S. Statutes and Regulations

In the High Level-of-Activity Alternative, total air traffic volume is predicted to be 47 percent greater than the No-Action Alternative, resulting in an estimated hazardous waste generation of 163,800 gallons (620,037 liters) per year. The facility capacity is estimated to be approximately 221,800 gallons (839,586 liters) if the wastes are removed monthly. However, if the wastes are removed bimonthly, the capacity drops to 110,900 gallons (419,793 liters). For the High Level of Activity, the waste would have to be removed from the facility more than once every 2 months to avoid a significant impact. If the waste is removed monthly, impacts would be nonsignificant because adequate storage capacity would be available.

As previously stated, significant progress has been made by USAKA in developing and implementing effective hazardous waste management practices. However, the increased volume of hazardous waste generated from this alternative would exceed the existing facilities' capacity if wastes are not removed monthly, thereby causing the same potential for significant environmental impacts described under the Intermediate Level of Activity. If the waste minimization and management practices described under the No-Action Alternative are continued, nonsignificant impacts are expected.

EOD activity alternatives for this alternative are identical to those described in the Intermediate Level-of-Activity Alternative and are considered to represent nonsignificant impacts because of the lack of exposure pathways to humans, groundwater resources, and marine water resources.

Mitigation–Existing U.S. Statutes and Regulations

Because no significant impacts are identified, no mitigation is required.

Impacts–Proposed USAKA Environmental Standards and Procedures

The proposed Standards for hazardous waste management (including PCBs) include requirements for reviews, recordkeeping, inventories, training, audits, and storage that exceed existing U.S. statutes and regulations, along with additional waste disposal prohibitions. However, analysis of the proposed activities using the Standards does not change the determination of nonsignificance for this alternative.

Mitigation–Proposed USAKA Environmental Standards and Procedures

Because no significant impacts are identified, no mitigation is required.

4.13.5.2 Proposed USAKA Environmental Standards and Procedures

The USAKA Standards that address hazardous waste storage are similar to those U.S. statutes and regulations written for hazardous waste generators.

NO ACTION: EXISTING U.S. STATUTES AND REGULATIONS

The applicable regulations for hazardous waste management are derived from a composite of U.S. controls and standards from the Resource Conservation and Recovery Act (RCRA), CERCLA, and the Toxic Substances Control Act (TSCA).

PROPOSED ACTION: ADOPTION OF THE USAKA ENVIRONMENTAL STANDARDS AND PROCEDURES

The proposed Standards provide review of DEPs for hazardous waste treatment, storage, disposal, or remedial activities and plans by four agencies (U.S. EPA, USFWS, USNMFS, and RMIEPA). The additional agency review of hazardous waste- and PCB-related DEPs should result in greater protection because of the added expertise provided during review.

The USAKA Standards allow generators to accumulate hazardous waste onsite for 90 days or less without initiating consultation and submitting a DEP. The storage requirements are similar to the U.S. statutes and regulations written for generators that generate more than 2,200 pounds (1,000 kilograms) of hazardous waste in a calendar month. In both cases, extensions of 30 days or less can be granted by the commander on USAKA (after U.S. EPA and RMIEPA have been notified and consulted) and by the U.S. EPA on a case-by-case basis if the wastes must remain onsite for more than 90 days as a result of unforeseen, temporary, and uncontrollable circumstances. Under no circumstances will hazardous wastes remain on USAKA for more than 120 days.

Existing U.S. statutes and regulations require signs for hazardous waste locations when other entry controls are inadequate. The proposed Standards require signs for all pollution control facilities. The proposed Standards also exceed existing U.S. standards for documentation and verification of employee training for pollution control equipment. These provisions have the potential to provide increased protection of human health and safety and the environment.

Environmental audits are required once every 2 years by the proposed Standards. Although no similar requirement exists, U.S. EPA encourages the use of internal audits under current U.S. statutes and regulations. The proposed Standards, therefore, provide a similar level of protection.

The proposed Standards require that the location of all PCB items be provided to the regulators and that PCB wastes be removed to a central area within 3 days of being collected near the point of generation or removal. The existing U.S. statutes and regulations address inspection of only certain PCB items. Although the existing U.S. statutes and regulations have no specific inventory requirements, the inspections provide limited inventory information. As required in other cases, long-term storage of PCBs is addressed through the DEP review process. The proposed Standard for PCB inventory requirements appears to be more stringent than the existing U.S. statutes and regulations.

Storage times for spent batteries and for PCB wastes under the proposed Standards are more stringent than permitted storage times under the existing U.S. statutes and regulations. Spent batteries cannot be stored for more than 2 months without a special exemption under the proposed Standards. The existing U.S. statutes and regulations allow 90-day storage without a permit.

In addition to the limitations previously described, the proposed Standards prohibit burning, incinerating, or disposing of hazardous waste; discharging ballast from watercraft fuel tanks; and incinerating or landfilling PCBs. Existing U.S. statutes and regulations allow these activities after appropriate permits have been issued.

Overall, the proposed Standards provide a higher degree of protection of human health and safety and the environment, a significant positive impact.

Mitigation

Because no significant adverse impacts of adopting the proposed Standards are identified, no mitigation is required.

4.13.6 Energy and Fuels

4.13.6.1 Level-of-Activity Alternatives

The level-of-activity alternatives may affect electrical peak load, electrical energy requirements (kilowatt hours), power plant generation capacity (kilowatts), electrical distribution feeder capacity, and fuel consumption for power generation and transportation.

Levels of Significance

Because there are no U.S. statutes and regulations or proposed Standards that address energy and fuels, a single set of levels of significance was defined.

- **No or Negligible Impact.** No increase in plant generation capacity or electrical distribution system required. Less than 10 percent increase in peak load (kilowatts), power production (kilowatt hours), or fuel consumption.

- **Nonsignificant Impact.** Minimal or no change required in plant generation capacity or electrical distribution system. An increase in peak load, power production, and fuel consumption greater than 10 percent, but no unprogrammed fuel storage or power production facilities must be built and the increase does not cause a significant impact to an environmental resource (air, water, or land).

- **Significant Impact.** Increase in power plant generation capacity required. Changes to electrical distribution system, such as the addition of new feeders, required. Increases in peak load, power production, and fuel consumption require the construction of additional fuel storage or power production facilities not already programmed or cause a significant impact to an environmental resource (air, water, or land).

NO ACTION

Under the No-Action Alternative, energy consumption for USAKA islands other than Kwajalein is predicted to increase approximately 10 percent over the next 10 years. This prediction is based on observation of historical trends and on the assumption that per capita electrical demand would increase slowly because of greater use of computerized equipment, more air conditioning of storage areas and other facilities, and other increases in electrical demand to support ongoing range activities.

For Kwajalein, the No-Action Alternative includes the construction of the GBR-X radar, with an average load of approximately 2,600 kW (4,100-kW peak). The annual fuel requirement of DFM for generation of electricity for the GBR-X would be approximately 1,825,000 gallons (6,908,227 liters), based on a 2,600-kW average load and 12.5 kWh per gallon of fuel.

Power plant capacities, including total number of engines and generator sizes, are shown in Table 4.13-8 for 1991 conditions, the No-Action, and the Low, Intermediate, and High Level-of-Activity alternatives.

Table 4.13-8
Power Plant Capacity

Island/Plant	Number of Engines and Size (kW)				
	Actual 1991	No Action	Low Level of Activity	Intermediate Level of Activity	High Level of Activity
Kwajalein					
Plant 1	7x1,500	0	0	0	0
Plant 1A	3x4,000	3x4,000	3x4,000	3x4,000	3x4,000
Plant 1B	---	4x4,400	4x4,400	4x4,400	4x4,400
Plant 2	6x715	6x715	6x715	6x715	6x715
Roi-Namur					
Existing	9x1,500	9x1,500	0	0	0
New	---	---	9x1,500	9x1,500	9x1,500
Meck	5x565	5x565	7x565	7x565	7x565
Ennylabegan	4x195	4x195	4x195	4x195	4x195
Illeginni	3x130	3x130	3x130	6x130	6x130
Eniwetak	3x60	3x60	3x60	3x60	4x130
Omelek	2x60	2x60	2x60	2x60	6x130
Gellinam	2x60+ 2x130	2x60+ 2x130	2x60+ 2x130	2x60+ 2x130	4x130
Gagan	2x130	2x130	2x130	2x130	4x130
Legan	2x130	2x130	2x130	2x130	4x130

[a]Source: JCWSI, 1992a.
"---" indicates plant has not been constructed.
"0" indicates plant is to be decommissioned.

Historical (1991) and projected DFM consumption for power generation are shown in Table 4.13-9 for the four level-of-activity alternatives.

With the addition of the GBR-X load and an assumed 10 percent increase in electrical load above 1991 consumption on islands other than Kwajalein, the overall USAKA fuel consumption for the production of electricity would increase approximately 30 percent from the 1991 levels in the No-Action Alternative.

Table 4.13-9
Predicted Annual Power Plant Consumption of Diesel Fuel Marine
(1,000 gallons)

Island/Plant	Existing[a]	No Action[b]	Low Level[c]	Intermediate Level[c]	High Level[c]
Kwajalein					
Plant 1	3,550	0	0	0	0
Plant 1A	1,715	3,275	4,380	4,280	4,450
Plant 1B	0	4,360	6,000	6,000	6,145
Roi-Namur	2,900	3,190	3,190	3,190	3,350
Meck	545[d]	600	830	1,390	1,700
Ennylabegan	130	145	145	145	155
Illeginni	90	100	100	200	220
Eniwetak	30	35	35	35	70
Omelek	30	35	35	35	70
Gellinam	90	100	100	100	200
Gagan	60	65	65	65	130
Legan	60	65	65	65	130
Totals	9,360	12,130	15,105	15,765	16,780

[a]Source: JCWSI, 1992a.
[b]No Action includes GBR-X on Kwajalein and 10 percent growth over 1991 for all islands.
[c]Low, Intermediate, and High Levels of Activity (see text).
[d]Source: October 1991 through September 1992 data, Arthur Gallagher, Meck Island Utilities Superintendent, JCWSI.

LOW LEVEL OF ACTIVITY

Impacts

Energy consumption at USAKA would substantially increase under this alternative. Increased quantities of fuels would be consumed for electrical power generation, aircraft, and automotive and small boat use. The increase in fuel use for transportation would be very small compared with the increase in DFM use for electrical power generation. Power consumption on Kwajalein for the Low Level-of-Activity Alternative would have a substantial impact on power generation. The launch facilities on Meck and Illeginni would have a substantial impact on energy consumption and facilities for individual islands, and would contribute to an overall increase in energy consumption (as measured by gallons of DFM consumed) of 25 percent for USAKA as a whole.

The square footage of new building facilities with associated support equipment (air conditioning, lighting, etc.) would have a more direct impact on electrical demand and energy requirements than would population. This results in part from the fact that housing facilities at USAKA are air conditioned, even when empty, in an effort to reduce damage caused by humidity.

The projected increase in DFM consumption for power generation in the Low Level-of-Activity Alternative, beyond that for the No-Action Alternative, is shown in Table 4.13-9. Although there would be a substantial increase in energy consumption, no facilities in addition to those proposed as part of this alternative would be required; therefore, energy impacts would be nonsignificant.

KWAJALEIN

The proposed electrical loads (average and peak) for construction for the Low Level-of-Activity Alternative on Kwajalein Island are shown in Table 4.13-10. Estimated diesel fuel required for electricity generation is also shown in Table 4.13-10.

Under this alternative, the GBR-T would be constructed instead of the GBR-X. The GBR-T peak load is 8,300 kW, and average load is 4,150 kW (assuming a 0.5 load factor). The approximate annual diesel fuel consumption for the production of electricity for the facility is approximately 2,905,000 gallons (11,000,000 liters), an increase of 1,085,000 gallons (4,107,050 liters) per year above the GBR-X in the No-Action Alternative.

Power Plant 1B (17,600 kW) would be constructed as an addition to new Power Plant 1A and would replace Power Plant 1, which would be demolished. The new plant would ensure adequate capacity to meet the power requirements of the Low Level-of-Activity Alternative.

The incremental load increase for the GBR-T facility (GBR-T loads minus GBR-X loads) plus the requirements of the new facilities listed in Table 4.13-10 would increase the total annual diesel fuel consumption on Kwajalein Island to approximately 10,540,000 gallons (40,000,000 liters). This is an increase of approximately 35 percent above the No-Action Alternative. However, this increase does not require the construction of any unprogrammed fuel storage or power supply facilities.

Table 4.13-10
New Electrical Loads and DFM Consumption for the Low Level-of-Activity Alternative
Proposed Construction Projects on Kwajalein Island

Facility	Average Load[a] (kW)	Peak Load[b] (kW)	Yearly DFM Consumption[c] (gal)
GBR-T incremental load[d]	1,550	4,200	1,085,000
Power plant upgrade auxiliary equipment[e]	500	715	350,000
Unaccompanied personnel housing, 188 unit, 76,000 sq.ft. @ 5 W/sq.ft., replacing 24 units in FN 501 (12,424, sq.ft.)	223	318	155,761
Unaccompanied personnel housing, 100 unit, 44,000 sq.ft. @ 5 W/sq.ft.	154	220	107,800
Family housing, 90 unit, 90,000 sq.ft. @ 5 W/sq.ft.	315	450	220,500
Physical security facilities upgrade, 8,170 sq.ft. @ 5 W/sq.ft.	29	41	20,017
Religious education facility, 8,160 sq.ft. @ 5 W/sq.ft.	29	41	19,992
HAZMAT storage facility, 40,000 sq.ft. @ 5 W/sq.ft.	140	200	98,000
Solid waste incinerator[f]	150	215	105,000
Cold storage warehouse, 26,200 sq.ft. @ 10 W/sq.ft.	92	131	64,190
Controlled humidity warehouse, 69,905 sq.ft. @ 5 W/sq.ft.	245	350	171,267
General purpose warehouse, 109,662 sq.ft. @ 2 W/sq.ft.	384	548	268,672
Corrosion control facility, 10,500 sq.ft. @ 5 W/sq.ft.	37	53	25,725
Hospital addition, 11,440 sq.ft. @ 5 W/sq.ft.	40	57	28,028
Child development center, 11,210 sq.ft. @ 5 W/sq.ft.	39	56	27,465
Total	3,925	7,594	2,747,416

[a]Average loads based on published data or assumed square footage and watts per sq.ft. shown.
[b]Peak demand based on 0.5 load factor for GBR-T and 0.7 load factor for all others.
[c]Yearly DFM consumption for the production of electricity based on average load and an average consumption rate of 0.7 gallon fuel per kilowatt-hour generation.
[d]GBR-T load minus GBR-X load shown in table (see text for GBR-T load).
[e]Assumed loads. Power Plant 1B incremental increase over Power Plant 1 loads.
[f]Assumed loads.

DFM is delivered to Kwajalein Island and stored at the Kwajalein fuel farm before use on Kwajalein or transfer to other USAKA islands for use there. The Kwajalein fuel farm currently has storage capacity of 6,387,150 gallons (24,177,279 liters). This amount of diesel fuel would support USAKA for approximately 8 months at 1991 consumption rates. With the increased energy consumption for all of USAKA required for the Low Level-of-Activity Alternative, the storage capability of the fuel farm would support USAKA for approximately 5 months.

ROI-NAMUR

The only proposed construction project on Roi-Namur that would involve a major increase in electrical load would be the proposed sewage treatment plant. Assuming an electrical load of 200 kW per million-gallon-per-day flows, an average of 62,000 gpd (16,000 Lpd), and a peak of 0.89 million gpd (.24 million Lpd) (USASDC, 1992d), the peak load is projected to be 20 kW, with an average load of 15 kW. This increase in load would have a negligible impact on energy demand for Roi-Namur. In addition, in this alternative, a new 13.5-MW power plant would replace the existing power plant, which was constructed in 1961. The new plant would use existing fuel facilities, which would be adequate for the new plant.

MECK

The existing power plant capacity would be insufficient to support the proposed expansion in launch activities. As part of this alternative, two 565-kW units would be added to the existing plant, which now has five 565-kW units. Fuel oil consumption is predicted to increase from approximately 60,000 to 830,000 gallons (2,271,198 to 3,141,824 liters) per year. The existing fuel tank capacity at Meck (a total of 300,000 gallons [1,135,599 meters]) would be adequate to handle this increase.

OTHER ISLANDS

This alternative would lead to negligible increases in energy consumption on the other USAKA islands.

Mitigation

Because there are no significant impacts, no mitigation is required under this alternative.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

There is a relatively small difference (4 percent) between the Low and Intermediate Levels-of-Activity alternatives in terms of predicted impacts on electrical load and fuel use. Total diesel fuel use is predicted to be 15,785,000 gallons (59,750,000 liters) per year, as shown in Table 4.13-9, or approximately 30 percent above the No-Action Alternative. The Kwajalein fuel farm could store slightly less than 5 months of this annual consumption amount.

The construction and operation of the Ground Entry Point communication facilities on Roi-Namur and Meck would increase electric loads only 10 kW average per year, a negligible amount.

Increased launch activity on Illeginni would cause a substantial impact on that island's fuel consumption, which would increase 100 percent from the No-Action Alternative (as shown in Table 4.13-9).

In order to serve the increase loads on Illeginni, as part of this alternative, the existing power plant (three 130-kW units) would be expanded with the addition of three more 130-kW generators. Diesel fuel storage would be increased from 30,000 to 50,000 gallons (113,560 to 189,267 liters).

On Meck Island, construction of new launch facilities is predicted to lead to a 132 percent increase in fuel consumption above the No-Action Alternative. The additional generators installed in the Low Level-of-Activity Alternative would be adequate for the island's power needs.

Mitigation

No mitigation measures are necessary because no significant impacts are predicted.

HIGH LEVEL OF ACTIVITY

Impacts

In this alternative, the increase in launch and mission activities is predicted to lead to a 37 percent increase in fuel consumption above the No-Action Alternative (a 6 percent increase above the Intermediate Level of Activity). The Kwajalein fuel farm could store approximately 4½ months' consumption at this annual rate. This level of increase is predicted to have a nonsignificant impact on energy consumption.

Additional programmed power plant capacity would be installed as part of this alternative on Eniwetak, Omelek, Gellinam, Gagan, and Legan. Individual load requirements are not known at this time, but it is assumed that the generation capacity and diesel fuel consumption of these islands would double. However, no additional unprogrammed fuel storage or power supply facilities need to be built and the increase would not cause a significant impact to an environmental resource. There would be a nonsignificant impact for these islands and the overall impact on diesel fuel consumption would be minor for USAKA as a whole. Table 4.13-8 shows assumed power plant capacities and Table 4.13-9 shows assumed diesel fuel consumption. The following facilities are programmed for construction as part of this alternative.

OMELEK

- Power plant rebuild with six 130-kW engine generators (similar to Illeginni). The existing power plant consists of two 60-kW units.
- Review and upgrade of island electrical distribution system.
- Diesel fuel storage increased from 10,000 to 50,000 gallons (37,853 to 189,267 liters).

LEGAN

- Power plant rebuild with four 130-kW units. The existing plant consists of two 130-kW units. The location of the plant should be reviewed with respect to the location of loads.
- Review and upgrade of island electrical distribution system.
- Diesel fuel storage increased from 10,000 to 20,000 gallons (37,853 to 75,707 liters).

GAGAN

- Power plant rebuild with four 130-kW engine generators (similar to Illeginni). The existing power plant consists of two 130-kW units.
- Review and upgrade of island electrical distribution system.
- Diesel fuel storage increased from 10,000 to 20,000 gallons (37,853 to 75,707 liters).

GELLINAM

- Power plant rebuild or upgrade to four 130-kW units. The existing plant consists of two 130-kW units.
- Review and upgrade of island electrical distribution system.
- Diesel fuel storage increased from 10,000 to 20,000 gallons (37,853 to 75,707 liters).

- Power plant rebuild with four 130-kW units. The existing plant consists of three 60-kW units.
- Review and upgrade of island electrical distribution system.
- Diesel fuel storage increased from 10,000 to 20,000 gallons (37,853 to 75,707 liters).

Mitigation

Because there are no significant impacts, no mitigation is required.

4.13.6.2 Proposed USAKA Standards and Procedures

There are no proposed USAKA Standards that address energy use.

4.14 Aesthetics

4.14.1 Level-of-Activity Alternatives

Impacts on visual resources were evaluated based on potential effects to the visual character of landscapes and on the number of viewers potentially affected. Changes to the landscape can fall into several categories: construction or renovation of structures in built-up areas, construction that blocks residential views, and clearing of vegetation that changes views. The importance of a landscape change can also vary according to the number of viewers of the landscape: visual changes that are seen daily by residents (e.g., changes on Kwajalein and Roi-Namur islands) are more important than changes on uninhabited islands visited only by security guards and other workers.

Levels of Significance

Because there are no existing U.S. statutes and regulations or proposed USAKA Standards that address aesthetics, a single set of levels of significance was defined.

- **No or Negligible Impact.** No change to the character of the visual landscape.
- **Nonsignificant Impact.** A change to the character of the visual landscape that would be perceived by few observers, and that would not affect the visual character of residential areas.
- **Significant Impact.** A change to the character of the visual landscape that would be perceived on a daily basis by the resident population.

NO ACTION

Construction that would occur on Kwajalein, Roi-Namur, and Meck islands as part of this alternative would occur within areas that are already dominated by buildings with similar functions and visual characteristics. On Omelek, construction of launch facilities would alter the north end of the island by changing the topography and clearing vegetation. The construction would change the visual character at that end of the island; however, the changes would result in a nonsignificant impact because they would be perceived by few viewers and because the island is not inhabited and is visited only by security guards and other workers.

LOW LEVEL OF ACTIVITY

Impacts

KWAJALEIN AND ROI-NAMUR

Most of the construction proposed for Kwajalein and Roi-Namur in this alternative would occur in areas with similar existing visual characteristics, and would have negligible aesthetic impact. The religious education facility on Kwajalein is planned to be constructed in an architectural style that is compatible with the existing World War II era chapel; therefore, visual impacts should be nonsignificant (see also Section 4.9, Archaeological, Historical, and Cultural Resources). The 90 units of accompanied housing units proposed to be built as multifamily units along the ocean side of the north end of Kwajalein Island would alter the view of the ocean from the existing residential areas to the west, and would have a significant aesthetic impact.

OTHER ISLANDS

Construction for launch facilities on Meck would occur in areas already similarly developed, and therefore would have negligible aesthetic impacts. Harbor improvements at Ennylabegan, Legan, and Illeginni may result in visual changes to land forms in the harbor areas; however, because these changes would be largely in character with the existing port facilities and would be seen by limited numbers of people, they would, therefore, be nonsignificant. Shoreline protection construction on several islands would likewise be visible, but would be nonsignificant because they would largely be compatible with the existing visual character of the shoreline and because they would have relatively few viewers.

Mitigation

The family housing structures proposed to be constructed along the ocean shoreline at the north end of Kwajalein Island would block views from the existing residential area toward the ocean. This visual impact could in part be mitigated through design and landscaping features; for example, grouping or positioning of units would preserve some views of the ocean from the existing residential area or extensive landscaping could create a new visual amenity.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

KWAJALEIN AND ROI-NAMUR

The construction at Kwajalein and Roi-Namur proposed in addition to the activities that would take place in the Low Level-of-Activity Alternative would occur within existing built-up areas and would be largely compatible with the existing visual environment. Aesthetic impacts would be negligible.

OTHER ISLANDS

The possible expansion of Meck Island in this alternative would alter the island topography; however, the facilities proposed for the landfill area would be similar in size and character to the existing facilities on this developed island. In addition, the change to the visual landscape would be viewed primarily by technical workers on Meck Island. For those reasons, aesthetic impacts of expanding Meck Island should be nonsignificant.

Construction of an access road and explosive ordnance disposal area on Legan Island would require clearing forested areas and constructing a new road. Because these visual changes would be seen by few viewers, they would be nonsignificant.

The renovation of launch and support facilities on Illeginni Island would occur in areas that are denuded of natural vegetation and that were formally occupied by similar buildings. Viewers (security guards and technical personnel) may well see the renovation and replacement of damaged buildings and foundations as a positive aesthetic change; overall, the aesthetic impact would be nonsignificant.

The proposed construction of an EOD area on Ennugarret Island would require extensive changes to the visual character of an island that currently has no active USAKA facilities and that is now covered with brush and forest. The southeast portion of the island would be cleared, and a helicopter pad, pier, and jetty would be constructed. These visual landscape changes would be visible from portions of the island that are not leased by USAKA, and that could potentially be used by Marshallese citizens. For that reason, the landscape changes that would result from the proposed construction at Ennugarret would be a significant aesthetic impact.

All other activities proposed for this alternative would have no or negligible aesthetic impacts.

Mitigation

The only significant aesthetic impact associated with this alternative (in addition to the impacts associated with the Low Level Alternative, which would also be part of this alternative) would be the ordnance disposal construction proposed ar Ennugarret. Other than by moving the facility to another island, this visual impact could not be mitigated while still providing a functional EOD area on Ennugarret Island.

HIGH LEVEL OF ACTIVITY

Impacts

KWAJALEIN AND ROI-NAMUR

There are no proposed construction or other activities (in addition to those proposed for the Low and Intermediate Levels of Activity) on Kwajalein and Roi-Namur that would have a significant visual impact on these two islands.

OTHER ISLANDS

In addition to the activities proposed for the Low and Intermediate Levels of Activity, there are a number of construction projects that would affect the visual character of several other islands.

New telemetry antennas and construction of a fiber optics cable at Ennylabegan would not change the visual character of this largely developed island.

The landscape of Omelek would be changed considerably by the construction of a launch hill, blast berms, and other associated structures. A vegetated area at the northern end of the island would be removed. However, the visual change would be observed only by workers on the island, and, therefore, would be nonsignificant.

At Legan, new sensors would be installed at the north end of the island, requiring additional clearing of forested areas. Gagan would be extensively developed with the construction of new sensing and tracking equipment, which would require the removal of most vegetation on the island. Gellinam would be expanded to accommodate new launch facilities, and Eniwetak would be extensively cleared and a new launch hill and associated facilities would be constructed. Although the changes proposed for these islands involve a substantial change to the visual character of each island, these changes would be viewed only by workers at the islands. For that reason, they would be considered nonsignificant aesthetic impacts.

Shoreline protection activities at seven islands would not substantially change the visual character of the islands.

Mitigation

No significant aesthetic impacts (in addition to those that are part of the Low and Intermediate Levels of Activity) are associated with this alternative; therefore, no additional mitigation measures have been identified.

4.15 Range Safety

4.15.1 Level-of-Activity Alternatives

Range safety is the protection of public health and property during the preparation and implementation of test programs at USAKA. Range safety issues that may be affected by the Proposed Action and alternatives are injury or loss of life from occupational accidents or exposure to toxic materials; and damage to property or to aircraft or surface vessels. Safety programs (described in the 1989 EIS) include ground safety for the handling of hazardous materials and for general operations, and flight safety for the protection of USAKA personnel, inhabitants of the Marshall Islands, and traffic in areas where tests are being conducted. The increased levels of activity at USAKA may result in increased exposure of USAKA personnel and the public to operations that require safety precautions.

Levels of Significance

The significance of range safety impacts is measured by the effect on human health and property, and by compliance with applicable federal safety regulations. Exposure limits to toxic or hazardous materials are set at levels to prevent long-term detrimental effects. The impact of range safety programs associated with heavy equipment operation, explosives handling, missile launches, and reentry of airborne payloads is measured by the number of injuries and deaths of program personnel and the general public, and by the extent of property damage. The levels of significance are defined as follows:

- **No or Negligible Impact.** The rate of program-related accidents causing injury or loss of life would not increase in the general public. The rate of occupational accidents (based on worker labor-hours) would not increase. Full compliance is attained for occupational safety and health standards and Army regulations.

- **Nonsignificant Impact.** The rate of accidents in the workplace and the rate of noncompliance with occupational safety and health standards would exceed average values for military installations having similar operations.

- **Significant Impact.** The rate of program-related accidents causing injury or loss of life or the rate of near-miss incidents involving inhabited land areas, aircraft, or ships would increase substantially.

There are no proposed USAKA Environmental Standards and Procedures that apply to range safety.

NO ACTION

Impacts

Safety procedures exist and are practiced at USAKA facilities with acceptable results. Ongoing operations will be conducted following these same procedures, as described in the 1989 EIS. All missile programs conducting missions at USAKA undergo thorough review and analysis prior to acceptance for testing at USAKA. Missile performance capability characteristics are obtained and analysis conducted to define test hazard areas that the USAKA Range Safety Program will control during tests. As described in more detail in the 1989 EIS, NOTAMS and NOTMARS are issued for each mission to identify the area and periods involved in each test and to warn air and ship traffic away from the affected areas. The RMI government is informed, and announcements are made on local radios, in local newspapers, and on the Ebeye ferry. Protection of people, facilities, equipment, boats, and aircraft, and compliance with the Compact of Free Association are the goals of the safety measures taken for each test. Past activities have occurred at USAKA at levels exceeding the No-Action Alternative with adequate compliance with safety standards, resulting in no or negligible impacts.

LOW LEVEL OF ACTIVITY

Ground Safety

KWAJALEIN

The Low Level-of-Activity Alternative would result in an increased number of hazardous operations and potential for accidents at Kwajalein. Missile launch programs would require the transportation and storage of solid rocket motors, liquid propellants, explosives, industrial raw materials, and solvents. Solid propellant rocket motors would be received at Kwajalein in flights from the mainland. The increased level of activity of the Low Level-of-Activity Alternative would cause the number of motors received, stored, and handled to increase. Propellant, hazardous materials, and most other materials would be handled in an area of Kwajalein that is not near residential housing. Some new materials would be handled, and greater quantities of familiar materials would be handled to supply the increased number operations. The impact of these activities is expected to be nonsignificant because the types of activities that would occur would be similar to those that have occurred in the past.

The existing storage magazines have the capacity to store sufficient propellant and explosives for this alternative in accordance with USAKA explosives safety regulations. The types of rocket motors received for this alternative are Minuteman second and third stages (M56A1 and M57A1), SR-19, Talos, and developmental motors for the Exo-Endoatmospheric Interceptor (E^2I) and Ground-Based Interceptor (GBI) programs. The proposed programs would not require more than three sets of solid rocket motors at Kwajalein for concurrent missions. The transportation of hazardous materials by aircraft into Kwajalein and by barge to the other islands would be more frequent as a result of increased activity.

MECK

The Low Level-of-Activity Alternative would expand the number of missile preparation and launch facilities at Meck Island and increase the number of operations at existing facilities. The construction of a new SLV launch pad and supporting facilities would employ a large construction workforce and would require demolition and heavy equipment operation. Existing general safety procedures would be in effect during construction, and the construction activities would result in a nonsignificant impact on workforce health.

This alternative involves the assembly of new configurations of launch vehicles to support proposed interceptor and sensor programs. The number of rocket motors in assembly on Meck would increase to meet the annual launch schedule. Missile assembly would occur in the two existing missile assembly buildings on Meck. There are no other facilities for storing rocket motors on Meck.

The reliability of solid rocket motors of new design is extensively tested before the motors are assembled and used in programs at USAKA. The manufacturing process involves strict quality control standards during each phase, and motors are fired on test stands to observe performance and reliability characteristics. Some of the launch vehicle configurations include solid rocket boosters that have been in service and subsequently stored for over 30 years. Although the original service life of these motors was in the range of 20 years, a surveillance and testing program that includes test stand firing is used to evaluate extending the service of older motors. No adverse experience has occurred in use of older motors in recent test flights. The reliability of solid rocket motors used in USAKA test flights is no different than for other missile programs.

Missile assembly buildings, launch silos, launch pads, and operations buildings are separated by distances specified in DoD and Army regulations. The types of facilities and quantity and type of propellant and other explosives stored in magazines and missile handling areas are used to determine the quantity/distance requirements for structure spacing. For example, as separation distance of 1,250 feet (385 meters) is required between a launch pad with more than 100 pounds (45 kilograms) of class or division 1.1 explosives and an inhabited building. In situations such as on Meck Island, where the quantity/distance requirements cannot be met by separation, other methods of personnel protection are implemented. Barricades between launch silos provide barriers between missiles and other exposed sites. The Meck Island Control Building (MICB) and the Systems Technology Testing Facility (STTF) are hardened and provide protection from fragments.

Evacuation of areas during explosive handling could be used to mitigate the potential safety hazard to personnel in operations buildings. This occurs on Meck during launches, when only essential personnel remain on the island. The protection of personnel during missile operations is specified in USAKA Regulation No. 385-4.

Waivers and exemptions from the strict application of explosives safety standards can be granted by Commander, USASSDC, and Secretary or Under Secretary of the Army, respectively.

Liquid propellants, such as chlorine pentafluoride, monomethyl hydrazine, and nitrogen tetroxide, are stored in separate storage facilities for explosives that are monitored for propellant vapor. These propellants are extremely toxic and corrosive, and are handled for many programs in single-use containers that are shipped to the mainland after use. Minimal potential exposure is achieved during the transfer of liquid propellants in these containers.

The Low Level-of-Activity programs would have approved systems safety hazard analyses before implementation at USAKA. The analyses would consider operations at all of the affected islands. Programs would have approved ground safety plans hat identify potential hazards and contain procedures for workforce safety. Safety and security requirements would be defined in the ground safety plan for each program.

Programs would have written procedures for all hazardous operations. These procedures would require approval of the USAKA Safety Office and would be supervised by a government safety representative during execution.

The potential for accidents resulting from launch preparation operations would be mitigated using existing explosives safety regulations and DoD directives, hazards analysis of launch programs and detailed procedures for hazardous operations. These measures were employed in past operations at USAKA; in the 1970s, a more frequent missile test flight schedule and a greater number of launch missions were completed without a serious injury or fatality to the island workforce. An accident during launch preparation activities would not affect neighboring islands or air and ocean traffic.

Based on the procedures and practices described above, nonsignificant impacts to ground safety can be expected.

Flight Safety

KWAJALEIN

The Low Level-of-Activity Alternative would increase the frequency of aircraft at Kwajalein. Flights would involve delivery of rocket motors and other materials and equipment for storage and distribution to other USAKA islands. The handling of additional supplies would have no or negligible impacts on flight safety.

ROI-NAMUR

The HAVE-JEEP IX program using a guided missile may be launched from Roi-Namur. Previous HAVE JEEP programs used unguided rockets, which were considered to pose no risk to the radar equipment on Roi-Namur. The guided missile configuration, which includes flight termination explosives, is currently considered to introduce an acceptable level of risk of debris damage to radars. Use of this missile at Roi-Namur would be preceded by a hazards study to identify any flight or ground safety requirement of this program. Based on these program precautions, no or negligible impacts to flight safety are expected.

MECK

This alternative would result in additional missile launches from new programs at Meck. The LEAP, E^2I, TASR, HAVE-JEEP IX, GBI, and Brilliant Pebbles programs would share the existing ERIS launch silo and HEDI/SBI launch station after modifications. An SLV launcher would be constructed south of the existing launch facilities. A sounding rocket launch rail would be constructed on the north side of the HEDI/SBI launch station. Launches would not occur simultaneously, and would not require multiple sets of rocket motors on Meck at the same time. No or negligible impacts to flight safety are anticipated.

OMELEK

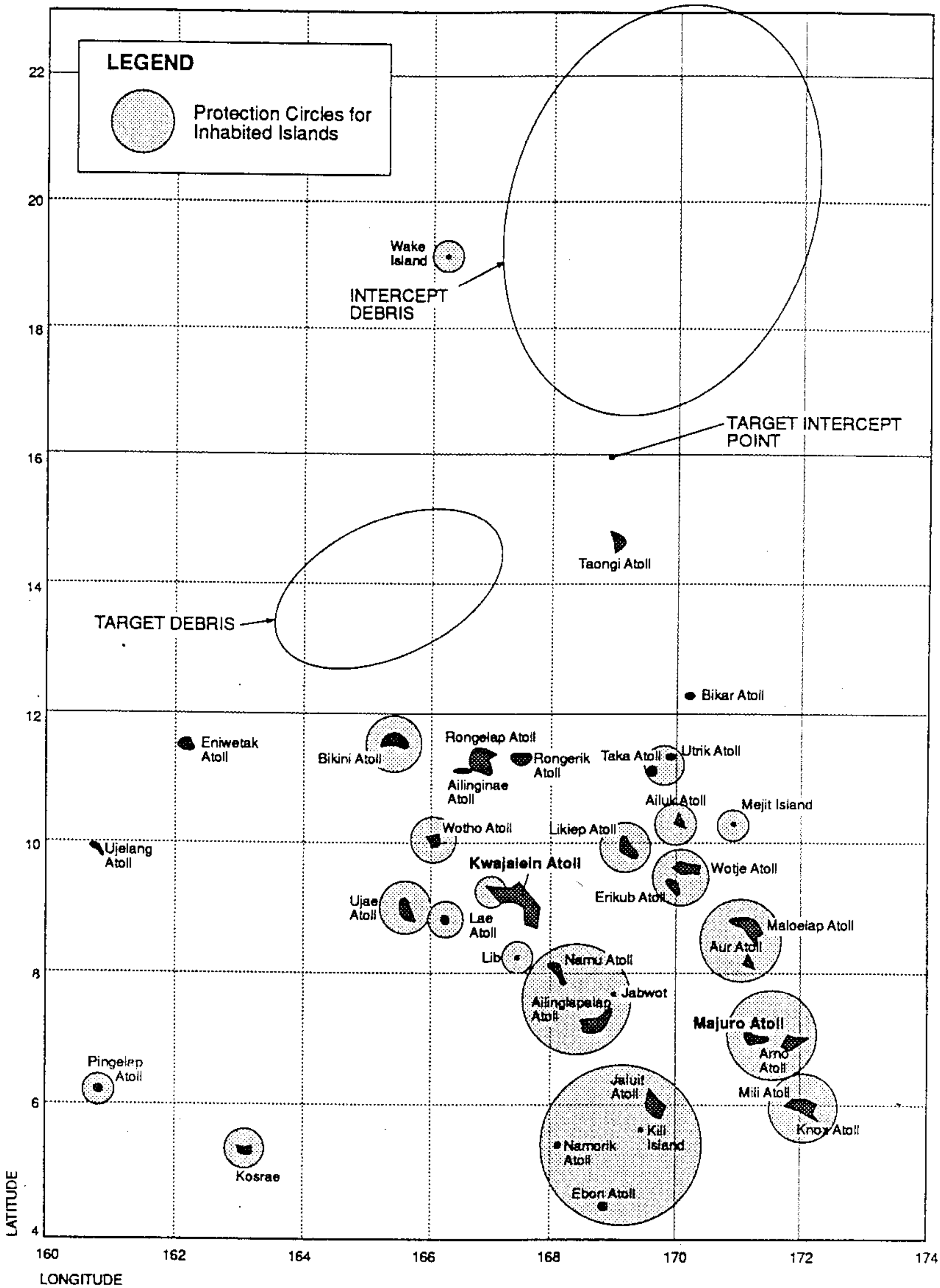
The SLV launch facility in use in the No-Action Alternative would be used for the simultaneous launch of an SLV payload with an interceptor payload at Meck. Adherence to existing safety procedures during operation of the SLV launch facility should result in no or negligible impacts to flight safety.

OTHER ISLANDS AND BROAD OCEAN AREA

An increase in reentry vehicle or target missions would accompany the advanced testing phases of new interceptor launches. Targets launched from California, Hawaii, and Wake Island would have impacts in the lagoon and BOA.

The SLV launches would include payloads and empty rocket motor cases that come down in the BOA. Some programs would consist of test flight missions of interceptor missiles, which produce a much larger debris footprint as a result of the collision of the interceptor and the target. The debris footprint of a comparable program—ERIS—is shown in Figure 4.15-1. In cases where an interceptor missed a target, the target and interceptor vehicles would enter the ocean within their respective debris pattern footprints shown in Figure 4.15-1. A large area could be affected by interceptor programs that would employ several simultaneously launched missiles.

Any potential threat to public safety from increased aircraft activity would be mitigated by procedures in the flight safety plan and established aircraft operating procedures.



U.S. ARMY KWAJALEIN ATOLL
SUPPLEMENTAL ENVIRONMENTAL
IMPACT STATEMENT

ERIS Intercept Debris Disposal Pattern

FIGURE 4.15-1

Each mission of the launch programs would have an approved flight safety plan that would define the areas affected by the mission, the caution and hazard areas, and the precautions required to protect inhabited islands. The range safety system would be in operation during these missions, and the missiles tested in these programs would be equipped with flight termination systems in the event of off-course flight.

Flight safety plans would also be written for reentry vehicle missions to specify the requirements for range safety system operation, warning messages, evacuation, shelter, and surveillance requirements. Payloads landing in the Mid-Atoll Corridor would require sheltering, and would be recovered from the lagoon or land impact areas. Missions affecting the BOA would require the implementation of current range safety measures, including aircraft and ship clearance from the caution area. Earlier interceptor missions have resulted in no debris having impacts on land.

Based on adherence to safety plans, established operating procedures, and flight termination systems, no or negligible impacts to flight safety are expected.

Mitigation

No mitigations are required because no significant impacts to range safety are predicted from this alternative.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

Ground Safety

Ground safety measures on USAKA islands would generally be similar to those described for the Low Level-of-Activity Alternative. The increase in construction activity would not present new hazards, but only more activity involving heavy equipment. Missile assembly at Meck, Omelek, and Illeginni would require the same procedures and ground safety plans to protect the workforce.

KWAJALEIN

In the Intermediate Level-of-Activity Alternative, the level of activity on Kwajalein would be increased to support more programs on Meck and rehabilitated launch facilities on Illeginni. The annual launch activities for the Proposed Action are shown in Table 2.1-6 (in Chapter 2 of this document). The increase in activity would consist primarily of handling explosives, fuels, solid rocket motors, and related mission equipment and the construction of Illeginni facilities. Existing procedures and facilities should be adequate to handle the increased activity, and should result in nonsignificant impacts to ground safety.

MECK

In this alternative, new launch facilities (one SLV launch facility and one sounding rocket launch facility) would be constructed on fill area added at the south end of the existing island. A total of five SLV and two sounding rocket launch facilities would exist on Meck (see Table 2.1-6), and there could be simultaneous launches of up-to-four SLVs from Meck. Launches from the island extension toward the BOA would fly over the central and northern part of Meck. As noted for the Low Level-of-Activity Alternative at Meck, barricades between launch silos and building hardening help protect equipment and other property, and all but essential personnel are evacuated from the island during launches. Launches from the southern end of the island would require similar protections, which would be identified and approved through safety hazards analysis before any of the expanded activities that make up this alternative could take place. Implementation of existing and planned safety procedures should result in nonsignificant impacts on ground safety.

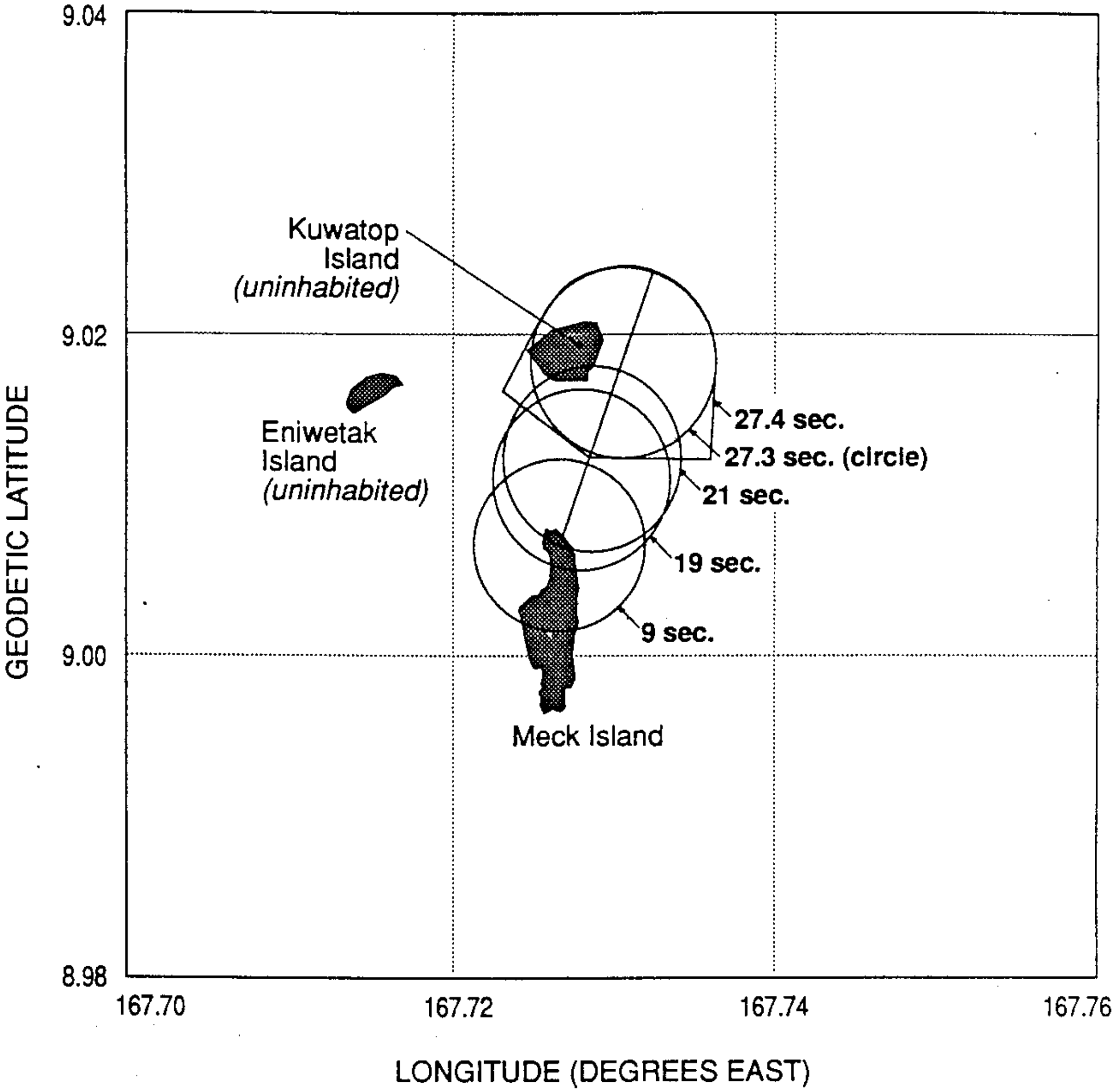
ILLEGINNI

In the Intermediate Level-of-Activity Alternative, Illeginni would be renovated to enable launches of the SLVs from the abandoned Spartan launch pad. Construction would include six launch silos, several support buildings, and utilities. This construction activity would be similar to construction that took place on Meck in 1989-90. Nonsignificant impacts on personnel safety occurred in that renovation and similar nonsignificant impacts are expected for the new construction.

After construction is completed, the facilities would be used for the assembly and preparation of interceptor launch vehicles. Rocket motors would be assembled and launched on the southern end of the island. Motors would be stored on Kwajalein and brought to Illeginni by barge as needed. Missions with multiple concurrent launches would require multiple missiles in the silos on Illeginni.

Launches for the Theater Missile Defense (TMD) program could occur toward the southwest or northeast. These Illeginni TMD test launches would intercept a target missile launched from a platform (such as a barge) that would be located up to 500 kilometers to the southwest or northeast. Target and interceptor debris would fall in open ocean areas southwest of Kwajalein. These TMD launch programs would undergo the same safety analysis by the USAKA Range Safety Office as all other launch programs at USAKA. The Range Safety Office analysis would ensure (through the imposition of flight constraints, if necessary) that all flights meet established range safety requirements, which are designed to minimize the potential impact that a missile or debris would have on a protected area (e.g., all inhabited islands).

EOD has been done at the northern end of Illeginni for several years, and might continue there, if necessary. Unexploded ordnance from World War II is routinely found during construction and excavation on many USAKA islands. The types of



U.S. ARMY KWAJALEIN ATOLL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT	**Debris Footprint for Flight Termination for Launch from Meck**

FIGURE 4.15-2

tracking equipment. Passenger aircraft activity would increase before and after missions. Existing and planned safety procedures should result in nonsignificant impacts to flight safety.

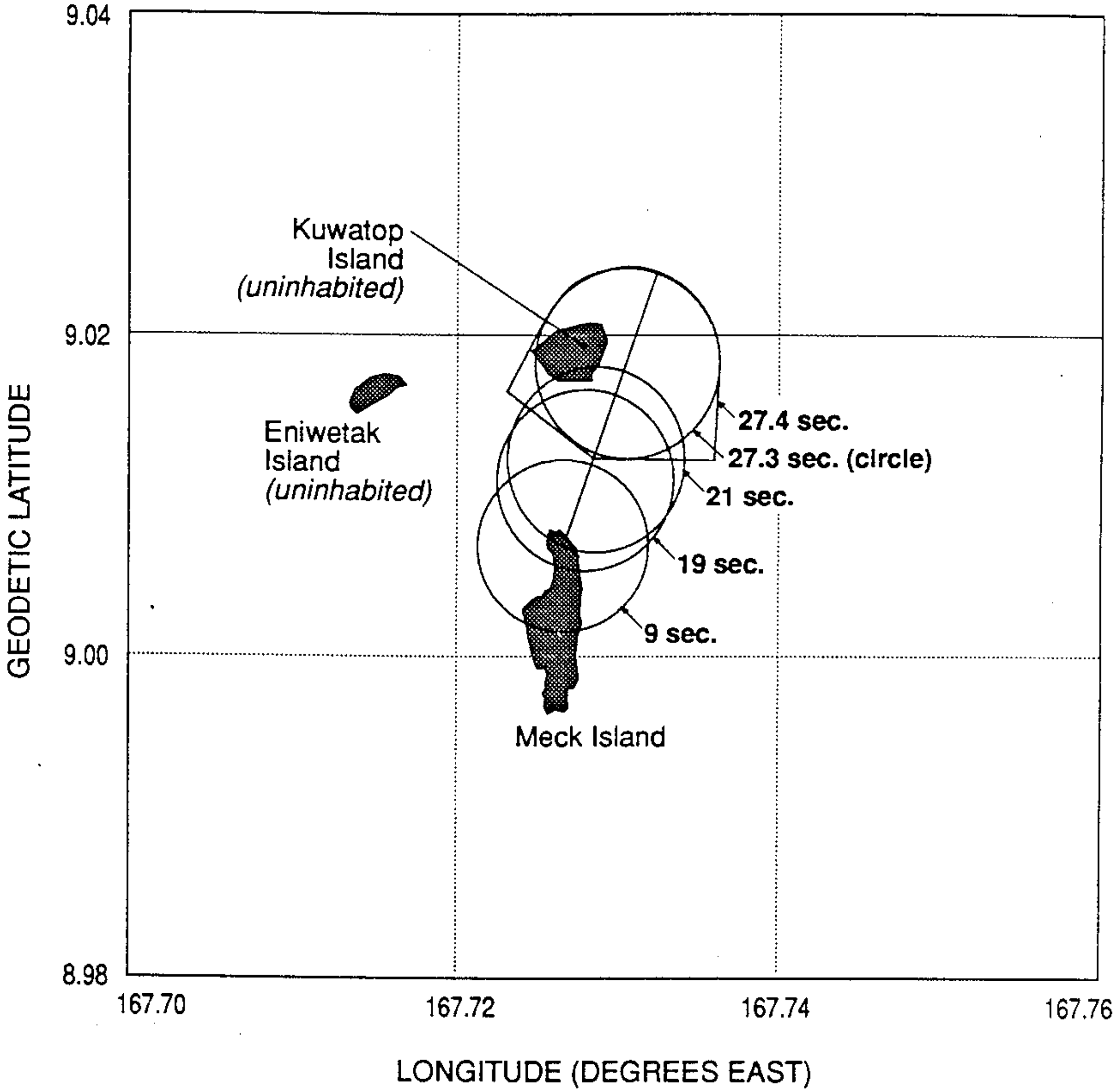
MECK

Increased numbers of SLV launches would occur from Meck—as many as 24 launches per year, including launches of up to four SLVs near simultaneously. Before multiple launches could occur, flight safety studies would be performed to ensure that multiple launches could not compromise range safety requirements. Although meeting range safety requirements while conducting multiple launches could require modifications of buildings or flight operations, multiple launches would not be permitted to take place without agreement by the Range Safety Office that safety requirements would be met. For that reason, nonsignificant impacts to flight safety could be expected.

Figure 4.15-2 shows the debris footprint of an M-56/M-57 booster system (representative of TMD target vehicle launches) at intervals from 9 to 27.4 seconds after launch. Such footprint analyses are used by flight safety officers to model the location of debris impacts if a flight had to be terminated during specified intervals after launch. Hazardous debris would be contained inside each circle if the flight were terminated at that time period after launch. By 27.4 seconds, the missile in this test would pitch over to such a point that the debris footprint is best represented by a pie-shaped figure. It should be noted that Meck has served as the launch location for a large number of missile tests beginning with the Safeguard Ballistic Missile Defense Test Program in the 1960s. Seventy missile tests were conducted for the Safeguard system at USAKA. Of these seventy launches, 12 experienced failures and were destroyed in the BOA. Some of the boosters impacted in the lagoon, as well as approximately ten of the target reentry vehicles. None of these incidents resulted in injuries or damage to non-USAKA property.

Figure 4.15-2 is an example of a debris footprint for a particular launch from Meck under specific assumptions about speed and altitude; Figure 4.15-1 shows the intercept debris patterns for a comparable past program—ERIS. Times and footprint sizes would vary in accordance with the particular missile configuration involved and the segment of the trajectory; however, in all cases, the safety analysis would ensure that no debris footprint impinges on the protected area surrounding each island other than Meck Island. At Meck, personnel safety would be assured by prohibiting all but essential personnel from being present during launches. Personnel required to be present would be sheltered in hardened buildings designed to protect personnel during launches.

Figure 4.15-3 shows the target and interceptor debris footprints for TMD launches from Meck and Illeginni. As the figure illustrates, similar debris footprints to those described above would be used to analyze debris footprints to ensure that protection circles around each island are maintained.



U.S. ARMY KWAJALEIN ATOLL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT	**Debris Footprint for Flight Termination for Launch from Meck**

FIGURE 4.15-2

OMELEK

The numbers of SLV launches that would occur from Omelek would be similar to those for the Low Level-of-Activity Alternative. Adherence to existing range safety requirements and practices would ensure that there would be no or negligible impacts to flight safety.

ILLEGINNI

Illeginni would be renovated so that up to six simultaneous launches of SLVs could occur. Some of these launches could be in conjunction with SITs involving concurrent launches of SLVs from Omelek and Meck. Other launches would be for TMD testing. As shown in Figure 4.15-3, the TMD launches could occur to the southwest, as targets for interceptors launched from a fixed platform (such as a barge) located up to 500 kilometers to the southwest. Target and interceptor debris would fall in open ocean areas to the southwest of Kwajalein Atoll, as shown in Figure 4.15-3. Adherence to existing range safety practices and procedures would ensure that nonsignificant impacts on flight safety would occur.

OTHER ISLANDS AND BROAD OCEAN AREA

An increased number of reentry vehicle and interceptor missions would be part of the Intermediate Level-of-Activity Alternative. Targets launched from California, Hawaii, Wake Island, and ocean platforms would impact in the lagoon and the BOA, and debris from interceptions would land in the BOA and in the ocean to the southwest of Illeginni and, possibly, on uninhabited islands within the debris footprint.

Increased flight activity would require the same protective measures as in the Low Level-of-Activity Alternative. Protective measures would include: sheltering nonessential personnel on "Take Cover" islands; evacuation of nonessential personnel from "Debris Hazard" islands, and evacuation of all personnel from "Evacuation" islands. A NOTAMS would be issued before and during tests to clear the affected areas of aircraft traffic. Because expanded activities would be preceded by flight safety analyses, no significant impact is anticipated.

Mitigation

The proposed EOD pit at Ennugarret requires the evacuation of any Marshallese from the entire island. This would necessitate obtaining full control of the island by USAKA, either through a lease or a restrictive easement, for the duration of EOD activities.

HIGH LEVEL OF ACTIVITY

Impacts

Ground Safety

This alternative would involve increased numbers of SLV and sounding rocket flights, thereby increasing the number of hazardous operations and the potential for accidents. Before any expanded activities would occur, analyses of potential ground safety hazards and any required changes in buildings and procedures would be conducted, as described for the Low Level-of-Activity Alternative. Because expanded activities would require such analyses and precautions to ensure conformance with safety regulations, this alternative would have nonsignificant impacts on ground safety.

Activities specific to each island are described below.

MECK

There would be an increase in mission activity on Meck in the High Level-of-Activity Alternative, with as many as 28 SLV launches per year (including near-simultaneous launches of six boosters).

OMELEK

Omelek would undergo construction of a launch hill to accommodate two silos for SLV launches. This would double the capacity of launches from Omelek, and provide a double simultaneous launch capability.

ENIWETAK

Eniwetak would undergo significant construction for the installation of six silos similar to the renovation of Illeginni in the Low Level-of-Activity Alternative. This alternative would allow Eniwetak to have the capability to launch SLV interceptor missions.

GELLINAM

Gellinam would be used for meteorological rocket launches in the High Level-of-Activity Alternative.

Flight Safety

Flight safety issues change substantially with the expansion of launch capabilities at Omelek, Eniwetak, and Gellinam. The nature of flight safety impacts would not change, but the number and frequency of launches and launch locations would require enhanced range safety coordination. New missions would require approved flight safety plans defining areas potentially affected by the operations, caution and in a 6-minute period for radio frequencies above 300 megahertz (MHz) has been derived from test data on human health, and is widely used as a standard for radar safety. As described in Section 3.16, this PEL derives from a PEL of 0.4 watt per kilogram in a 6-minute period, which contains a safety factor of 10.

Table 4.16-1
Frequency Spectrum

Frequency (Hertz)	Characteristics
50 or 60 Hz	Alternating current electric power
20 to 20,000 Hz	Range of human hearing
500 kHz to 1,100 kHz	AM radio band
88 MHz to 106 MHz	FM radio band
170 MHz to 280 MHz	Television broadcast band
100 MHz to 300,000 MHz	Radar systems
700,000 GHz to 1,000,000 GHz	Daylight
1,000,000 GHz to 10,000,000 GHz	Ultraviolet light
1,000,000,000 GHz	X-rays

In the last two decades, several studies have addressed the potential health effects of exposure to extremely low frequency (ELF) radiation and radio frequency radiation. These studies have looked at exposures in residential settings, and suggest that human exposure to magnetic fields associated with electric transmission lines and home wiring and appliances may affect human health at levels considerably lower than those that could cause cellular heating. These studies are summarized in the 1989 FEIS, pages 4-33 through 4-43.

Since the 1989 EIS was published, there have been a number of studies that have addressed the potential effects of 60-Hz magnetic fields. A residential epidemiology study completed in Los Angeles in 1990 attempted to replicate the findings of the Wertheimer and Leeper (1979) and Savitz et al. (1988) studies cited in the 1989 FEIS (pages 39-40). The results of the Los Angeles study conducted by Dr. John Peters (Johns Hopkins University, 1991) generally confirm the results of these earlier studies, by finding an increased risk of cancer associated with certain wiring configurations, without finding a correlation to directly measured magnetic fields.

The most recent study on this issue was released September 30, 1992, in Stockholm. Doctors Maria Feychting and Anders Ahlbom investigated the relationship between magnetic fields from high-voltage transmission lines (220 kV and 440 kV) and the incidence of cancer in children and adults. The Swedish study found no correlation between actual spot measurements of magnetic fields and cancer incidence, but it did find a small but statistically significant relationship between measures of individuals' historic exposure to electromagnetic frequency (EMF) and the incidence of childhood leukemia (Feychting and Ahlbom, 1992).

The Peters and Feychting/Ahlbom and similar studies investigating the health effects of powerlines were concerned with 60-Hz (ELF) radiation associated with electrical power transmission. As was discussed in the 1989 FEIS (pages 4-40 to 4-42), a pulse-modulated radar system exhibits certain characteristics that are similar to ELF frequencies. A pulsed radar signal operates by turning a radio frequency transmitter on and off at a rate of between 15 and 20,000 cycles per second (Hertz). It is possible for radar systems to operate with a modulation frequency of 50 to 60 Hz, the same frequency as alternating current (AC) power systems. If there is a physiological effect resulting from exposure to alternating current magnetic fields, it is possible that there could be a similar effect from exposure to radar emissions pulsed at the same modulation frequency. To date, the research that has been completed cannot confirm or refute this hypothesis.

Eight studies of radio frequency radiation and, specifically, radar emissions (U.S. EPA, 1990), more closely pertain to the radar frequency emissions at USAKA (Lilienfield et al., 1978; Robinette and Silverman, 1977; and Robinette et al., 1980; Milham, 1985a and b, and Milham, 1988a and b; State of Hawaii Department of Health, 1986; Hill, 1988; Szimiglelski et al., 1988). These studies suggest that a variety of tumors or pre-cancerous growths may occur with exposure to low levels of pulsed and unpulsed radio frequency emissions; however, none of these studies provides statistically valid evidence to support a correlation between radio frequency emissions and cancer.

In late 1990, the U.S. EPA Office of Research and Development released a review draft report titled *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields* summarizing preliminary findings on the effects of various types of electromagnetic radiation, including radar, on humans. The report includes no definitive findings regarding health effects of electromagnetic fields. The studies to date have not been conclusive. In some cases, results have not been reproducible between studies, while in other cases, there is a lack of exposure data that demonstrate dose-response effects, or the data are confounded by other variables that mask possible effects of exposure to radio frequency emissions. U.S. EPA has reached no conclusions that would cause the current exposure standards to be changed. The draft document has been reviewed by U.S. EPA's Science Advisory Board and U.S. EPA is now taking comment from the public. After public comments and the results of certain ongoing studies have been incorporated, the document will be issued in final form in 1994.

Pending results of the continuing research, radio frequency emissions from the radars will be controlled to below 5 mW/cm^2 measured at ground level. If research identifies a need to change standards for exposure to radio frequency emission, these standards would be promulgated through USAEHA and operations would be modified appropriately.

NO ACTION

Impacts

In the No-Action Alternative, the cumulative impacts of several existing radar, communications, and radio frequency transmitters would not exceed power densities of 4.3 mW/cm^2 anywhere on Kwajalein. The GBR-X and other radars would operate singly or together. Operational controls, mechanical stops, and software interlocks prevent exposure in excess of PEL guidelines, as described in Section 4.15 of the 1989 EIS. Because changes in EMR exposure would not exceed established human health standards, nonsignificant impacts are expected.

LOW LEVEL OF ACTIVITY

Impacts

The electromagnetic environment would be affected by the GBR-T radar, which is more powerful than other radars currently in use on Kwajalein. GBR-T radar design and development are in progress, and performance specifications have not yet been defined. The GBR-T would use a pulsed microwave beam to detect and track objects. The main beam normally would be operated at or above an inclination of 2 degrees. This would result in no exposure from the main beam above the PEL of 5 mW/cm^2 on the ground or ocean surface in the immediate area of the radar.

The following information is taken from *A Ground Based Radar (GBR) Family of Strategic and Theater Radars Environmental Assessment* (U.S. Army Program Executive Office, Missile Defense, June, 1993):

The antenna design for GBR-T creates a different antenna pattern that, in addition to a main beam and side lobes, includes grating lobes. Grating lobes are secondary beams whose energy is generally above side lobe energy but below main beam energy. Grating lobes of primary concern (i.e., those directed at the ground) occur at angles in the range of 31 to 46 degrees with respect to the main beam. Although grating lobes occur, their effects can be controlled to a safe level. The far-field power density in the grating lobes varies with positions and operational variables but never exceeds a strength of 0.8 percent (-21 decibels [dB]) of the main beam at the same distance in the far field. The main beam would normally be operated at an angle of at least 2 degrees in elevation above horizontal; therefore, the EMR hazard of the main beam would only occur well above earth and water surfaces. It is possible that the GBR-T, under certain range operations such as missile transponder acquisition for range safety and splashdown observation, would operate the main beam below the normal minimum of positive 2 degrees. GBR-T activities during these range operations are restricted to a greatly reduced duty cycle to ensure that EMR safety standards are not exceeded.

Safe operation of the GBR-T is a major criterion associated with the design of the system. Inherent to the GBR-T design is the requirement that EMR power densities

- To ensure personnel safety and eliminate the need for a controlled-access zone outside the GBR-T facility, independent evaluations by Raytheon Company and USAKA safety personnel would verify the ability of the GBR-T to control power densities on land and sea. Testing would be supported by the placement of measuring equipment in the vicinity of the GBR-T. To ensure that personnel exposure limits are not exceeded, testing would proceed in a step-by-step manner, initially using low duty cycles to perform limited radar operations. Only when measurements successfully verify the predicted operational conditions would increases in power levels for testing be allowed.

The monitoring system receives radar commands directly from the data line between the data processor and the radar. It computes the EMR grating and side lobe strength at ground level every second for the geographical cells and will inhibit EMR transmission if the specified limits are approached. The program will be calibrated by using actual measurements as the GBR-T system becomes operational at USAKA. In addition, the pole-mounted EMR sensors, which continuously monitor the radar emissions, report the measured power density to the monitoring system to inhibit EMR transmission if the power-density threshold is approached. This system is in addition to the main data processor, and would have EMR safety rules or algorithms to schedule each transmitted beam. These safety measures ensure personal safety at USAKA and in the off-shore vicinity.

The GBR-T is near Bucholz Army Airfield on Kwajalein Island, and EMR from the radar that might impact personnel and aircraft activities at the airport will be controlled. In addition to the potential hazard to personnel identified above, large electromagnetic fields can detonate electroexplosive devices (EEDs) or induce malfunctions in avionics equipment on aircraft. Actions similar to those described above for mitigating personnel exposure will limit EMR power density at the airport, except that power density criteria for human exposure and for EED safety will be applied. The limit for EEDs is currently an instantaneous power density of 10 mW/cm^2 (Air Force Regulation 127-100, August 3, 1990, *Explosive Safety Standards*).

If aircraft in flight are illuminated at close range by the radar, malfunctions induced in avionics equipment or EED detonations are possible. Prior permission from the Commander of USAKA is required to land at Bucholz and the airspace out to 180 nautical miles (nmi) is controlled by the tower or the FAA Air Route Traffic Control Center at Oakland, California, so aircraft without the knowledge and permission of an air traffic control authority are not expected to fly within close range of GBR-T. Local flights are managed by the tower and USAKA flight operations. Because all GBR-T operations that involve transmitting EMR energy would be considered Kwajalein Missile Range operations, GBR-T EMR will be coordinated with other activities, including range safety and flight safety, through the range scheduling organization. The range schedule is therefore the probable vehicle for coordinating GBR-T EMR with flight operations to avoid illuminating aircraft at close range. In addition, communication procedures will be established with the tower and the range safety organization to inhibit EMR immediately should an unplanned penetration of a hazard zone occur. Additional safety measures, to be developed in cooperation with FAA and USAKA flight safety personnel, would be designation of any aviation hazard areas, publication of NOTAMS, and briefings to local aviators about any safety procedures that may be needed regarding GBR-T.

Electromagnetic Compatibility Analysis Center (ECAC) studies were conducted to examine the potential for interference with or damage to marine and aeronautical weather radar systems from high-intensity, pulsed-radar fields arising from the GBR-T operation, and to identify the means to eliminate any unacceptable risk of such impacts. Means to control interference or damage to marine and aeronautical weather radar systems may include coordinating GBR-T test activities with aircraft and marine activity, control tower operations, and other USAKA operations; and issuing an appropriate NOTAMS to specify procedures for coordination between the aircraft control tower and approaching aircraft.

GBR-T system design and operation would limit human exposure to acceptable levels. This would reduce any impact of the GBR-T electromagnetic fields on fuel ignition hazards, prevent any inadvertent detonation of EEDs or ordnance, and reduce interference with critical medical electronic devices such as cardiac pacemakers.

Potential hazards from fuel ignition or inadvertent detonation of explosives and ordnance would be evaluated by calculating the potential EMR levels of the locations involved (e.g., hot pads, meteorological rocket launchers, fueling points) and comparing the EMR levels with all applicable safety criteria. Before initiating activities involving the use of explosive devices and/or fueling operations during GBR-T activities, measurements would be taken at the selected sites using the USAKA mobile EMR surveillance system or portable hand-carried instrumentation, as appropriate. If measurements indicate a potential hazard, operational constraints would be imposed to eliminate the potential hazards by coordinating USAKA and GBR-T operations.

Although EMR levels associated with the GBR-T would be less than the personnel exposure limits established in U.S. Army standards, there is a possibility that such EMR could affect the operation of some models of cardiac pacemakers. Because of the potential for significant adverse effects in the form of interference with cardiac pacemakers worn by some individuals living on and traveling to Kwajalein Island, an administrative procedure would be implemented to inform all travelers of the presence of EMR fields near the GBR-T before traveling to USAKA. Separately, residents of USAKA who wear pacemakers would be identified and informed of the EMR fields near the GBR-T prior to initiation of operation.

Mitigation

Because no new or existing sources of EMR would be allowed to operate at USAKA without controls to ensure compliance with Standards, no significant impacts are expected.

PROPOSED ACTION: INTERMEDIATE LEVEL OF ACTIVITY

Impacts

Splash Detection Radar/Hydroacoustic Impact Timing System. The installation of new SDR and rehabilitation of other SDR and HITS would have a negligible impact on human health resulting from EMR exposure. As explained on page 3-204 of the 1989 DEIS, the radiation hazard radius of the SDR is 213 feet (65 meters). This radius is small and access within this area is easily controlled. The HITS system is a sound receiving system only. There is no transmitter associated with the HITS system.

Ground Entry Point. As part of the GSTS/GBI test programs, an Extremely-High-Frequency (EHF) transmitter/receiver would be installed on Kwajalein and Roi-Namur. As shown in Figures 2.1-17 and 2.1-18, a total of four possible locations are under consideration. Three of these sites are along the lagoonside of Kwajalein, and the fourth is on the northeast side of Roi-Namur. Only one of the three sites on Kwajalein would be selected in addition to the single site on Roi-Namur. The GEP transmitter would operate at 44 GHz (uplink) and 20 GHz (downlink), with a maximum power of 200 watts. The transmitter would be connected to a parabolic dish antenna to provide a narrow beam that is focused on the missiles being tracked.

Siting and installation details for this transmitter have not yet been determined. An analysis of potential electromagnetic interference was completed in August 1993 by the ECAC. This analysis determined that a separation distance of 36 feet is required between the GEP transmitter antenna and any communications equipment to avoid potential high-power interference interactions, but no separation distance is required between the GEP antenna and personnel in order to meet EMR exposure standards and operation of the GEP will not pose an electromagnetic radiation hazard to personnel. Operation of the GEP would be compatible with the operation of the GBR-T radar at the three GEP sites proposed on Kwajalein as long as the GBR-T antenna grating lobes are not scanned across the GEP site when the GEP is attempting to receive signals. Operation of the GEP would be compatible with radars at Roi-Namur as long as operation of the GEP is coordinated with operation of the other Roi-Namur radars.

Specific control measures would be selected during the siting of the GEP facility; however, by Army Regulation, the facility could not be operated unless controls and mitigations were installed to ensure that Army exposure standards are not violated. For that reason, the GEP should have nonsignificant impacts on the EMR environment.

Theater Missile Defense Ground-Based Radar. In this alternative, a mobile Theater Missile Defense Ground-Based Radar (TMD-GBR) could be temporarily deployed at Meck, Omelek, Illeginni, Gagan, Gellinam, and/or Legan, to track interceptors launched from Meck, Omelek, or Illeginni. The radar's operating frequency is anticipated to be between 8 and 12 GHz, with a pulsed emitter operation.

The TMD-GBR is being designed to ensure that all personnel are not exposed to EMR power densities exceeding 5 mW/cm^2 averaged over any 6-minute period, or 50 mW/cm^2 averaged over any 1-second period, or 1 mW/cm^2 averaged over any 6 minutes at distances greater than 1 km from the radar. TMD-GBR system design and operation would limit exposure to within these levels, would reduce any impact of the TMD-GBR EMR fields on fuel ignition hazards, prevent any inadvertent detonation of EEDs or ordnance, and reduce interference with critical medical electronic devices such as cardiac pacemakers. The TMD-GBR main beam normally would be operated at an angle of at least 4 degrees above horizontal, greatly reducing the potential for exposure to EMR by focusing the main beam above the earth's surface and away from humans and wildlife. Control measures for EMR would also include a safety zone extending out to 330 feet (100 meters) in front of the antenna equipment unit. This zone would be identified with warning signs indicating that the area is unsafe to enter. Warning lights would also be activated during periods when the radar is transmitting. The six islands proposed as temporary sites for use of the TMD-GBR are all uninhabited islands with access controlled by USAKA; this access control will help ensure that the EMR control measures prevent any hazards to personnel.

The operation of the TMD-GBR could result in interference with military and aircraft communications systems. However, range operations scheduling procedures, including the enforcement of air space restrictions, would eliminate adverse effects to such equipment. In addition, the TMD-GBR would have no adverse effects to EEDs, including ordnance storage areas, because no such areas are located within several kilometers of any of the proposed locations of the TMD-GBR. Interference with any EEDs temporarily present on the islands proposed for TMD-GBR use (e.g., EEDs aboard rocket motors prepared for launch from Meck, Omelek, or Illeginni) will be prevented by coordinating scheduling and/or separation distances. The controls built into the design and operation of the TMD-GBR would ensure no significant impacts on human health and safety.

Mitigation

Because no new or existing sources of EMR would be allowed to operate at USAKA without controls to ensure compliance with Standards, no significant impacts are expected.

HIGH LEVEL OF ACTIVITY

Impacts

In this alternative, the TMD-GBR might also be operated at Eniwetak and Omelek Islands. Impacts would be as described above for the Intermediate Level of Activity.

Mitigation

Because no new or existing sources of EMR would be allowed to operate at USAKA without controls to ensure compliance with Standards, no significant impacts are expected.

4.16.2 Proposed USAKA Environmental Standards and Procedures

There are no proposed USAKA Environmental Standards and Procedures that address electromagnetic radiation.

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Bibliography and References

Abadie, C. J., Jr. Base Operations Manager, USAKA. Personal communication. March 22, 1989.

ACGIH. See American Conference of Governmental Industrial Hygienists.

Adriani, A., et al. 1987. Correlated Behavior of the Aerosol and Ozone Contents of the Stratosphere after the El Chichon Eruption. *Journal of Geophysical Research* 92 (D7):8,365-8,372.

AECOS, Inc. 1988. *Water Quality Sampling Study at Kwajalein and Roi-Namur Islands*. Fort Shafter, HI: U.S. Army Corps of Engineers.

Aftergood, S. 1991. Poisoned Plumes. *New Scientist* (1,785):34-38.

Alexander, W. J. 1978. *Wage Labor, Urbanization, and Cultural Change in the Marshall Islands: The Ebeye Case*. Doctoral Thesis. New York: The New School for Social Research.

Allen, H. C., et al. 1991. *A Study of Ozone Layer Damage by Freon 114b2 and Alternative Fluids for the STARS Second-Stage TVC*. Huntsville, AL: U.S. Army Strategic Defense Command.

American Conference of Governmental Industrial Hygienists. 1992. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1991-1992*. Cincinnati, OH.

__________. 1990. *Threshold Limit Values and Biological Exposure Indices for 1990-1991*. Cincinnati, OH.

American Institute of Aeronautics and Astronautics. 1991. *Atmospheric Effects of Chemical Rocket Propulsion*. Report of an American Institute of Aeronautics and Astronautics workshop, Sacramento, CA. June 28 and 29. Washington, DC. October 1, 1991.

Amerson, A. B., Jr. 1969. *Ornithology of the Marshall and Gilbert Islands*. Atoll Research Bulletin No. 127.

Amesbury, S., et al. 1975. *Limited Current and Underwater Biological Surveys of Proposed Sewer Outfall Sites in the Marshall Islands District: Ebeye, Kwajalein Atoll*. University of Guam Technical Report No. 22. University of Guam Marine Laboratory.

Anderson, F. R., D. R. Mandelker, and A. D. Tarlock. 1984. *Environmental Protection: Law and Policy*. Boston, MA: Little, Brown and Co.

Anderson, J. G., et al. 1989. Kinetics of O_3 Destruction by ClO and BrO within the Antarctic Vortex: An Analysis Based on *in situ* ER-2 Data. *Journal of Geophysical Research* 94 (D9):11,480-11,520.

Anderson, K., JCWSI. 1992. Personal communication. March.

Asian Development Bank and the Government of the Republic of the Marshall Islands. 1990. *Consultant's Final Report, Fisheries Development Project.* T.A. No. 1379: MAR. December 1990.

Association of American Railroads. 1989. *Hazardous Materials Regulations of the Department of Transportation, by Air, Rail, Highway, Water, and Military Explosives by Water including Specifications for Shipping Containers.* Bureau of Explosives Tariff No. BOE-6000-I.

Athens, J. S. 1984. Archaeological Reconnaissance Survey of Six Islets at Kwajalein Atoll, Marshall Islands. Appendix prepared for Sea Engineering, Inc. In *Draft Environmental Impact Statement/U.S. Department of the Army Permit Application, Discharge of Fill Material for the Kwajalein Atoll Causeway Project.* Honolulu, HI: U.S. Army Corps of Engineers.

Baker, R. H. 1951. *The Avifauna of Micronesia: Its Origin, Evolution, and Distribution*. University of Kansas, Museum of Natural History.

Bell Telephone Laboratories and Kwajalein Post 10268,Veterans of Foreign Wars. 1974. The Battles of Kwajalein and Roi-Namur. *The Interceptor*. Reprint.

Bennet, R. R., J. C. Hinshaw, and M. W. Barnes. 1991. *The Effects of Chemical Propulsion on the Environment*. New York: American Institute of Aeronautics and Astronautics.

Bond, R., Chief, Construction Management Branch, U.S. Army Health Facilities Planning Agency. 1992. Personal communication. July.

Bowers, R. L. 1978. *Brief Marine Biological Reconnaissance of Several Nearshore Areas in the Kwajalein Atoll, Marshall Islands*. Submitted to M & E Pacific, Inc.

Brewer and Associates. 1984. Baseline Marine Environmental Survey of Kwajalein Atoll. In *1985 Draft Environmental Impact Statement/ U .S. Department of the Army Permit Application for Discharge of Fill Material for the Kwajalein Atoll Causeway Project*. U.S. Army Corps of Engineers.

Bryan, E. H., Jr. 1972. *Life in the Marshall Islands*. Honolulu, HI: Pacific Scientific Information Center, Bernice P. Bishop Museum.

CFR. See Code of Federal Regulations.

Chemical Propulsion Information Agency. 1979. *Rocket Motor Manual*. Baltimore, MD: Johns Hopkins University Applied Physics Laboratory.

Clapp, R. B. 1988. *Notes of the Birds of Kwajalein Atoll, Marshall Islands*. Prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division. Washington, DC: National Ecology Research Center, U.S. Fish and Wildlife Service, National Museum of Natural History.

Cocks, A. T., and W. J. McElroy. 1984. The Absorption of Hydrogen Chloride by Aqueous Aerosols. *Atmospheric Environment* 18 (7):1,471-1,483.

Code of Federal Regulations. Title 36 Parks, Forests, and Public Property, Chapter I National Park Service, Interior, Parts 60 to 60.4. Revised July 1, 1991. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

_________. Title 40 Protection of the Environment, Chapter I Environmental Protection Agency, Part 50. Revised July 1, 1991. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

_________. Title 40 Protection of the Environment, Chapter I Environmental Protection Agency, Parts 100 to 140 and 400 to 403. Revised July 1, 1991. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

_________. Title 36 Parks, Forests, and Public Property, Chapter VIII Advisory Council on Historic Preservation, Protection of Historic and Cultural Properties, Part 800. Revised July 1, 1991. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

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_________. Title 40 Protection of the Environment, Chapter V Council on Environmental Quality, Parts 260 to 272. Revised July 1, 1990. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

_________. Title 40 Protection of the Environment, Chapter V Council on Environmental Quality, Parts 1500 to 1508. Revised July 1, 1991. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

_________. Title 49 Transportation, Chapter I Research and Special Programs Administration, Department of Transportation, Parts 100 to 199. Revised October 1, 1990. Washington, DC: Office of the Federal Register, National Archives and Records Administration.

Cofer, W. R., III, G. G. Lala, and J. P. Wightman. 1987. Analysis of Mid-Tropospheric Space Shuttle Exhausted Aluminum Oxide Particles. *Atmospheric Environment* 21 (5):1,187-1,196.

Coles, S. L., et al. 1976. Thermal Tolerance in Tropical vs. Subtropical Reef Corals. *Pacific Science* 30; pp. 159-166.

Corby, P., JCWSI. 1992. Personal communication. February 1992.

Cour-Palais, G. B., comp. 1977. *Proceedings of the Space Shuttle Environmental Workshop on Tropospheric Effects* (NASA TM X 58199). Houston, TX: National Aeronautics and Space Administration.

Cox, R. V. 1979. Personal communication. *KMR Shadowgraphs for Instrumentation Site*. Huntsville, AL: Kentron International, Incorporated. July.

Craib, J. L. 1989. *Archaeological Reconnaissance Survey and Sampling, U.S. Army Kwajalein Atoll Facility (USAKA) Kwajalein Atoll, Republic of the Marshall Islands, Micronesia*. Prepared by ERC Environmental and Energy Services Company. Honolulu, HI: U.S. Army Corps of Engineers. February 6, 1989.

Cross, B., Programming and Analysis Branch, U.S. Army Health Facilities Planning Agency. 1992. Personal communication. August.

Crowel, P. A., and E. G. Love. 1955. *Seizure of the Gilberts and Marshalls: The War in the Pacific: United States Army in World War II*. Washington, DC: Government Printing Office.

Dale, P., JCWSI Education Services. 1992. Personal communication. February.

_________. 1991. Personal communication.

Darwin, C. 1898. *The Structure and Distribution of Coral Reefs*. New York: D. Appelton and Company.

Denfeld, D. 1980. *An Historic Site Survey of Kwajalein Missile Range, Kwajalein Atoll, Marshall Islands*. Agana, Guam: Pacific Studies Institute.

Devaney, D. M., et al. 1987. *The Natural History of Eniwetak Atoll.* U.S. Oak Ridge, TN: Department of Energy, Office of Scientific and Technical Information.

Dohrman, G. 1992. USAKA. Personal communication. October 9, 1992.

Dreschel, T. W., and C. R. Hall. 1985. *Near-Field Deposition Patterns of Chlorides and Particulates Resulting from Launches of the Space Transportation System at the John F. Kennedy Space Center.* Contract NAS10-10285.

Dye, T. 1987. Archeological Survey and Test Excavations on Arno Atoll, Marshall Islands. In *Marshall Islands Archaeology.* T. Dye, ed. Pacific Anthropological Records No. 38. Honolulu, HI: Bernice P. Bishop Museum.

Eady, C., Manager, Air Services Department, DynCorp. 1992. Personal communication. May.

ECT. See Environmental Consulting & Technology, Inc.

Eckert, K. L. 1991. *The Biology and Population Status of Marine Turtles in the North Pacific Ocean.* Final Report Prepared Pursuant to NOAA/NMFS Purchase Order 40ABNF002067.

Emery, K. O. 1956. In *Military Geography of the Northern Marshall Islands.* U.S. Army Intelligence Division, Office of the Engineer, Headquarters, U.S. Air Force Engineers with U.S. Geologic Survey.

Environmental Consultants, Inc. 1977. *Reconnaissance Survey of Terrestrial and Marine Environments on Illeginni, Kwajalein Atoll.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division, Contract No. DACW84-77-C-0034.

Environmental Consulting & Technology, Inc. 1992. *An Environmental Assessment for the U.S. Army Kwajalein Atoll Submarine Fiber Optic Transmission System.* McLean, VA: Northern Telecom Federal Systems. January 1992.

Feychting, M., and A. Ahlbom. 1992. Magnetic Fields and Cancer in People Residing Near Swedish High Voltage Power Lines. *EMF News, Vol. 2, No. 18.* October 12.

Federal Aviation Administration. 1992. *Air Traffic Control Capacity for Bucholz Airfield.*

Forsyth, R. G., and G. H. Balazs. 1989. *Species Profiles: Life Histories and Environmental Requirements of Coastal Vertebrates and Invertebrates, Pacific Ocean Region; Report 1, Green Turtle*, Chelonia mydas (Technical Report EL-

89-10). Prepared by National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Honolulu, HI. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

Fosberg, F. R. 1956. *Military Geography of the Northern Marshall Islands.* Washington, DC: U.S. Army Chief of Engineers.

Gallagher, A., Meck Island Utilities Superintendent, JCWSI. 1991/1992. Personal communication.

Garrett, H. B., and C. P. Pike. 1980. *Space Systems and Their Interactions with Earth's Space Environment.* Air Force Geophysics Laboratory, American Institute of Aeronautics and Astronautics.

Gerritsen, F. 1981. Wave Attenuation and Wave Set-up on a Coastal Reef. *Look Lab Technical Report 48.* Honolulu, HI: University of Hawaii.

__________. 1980. Wave Attenuation and Wave Set-up on a Coastal Reef. *Proceedings of the 17th Annual International Conference of Coastal Engineers.* Pp. 444-469. New York: American Society of Civil Engineers.

Global Associates. 1987. *Analysis of Existing Facilities: U.S. Army Kwajalein Atoll, Marshall Islands.* DASG60-82-C-0063. Huntsville, AL: U.S. Army Strategic Defense Command. June 1987.

GMP Associates. 1989. *U.S. Army Kwajalein Atoll Draft Waste Management Plan Report.* Contract DACA83-89-C-0025. Honolulu, HI: U.S. Army Corps of Engineers, Pacific Ocean Division.

Gorenflo, L. J., and M. Levin. 1989. The Demographic Evolution of Ebeye. *Pacific Studies.* Vol. 13.

Gunesaka, H. M., RMI Office of Planning and Statistics. 1993. Personal communication. August 11.

Harris, C. M., Ed. 1979. *Handbook of Noise Control.* 2nd Ed. New York: McGraw Hill Book Co. 1979.

Hawkins, W. E., R. M. Overstreet, and M. J. Provancha. 1984. Effects of Space Shuttle Exhaust Plumes on Gills of Some Estuarine Fishes: A Light and Electron Microscopic Study. *Gulf Research Reports* 7 (4):297-309.

Heck, W. W., et al. 1980. *Response of Selected Plant and Insect Species to Simulated Solid Rocket Exhaust Mixtures and to Exhaust Components from Solid Rocket*

Fuels (NASA TM 74109). John F. Kennedy Space Center, FL: National Aeronautics and Space Administration.

Henricksen, T., et al. 1990. Ultraviolet-Radiation and Skin Cancer Effect of an Ozone Layer Depletion. *Photochemistry and Photobiology* 51 (5):579-582.

Herbst, D. R. 1988. *Botanical Survey of Kwajalein Missile Range, Marshall Islands.* Prepared for U.S. Army Corps of Engineers. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service.

Hezel, F. X. 1983. *The First Taint of Civilization: History of the Caroline and Marshall Islands in Pre-Colonial Days, 1521-1885.* Honolulu, HI: University of Hawaii Press.

Hill, D. 1988. *A Longitudinal Study of a Cohort with Past Exposure to Radar: The MIT Radiation Laboratory Follow-up Study.* Ann Arbor MI: University of Michigan Dissertation Service.

Hofmann, D. J., and S. Solomon. 1989. Ozone Destruction through Heterogeneous Chemistry Following the Eruption of El Chichon. *Journal of Geophysical Research* 94 (D4):5,029-5,041.

Houghton, R. A., and G. M. Woodwell. 1989. Global Climate Change. *Scientific American* 260(4):36-44.

Hunt, C., and F. Peterson. 1980. *Groundwater Resources of Kwajalein Island, Marshall Islands.* Technical Report No. 126. Honolulu, HI: University of Hawaii Water Resources Research Center.

Hunt, C., USGS. 1992. Personal communication. October 3.

Jager, H., and K. Wege. 1990. Stratospheric Ozone Depletion at Northern Midlatitudes after Major Volcanic Eruptions. *Journal of Atmospheric Chemistry* 10:274-287.

JCWSI. See Johnson Controls World Services, Inc.

Johnson Controls World Services, Inc. 1992a. *Analysis of Existing Facilities, USAKA.* U.S. Army Strategic Defense Command. June 1992.

_________. 1992b. Monthly Marine Services Activity Report. USAKA. January 1992.

__________. 1991. *Analysis of Existing Facilities, U.S. Army Strategic Defense Command*. Kwajalein Atoll, Marshall Islands. Contract DASG60-87-C-0115. June 1991.

__________. Various dates. Monthly Activity Reports.

Johnson, M. W. 1954. Plankton of Northern Marshall Islands. *Geological Survey Professional Paper No. 260-F*. Pp. 301-314.

Johnson, S. 1988. Avoiding Ciguatera is the Best Treatment. *The Kwajalein Hourglass*. September 26, 1988. P. 5.

Jokiel, P. L., and S. L. Coles. 1990. Response of Hawaiian and Other Indo-Pacific Reef Corals to Elevated Temperature. *Coral Reef* 8:155-162

Kelfkens, et al. 1990. Ozone Depletion and Increase in Annual Carcinogenic Ultraviolet Dose. *Photochemistry and Photobiology* 52(4):819-823.

Kelly, T. 1992. Personal communication. February.

Kirkpatrick, K., USAKA Environmental Office. 1992. Personal communication.

Ko, M. K. W., et al. 1989. Implications of AAOE Observations for Proposed Chemical Explanations of the Seasonal and Interannual Behavior of Antarctic Ozone. *Journal of Geophysical Research* 94 (D14):16,705-16,715.

Kolb, C. E., et al. 1990. *Assessment of the Impact of Chemical Propulsion Exhaust Species on Stratospheric Ozone* (ARI-RR-787). Prepared for Thiokol Corporation, Brigham City, UT.

Kwajalein Atoll Development Authority. 1988. *Ebeye Disaster Recovery and Resettlement Authority*. Prepared by Carleton Hawpe and Associates, Inc., Honolulu, HI.

__________. 1985. *Kwajalein Atoll Development Plan*. Prepared by Carleton Hawpe and Associates, Inc., Honolulu, HI.

Lefebvre, P. Airfield Manager, Airfield Service Department. Johnson Controls World Services, Inc. 1992. Personal communication. March.

Lilienfeld, A. M., et al. 1978. *Foreign Service Health Status Study—Evaluation of Health Status of Foreign Service and Other Employees from Selected Eastern European Posts*. Final Report, Contract No. 6025-619073. Washington, DC: Department of State.

Lindborg, E. 1992. Personal communication. February.

London, S. J., et al. 1991. Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia. *American Journal of Epidemiology* 134(9):923-937.

Longstreth, J. 1988. Cutaneous Malignant Melanoma and Ultraviolet Radiation: A Review. *Cancer and Metastasis Review* 7(4):321-333.

Madsen, B. C. 1981. Acid Rain at Kennedy Space Center, Florida: Recent Observations. *Atmospheric Environment* 15 (5):853-862.

Manci, K. M., et al. 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis* (NERC-88/29). Fort Collins, CO: U.S. Fish and Wildlife Service National Ecology Research Center.

Martin Marietta. 1985. SA2-324001 Revision I, Accident Risk Assessment Report. *Integrated System Hazard Control Assessment Report for Peacekeeper Missile System at Vandenberg Air Force Base.* F04704-84-C-0048, II(1):59.

McCain, J. C., and J. E. Maragos. 1975. *A Survey of the Marine Environmental Impact of Thermal Discharges on Kwajalein Atoll, Marshall Islands.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division.

McElroy, M. B., and R. J. Salawitch. 1989. Changing Composition of the Global Stratosphere. *Science* 243 (4,892):763-770.

McElroy, M. B., et al. 1986. Reductions of Antarctic Ozone due to Synergistic Interactions of Chlorine and Bromine. *Nature* 321 (6,072):759-762.

Milham, S., Jr. 1985a. Mortality in Workers Exposed to Electromagnetic Fields. *Environmental Health Perspective.* 62:297-300.

__________. 1985b. Silent Keys: Leukemia Mortality in Amateur Radio Operators. *Lancet* 1:812 (April 6).

__________. 1988a. Increased Mortality in Amateur Radio Operators due to Lymphatic and Hematopoietic Malignancies. *American Journal of Epidemiology* 127(1):50-54.

__________. 1988b. Mortality by License Class in Amateur Radio Operators. *American Journal of Epidemiology* 128(5)1175-1176.

Molina, M. J., and F. S. Rowland. 1974. Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone. *Nature* 249:810-812.

Morison, S. E. 1951 (Reprinted 1975). *Aleutians, Gilberts, and Marshalls, June 1942-April 1944: History of United States Naval Operations in World War II. Vol. 4.* Washington, DC: U.S. Government Printing Office.

Morrow, J. W. 1989. *Air Quality Impact Report, Kwajalein Island.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division. April 27, 1989.

__________. 1986. *Air Quality Impact Analysis, Kwajalein Island Power Plant No. 1.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division.

National Institute of Occupational Health. 1992. *Occupational Exposure to Electromagnetic Fields in Relation to Leukemia and Brain Tumors. A Case Control Study.* Solna, Sweden.

National Oceanographic and Atmospheric Administration. 1990a. *1990 Local Climatological Data, Annual Summary: Kwajalein, Republic of the Marshall Islands.* Asheville, NC: National Climatic Data Center.

__________. 1990b. *Climate and Meteorological Data—1990 Surface Observation on Kwajalein Island.* Asheville, NC: National Climatic Data Center.

__________. 1988. *Climate and Meteorological Data—1988 Surface Observation on Kwajalein Island.* Asheville, NC: National Climatic Data Center.

__________. 1987. *Emergency and Continuous Exposure Guidance Levels for Selected Airborne Contaminants.* Vol. 7, *Ammonia, Hydrogen Chloride, Lithium Bromide, and Toluene.* Washington, DC: National Academy Press.

__________. 1987. Local Climatological Data, Annual Summary with Comparative Data: Kwajalein, Republic of the Marshall Islands.

__________. 1985. 1985 Local Climatological Data, Annual Summary: Kwajalein, Republic of the Marshall Islands.

National Research Council. 1985. *Emergency and Continuous Exposure Guidance Levels for Selected Airborne Contaminants.* Vol. 4 and 5. Prepared by the Committee on Toxicology. Washington, DC: National Academy Press.

__________. 1982. *Causes and Effects of Stratospheric Ozone Reduction: An Update.* Washington, DC: National Academy Press.

NOAA. See National Oceanic and Atmospheric Administration.

NRC. See National Research Council.

Ott, D., USAKA Environmental Office. 1992a. Personal communication. February.

_________. USAKA Environmental Office. 1992b. Personal communication. November 4.

Pan Am World Services. 1988. *Analysis of Existing Facilities: U.S. Army Kwajalein Atoll*. Prepared for the U.S. Army Strategic Defense Command, Contract DASG60-87-C-0115. June 1988.

Patrick, P. 1992. Personal communication. April.

Pellet, G. L., et al. 1983. HCl in Rocket Exhaust Clouds: Atmospheric Dispersion, Acid Aerosol Characteristics, and Acid Rain Deposition. *Journal of the Air Pollution Control Association* 33 (4):304-311.

Pera, D., JCWSI Education Services. 1992. Personal communication. February.

Prather, M. J., et al. 1990. The Space Shuttle's Impact on the Stratosphere. *Journal of Geophysical Research* 95 (D11):18,583-18,590.

Radian Corporation. 1987. *NAT/CH Data Base Report on State, Local, and EPA Air Toxics Activities*. EPA-450/ 5-87-006 OAQPS. Research Triangle Park, NC: U.S. Environmental Protection Agency.

Randall, J. E. 1980. A Study of Ciguatera at Eniwetak and Bikini, Marshall Islands, with Notes on the Systematics and Food Habits of Ciguatoxic Fishes. *Fishery Bulletin* 78(2):201-249.

Rasmussen, R. A., et al. 1980. Concentration Distribution of Methyl Chloride in the Atmosphere. *Journal of Geophysical Research* 85 (C12):7,350-7,356.

Reese, E. S. 1987. Terrestrial Environments and Ecology of Eniwetak Atoll. In Devaney et al. *The Natural History of Eniwetak Atoll, Volume I: The Ecosystem: Environments, Biotas, and Processes*. DOE/EV/00703-T1-Vol. 1. Oak Ridge, TN: U.S. Department of Energy, Office of Scientific and Technical Information.

Republic of the Marshall Islands, Office of Planning and Statistics. 1989. *1988 Census of Population and Housing: Interim Report*. April 12, 1989.

_________. *1988 Census of Population and Housing: Preliminary Results*. December 1988.

_________. 1987a. Marshall Islands Statistical Abstract, 1986. Majuro, Republic of the Marshall Islands.

_________. 1987b. First Five-Year Development Plan, 1985-1989, Rephased for 1986/87–1990/91. Majuro, Republic of the Marshall Islands.

Ristvet, B. L. 1987. Geology and Geohydrology of Eniwetak Atoll. In Devaney et al. *The Natural History of Eniwetak Atoll, Volume I: The Ecosystem: Environments, Biotas, and Processes*. DOE/EV/00703-T1-Vol. 1. Oak Ridge, TN: U.S. Department of Energy, Office of Scientific and Technical Information. Pp. 37-56.

Robinette, C. D., et al. 1980. Effects upon Health of Occupational Exposure to Microwave Radiation (Radar). *American Journal of Epidemiology* 112:39-53.

Robinette, C. D., and C. Silverman. 1977. Causes of Death Following Occupational Exposure to Microwave Radiation (Radar) 1950-1974. In *Symposium on Biological Effects and Measurements of Radiofrequency/Microwaves*. Hazzard, D. G., ed. Rockville, MD: Food and Drug Administration. HEW Publication (FDA) 77-8026, pp. 338-344.

Savitz, D. A., et al. 1988. Case-Control Study of Childhood Cancer and Exposure to 60-Hertz Magnetic Fields. *American Journal of Epidemiology* 128(1):21-38.

Schilz, A. J. 1988. Letter Progress Reports Nos. 1 and 2. Cultural Resources Survey and Testing Program, USAKA, Kwajalein Atoll, Republic of the Marshall Islands. Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division. San Diego, CA: WESTEC Services, Inc.

Schipper, W. L. 1985. Observations of Birds on Kwajalein Atoll, 1978-1983. *'Elepaio* 46(4):27-32.

SDIO. See Strategic Defense Initiative Organization.

Sea Engineering, Inc. 1990. *Evaluation of Thermal Discharge Plume Excursion*. Honolulu, HI: U.S. Army Corps of Engineers. May 1990.

_________. 1989. *Roi-Namur Wastewater Treatment and Disposal Study*. Prepared for Engineering Concepts, Inc., for the U.S. Army Corps of Engineers, Pacific Ocean Division.

Sea Engineering, Inc., and R. M. Towill Corporation. 1988. *Shoreline Inventory and Protection Study, U.S. Army Kwajalein Atoll.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division.

Sebacher, D. I., R. J. Bendura, and D. E. Wornom. 1980. Hydrochloric Acid Aerosol and Gaseous Hydrogen Chloride Partitioning in a Cloud Contaminated by Solid Rocket Exhaust. *Atmospheric Environment* 14:543-547.

Seinfield, J. H. 1986. *Atmospheric Chemistry and Physics of Air Pollution.* New York: John Wiley and Sons.

Shun, K., and J. S. Athens. 1987. *Archaeological Investigations on Kwajalein Atoll, Marshall Islands, Micronesia.* Paper presented at the Indo-Pacific Prehistory Association, University of Guam Micronesian Archaeological Conference, Guam. September 9-12, 1987.

Silverberg, E., C. C. Boring, and T. S. Squires. 1990. Cancer Statistics, 1990. *Ca-A Cancer Journal for Clinicians* 40 (1):9.

Sims, K. 1992. USASSDC. Personal communication. August 5.

Sittig, M. 1985. *Handbook of Toxic and Hazardous Chemicals and Carcinogens.* 2d ed. Park Ridge, NJ: Noyes Publications.

State of Hawaii Department of Health, Environmental Epidemiology Program. 1986. *Cancer Incidence in Census Tracts with Broadcasting Towers in Honolulu, Hawaii.* Report to the City Council, City and County of Honolulu, Hawaii.

Stephens, J. B., and R. B. Steward. 1977. *Rocket Exhaust Effluent Modeling for Tropospheric Air Quality and Environmental Assessments* (NASA TR R-473). Washington, DC: National Aeronautics and Space Administration.

Stern, A. C., et al. 1984. *Fundamentals of Air Pollution.* 2d ed. San Diego, CA: Academic Press, Inc.

Strategic Defense Initiative Organization. 1992. *Supplemental Environmental Assessment, Lightweight Exoatmospheric Projectile (LEAP) Test Program.* Washington, DC: U.S. Department of Defense. June 1992.

__________. 1991. *Environmental Assessment, ZEST Flight Test Experiment.* Washington, DC: U.S. Department of Defense.

__________. 1987. *Exoatmospheric Reentry Vehicle Interception System (ERIS): Demonstration/Validation Program Environmental Assessment.* Washington, DC: U.S. Department of Defense.

__________. 1987. *Ground-Based Surveillance and Tracking System (GSTS): Demonstration/Validation Program Environmental Assessment.* Washington, DC: U.S. Department of Defense.

__________. 1987. *Space-Based Interceptor (SBI): Demonstration/Validation Program Environmental Assessment.* Washington, DC: U.S. Department of Defense.

__________. 1987. *Space-Based Surveillance (SSTS): Demonstration/Validation Program Environmental Assessment.* Washington, DC: U.S. Department of Defense.

Strategic Defense Initiative Organization/TNE. 1992. *Launch Vehicles Reference Guide.* February 1992.

Streck, C. F., Jr. 1992. U.S. Army Corps of Engineers, Honolulu, HI. Personal communication. March 17.

__________. 1987a. Archaeological Reconnaissance Site Survey of the Islands of Bikini Atoll, Republic of the Marshall Islands, Micronesia. Supplementary Document No. 2, Appendix B. Bikini Atoll Rehabilitation Committee: Berkeley, CA.

__________. 1987b. Prehistoric Settlement in Eastern Micronesia: Archaeology on Bikini Atoll, Republic of Marshall Islands, Micronesia. Paper presented at the Indo-Pacific Prehistory Association, University of Guam Micronesian Archaeological Conference, Guam, September 9-12, 1987.

__________. 1987c. Trip Report: Site Visit for Archaeological Contract Management on Kwajalein Island and Archaeological Reconnaissance Survey on Legan and Roi-Namur, USAKA, July 20-28, 1987. Prepared for U.S. Army Corps of Engineers, Honolulu Engineer District. August 13, 1987.

__________. 1987d. Trip Report for Unscheduled Emergency Archaeological Assistance at USAKA, Kwajalein, Marshall Islands, March 17-18 and April 1-3, 1987. Prepared for U.S. Army Corps of Engineers, Honolulu Engineer District. April 21, 1987.

__________. 1986. Interim Report: Archaeological Investigations on Eneu Island, Bikini Atoll, Republic of the Marshall Islands, Micronesia. Supplementary Document No. 1, Appendix B. Bikini Atoll Rehabilitation Committee: Berkeley, CA.

Summers, H. U.S. State Department, Office of Pacific Island Affairs. 1993. Personal communication. August 6 through 10.

Sutherland, L. C. 1968. *Sonic Vibrations for Ground Facilities, Chapter 6, NASA Empirically Derived Prediction Model.* NAS-8-11217. George C. Marshall Space Flight Center.

Symonds, R. B., W. I. Rose, and M. H. Reed. 1989. Contribution of Cl- and F-bearing Gases to the Atmosphere by Volcanoes. *Nature* 334:415-418.

Szmigielski, S., et al. 1988. Immunological and Cancer-Related Aspects of Exposure to Low-Level Microwave and Radiofrequency Fields. In *Modern Electricity*. Marino, A., ed. Marcel-Dekker, Inc.

Thomas, P. E. J. (Compiler). 1989. *Report of the Northern Marshall Islands Natural Diversity and Protected Areas Survey, September 7-24, 1988*. South Pacific Regional Environment Programme, Noumea, New Caledonia and East-West Center, Honolulu, HI. March 1989.

Thompson, E. N. 1984a. National Register of Historic Places Inventory Nomination Form: Kwajalein Island Battlefield. Prepared by the Denver Service Center, U.S. National Park Service.

__________. 1984b. National Register of Historic Places Inventory Nomination Form: Roi-Namur Battlefield. Prepared by the Denver Service Center, U.S. National Park Service.

Titgen, R. H., A. M. Orcutt, and P. J. Rappa. 1988. *Marine Environmental Assessment Report on U.S. Army-Leased Lands at Kwajalein Atoll.* Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division. University of Hawaii, Honolulu: Sea Grant Extension Service. August 11, 1988.

Titters, T., JCWSI. 1992. Personal communication. February 24.

Tribble, G., USGS. 1992. Personal communication. August 3.

Trust Territory of the Pacific Islands, Office of Planning and Statistics. 1978. *Briefing Document for Ebeye Redevelopment and Gugeegu Development*. Office of the High Commissioner.

Tsuda, R. T., F. R. Fosberg, and M. H. Sachet. 1977. Distribution of Seagrasses in Micronesia. *Micronesica* 13(2):191-198.

Turgeon, G., JCWSI. 1992. Personal communication. February.

Turner, D. B. 1970. *Workbook of Atmospheric Dispersion Estimates*. Research Triangle Park, NC: U.S. Environmental Protection Agency.

United States Code. Title 42, Public Health and Welfare, Chapter 82 Solid Waste Disposal, Sections 6901 *et seq*., 1982, Cumulative Supplement, June 1991.

_________. Title 16, Conservation, Chapter 31 Marine Mammal Protection, Sections 1361-1384 and 1401-1407. 1988.

_________. Title 16, Protection of Migratory Game and Insectivorous Birds, Chapter 7, Subchapter II, Migratory Bird Treaty. Sections 703-712.

_________. Title 16, Endangered Species, Chapter 35, Sections 1531-1543. 1973.

_________. Title 33. Clean Water Act, Sections 1251 *et seq*.

United States Code Service. 1991. *Defense '91*. Alexandria, VA: Armed Forces Information Service.

University of Hawaii Sea Grant. 1988. *Marine Environmental Assessment Report on the United States Lease Lands at Kwajalein Atoll.*

USAEDPO. See U.S. Army Corps of Engineers.

U.S. Air Force. 1990. *Environmental Assessment Titan IV/Solid Rocket Motor Upgrade Program*. Los Angeles Air Force Base, CA.

_________. 1989. *Draft Environmental Impact Statement, Construction and Operation of Space Launch Complex 7*. Vandenberg Air Force Base, CA.

_________. 1988. *Air Force Regulation 71-4, Preparing Hazardous Materials for Military Air Shipments*.

_________. 1988. *Environmental Assessment: TITAN IV Space Launch Vehicle Modification and Operation*. Vandenberg Air Force Base, CA.

_________. 1987. *Environmental Assessment, Chemical Release Experiments*. Headquarters Space Division, Los Angeles Air Force Station, CA.

_________. 1986. *Draft Environmental Assessment Hydrazine Release Experiment*. Los Angeles Air Force Station, CA: Department of the Air Force, Headquarters Space Division/DEV.

_________. 1978. *Final Environmental Impact Statement, Space Shuttle Program, Vandenberg, California*.

USAKA. See U.S. Army Kwajalein Atoll.

U.S. Army Ballistic Missile Defense Systems Command. 1980. *Environmental Impact Assessment of Kwajalein Missile Range Operations*. Revision No. 1. Kwajalein Atoll, Republic of the Marshall Islands.

__________. Kwajalein Missile Range Directorate. 1979. *Analysis of the Relocation of Kwajalein*. Vol. 1-3.

U.S. Army Corps of Engineers, Pacific Ocean Division. 1992. *USAKA Master Plan Report*. Prepared by CH2M HILL. Honolulu, HI.

__________. 1991a. *Natural Resources Plan, U.S. Army Kwajalein Atoll*. Prepared by CH2M HILL. Honolulu, HI.

__________. 1991b. *Environmental Quality Protection Plan, U.S. Army Kwajalein Atoll*. Issued in two volumes, one text and one figures. Prepared by CH2M HILL. Honolulu, HI.

__________. 1990. *Final Report Potable Water System Study for Kwajalein Atoll*. Prepared by CH2M HILL. Honolulu, HI.

__________. 1989a. *Environmental Assessment—Quarry on Meck Island, Kwajalein Atoll, Republic of the Marshall Islands*. Honolulu, HI. January 1989.

__________. 1989b. *Kwajalein Atoll Coastal Resources Atlas*. Prepared by AAA Engineering and Drafting, Inc. Honolulu, HI.

__________. 1988b. *United States Army Kwajalein Atoll Master Plan Report*. DACA83-87-C-0065. Prepared by CH2M HILL and Belt Collins and Associates. Honolulu, HI. April 1988.

__________. 1988c. Summary of Scoping Meetings, USAKA Environmental Impact Statement. Memorandum for Record. Honolulu HI.

__________. 1987. *Hazardous Waste Management Plan for U.S. Army Kwajalein Atoll, Marshall Islands*. May 1987.

__________. 1985. *Draft Environmental Impact Statement/U.S. Department of the Army Permit Application: Discharge of Fill Material for the Kwajalein Atoll Causeway Project*. Kwajalein Atoll, Republic of the Marshall Islands.

__________. 1976. *Environmental Assessment, Ocean Dumping of Solid Wastes at the Kwajalein Missile Range, Kwajalein Atoll, Marshall Islands District, Trust Territory of the Pacific Islands*. Prepared for the Ballistic Missile Defense Systems Command, Kwajalein Missile Range Directorate.

U.S. Army Environmental Hygiene Agency. 1992a. *USAKA Ambient Air Quality Study—Interim Compliance Summary Reports*, March 2, 1992.

__________. 1992b. Memorandum for Commander: USAKA CY1991 Comprehensive Potable Water Monitoring Program—Third Quarter Results. January 15, 1992.

__________. 1992c. Memorandum for Commander: USAKA CY1992 Comprehensive Potable Water Monitoring Program—First Quarter Results. U.S. Army Kwajalein Atoll.

__________. 1991a. *Potable Water Quality Issues, U.S. Army Kwajalein Atoll, May 1990-May 1991*. Water Quality Engineering Consultation No. 31-24-G949-91. November 22, 1991.

__________. 1991b. *Soil and Groundwater Contamination Study, U.S. Army Kwajalein Atoll*. No. 38-26-K144-91. November 1991.

__________. 1991c. Memorandum for Commander: USAKA CY1991 Comprehensive Potable Water Monitoring Program—First and Second Quarter Results.. December 10, 1991.

__________. 1991d. *Waste Discharge Analysis, U.S. Army Kwajalein Atoll, Marshall Islands*. Wastewater Management Study No. 32-24-H 601-91. February 8-19, 1991.

__________. 1990. *Groundwater Quality Survey, U.S. Army Kwajalein Atoll, March 5-16, 1990*. No. 38-26-0357-90. June 13, 1990.

__________. 1987. *Guidelines for Controlling Potential Health Hazards from Radio Frequency Radiation*. Technical Guide No. 153.

__________. 1977. *Evaluation of Polychlorinated Biphenyls, Chlorinated Hydrocarbon, and Organophosphorus Pesticides and Heavy Metals in the Marine and Terrestrial Environments of Kwajalein Atoll, Marshall Islands*. Water Quality Biological Study No. 24-0004-77. Aberdeen Proving Ground, MD. July/August 1976.

U.S. Army Headquarters. 1991a. *Medical Services—Hearing Conservation*. Pamphlet 40-501. August 27, 1991.

__________. 1991b (revised). *Installations—Master Planning for Army Installations*. Army Regulation (AR) 210-20. Washington, DC. November 1, 1991.

__________. 1990. *Medical Services—Preventive Medicine*. AR 40-5. October 15, 1990.

_________. 1989. *Environmental Quality–Environmental Effects of Army Actions.* AR 200-2. Washington, DC. Updated January 23, 1989.

_________. 1988. *USAKA Range Instrumentation Support Facilities Manuals.* Huntsville, AL: U.S. Army Strategic Defense Command.

_________. 1987. *Installations–Family Housing.* AR 210-50. Washington, DC. March 1, 1987.

_________. 1983a. *Installations–Billeting Operations.* AR 210-11. Washington, DC. July 15, 1983.

_________. 1983b. *Noise and Vibration Control for Mechanical Equipment.* Army TM 5-805-4. December 1983.

_________. 1982. *Environmental Quality–Environmental Protection and Enhancement.* AR 200-1. Washington, DC. June 15, 1982.

_________. TM 9-1300-206. _________________.

_________. n.d. AR 385-64.

U.S. Army Kwajalein Atoll. 1993a. *Record of Environmental Consideration for the Document Control Facility, USAKA.* FY92, MCA PN 9206520. May 11, 1993.

_________. 1993b. *Record of Environmental Consideration for the Child Development Center, USAKA.* FY92, MCA PN 27262. February 5, 1993.

_________. 1992a. *Environmental Assessment and FONSI for the Physical Security Facilities Marine Terminal, Kwajalein Island.* October 1992.

_________. 1992b. *Record of Environmental Consideration for the Community Support Building, USAKA.* May 22, 1992.

_________. 1992c. *Safety–Protection of Personnel during Missile Operations.* Regulation No. 385-4. February 18, 1992.

_________. 1989. *Control of Potential Hazards to Personnel from Microwave and Radio Frequency Radiation and Ultrasound.* Regulation 385-3. January 9, 1989.

_________. 1988a. *Energy Conservation Manual, USAKA.* September 1988.

_________. 1988b. *Employment of Marshallese.* Prepared by Victor Hobson, Jr., Host Nation Activities Office.

__________. 1987. *Technical Memorandum for Site Visit: U.S. Army Kwajalein Atoll Concept Plans, Future Development Plans, and Analysis of Existing Utilities.* Prepared by CH2M HILL and Belt Collins and Associates. August 7, 1987.

__________. Ongoing. Housing Files.

__________. *Kwajalein Missile Range, Range Safety Manual.*

U.S. Army Pacific Environmental Health Engineering Agency. 1986. *Evaluation of the Potable Water Supply System, Kwajalein Atoll Marshall Islands.* Project No. 31-91-0500-860. June 16-27, 1986.

U.S. Army Program Executive Office, Missile Defense. 1993. *A Ground-Based Radar (GBR) Family of Strategic and Theater Radars Environmental Assessment and Finding of No Significant Impact.* June 1993.

U.S. Army Strategic Defense Command. 1992a. *Environmental Assessment for Cold Storage Warehouse, Controlled Humidity Warehouse, and Consolidated General Purpose Warehouse.* Prepared by U.S. Army Corps of Engineers, Pacific Ocean Division: Honolulu, HI. September 1992.

__________. 1992b. *Finding of No Significant Impact for Cold Storage Warehouse, Controlled Humidity Warehouse, and Consolidated General Purpose Warehouse.* Prepared by U.S. Army Corps of Engineers, Pacific Ocean Division: Honolulu, HI. Issued November 17, 1992.

__________. 1992c. *Environmental Assessment and FONSI for the Power Plant (1B) Upgrade and Fresh Water Production Facility, Kwajalein Island.* U.S. Army Kwajalein Atoll. Prepared for U.S. Army Corps of Engineers, Pacific Ocean Division. May 1992.

__________. 1992d. *Roi-Namur Wastewater Treatment Study.* Prepared by CH2M HILL. March 1992.

__________. 1992e. *Environmental Assessment and Finding of No Significant Impact for Dredging Around Fuel Pier, Kwajalein Island, U.S. Army Kwajalein Atoll.* May 1992.

__________. 1991. *Marine Heavy Metals Study, U.S. Army Kwajalein Atoll, Final Technical Report.* Prepared by Advanced Sciences, Inc., San Diego, CA. February 1991.

__________. 1989a. *Draft Environmental Impact Statement—Proposed Actions at U.S. Army Kwajalein Atoll.* Prepared by U.S. Army Corps of Engineers. June 1989.

_________. 1989b. *Final Environmental Impact Statement–Proposed Actions at U.S. Army Kwajalein Atoll.* Prepared by U.S. Army Corps of Engineers. October 1989.

_________. 1989c. *USAKA Environmental Mitigation Plan.* Huntsville, AL. December 4, 1989.

_________. 1989d. *USAKA Mitigation Project, Technical Report, Kwajalein Atoll Marshall Islands.* Prepared by Advanced Sciences, Inc., San Diego, CA. September 1989.

_________. 1989e. *Environmental Assessment–Ground Based Radar.* Huntsville, AL. March 1989.

_________. 1988a. Draft. *High Endoatmospheric Defense Interceptor (HEDI) Environmental Assessment.* Huntsville, AL. December 1988.

_________. 1988b. *USAKA Range Instrumentation and Support Facilities Manual.*

U.S. Army Space and Strategic Defense Command. 1993a. *Supplemental Environmental Assessment and Finding of No Significant Impact for Kwajalein Dry Dock Facility, USAKA.* DACA83-90-C-0006, FY92, MCA PN 9206180. Prepared for the U.S. Army Corps of Engineers, Honolulu Engineer District. June 1993.

_________. 1993b. *Environmental Assessment and Finding of No Significant Impact for the Construction and Operation of a Religious Education Facility, USAKA.* FY92, MCA PN 0308570. Prepared for the U.S. Army Corps of Engineers, Honolulu Engineer District. April 1993.

_________. 1993c. *Study of Zones of Mixing at Kwajalein Atoll (Draft).* Prepared by Advanced Sciences, Inc.: San Diego, CA. November 1993.

_________. 1993d. *Environmental Assessment and Finding of No Significant Impact for Vehicle Maintenance Shop, USAKA* FY92, MCA PN 027996. Prepared for the U.S. Army Corps of Engineers, Honolulu Engineer District. February 1993.

_________. 1993e. *Kwajalein Missile Range (KMR) Test Facilities Siting Recommendation Technical Report.* Prepared by Teledyne Brown Engineering. June 25, 1993.

USASDC–See U.S. Army Strategic Defense Command.

USASSDC–See U.S. Army Space and Strategic Defense Command.

U.S. Congress. House. Merchant Marine and Fisheries. 99th Congress, 1st session, 1985. House Document 99-392.

U.S. Congress, Office of Technology Assessment. 1989. *Biological Effects of Power Frequency Electric and Magnetic Fields—Background Paper.* OTA-BP-E-53. Washington, DC: U.S. Government Printing Office. May 1989.

U.S. Department of Defense. 1991. *Military Standard, Noise Limits for Military Material (Metric)*. MIL-STD-1474C. March 1991.

__________. 1986. *Protection of DoD Personnel from Exposure to Radio-Frequency Radiation*. DoD Instruction No. 6055.11. Huntsville, AL: U.S. Army Strategic Defense Command Administrative and Technical Library. August 20, 1986.

U.S. Department of Defense. 1986. *DoD Ammunition and Explosives Safety Standard*. DoD 6055.9-STD. August 19, 1986.

U.S. Department of Defense, Office of Economic Adjustment. 1984. *Economic Development in the Marshall Islands*.

U.S. Department of Energy. 1992. *Kauai Test Facility (KTF) Environmental Assessment.* Sandia National Laboratory. April 1992.

U.S. Department of Health and Human Services. 1989. *Cancer Statistics Review 1973 - 1986*. Bethesda, MD: National Cancer Institute.

__________. 1987. *NIOSH Pocket Guide to Chemical Hazards*. Washington, DC: U.S. Government Printing Office.

__________. 1984. *Endangered Species Bulletin*. Vol. 9, No. 4.

__________. n.d. *Guidelines for Evaluating and Documenting Traditional Cultural Properties*. National Register Bulletin 38. National Park Service.

U.S. Environmental Protection Agency. 1988. *Screening Procedures for Estimating Air Quality of Stationary Sources*. EPA 450/4-88-010. Research Triangle Park, NC

__________. 1987. *Industrial Source Complex (ISC) Dispersion Model User's Guide—Second Edition* (Revised). OAQPS. EPA-450/4-88-002a. Research Triangle Park, NC.

__________. 1985. *Compilation of Air Pollutant Emission Factors* (AP-42). Research Triangle Park, N.C.

__________. 1970 (revised). *Workbook of Atmospheric Dispersion Estimates.* Research Triangle Park, N.C.

U.S. Environmental Protection Agency, Office of Noise Abatement and Control. 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.*

__________. 1971. Effects of Noise on Wildlife and Other Animals. Prepared by Memphis State University under Contract 68-04-0024.

U.S. Environmental Protection Agency, Office of Research and Development. 1990. *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields.* External Review Draft. EPA 600/6-90/005B. Washington, DC. October 1990.

__________. 1984. *The Acidic Deposition Phenomenon and Its Effects, Critical Assessment Review Papers, Volume I, Atmospheric Sciences.* Washington, D.C. EPA-600/8-83-016AF.

U.S. EPA. See U.S. Environmental Protection Agency.

USFWS. See U.S. Fish and Wildlife Service.

Walker, James, Senior Historian, USASSDC. 1992. Memorandum to James R. Cooper, Command Historian, regarding visit to USAKA between May 23, 1992 and June 3, 1992. June 22, 1992.

Watanabe, F. K. 1986. *Archaeological Reconnaissance for Family Housing Dwellings, FY1987-1989 Increments: Kwajalein Island, Kwajalein Missile Range, Kwajalein Atoll, Marshall Islands.* Prepared for U.S. Army Ballistic Missile Defense Systems Command. Honolulu, HI: U.S. Army Corps of Engineers. March 10, 1986.

Wayne, R. P. 1985. *Chemistry of Atmospheres: An Introduction to the Chemistry of the Atmospheres of Earth, the Planets, and their Satellites.* Oxford: Clarendon Press.

Wells, J. W. 1957. Coral and Coral Reefs. In Treatise on Marine Ecology and Paleocology. *Geological Society of America. Memoir.* Ladd, H. S., ed. 67(2):773-782 and 1087-1104.

Wertheimer, N., and E. Leeper. 1979. Electrical Wiring Configurations and Childhood Cancer. *American Journal of Epidemiology* 109:273-284.

Williams Brothers Engineering Company. 1991. *Consolidation Pre-Final Analysis Report.* December 4, 1991.

Withers, N. W. 1982. Ciguatera Fish Poisoning. *Annual Review of Medicine* 33:97-111.

World Meteorological Organization. 1990. *Scientific Assessment of Stratospheric Ozone: 1989.* Global Ozone Research and Monitoring Project Report No. 20. Geneva, Switzerland: World Meteorological Organization.

Wynne, R. 1992. U.S. Army Corps of Engineers. Personal communication.

Young, I. R. 1989. Wave Transformation Over Coral Reefs. *Journal of Geophysical Research* 94(C7):9779-9789.

8.1 Abbreviations and Acronyms

ABM	Antiballistic missile
AC	Alternating current
ACM	Asbestos containing materials
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AHPA	Archaeological and Historic Preservation Act
AMC	Air Mobility Command
AMI	Airline of the Marshall Islands
AR	Army Regulation
ARE	Aerothermal Reentry Experiment
ASP	Annual Service Practice
AST	Airborne Surveillance Testbed
BACT	Best available control technology
BMC^3	Battle Management Command Control Communications
BOA	Broad Ocean Area
BOD	Biochemical oxygen demand
BOE	Bureau of Explosives
BP	Brilliant Pebbles
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species

COD	Chemical Oxygen Demand
CSTC	Consolidated Space Test Center
CWA	Clean Water Act
dB	Decibel
dBA	"A"-weighted decibel level
dBC	"C"-weighted decibel level
DEIS	Draft environmental impact statement
DFM	Diesel fuel marine
DLNR	Department of Land and Natural Resources
DMFO	Defense Medical Facilities Office
DNL	Day-night level [noise]
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DT	Developmental Test
EA	Environmental assessment
ECAC	Electromagnetic Compatibility Analysis Center
EDX	Exoatmospheric Discrimination Experiment
EED	Electroexplosive devices
E^2I	Exo-Endoatmospheric Interceptor
EIS	Environmental impact statement
ELF	Extremely low frequency
EMF	Electromagnetic field
EMR	Electromagnetic radiation
EOD	Explosive ordnance disposal
EQPP	Environmental Quality Protection Plan
ERIS	Exoatmospheric Reentry-Vehicle Interceptor Subsystem
ERPA	Evader Replica Penetration Aid
ESA	Endangered Species Act
ESQD	Explosive safety quantity-distance
EWC	East-West Center

FAA	Federal Aviation Administration
FAC	Free available chlorine
FEIS	Final environmental impact statement
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FONSI	Finding of no significant impact
FTS	Flight Termination System
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal year
GBI	Ground-Based Interceptor
GBR-T	Ground-Based Radar Test
GBR-X	Ground-Based Radar-Experimental
GEP	Ground Entry Point
GMD	Global Missile Defense
GPALS	Global Protection Against Limited Strikes
GPO	Government Printing Office
GSTS	Ground-Based Surveillance and Tracking System
GVW	Gross vehicle weight
HABS/HAER	Historic American Buildings Survey and Historic American Engineering Record
HALO/IRIS	High Altitude Observatory and Infrared Instrumentation System
HCl	Hydrogen chloride
HITS	Hydroacoustic Impact Timing System
HPO	Historic Preservation Officer
ICBM	Intercontinental ballistic missile
IFR	Instrument flight rule
INF	Intermediate Nuclear Forces
ISCST	Industrial Source Complex Short-Term Model
JCWSI	Johnson Controls World Services, Inc.
KADA	Kwajalein Atoll Development Authority
KALGOV	Kwajalein Atoll Local Government

KEEP	Kwajalein Environmental Emergency Plan
KREMS	Kiernan Reentry Measurements Site
KTF	Kauai Test Facility
LAER	Lowest achievable emission rate
LCM	Landing Craft Mechanized
LCU	Landing Craft Utility
L_{dn}	Day-night average sound level
LEAP	Lightweight Exoatmospheric Projectile
L_{eq}	Equivalent continuous sound level
L_{max}	Greatest continuous sound level
L_pA	A-weighted sound pressure level
MAB	Missile Assembly Building
MBTA	Migratory Bird Treaty Act
MCL	Maximum contaminant level
MDCL	Maximum desirable contaminant level
MICB	Meck Island Control Building
MM I	Minuteman I
MM II	Minuteman II
MM III	Minuteman III
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPN	Most probable number
MSDS	Material safety data sheet
MSW	Municipal solid waste
MSX	Mid-Course Space Experiment
MUORA	Military Use and Operating Rights Agreement
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NAVSEA	U.S. Navy Ammunitions and Explosives Ashore Manual
NAVSUP	Navy Supply

NCA	Notice of Continuing Activities
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NMD	National Missile Defense
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of Deficiency
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPA	Notice of Proposed Action
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRP	National Resources Plan
ODA	Ocean Dumping Act
OSHA	Occupational Safety and Health Administration
PAB	Payload Assembly Building
PCB	Polychlorinated biphenyl
PEL	Permissible Exposure Level
PL	Public law
PMRF	Pacific Missile Range Facility
PMTC	Pacific Missile Test Center
POL	Petroleum, Oil, and Lubricants
PROC	Programmatic Record of Consultation
PSD	Prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act
REEDM	Rocket Exhaust Effluent Dispersion Model
RF	Radio frequency
RMI	Republic of the Marshall Islands
RMIEPA	Republic of the Marshall Islands Environmental Protection Authority

ROC	Record of Consultation
ROC	Regional Operations Center
ROD	Record of Decision
RV	Reentry vehicle
SARA	Superfund Amendments and Reauthorization Act
SBI	Space-based interceptor
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDR	Splash detection radar
SDWA	Safe Drinking Water Act
SEL	Sound exposure level
SFOTS	Submarine Fiber Optics Transmission System
SHPO	State Historic Preservation Office
SITs	System Integration Tests
SLBM	Sea-launched ballistic missile
SLV	Strategic Launch Vehicle
SNL	Sandia National Laboratories
SOP	Standard operating procedure
SPCC	Spill prevention control and countermeasure
SPI	Standard practice instructions
SPEGL	Short-Term Public Emergency Guidance Level
SPREP	South Pacific Regional Environmental Programme
STARS	Strategic Target System
START	Strategic Arms Reduction Talks
STEL	Short-term exposure limit
STTF	Systems Technology Test Facility
SVOC	Semivolatile organic compound
TASR	Talos/Aries Sounding Rocket
TCLP	Toxicity Characteristic Leachate Procedure
THAAD	Theater High Altitude Area Defense System
TLV	Threshold limit value

TLV-C	Threshold limit value-ceiling
TMD	Theater Missile Defense
TMD-GBR	Theater Missile Defense-Ground Based Radar
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSP	Total suspended particulate
TSS	Total suspended solids
TTO	Total toxic organics
TTPI	Trust Territory of the Pacific Islands
TTHM	Total trihalomethanes
TU	Turbidity unit
TWA	Time-weighted average
UDMH	Unsymmetrical dimethyl hydrazine
UPH	Unaccompanied personnel housing
U.S.	United States
USAEHA	U.S. Army Environmental Hygiene Agency
USAHFPA	U.S. Army Health Facilities Planning Agency
USAKA	U.S. Army Kwajalein Atoll
USASSDC	U.S. Army Space and Strategic Defense Command
USC	United States Code
USDA	U.S. Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNMFS	U.S. National Marine Fisheries Service
UST	Underground storage tank
UXO	Unexploded ordnance
VAFB	Vandenberg Air Force Base
VOC	Volatile organic compound
WSMC	Western Space and Missile Center
WSMR	White Sands Missile Range

WSTF	White Sands Test Facility
WTR	Western Test Range
ZAR	Zeus Acquisition Radar

8.2 Units of Measure

cm	Centimeter
ft	Foot
ft^2	Square foot
g	Gram
gal	Gallon
gcpd	Gallons per capita per day
gHz	Gigahertz
gpm	Gallon(s) per minute
Hz	Hertz
kg	Kilogram
kHz	Kilohertz
km	Kilometer
kt	Knot
kV	Kilovolt
kVA	Kilovoltampere
kW	Kilowatt
kWh	Kilowatt-hour
L	Liter
lb	Pound
m	Meter
m^2	Square meter
m^3	Cubic meter
mg	Milligram
mgd	Million gallons per day
MHz	Megahertz
mi	Mile
m/s	Mile(s) per second
mph	Mile(s) per hour

mtpd	Metric tons per day
mtpy	Metric tons per year
mW	Milliwatt
MW	Megawatt
ppb	Parts per billion
ppm	Parts per million
psi	Pounds per square inch
pt	Pint
sec	Second
tpd	Tons per day
tpy	Tons per year
°C	Degrees centigrade
°F	Degrees Fahrenheit
μg	Microgram
μm	Micrometer

8.3 Glossary

A-weighting curve for sound measurement. The A-weighted curve is applied to sound measurements to adjust for the limited response characteristic of human hearing.

Alluvium. A general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its flood plain or delta, or as a cone or fan at the base of a maintained slope.

Ambient air quality standards. Legal limitations on pollutant concentration levels allowed to occur in the ambient air established by the U.S. Environmental Protection Agency or state agencies. Primary ambient air quality standards are designed to protect public health with an adequate margin of safety. Secondary ambient air quality standards are designed to protect public welfare-related values, including property, materials, and plant and animal life.

Anthropogenic. Of, relating to, or resulting from the influence of human beings on nature (e.g., sources of pollution).

Antiballistic missile. A missile that intercepts and destroys ballistic missiles (self-propelled missiles guided in the ascent of a high-arch trajectory and freely falling in the descent).

Aquifer. A subsurface water-bearing (bed or stratum) formation that contributes considerable quantities of water to wells and springs. A porous, water-bearing geologic formation, generally restricted to materials capable of yielding an appreciable supply of water.

Attainment area. A geographic area in which the quality of the air is better than federal air pollution standards.

Azimuth. A distance in angular degrees in a clockwise direction from the north point.

Baseline condition. In the USAKA Environmental Standards and Procedures, the baseline condition relative to air quality for criteria pollutants that is established either by monitoring specific ambient conditions or by calculating the ambient condition on the basis of source inventories. The USAKA Environmental Standards and Procedures state that the baseline condition is to be established as of the day before the effective day of the Standards.

Basement rock. Rock generally with complex structure beneath the dominantly sedimentary rocks.

Biotic. Caused or produced by living beings.

Booster. The first stage of a multistage rocket, providing thrust for the launching and the initial part of the flight.

Brackish. Slightly salty; term applied to waters whose saline content is intermediate between that of freshwater streams and seawater.

C-weighting curve for sound measurement. For short-term low-frequency sounds, such as surface blasting and demolition activities, a C-weighting curve is normally used. The C-weighting curve helps to account for the short period and low-frequency characteristics representative of explosive noises.

Calcareous. Containing calcium carbonate.

Chlorofluorocarbons. A group of synthetic organic compounds composed of chlorine, fluorine, carbon, and hydrogen, used primarily as industrial solvents and refrigerants. Chlorofluorocarbons have been implicated in stratospheric ozone depletion.

Day-night average sound level (L_{dn}). A 24-hour equivalent continuous level in dBA wherein 10 dB is added to nighttime noise levels from the hours of 10:00 p.m. to 7:00 a.m.

Decibel (dB). A unit of measure of the change in air pressure that denotes the ratio between two quantities proportional to power; the number of decibels corresponding to the ratio that expresses the change in air pressure is 10 times the Log (base 10) of this ratio.

Desalination. Removal of salt; also called desalting.

District. National Register of Historic Places designation of a geographically defined area (urban or rural) possessing a significant concentration, linkage, or continuity of sites, structures, or objects united by past events (theme) or aesthetically by plan of physical development.

Drogue. A parachute for stabilizing or decelerating something or for pulling a larger parachute and helping to guide its course. A separate meaning for this word describes an object that is placed in a current (e.g., freshwater, marine, wastewater) in order to track the flow direction and rate.

Endangered species. A species that is threatened with extinction throughout all or a significant portion of its range.

Endemic. Plants or animals that are native or limited to a certain region.

Equivalent continuous sound level (L_{eq}). The constant sound level in dBA that, lasting for a time "T," would have produced the same energy in the same time period "T" as an actual A-weighted noise event.

Escarpment. (1) A steep slope in front of a fortification; (2) a long cliff or steep slope separating two comparatively level or more gently sloping surfaces and resulting from erosion or faulting.

Exotic. That which is not native to an area.

Explosive safety quantity-distance (ESQD). The quantity of explosives material and distance separation relationships providing defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures.

Feature (archaeology). Nonportable portion of an archaeological site. These include facilities such as fire pits, storage pits, stone circles, or foundations.

Federal-candidate species. Taxa placed in federal categories 1 and 2 by the U.S. Fish and Wildlife Service; candidates for possible addition to the List of Endangered and Threatened Species.

Freon. A trademark name for various chlorofluorocarbons.

Greenhouse effect. Global atmospheric warming caused by rising concentrations of carbon dioxide from the burning of fossil fuels.

Ground hazard area. The area in which dangerous debris may fall.

Halon. A group of synthetic organic compounds composed of fluorine and other halogens (e.g., bromine), carbon, and hydrogen used primarily as fire suppressant agents. Halons have been implicated in stratospheric ozone depletion.

Hazardous material. Generally, a substance or mixture of substances that has the capability to either cause or significantly contribute to an increase in mortality or an increase in serious irreversible or reversible but incapacitating illness; it may pose a threat of substantial current or potential risk to human health or the environment. Use of hazardous materials is regulated by the Department of Transportation, the Occupational Safety and Health Administration, and the Superfund Amendments Reauthorization Act.

Hydrazine. A colorless, fuming, corrosive hygroscopic (moisture absorbing) liquid used in jet and rocket fuels.

Hydrology. The science dealing with the properties, distribution, and circulation of water on the surface of the land and in the soil and underlying rocks.

Immediately Dangerous to Life and Health (IDLH). The IDLH level, defined for the purpose of respirator selection, represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without experiencing any escape-impairing or irreversible health effects.

Intertidal. Relating to or part of the littoral zone (shore zone between high and low watermarks) above low-tide mark.

Lamina. Unit layer or sheet or a sediment in which the stratification planes are 1 centimeter or less apart. Laminae need not be parallel to bedding.

Leachate. Solution or product obtained by leaching (the action of percolating liquid in order to separate soluble substances).

Lithified. Turned to rock.

Loam. A soil composed of a mixture of clay, silt, sand, and organic matter.

Mitigation. The method or action to reduce or eliminate an adverse environmental impact.

Material safety data sheet (MSDS). Presents information, required under Occupational Safety and Health Act standards, on a chemical's physical properties, health effects, and use precautions.

Maximum A-weighted RMS sound level ($M_{ax}L$). The greatest RMS (root-mean square) sound level, in dBA, measured during a preset measurement period.

Maximum A-weighted sound level ($M_{ax}P$). The greatest continuous sound level, in dBA, measured during a preset measurement period.

National Register Eligible Property. A property that has been determined eligible for National Register listing by the Secretary of the Interior, or one that has not yet gone through the formal eligibility determination process but that meets the National Register Criteria for section review purposes. An "eligible" property is treated as if it were already listed.

National Register of Historic Places. The federal inventory of known historic properties worthy of preservation. The National Register of Historic Places is administered by the National Park Service on behalf of the Secretary of the Interior. National Register listings include buildings, structures, sites, objects, and districts possessing historic, architectural, engineering, archaeological, or cultural significance. Properties listed are not limited to those of national significance; most are significant primarily at the regional, state, or local level.

Native vegetation. Plant life that occurs naturally in an area without agricultural or cultivational efforts.

Neustonic organism. Minute organisms that float in the surface film of water.

Nitrogen tetroxide. A dark brown, fuming liquid or gas with a pungent, acrid odor, used in rocket fuels.

Noise dose exposure level. The ratio, expressed as a percentage of the severity of noise environment to the severity of exposure to 85 dBA for 8 hours per day.

Ozone (O_3). A highly reactive form of oxygen that is the predominant component of photochemical smog. Ozone is not emitted directly into the atmosphere but results from a series of chemical reactions between oxidant precursors (nitrogen oxides and volatile organic compounds) in the presence of sunlight. Ozone is an irritating agent to the respiratory system.

Ozone layer (ozonosphere). Atmospheric layer at heights of 20 to 30 miles. It has a high ozone content and relatively high temperature resulting from absorption of ultraviolet solar radiation.

Particulate. Of or relating to minute separate particles.

Particulate matter, fine respirable. Finely divided solids or liquids less than 10 microns in diameter that, when inhaled, remain lodged in the lungs and contribute to adverse health effects.

Particulate matter, total suspended. Finely divided solids or liquids ranging from about 0.1 to 50 microns in diameter that comprise the bulk of the particulate matter mass in the atmosphere.

Payload. Any nonnuclear and possibly propulsive object or objects, weighing up to 600 pounds, which are carried above the Strategic Target System third stage.

Phytoneustonic. Plants that float in the surface film of water.

Pisonia. Genus of tropical, often thorny trees, vines, and shrubs having small flowers and utricular fruits.

Power law. A mathematical function that equals the product of a constant and a power of the independent variable.

Radionuclide. Radioactive nuclide (a species of atom characterized by the number of protons and neutrons and the energy content).

Ruderal vegetation. Growing where the natural vegetational cover has been disturbed by man (weeds of old fields and roadsides).

Rocket Exhaust Effluent Dispersion Model (REEDM). Designed to predict downwind concentrations from normal rocket launches and launch failures.

Shield volcano. A broad, gently sloping volcanic cone of flat domicil shape, usually several tens of hundreds of square miles in extent, built chiefly of overlapping and interfingering basaltic lava flows.

Short-term Public Exposure Guidance Level (SPEGL). Published by the National Research Council, the SPEGL represents an acceptable concentration for unpredicted, single, short-term emergency exposure of the general public.

Spur and groove system. A system or network of angular projections, offshoots, or branches extending out, beyond, or away from a main body or formation, such as a coral reef, in association with long, narrow channels or depressions.

Strategic Launch Vehicle (SLV). For the purposes of analysis in this Supplemental EIS, a Strategic Launch Vehicle is a one-, two-, or three-stage rocket used as an interceptor or target, or for other missile tests. In this Supplemental EIS, SLVs are assumed to include launch vehicles used for Theater Missile Defense testing.

Stratosphere. The upper portion of the atmosphere that is above approximately 7 miles (11 kilometers), depending on latitude, season, and weather; it extends to about 31 miles (50 kilometers), in which temperature changes and clouds of water are rare.

Subspecies. A geographically defined grouping of local populations that differs taxonomically from similar subdivisions of species.

Surface collection (archaeology). Systematic mapping and removal of artifacts from a site by means not involving excavation.

Threatened species. Plant and wildlife species likely to become endangered in the foreseeable future. Such a designation is typically assigned by one of the following: U.S. Fish and Wildlife Service, National Marine Fisheries Service, East-West Center, South Pacific Regional Environmental Programmer.

Threshold Limit Value-Ceiling (TLV-C). A guideline for occupational exposure to airborne substances that is published by the American Conference of Governmental Industrial Hygienists. The TLV-C is a concentration that should not be exceeded during any part of the working exposure.

Threshold Limit Value—Time-Weighted Average (TLV—TWA). A guideline for occupational exposure to airborne substances that is published by the American Conference of Governmental Industrial Hygienists. The TLV—TWA is the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Troposphere. The portion of the atmosphere below the stratosphere; it extends outward about 7 to 10 miles (11 to 16 kilometers) from the earth's surface, in which temperature generally deceases rapidly with altitude, clouds form, and convection is active.

TRPUF. A commercially available air dispersion model based on the EPA puff model for predicting downwind concentrations from a sudden release of emissions.

Tsunami. A great sea wave produced by a submarine earthquake or volcanic eruption; commonly misnamed tidal wave.

Ultraviolet radiation. A portion of the electromagnetic spectrum with wavelengths shorter than those of visible light and longer than those of X-rays.

Understory. A layer of vegetation growing near the ground and beneath the canopy of a taller layer.

Unique and sensitive habitats. Areas that are especially important to regional wildlife populations or protected species that have other important biological characteristics (e.g., wintering habitats, nesting areas, and wetlands).

Wetlands. Areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil, including swamps, marshes, bogs, and similar areas.

Zooxanthellae. Various symbiotic dinoflagellates that live within the cells of other organisms (such as reef-building coral polyps).

Appendix A
Status of USAKA Environmental Mitigation Plan

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Environmental Management		
Procure onsite environmental management expertise	All[1]	Completed
Revise logistics engineering contract	All[1]	Completed
Interim–assign environmental point of contact at USAKA	All[1]	Completed
Establish written site protection program	All[1]	Initiated
Budget/execute environmental program	All[1]	Completed; ongoing
Water Quality–Freshwater		
Install desalination plant	Kwajalein	Initiated; construction contract awarded
Expand capacity of desalination plant	Kwajalein	Need will be evaluated after desalination plant is operational
Begin quarterly water sampling program	Kwajalein, Roi-Namur, Meck	Completed
AEHA tests water samples by priority	Kwajalein, Roi-Namur, Meck	Completed
Alter operation of lens well and distribution system	Kwajalein, Roi-Namur	Completed
Install additional water filtration equipment	Kwajalein	Completed
Conduct potable water quality study	Kwajalein, Roi-Namur, Meck	Completed
Install liners and bladders at fuel farm berms and tanks as interim protection	Kwajalein	Planned, but uncertain schedule; FY93 probable
Develop/implement spill control plan	Kwajalein, Roi-Namur, Meck	Completed
Complete closed-loop distribution system	Kwajalein	Completed
DLA fuel storage replacement study	Kwajalein	Completed
Construct containment for aboveground tanks		Design initiated; construction expected to start in FY95
Install oil/water separators	Kwajalein	Initiated

Action	Location	Status
Conduct hydrogeological study of groundwater	Kwajalein, Roi-Namur	Final draft completed 11/93
Construct/equip environmental testing laboratory	Kwajalein	No longer required; services subcontracted
Implement improvements to water distribution system	Kwajalein	Initiated
Install cover on clear well storage	Kwajalein	Completed
Replace bulk fuel storage/containment facility	Kwajalein	Not planned
Conduct groundwater quality study	Kwajalein, Roi-Namur	Completed
Install covers on 14 raw water tanks	Kwajalein	Planned; expect to initiate FY95; one covered; covers needed on only eight additional tanks
Water Quality–Marine Water		
Conduct bioassays of marine life	Kwajalein	Completed
Conduct water quality criteria and waste discharge analysis study	Kwajalein, Roi-Namur	Completed
Conduct Roi-Namur wastewater treatment study	Roi-Namur	Completed
Adopt guidelines for monitoring wastewater discharge and solid waste leaching	Kwajalein	Completed
Use silt curtains and/or turbidity control standards for dredging	All[1]	Completed
Construct Roi-Namur wastewater treatment plant	Roi-Namur	Treatment plant feasibility study completed; construction planned
Implement water conservation and/or add wastewater treatment capacity	Kwajalein	Completed
Waste Management–Solid Waste		
Process septage through wastewater treatment plant	Roi-Namur	Cannot be initiated until treatment plant is constructed
Separate hazardous waste from solid waste	All[1]	Completed
Stop burning waste oil in unlined pits	Kwajalein, Roi-Namur	Completed
Segregate solid waste by type for landfill	All[1]	Completed

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Adopt solid waste disposal guidelines	All[1]	Completed
Record type, volume, and location of wastes	All[1]	Completed
Establish construction debris solid waste transportation procedures	Meck, Omelek	Completed
Procure glass bed incinerator for hazardous waste	Kwajalein	Not planned; hazardous waste being shipped off island
Construct solid waste incinerator	Kwajalein	Interim incinerators installed
Operate solid waste incinerator	Kwajalein	Initiated; ongoing
Install monitoring wells at landfill	Kwajalein	Completed
Waste Management–Hazardous Waste		
Segregate solvents from other waste oils	All[1]	Completed
Stop burning oils mixed with solvents in pits	Kwajalein, Roi-Namur	Completed
Place separate collection containers for each solvent type in maintenance area	All[1]	Completed
Implement hazardous waste storage, labeling, and segregation practices	All[1]	Completed
Install drip pans under hazardous waste dispensers and waste containers	All[1]	Completed
Initiate burn control program	All[1]	Completed
Test sandblast material for EP toxicity and drum if hazardous	All[1]	Completed
Provide hazardous waste handling training for USAKA personnel	All[1]	Completed
Establish cradle-to-grave management of hazardous materials	All[1]	Completed
Establish/characterize waste inventory	All[1]	Completed
Obtain hazardous waste generator ID number	All[1]	Completed
Install disintegrator for film and classified documents	Kwajalein	Completed
Remove oil from waste pits and stabilize sites	Kwajalein, Roi-Namur	Completed

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Complete cleanup of oil pits and dispose of resulting hazardous waste	Kwajalein, Roi-Namur	Pit no longer used; cleanup initiated
Establish temporary staging/storage facilities for hazardous wastes	Kwajalein, Roi-Namur, Meck	Completed
Store drummed waste on an appropriate surface to contain any spills	Kwajalein, Roi-Namur, Meck	Completed
Manage acid neutralization and disposal	Kwajalein	Not planned; currently shipped off island without neutralization
Dewater and ship batteries to Honolulu	Kwajalein	Completed
Initiate waste characterization program	All[1]	Completed
Initiate waste minimization study	All[1]	Completed
Conduct feasibility for hazardous waste treatment and disposal alternatives	Kwajalein	Addressed by waste minimization study
Install diesel generator oil recycling equipment	Kwajalein, Roi-Namur	Completed
Construct fire suppression training facility	Kwajalein	Use of alternative off-island facilities in place of USAKA facility
Establish permanent hazardous material dispensing areas	Kwajalein	Completed
Construct conforming hazardous waste staging area	Kwajalein	Completed
Conduct underground storage tank survey	All[1]	Completed
Conduct sandblast containment facilities	Kwajalein, Roi-Namur, Meck	Completed on Meck; design initiated on Kwajalein and Roi-Namur
Waste Management–PCBs		
Monitor PCB items for leaks	Kwajalein, Roi-Namur, Meck, Ennylabegan, Gellinam	Completed
Remove leaking transformers	All	Ongoing
Design and construct PCB storage facility	Kwajalein	Not planned; will use hazardous waste storage facility instead

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Remove stored PCBs from Building 1500 by October 1, 1989	Kwajalein	Completed
Assign additional personnel with PCB removal training	All[1]	Completed
Revise plan for response to PCB spills/fires	All[1]	Completed
Devise and execute PCB decontamination plan for Building 1500	Kwajalein	Completed
Devise and execute PCB item replacement plan	All[1]	Completed
Devise and execute PCB decontamination plan for Building 1045	Kwajalein	Completed
Waste Management–Asbestos		
Identify and mark asbestos burial site boundaries at Kwajalein landfill	Kwajalein	Completed
Discontinue landfill disposal of asbestos	Kwajalein	Completed
Implement approved disposal practices	All[1]	Completed
Conduct survey of laundry, school, mess hall	Kwajalein	Completed
Train/assign additional personnel to asbestos removal activities	All[1]	Completed
Perform asbestos survey inventory to identify locations and boundaries of all asbestos-containing materials still in service	All[1]	Completed
Provide air quality monitoring equipment and laboratory analysis capabilities for asbestos	Kwajalein	Completed
Provide additional asbestos removal equipment	All[1]	Not planned; if asbestos is cleaned/removed from existing facilities by subcontractor, additional equipment will not be needed
Establish assessment/removal/abatement program	All[1]	Completed

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Rare, Threatened, and Endangered Species		
Promulgate USAKA regulations prohibiting the taking of giant clams (based on RMI regulations)	All[1]	Waiting for RMI to promulgate regulation
Locate and transplant giant clams away from construction activity	All[1]	Completed
Assist RMI in transplanting immature clams	All[1]	Completed
Marine Biological Resources		
Improve site planning and construction practices	All[1]	Completed
Implement improved waste management practices	All[1]	Completed
Improve waste management facilities	All[1]	Initiated
Air Quality–Ambient Air Quality		
Stop oil pit incineration practices	Kwajalein, Roi-Namur	Completed
Conduct discrete sampling to assess air quality	Kwajalein	Completed
Repair forced air blower on pit incinerator	Kwajalein	Completed
Conduct ambient air quality study to characterize baseline	Kwajalein	Completed
Air Quality–Point Source Emissions		
Conduct sampling of power plant and pit incinerator emissions	Kwajalein	Completed
Determine/establish emissions standards	All[1]	Programmed
Review power plant for air emissions	Kwajalein	Completed
Implement program to meet emissions standards	All[1]	Programmed
Alter operation of power plant to meet standards	Kwajalein, Roi-Namur	Programmed
Modify power plant physical design if required	Kwajalein, Roi-Namur	Programmed

Appendix A
Status of USAKA Environmental Mitigation Plan

Action	Location	Status
Install incinerator with air pollution controls	Kwajalein	Temporary incinerator planned to be installed by late 1993; permanent planned
Archaeological, Cultural, and Historical		
Conduct preconstruction surveys	All[1]	Completed; ongoing
Perform significance determination/data recovery	All[1]	Completed; ongoing
Conduct preconstruction sampling and data recovery	All[1]	Completed; ongoing
Establish siting consideration	All[1]	Completed; ongoing
Initiate educational program	All[1]	Initiated
Housing		
Construct 400-person unaccompanied personnel housing units	Kwajalein	Proposed but not initiated
Construct 130 family housing units	Kwajalein	Proposed but not initiated
Retain sufficient trailers	Kwajalein	Completed
Assess need for additional housing	Kwajalein, Roi-Namur	Completed
Noise		
Perform noise study	Kwajalein	Completed
Island Flora		
Implement siting practices to minimize adverse impacts	All[1]	Completed; ongoing
Transplant vegetation as needed	All[1]	Completed; ongoing

[1]Refers to all 11 USAKA islands or procedural issues applicable to all 11 USAKA islands.
Source: U.S. Army Strategic Defense Command, 1989.

Appendix B
USAKA Standards and U.S. Regulations: Comparison

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
AIR QUALITY				
1. 3-1.5.1 Protection of Ambient Air Quality	Clean Air Act, Section 110.(a)(2)(I)	The USAKA Standards require demonstration in a DEP that activities will not cause or contribute to ambient air quality concentrations greater than 80 percent of any standard or the sum of baseline conditions and 25 percent of the standard, whichever is less.	The Clean Air Act denies permits for regulated activities causing or contributing to ambient air quality greater than any standard.	The differences in these regulations are insignificant because each regulation precludes exceedance of established ambient air quality standards.
	40 CFR 52.21 Prevention of Significant Deterioration	The USAKA Standards do not allow regulated activities to cause more than a 25 percent increase in an ambient air concentration above the baseline.	Federal regulations apply only to larger emission sources or modifications.	USAKA Standards are more stringent because they allow an increase in ambient air concentration of any criteria pollutant of only 25 percent of the published ambient air quality standards, after which any additional new source or sources must obtain offsets or install controls on existing sources to create no net impact.
2. 3-1.5.2(a) Document of Environmental Protection	TTPI Title 63, Chapter 13, Part 4.1	The USAKA Standards require a DEP for activities involving emissions of specified pollutants exceeding applicable threshold. Multiple activities may be handled under a single DEP.	Trust Territory of the Pacific Islands (TTPI or TT) regulations require all sources having the potential to emit air pollutants to obtain permits for modification construction.	The USAKA Standards and the TTPI regulations are comparable because each requires review and comment on a proposed action by appropriate agencies. Because fewer sources will require a DEP under the USAKA Standards, local air quality may be degraded more than if TTPI regulations were in effect. Under neither the USAKA Standards nor the TTPI regulations are air quality standards allowed to be exceeded.
3. 3-1.5.4 Modification of Sources	TTPI Title 63, Chapter 13, Part 4.1	The USAKA Standards require submittal of a new DEP if air emissions increase over existing DEP levels by 5 percent or more.	The Clean Air Act does not identify a specific increase requiring a permit modification. TTPI regulations require all sources having the potential to emit air pollutants to obtain permits for modification or construction.	The TTPI regulations are more stringent in requiring a permit revision for facility modifications. At USAKA, selected facility modifications will not require a revised DEP.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
4. 3-1.5.3 Existing Sources 3-1.5.4 Modification of Sources	40 CFR 52.21 Prevention of Significant Deterioration	The USAKA Standards require all DEPs to complete a demonstration of compliance with standards and an assessment of the effects on visibility, soil, and vegetation.	U.S. regulations require from the applicant demonstrations of compliance with the standards only for larger sources. The burden of demonstrating continued compliance with standards for all sources is borne by the regulator.	The USAKA Standards are applicable to a greater number of sources and therefore, potentially provide more protection than U.S. regulations.
5. 3-1.5.4 Modification of Sources	40 CFR 52.21 Prevention of Significant Deterioration	The USAKA Standards define a modification of a major source as an increase in net emissions above 105 percent of the emission levels allowed in a DEP.	U.S. regulations define a modification of a major source as an increase in net emissions above actual emission levels.	The USAKA Standards have the potential to regulate a greater number of sources than the U.S. regulations; this is a result of the differences in how a major source is defined by the two regulations.
6. None	TTPI Title 63, Chapter 13, Parts 6, 7, 12, and 13	There are no USAKA Standards for fugitive-dust control and for sampling and testing for opacity and odors.	TTPI air regulations contain provisions for fugitive-dust control and for sampling and testing for opacity and odors.	TTPI regulations are more stringent because they regulate a source that USAKA Standards do not regulate.
7. None	40 CFR 52.21 Prevention of Significant Deterioration	USAKA has no similar provision to PSD technology-based requirements.	U.S. regulations require major sources to install best available control technology.	The differences between these regulations are insignificant. Each regulation requires the control of emissions in a way that causes no exceedance of an ambient quality standard and that creates no adverse effects on the environment.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
WATER QUALITY				
8. 3-2.4.1 Classification of Coastal-Water Uses	TTPI Title 63, Chapter 13, Part 5	Classifies coastal-water use into Class AA, Class A, and Class B. Class AA water is to be maintained at near-pristine condition; Class A water is to be maintained for recreation, water supply, and propagation of aquatic life. The uses protected in Class B water are small-boat harbors, commercial and industrial shipping, compatible recreation, and support and propagation of aquatic life. Point source discharges are specifically precluded for Class AA water. Class A water is protected as a potential potable water source.	TTPI regulations classify coastal-water use into Class AA, Class A, and Class B and have the same conditions and requirements as the USAKA Standards. TTPI regulations can require additional treatment beyond the USAKA Standards if practicable under existing technological and economic conditions.	Discharge locations are restricted by the receiving-water classifications in the USAKA Standards. Best practical treatment is not required in the U.S. regulation, but the USAKA Standards provide the same or more stringent protection than federal regulations do.
9. 3-2.5.1 Contents of Water Quality Management Plan 3-2.5.2 Submission of Water Quality Management Plan 2-9.2.2 Water Quality	40 CFR 130.6(c) and 130.10	The USAKA plans (3-2.5.1 and 3-2.5.2) include nonpoint source management, dredge or fill control, prohibited areas for dredging and filling, groundwater-pollution control, water quality monitoring, identification of nonattainment water bodies, identification of necessary control practices, stormwater-discharge assessment, and identification of reef resources and management and control practices for protecting the reefs.	U.S. water quality management plans include nonpoint-source management, dredge or fill control, groundwater-pollution control, water quality monitoring, and stormwater-discharge assessment, and the plans establish total maximum daily loads, effluent limits, municipal and industrial water treatment requirements, management agencies, implementation measures, and basin plan requirements.	Management plans provide a process to improve or maintain existing water quality by requiring studies to assess effects. TMDLs, effluent limits, and treatment requirements are used in U.S. regulations; however, a DEP could be used to establish needs for specific discharges. The implementation process would be the final determinant of the level of protectiveness. The USAKA Standards include additional protection for reef resources in management plans, which is not required by U.S. regulations.

Appendix B

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON				
				Page 4 of 18
Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
9. (continued)		Specific water quality studies (2-9.2.2) must be performed when new pollutants are proposed to be discharged or when facilities for handling hazardous material, hazardous waste, or solid waste facilities are being sited. A report on the effectiveness of waste-water treatment is prepared when the plant's capacity is exceeded or when discharge limits are exceeded continually.	A biennial water quality report is required.	See above.
10. 3-2.6.2 Antidegradation	40 CFR 131.12 TTPI Title 63, Chapter 13, Subchapter VII, Part 3	The USAKA Standards do not allow Class I or Class II groundwater to be degraded so that (a) primary or secondary standards are exceeded or (b) existing groundwater quality already exceeding primary or secondary standards or containing hazardous constituents is further degraded. Class III groundwater cannot be degraded so that (a) primary standards are exceeded or (b) existing groundwater quality already exceeding primary standards or containing hazardous constituents is further degraded. All three classes of groundwater are protected for existing groundwater quality from specific hazardous constituents. A variance from these provisions may be granted. The water quality management plan addresses antidegradation by requiring the identification of nonpoint sources of pollution and other sources of groundwater contamination and the management and control practices to be used to reduce or eliminate the sources.	Federal regulations direct states to develop and adopt antidegradation policies and to identify methods for implementing such policies. These policies are required at a minimum to prevent degradation primarily for protecting existing uses and for protecting the quality of water where it exceeds that required for existing uses. TTPI regulations require that, as policy, water whose quality is less than defined by the standards will be improved to comply with the standard.	USAKA Standards protect existing water quality. Where existing quality is degraded, control and corrective actions are required; however, restoration is not required. USAKA Standards provide a lesser level of protection where existing conditions are already degraded. Variances and exemptions are restricted to human health and marine resource issues; other issues are not included as in TTPI regulations.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
11. 3-2.7.1 Point-Source Discharges 2-17.3 Document of Environmental Protection	40 CFR 122.21, 125.3, 133.100, 133.102, 133.103, 133.105, and 230.7 40 CFR 122.26 *Stormwater Discharge Permits* 40 CFR 400-403 General Pretreatment Regulations for Existing and New Sources of Pollution	The USAKA Standards require a DEP for new or existing discharges or before an existing point source is modified or a new point source is constructed. Application for a DEP for a new discharge must include: • Description, location, and characteristics of discharge • Dilution calculation • Pollution minimization measures taken • Assessment of biological effect • Description of treatment methods and by-product handling	U.S. regulations require an NPDES permit for discharges; the permit must contain a description, the location, and the characteristics of the discharge.	The USAKA DEP and the U.S. NPDES permit processes provide similar protection.
		Stormwater discharges that result in a point source discharge would require a DEP. In addition, as part of a water quality management plan (3-2.5.1), an assessment of the nature and extent of stormwater discharges is required, and control practices for managing stormwater must be identified. For point and nonpoint stormwater discharges that do not meet standards, additional management controls must be identified so that water quality standards are met.	U.S. regulations require a permit for surface water discharges composed entirely of stormwater.	
		A DEP is required before construction of new point sources.	U.S. regulations require that an NPDES permit be obtained before facilities that will discharge wastewater are constructed.	

Appendix B

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON Page 6 of 18				
Citation		**Regulation**		
USAKA	**U.S./Other**	**USAKA**	**U.S./Other**	**Regulatory Effect**
12. 3-2.7.2 Dredging, Quarrying, and Discharge of Dredged or Fill Material 3-2.8.2 Dredged or Fill Material 2.17-3 Document of Environmental Protection	40 CFR 225, 230, 231, 232, and 233	A DEP for dredging, quarrying, or discharging dredged or fill materials must include the following requirements: • Documentation that no alternative means of disposal is available that would have a less adverse effect on the marine ecosystem • Documentation that water quality standards and resources will be protected • A description of mitigation measures	A CWA 404 permit is required for disposal of dredged or fill material.	Both the DEP and 404 permit processes are similar. The USAKA Standards exceed U.S. regulations in requirements for analyzing effects and, in addition to spoil disposal, are applicable to dredging and quarrying.
13. 3-2.7.4 Control of Sewage Disposal from Vessels 3-2.8.3 Discharges from Marine Sanitation Devices	40 CFR 140	Disposal of sewage into the waters of the RMI from USAKA vessels is prohibited.	U.S. regulations apply only to vessels on which a marine sanitation device has been installed; they do not require installation of marine sanitation devices on all vessels with toilets. U.S. regulations require fecal coliforms $\leq$200 per 100 ml and suspended solids $\leq$150 mg/L. A state may completely prohibit sewage discharge from any vessel by applying to EPA with documentation for the need for the prohibition.	The USAKA Standards are more stringent than the federal regulations because the USAKA Standards prohibit all discharges from USAKA vessels into RMI waters, whereas U.S. regulations allow discharges subject to numerical limits.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	**U.S./Other**	**USAKA**	**U.S./Other**	**Regulatory Effect**
14. Appendix 3-2C Specific Water Quality Criteria for Surface Water	Federal Water Quality Criteria (WQC) TTPI Title 63, Chapter 13, Subchapter VII, Part 6	USAKA establishes water quality criteria for 40 toxic substances. Ammonia, iron, boron, manganese, hydrogen sulfide, elemental phosphorus, and barium are considered toxic substances, unlike under federal criteria. Criteria exist for some pesticides not covered in federal criteria. Criteria do not specify if for fresh water or marine water. USAKA prohibits the presence of substances or combinations of substances in surface water in amounts that exceed 0.01 times the 96-hour lethal concentration for toxic substances.	Federal water quality criteria, established as proposed standards, are for 126 toxic substances. The criteria specify whether for fresh water or marine water application or for human health. Criteria are listed for both acute and chronic protection. TTPI regulations establish water quality criteria for the same compounds as the USAKA Standards do.	The USAKA Standards would essentially regulate the same substances, but actual application of criteria is based on the content of an individual DEP rather than for all waters at USAKA. Application factors in the DEP would determine the effectiveness of the protection in the USAKA Standards.
15. Appendix 3-2-D Primary Standards for Groundwater Quality	40 CFR 141.11, 141.12, 141.15, 141.16, 141.61, and 141.62	The USAKA Standards apply to all groundwater classifications, regardless of use.	U.S. regulations establish primary standards for health protection for 46 metals and organics and 5 radiochemicals and apply to groundwater designated in the drinking water classification.	The USAKA Standards are more stringent for groundwater resources than are U.S. regulations. Application of the USAKA Standards could incur additional treatment and compliance costs.
16. Appendix 3-2-E Secondary Standards for Groundwater Quality	40 CFR 143.3 (guidelines to states)	The USAKA Standards are the same as 40 CFR 143.3, except total dissolved solids (TDS) have been removed. Applies to potential water sources as well as to actual sources.	U.S. regulations establishes secondary standard for aesthetics and other nonhealth-related considerations; 15 parameters are included.	The USAKA Standards are comparable to the U.S. regulations.

Appendix B

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON				
Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
DRINKING WATER				
17. 3-3.6.1 MCLs for Inorganic Contaminants	40 CFR 141.80 Lead and Copper Rule	Lists MCLs for lead and copper. Violation of MCLs triggers public notification and a notice of deficiency. If the MCL cannot be met, a variance can be requested (if the MCLs for lead and copper become burdensome).	Violation of action levels under U.S. regulations triggers a series of compliance measures which, if unsuccessful, are evaluated by the state. The state may specify maximum permissible source water levels. If lead or copper levels are still exceeded after optimal corrosion control is implemented, the state specifies monitoring programs to ensure continual optimal corrosion control, and public education is required.	Violation of the USAKA Standards may trigger notification of the public rather than the corrosion control, sampling of source water, and public education required by U.S. regulations.
18. 3-3.11.10 Analytical and Monitoring Requirements Related to Filtration and Disinfection	40 CFR 141.74 Analytical and Monitoring Requirements for Filtration and Disinfection	Requires disinfectant residual monitoring every 4 hours.	Requires continuous monitoring of disinfectant residual for systems serving 10,000 or more.	The USAKA Standards are similar to U.S. regulations and provide similar levels of protection.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		Regulatory Effect
USAKA	U.S./Other	USAKA	U.S./Other	
ENDANGERED SPECIES AND WILDLIFE RESOURCES				
19. 3-4.6.2 Coordination on Other Wildlife Resources 3-4.6.3 Procedures for Coordination of Other Wildlife Resources at USAKA 2-9.2.3 Biological Assessments and Requests for Coordination Reports	50 CFR, Part 402, 402.13 Informal Consultation 402.14 Formal Consultation 50 CFR 402.12 Biological Assessments	The USAKA Standards have both consultation and coordination for evaluating the effects of proposed activities on endangered species and other wildlife resources and their habitats. The USAKA Standards require coordination with the designated agencies for actions that may significantly affect migratory birds and species and habitats of significant biological importance. Coordination is initiated by USAKA through the preparation of a preliminary review of proposed activities.	The U.S. regulations require only consultation.	The U.S. regulations and the USAKA Standards are similar in that they both require communication with the designated agencies concerning the potential for adverse impacts to threatened and endangered species. The USAKA Standards use consultation and coordination, while the U.S. regulations use consultation. Because the USAKA Standards list more species and habitats than the U.S. regulations do, more species and habitats potentially will be evaluated before activities that can adversely affect species and critical habitats are conducted.
		In addition to listed species, the Standards address all species or habitats proposed for designation are candidates for designation, or all petitioned for designation. The Standards also include species not covered in the U.S. list.	U.S. regulations apply consultation for listed species and their critical habitats.	
		The USAKA Standards require biological assessments whenever the RMI or the designated agency disagrees with a USAKA preliminary review of "no effect" or they agree with a USAKA preliminary review concluding an activity "may affect" an endangered resource.	The U.S. regulations require biological assessments only for major construction activities.	Both the U.S. regulations and the USAKA Standards require the preparation of a biological assessment (BA). The USAKA Standards may result in more BAs being prepared because they include a larger list of species and habitats requiring consideration.

Appendix B

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON Page 10 of 18				
Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
20. 2-17.3 Document of Environmental Protection	50 CFR 402.12 Biological Assessments	The USAKA Standards identify which activities require a DEP after an adverse biological opinion has been agreed upon by USAKA, RMI, and the designated agency, or when USAKA agrees that a project will result in the taking of migratory birds or that a species or habitat covered by Appendix 3-4H will be affected.	The U.S. regulations do not allow construction contracts to be let or construction to begin before a biological assessment is completed. No documentation comparable to a DEP is required.	Both the U.S. regulations and the USAKA Standards allow for the resolution of conflicting opinions that arise through the consultation or coordination processes.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		Regulatory Effect
USAKA	U.S./Other	USAKA	U.S./Other	
OCEAN DUMPING				
21. 3-5.5.1 Selection and Designation of Disposal Sites	40 CFR 228.6 Specific Criteria for Site Selection 40 CFR 221 Applications for Ocean Dumping Permits under Section 102 of the Ocean Dumping Act 40 CFR 222 Action on Ocean Dumping Permit Applications under Section 102 of the Ocean Dumping Act	Under the USAKA Standards, selection and designation of ocean dumping sites are subject to the review and comment procedures of a DEP. Studies are required for assessing environmental effects and supporting the preparation of an EIS.	Under federal regulations, selection and designation of an ocean dumping site is initiated by applying for a permit. Similar studies are required for preparing an EIS if an EIS is required by EPA policy.	The USAKA Standards and the U.S. regulations are similar. The primary difference is a DEP (USAKA) and a permit (United States). The DEP procedures involve the coordination of the review of USAKA activities between USAKA and appropriate agencies. U.S. regulations require public notification of the permit application and possible public hearings.
22. 3-5.5.2 Modification of the Use of Disposal Sites	40 CFR 228.10 Evaluating Disposal Impact 40 CFR 228.11 Modification in Disposal Site Use	The USAKA Standards state that modifications to use of disposal sites must be evaluated on the basis of monitoring data compiled in compliance with 3-5.11.3 of the USAKA Standards.	The effects of disposal at each site must be evaluated periodically, and a report prepared under the direction of USEPA must be submitted as appropriate as part of the Annual Report to Congress. Specific effects are listed that must be considered in determining the extent the environment has been affected by materials disposed of at the site. Effects are classified in one of two categories according to severity.	The USAKA Standards and U.S. regulations require a similar degree of monitoring and data analysis. The U.S. regulations specify the effects that must be considered during evaluation of the results of the monitoring and data analysis for determining the environmental impacts of dumping and give guidelines for classifying the impacts into categories that indicate whether the disposal site use should be modified. The USAKA Standards do not give guidance on the evaluation of monitoring data in order to determine whether or not the disposal site use should be modified (i.e., the USAKA Standards do not indicate the severity of impacts that would indicate a need to modify or terminate the use of a disposal site.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	**U.S./Other**	**USAKA**	**U.S./Other**	**Regulatory Effect**
23. 3-5.5.3 Case-by-Case Authorization for Ocean Dumping	40 CFR 221 Applications for Ocean Dumping Permits under Section 102 of the Ocean Dumping Act 40 CFR 220 General	Decisions on ocean dumping are made on a case-by-case basis for individual instances of dumping and are based on an evaluation of the content of case-specific DEPs. A single DEP may allow up to three individual instances of ocean dumping within a 30-day period if the amount of material is identified and the time periods for dumping are specified.	Permit applications required for ocean dumping activities must specify quantities of material and times and dates of the proposed dumping but do not specifically limit the number of instances. General Permits (normally issued for dumping small quantities of materials that will have a minimal adverse environmental effect) may be issued without an application if the USEPA Administrator determines that it is necessary or appropriate.	The USAKA Standards are potentially more stringent because they require more-frequent reviews for making decisions on ocean dumping activities. (Refer to "Selection and Designation of Disposal Sites," above, for conclusions related to DEP and permit application procedures.)

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		Regulatory Effect
USAKA	U.S./Other	USAKA	U.S./Other	
MATERIAL AND WASTE MANAGEMENT				
24. 3-6.1.2 Material Management 3-6.1.2(c)(4) Use and Approval 3-6.1.2(c)(1) Introduction, Identification, and Classification of Materials	40 CFR 721 Significant New Uses of Chemical Substances 40 CFR 707.20 Chemical Substances Import Policy 40 CFR 710 Inventory Requirements	The USAKA Standards specify general use requirements and categorization for all materials imported to USAKA and do not provide for exemptions. Atypical uses of products, which generally refers to hazardous materials and oil, need to be approved by safety and environmental personnel.	U.S. regulations require that all chemicals be listed in the TSCA chemical inventory. Significant new uses of chemicals must be reported to EPA.	In comparison to the U.S. regulations, which apply only to chemicals, the USAKA Standards apply to all materials. Federal regulations also are limited to the initial listing of the chemicals in a toxic substances inventory; the USAKA Standards address inventory and classification of the imported materials. The additional information required by USAKA will be more protective of the environment because incompatible materials are less likely to be stored together.
25. 3-6.5.2(c)(3) Transport of Regulated Medical Waste	40 CFR 259.70 Army Regulation 40-5 (Preventive Medicine)	USAKA includes specifications for transporting medical waste within and outside health-care facilities.	There is no similar federal requirement. The U.S. regulations specifically state that the standards do not apply to onsite transport of RMW (40 CFR 259.70[b]).	The USAKA Standards are more stringent than the U.S. regulations; five U.S. states, however, have volunteered to participate in a pilot program for tracking RMW. The USAKA requirements should provide more protection to public health as a result of greater control of infectious wastes.
26. 3-6.5.3 Storage—General Requirements 3-6.5.3(b) Hazardous Materials and Petroleum Products 3-6.5.3(c)(i) Storage of Compressed-Gas and Compressed-Gas Cylinders	40 CFR 112.7(e)(2) Spill Prevention, Control, and Countermeasures (SPCC) Design Requirements	The USAKA Standards include storage, security, and inspection requirements for hazardous materials, hazardous wastes, and petroleum products (HMWPPs).	No similar federal requirements exist for hazardous materials. There are similar requirements in the SPCC regulations for petroleum products.	The USAKA Standards for storage are more comprehensive than the U.S. regulations. The USAKA standards will prevent releases of hazardous materials to the environment.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON Page 14 of 18				
Citation		**Regulation**		
USAKA	**U.S./Other**	**USAKA**	**U.S./Other**	**Regulatory Effect**
26. (continued) 3-6.6.6 Prohibition—Underground Storage Tanks	40 CFR 280	The USAKA Standards specify that all installations of petroleum-product storage tanks must be constructed so that a secondary means of impervious containment is provided for the entire contents of the largest single tank or for 10 percent of the total volume, whichever is greater. Diked areas must be sufficiently impervious to contain spilled oil.	The U.S. mandates that a secondary means of containment must be provided for the entire contents of the largest single tank and sufficient free board to allow for precipitation.	The USAKA Standards will provide more environmental protection than the U.S. regulations when 10 percent of the volume of all tanks is larger than the largest single tank.
		The USAKA Standards include compressed gas in the category of hazardous materials and specify storage requirements similar to those for HMWPP.	There are no similar federal requirements for compressed gas.	The USAKA Standards will provide more environmental protection because compressed gases could liquefy and be released to the environment.
		Installation of new USTs is prohibited at USAKA.	The U.S. allows UST installation and applies technical requirements.	The USAKA Standards are more stringent than U.S. regulations because they prohibit installation of new USTs. Given the regulatory-driven design requirements for above-ground and under-ground storage tanks, there should not be any net difference regarding protection of the environment between either types of tanks. The slightly greater likelihood of a release from an UST may be offset by the increased fire hazard of above-ground tanks.
27. 3-6.5.4(b)(1)(iii) Hazardous Materials and Petroleum Products	None	USAKA requires workers handling hazardous materials to work in pairs. In addition, distributors of hazardous materials must have special authorization.	There are no similar federal requirements.	The USAKA Standards are more comprehensive than the U.S. regulations because they specify that staff involved in handling hazardous waste must work in pairs. This requirement should provide greater environmental protection and increased worker protection given the additional person.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
28. 3-6.5.4(c)(3) PCB Materials	None	The USAKA Standards require that information on the location of all PCB items must be provided to the appropriate agencies.	There are no similar federal requirements. However, there are U.S. regulations for inspection of certain PCB items.	The USAKA Standards are more comprehensive than the U.S. regulations because they require specific information on the location of PCB items, whereas U.S. regulations cite only inspections. Unless USAKA uses the submitted information to conduct more inspections than would occur in the U.S., there is unlikely to be a difference in environmental protection between the two regulations.
29. 3-6.5.5(a)(3)(ii) Management of Pesticide Containers 3-6.5.7(c)(2) Pesticide Waste Management	40 CFR 261.7 Management of Empty Containers	All pesticide containers are considered hazardous wastes. Containers are not to be reused except for their original purposes. All containers must be disposed of as hazardous waste, with no treatment option. USAKA has an additional inspection program for determining container reuse applications.	In the U.S. regulations, some pesticide containers are managed as hazardous wastes, but containers can be triple-rinsed or defined as "empty" to make them nonhazardous.	The USAKA Standards are more comprehensive than the U.S. regulations because they require disposal of containers, whereas U.S. regulations allow triple rinsing as treatment. There should not be any difference in environmental protection between these two regulations.
30a. 3-6.5.5(a)(3)(iv) Collection of PCBs	None	PCB and asbestos wastes shall be collected near the point of generation or removal and must be moved to a central collection area within 3 days.	There are no similar federal requirements.	The USAKA Standards are more comprehensive than the U.S. regulations because they specify a 3-day period for collection before removal is required; the U.S. regulations have no such time limit.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
30b. 3-6.5.5(a)(3)(v) Collection of Asbestos Wastes	40 CFR 61.150(a) Management of Asbestos Waste Materials	The USAKA Standards require asbestos material to be wet to the touch and placed in double polyethylene bags labeled according to EPA and OSHA requirements. The USAKA Standards mandate that the double bags be placed in a polyethylene-lined container, that labels be placed on top of the liners, and that the lid be placed on top of the container and sealed. The number of bags must be marked on the outside of the container.	Federal requirements specify that asbestos wastes be placed in leak-tight containers without further container requirements.	The USAKA Standards will provide a greater level of confidence that asbestos is not inadvertently released to the environment.
31. 3-6.5.5(b)(1)(v)(C) Spent-Battery Storage	40 CFR 261.6 Hazardous Waste Recycling Requirements	Spent batteries cannot be stored for more than 90 days without a variance, which can extend the storage for an additional 90 days.	In the U.S., spent batteries cannot be stored for more than 90 days unless a permit is obtained or they will be recycled (roughly 1-year limit for recyclables).	Under the Standards, spent batteries must be moved more frequently and therefore the collection requirements at USAKA are more stringent. Given the more frequent collection, there should be less likelihood of a release of a hazardous substance.
32. 3-6.5.7(a) Treatment and Disposal—General Requirements 3-6.6.1 Prohibition—Disposal of Hazardous Waste 3-6.6.2 Prohibition—Discharge of Ballast 3-6.6.3 Prohibition—Disposal of PCB Wastes	None	USAKA prohibits (1) burning, incinerating, or disposing of hazardous waste; (2) discharge ballast from watercraft fuel tanks; and (3) incineration or landfill for disposal of PCBs.	No U.S. regulation contains these provisions.	The USAKA Standards are more comprehensive than the U.S. regulations because of the specific prohibitions for burning, incinerating, or disposing of hazardous waste; discharge of ballast; and incineration or landfill for disposal of PCBs. These prohibitions will provide more protection of the environment because these operations would potentially have some releases of hazardous substances to the environment.

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON

Citation		Regulation		
USAKA	U.S./Other	USAKA	U.S./Other	Regulatory Effect
33. 3-6.5.1(d) Documentation of Employee Training 3-6.5.1(d)(3) Pollution-Control Equipment Training	None	All USAKA personnel involved in working with pollution-control devices must be trained (and the training must be documented and verified) in the operation of that equipment.	No similar federal requirements.	The USAKA Standards are more comprehensive than the U.S. regulations because of the specific training requirements for environmental staff. These requirements should result in better facility operations and therefore more environmental protection.
34. 3-6.5.3.(a)(11)(iii) Marking	40 CFR 264.14(c)	The USAKA Standards require signs to be posted for "Hazardous Waste," "Wastewater Treatment Facility," "Potable-Water Treatment Plant," "Pesticides," in English and Marshallese.	Federal regulations require signs only for hazardous waste ("Danger—Unauthorized Personnel Keep Out") and only when other more direct security measures (such as surveillance systems or fences) do not adequately control unauthorized entry.	The USAKA Standards extend to other facilities in addition to hazardous waste facilities but are otherwise similar to the U.S. regulations. The posting of these signs should prevent unknowing entry of personnel and therefore reduce contaminant exposure.
35. 2-17.3.1(k) DEP—Emergency Exemptions and Special Local Needs for Pesticide Use 3-6.5.4 (c)(2)(iii) Specific, Quarantine, and Public Health Exemptions for Pesticide Use	RMIEPA Pesticide Regulations—Part IV (No. 16)	USAKA requires a DEP for emergency exemptions and special local needs for pesticide use. The appropriate agencies must be contacted if the proposed use of a pesticide is likely to be of concern to other agencies, and those agencies must have an opportunity to submit comments in response to an NPA.	RMIEPA has a permitting process for persons involved in working with restricted-use pesticides.	The USAKA Standards are more comprehensive than the RMIEPA regulations because they require documentation of more information on pesticide use and the submittal of the documentation to more than one appropriate agency. Given the wider review of pesticide use, adverse impacts associated with the pesticides are more likely to be identified.

Appendix B

USAKA STANDARDS AND U.S. REGULATIONS: REGULATORY EFFECT COMPARISON				
				Page 18 of 18
Citation		**Regulation**		
USAKA	**U.S./Other**	**USAKA**	**U.S./Other**	**Regulatory Effect**
CULTURAL RESOURCES				
36. 3-7.11.4 Eligibility Criteria for National Register	36 CFR 60 National Register Eligibility Criteria	Establishes the types of resources that are eligible for listing on the RMI National Register of Historic Places. Includes 11 eligibility categories.	Establishes four eligibility criteria for resources eligible for listing on the U.S. National Register of Historic Places.	The RMI National Register Criteria are more inclusive than the U.S. National Register Criteria and, therefore, could result in a greater number of resources being eligible for listing at USAKA than if only the U.S. National Register Criteria were applied.

Notes:
DEP: Document of Environmental Protection
EIS: Environmental impact statement
HMWPP: Hazardous Materials, Waste, and Petroleum Products
NPA: Notice of Proposed Activity
PSD: Preservation of Significant Deterioration
RCRA: Resource Conservation and Recovery Act
RMW: Regulated medical waste
TTPI: Trust Territories of the Pacific Islands
USAKA: United States Army Kwajalein Atoll
UST: Underground storage tank
WWTP: Wastewater treatment plant

Appendix C
Substances Requiring a Document of Environmental Protection Under Proposed USAKA Standards

Appendix C
Substances Requiring a Document of Environmental Protection Under the USAKA Environmental Standards if Emissions Exceed 10 Tons per Year

Chemical Abstract Service (CAS) No.	Chemical Name
75070	Acetaldehyde
60350	Acetamide
75058	Acetonitrile
98862	Acetophenone
53963	2-acetylaminofluorene
107028	Acrolein
79061	Acrylamide
79107	Acrylic acid
107131	Acrylonitrile
107051	Allyl chloride
92671	4-aminobiphenyl
62533	Aniline
90040	o-anisidine
1332214	Asbestos
71432	Benzene (including benzene from gasoline)
92875	Benzidine
98077	Benzotrichloride
100447	Benzyl chloride
92524	Biphenyl
117817	Bis(2-ethylhexyl)phthalate (DEPH)
542881	Bis(chloromethyl)ether
75252	Bromoform
106990	1,3-butadiene
156627	Calcium cyanamide
105602	Caprolactam
133062	Captan
63252	Carbaryl
75150	Carbon disulfide
56235	Carbon tetrachloride
463581	Carbonyl sulfide
120809	Catechol
133904	Chloramben
57749	Chlordane
7782505	Chlorine
79118	Chloroacetic acid
532274	2-chloroacetophenone
108907	Chlorobenzene
510156	Chlorobenzilate
67663	Chloroform

Appendix C
Substances Requiring a Document of Environmental Protection Under the USAKA Environmental Standards if Emissions Exceed 10 Tons per Year

Chemical Abstract Service (CAS) No.	Chemical Name
107302	Chloromethyl methyl ether
126998	Chloroprene
1319773	Cresols/crysylic acid (isomers and mixture)
95487	o-cresol
108394	m-cresol
106445	p-cresol
98828	Cumene
94757	2,4-D, salts and esters
3547044	2,2-bis(p-chlorophenyl)-1,1-dichloroethylene
334883	Diazomethane
132649	Dibenzofurans
96128	1,2-dibromo-3-chloropropane
34742	Dibutylphthalate
106467	1,4-dichlorobenzene(p)
91941	3,3-dichlorobenzidene
111444	Dichloroethyl esther (bis(2-chloroethyl)ether)
542756	1,3-dichloropropene
62737	Dichlorvos
111422	Diethanolamine
121697	n,n-diethyl aniline (n,n-dimethylaniline)
64675	Diethyl sulfate
119904	3,3-dimethoxybenzidine
60117	Dimethyl aminoazobenzene
119937	3,3'-dimethyl benzidine
79447	Dimethyl carbamoyl chloride
68122	Dimethyl formamide
57147	1,1-dimethyl hydrazine
13113	Dimethyl phthalate
77781	Dimethyl sulfate
534521	4,6-dinitro-o-cresol, and salts
51285	2,4-dinitrophenol
121142	2,4-dinitrotoluene
123911	1,4-dioxane (1,4-diethyleneoxide
122667	1,2-diphenylhydrazine
106898	Epichlorohydrin (1-chloro-2,3-epoxypropane)
106887	1,2-epoxybutane
140885	Ethyl acrylate
100414	Ethyl benzene
51796	Ethyl carbamate (urethane)
75003	Ethyl chloride (chloroethane)
106934	Ethylene dibromide (dibromoethane)
107062	Ethylene dichloride (1,2-dichloroethane)

Appendix C
Substances Requiring a Document of Environmental Protection Under the USAKA Environmental Standards if Emissions Exceed 10 Tons per Year

Chemical Abstract Service (CAS) No.	Chemical Name
107211	Ethylene glycol
151564	Ethylene imine (aziridine)
75218	Ethylene oxide
96457	Ethylene thiourea
75343	Ethylidene dichloride (1,1-dichloroethane)
50000	Formaldehyde
76448	Heptachlor
118741	Hexachlorobenzene
87683	Hexachlorobutadiene
77474	Hexachlorocyclopentadiene
67721	Hexachloroethane
822060	Hexamethylene-1,6-diisocyanate
680319	Hexamethylphosphoramide
110543	Hexane
302012	Hydrazine
7647010	Hydrochloric acid
7664393	Hydrogen fluoride (hydrofluoric acid)
123319	Hydroquinone
78591	Isophorone
58899	Lindane (all isomers)
108316	Maleic anhydride
67561	Methanol
72435	Methoxychlor
74839	Methyl bromide (bromomethane)
74873	Methyl chloride (chloromethane)
71556	Methyl chloroform (1,1,1-trichloroethane)
78933	Methyl ethyl ketone (2-butanone)
60344	Methyl hydrazine
74884	Methyl iodide (iodomethane)
108101	Methyl isobutyl ketone (hexone)
624839	Methyl isocyanate
80626	Methyl methacrylate
1634044	Methyl tert butyl ether
101144	4,4-methylene bis(2-chloroaniline)
75092	Methylene chloride (dichloromethane)
101688	Methylene diphenyl diisocyanate (MDI)
101779	4,4'-methylenedianiline
91203	Naphthalene
98953	Nitrobenzene
92933	4-nitrobiphenyl
100027	4-nitrophenol
79469	2-nitropropane

Appendix C
Substances Requiring a Document of Environmental Protection Under the USAKA Environmental Standards if Emissions Exceed 10 Tons per Year

Chemical Abstract Service (CAS) No.	Chemical Name
684935	n-nitroso-n-methylurea
62759	n-nitrosodimethylamine
59892	n-nitrosomorpholine
56382	Parathion
82688	Pentachloronitrobenzene (quintobenzene)
87865	Pentachlorophenol
108952	Phenol
106503	p-phenylenediamine
75445	Phosgene
7803512	Phosphine
7723140	Phosphorus
85449	Phthalic anhydride
1336363	Polychlorinated biphenyls (aroclors)
1120714	1,3-propane sultone
57578	Beta-propiolactone
123386	Propionaldehyde
114261	Propoxur (baygon)
78875	Propylene dichloride (1,2-dichloropropane)
75569	Propylene oxide
75558	1,2-propylenimine (2-methyl aziridine)
91225	Quinoline
106514	Quinone
100425	Styrene
06093	Styrene oxide
1746016	2,3,7,8-tetrachlorodibenzo-p-dioxin
79345	1,1,2,2-tetrachloroethane
127184	Tetrachloroethylene (perchloroethylene)
7550450	Titanium tetrachloride
108883	Toluene
95807	2,4-toluene diamine
584849	2,4-toluene diisocyanate
95534	o-toluidine
8001352	Toxaphene (chlorinated camphene)
120821	1,2,-4-trichlorobenzene
79005	1,1,2-trichloroethane
79016	Trichloroethylene
95954	2,4,5-trichlorophenol
88062	2,4,6-trichlorophenol
121448	Triethylamine
1582098	Trifluralin
540841	2,2,4-trimethylpentane
108054	Vinyl acetate

Appendix C
Substances Requiring a Document of Environmental Protection Under the USAKA Environmental Standards if Emissions Exceed 10 Tons per Year

Chemical Abstract Service (CAS) No.	Chemical Name
593602	Vinyl bromide
75014	Vinyl chloride
75354	Vinylidene chloride (1,1-dichloroethylene)
1330207	Xylenes (isomers and mixture)
95476	o-xylenes
108383	m-xylenes
106423	p-xylenes
0	Antimony compounds
0	Arsenic compounds (inorganic, including arsine)
0	Beryllium compounds
0	Cadmium compounds
0	Chromium compounds
0	Cobalt compounds
0	Coke oven emissions
0	Cyanide compounds[1]
0	Glycol ethers[2]
0	Lead compounds
0	Manganese compounds
0	Mercury compounds
0	Fine mineral fibers[3]
0	Nickel compounds
0	Polycyclic organic matter[4]
0	Radionuclides (including radon)[2]
0	Selenium compounds

Note: For all lists above that contain the word "compounds" and for glycol ethers, the following applies: unless otherwise specified, these lists are defined as including all unique chemical substances that contain the named chemical (e.g., antimony, arsenic) as part of the chemical's infrastructure.

[1] X^1CN where $X = H^3$ or any other group where a formal dissociation may occur. For example, KCN or $Ca(CN)_2$.

[2] Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol $R\text{-}(OCH2CH2)_n\text{-}\ OR^1$ where

- n = 1, 2, or 3
- R = alkyl or aryl groups
- R^1 = R, H, or groups that, when removed, yield glycol ethers with the structure: $R\text{-}(OCH2CH)_n\text{-}$ polymers are excluded from the glycol category

[3] Includes emissions of mineral fibers from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral-derived fibers) of average diameter of 1 micrometer or less.

[4] Includes organic compounds having more than one benzene ring and a boiling point greater than or equal to 100°C.

[5] A type of atom that spontaneously undergoes radioactive decay.

Appendix D
Proposed USAKA Environmental Standards And Procedures: Cost Comparison

USAKA Standards and U.S. Regulations: Cost Comparison

Introduction

An economic analysis of the draft USAKA Standards (Standards) was conducted to determine the direct cost effects of implementing the Standards instead of the corresponding U.S. regulations on USDOD and other appropriate reviewing agencies.

The following text presents the general approach to the economic analysis, the assumptions underlying the analysis, and a summary of the cost differences for USDOD and other appropriate agencies to implement the compliance measures of the Standards as opposed to those of U.S. regulations. The attached table presents the results of the economic analysis.

Approach

The economic analysis presents a judgment of the range of cost differences between implementing the Standards and the corresponding U.S. regulations at USAKA. Approximating the total cost of implementing either the Standards or the U.S. regulations would not add insight on burdens or savings caused by the proposed Standards, because the Standards and the regulations share many common activities and associated common costs.

The general approach to the economic analysis consists of identifying principal regulatory differences, the types of facilities affected by the differences, and the types of costs incurred by the affected facilities in complying with the regulations. The costs to both USDOD (USAKA) and other appropriate reviewing agencies are considered; the costs to the Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) are not.

The economic analysis involves the following sequential steps:

1. **Identify Principal Regulatory Differences.** The first step identifies the principal differences between the Standards (August 1992 draft and October 1992 comments) and the U.S. regulations (as of December 1991) on the basis of differences in environmental protection or cost of implementation. Regulations of the Trust Territory of the Pacific Islands (TTPI) and the Republic of the Marshall Islands (RMI) also may be consulted when needed for comparison with the Standards.

2. **Combine Identified Differences, as Needed.** After the differences have been identified, the next part of the analysis involves reviewing the differences to see if they can be grouped, as needed, for completing the cost approximations. Some subsections may have opposing effects if implemented in isolation. They will be considered concurrently in the economic analysis to approximate the net cost difference. Other subsections may have similar environmental effects but may need to be grouped together to show the cost difference.

3. **Identify Affected Costs.** After the regulatory subsections have been grouped, the third step identifies which cost categories may be affected by each regulatory difference. The cost categories are the following:

   - Costs to appropriate agency
     - Administrative (includes regional compliance monitoring)
     - Oversight (includes facility compliance monitoring)
   - Costs to USDOD (USAKA)
     - Capital (includes design and support costs)
     - Operation and maintenance
     - Monitoring
     - Administrative (includes processing the record of consultation)

Certain administrative differences and costs are not included in this analysis. The costs not included represent cross-media procedural functions not performed previously and with little basis for a cost judgment such as the annual review of the USAKA Standards, installation audits, enforcement and fines, and conflict resolution.

4. **Gather Facility Information.** Next, information specific to USAKA facilities is gathered (according to Standards section) as a preliminary step in determining required compliance measures. A compliance measure may apply to a specific facility (e.g., the need for a facility to meet a standard for water quality) or may be nonspecific (e.g., the need for USAKA to develop a management plan for water quality). The primary sources of documentation for this step are the following:

   - The 1989 Environmental Impact Statement (EIS)
     - No-Action Alternative
     - Proposed Action, excluding elements of the Proposed Action that will not be initiated
   - The 1992 Environmental Mitigation Plan and Resources Report, excluding the elements that will not be initiated
   - The Proposed Action in the 1992 Supplemental EIS

5. **Identify and Define Differences in Compliance Measures.** When the facility information is complete, the next step is identifying required compliance measures for ensuring compliance of current and future facilities with either U.S. regulations or the Standards. The baseline of compliance measures for the analysis will consist of current conditions and completed or planned compliance measures; the assumption is that when we compare the costs USAKA will be in compliance.

   After the compliance measures have been identified, the differences between compliance measures required for meeting the U.S. regulations and the Standards are identified. This step identifies differences in how the Standards and the U.S. regulations specifically apply at USAKA so that the cost differences can be evaluated.

The compliance difference equals the compliance measures needed for meeting the Standards that are different from current compliance measures for meeting U.S. regulations, plus the compliance measures needed for meeting the Standards that are different from planned or budgeted compliance measures for meeting U.S. regulations, plus the compliance measures needed for meeting the Standards that are different from unplanned compliance measures for meeting U.S. regulations. Under this structure, unplanned compliance measures include differences in future capital costs. Current and planned compliance measures are considered to include sunk capital costs.

6. **Cost Judgments.** When the facility information has been gathered and the differences in compliance measures have been assessed, the cost burden or saving will be documented and identified in four cost ranges: negligible (less than $5,000), low ($5,000 to $50,000), medium ($50,000 to $250,000), and high (more than $250,000). The cost ranges for the cost differences will be separated by the cost categories presented in No. 3, above, as either capital or single annual costs. Because we are dealing with a cost comparison rather than with total cost, continental U.S. costs are used in the analysis and the price differences between the mainland and USAKA are not considered.

7. **Summarize Cost by Category.** After the cost judgments are complete, this step summarizes the costs according to regulatory difference and cost category. This step results in development of the summary table for the economic analysis.

Assumptions

The economic analysis is based on the following assumptions:

- The cost approximations focus on the principal differences between the two sets of regulations. Minor differences due to wording or presentation that do not change expectations for protection of the environment or cost of implementation are not addressed.

- The cost approximations do not include general procedures that apply to all resource areas but differ across resource areas. Examples of such differences for which costs were not included are the annual review of the Standards, audits of the installation, conflict resolution, inventories, and enforcement and fines.

- Rough cost ranges are developed (see "General Approach," above) that have no preestablished level of accuracy. The costs are not appropriate for, and should not be used for, planning or implementation.

- The analysis includes only existing and planned USAKA facilities and planned and unplanned compliance measures. Unplanned facilities and response actions are not included.

- The economic analysis focuses on the cost difference between what must be done so that current facilities stay in compliance with the U.S. regulations and complete future projects in compliance with the U.S. regulations and what must be done so that current facilities come into compliance with the Standards and complete future projects in compliance with the Standards.

- The costs of completed and planned mitigation measures for bringing current facilities into compliance with U.S. regulations are assumed to be budgeted and are not considered. Typical upgrades for expanding facilities or other actions that meet U.S. regulations are assumed.

- The planning horizon includes the years 1992 through 2001. The end date is the termination date of USAKA's October 1986 lease on Kwajalein Atoll.

- The U.S. regulations as of December 1991 are compared with the Standards in the economic analysis. The Standards have provisions for incorporating future U.S. environmental regulations.

- The environmental regulations of the RMI were considered during development of the Standards. Although some differences in environmental protection may arise for certain media that cross USAKA boundaries into the RMI, the comparative analysis of the cost of implementing the Standards and the cost of implementing the U.S. regulations should not change. Therefore, how the RMI environmental regulations affect media that cross boundaries is not considered in the economic analysis.

- Benefits in the form of direct cost saving or increased environmental protection are inherently recognized in the analysis through the approximation of cost differences. Benefit valuations and indirect costs, however, are not included in the analysis. Because the regulations remain limited to application at USAKA, extending the analysis to document the benefit valuations and the indirect costs would not contribute to understanding a change in the cost burden on either USDOD (USAKA) or other appropriate agencies.

Summary of Cost Differences

For more than half of the compliance measures discussed in the attached table, there is no expected difference in cost for USDOD or the appropriate agencies to comply with the Standards rather than the U.S. regulations. This applies to all the resource categories discussed below. For the compliance measure differences where cost differences are anticipated, the majority of cost differences for both USDOD and the appropriate agencies are administrative costs.

The expected administrative cost differences are for preparing and reviewing plans, reports, studies, and Records of Consultation (ROCs) and are due in part to the extent to which comparable U.S. regulations are incorporated into the Standards. Differences in capital costs are anticipated to occur only in the resource categories of water quality and waste and material management. O&M cost differences are also anticipated for those two categories, as well as for the cultural resources section.

The cost categories that may be affected by the regulatory compliance measure differences for USDOD and other appropriate agencies are discussed above in the Approach section. In particular, it is important to note that specific administrative differences and costs (such as procedural functions that are applicable to all resource categories) are not addressed in this analysis. For further discussion on this issue, refer to number 3 of the Approach, Identify Affected Costs. The summary of cost differences is organized below by the resource categories of air quality, water quality, drinking water quality, endangered species and wildlife resources, ocean dumping, waste and material management, and cultural resources. Because the majority of costs differences identified in the comparative table are administrative, the discussion below focuses on that cost type. Whenever appropriate, however, other costs differences are discussed.

1. **Air Quality.** Although the ambient air quality standards at USAKA are more stringent than the U.S. regulations, the only compliance measure difference expected to result in an additional cost to USDOD is associated with facility modifications requiring compliance evaluations under the Standards because more USAKA sources are subject to compliance demonstration requirements. Where compliance measure differences are expected to result in administrative cost differences for USDOD and the appropriate agencies, the majority of costs of complying with the USAKA Standards for air quality are anticipated to be less than the cost of complying with U.S. regulations.

2. **Water Quality.** Fewer than half the compliance measure differences identified for water quality are anticipated to result in any cost differences for either USDOD or appropriate agencies. Several compliance measure differences, however, could result in increased administrative costs. Because the Standards require that ROCs contain information on the effects of point-source discharges (which is optional under U.S. permitting regulations) and for dredging and quarrying (which is not required by U.S. regulations), issuing a ROC that contains the additional data could result in greater administrative costs for USDOD and the agencies. The expected difference in capital costs for USDOD would be for additional capital expenditures to install marine sanitation devices in all vessels that discharge sewage to RMI waters.

3. **Drinking Water Quality.** With the exception of a projected decrease in capital costs related to filtration and disinfection, the cost differences incurred by USDOD and the appropriate agencies in implementing the drinking water quality standards are not expected to be different than the costs of complying with U.S. regulations. The decreased capital cost is related to the USAKA Standards for filtration and disinfection, which would require less expensive equipment to accomplish monitoring.

4. **Endangered Species and Wildlife Resources.** All the cost differences projected to be incurred by USDOD and the appropriate agencies would be administrative costs for preparing ROCs and biological assessments and for issuing public notices. The anticipated cost increase is linked to the greater number of endangered, threatened, and wildlife species that must be considered under the Standards and the subsequent additional baseline data required to prepare ROCs and biological opinions.

5. **Ocean Dumping.** None of the compliance measure differences identified for ocean dumping is anticipated to result in any substantive compliance cost difference for either USDOD or appropriate agencies. The compliance measure difference for ocean dumping of radioactive wastes could result in an O&M cost increase for USDOD because the Standards (unlike U.S. regulations) prohibit dumping of low-level radioactive wastes.

6. **Waste and Material Management.** With the exception of several compliance measure differences that pertain to preparing ROCs, no administrative cost differences are anticipated for the appropriate agencies to implement the USAKA Standards for waste and material management. The USDOD, however, is anticipated to incur additional administrative cost differences for activities that include classifying materials introduced to USAKA, furnishing information to appropriate agencies, documenting employee training, and preparing ROCs. In implementing the Standards as opposed to U.S. regulations, USDOD also is projected to incur capital and O&M costs for constructing and maintaining secondary containment facilities for hazardous materials and petroleum products. A one-time capital cost is anticipated for producing signs for facilities, and subsequent O&M costs for upkeep is also anticipated. In addition, procedural requirements of the Standards for handling and storing special wastes (such as asbestos and PCBs) could result in additional O&M costs for USDOD.

7. **Cultural Resources.** Because the RMIEPA (and not a U.S. regulatory agency) is designated as the appropriate agency for the cultural resources standards, the cost differences incurred by RMIEPA were not addressed in the economic analysis. For USDOD, implementing the Standards would result in either no cost difference from the U.S. regulations or in lower administrative costs related to the number of interested persons who must be consulted in the development of the Programmatic ROC for cultural resources. The compliance difference for National Register eligibility criteria is anticipated to result in slight increases in administrative and monitoring costs for USDOD because the Standards have more resources eligible for listing than do the U.S. regulations.

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
AIR QUALITY									
1. 3-1.5.1 Protection of Ambient Air Quality.	Clean Air Act Section 110.(a)(2)(I)	The USAKA Standards require demonstration in a DEP that activities will not cause or contribute to ambient air quality greater than 80 percent of any standard or the sum of the baseline air quality and 25 percent of the standard, whichever is less.	The Clean Air Act denies permits for regulated activities causing or contributing to ambient air quality greater than any standard.	All facilities and activities requiring a DEP are affected by the need to compare their contributions to ambient air quality with the requirements of a more stringent USAKA standard.	None.	None.	The USAKA ambient air quality stand-ards are more stringent than the U.S. regula-tions. The more stringent stand-ards are not projected to be exceeded by a combination of current condi-tions and the proposed action.	None.	None.
2. 3-1.5.2(a) Document of Environmental Protection	TTPI Title 63, Chapter 13, Part 4.1	USAKA requires a DEP for activities involving emissions of specified pollutants exceeding applicable thresholds. Multiple activities may be handled under a single DEP.	The TTPI regulations require all sources having the potential to emit air pollutants to obtain permits for construction. Only sources of minor significance are exempted from this requirement.	Facilities not requiring a DEP under the USAKA Standards but not exempt from permit require-ments under TTPI regulations are affected. The affected facilities include boilers, maintenance facilities, and tanks on each island.	A DEP will not be required for certain USAKA emission sources. In the TTPI, a permit would be required. Also, multiple facilities may be handled under a single DEP.	Less. Low, Admin-istrative	None.	Less. Low, Admin-istrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
3. 3-1.5.4 Modification of Sources	TTPI Title 63, Chapter 13, Part 4.1	The USAKA Standards require submittal of a new DEP if air emissions increase above DEP levels by 5 percent or more.	The Clean Air Act does not identify a specific increase requiring a permit modification. TTPI regulations require all sources having the potential to emit air pollutants to obtain permits for construction. Only sources of minor significance are exempted from this requirement.	Facility modifications emitting less than 105 percent of current DEP emission levels as defined under the USAKA Standards are not exempt from permit- revision requirements under TTPI regulations. The facilities include the solid waste incinerator, power plant No. 2; fuel-storage tanks; boilers for the Yokwe Yok Club; the dining room, the bakery, and laundry facilities at Kwajalein; the burn pit at Roi Namur; and the fuel tanks at Roi Namur, Ennylabegan, Eniwetak, Legan, Gellinam, Gagan, and Omelek.	Selected USAKA facility modifications will not be required for obtaining a revised DEP. In the TTPI, they would need a permit revision.	Less. Low, Administrative	None.	Less. Low, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
4. 3-1.5.3 Existing Sources 3-1.5.4 Modification of Sources	40 CFR 52.21 Prevention of Significant Deterioration	Requires USAKA, through the DEP process to complete a demonstration of compliance with standards and an assessment of the effects on visibility, soil, and vegetation.	Requires from the applicant demonstrations of compliance with standards only for larger sources. The burden of demonstrating continued compliance with standards for all sources is borne by the regulator.	Existing facilities requiring compliance evaluations under the USAKA Standards but not under TTPI regulations include all facilities projected to require a DEP; the power plants on Kwajalein, Roi Namur, Meck, Illeginni, Gellinam, and Ennylabegan; the burn pits on Kwajalein and Roi Namur; and the main fuel tanks on Roi Namur. Major facility modifications requiring these compliance evaluations under the USAKA Standards but not under TTPI regulations	Under both the USAKA Standards and TTPI regulations, existing and new or modified major sources are required to demonstrate compliance with ambient air standards and to evaluate the effect on soil, vegetation, water, and visibility. More USAKA sources are subject to these demonstration requirements.	More. Low, Administrative	None.	More. Low, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
4. (continued)				include the power plant modifications on Roi Namur, Meck, and Illeginni; fuel-storage tank upgrades on Roi Namur and Kwajalein; and the new solid waste incinerator on Kwajalein.					
5. 3-1.5.4 Modification of Sources	40 CFR 52.21	Defines a modification of a major source as an increase in net emissions above 105 percent of the emission levels allowed in a DEP.	Under PSD regulations, defines a modification of a major source as an increase in net emissions above actual emission levels.	Facilities often operate below capacity and when a modification to the facility is proposed, a revised permit is required under U.S. regulations but not under the USAKA Stand-ards. The difference in the definition of a major source results in potentially more sources being subject to modification requirements under the Standards than under the U.S. regulations.	Not applicable.	None.	None.	None.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
6. None	TTPI Title 63, Chapter 13, Parts 6, 7, 12, and 13	There are no USAKA Standards for fugitive- dust control and for sampling and testing for opacity and odors.	TTPI air regulations contain provisions for fugitive-dust control and sampling and testing for opacity and odors.	Under the USAKA Standards, facilities not affected by opacity requirements are the USAKA power plants and the Kwajalein solid waste incinerator. Facilities not affected by requirements for fugitive-dust control are demolition of the Roi Namur power plant and construction of the new Roi Namur power plant, the new Illeginni fuel tank and modifications to the Meck and Illeginni power plants, and the solid-waste burn pit and incinerator at Roi Namur and Kwajalein. No facilities were determined to be subject to TTPI odor requirements.	Opacity: The USAKA Standards do not require visual inspection for opacity at facilities with DEPs that emit particulates. Fugitive-dust control: The USAKA Standards do not require the purchase and O&M of dust-suppression equipment during construction and demolition.	Less. Medium, O&M Negligible, Administrative	None.	Less Negligible, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
7. None	40 CFR 52.21 Prevention of Significant Deterioration	USAKA has no similar provision to PSD technology-based requirements.	The U.S. regulations require major sources to install best available control technology.	Roi Namur power plant: Only this facility is defined as a major emission source under the U.S. definition, and its modification under the proposed action would be considered major.	Under the USAKA Standards, a demonstration of best available control technology is avoided.	Less. Negligible, Administrative.	None.	Less. Negligible, Administrative.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	*U.S./Other***	*Affected Facilities*	Compliance Measure *Differences*	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
WATER QUALITY									
8. 3-2.4.1 *Classification of* Coastal-Water Uses	TTPI *Title 63,* Subchapter VII, Chapter 13	Classifies *coastal-water* use into Class AA, Class A, *and Class B.* Class AA water is to be maintained *at near-*pristine conditions; Class A water is to be maintained for recreation, water supply, and propagation of aquatic life. The uses protected in Class B water are small-boat harbors, commercial and industrial shipping, *compatible* recreation, and support and *propagation of* aquatic life. *Point-source* discharges are specifically precluded for Class AA water.	TTPI regulations classify coastal-water use into Class AA, Class A, *and Class B* and has the same conditions and *requirements as* the USAKA Standards. The TTPI regulations can require additional treatment beyond the USAKA Standards if practicable under existing technological and economic conditions.	USAKA-wide and all point-source discharges.	TTPI regulations can require that "best degree of treatment practicable" *may* be provided. The USAKA Stand-*ards do not* contain this requirement; they require only that the classifications be protected to the specified quality level.	None.	A major assumption is that the possible TTPI requirement to provide "best degree of treatment practicable" will not be implemented at USAKA. If it is implemented, however, the cost saving at USAKA will be significant but will depend on the definition of "best degree of treatment practicable."	None.	Same as the comments for USDOD.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
8. (continued)		Destruction of reefs is prohibited unless protective measures are used (except in Class AA waters where destruction of reefs is prohibited). Class A water is protected as a potential potable-water source.							
9. 3-2.5.1 Contents of Water Quality Management Plan 3-2.5.2 Submittal of Water Quality Management Plan 2-9.2.2 Water Quality	40 CFR 130.6(c) and 130.10	The USAKA plans (3-2.5.1, 3.2.5.2) include nonpoint-source management, dredge or fill control, prohibited areas for dredging and filling, groundwater-pollution control, water quality monitoring, identification of nonattainment water bodies, identification of	U.S. plans for managing water quality include nonpoint-source management, dredge or fill control, groundwater-pollution control, water quality monitoring, and stormwater-discharge assessment, and the plans establish total maximum daily loads, effluent limits, municipal	• Desalination plant • Kwajalein power plants • Roi Namur power plant • Meck power plant • Illeginni power plant • Kwajalein WWTP • Roi Namur WWTP • Meck WWTP • Illeginni Outfall • Reef areas off all islands	Additional studies are required under the USAKA Standards for new pollutants, discharges, and disposal or storage facilities for solid and hazardous waste. Additional studies are required for WWTPs when capacity is exceeded or discharge limits are continually	More Medium, Administrative	Some states have evaluation requirements that are similar to the USAKA-specific water quality studies. However, they are not required by U.S. or TTPI regulations for the proposed discharge.	More. Low, Administrative.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
9. (continued)		necessary control practices, assessment of stormwater discharge, and identification of reef resources and the management and control practices necessary to protect them. Specific studies of water quality (2-9.2.2) must be performed when new pollutants are proposed to be discharged or when facilities for handling hazardous material, hazardous waste, or solid waste are being sited. A report on the effectiveness of wastewater treatment is prepared when the plant's capacity is exceeded or when discharge limits are exceeded continually.	and industrial water treatment requirements, management agencies, implementation measures, and requirements for basin plans. A biennial report on water quality is required.		exceeded. Additional studies are required to identify reef resources and measures to protect them.				

*Explanatory notes are at the end of the table (p. 42).

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
10. 3-2.6.2 Antidegradation	40 CFR 131.12 TTPI Title 63, Subchapter VII, Chapter 13, Part 3	The USAKA Standards do not allow Class I or Class II groundwater to be degraded so that (a) primary or secondary standards are exceeded or (b) existing groundwater quality already exceeding primary or secondary standards or containing hazardous constituents is further degraded. Class III groundwater cannot be degraded so that (a) primary standards are exceeded or (b) existing groundwater quality already exceeding primary standards or	U.S. regulations direct states to develop and adopt antidegradation policies and to identify methods for implementing such policies. The policies are required at least to prevent degradation primarily for protecting existing uses and for protecting the quality of water where it exceeds that required for existing uses. TTPI regulations require that, as policy, water whose quality is less than defined by the standards will be improved to comply with the standard.	USAKA-wide	The USAKA Standards require fewer facilities to prevent the degradation of groundwater when the quality is higher than the standards. Waiver petitions would not be required.	Less. Low, Administrative (once)	The major assumption is that groundwater is not currently degraded below the standard.	Less. Low, Administrative (once)	The same oversight activities would be performed. The quality being met, however, would be different; therefore, fewer reviews would be performed.

*Explanatory notes are at the end of the table (p. 42).

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
10. (continued)		containing hazardous constituents is further degraded. All three classes of groundwater are protected for existing ground-water quality from specific hazardous constituents. A variance from these provisions may be granted. The water quality plan addresses anti-degradation by requiring the identification of nonpoint sources of pollution and other sources of groundwater contamination and the manage-ment and control practices to be used to reduce or eliminate the sources.							

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
11. 3-2.7.1 Point-Source Discharges 2-17.3 Document of Environmental Protection	40 CFR 122.21, 125.3, 133.100 133.102, 133.103, 133.105, and 230.7 40 CFR 122.26 Stormwater Discharge Permits 40 CFR 400-403 General Pretreatment Regulations for Existing and New Sources of Pollution	Require a DEP for new or existing discharges or before an existing point source is modified or a new point source is constructed. Application for a DEP for a new discharge must include: • Description, location, and characteristic of discharge • Dilution calculation • Measures taken to minimize introduction of toxic pollutants • Assessment of biological effect • Description of treatment methods and by-product handling	Require a National Pollutant Discharge Elimination System (NPDES) permit for discharges; the permit must contain a description, the location, and the characteristics of the discharge.	All point sources and all storage and disposal facilities for solid and hazardous waste.	Requirement for more information to be submitted by USAKA in the DEP than the U.S. regulations require in an NPDES permit.	More. High, Administrative (once)	The supplemental information that is required by USAKA on effects of point-source discharges often is provided at the discharger's option under the U.S. regulations, with state implementation. The information often is supplied by the discharger to negotiate less stringent discharge limits.	More. Low, Administrative (once)	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	*Compliance* Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
11. (continued)		Stormwater discharges that result in a point-source discharge would require a *DEP*. In addition, as part of a water quality management plan (3-2.5.1), an assessment of the nature and extent of stormwater discharges is required, and control practices for *managing* stormwater must be identified. For point and nonpoint stormwater discharges *that do not meet* the water quality *standards*, additional management *controls must be* identified so that water *quality* standards are met.	U.S. regulations require a permit *for surface water* discharges composed *entirely of* stormwater.		•				

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
11. (continued)		A DEP is required before construction of new point sources.	U.S. regulations require that an NPDES permit be obtained before construction of facilities that will discharge wastewater.						
12. 3-2.7.2 Dredging, Quarrying, and Discharge of Dredged or Fill Material 3-2.8.2 Dredged or Fill Material 2-17.3 Document of Environmental Protection	40 CFR 225, 230, 231, 232, and 233	A DEP for dredging, quarrying, or discharging dredged or fill materials must include the following requirements: • Documentation that water quality standards and resources will be protected • A description of mitigation measures • Documentation that no alternative means of disposal are available that would have a less adverse effect on the marine ecosystem.	A 404 permit is required for disposal of dredged or fill material.	Dredging and quarrying operations on nine islands.	At USAKA, a DEP must be submitted for dredging, quarrying, and disposal. A permit is required under U.S. regulations only for disposal.	More. High, Administrative	None.	More. Low, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
13. 3-2.7.4 Control of Sewage Disposal from Vessels 3-2.8.3 Discharges from Marine Sanitation Devices	40 CFR 140	Disposal of sewage into the waters of the RMI from USAKA vessels is prohibited.	Apply only to vessels on which a marine sanitation device has been installed; they do not require installation of marine sanitation devices on all vessels with toilets. Federal regulations require fecal coliforms of less than or equal to 200 per 100 ml and suspended solids of less than or equal to 150 mg/l. A state may completely prohibit sewage discharge from any vessel by applying to EPA with documentation of the need for the prohibition.	Kwajalein: USS Observation Island; 30-foot recovery ship; two tugs; five landing craft, utility; three landing craft, material; two catamaran ferries; one 65-foot personnel boat; five barges; two patrol boats. Illeginni: two catamaran boats.	Under the USAKA Standards, no ship-generated sewage can be discharged to RMI waters. Under U.S. regulations, discharges are allowed but are regulated.	More. High, Capital Medium, O&M	None.	None.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
14. Appendix 3-2C Specific Water Quality Criteria for Surface Water	Federal Water Quality Criteria (WQC) TTPI Title 63, Chapter 13, Subchapter VII, Part 6	Establishes water quality criteria for 40 toxic sub-stances. Ammonia, iron, boron, manga-nese, hydrogen sulfide, elemental phosphorus, and barium are con-sidered toxic substances, unlike under federal criteria. Criteria exist for some pesti-cides not covered under federal criteria. Criteria do not specify fresh water or marine water. USAKA pro-hibits the presence of substances or combinations of substances in surface water in amounts that exceed 0.01 times the 96-hour lethal concentration for toxic substances.	Federal water quality criteria, established as proposed standards, are for 126 toxic substances. Criteria specify application to fresh water, marine water, and human health. Criteria are listed for both acute and chronic protection. TTPI regulations establish water quality criteria for the same compounds as the USAKA Standards do.	USAKA-wide. All point sources and storage and disposal facilities for solid and hazardous waste,	There are no differences between the USAKA Stand-ards and the TTPI regulations. The USAKA Standards would essentially regulate the same substances, but actual application of criteria is based on the content of an individual DEP; in contrast, the U.S. criteria is specifically applied to fresh water, marine water, and human health. The USAKA Standards for treatment and waste mini-mization needed to protect water quality are more stringent than U.S. regulations.	None.	The baseline comparison is between the USAKA Stand-ards and the TTPI regula-tions. Gener-ally, the USAKA Stand-ards are more stringent than U.S. regulations, except for copper. There are, however, some differ-ences in format and content between the USAKA Stand-ards and the U.S. regulations.	None.	No change in costs of administration.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
15. Appendix 3-2D Primary Standards for Groundwater Quality	40 CFR 141.11, 141.12, 141.15, 141.16, 141.61, and 141.62	Apply to all groundwater classifications, regardless of use.	Establish primary standard for health protection for 46 metals and organics and five radiochemicals. The U.S. regulations apply to groundwater designated in drinking-water classification.	USAKA-wide; particularly applicable to storage and disposal facilities for solid and hazardous waste that have the potential to affect ground-water.	None.	None.	There may be some increase in monitoring costs if a large per-centage of the groundwater is classified as not potable. Under the USAKA Standards, USAKA would still need to maintain pri-mary standards, which would require addi-tional periodic monitoring.	None.	None.
16. Appendix 3-2E Secondary Standards for Groundwater Quality	40 CFR 143.3 (guidelines for states)	Are the same as 40 CFR 143.3 except that total dissolved solids (TDS) have been removed. Applies to potential water sources as well as to actual sources.	Establish secondary standard for aesthetics and other nonhealth-related consi-derations. Fifteen parameters included.	USAKA-wide. As in the pri-mary standards, particularly applicable to disposal and storage facilities for solid and hazardous waste.	Protects potential potable-water sources as well as actual sources.	None.	Same as comments for Appendix 3-2D, "Primary Standards for Groundwater Quality."	None.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
DRINKING WATER									
17. 3-3.6.1 MCLs for Inorganic Contaminants	40 CFR 141.80 Lead and Copper Rule	Lists maximum contaminant levels (MCLs) for lead and copper. Violation of MCLs triggers public notification and a notice of deficiency. If the MCL cannot be met, a variance can be requested (if the MCLs for lead and copper become burdensome).	Violation of action levels under U.S. regulations triggers a series of compliance measures, which if unsuccessful, are evaluated by the state. If lead or copper action levels are still exceeded after optimal corrosion control is installed, the state specifies monitoring programs to ensure continued optimal corrosion control, and public education is required.	• All five potable-water treatment plants: - Kwajalein (two plants) - Roi Namur - Meck - Ennylabegan	Under the USAKA Standards, no agency review of corrosion-control measures and no agency action (oversight, administrative, etc.) are triggered by the requirement for source-water sampling. Requirements for public education are more detailed under U.S. regulations.	None.	Assuming that the planned mitigation measures result in compliance, there is no cost difference in implementing these regulations. If the USAKA MCLs are violated, the cost to USAKA would be less.	None.	None.
18. 3-3.11.10 Analytical and Monitoring Requirements Related to Filtration and Disinfection	40 CFR 141.74 Analytical and Monitoring Requirements for Filtration and Disinfection	Requires disinfectant residual monitoring every 4 hours.	Requires continuous monitoring of disinfectant residual for systems serving 10,000 or more.	• All four potable water treatment plants: - Kwajalein - Roi Namur - Meck - Ennylabegan	U.S. regulations require continuous monitoring. The USAKA Standards allow samples to be collected every 4 hours.	Less. Low, Capital	Cost differences are incurred for monitoring equipment.	None.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
ENDANGERED SPECIES AND WILDLIFE RESOURCES									
19. 3-4.6.2 Coordination on Other Wildlife Resources 3-4.6.2 Procedures for Coordination of Other Wildlife Resources at USAKA	50 CFR, Part 402, 402.13 Informal Consultation 402.14 Formal Consultation	The USAKA Standards have both consultation and coordination for evaluating the effects of proposed USAKA activities on endangered species and other wildlife resources and their habitats. In addition to listed species, The Standards address all species or habitats proposed for designation, are candidates for designation, or are petitioned for designation. The Standards also include species not covered in the U.S. list.	The U.S. regulations require only consultation. U.S. regulations apply consultation to listed species and their critical habitats.	All actions funded, authorized, or carried out at USAKA.	The USAKA Standards require coordination with the designated agencies for actions that may significantly affect migratory birds and other wildlife species and habitats of significant biological importance. Coordination is initiated by USAKA through the preparation of a preliminary review of proposed activities.	More. Low, Administrative	The increase in the number of species may result in more-frequent preparation of biological assessments by USAKA.	More. Low, Administrative	The preparation of biological assessments may require the preparation of more biological opinions by the designated agency. Designated agencies also are responsible for costs associated with coordination reports.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
19. (continued)					In addition to species listed as threatened and endangered under the U.S. ESA, the USAKA Standards list species protected under the RMI Endangered Species Act of 1975, species that may be affected by USAKA activities covered by the Marine Mammal Protection Act of 1990 and by the Marine Resources Act or the Marine Resources (Trochus) Act of 1983. These additional requirements increase by 23 the number of species for which consultation could be required. In addition, all sponges (the number is unknown) are provided this level of protection at USAKA.				

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
19. (continued) 2-9.2.3 Biological Assessments and Requests for Coordination Reports	50 CFR 402.12 Biological Assessments	Require the preparation of biological assessments whenever the RMI or designated agency disagrees with a USAKA preliminary review of "No Effect" or they agree with a USAKA preliminary review concluding an activity "May Affect" an endangered resource.	Require biological assessments only for major construction activities.		USAKA will determine whether actions significantly affect the fish and wildlife resources and habitats of special concern included in appendices 3-4F, 3-4G, and 3-4H. The species include migratory birds included in the Migratory Bird Conservation Act (Appendix 3-4F) marine and terrestrial species and habitats determined by RMI and the resource agencies to be of special concern (Appen-dix 3-4G).	See above.	See above.	See above.	See above.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
20. 2-17.3 Document of Environmental Protection	402.12 Biological Assessments	Identify which activities require a DEP after an adverse biological opinion has been agreed to by USAKA, RMI, and the designated agency, or when USAKA agrees that a project will result in the taking of migratory birds or that a species or habitat covered by Appendix 3-4H will be affected.	Do not allow construction contracts to be let or construction to begin before a biological assessment is completed. No documentation comparable to a DEP is prepared.	This difference is most applicable to facilities or actions that result in effects on marine resources, because most of the protected species are marine animals (e.g., sea turtles, marine mammals); however, land facilities are also affected. Dredging and quarrying are used for construction aggregate and shoreline-protection materials. Fill will be placed to create new land. New outfalls and sea-floor cable crossings will be constructed. All islands will be affected.	More documentation is required by the USAKA Standards than by the U.S. regulations for compiling summary information on the biological and jeopardy opinions that have been agreed to by USAKA and the designated agency.	More. Low, Administrative	The details of a DEP are project-specific. Costs can be estimated only after some assessment has been conducted and USAKA and the appropriate agencies have negotiated a specific resolution to a specific problem. Any economies of scale for preparing DEPs are offset by the potential for new species to be added to the appendices for endangered species and other wildlife resources at USAKA.	More. Low, Administrative	Because the USAKA Standards try to streamline actions, the designated agencies should incur a low level of effort.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
OCEAN DUMPING									
21. 3-5.5.1 Selection and Designation of Disposal Sites	40 CFR 228.6 Specific Criteria for Site Selection 40 CFR 221 Applications for Ocean Dumping under Section 102 of the Ocean Dumping Act	Selection and designation of ocean dumping sites are subject to the review and comment procedures of a DEP. Studies are required for assessing environmental effects and supporting the preparation of an EIS.	Selection and designation of an ocean dumping site are initiated by applying for a permit. Similar studies are required for preparing an EIS if an EIS is required by EPA policy.	USAKA-wide.	The primary difference between the two sets of regulations is the requirements for a DEP at USAKA versus a permit in the United States. U.S. regulations also require public notification of the permit application and possible public hearings.	None.	Additional administrative costs would be incurred only if the site selection were exempt from preparation of an EIS under U.S. regulations through the preparation of a FONSI. It is unlikely that a FONSI would be supported for designing an ocean dumping site. Therefore, preparation of an EIS would be required under both the U.S. regulations and the USAKA Standards, and there would be no difference.	None.	See comments for USDOD costs.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
21. (continued)	Action on Ocean Dumping Permit Applications under Section 102 of the Ocean Dumping Act				Potentially, an EIS would be required under the USAKA Standards even if an environmental analysis could be performed to support a Finding of No Significant Impact (FONSI). Under U.S. regulations, a FONSI would exempt the Army from preparing an EIS. Approval of an ocean dumping site is not expected without the requirement for an EIS. Under this assumption, the differences between the two regulations are only in wording.				

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
22. 3-5.5.2 Modification of the Use of Disposal Sites	40 CFR 228.10 Evaluating Disposal Impact 40 CFR 228.11 Modification in Disposal Site Use	Modifications to use of disposal sites must be evaluated on the basis of monitoring data compiled in compliance with 3-5.11.3 of the USAKA Standards.	The effects of disposal at each site must be evaluated periodically, and a report must be prepared under the direction of USEPA must be submitted as appropriate as part of the Annual Report to Congress. Specific effects are listed that must be considered in determining the extent the environment has been affected by materials disposed of at the site. Effects are classified in one of two categories according to severity.	USAKA-wide.	The USAKA Standards and U.S. regulations require a similar degree of monitoring and data analysis. The U.S. regulations specify the effects that must be considered during evaluation of the results of the monitoring and data analysis for determining the environmental impacts of dumping and give guidelines for classifying the impacts into categories that indicate whether the disposal site use should be modified. The USAKA Standards do not	None to Less. Low to Negligible, Administrative	These costs assume that the scope under the USAKA Standards will be less than under the U.S. regulations and that documents will be prepared less frequently.	None to Less. Low to Negligible, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
22. (continued)			The classifi-cations are based on the presence of specific conditions at the site that are attributable to ocean dumping activities. The decision to modify the use of a site is based on the category of effects.		give guidance on the evaluation of monitoring data in order to determine whether or not the disposal site use should be modified (i.e., the USAKA Standards do not indicate the severity of impacts that would indicate a need to modify or terminate the use of a disposal site).				

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
23. 3-5.5.3 Case-by-Case Authorization for Ocean Dumping	40 CFR 221 Applications for Ocean Dumping Permits under Section 102 of the Ocean Dumping Act 40 CFR 220 General	Decisions on ocean dumping are made on a case-by-case basis for individual instances of dumping and are based on an evaluation of the content of case-specific DEPs. A single DEP may allow up to three individual instances of ocean dumping within a 30-day period if the amount of material is identified and the time periods for dumping are specified.	Permit applications required for ocean dumping activities must specify quantities of material and times and dates of the proposed dumping but do not specifically limit the number of instances. General Permits (normally issued for dumping small quantities of materials that will have minimal adverse environmental effect) may be issued without an application if the USEPA Administrator determines that it is necessary or appropriate.	USAKA-wide	The USAKA Standards potentially require more frequent reviews for making decisions on ocean dumping activities. The U.S. regulations do not limit the number of instances of dumping that may occur under a single permit and the review process may be eliminated if the USEPA Administrator determines that a General Permit is appropriate. A DEP, required for each case of ocean dumping at USAKA, covers a maximum of three individual dumping events over a 30-day period.	None to More. Low to Negligible, Administrative	Assumes one dumping activity a year will require a DEP under the USAKA Standards.	None to More. Low to Negligible, Administrative	Additional agency costs are based on the additional review required under the USAKA Standards.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
MATERIAL AND WASTE MANAGEMENT									
24. 3-6.1.2 Material Management 3-6.1.2(c)(4) Use and Approval 3-6.1.2(c)(1) Introduction, Identification, and Classification of Materials	40 CFR 721 Significant New Uses of Chemical Substances 40 CFR 707.20 Chemical Substances Import Policy 40 CFR 710 Inventory Requirements	Specify general-use requirements and categorization for all materials imported to USAKA and do not provide for exemptions. Atypical uses of products, which generally involve hazardous materials and oil, need to be approved by safety and environmental staff.	Require that all chemicals be listed in the Toxic Substances and Control Act (TSCA) chemical inventory. Significant new uses of chemicals must be reported to USEPA.	All facilities that use materials imported to USAKA that are potentially toxic or hazardous will have an effect on the need to identify and classify materials when they are received.	Under the USAKA Standards, environmental staff will have to identify and classify imported materials and review the materials to identify atypical uses.	More. Low, Administrative	None.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	*Affected* Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
25. 3-6.5.2(c)(3) Transport of Regulated Medical Waste	40 CFR 259.70 Army Regulation 40-5 (Preventive Medicine)	The Standards for USAKA are derived from the Army regula-tions for transport of RMW. USAKA includes *specifications* for transporting medical waste within and out-side of health-care facilities.	There is no similar federal requirement. The U.S. regulations specifically state that the standards *do not apply* to onsite transport of regulated *medical waste* (RMW) (40 CFR 259.70(b)).	All facilities that generate, trans-port, or receive RMW.	U.S. regulations do not regulate *the transport of* RMW. The Army, however, regulates the transport of RMW under AR40-5 (Preventive Medicine), and AR 40-5 was used as a basis for *the USAKA* Standards for RMW; therefore, there is no difference between current practices at USAKA and the proposed Standards for RMW.	None.	None.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
26. 3-6.5.3 Storage—General Requirements 3-6.5.3(b) Hazardous Materials and Petroleum Products	40 CFR 112.7(e)(2) Spill Prevention, Control, and Countermeasures Design Requirements	Include storage, security, and inspection requirements for hazardous materials, hazardous wastes, and petroleum products (HMWPPs).	No similar federal requirements exist for hazardous materials.	At sites where petroleum products, hazardous materials, and compressed gas are stored.	Under both the U.S. and USAKA regulations, secondary containment will be required for petroleum products. Under the USAKA Standards, security will be provided and weekly inspections will be performed at sites where hazardous materials and compressed gas are stored.	More. Low, O&M	Security is anticipated to be covered through existing operations at USAKA.	None.	None.
		Specify that all installations of petroleum-product storage tanks must be constructed so that a secondary means of impervious containment is provided for the entire contents of the largest single tank or for 10 percent of the total volume, whichever is greater. Diked areas must be sufficiently impervious for containing spilled oil.	A secondary means of containment must be provided for the entire contents of the largest single tank and sufficient free board to allow for precipitation.			None.	Although capital costs for constructing secondary containment facilities are applicable to the USAKA Standards, these costs have been expended and, therefore, are not included in this analysis.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
26. (continued) 3-6.5.3(c)(1) Storage of Compressed Gas and Compressed-Gas Cylinders	40 CFR	The USAKA Standards include compressed gas in the category of hazardous materials and specify storage requirements similar to those for HMWPP.	There are no similar federal requirements for compressed gas.			None.	OSHA requirements addressing storage of compressed gas are applied at USAKA.	None.	None.
3-6.6.6 Prohibition—Underground Storage Tanks		Installation of new USTs is prohibited at USAKA.	The U.S. allows UST installation and applies technical requirements.		Differences in the design of petroleum-storage areas at USAKA versus those areas in the United States should be minimal.	Less. Low, Capital More Negligible O&M	None.	None.	None.
27. 3-6.5.4(b)(1)(iii) Hazardous Materials and Petroleum Products	None	USAKA requires workers who handle hazardous materials to work in pairs. In addition, distributors of hazardous materials must have special authorization.	There are no similar federal requirements.	Hazardous materials are held at 37 facilities.	At least two people are required for handling hazardous materials at USAKA. This is not a requirement under the U.S. regulations.	More. Medium, O&M	Thirty to 50 people are involved as handlers of hazardous materials. The assumption is that 6 of the 30 to 50 people are full-time personnel, half of whom account for the basis of the cost difference between the two sets of regulations.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
28. 3-6.5.4(c)(3) PCB Materials	None	Require that information on the location of all PCB items must be furnished to the appropriate agencies.	There are no similar federal requirements, but there are U.S. regulations for inspection of certain PCB items.	All buildings or outside areas where PCB materials may be used.	When PCB materials are identified at a new location, the address of the building, the location of the building, and the location of an outside area will be noted and submitted to the Commander, USAKA, and to emergency-response personnel and will be included in the KEEP. This is not a requirement under the U.S. regulations.	More. Negligible, Administrative	None.	More. Negligible, Administrative	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
29. 3-6.5.5(a)(3)(ii) Management of Pesticide Containers 3-6.5.7(c)(2) Pesticide Waste Management	40 CFR 261.7 Management of Empty Containers	All pesticide containers are considered hazardous wastes. Containers are not to be reused except for their original purposes. All containers must be disposed of as hazardous waste, with no treatment option. USAKA has an additional inspection program for determining container-reuse applications.	Some pesticide containers are treated as hazardous wastes, but containers can be triple-rinsed to make them non-hazardous.	All facilities where pesticide containers are stored or used.	USAKA will not be able to rinse pesticide containers for reuse; rather it will have to manage all used pesticide containers as hazardous waste. Under the USAKA Standards, these wastes will be shipped off the island for disposal.	More. Low, O&M Low, Administrative	None.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
30. 3-6.5.5(a)(3)(iv) Collection of PCBs	None	PCB and asbestos wastes must be collected near the point of generation or removal and must be moved to a central collection area within 3 days.	There are no similar federal requirements.	All facilities that may have asbestos or PCB materials.	Under the USAKA Standards, PCB and asbestos wastes can be held at the point of generation for no more than 3 days before the wastes must be moved to a central collection location. U.S. regulations do not specify a length of time for storing asbestos or PCB wastes at the generation point.	More. Medium, O&M, Negligible, Administrative	The additional costs are for more frequent inter-island transport to comply with the 3-day maximum for holding PCB or asbestos wastes at the point of generation.	None.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
30. (continued) 3-6.5.5(a)(3)(v) Collection of Asbestos Waste	40 CFR 61.150(a) Management of Asbestos Waste Materials	Require asbestos material to be wet to the touch and placed in double polyethylene bags labeled according to EPA and OSHA requirements. The USAKA Standards mandate that the double bags be placed in a polyethylene-lined container, that labels be placed on top of the liners, and that the lid be placed on top of the container and sealed. The number of bags must be marked on the outside of the container.	Specify that asbestos wastes be placed in leaktight containers without further container requirements.		Asbestos wastes must be wet and placed in double polyethylene bags and labeled. The bags then must be placed in a polyethylene container that is sealed and is affixed with a label showing the number of bags inside. The U.S. regulations require only that asbestos wastes be placed in a leaktight container.	More. Negligible, capital	USAKA cost assumes use of a tri-wall container rather than a roll-off container as commonly used in the United States.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
31. 3-6.5.5(b)(1)(v)(C) Spent-Battery Storage	40 CFR 261.6 Hazardous Waste Recycling Requirements	Spent batteries cannot be stored for more than 90 days without a variance, which can extend the storage for an additional 90 days.	Spent batteries cannot be stored for more than 90 days unless a permit is obtained or they will be recycled (roughly 1-year limit for recyclables).	Spent-battery storage applies more to the transport of batteries than to specific facilities.	USAKA can store spent batteries for up to 90 days under the USAKA Standards. This is the same length of time allowed by the U.S. regulations. Both the USAKA Standards and the U.S. regulations allow an extension. Under USAKA, a request for a variance is prepared, and if the variance is granted, the batteries can be stored for up to 6 months. The extension allowed under the U.S. regulations allows storage for up to a year. Under the USAKA Standards, spent batteries would have to be moved more frequently.	More. Negligible, O&M Negligible, administrative	Administrative costs for labeling and manifesting.	More. Negligible, administrative	Administrative costs for filing.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
32. 3-6.5.7(a) Treatment and Disposal—General Requirements 3-6.6.1 Prohibition—Disposal of Hazardous Waste 3-6.6.2 Prohibition—Discharge of Ballast 3-6.6.3 Prohibition—Disposal of PCB Wastes	None	USAKA prohibits (1) burning, incinerating, or disposing of hazardous waste; (2) discharge of ballast from watercraft fuel tanks; and (3) incineration or landfill for disposal of PCBs.	No U.S. regulation contains these provisions.	All sites that generate hazardous wastes, ballast from the fuel tanks of water-craft, or PCB wastes.	The USAKA Standards prohibit the burning, incin-eration, and disposal of hazardous wastes; the discharge of ballast from the fuel tanks of watercraft; and the incineration or landfilling of PCB wastes. The U.S. regula-tions do not include these prohibitions. The assumption is that USAKA will dispose of all of these wastes off the island.	None.	No additional costs are incurred because disposal of these wastes under the USAKA Stand-ards is con-sistent with current practices at USAKA.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation							
USAKA	U.S./Other	USAKA	U.S./Other**	Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
33. 3-6.5.1(d) Documentation of Employee Training 3-6.5.1(d)(3) Pollution-Control Equipment Training	None	All USAKA personnel involved in working with pollution-control devices or involved in the handling, treatment, storage, or cleanup or HMWPPs must be trained in the operation of that equipment or the handling of those wastes, and the training must be documented and verified.	No similar federal requirements.	The affected facilities will be those where pollution-control devices are used. The effect, how-ever, is not on the facility but is on the employees who are responsible for pollution-control devices and the admini-strative personnel who are responsible for conducting and documenting training and certification.	Under the USAKA Stand-ards, adequate training must be documented and verified. USAKA cur-rently provides 40-hour training to all of its hazardous-material handlers; the U.S. regulations require only 8-hour training.	More. Medium, Administrative	Although the USAKA Stand-ards do not itemize the content or length of employee training, the Standards specify that workers engaged in processes that generate waste or require handling of waste must be trained in a basic course on the properties and dangers of hazardous waste, and on proper handling procedures; therefore, the costs are estimated on the basis of current training practices at USAKA.	None.	None.

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
34. 3-6.5.3(a)(11)(iii) *Marking*	40 CFR 264.14(c)	Require the following signs to be posted in English and in Marshallese: "*Hazardous* Waste," "Wastewater Treatment Facility," "*Potable-Water* Treatment Plant," and "Pesticides."	Require signs only for hazardous waste ("Danger—Unauthorized *Personnel Keep* Out") and only when other more-direct security measures (such *as surveillance* systems or *fences) do not* adequately control unauthorized entry.	*Hazardous* waste, WWTPs, potable-water treatment plants, and pesticide facilities.	The U.S. regulations require signs at hazardous waste areas; the USAKA Standards also require signs at waste-water treatment, potable-water treatment, and pesticide facilities. Signs must be posted on all four sides of a fenced facility and at the entrance of an unfenced facility. Signs must be legible from a distance of 50 feet and must be written in English and Marshallese.	More. Low, Capital Negligible, O&M	None.	None.	None.

*Explanatory notes are at the end of the table (p. 42).

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USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						
35. 2-17.3.1(k) DEP—Emergency Exemptions and Special Local Needs for Pesticide Use 3-6.5.4(c)(2)(iii) Specific, Quarantine, and Public Health Exemptions for Pesticide Use	RMIEPA Pesticide Regulations, Part IV (#16)	USAKA has a DEP process for emergency exemptions and special local needs for pesticide use. The appropriate agencies must be contacted if the proposed use of a pesticide is likely to be of concern to other agencies, and those agencies must have an opportunity to submit comments in response to an NPA.	RMIEPA has a permitting process for persons working with restricted-use pesticides.	This difference is independent of any facilities.	A DEP must be prepared for emergency exemptions and special local needs for pesticide use. Although RMIEPA has a permitting process to allow people to work with restricted-use pesticides, the USAKA Standards require more information on and involve more agencies in the review.	More. Negligible, Administrative	None.	More. Negligible, Administrative	Agency costs are for responding to an NPA in an ECR. At a minimum, the USEPA and one appropriate agency, other than the RMIEPA, will contribute to an ECR.

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pdxmail\11-19-93\WDCR674/004.51/11-19-93

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USAKA	U.S./Other	USAKA	U.S./Other**						
CULTURAL RESOURCES									
36. 3-7.11.4 Eligibility Criteria for National Register	36 CFR 60 National Register Eligibility Criteria	Establishes the types of resources that are eligible for listing on the RMI National Register of Historic Places. Includes 11 eligibility categories.	Establishes four eligibility criteria for resources eligible for listing on the U.S. National Register of Historic Places.	Cultural resources on all USAKA-leased islands.	The RMI National Register criteria are more inclusive than the U.S. criteria and, therefore, could result in a greater number of resources being eligible for listing at USAKA than if only the U.S. National Register Criteria were applied.	Potentially More. Low, Administrative Low, Monitoring	Because the RMI National Register criteria are more inclusive, more resources could be listed and would require protection.	Costs incurred by RMIEPA were not considered in this analysis.	None.

*Explanatory notes are at the end of the table (p. 42).

USAKA STANDARDS AND U.S. REGULATIONS: COST EFFECT COMPARISON

Citation		Regulation		Affected Facilities	Compliance Measure Differences	USDOD (USAKA) Cost	USDOD (USAKA) Comments	Appropriate Agency Cost	Appropriate Agency Comments
USAKA	U.S./Other	USAKA	U.S./Other**						

Notes:

** Comments apply to U.S. regulations unless otherwise noted.
Citation (USAKA; U.S./Other) = The appropriate regulatory cite from the USAKA Standards, the U.S. Code of Federal Regulations, or other applicable regulatory source (e.g., TTPI or RMIEPA).
Regulation (USAKA; U.S./Other) = A summary of the contents of the appropriate regulatory cite.
Affected Facilities = The facilities at USAKA that may be affected by the regulatory cites.
Compliance Measure Differences = The differences in the measures necessary for current and future facilities at USAKA to comply either with the USAKA Standards or with the U.S. regulations.

USDOD (USAKA) Cost = The costs to USAKA of implementing compliance measures, including:

- Capital (includes design and support costs)
- Operation and Maintenance (O&M)
- Monitoring
- Administrative (includes processing the record of consultation)

USDOD Cost Comments = Comments on the assumptions associated with the USDOD costs.

Appropriate Agency Cost = The costs to the appropriate agencies of implementing compliance measures at USAKA, including:

- Administrative (includes regional compliance monitoring)
- Oversight (includes facility compliance monitoring)

Appropriate Agency Comments = Comments on the assumptions associated with the appropriate agency costs.

Abbreviations:

CAA: Clean Air Act
DEP: Document of Environmental Protection
EIS: Environmental impact statement
ESA: Endangered Species Act
FONSI: Finding of No Significant Impact
HMWPP: Hazardous Materials, Waste, and Petroleum Products
NPA: Notice of Proposed Activity
PSD: Preservation of Significant Deterioration
RCRA: Resource Conservation and Recovery Act
RMI: Republic of the Marshall Islands
RMW: Regulated medical waste
USAKA: United States Army Kwjalein Atoll
USFWS: United States Fish and Wildlife Service
USNMFS: United States National Marine Fisheries Service
UST: Underground storage tank
WWTP: Wastewater treatment plant
TTPI: Trust Territories of the Pacific Island

Key to Cost Categories for USDOD and Appropriate Agency:

- Less = The cost to USAKA or the appropriate agency of complying with the USAKA Standards is less than the cost of complying with U.S. or other regulations.
- More = The cost to USAKA or the appropriate agency of complying with the USAKA Standards is more than the cost of complying with U.S. or other regulations.
- Negligible = Costs are less than $5,000.
- Low = Costs are between $5,000 and $50,000.
- Medium = Costs are between $50,000 and $250,000.
- High = Costs are more than $250,000.

*Explanatory notes are at the end of the table (p. 42).

Index